

Further Analysis of the *Democracy in Practice* Database
Thomas Dietz
Michigan State University
and
Paul C. Stern
The National Academies

First Draft – January 24, 2005

In *Democracy in Practice: Public Participation in Environmental Decisions*, Beierle and Cayford (2002) reported on their analysis of the broadest and most comprehensive available database for examining what works, and why, in environmental public participation. They collected case-study reports on 239 public participation processes and painstakingly coded the information in those reports with respect to over 100 variables representing the context, process, and results of each case. By doing this, they transformed a large body of non-comparable qualitative case-study information into a quantitative and qualitative database with a common conceptual framework that allows comparability across cases.

There are inherent limitations to what can be inferred from any dataset of this type. There is considerable room for error in judgment, both by the researchers who prepared the original case reports and by Beierle and Cayford in transforming narrative information into their coding categories. Also, the variables selected for coding may not prove to be the most useful ones for explaining the phenomena. Consequently, this sort of data cannot yield definitive conclusions about what works in public participation. A good dataset of this sort can, however, prove invaluable in generating hypotheses to guide future research in ways that can yield more definitive results.

The *Democracy in Practice* dataset appears to have this potential. Beierle and Cayford have defined variables that are easily understood and that relate to many of the key questions raised in the research literature. The coverage is systematic. The rating systems for the variables are appropriately coarse, reflecting the limited precision of measurement that can be gleaned from case narratives. And the authors report a reasonable level of reliability in their coding. Because of these attributes and the breadth of the dataset, this dataset is probably the best available source for empirically supported hypotheses about what works across the great variety of environmental issues subjected to public participation and the variety of participatory processes used. It is an excellent source of tentative judgments about which conclusions about public participation are likely to be generic and which context-specific.

Although their book reports on many important aspects of their data, Beierle and Cayford did not exhaust the potential of their dataset in the book. In this paper, we review selected findings reported in the book that speak to key questions for the workshop and report preliminary results from some analyses of the *Democracy in Practice* data that we have done to further explore these and related questions for which this dataset gives us particular opportunities for insight. We thank Thomas Beierle for providing us access to the dataset and to the aggregate variables that were developed to organize the analysis.

The *Democracy in Practice* Quantitative Data

The Missing Data Problem

For conducting quantitative analysis, particularly to address complex questions of causality and relationships among context, process, and outcome variables, the problem of missing data in the Beierle and Cayford dataset is central. There are very substantial amounts of missing data, due to the fact that the authors of the case reports did not report information bearing on all the variables Beierle and Cayford wanted to code. This problem is generic for any data set that is based on a large number of case studies collected for purposes other than contributing to a quantitative data base. Despite commendable efforts by Beierle and Cayford to uncover as much information as possible about each of the cases that formed the basis of their data set, many case studies simply did not provide a basis for coding all the variables that were theoretically important.

Missing data present a difficult problem for statistical analyses (Rubin 1996). The traditional solution, long considered “conservative,” is to use “listwise” deletion, in which a case that is missing data on any variable used in an analysis is dropped from that analysis. As a result, sample sizes can fluctuate substantially from analysis to analysis. More importantly, the characteristics of the samples used will differ from one analysis to another and from the characteristics of the overall data set. Nonetheless, listwise deletion is the most common practice in the literature. Two alternatives seem promising. One is to use available information to impute values to key variables; the other is to conduct maximum likelihood estimates of parameters and their standard errors on the basis of all available information. In our preliminary analyses here we use both listwise deletion and imputation, as did Beierle and Cayford. In subsequent analyses we will explore maximum likelihood methods. Maximum likelihood estimation methods present problems of their own: they assume large (asymptotic) sample sizes and are small sample biased--and we are dealing with small samples here.

Developing Process and Context Indicators

Beierle and Cayford addressed the missing data problem by reporting some analyses using listwise deletion and in other instances, reporting analyses of what they call “aggregated variables.” These were calculated by combining the measures of several variables that are closely related conceptually into indicators of more broadly defined constructs, usually by averaging all the values that were present for each case that had any of the component values present. This procedure allowed analysis of data from a much larger proportion of the case studies, although it presumed that the data on the available components of the aggregate accurately represented the missing values. Some of the most provocative analyses in the Beierle-Cayford book involve the use of these aggregated measures.

We re-examined the Beierle-Cayford data to develop indicators in which we checked our initial judgments of the conceptual relatedness of different measures empirically. We developed indicators consisting of variables that both appeared to be conceptually related and that, when combined, had the features of statistically reliable scales. In this section, we identify these indicators; below, we use them to address the question of whether any of these factors is a necessary condition for a successful outcome from public participation.

Capacity. Beierle and Cayford recorded three measures of participant capacity at the start of the process: political capacity, technical capacity and participator capacity. A factor

analysis indicates that these three components are unidimensional, and an additive scale based on these three indicators has an alpha reliability of 0.61.

Trust. Beierle and Cayford recorded five measures related to pre-existing trust: the reputation of the agency with the public, the reputation of the agency with the participants, the history if any of withheld information about the project, a history if any of unacceptable management, and a history if any of ignoring management problems. A principal components analysis suggests that these can be treated as a single trust dimension, with an alpha reliability of 0.84.

Conflict. Beierle and Cayford recorded six measures related to pre-existing conflict among the participants: the history of conflict among citizens or their groups, the overall relationship among participants, conflict between economic and environmental goals, historical imbalance in power among participants, costs concentrated on particular stakeholders and high stakes. Unfortunately, missing data preclude using all of these items to generate an indicator. 56 cases include data on all of the first three measures. A principal components analysis suggests that they form one dimension. An additive scale of these items produces an alpha of 0.62. We calculated scale values by taking the mean of the values available for any of these three variables for a case. This method gives a value for the conflict scale for 196 cases. It assumes that missing values are perfectly correlated with the observed values for all the 140 cases for which some values are missing.

Problem complexity. Beierle and Cayford recorded four measures of problem complexity: how complex the number and relations of groups are, the level of scientific understanding, the geographic scope of the problem and the policy complexity of the problem. The principal components analysis suggests either one or two factors, with geographic complexity having lower correlations with the other items than they do among themselves. Creating a three item rather than four item scale increases reliability only from 0.51 to 0.53 so we have used the four item scale.¹

Agency commitment. Only two of the three items coded by Beierle and Cayford form a scale: obvious agency commitment, and the involvement of decision makers. The alpha coefficient for the resulting two-item scale is 0.67 and the scale is available for 112 cases (that is, 112 cases had data available for one or both of these items). A third measure, agency commitment of resources and personnel, was not sufficiently well correlated with the other two to form a reliable scale when combined.

Representativeness. Beierle and Cayford used three measures of the degree to which participation was representative: the degree to which participants were socio-economically representative, the degree to which all interests were represented and the degree to which the group was “balanced” across interests. The three items appear to form one factor and an additive scale has an alpha reliability coefficient of 0.51.

Results from the *Democracy in Practice* Dataset

This section summarizes findings from this dataset on several key questions for the workshop and the NRC study, including both analyses from the 2002 volume and our additional preliminary analyses.

Is Success One Thing or Many?

Beierle and Cayford defined five “social goals” that can be interpreted as aspects of elements of success: incorporating public values into decisions, improving the substantive quality of decisions, resolving conflict among competing interests, building trust in institutions, and educating and informing the public. It would be ideal if there were ways of designing public participation processes that would simultaneously advance all these goals, but it is possible that promoting one social goal may sometimes have no effect on, or even interfere with, achieving another social goal.

Beierle and Cayford measured each of the social goals and found evidence that public participatory processes in general tended to advance each of these goals. The proportion of processes rating “high” on each goal, using a rating scale of high, medium, or low were as follows: incorporating public values into decisions, 58%; improving the substantive quality of decisions, 68%; resolving conflict among competing interests, 61; building trust in institutions, 45%; and educating and informing the public, 77%. The data provide some support for the idea that processes that achieve one of the social goals are likely to achieve the others as well. The correlations among the five indicators of success were all positive, and greater than zero at conventional levels of statistical significance. Moreover, almost all the correlations were at levels considered moderate to high (only one was below 0.36).

Still, the correlations were not so high as to suggest that these five indicators are all part of the same construct. The pattern of correlations suggests that there may be important differences in the determinants of achieving certain goals, particularly the goals of educating and informing the public and of improving the substantive quality of decisions. The correlation between these two measures was only 0.16. Some participation mechanisms seem to have comparative advantages with respect to certain social goals. For example, public meetings and hearings were as likely as advisory committees to score high on building trust in institutions, but less than half as likely to score high on resolving conflict.

The patterns suggested that there may be complex relationships linking process attributes to the various social goals. For example, it may be that activities aimed at improving public understanding and those aimed at improving the quality of decisions might both contribute to overall success by helping with another factor, such as conflict resolution. It may also be that certain factors, such as trust or conflict resolution, help shape the relationships between process features and outcomes. It is possible that there are non-complementarities between social goals, such that processes that enhance one social goal may do nothing for another goal, or might even have a negative effect. Such hypotheses cannot be investigated from the data reported in the book, but they can be explored by reanalysis of the underlying data.

We reexamined the data to try to gain further insight into this question. Using listwise deletion reduces the working sample size (the subsample for which Beierle and Cayford were able to code data on all components of success) to only 35 cases. Principal components factor analysis of the data for these cases suggests that there might be two components to success (see Table 1), but we have little faith in an analysis based on such a small sample size. When we use regression-based imputation to predict missing success measures based on all available measures, the factor analysis seems to confirm Beierle and Cayford’s treatment of success as a single dimension in practice, even if there are conceptual distinctions. Note two caveats, however. First, the regression imputation method tends to inflate correlations among variables,

which would bias our results towards a single-factor solution. Second, the fact that all elements of success tend to co-occur does not mean that they all have the same causes.

We attempted to reanalyze the data to address empirically the question of whether different factors influence different aspects of success. Unfortunately, because of missing data, the sample sizes for the analyses using listwise deletion are never greater than 60, and are usually much smaller, using the above scales and the five outcome measures provided by Beierle and Cayford. It may be possible to increase the sample sizes enough with maximum likelihood estimation measures to conduct the analysis we want, but we were not able to do this analysis in time for completing this draft.

We are left with the conclusion that successful public participation processes may indeed tend to advance all five of the Beierle-Cayford social goals, but also with the possibility that some process or context attributes are particularly strongly associated with advancing certain social goals. The intuitively plausible idea that some aspects of process are particularly valuable for advancing trust and resolving conflict while others are particularly valuable for educating the public and getting better quality decisions is neither strongly confirmed nor refuted by these data.

Does the Success of Public Participation Depend on the Context?

Unlike almost anything else in the research literature, *Democracy in Practice* covers a sufficiently varied set of contexts to allow empirical examination of this question. The central conclusion Beierle and Cayford drew from the data was that the contextual variables analyzed in the book do not have much effect on the likelihood of a successful outcome (defined by a global indicator as discussed below). Their summary statement was that “process is a much better predictor of success than context is” (p. 101). Specifically, the likelihood of success was not associated with whether the decision involved a general (usually national) policy issue or a site-specific one; neither was it associated with whether the process addressed natural resource management or pollution issues. In cases managed by federal agencies, EPA had the highest rate of success and the Army Corps of Engineers the lowest, though the number of cases per agency was limited: Only EPA had more than 15 cases in the database.

Only two context variables were found to have statistically reliable relationships to the likelihood of success when process factors were held constant. Cases with federal agencies taking the lead were somewhat less likely to be successful than cases led by state or local agencies. Also, cases involving policy development or comparative risk assessment were somewhat less likely to be successful than cases involving siting, permitting, regulation, or the management of natural resources or hazardous wastes. The latter finding may reflect the fact that the less-successful policy development cases often involved the use of consensus-based advisory committees. This finding suggests that this mechanism may not be well suited to broad policy development. The analyses suggest that conclusions about the effects of public participation process on success are likely to be largely the same regardless of the kind of environmental issue or decision.

Do More “Intensive” Public Participation Processes Produce Better Results?

Beierle and Cayford argued that participatory mechanisms vary in “intensity,” from public meetings and hearings at the low-intensity end of the spectrum, through advisory

committees not seeking consensus to advisory committees seeking consensus, and finally to negotiations and mediations at the high-intensity end. Intensity was strongly associated with the likelihood that a process was rated highly on the aggregate success measure: less than one-quarter of processes featuring public meetings and hearings were rated highly successful, compared with over 90 percent of the negotiations and mediations. The two advisory committee mechanisms had an intermediate level of success, and did not differ much from each other.

The findings do not, however, point unequivocally to a conclusion that using more intensive mechanisms always produces better results. For example, the more-intensive mechanisms were less likely to involve a socioeconomically representative cross-section of the public, either as participants or through supplementary mechanisms such as surveys, consultations, public meetings, or educational outreach efforts. Beierle and Cayford concluded that “as processes intensify, the range and representativeness of the voices heard—as well as the social benefits of education, conflict resolution, and trust formation—tend to narrow down to the relatively small group of active participants” (p. 48). Also, the more-intensive mechanisms were more likely to achieve consensus by “leaving out participants or ignoring issues.” The result sometimes was that a strong consensus on a decision that appeared to satisfy the interests and yield a cost-effective result was greeted by outrage from wider publics. It appears that more intensive processes lead to greater success as judged from standpoints within the process but may not lead to better results when the participation moves out to the broader society. This possibility poses a significant challenge to the designers of participatory processes.

The type of participation mechanism was not the most important process factor affecting success. More important were other attributes of participatory processes that vary both across and within mechanisms. Beierle and Cayford found that most of the effect of mechanism on success could be explained by the following set of process features: *responsiveness* of the lead agency (i.e., commitment to and communication with the participants), *motivation* of the participants (optimism about and confidence in the process), *quality of deliberation* (mutual understanding, primacy of good arguments over power, etc.), and *degree of public control* over the initiation, design, and execution of the participatory process. Each of these characteristics was associated with the type of mechanism and also with the success of participatory processes and it appears that it was these characteristics, more than the mechanisms themselves, that accounted for success. The correlations between scores on the process attributes and success were rated respectively as high, moderate-to-high, moderate, and low, and all the associations were statistically significant.

When scores on the four processes were combined into a single overall measure of process quality, this measure greatly increased the ability to account for variation in success beyond what could be explained by mechanism alone: process quality was strongly related to the success measure, across contexts. This finding underlines the importance of the ways public participation processes are conducted. It implies that the process features measured explain some of the differences in success not only across mechanisms, but also among cases using the same participatory mechanism. One mechanism did have some effect on success, even controlling statistically for these process features. The negotiation or mediation mechanism had more successful outcomes than the other mechanisms, indicating the importance of some aspect of the negotiation mechanism not covered by the aggregate process measure.

Are There Any Necessary Conditions for Success?

We examined the *Democracy in Practice* dataset to consider whether there are any “necessary conditions” for success, that is, whether there are contexts or process attributes that effectively preclude success by their absence. Braumoeller and Goertz (2000) have proposed a method for examining this question quantitatively when the dependent variable is measured as a dichotomy and the independent variable is continuous. They argue that if one can reject the hypothesis that the intercept in a linear probability model is zero, one can conclude that there is a non-zero probability of success even when the predictor variable equals zero—that is, that even when a contextual or process factor is absent, a successful outcome remains possible. In such circumstances, even if having a better context or process on a particular dimension increases the probability of success, it cannot be called a necessary condition for success.

Beierle and Cayford provide trichotomous rather than dichotomous measures of success. We have examined the “hard” criterion in which we count as success only those cases that achieve a score of 3 on the success measure. We then analyzed success by this definition in relation to the aggregated measures described above, coded on a 0-3 scale so that the most adverse category of each predictor variable is 0. Thus a test that the intercept of the resulting linear probability model is zero indicates the probability that the independent variable can be considered a necessary condition for success.

The results provide some optimism about public participation processes. None of the predictor variables we examined qualifies as a necessary condition for the overall measure of success (see Table 2). When we separately consider the components of success using rather stringent significance criteria, only two possible necessary conditions emerge. Both involve attributes of the process and their effects on enhanced trust in institutions. It is possible that the lowest levels of agency commitment to the process and the lowest levels of representativeness of the participation process preclude improvement in trust. These are both variables that are largely under the control of the responsible agency, so this analysis suggests that it may be essential for success for the agency to signal a strong commitment to the process and work to insure a high degree of representativeness in participation.

Conclusions

The data from the *Democracy in Practice* study suggest that although there are multiple social goals desired from environmental public participation, participatory processes overall tend to advance all these goals somewhat in tandem. It is possible, though, that some attributes of participatory process, either generally or in certain contexts, may have different, or even opposite, effects on the achievement of different social goals. The data do not seem sufficient to reach conclusions on this question.

The data suggest that for the most part, context is not determinative of the results of public participation processes and that processes with the right attributes are likely to work better, across a variety of contexts, than processes that have less of these attributes. The data support the conclusion that the following process attributes are associated with successful outcomes: responsiveness of the lead agency (i.e., commitment to and communication with the participants), motivation of the participants (optimism about and confidence in the process),

quality of deliberation (mutual understanding, primacy of good arguments over power, etc.), and degree of public control over the initiation, design, and execution of the participatory process.

Note

1 This scale contains an anomaly that we still need to examine further. High scores on the scientific understanding variable should indicate less complexity, whereas high scores on the other three variables indicate more complexity. The alpha reliability of the scale is higher (0.51) with this reverse-direction science variable included than it is with the science variable omitted (0.48). We would expect the reverse result.

References

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Table 1. Principal components factor analysis of five elements of success using listwise deletion of data and imputation of missing values.

	Listwise	Listwise	Imputed	Imputed
Success attribute	Factor 1	Factor 2	Factor 1	Factor 2
Principal component eigenvalue	2.43	1.17	3.24	0.79
Factor Loadings				
Educating and informing the public	2.32	-0.19	0.69	
Incorporating public values into the decision	0.32	0.59	0.81	
Improving the substantive quality of decisions	-0.00	0.47	0.52	
Resolving conflict among competing interests	0.20	0.90	0.86	
Building trust in institutions	0.16	0.45	0.84	

Table 2: Probability that listed predictor variables are necessary conditions for five elements of success and for the aggregate success measure (sample sizes in parentheses).

Predictor	Educating and informing the public	Incorporating public values into the decision	Improving the substantive quality of decisions	Resolving conflict among competing interests	Building trust in institutions	Overall Success
Capacity	<0.001 (92)	<0.001 (145)	<0.001 (133)	<0.001 (131)	0.022 (58)	<0.001 (126)
Trust	<0.001 (69)	<0.001 (118)	<0.001 (100)	<0.001 (101)	<0.001 (71)	<0.001 (105)
Pre-existing conflict ¹	<0.001 (100)	<0.001 (165)	<0.001 (150)	<0.001 (153)	<0.001 (73)	<0.001 (148)
Complexity ²	<0.001 (114)	<0.001 (189)	<0.001 (167)	<0.001 (160)	<0.001 (85)	<0.001 (161)
Agency commitment	<0.001 (62)	0.001 (101)	<0.001 (90)	0.009 (83)	0.059 (53)	<0.001 (91)
Representativeness	<0.001 (95)	<0.001 (154)	0.001 (142)	0.009 (140)	0.047 (63)	<0.001 (139)

Notes: The reported p values are for two sided tests although the hypothesis is one-sided. This is conservative in the sense of making us more likely to reject the null hypothesis and thus find more necessary conditions than the stricter and more appropriate test.

1 The highest levels of conflict are coded zero. Thus the necessary condition is that the probability of a particular kind of success is greater than zero even in the face of the highest stakes.

2 The most complex problems are coded zero. Thus the necessary condition is that the probability of a particular kind of success is greater than zero even in the face of the highest levels of complexity.