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Public Value Mapping

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Workshop Report

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Abstract

Twelve participants convened on 13 October 2006 to discuss the continued development of Public Value Mapping (PVM). The group reviewed the conceptualization of PVM and exchanged insights and experiences from their works-in-progress. This report consists of a set of comments by PVM creator Barry Bozeman on the history behind its conceptualization, syntheses of five presentations of the works-in-progress, and discussions of the lessons learned as they apply to PVM. The syntheses includes two discussions of research production in knowledge value collectives – one at the Department of Health and Human Services and the second at the National Institute of Justice, one project on public value in the U.S. Climate Change Science Program, two projects on nanotechnology, one involving public failures and a second on public engagement. As a set, these research projects demonstrate the richness of the PVM framework and its potential for further development.

Table of Contents

Acknowledgements

We would like to acknowledge all the participants of the workshop (see Appendix B) who contributed their insight and experience, but in particular Barry Bozeman and Daniel Sarewitz who continue refining the conceptual framework of PVM. We would also like to thank Lori Hidinger and Geri Eastman at the Consortium for Science, Policy, and Outcomes for their organizational and administrative assistance for the workshop.

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1. Introduction

This report summarizes the findings of a workshop on the Public Value Mapping (PVM) research project, held at Arizona State University on 13 October 2006 and supported by National Science Foundation grants #0532637 and #0322505.

The workshop served as a forum for researchers to discuss their work in progress under the PVM project, but it also provided the opportunity to discuss the conceptual roots of PVM and clarify the concepts, practices, and direction of this emerging approach.

The original grant proposal states that the purpose of PVM is to investigate the public value of the research funded by social policy agencies of the US federal government. By social policy agencies it was meant agencies whose primary mission involves making policy for the promotion of social welfare and not, for example, fostering knowledge creation. Such agencies include the Departments of Education, Housing and Urban Development, Justice, Labor, and some human services agencies within Health and Human Services. By public value it is not meant the outputs of research (in terms of papers, report, patents, etc.), but the societal outcomes such research influences, according to the agencies' missions and as measured by the broadest available indicators.

Examining the public value of social policy research means, crudely, studying the societal outcomes of the research and the hypothesized causal links between mission-related research programs and these outcomes. The general approach of PVM studies is to begin by scrutinizing the public articulation of goals and objectives for the research and continue by analyzing the procedural and logical connections between them and identifiable societal outcomes. Sources for the articulation of goals and objectives include authorizing legislation, mission statements, and strategic plans. Societal outcomes include available, systematic social indicators, as well as ad hoc indicators that policy makers and stakeholders have used in articulating the societal problem triggering the need for the research program. Although agencies' responses to the Government Performance and Results Act (GPRA) can be an important resource, the work does not focus on assessing GPRA's impact, per se, on the agencies or their research. Rather, the work concentrates on asking how social policy agencies set priorities among current programs and research, how these agencies manage research for societal outcomes, how they transfer new knowledge and/or technologies from their sponsored research into the pursuit of their missions, how they anticipate the linkages between their research and societal outcomes, and what those outcomes may be.

In the same spirit, Bozeman (2003) proposes an approach to PVM that departs from traditional research evaluation. Here too the focus is not on single outcomes of narrowly define social groups, but on the dynamics of the broadest social group defined as Knowledge Value Collective. KVC is the "set of networks and institutions that move science from an individual and small group enterprise, to knowledge development and dissemination" through the whole of society, "ultimately, [producing] social outcome[s]" (Bozeman, 2003, p. 27). Thus, KVC can be understood loosely as, the collective of produces and users of knowledge.

This is a process-oriented approach to PVM that begins with the identification of the KVC and the public values at play and then operationalizes and measures them, to later build explanatory models of the paths from values to outcomes within the KVC. A summary of this approach is presented below:

Table 1. PVM Steps.

Steps of analysis	Tasks
1. Outcomes domain.	Identification of the KVC.
2. Public values	Examine relevant public value statements, authorizing statutes, GPRA documents, etc.
3. Sorting values	Identify relative importance of values. Establish non-hierarchical values. Establish means-ends relationships. Preliminary operationalization of values.
4. Map public values	Establish metrics for public value. Identify target problems and research programs. Develop causal models linking value statements with program activities. Test causal paths from public values to aggregate social indicators Develop a prescriptive models and recommendations.

Source: Bozeman (2003)

This conceptual framework constitutes the basis for the empirical studies advanced by the researchers participating in the PVM workshop.

The report proceeds as follows: Section 2 provides a brief commentary on the development of PVM. Section 3 describes in some detail the five research projects presented by workshop participants. The first two papers discuss research production and use within knowledge value collectives at the Department of Health and Human Services (DHHS) and at the National Institute of Justice (NIJ). The study of DHHS introduces a hybrid model of knowledge production and diffusion named shield model, while the study of NIJ explores the tensions between transformation value and creation capacity. A third paper examines the articulation of public values embedded in the vision, mission, and goals of the US Climate Change Science Program, and an assessment of the internal consistency of its structure. The two final papers are applications of PVM to nano-scale science and engineering (NSE): One applies public failure theory to the case of water policy; the second broadly examines the adoption of nanotechnology in terms of public engagement. Section 4 summarizes the main lessons learned from the work advanced thus far, suggests further refinements to the PVM approach generated by the workshop. A glossary of terms supports the text with concise definitions of related concepts. Appendices include unpublished documents discussed in the workshop and brief biographical notes of the participants.

2. Development of Public Value Mapping

The idea of Public Value Mapping dates back to the late 1980s. At that time Barry Bozeman was invited as consultant for a municipal privatization project. He observed that the arguments in favor of privatization drew heavily from the economic literature on market failure; yet, the counterarguments lacked the cohesiveness of the economic theory. These arguments were loosely congregated around one substantial point: the failure of government to further the public interest, i.e. the interests of the communities affected by the privatization policy. It seemed therefore natural to talk about public failure as the source of problems overlooked by prescriptions derived from market failure. Furthermore, in the world of *realpolitik*, the notion of public interest is the flag behind which lawmakers rally support for their policy initiatives, such as that of municipal privatization. The public interest is therefore articulated by policy makers as social, economic and political values; values embraced by the social group bearing the full effect of public policy. Hence, to speak of public value is to speak of the social referent of public interest (Bozeman, 2002).

It is often the case that the public values that shape policy are not made explicit in the text of law or other policy statements. There is hope however, that a democratic policy process would ensure at least a minimal correspondence from public values to policy design, and ideally from public values to policy outcomes. However, such a correspondence is rather unclear. PVM seeks to resolve this connection between public values and policy outcomes by accounting for the observable institutional and other connections between concrete expressions of public values and the policy outcomes they target. This exercise is tantamount to plotting a map of public values, and it is the intuition behind PVM, broadly defined as the intellectual exercise of systematically disentangling the pathways from values embedded in policies to their outcomes.

Public Value Mapping can thus be applied to study policy problems at several levels. At the narrowest level, PVM is a strategy, heuristic, or perhaps when further developed, an actual methodology for analyzing particular public policies. At the broadest level, PVM is a theoretical framework for policy evaluation – guiding more micro-level evaluations and providing principles of policy design for the reflexive assessment of policy outcomes.

3. Detailed Research Projects

3.1 A Shielding Model of Knowledge Transfer

This study draws PVM as a heuristic into conversation with the literature on knowledge utilization (KU), seeking to determine what qualities of research and its management facilitate the movement (transfer or diffusion) of research from producers to users, collectively characterized as a research ecology (Gano, et al., 2007) or the knowledge value collective (Bozeman, 2003).

The paper draws on 25 semistructured interviews of knowledge producers at the Department of Health and Human Services (HHS) and 9 additional interviews of the downstream community of users of that knowledge. The analysis of the interviews uses methods of grounded theory. The data are compared to two models of utilization and diffusion from the KU literature, the engineering model and the socio-organizational model. The paper poses attention to peer review and rigor of research design (e.g., avoidance of selection bias through experimental design) as evidence in favor of the engineering model, while attention to social networks between producers and users and to the format and access to research products embedded in the dissemination strategies is evidence of the socio-organizational model.

The paper concludes that both theoretical models explain aspects of research production at DHHS and its use – respondents value the quality of research and its technical design because it endows knowledge of objectivity, and they also value the social interactions of knowledge-use because it strengthens knowledge diffusion – but respondents proved inclined to favor the engineering criteria when the quality of research was at risk. The paper introduces a third model, the shield model, to explain these observations: while knowledge producers and consumers attribute importance to social interactions, they see the necessity to support and expand a shared professional norm that shields the research process from political pressures. This devotion to the norms of peer review and experimental design are not commitments to the knowledge production process, per se, but is rather a pragmatic approach to "shield" research as best they can.

This study enriches the PVM project in several fronts: First, it highlights the importance of the KU literature in conjunction with PVM methodologies. Second, the shield model may prove conducive to understanding the dynamics of transactions that take place within the research ecology or knowledge value collective. Third, shielding may influence knowledge utilization generally across the knowledge value collective. Fourth, shielding may increase as a byproduct the expertise of research consumers, thus further demonstrating the dynamics of the knowledge value collective.

One risk that follows from this fourth point is that shielding may cloud the judgment of users who cannot evaluate social outcomes outside the language of experts, even if these outcomes are inadvertently harming their interests. By shielding political bias, knowledge users adopt the language of science but also its blind spots.

3.2 High Transformation Value and Low Creation Capacity

Using roughly the same methodology as the study of DHHS discussed above, Hays and Guston (in preparation) analyze 16 interviews with knowledge producers and users at the National Institute of Justice (NIJ) and find a knowledge value collective (KVC) more vulnerable to political pressures than that of DHHS.

There are two sources for this vulnerability. The first, endemic to bureaucracies, is the rapid and sometimes repeated turnover of priorities set for NIJ by political principals. On one hand, Congress approves NIJ's budget – which reflects political bargaining within Congress and between it and the executive branch – on an annual basis; on the other hand, the President appoints the director of the NIJ, who advances the executive's political agenda. The second reason for a vulnerable KVC is a consequence of the first, that changing priorities leaves funding only for research projects with short time horizon, limiting the ability of researchers to advance important programs that require sustained financial support and intellectual investment for periods longer than one year.

In this context, Hays and Guston find that NIJ has an implicit, hierarchical set of funding criteria. Above all stands practicality to law enforcement practitioners, followed in importance by political expediency, and only to a lesser extent, reliability of the knowledge produced. Hays and Guston (in preparation) also note that "this politicization severely delimits the range of research proposals available for funding," increasing the probability for studies of medium and large time horizons to remain unfunded. However, they emphasize that the quality of research actually funded is not in question. The funded research enjoys high reliability, and what is more, high applicability; in PVM terms, it possesses a high transformation value (Bozeman and Rogers, 2002, p. 770). But again, the constrained scope of the research limits the ability of this KVC to create a broad range of knowledge.

This paper sheds further light on the tensions that take place in the collective of producers and users of knowledge. While the study of DHHS identified a knowledge value collective that favors the norms of peer review and experimental design over social interactions, the NIJ study identified a balance tilted the other way. Yet, in the latter case, the result of this change in balance was the compromised scope of research and not, apparently, compromised objectivity. The limited scope may result in a public failure by neglecting the specific ability of long-range studies to contribute to specific social needs.

3.3 Identifying Public Values

Meyer (in preparation) conducts a content analysis to address the second and third steps of the PVM approach suggested by Bozeman (2003), namely, to identify measurable public values (step 2) and sort them out (step 3). Bozeman advises: "In most cases of PVM of public research programs, the mission and goal statement of the sponsoring entities should prove satisfactory statement of public value." (2003, p. 37). Meyer builds on this premise through an investigation of the US Climate Change Science Program (CCSP). The goal of the project is to examine, through content analysis of the CCSP strategic plan and other supporting documents, the internal logic and structure of the program for consistency, coherence, and plausibility. The result is a framework allowing the researcher to hold the CCSP accountable to those values identified in its own internal structure.

Studying CCSP's strategic plan, Meyer finds a self-serving and incomplete articulation of the connection of research activities to desired social outcomes. The language of the plan indicates a clear need for creating usable knowledge for decision making and risk management of global climate change. However, the program structure laid out by the plan focuses on the task of advancing basic research, and little or not attention is paid to applied climate change research. The problem of connecting knowledge production to other social processes equally important for policy to achieve desired outcome remains largely unattended.

This paper tackles one of the main tasks of PVM: the characterization of public values. As Meyer shows, even a bureaucracy populated by highly qualified experts neglects the logical consistency of its strategic plan. It is unclear whether this discrepancy is due to implicit (and flawed) mental models that assume automatic benefits from science; the institutional inertia of old framings and research programs already in place; or the cynical, self serving politics of science agency funding battles. When policy reflects a compromise of diverging public values among political actors, the articulation of those public values becomes a difficult task for public administrators, and nearly an intractable problem for policy students attempting to map public values into social outcomes. But PVM provides a hope to those students. As Meyer concludes, PVM elicits a reflexive exercise to help agencies redefine and articulate values with, at least, a modest adherence to logic and consistency.

3.4 PVM and Public Failure

Monica Gaughan and Ben Clark (in preparation) present an ambitious research design that, keeping to the methodology suggested by Bozeman (2003), addresses problems of potable water and the possible solutions brought to bear by the adoption of nanotechnolgies. The study attempts to:

- Understand the governmental structures responsible for the provision of potable water;
- Establish a knowledge base about nanotechnology applications – scientific and commercial – related to the provision of potable water; and
- Examine how these governmental structures use such nanotechnology applications toward the provision of potable water.

Public values can be distilled from historical and cultural analysis, empirical approaches, and the so-called "sciences of the artificial." (Simon, 1969). Potable water is a problem recognized globally, e.g., in the World Bank's millennium development goals (World Bank, 2007), and nationally in the broad literature on water stressors and water policy. The research will also include an abridged history of water policy in the US and its place within environmental policy, with particular attention to the Clean Water Act of 1977 and the Safe Drinking Water Act of 1974 (amended in 1986 and 1996).

The relevance of nanotechnology in the governance of water resides in its capacity to provide a "leap frog" type of solution. Nanofilters may provide water filtration, often more effective in terms of sustainable development, than piped water supplies.

An important part of the paper is the identification the public failures in the provision of potable water. A synthesis of these is proposed in the design as an agenda to pursue further and is reproduced in the table below (see Table 1). As an exemplar application of the PVM methodology, this paper will also test PVM's limitations by comparing the study of the KVC with the public values of water management in light of the public failures shown in the table.

Table 1: Public Failures in the Provision of Potable Water

Public Failure	Failure Definition	Illustration
Mechanisms for values articulation and aggregation	Political processes and social cohesion insufficient to ensure effective communication and processing of public values.	Fragmented world and national political and regulatory mechanisms.
Imperfect monopolies	Private provision of goods and service permitted even though government monopoly deemed in the public interest	Local control of federal priorities.
Benefit hoarding	Public commodities and services have been captured, limiting distribution to the population.	Let a thousand water filters bloom… When a bottle of water costs more than gas.
Short time horizons	A short time horizon is employed when a longer term view shows that a set of actions is counter to public value	Deferred maintenance of public water systems. Unintended consequences of nano.
Substitutability vs. Conservation	Policies focus on substitutability or	American regulatory framework.

	indemnification when there is not satisfactory substitute	Limitations of precautionary principle.
Scarcity of providers	Despite the recognition of a public value and agreement on the public provision of goods and services, they are not provided because of the unavailability of providers.	Loss of investment in public water infrastructure at national and international levels. High risk, low return investment.
Threats to human dignity and subsistence	The core value of subsistence is violated.	One in five people lack access to drinking water.

Based on Bozeman (2002).

3.5 PVM and Public Engagement

Evan Michelson's presentation summarized the work undertaken by the Project on Emerging Nanotechnologies at Woodrow Wilson International Center for Scholars regarding the formation of public values as society reacts to technological innovations. Michelson argues that social expectations of formidable benefits emanating from advances in nanotechnology are tempered by concerns over potential risks to public health and the environment. The victories in fighting disease and environmental degradation may not necessarily outweigh the potential damage of yet unknown toxicity or bioaccumulation, especially if government is slow to react to emerging problems. In turn, the government has a unique opportunity to regain the trust of the public regarding its ability to manage these extreme technological risks. Regaining public trust will require increased programs of public engagement—from traditional media to online video games to web-based dialogues—to help inform the policy process, the adoption of oversight strategies, public-private partnerships, and precautionary safeguards, and heavier investments in social science studies of technological impact.

Though not conducted under the explicit rubric of PVM, Michelson argues that this framework provides an implicit conceptual underpinning for the work of the Project. Michelson concludes that public values will be better articulated by increasing public participation in the design of new regulations and other policies for nanotechnology, particularly related to the commercialization of consumer products. He will continue to seek the creation of forums to engage different publics, analyze the societal impact of nano-enabled products, and monitor public attitudes with respect to nanotechnologies.

4. Conclusion

Public Value Mapping is proving to be a fruitful way of framing empirical studies of science and technology, both at a general heuristic level and at a more detailed methodological level. The case studies of the Department of Health and Human Services and the National Institute of Justice show the versatility of PVM to capture the dynamics within a knowledge value collective by opening the KVCs, as it were, in transverse slices. In the DHHS study, a horizontal cut reveals a way of synthesizing a potential conflict between objectivity and socialization in knowledge production to reveal a KVC in which professional norms shield social policy research from political influence. In the NIJ case, a vertical slice exposes the competing demands for practicality versus scope of the research in which the scope of research is sacrificed to a high transformation value.

The case study of the Climate Change Science Program demonstrates the challenges of disentangling the public values embedded in policy – a task that must precede any full PVM analysis – as well as the difficulties policy makers have in designing logically consistent policies. In the PVM perspective, the clear articulation of public values is a necessary condition for policy to advance the public interest. This study exposes public failure by demonstrating the inconsistencies in the CCSP’s strategic plans and thereby questions what public value should be expected from the research it supports.

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6. Glossary of Terms

Knowledge Utilization (KU): The dissemination and uptake of information by particular individuals and communities; a distinct literature in both public administration and science studies which can reveal some of the dynamics in the knowledge value collective.

Knowledge Value Collection (KVC): Set of networks and institutions that involves knowledge production (basic research), development (applied research), dissemination (publication, outreach, training) and use (consumer and industry applications).

Outcomes: the broader, measurable societal impacts of research projects or programs, e.g., reduction in morbidity and mortality or in the number of families living in poverty; closely related to public value.

Outputs: the narrow and immediate products of research and other activities, e.g., papers published, new students trained, or patents produced.

Public Value(s): The social referent of public interest. The public interest is the aggregation of all private interests by means of a democratic process. For instance the right to property, or technological progress are public values when, democratically organized, ownership or new technologies advance the private interest of a segment or all the society.

Public Value Mapping (PVM): A map from public values to policy outcomes broadly defined across the KVC. Each connector of two nodes in the map is an empirically testable causal relation.

Research Ecology: The institutions in a chain of production and use of knowledge. Closely related to a KVC.

Transformation Value: The value in use of knowledge. Existing knowledge is transformed into uses or applications. These new uses in turn increase the collective repository of knowledge, which is recursively transformed into new uses or applications.

Appendix A: Workshop Participants

Ben Clark is a Ph.D. student in the Department of Public Administration and Policy at the University of Georgia. He holds a Master in Public Administration from the Maxwell School at Syracuse University, and a BA in political science from Indiana University. He has experience in an international public health consulting firm, with assignments in South Africa, Lesotho, Tanzania, and Jamaica. As a Peace Corps volunteer in Senegal, worked as a small enterprise development agent near Mauritania. His research interests include environmental management and HIV/AIDS policy, with a primary focus on the intersection of government and business.

Ira Bennett is a post-doctoral researcher at the Consortium for Science, Policy and Outcomes and the Center for Nanotechnology in Society who is studying policies and politics of emerging technologies specifically nanotechnologies. His projects include: educational programs in Nanotechnology in Society, explorations in State and Regional investments in Nanotech, and maintaining an international network of social scientists studying nanotechnology (International Nanotechnology and Society Network). Previously he was a post-doctoral researcher in the Department of Chemistry and Biochemistry at Arizona State University, working with de novo designed peptides directed towards the development of bio-compatible catalysts. Ira completed his Ph.D. in Chemistry in 2003 developing artificial photosynthetic membranes capable of metal ion transport. This work occurred at ASU as part of a NSF funded Research Training Grant focusing on Bio-molecular Devices after receiving a B.S. from The Evergreen State College in Olympia, Washington.

Barry Bozeman is Crenshaw Professor of Public Policy at the University of Georgia. He holds an appointment as Adjunct Honorary Professor of Political Science at the University of Copenhagen. Before joining the University of Georgia he was Regent's Professor of Public Policy, Georgia Tech, and Professor of Public Administration and Adjunct Professor of Engineering, the Maxwell School, Syracuse University. At Georgia Tech, he was first full-time Director of the School of Public Policy and founding Director of the Research Value Mapping Program. At Syracuse University, he was founding Director of the Center for Technology and Information Policy. Bozeman 's practitioner experience includes a position at the National Science Foundation's Division of Information Technology and a visiting position at the Science and Technology Agency's (Japan) National Institute of Science and Technology Policy. Bozeman is co-editor of Journal of Technology Transfer. Bozeman has served as a consultant to a variety of federal and state agencies in the United States, including the Internal Revenue Service, the Department of Commerce, the National Science Foundation and the Department of Energy. He has helped in the design and evaluation of the national innovation systems of the Republic of South Africa, Canada, New Zealand, France, Chile, and Argentina. His research has been funded by grants from the National Science Foundation, the Department of Energy, the National Institutes of Health, the Department of Commerce, EPA, the Office of Naval Research, the Kellogg Foundation, the Sloan Foundation, and the Rockefeller Foundation, among others. He has served on four National Academy of Science/National Academy of Engineering panels. He is author or editor of 15 books**.**

Gretchen Gano is an assistant curator librarian for public administration and government information at New York University Library. She holds a Masters in Public Policy and a Masters in Library and Information Science from Rutgers University.

Monica Gaughan is Assistant Professor in the College of Public Health at the University of Georgia. She holds a Ph.D. degree in sociology from University of North Caroline at Chapel Hill. He research interest are in the areas of scientific labor force, adolescent and young adult life course, policies and organizational contextual effects, individual and institutional gender dynamics.

David Guston is Professor of Political Science, Director of the Center for Nanotechnology in Society, and co-director of the Consortium for Science Policy and Outcomes at Society at Arizona State University. His book, *Between Politics and Science: Assuring the Integrity and Productivity of Research* (Cambridge U. Press, 2000), was awarded the 2002 Don K. Price Prize by the American Political Science Association for best book in science and technology policy. He has also co-authored *Informed Legislatures: Coping with Science in a Democracy* (with Megan Jones and Lewis M. Branscomb (University Press of America, 1996), and co-edited *The Fragile Contract: University Science and the Federal Government* (with Ken Keniston, MIT Press, 1994). His most recent book is co-edited with Daniel Sarewitz, *Shaping the Next Generation of Science and Technology Policy* (University of Wisconsin Press, 2006). Professor Guston has published numerous articles and book chapters and made more than seventy research presentations on research and development policy, scientific integrity and responsibility, public participation in technical decision making, peer review, and the politics of science policy. He is the North American editor of the peer-reviewed journal Science and Public Policy. Professor Guston has served on the National Science Foundation's review panel on Societal Dimensions of Engineering, Science, and Technology (2000-2002) and on the National Academy of Engineering's Steering Committee on Engineering Ethics and Society (2002). In 2002, he was elected a fellow of the American Association for the Advancement of Science. He holds a B.A. from Yale and a Ph.D. from MIT.

Sean Hays is a graduate student in Political Science at Arizona State University and a research associate at the Center for Nanotechnology in Society. His concentration field is political theory and public policy.

Ryan Meyer is a graduate student at ASU's School of Life Sciences and the Consortium for Science, Policy and Outcomes, and a Research Associate in the ASU Office for Sustainability Initiatives. He arrived in Arizona in the fall of 2005 after spending three years working as a Program Manager at the Earth Institute at Columbia University. Prior to that, he received his BA in Biology from Bowdoin College, where his focus was ecology and marine biology. Ryan's most general interest is in how disciplines frame problems and determine what qualifies as valid knowledge or acceptable fact. His work at CSPO focuses on how conflicts among these differing perspectives influence deliberation and decision making, with particular focus on uncertainty in debates over climate policy and climate science policy.

Evan Michelson is a research associate for the Project on Emerging Nanotechnologies at the Woodrow Wilson International Center for Scholars. He received a M.A. in international science and technology policy from The Elliott School of International Affairs at The George Washington University, a M.A. in philosophical foundations of physics from Columbia University, and a B.A. in philosophy of science from Brown University. He previously served as a visiting researcher in the Korea Science and Engineering Foundation's Performance Assessment Team as part of the National Science Foundation's Korea Summer Institute program. In 2004, he developed public outreach and education programs as a Christine Mirzayan Science and Technology Policy Graduate Fellow at the Koshland Science Museum of the National Academies. Michelson received a 2005 Navigator Award from the Potomac Institute for Policy Studies and the Phi Beta Delta Honor Society for International Scholars. He has published articles in several journals and collections, including *Science and Public Policy*, *Ethics and Infectious Disease*, and *Converging Technologies for Human Progress*.

John Parsi graduated from Arizona State University with a B.S. in Political Science and a B.A. in Sociology in May, 2002. After graduation John took a position as Assistant Director of a documentary film company in Milan, Italy. In the Spring of 2004 John returned to Arizona State University to pursue a PhD in Political Science, receiving his M.A. in May, 2006. In the Fall of 2005 John began work for the Center for Nanotechnology in Society. His work spans the major political and philosophical questions concerning contemporary society both within the political realm and the scientific realm. John's major projects are the exploration of the political and philosophical issues of human enhancement and the tracing the global social justice movement. Within the sphere of human enhancement John is working on the need for anticipatory governance when examining the political and ethical dimensions of advancing technology.

Daniel Sarewitz is Director of the Consortium for Science, Policy and Outcomes. His work focuses on understanding the connection between scientific research and social benefit, and on developing methods and policies to strengthen such connections. His most recent book, co-edited with David Guston, is *Shaping the Next Generation of Science and Technology Policy* (University of Wisconsin Press, 2006). He has also co-edited *Living with the Genie: Essay on technology and the Quest for Human Mastery* (Island Press, 2003), co-edited *Prediction: Science, Decision-Making, and the Future of Nature* (Island Press, 2000) and is the author of *Frontiers of Illusion: Science, Technology, and the Politics of Progress* (Temple University Press, 1996). He has also written many other articles, speeches, and reports about the relationship between science and social progress. Previously, he was the director of the Geological Society of America's Institute for Environmental Education. From 1989 to 1993 he worked on Capitol Hill, first as a Congressional Science Fellow, and then as science consultant to the House of Representatives Committee on Science, Space, and Technology, where he was also principal speech writer for Committee Chairman George E. Brown, Jr. Before moving into the policy arena he was a research associate in the Department of Geological Sciences at Cornell University, with field areas in the Philippines, Argentina, and Tajikistan. He received his Ph.D. in geological sciences from Cornell University in 1986.

Walter Valdivia is a doctoral student at the School of Public Administration and holds a MS in Economics. His area of interest is science policy, currently focusing on (i) empirical studies of game theory in science policy, (ii) applications of principal-agent theory to government funding of S&T research, (iii) technology assessment.

Appendix B: Working Papers

Gano, Crowley, and Guston: "Shielding" the Knowledge Transfer Process in Human Service Research (Abstract)

"Knowledge utilization studies aim to understand the pathways whereby research moves from a specific set of producers to a specific set of consumers. Broadly speaking, two sets of explanations exist: (1) the engineering model, which focuses on the inevitability of science in advancing knowledge, and (2) the socio-organizational model, which stresses the importance of communication between and among groups as the critical factor in promoting utilization. This study asks both research managers at the Department of Health and Human Services and representatives from a particular set of consumer organizations to elaborate on the qualities of the research process that make knowledge most useful to them. We find that the qualities valued in both communities signal convergence around a novel third approach–the shield model–in which aspects of the original two models reinforce a powerful professional norm of objectivity that shelters the knowledge production and transmission process from external political pressures." (Gano, Crowley, and Guston, 2007).

Ryan Meyer: Priorities, Goals, Metrics and Reality: How will the USCCSP contribute to policy and decision making? (in preparation).

Introduction

Traditional research policy analysis has tended to focus on products (peer-reviewed papers, new research tools, etc.) or impacts (usually economic) that have no necessary connection to public value. New tools are needed for analysis of research with explicit goals that cannot be evaluated in terms of these more common metrics. Public Value Mapping (Bozeman, 2003), a new framework aimed at remedying this lacuna, is explored here in the context of the US Climate Change Science Program (CCSP).

Public Value Mapping, and this work in particular, is motivated by the recognition that publicly funded research programs directed toward explicit societal goals should be evaluated in terms of their ability to reach those goals. Put differently, research intended to generate public value should be structured to achieve that end; it must go beyond the generation of new knowledge and explicitly bridge the gap between scientific product and social outcome (Bozeman, 2002; Bozeman and Sarewitz, 2005). This approach is consistent with calls for the democratization of science toward the generation of knowledge that is both scientifically valid *and* socially robust (Gibbons, 1999; Nowotny, 2003; Guston, 2004).

My purpose is to hold the CCSP accountable to those values identified in its own internal structure through an analysis of its strategic plan and other supporting documents. It is too early to evaluate the success or failure of the program in achieving its mission, as many of its planned activities have only just gotten under way. However, an examination of the internal logic and structure of the program for consistency, coherence and plausibility may prove valuable as it moves forward in the coming years.

Here I develop a "map" of the CCSP's structure, and then discuss key parts that will be exceptionally important to the success of climate research in the U.S. in terms of achieving its self-defined objectives. I conclude with recommendations for addressing inconsistencies identified in the analysis that raise doubts as to the program's potential to generate the public value it has promised the American taxpayers.

Internal Logic of the CCSP

Figure 1 provides a conceptual map of the basic structure of the CCSP, as interpreted from the first two chapters of its strategic plan (USCCSP, 2003). Solid connectors represent relationships explicitly defined in the text, and dotted connectors represent implied but unstated relationships. The CCSP defines a vision and mission, along with five overarching goals and "core approaches" designed to achieve those goals. A close analysis of this structure leads to the following observations:

- The mission is not explicitly linked to the vision. In other words, the plan does not explain how achievement of the mission will help to realize the vision.
- The plan gives no explanation or justification for its choice of goals (why these and only these?), or why their achievement can be expected to generate progress toward the mission.
- One might expect the goals to be discussed in terms of their ability to achieve the program's mission. Instead they are presented in response to two "basic

questions" (USCCSP, 2003, p.3) which are also not linked to the mission or vision.

- The plan does not define the difference between approaches and goals. For example, decision support might just as easily be a goal, while the reduction of uncertainty might be one approach to achieving that goal.
- Rather than adopting a linear model (e.g. using **approaches** to achieve **goals**, which achieve the **mission** and thus the **vision**), this model is implicitly circular. The mission is to use the core approaches to achieve the goals which, one must assume, will achieve the mission. Thus, ***if*** one accepts the (unstated) premise that the mission will support the vision and that the approaches will achieve the goals, then ***by definition the program cannot fail***.

Decision Support and Communications

It is unclear how the decision support and communications core approaches can be expected to contribute to the five overarching goals of the CCSP (more on this below). However, one could argue that these two activities are absolutely essential to the vision and the part of the mission dealing with the application of knowledge. In fact they may be the only two elements of the plan with the potential to link its scientific activities with broader societal goals.

Drawing from research and experience in a variety of areas, Cash et al. (2006) have identified a useful framework for linking science to decision making. They emphasize the effective **management of boundaries**; **coproduction** of knowledge; and a balance among **credibility**, **salience** and **legitimacy** of information communicated to stakeholders. CCSP Figure 11-1 (Figure 2), which outlines a process for the development of decision support resources and communication, suggests some consideration for the first two of these elements. In addition, the plan states that access and credibility will be key priorities in communicating results (USCCSP, 2003, p. 151). However, a balance among the last three elements of the Cash et al. framework may prove exceptionally difficult because of competing definitions of salience. The CCSP scientific activities are geared largely toward the production of knowledge that will enable progress in other research areas, but this *scientific* salience may not always be compatible with addressing issues presently most important to stakeholders and policy makers.

The primary activity in decision support will be the production of synthesis and assessment reports (seen as the brown pie slice in Figure 2). According to the CCSP, "Assessment used to support decisions is an iterative analytic process that engages both researchers and interested stakeholders in the evaluation and interpretation of the interactions of natural and socioeconomic systems" (USCCSP, 2003, p. 26). The structure of this lessons "learned approach" (Figure 3) leads to two key observations:

- Considerable attention is given to the process of integration and stakeholder involvement prior to, and during assessment activities. However, there is no plan explaining how the information in a report will be actively inserted into appropriate decision making processes *after* this process.
- Assessment reports will be aimed at three very different types of decisions (see Figure 3), but no plan is given for evaluating the success or failure of efforts in each case. Brief case studies (p. 117, 118, 121) give examples of how support might successfully be carried out, but in the case of policy support the example is

only hypothetical. Given the difficulty of evaluating the impact of science and policy analysis on decision making (e.g. Bimber 1996; Shulock 1999; Sarewitz 2004; Cash et al., 2006), this step should be highlighted, not glossed over.

Reduction of Uncertainty and Other Aspects of Advancing Knowledge

A central problem of the CCSP's strategic plan is its inconsistent, heavy-handed and, at times, incomprehensible treatment of the concept of advancing and evolving knowledge. For example, the reader (and potential stakeholder) must intuit the difference between sharpening, improving and increasing understanding. The plan uses at least ten different terms in reference to the concept of uncertainty or its reduction. Thus, even if the crude definition of "uncertainty" offered in the glossary were improved (e.g. Shackley and Wynne 1996), undefined terms like "reliability limits" (p. 3), "applicability limits" (p. 111), or "confidence limits" (p.121), would continue to breed confusion. Given the highly interdisciplinary nature of the CCSP enterprise, and the fact that all five overarching goals of the plan involve changing aspects of knowledge that emerges from climate science, it is absolutely essential that these terms be clarified, standardized and distinguished from one another in future documents.

This is more than an issue of semantics. The reduction of uncertainty is the plan's primary measure of progress (NRC, 2005). A NRC report noted that this may "create an erroneous sense of progress, since uncertainty can increase, decrease, or remain constant as the understanding of causal factors improves" (NRC 2005, p. 4), and recommended including additional measures. The NRC report does not point out that, if uncertainty can increase with improved understanding, then *perhaps many of the overarching goals are inappropriate to achieving the mission and vision* of the program. Furthermore, while this speaks to an unstable relationship between advancing knowledge and uncertainty, the political and social context of uncertainty are important as well (Shackley and Wynne 1996; van der Sluijs et al. 1998). Uncertainty is a social phenomenon as well as a scientific one, especially in the context of political decision making, and the CCSP plan should recognize this.

Recommendations

The CCSP has grown out of a large community of scientists doing excellent work toward the goals defined here and it manages to integrate a broad ranging science in a very impressive manner, drawing together activities in 13 federal agencies, not to mention international collaborators. The primary weakness, however, is in the part of the plan most crucial to achieving that which has been promised to the taxpayers. Advancing scientific knowledge is important, but is only one piece of what is needed to generate the value expected of this program. CCSP will continue to evolve, with multiple opportunities for stakeholders and scientists to influence the process. It is with this in mind that I make the following recommendations:

- The goals of the plan must be linked to the mission in a convincing manner. This will require clarification of the goals and an account of the relationship between advancing knowledge and improved decision making.
- Decision support should recognize the social and political context of knowledge as it is generated, synthesized and applied in decision making.

- The CCSP should clarify and distinguish different ways that knowledge may "improve," and address the implications of this for decision support.
- Beyond an ad hoc "lessons learned" approach, feedback into science policy decisions and decision support strategies should be informed by research on the role of science in decision making, especially for policy.

Further work will expand upon this analysis through supporting documents of the CCSP as they emerge, as well as interviews and other qualitative work on the program as it progresses.

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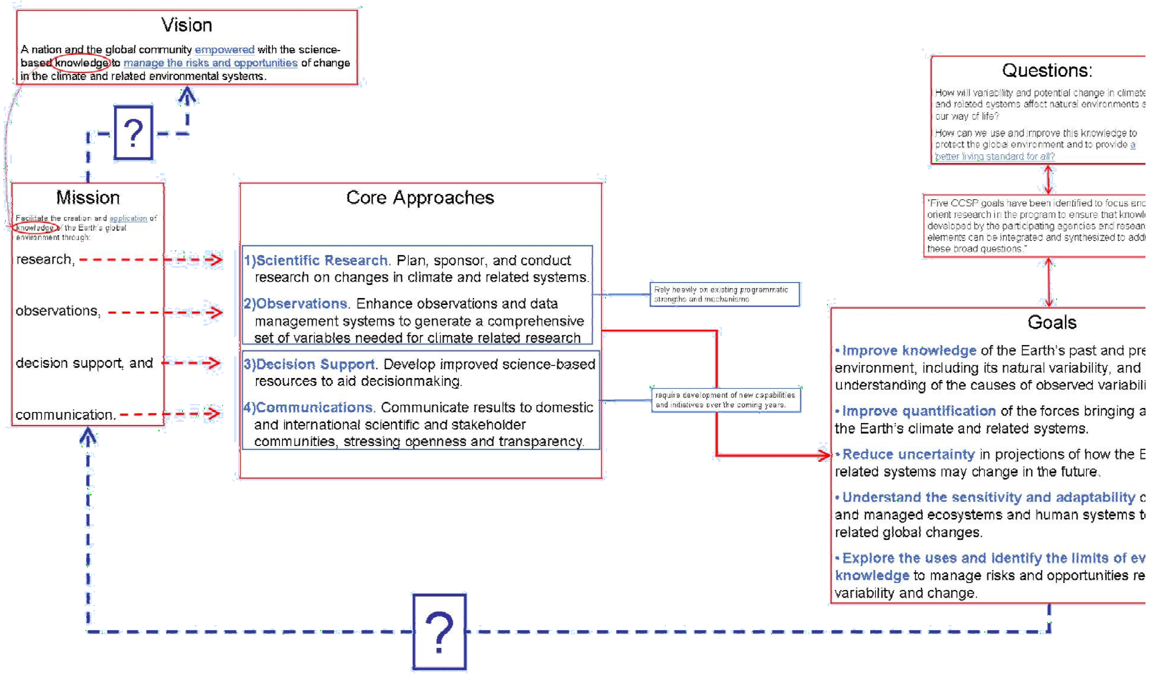

Figure 1. Conceptual Map of the US Climate Change ProgramÕs Internal Logic

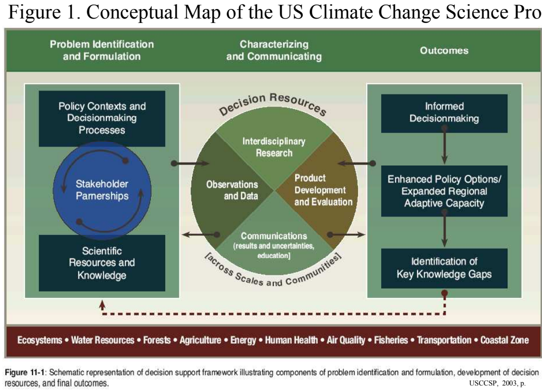

Figure 2. USCCSP diagram showing plans for decision support act

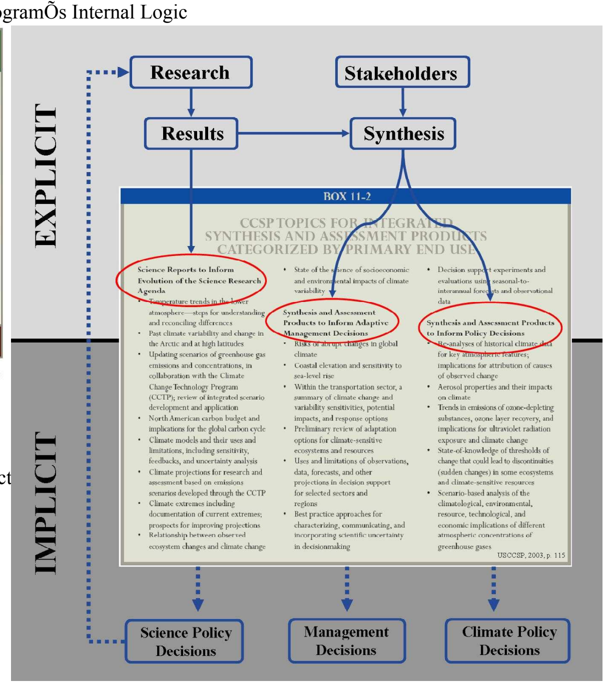

Figure 3. Conceptual model of decision support activities of the USC(

Sean Hays and David Guston: High Transformation Value and Low Creation Capacity (in preparation).

Monica Gaughan: Water, Nanotechnology, and Public Health: Promise and Precaution (PPT presentation).

Water, Nanotechnology, and Public Health: Promise and Precaution

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Questions and Objectives

- Is the nanotechnology of potable water a suitable case for a public value mapping analysis?
- Understand the governmental structures responsible for governance of potable water.
- Establish knowledge base about nanotechnology applications (scientific and commercial) related to the provision of potable water.
- Examine how these governmental structures are addressing the nanotechnology of potable water.

Where do we find Public Values?

(1)ŹŹŹŹDistill public values from literature
(2)ŹŹŹŹHistorical and cultural analysis
(3)ŹŹŹŹEmpirical approaches
(4)ŹŹŹŹSciences of the Artificial

This Presentation:
→Why Water
→Water regulation in US
→Promise and peril of nanotechnology
→A brief public failure application

Why water?

World Bank
Millennium Development Goals
Goal 7 Ensure environmental sustainability
Target 10:
Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation

Evan Michelson: Falling Through the Cracks? Public Perception, Risk, and the Oversight of Emerging Nanotechnologies (Abstract)

"Nanotechnology is expected to be the key technology of the 21st century. Researchers are exploring ways to see and build at this scale, reengineering familiar substances like carbon and silver to create new materials with novel properties and functions. However, the emergence of nanotechnology also provides us with an opportunity to reshape how the public perceives the government's ability to manage risks posed by new technologies. As the first wave of nano-based products–including cosmetics, dietary supplements, food additives, and consumer products–enters the market, society will begin to ask questions about the health, environmental, and safety implications of these materials. The purpose of this paper is to connect the current state of such public perceptions–both with respect to nanotechnology, in particular, and to emerging technologies, in general–with the current state of nanotechnology product development and to analyze how well situated the public sector is to deal with these challenges." (Rejeski and Michelson, 2006)