The "Public Value Innovation" Alternative

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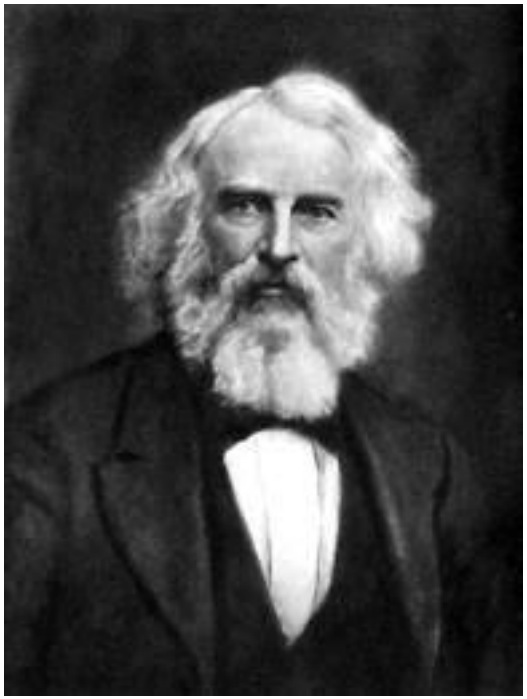
“Who has gone farthest? For I would go farther… And who thinks the amplest thoughts? For I would surround those thoughts (.)”

Henry Wadsworth Longfellow, Poem 228, “Excelsior,” *Leaves of Grass*.



Objectives

- To suggest that the traditional rationale and evaluation assumptions for Innovation Policy are insufficient
- To provide some additional criteria for analyzing Science and Innovation Policy
- To introduce (briefly) results from a 10 year research program on “public values science and innovation”

A word from our sponsors:

National Science Foundation

Science of Science and Innovation Policy Program

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'Public Values Failure in Science Policy'

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'S&T Policy and Social Capital'

Generic Innovational Policy Statement
(U.S. Engine Metaphor Varietal):

"Reaffirming and strengthening America's role as the world's engine of scientific discovery and technological innovation is essential to meeting the challenges of this century."

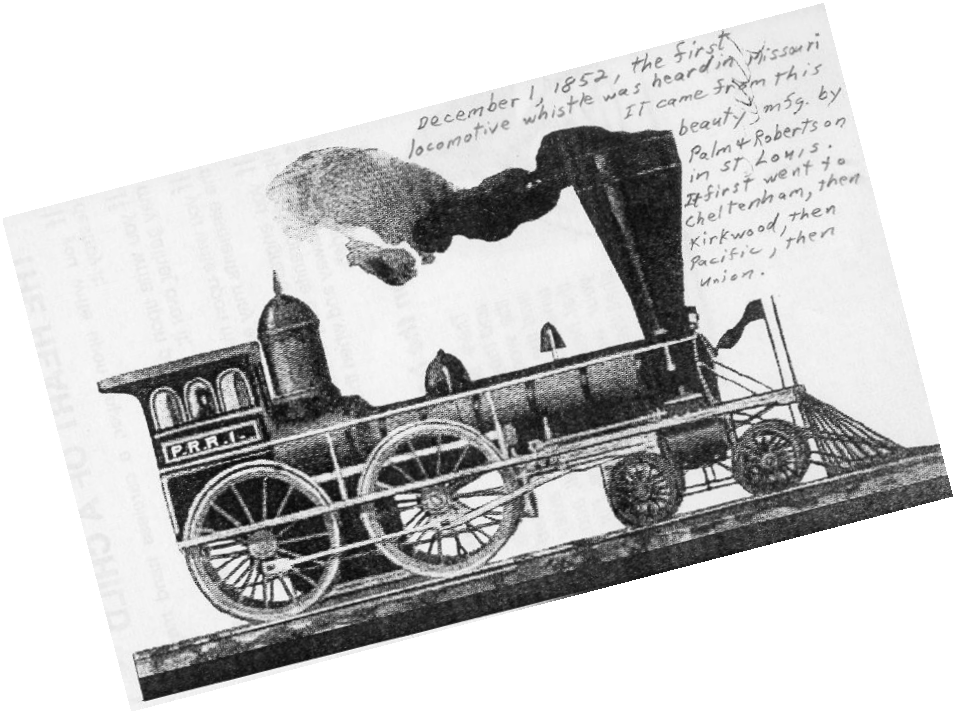
- President Barack Obama, quoted in announcement of policy initiative "Educate to Innovate," November 23, 2009.

"Innovation as engine of the economy."

- The economy is critically dependent upon technological innovation as a source of growth

- Science is the primary ingredient fueling technological innovation

- Science must be unfettered so that the "marketplace of ideas" can achieve efficiency



Conclusion: leave science unfettered and the best of all possible worlds will emerge.

Historical Roots of S,T&I as the "Engine of the Economy"

The notion of science as engine of economic growth gained "an overwhelming grip on the public imagination in the U.S in the postwar era" (G. Poggi, *The Development of the Modern State, Stanford University Press, 1978*). INCLUDING:

- **power of science demonstrated through the Manhattan Project and atomic energy applications**
- **the confidence in managing the economy through Keynesian ideas**
- **the rise of large corporate science in U.S. industry and government**
- **the mantel of "world leadership" thrust on the U.S.**

Research and Theory Basis

- Econometric evidence formidable (e.g. Griliches, 1995; Jones, 1995; Denison, 1962; Solow, 1957)
- Bureau of Labor Statistics:
  - **Contribution of S&T approx. 30%** (depending upon the particular combination of unrealistic assumptions one wishes to embrace)

PISTONS in the the Economic Engine

- Market Failure
- Linear Model of Innovation
- “Production Function Logic”
- Emphasis on Property Rights
- Theory of the Firm and, generally, Economic Individualism

The American People and the Engine

- From Pew Research Center study (2009)
  - 84% of U.S. respondents feel that science has "mostly positive effects" and 70% agreed that science "contributes a great deal to society"
  - **Topped only by the military**: 84% agreed that the military "contributes a great deal to society"

What is it Americans Like So Much?

- When the more than 2,000 respondents were asked to give specific examples of science's positive impacts,
  - Computers and information technology advances were mentioned by 76%.
  - More than half (52%) mentioned developments in either general medicine, health care, cures, disease research, stem cells or vaccines.
  - Nothing else came close:
    - space exploration (8%)
    - environment and global warming research 4%)

The European Innovation Engine? EU Horizon 2020

Framework Programme for Research and Innovation

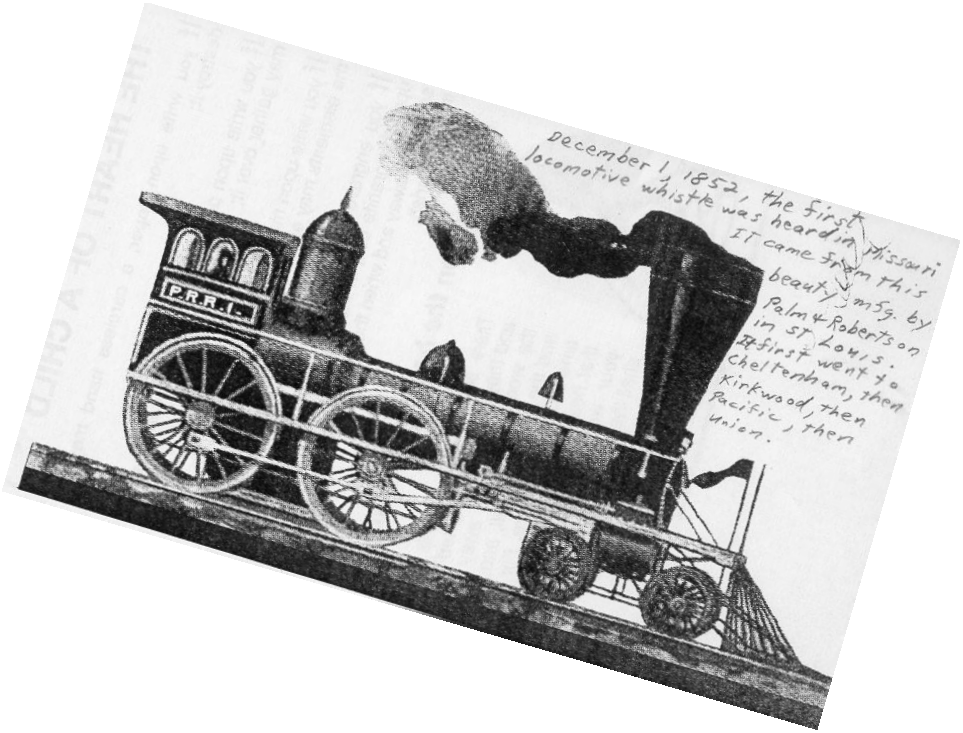
European Commission

-Excellent Science
-Industrial Leadership
-Societal Challenges:

- Health, demographic change and wellbeing;
- Food security, sustainable agriculture, marine and maritime research;
- Secure, clean and efficient energy;
- Smart, green and integrated transport;
- Climate action, resource efficiency and raw materials;
- Inclusive, innovative and secure societies.

Public Values Science:
"Innovation as engine of the **change**."

- **Innovation is an engine of *social* change as well as economic change**
- **Innovation is not always an engine of *beneficial* social change**
- **You can't have "creative destruction" with all "creative" and no "destruction"**



Michael Schrage “Does Europe Really Want to be Innovative?” in S. Tilford and P. Whyte (2011) *Innovation: How Europe can Take Off* (Centre for European Reform).

“Schumpeter deserves to be taken more seriously. The empirical reality is that ‘innovation’ isn’t a euphemism for economic growth but a dynamic that comes with risks and costs attached” (pp. 63-64)

Innovation Advantage and Social Benefit(?)

- **Patents per million** (Eurostat)
  - U.S.: 283
  - EU-27: 37
- **New Business Start-Up**
  - U.S. approx. 2 million per year (80% fail in 3 years)
- **R&D Expenditures** (Battelle)
  - U.S.: EUR 301 billion in 2011
  - EU-27: EUR 245 billion in 2010
- **U.S. World Health Care** Rankings: 37th (Slovenia is 38th)
- **U.S. Infant Mortality** Ranking: 34th (Malta is 35th)
- **U.S. Gini Index:** 45 (Malaysia: 46, Sweden 23, Hungary 24)
- **Corruption Index** Rankings: 24th (Uruguay is 25th)

Possible Implications:

- Innovation is neither necessary nor sufficient to ensure well being
- Economic growth is neither necessary nor sufficient to ensure well being
- So….Why near exclusive reliance on economic models for assessing innovation?

Public Value Innovation

An Alternative to Market-Based, 'Economic Engine' Innovation

Public Value Innovation

- Innovation is beneficial to the extent that it enhances public values and equitable and positive social outcomes

- Entails much more difficult than optimizing for economic growth alone.

"Efficient markets may not do, …efficiency of the 'invisible hand' does not preclude preference for other efficient modes of organization"
-Francis Bator, 1958

General Principles of Public Value Innovation

1. Privileging capacity enhancement (some innovations are enabling others not)
2. Working for fairness and equity in distribution of social costs and benefits of innovation
3. Public values failure criteria
4. Public Value Mapping

1. Capacity Enhancing Innovations

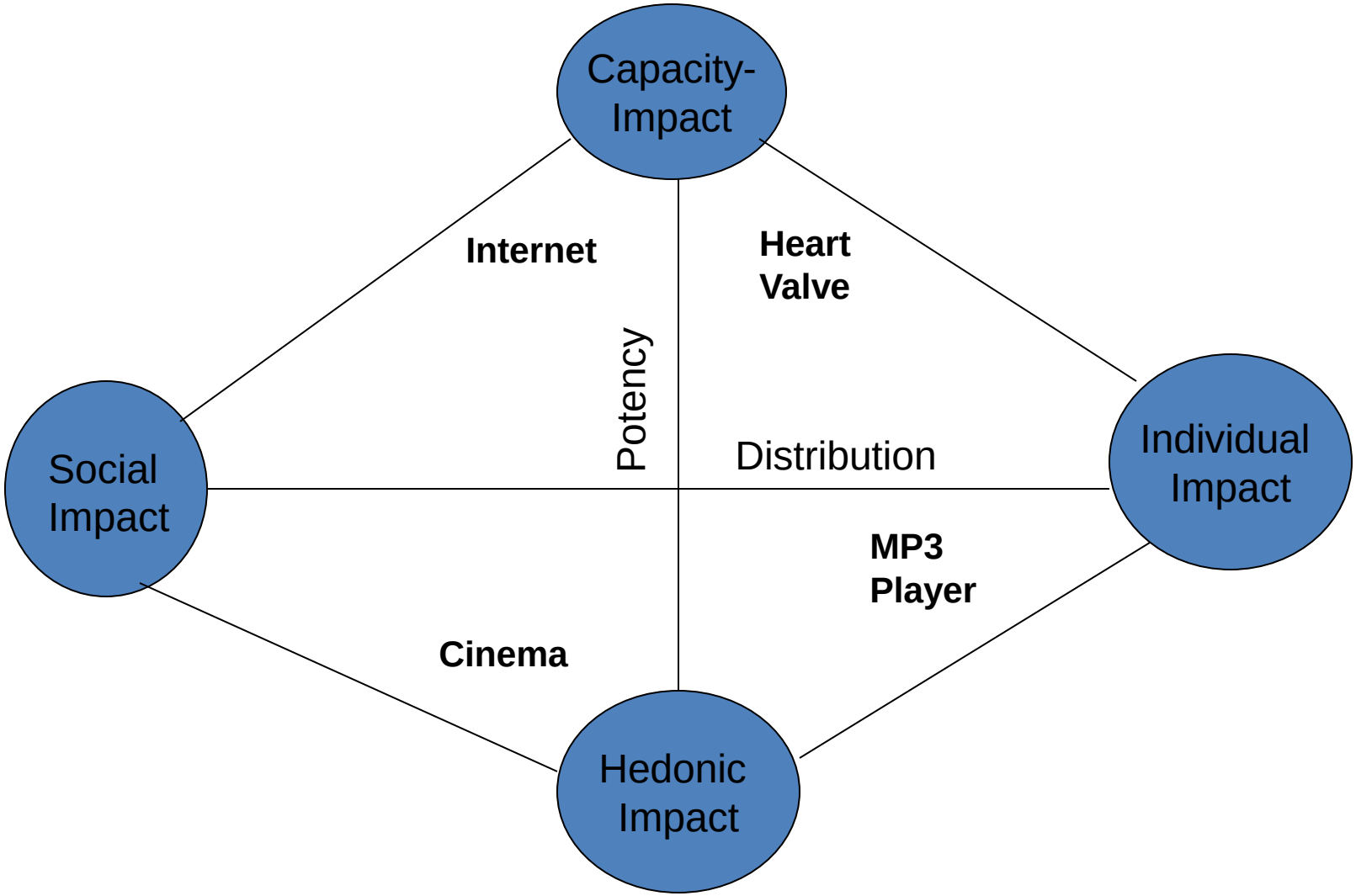


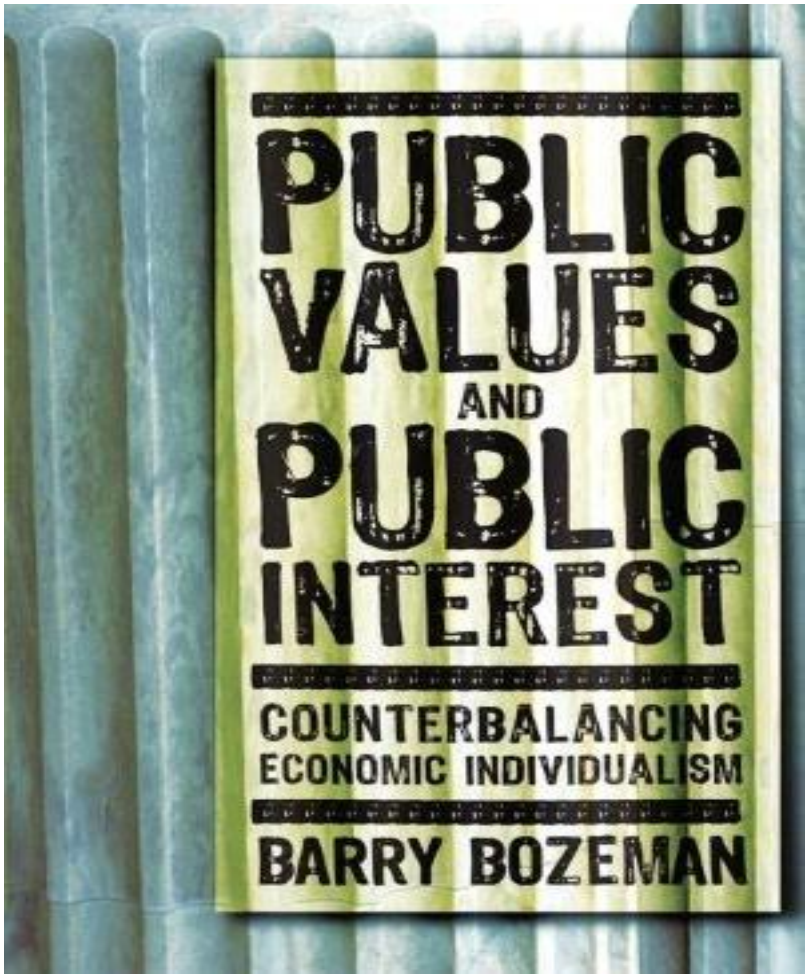
Figure One: Innovation Social Impact Model (adapted from Bozeman, Slade, Hirsch, 2011)

2. Distributional Equity Accounting

- Minimal research and innovation devoted to "diseases of the poor"
- Increasing funds allocated to enormously expensive medical technology innovations- useful for the well insured.
- Placement of toxins and nuclear waste in low income areas
- R&D tax credits policy (for profitable, "high technology" business)
- The science and engineering "pipeline"- not a land of opportunity

3.Public Values

A society's public values are those providing normative consensus about (1) the rights, benefits, and prerogatives to which citizens should (and should not) be entitled; (2) the obligations of citizens to society, the state and one another; (3) and the principles on which governments and policies should be based.



Public Value Mapping Model: "Public Failure Criteria"

Public Value	Definition
Mechanisms for values articulation and aggregation	Political processes and social cohesion should be sufficient to ensure effective communication and processing of public values
Legitimate monopolies	When goods and services are deemed suitable for government monopoly, private provision of goods and service is a violation of legitimate monopoly.
Imperfect Public Information	Similar to the market failure criteria, public values may be thwarted when transparency is insufficient to permit citizens to make informed judgments.
Distribution of benefits	Public commodities and services should, ceteris paribus, be freely and equitably distributed. When "equity goods" have been captured by individuals or groups, 'benefit hoarding' occurs in violation of public value.
Provider availability	When there is a legitimated recognition about the necessity of providing scarce goods and services, providers need be available.
Time horizon	Public values are long-run values and require an appropriate time horizon.
Substitutability vs. conservation of resources	Actions pertaining to a distinctive, highly valued common resource should recognize the distinctive nature of the resource rather than treat the resource as substitutable or submit it to risk based on unsuitable indemnification.
Ensure subsistence and human dignity	In accord with the widely legitimated Belmont Code, human beings, especially the vulnerable, should be treated with dignity and, in particular, there subsistence should not be threatened.

Public Value Mapping Grid

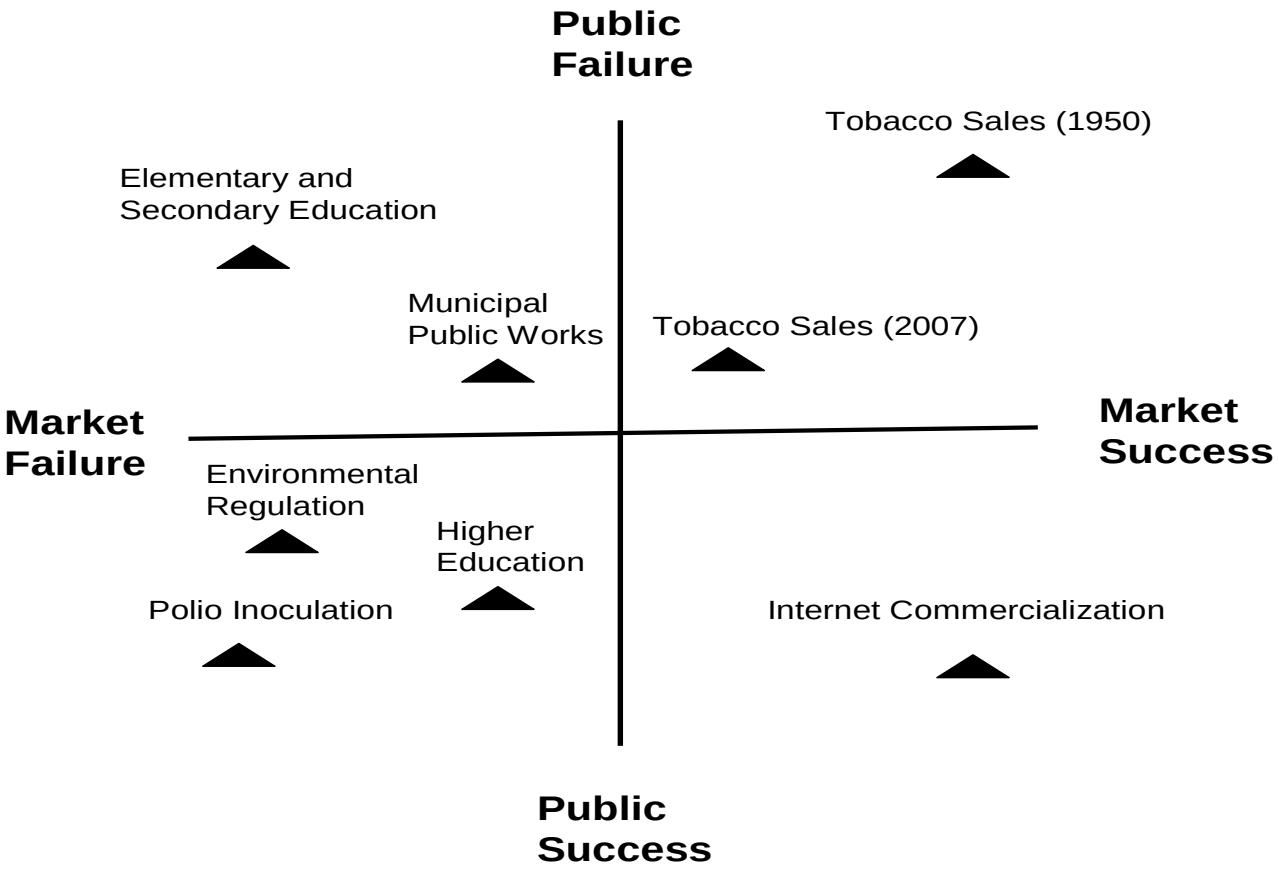


TABLE 1 | PUBLIC FAILURE CRITERIA

CRITERIA	DEFINITION	SCIENCE POLICY ILLUSTRATION
Inadequate mechanisms for values articulation and aggregation	Political processes and social cohesion insufficient to ensure effective communication and processing of public values	Peer review, the favored means of making decisions of individual-level projects, is appropriated for decisions about huge scientific programs, resulting in the displacement of social goals for more easily resolved technical goals
Imperfect monopolies	Private provision of goods and services permitted even though Government monopoly deemed in the public interest	When public authorities abrogate their responsibility for overseeing public safety in clinical trials for medical research, there is potential for violation of public trust and public value
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 unavailable providers	The premature privatization of the Landsat program shows that a scarcity of providers can create a public failure potentially remediable by Government action
Short time horizon	A short-term time horizon is employed when a longer-term view shows that a set of actions is counter to public value	Policy for energy R&D, by considering the short-term, fails to fully capture the costs of global climate change on future generations
Substitutability vs conservation of resources	Policies focus substitutability (or indemnification) even in cases when there is no satisfactory substitute	'No-net-loss' policies fail to take into account the non-substitutability of many natural organisms ranging from wetlands protection to prohibiting the sale of human organs on the open market
Benefit hoarding	Public commodities and services have been captured by individuals or groups, limiting distribution to the population	A prime technical success of genetic engineering, the 'terminator gene', proves an excellent means of enhancing the efficiency of agricultural markets, to the detriment of millions of subsistence farmers throughout the world

4. A “Method”: Public Value Mapping

OBJECTIVES:

- **To provide a social theory (i.e. public value theory) basis for research evaluation**
- **To connect assessments of research outputs and first order impacts (e.g. RVM) with broad social impacts, both anticipated and unanticipated (PVM)**
- **To develop and implement a methodology that is valid, sensitive to institutional and policy context and widely applicable.**

Public Value Mapping (PVM) Goal

- Public Value Mapping of Science Outcomes seeks to develop alternative means of thinking about *public values* in science, ones focusing on social outcome criteria rather than traditional market-based and economic criteria.

PVM Objectives

- **To provide a social theory (i.e. public value theory) basis for research evaluation**
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PVM Operations

- **Step 1: Provisionally, identify research and social outcomes domain**
- **Step 2: Identify measurable public values**
- **Step 3: Sort values and their relationships (means-ends, hierarchies)**
- **Step 4: Establish metrics for public value (e.g. mission statements, statutory guidelines)**
- **Step 5. Identify research domain and researchers, map the "research ecology"**
- **Step 6. Identify target problems of researchers and research programs, ultimately linking to social indicators.**
- **Step 7. Develop causal logic models relating public value statements and research and program activities**
- **Step 8. Identify research techniques appropriate for testing causal paths from research to public value at various outcome levels, to social indicators.**
- **Step 9. Using causal logic models, develop hypotheses about causal paths from research to public value.**
- **Step 10. Use research techniques to test the hypotheses and, when necessary, identify alternative outcome models.**
- **Step 11. Write PVM summary including findings about models relating research programs and activities to public value.**
- **Step 12. Develop prescriptive model and recommendations for enhancing contribution of research to public value.**

PVM Application: CSPO Case Studies

- Breast cancer research and innovation (Gaughan, 2002)
- GMO's (Gupta, 2003)
- Nanotechnology Water (Leech, 2009)

PVM Case Studies: Special Issue

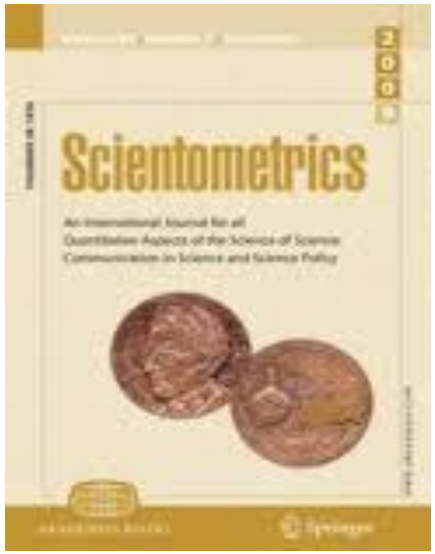
D. Sarawitz and B. Bozeman (2011),
Cases in Special Issue:

-C. Slade, Nanomedicine
-N. Logar, Green Chemistry
-G. Marical, Earthquake Preparedness
-R. Meyer, Climate Change
-W. Valdivia, Technology Transfer

PVM Quantitative Application

E. Fisher, C. Slade, D. Anderson and B. Bozeman,

"Public Value of Nanotechnology?" *Scientometrics,* 85, 1, 29-39.



Objective

To demonstrate a new approach for analyzing the public and social values underpinning science and innovation policy, public value mapping (Bozeman, 2007).

Primary Question: does the policy rhetoric (as reflected in public documents) change with time, politics and policy-making stage?

The Technique

PVM model combines interpretative and qualitative analytical approaches, with structured content analysis of text streams and then employs factor analysis and calculation of factor scores, to identify mathematically-specified dimensions of values embodied in text.

The result of vetting produced 84 value statement search terms for analysis (see Table 2). Relevant sections of each public document were reviewed by the research team to produce a final list of search terms. For example, we reviewed the purpose, legislative history and dissenting opinion sections of the congressional reports since they were considered among the most value-statement relevant.

Access	Developing	Hispanic	Renewable
Advanced Science	Discovery	Homeland	Renewable Energy
Afford	Disease	Infection	Rural
African American	Disseminate	Integrate	Security
Armed Forces	DOD	Justice	Servicemen
Atmosphere	Domestic	Knowledge	Smallpox
Attack	Durable	Leadership	Social
Basic Research	Economic Competition	Legal	Socioeconomic
Basic Science	Education	Low-cost	Soldier
Brain	Efficiency	Market	Supply and/or Demand
Business	Emergency	Medical	Surveillance
Cancer	EPA	MEMS	Technology Transfer
Clean Air	Equal	Military	Terror
Climate Change	Ethics	Minority	Toxic
Commerce	First Principles	Modeling	Training
Community	Flu	Native American	Under Represented
Company	Forefront	Oversight	Understand
Consumer	Gender	Product	Virus
Decentralized	Global Warming	Progressive	Waste
Defense	Greenhouse Gas	Proper Disposal	Weapon
Demand	High Performance	Reliable	Wound

Value Statements for N*Vivo n=84

	Search Terms 1-43	Security & Defense	Equal Opportunity	Energy & Environment
1	Defense	.981		
2	Military	.975		
3	DOD	.974		
4	Armed Forces	.890		
5	Attack	.756		
6	Weapon	.751		
7	Oversight			
8	Security			
9	Reliable			
10	Wound	.683		
11	Low-cost			
12	Modeling			
13	Terror	.648		
14	Soldier	.630		
15	Understand			
16	Legal			
17	Afford			
18	Gender			
19	Basic Research			
20	Brain			
21	Homeland			
22	Servicemen			
23	Surveillance			
24	Ethics			
25	Community		.889	
26	Native American		.849	
27	Education		.839	
28	Minority		.824	
29	Hispanic		.808	
30	Social		.802	
31	Leadership		.775	
32	African American		.759	
33	Developing			
34	Disseminate		.713	
35	Infection			
36	Access			
37	Rural		.695	
38	Knowledge			
39	Cancer			
40	Medical			
41	Business		.661	
42	Training			
43	Disease			
44	Progressive			
45	Discovery			
46	Market		.611	
47	Integrate			
48	Commerce		.592	
49	Equal			
50	Domestic			
51	Decentralized			
52	Virus			
53	Emergency			
54	Justice			
55	Waste			
56	Atmosphere			
57	Toxic			
58	Durable			
59	Basic Science			
60	Climate Change			
61	Flu			
62	EPA			
63	Forefront			
64	Under Represented			
65	Socioeconomic			
66	Smallpox			
67	Economic Competition			
68	Efficiency			.631
69	Product			
70	Renewable Energy			.603
71	Renewable			.576
72	Demand			
73	Clean Air			.531
74	Supply and/or Demand			
75	Company			
76	Technology Transfer			
77	Greenhouse Gas			
78	Proper Disposal			
79	High Performance			
80	Global Warming			
81	Advanced Science			
82	First Principles			
83	Consumer			
84	MEMS			
	Total Variance	32.98	10.05	8.64
	Cumulative Variance	32.98	43.03	51.67

Illustrative Factor Analytical Results

Model with Factor Loadings and Cumulative Variance

Factor and Item	Factor Loading	_	% Variance
Factor 1: Security & Defense		0.798	32.98
Defense	.981		
Military	.975		
DOD	.974		
Armed Forces	.890		
Attack	.756		
Weapon	.751		
Wound	.683		
Terror	.648		
Soldier	.630		
Factor 2: Equal Opportunity		0.792	10.05
Community	.889		
Native American	.849		
Education	.839		
Minority	.824		
Hispanic	.808		
Social	.802		
Leadership	.775		
African American	.759		
Disseminate	.713		
Rural	.695		
Business	.661		
Market	.611		
Commerce	.592		
Factor 3: Environment & Energy		0.927	8.64
Efficiency	.631		
Renewable Energy	.603		
Renewable	.576		
Clean Air	.531		

Conclusions

- PVI/PVM Complement to economics and market-based approaches, not a pretender to the analytical throne.
- Advantages: very different perspective, focus on ends rather than means.
- Disadvantages: poor theory, limited technique.
- Challenges: Move from “soft heart/soft mind” to “soft heart/hard mind”