Valuing the Commons:

A Fundamental Challenge across Complex Systems

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Future Research in the Social, Behavioral & Economic Sciences

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Abstract

The political, economic and social landscapes of the 21st Century are increasingly dominated by complex, sociotechnical systems that are essential to human civilization, yet incompletely addressed with existing theory, tools, methods, and policies. Illustrative systems are found in transportation, information, finance, energy, health care, education, disaster response, and supply chains. Social, behavioral and economic sciences in the 20th Century were focused on hierarchical corporations and expanding markets – the organizational and institutional underpinnings of the industrial revolution. Twentieth Century successes were tempered by various "tragedies of the commons" (such as negative impacts on working conditions, human dignity, the environment, and developing economies). In the 21st Century, increasing interdependencies and accelerating rates of change are dramatically expanding the ways in which complex "systems" shape organizations and markets. Multi-level research incorporating the systems context and systems-level policies have great transformative potential – addressing externalities and expanding how we "value the commons." This white paper highlights layers and networks of aligned (or misaligned) stakeholders, which are at the heart of these systems. Orienting social, behavioral, and economic sciences and public polices to better address stakeholders in complex systems is essential to generating new forms of value for society and mitigating catastrophic systems failures.

Introduction

Understanding the roles of stakeholders in systems, faced with accelerating rates of technological change, will be as critical for the social, behavioral and economic sciences in the 21st Century as was the 20th Century focus on individuals in hierarchies and firms in markets. Increasingly, a new class of organizational and institutional forms – what are termed complex systems or sociotechnical systems[1] – are giving shape to *The Second Industrial Divide,* as identified by Michael Piore and Charles Sabel in 1984*.* These new organizational and institutional forms, and the stakeholders[2] that populate them, will compel transformations in the social, behavioral and economic sciences, as well as in engineering and other fields – all with deep implications for public policy.

Stakeholders in complex sociotechnical systems (e.g. systems associated with air, ground and water transportation; energy; telecommunications; health care; finance; food and water supply; housing; education; research and development; disaster response; and supply chains) are faced with the challenges of decision making in a dynamic and fragmented, yet interconnected world – circumstances that motivated the National Science Foundation in its call for white papers (NSF 10-069). These systems encompass social networks that Walter Powell and others examine as counterpoints to markets and hierarchies, but have essential, additional technical and functional properties.

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[1] In order to define a complex sociotechnical system, we adapt a definition advanced by Chris Magee and Olivier deWeck in 2002: "A large set of interdependent, interacting social and technological components designed by humans, having well-defined (if incompletely understood) behavior or purpose." The first joining of the terms "socio" and "technical" was by Eric Trist, Fred Emery, and others in the socio-technical systems movement, begun at the Tavistock Institute following World War Two. Ludwig von Bertalanffy, Jay Forester, Donella Medows, and others led a first wave of "systems" scholarship in the 1960s, which achieved some success and is of renewed importance. The burgeoning literature on complexity is also relevant, as is the growing Engineering Systems literature. Ultimately "system" is a socially constructed concept, though it corresponds to tangible phenomena.

[2] Stakeholders in these systems are defined as: "Individuals, groups and organizations who have common and/or competing interests with respect to the purpose or behavior of the system." Examples of such stakeholders span public and private sectors, large and small organizations, known and unknown individuals (including future generations), organized and unorganized collective groups.

A defining feature of sociotechnical systems is what can be termed a double bottom line – encompassing both individual stakeholder interests and interests that reside at the level of the system as a whole, including various "commons" or public goods. Inherited institutional arrangements in organizations and markets emphasize separate, unitary objectives; yet, as the pace of technological change accelerates, system-level challenges reach beyond the capacity of individual public or private organizations. The alignment (or misalignment) of stakeholders represents the primary social and behavioral mechanism by which system-level engagement does (or does not) occur and must, therefore, be a central focus for science and policy.

The need for stakeholder alignment is, perhaps, obvious in the case of large infrastructure systems, where observers such as Henry Petroski caution that declining investment in infrastructure threatens the future of civilization. It is also the case in many other situations. For example, NSF-supported research on the "Biomarkers Consortium" operating at the National Institutes for Health Foundation is documenting how no single public or private organization has the resources on its own to support the range of biomarkers research that is needed. Barbara Mittleman, Director of Public-Private Partnerships for the NIH, argues that the entire domain of biomedical research and development requires new, systems-level partnerships.

Ronald Coase, John R. Commons, Kurt Lewin, Adam Smith, Max Weber and other iconic scholars in the social, behavioral and economic sciences were motivated by what were then new, increasingly salient organizational and institutional features of the industrial era. As Piore and Sabel noted, the craft-based forms didn't disappear following the first industrial divide; they just became less central. Similarly, hierarchical organizational structures and market-based transactions will continue, but the interaction of stakeholders across organizational and market boundaries will increasingly drive important outcomes. Documenting these dynamics will shape future social, behavioral and economic sciences.

Valuing the Commons

"Valuing the commons" is how we describe the 21st Century challenge facing

stakeholders bound together in a sociotechnical system. This substantially extends one of the

great the 20th Century challenges, the "tragedy of the commons" – a phrase first coined by

William Forster Lloyd in an 1833 pamphlet in which overgrazing of a village commons was a

metaphor for how individual self interest undermines the common good. This concept was

revitalized by Garret Hardin in 1968 to call for an expanded regulatory role of the state with

respect to what economists term "externalities." Elanor Ostrom earned a Nobel Prize in

economics for documenting how non-governmental, cooperative arrangements can serve as an

alternative to government regulation in mitigating tragedies of the commons. We build on and

extend these and related works to consider the alignment of public and private stakeholders

where market dynamics, regulatory choices, private cooperation, and social networks all

interweave in the operation of systems that play increasingly pivotal roles in society. Consider

the mix of public and private stakeholders and the nature of the "commons" in each of the

following images:

Figure 1:
Visual Representations of Complex Sociotechnical Systems
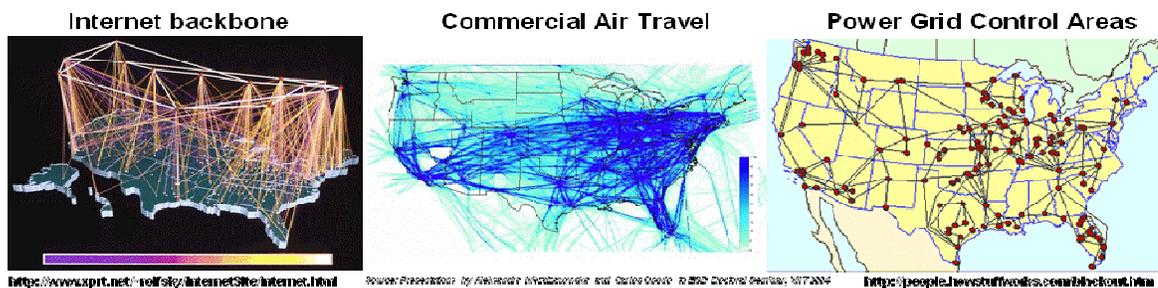
The "commons" involves more than externalities. On the positive side, the commons

includes expanded value beyond the reach of individual stakeholders.   Archetypical examples

are new forms of value made possible by Internet protocols/standards, regional innovation

clusters, and systems for micro loans. There are many other relevant contexts, including

distributed systems for energy generation, new models for research and development, space-

based global positioning technologies, industry centers/consortia, and new mechanisms for

health care delivery – all demonstrating potential for "game changing" forms of collaboration

(what Mary Parker Follett termed in 1926 "integration," but now at the system level).

Consider the intersection of two systems-level challenges: climate change and air

transportation. Both systems are mostly characterized by stakeholders who are highly

segmented, protective of turf, and generally lack effective means to "govern the commons." Yet,

in the domain of aircraft noise and emissions, stakeholders are fundamentally changing the

way they work together. The FAA's Carl Burleson, for example, has restructured internal

operations to operate continuously through public-private partnerships.   While, Larry

Susskind and colleagues have consistently demonstrated how principled, creative approaches

to stakeholder negotiations can produce mutual gains outcomes at a systems level, the aim

here is deeper: Sustainable institutional restructuring, operating in the context of accelerating

rates of change, and creating value with respect to systems-level properties or outcomes.

Relevant system-level outcomes include traditional measures of efficiency, effectiveness, and

equity, as well as systems-level properties that Joel Moses has dubbed the "illities:" Reliability,

Flexibility, Sustainability, Adaptability, Maintainability, Viability, Quality, Fragility, and others.

On the negative side, the lack of stakeholder alignment doesn't just risk externalities,

but catastrophic systems failure. After the recent off-shore oil platform explosions in the Gulf

of Mexico, four oil companies did contribute $1 billion to a gulf rapid response initiative, but

what about other points of vulnerability in the system? Nancy Leveson teaches us that systems

safety requires systems-level analysis (particularly since most systems failures do not have a

single root cause). Yet most analytic methods are based on decomposition, focusing on

component parts. Regulatory mechanisms are similarly fragmented.   Further, Stephen Barley

documents decades of private influence on public organizations that can distort regulatory functions. Given the limits to public regulation and private cooperation for mitigating catastrophic systems failures, we need to focus on multi-stakeholder, systems-level dynamics.

In sum, valuing the commons involves both the creation of new value and mitigation of new risks. At the heart of both challenges is human agency – sets of public and private stakeholders with common and competing interests, who are (or are not) aligned sufficiently for individual and collective success. In many ways, a sufficient degree of alignment of stakeholders constitutes a sociotechnical system – much as a sufficient degree of hierarchical structuring of actors constitutes an organization and a sufficient set of exchange relationships constitutes a market. Thus, we urge a focus on stakeholder alignment in complex systems for the social, behavioral and economic sciences, as well as a framework to guide public policy.

Mapping the Conceptual Territory

There is no single field or discipline centered on stakeholder alignment in complex systems, which draws on anthropology, economics, engineering systems, history, industrial relations, industry studies, law, management science, negotiations and game theory, organizational behavior, political science, psychology, and sociology. These literatures span individual, group, organizational, institutional, and (we urge) systems levels of analysis. Scholars vary in their underlying assumptions about stakeholder motives, including competitive, cooperative, or mixed-motive assumptions.

When we attend to the "commons" at a systems level, Thomas Kochan points out that traditional economic assumptions of individual utility maximization and individual firm profit maximization need to give way to assumptions of mixed-motive, interdependent groups, organizations, and networks. He adds that, in sociology and organization theory, we need to more fully attend to firms or organizations in context, recognizing that individual participants will have multiple loyalties and/or identities and will frequently move across boundaries. In

psychology too there needs to be a stronger focus on individuals in context, as highlighted by

Howard Weiss and Deborah Rupp, which points to issues of awareness, tolerance, and trust.

Beyond these implications, which are needed for greater internal fidelity within disciplines, key

systems-level challenges will require cross-disciplinary integration for research and public

policy.

This new concept, alignment of stakeholders in a complex sociotechnical system, can be

defined as:

> *The extent to which interdependent stakeholders orient and connect with one another to*
> *advance their separate and shared interests.*

This definition was first developed in 2005, focusing on the process of "orienting and

connecting," both of which are needed for alignment. It encompasses both lateral alignment

and alignment across levels in a system. It is assumed that all stakeholders will have separate

interests as well as shared interests (including identification with the system as a whole), even

if they have differing conceptions of the scale and scope of the system.

Operating at the system level doesn't require understanding every aspect of a system

for every issue, but does require mental models that are mindful of the whole, with appropriate

tools and methods. For research and policy on stakeholder alignment in complex systems

there are four conceptually distinct, interrelated dimensions along which alignment may (or

may not) occur, which are: culture, strategy, structure and behavior.[3]   Along the behavioral

dimension, stakeholder alignment is a product of systems-level: communications &

information sharing; trust, leadership & decision making; negotiation & conflict resolution; and

learning & development. The structural dimension includes: interdependent work flows &

what are termed "value streams;" levels of governance & forums; functional roles & expertise;

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[3] This framework draws on the 1994 book *Strategic Negotiations* where Richard Walton, Joel Cutcher-Gershenfeld and Robert McKersie organize a theory of change in labor-management relations around strategy, structure and process (adding strategy and structure to the original 1965 Walton and McKersie Behavioral Theory of Labor Negotiations). In going beyond bi-lateral relationships, the focus is on culture, strategy, structure and behavior.

protocols & standards; performance metrics & incentives; and support functions & support systems. Stakeholders bring individual strategic intent and stated goals, as well as enacted goals and strategies (only observable after the fact). These elements of strategy also operate at the level of the system as a whole (as illustrated by industry roadmaps), resulting in a systems-level focus on: stated goals & strategic intent; enacted goals & strategies. Cultural alignment and misalignment incorporates the distinct cultures of each stakeholder, as well as the emergent culture of the system. This includes both the visible artifacts and what Ed Schein terms the deeply embedded aspects of culture: underlying values & assumptions.

While the dimensions represent distinct domains for scholarship and policy, they also interweave. For example, it is said that structure drives behavior; that strategy should lead structure, but structure constrains strategy; that culture "eats strategy for breakfast," and that, over time, behavioral change can shift culture and strategy. Figure 2 illustrates that the four dimensions are not independent or static.

Figure 2:
Salient Relationships among Dimensions of Stakeholder Alignment
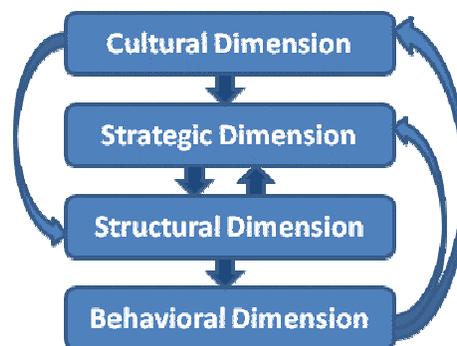
The appendix presents specific research questions along all four dimensions and overarching questions.

Conclusion

The behavioral literature on groups in organizations was once criticized by one of its leading theorists, Richard Hackman, for "studying the ripples while holding the waves

constant" (leaving out, for example, power and institutions). We are arguing, in effect, that all of the macro social, behavioral and economic sciences are at risk of the same criticism if they don't take into account the systems context and the challenge of valuing the commons. Research and policies that operate only with tools, methods and assumptions rooted in hierarchies and markets will be increasingly limiting.

There are compelling research and policy questions at the behavioral, structural, strategic and cultural levels. The challenge of developing, testing and applying integrated causal models and other analytic methods is critical. Existing research in the social, behavior and economic sciences is enriched by adding the systems level, taking into account accelerating rates of change, and an orientation toward generating value.

If the 20th Century was about individual gain tempered by the tragedy of the commons, we urge that the 21st Century *should* be about both individual and collective gain, enabled by new and better ways of valuing the commons.

Appendix: Sample Systems-Level Research Questions for Valuing the Commons

Sample Behavioral Research Questions:

- How do patterns of individual, behavioral choices add up to systems-level impacts? Can public policy influence individual behavioral choices that have systems-level impacts?
- What are effective and ineffective mechanisms for communication and information sharing among multiple, geographically dispersed stakeholders?
- How to manage the geometrically increasing complexity associated with linear increases in the number of stakeholders?
- What are the limits and advantages of leadership in a complex system, which is based more on influence than authority? What are the implications for policy makers who are also actors in these systems?
- What can we learn from multilateral negotiations in which the "rules of the game" are on the table at the same time as substantive matters – a process that Joel Cutcher-Gershenfeld has termed "bargaining over how to bargain"?
- Is trust the fragile foundation on which all complex, sociotechnical systems rest?

Sample Structural Research Questions:

- What are the best tools and methods to map and improve workflows that span multiple organizations and that require multidimensional optimization?
- How best to identify and address what Burt has termed "structural holes" in complex systems, where there are gaps in institutional arrangements?
- What is it about protocols and standards that provide unique leverage for change in sociotechnical systems?
- How to document social networks where "nodes" are a diverse mix of stakeholder types (rather than single individuals)?
- How best to model and align metrics and incentives to foster individual and collective success, which goes well beyond the alignment needed for a balanced scorecard, as defined by Kaplan and Norton in 2006?
- How to assess the roles of traditional support functions (finance, human resource management, purchasing, marketing, information systems, etc.) in the operation of a complex sociotechnical system?
- How can we best structure government agencies and operations to interact with complex systems that span multiple parts of any one government and multiple nations?

Sample Strategic Research Questions:

- How best to specify goals and strategy at the system level – neither over specifying nor under-specifying?
- How best can we construct effective, shared visions of success among multiple stakeholders with both common and competing interests?
- How to adjust goals and strategy at the systems level taking into account lessons learned, known unknowns and (the most pernicious) unknown unknowns (termed "unk unks" by systems engineers)?

Sample Cultural Research Questions:

- Over time, what happens to highly contrasting (or even somewhat different) core values and assumptions among stakeholders that are working together in the context of complex sociotechnical systems? Can underlying values and assumptions shift over time as result of systems-level engagement?
- How do deep cultural differences provide a basis for generating value in sociotechnical systems – leveraging the differences in inventive ways?

Overarching Research Questions:

- In a given system, what is the mix of forces (economic, social, and technological) that drive stakeholders to aspire to enlarge the "commons"? What is the minimum level of stakeholder alignment that constitutes a sociotechnical system?
- Is a crisis needed to foster realignment of stakeholders, or is vision, leadership and constructive engagement sufficient?
- How do small, distributed "micro systems" fit into larger sociotechnical systems?
- How do behavior, structure, strategy and culture interact to enable or undercut alignment of stakeholders in a complex, sociotechnical system?
- How do we measure and improve overall efficiency and effectiveness at a system level? How do these traditional economic outcome measures interrelate with system properties/outcomes such as reliability, sustainability, flexibility, adaptability, maintainability, viability, quality, and fragility?
- What institutional changes serve to sustain aligned networks or consortia of stakeholders as organizational and institutional forms? Will these become the dominant organizational and institutional forms of the 21st Century?

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