

Practice at the Boundaries

*Summary of a workshop of practitioners working at the interfaces of science,
policy and society for environmental outcomes*

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@ Jamaica Bay

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Executive Summary

These proceedings provide an overview of a workshop that brought together people involved in the day-to-day practice of managing interactions between science, society, and policy, i.e., boundary-spanning. The workshop was co-sponsored by the environmental science division at The Pew Charitable Trusts, the Luc Hoffmann Institute, the California Ocean Science Trust, and the Science and Resilience Institute at Jamaica Bay, and held at The Pew Charitable Trusts, in Washington, D.C., on February 10-11, 2016.

Participants were invited in recognition of their practical work as boundary-spanners. The 49 participants came from many different kinds of organizations, some explicitly boundary organizations and some not, and included nonprofits, foundations, government, academia, and professional societies. They displayed a strong commitment to, and rich knowledge about, many aspects of boundary-spanning. They highlighted the wide variety of boundary-spanning institutional homes and work in the environmental domain.

The four goals of the workshop were to begin to:

1. Engage diverse practitioners in developing a shared understanding of successful boundary-spanning work and boundary organizations;
2. Assess when and what kinds of boundary work are needed;
3. Identify critical skills and capacity-building needs for practitioners, and;
4. Foster the community of practice around boundary-spanning on environmental problems.

Key messages from the workshop included:

- Boundary-spanning and boundary organizations can be of substantial value in managing complex or wicked environmental problems. These problems are common, yet investment in boundary-spanning and deliberate development of rules, structures, incentives and norms to support boundary-spanning are not.
- Participants identified a need for more strategic boundary-spanning to help address a variety of complex problems.
- Boundary-spanning is not straightforward; it requires specific skills, experience and improved linkages between research and practice.
- Practice at the boundaries presents numerous overlapping tensions and trade-offs related to process, participation, power, credibility, relevance and legitimacy, and timing.
- Scholars and practitioners need to focus on better understanding ‘successful’ boundary-spanning practice.
- Participants called for a forum to further collate and share existing resources and case studies to inform practice and skill development. There is also a need to build greater capacity for boundary-spanning in higher education and professional training opportunities.

The experience reflected by over two decades of boundary-spanning work represented in the group is promising. Maintaining momentum in this community of practice and moving forward on the challenges laid down in this summary will benefit from more opportunities for collaboration.

Introduction

Background

Practical experience and scholarship suggest more active and effective engagement at the boundaries between science, policy, and society can improve governance and management of complex environmental problems. Boundary-spanning, when done well, reconciles the production of knowledge with its use, ensuring information is relevant, credible and legitimate within decision-making processes (Cash et al. 2003). Boundary-spanners, whether they are individuals, programs or organizations, do this by facilitating and convening productive exchanges among those involved in understanding and managing complex problems. Ultimately, boundary-spanners can help researchers effectively inform policy and policy-makers or actors from broader society influence research agendas.

While the aspirations of boundary spanning have been relatively well-established, it's less clear what this work actually entails, and when it is most useful. Theory and research often lack concrete and pragmatic approaches that are useful in specific contexts. Indeed, boundary-spanning has been challenging to operationalize in practice. Who is actually doing it, and how? What skills do they have and need? What are the challenges and opportunities for individuals and organizations operating in this space? What are the important tensions and trade-offs that need to be grappled with and managed? And how is success and learning assessed and recorded, and used to inform further boundary-spanning efforts? Scholarship remains an important guide to practice, but needs to be enriched by exchange and learning among boundary practitioners.

Boundary-spanning aims to foster civic and policy debate that is well grounded in relevant science, and to encourage science that can serve communities, places, environments, and sustainability.

Meeting design

This workshop did not attempt to develop consensus and well-defined positions among the participants; rather we explored and learned from the diverse experiences of the practitioners present at the workshop. Nevertheless, the discussions indicated some shared challenges and future directions for boundary-spanning. Working groups or individuals within the emerging community of practice are pursuing these agendas in various ways.

The organizers framed the workshop and the five working group topics based on their collective experience in boundary-spanning practice. We have attempted to summarize these group discussions but have undoubtedly not captured all perspectives, and may have misinterpreted some. We were keen to represent the richness of the group's discussion, rather than tightly structure the summary. The resulting document contains differences in tone and other inconsistencies that reflect the many ways that boundary-spanning was considered and discussed across groups.

Lessons learned about the meeting format are reported in the final section on workshop evaluation.

Working Group Results

1. Diagnosing the Need

Facilitators: Adam Parris and Peat Leith

Focus

This group focused on developing a rationale for boundary spanning: why is it needed, and in which situations? This group was only convened for a single session, after which participants joined other groups.

Importance

This group discussed the substantial interest in boundary-spanning and boundary organizations, and identified the value and drivers of this work as including:

- **Finding new ways forward:** People deeply care about environments, habitats, species, places and ecosystems. As pressure on many of these systems grows or degradation worsens, people are looking for new ways to intervene, including ways of linking science, society and policy more effectively.
- **Problem complexity:** The most pressing and challenging environmental problems are also social problems. To understand them requires social and natural science disciplines to work together with decision-makers and other stakeholders. To manage them effectively demands coordination across management agencies, jurisdictions, and users with many different backgrounds, knowledge, worldviews, values and cultures. Boundary-spanning helps to coordinate who does what and why in addressing complex problems.
- **Science impact:** There is an increasing demand to justify research funding in terms of societal outcomes rather than traditional outputs such as research papers and reports. Such impact often requires science to be translated, synthesized and brought into new discussions that allow groups to rethink problems and to develop and implement options for addressing them. These efforts are often outside of the resources or skill-sets of many scientists.
- **Science, trust and decision-making:** In the 21st century, scientists cannot expect scientific results to be automatically influential. Rather scientists are increasingly expected to work with policy-makers, farmers, fishermen, indigenous people and other natural resource managers to inform debate and build relevant and credible solutions and management options. This necessitates boundary-spanning to convene groups and facilitate often-difficult discussions, while carefully engaging with questions of power and politics.
- **Technology:** We are now able to understand, simulate, and communicate complexity in unprecedented ways across diverse domains. Technologies such as simulation models provide opportunities to support new forms of discussion among groups of scientists, stakeholders and decision-makers.
- **Linkages between theory and practice:** Much of the theory of boundary-spanning stems from researchers studying what practitioners do. This scholarship has started to link back to the practice of boundary-spanning, inspiring more systematic thinking and reflection about different dimensions of the work itself.

Many of these issues are dealt with in more detail in other working group synopses, particularly “Tensions and Trade-offs.”

What problems do boundary-spanning and boundary organizations address?

The group considered problems and contexts that exemplify greater (or lesser) need for boundary-spanning by intermediaries or boundary organizations.

Problems were discussed as being consistently affected by two factors (reflecting work by many scholars, see Hoppe et al. 2013; Pielke 2007; Funtowicz and Ravetz 1993; Rittel and Webber 1973; Thompson and Tuden 1959):

1. status of knowledge (e.g., complexity and uncertainty), and;
2. decision-making context (e.g., degree of disagreement about goals and means of achieving them).

Some problems can be considered as relatively ‘tame’ or ‘well-structured’. A discrete point source pollution problem, for example, can be described through scientific analysis; most people agree that the pollution is not desirable and the problem can be addressed through regulation, technological change, or both. Yet, ensuring science is usable is rarely as simple as delivering an analysis in a technical report or peer-reviewed paper. Even in such relatively simple problems where science meets the requirements of regulators and be accepted as credible by polluters, it is still likely to require some boundary-spanning to ensure well-targeted science is understood and used correctly.

Many environmental problems are much more messy, poorly structured, or unstructured (see Figure 1). They involve interacting, dynamic, and complex biophysical and social systems with high levels of uncertainty how everything works together and conflicting values. They are often plagued by substantial disagreement about management priorities, goals, and options. Climate change is the archetypal example, but many environmental and conservation challenges bear the same hallmarks.

Ecosystem-based management, for example, aimed at sustaining both livelihoods and ecosystems, is complicated by highly uncertain system dynamics and tensions among diverse stakeholders about priorities and solutions.

Boundary-spanning and boundary organizations may be particularly relevant in these situations, especially where arrangements for incorporating science into decision-making are contentious or unclear. Boundary-spanning can help connect disjointed management and find ways to reconcile values, priorities, and management options. While boundary-spanning and organizations are considered to be useful in these situations, however, there is less clarity around how this work should be done in practice.

Knowledge	Goals	
	Close to agreement	Far from agreement
Far from certainty	Moderately-structured (disagreement about means)	Unstructured problems (disagreement about means and goals)
Close to certainty	Well-structured (agreement about goals and understand how to achieve them)	Moderately-structured (disagreement about goals)

Figure 1: The group suggested that there is greatest need for boundary-spanning in situations where there is high scientific uncertainty and disagreement about goals, adapted from Hoppe (2011)

Recommendations

Boundary-spanners may be particularly useful in improving governance of complex or ‘wicked’ environmental problems. But as described in other sections of this summary, success requires: boundary-spanning expertise (including content and institutional knowledge related to the problem); relevant organizations to enable and support boundary-spanning; careful consideration of how tensions, trade-offs as well as power and politics are dealt with, and; deft use of technologies to facilitate dialogue. Above all, we emphasize the need to start with a thorough understanding of a problem, developed by:

- synthesis of the scientific aspects of the problem including uncertainty, risk and different disciplinary perspectives;
- analysis of social and political dimensions of problems including trade-offs and tensions among stakeholders; and
- thorough understanding of the existing institutional, policy and structural settings for linking science with decision-making.

This work needs to be done iteratively with stakeholders, scientists and decision-makers to develop a collective understanding of a well-specified problem, create processes tailored to addressing it, and define what science can be useful and how.

2. Organizational Structure

Facilitators: Ryan Meyer and Angela Bednarek

Focus

While models for boundary-spanning processes have been widely explored in academic literature, the many forms of existing organizations that initiate and manage these processes have been less so. The range of organizations and diverse expertise of individual participants represented at this meeting shows the many ways in which capacity for linking science, policy and society has been developed for a variety of difficult environmental problems. For example, some organizations are stand-alone organizations, while others are embedded in, and directly serving a parent organization. There seems to be little consistency in their organizational structure.

This diversity reflects the emergence and evolution of boundary organizations within specific settings, and in response to range of environmental governance challenges outlined throughout this summary. The diversity at the workshop provided an opportunity to explore how boundary-spanning efforts succeed (and struggle) in different settings, and why. For people working across specific boundaries, understanding how other boundary organizations operate provides useful guidance on how to modify and scale elements of their own organizations. For funders and potential partners (including scientists), there are lessons that could be learned about how best to support or collaborate with different kinds of boundary organizations.

This working group sought to characterize and consider the diversity of organizational models for boundary-spanning. Working group participants reflected on specific challenges they faced within their respective organizations. The working group also surveyed workshop participants about key institutional characteristics and functions of their boundary-spanning work. The group identified a list of relevant institutional attributes of boundary organizations, beginning with basic structural elements (see Box 1) and expanding out to issues such as problem orientation, and the types of functions that the different organizations fulfill (see Box 2).

Box 1: Structural factors:

- Type - philanthropic, academic, government, non-profit, or other
- Funding source
- Budget size, stability
- Staff size/makeup
- Program age
- Embedded vs independent
- Types of oversight
- Variety of clients/partners
- Geographic scope
- Publish or perish culture
- Place-based or problem-based mission, or both

Box 2: Functions fulfilled:

- Convene dialogue (multiple scales)
- Informing policy
- Conducting research
- Funding
- Lobby and advocacy
- Developing information portals
- Technical support
- Communications and publications
- Leadership and other training
- Co-production of knowledge
- Science translation
- Policy analysis
- Matchmaking
- Peer review

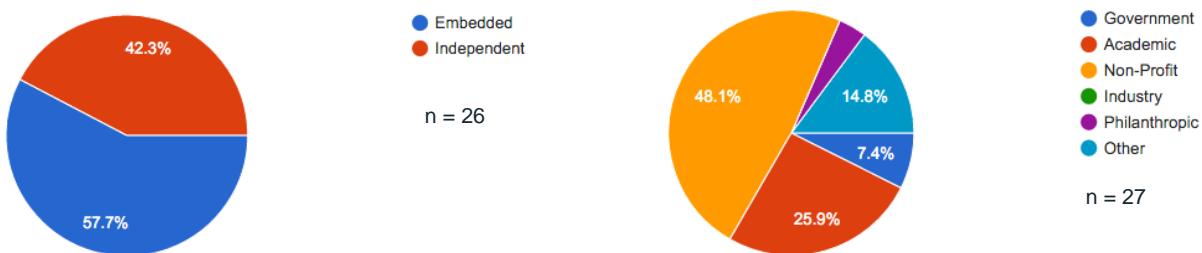


Figure 2: From an overnight poll of 49 workshop participants, proportion of respondents working in different types of organizations.

Advantages and Challenges

The working group used case studies to illustrate the range of benefits and challenges of boundary organizations within different institutional settings, but also the critical trade-offs in credibility, salience, and legitimacy within different contexts. For example:

- **Academic setting:** Being embedded in a university means access to a wide and deep knowledge base. However, boundary-spanning activities are not necessarily well recognized or rewarded. It is a substantial challenge to develop proper incentives, cultures and norms to support faculty and students in making science useful.
- **Advocacy organization:** Boundary organizations embedded within an advocacy organization have a clear client (i.e., the other staff working in the organization), and as a result may gain access to useful insights about policy and resource management needs. They may also benefit from brand recognition of the parent organization. However, advocacy efforts within the larger organization can impact the credibility and legitimacy of the boundary organization function.
- **Funder as boundary organization:** Some funders try to help grantees connect science, policy, and practice by acting as a boundary-spanner for them – for example, conducting policy and network analysis so that the research project and results are well-matched for a particular decision-making situation. As with other boundary-spanning efforts, it is important that hands-on boundary management throughout a project, is not seen as interfering with the rigor of scientific research, but is able to increase its relevance and legitimacy to decision-makers.

Beyond these three broad examples, boundary-spanning organizations now exist in diverse contexts and with differing purposes. This diversity provides a rich body of information from which boundary-spanners can learn about the advantages and disadvantages of different structural models. However, this working group also found it challenging to decipher patterns in how boundary organizations work.

Scaling up

Many boundary-spanning efforts have started small, focusing on a specific issue and using minimal resources. Thereby individuals do a range of boundary-spanning activities - from policy analysis, scientific synthesis, and working with stakeholders directly. Small organizations can move nimbly into new situations and efficiently use past experiences to guide new efforts. Success can build demand, but as boundary-spanning efforts expand the original group identity, function and focus can be lost.

Management of expertise, resources and leadership to prioritize boundary-spanning activity is essential.

Adding boundary-spanning capacity without an organizational structure in place

There are organizations without the capacity and resources for boundary-spanning themselves that would like to partner with boundary-spanners. Yet many boundary-spanning organizations are at capacity with their own priorities and commitments. This need also raises questions about how best to create “consultancy” versions of boundary-spanning.

Next steps for Organizational Structure

The working group discovered how challenging it is to characterize boundary organization structure and function. However, there was also immediate recognition that our respective insights about and experiences with building and maintaining boundary spanning capacity could be quite valuable, both to ourselves and to funders focused on linking knowledge with action.

A possible next step is to survey a larger number of boundary organizations and individuals, extending beyond workshop participants, about the institutions (rules and norm), structures (incentives and funding), cultures and leadership, and perceived precursors of success. The aim of such survey would be to investigate what works, and why, across different contexts and settings. This could lead to an informal typology of boundary-spanning efforts classified by the above categories. It could also be a guide to funders and decision makers seeking to build boundary spanning capacity for a particular purpose.

3. Tensions and trade-offs

Facilitators: Bridie McGreavy and David Hart

Focus

This working group sought to identify a common set of tensions and trade-offs in boundary-spanning work. This group shared examples from diverse issues and approaches to developing relationships, producing knowledge, and advancing solutions to problems.

This discussion laid the foundation for developing a set of design principles and guiding questions that promote informed decision-making for achieving multiple goals.

Importance

The diverse cases¹ discussed by the group were consistently characterized by multiple diverging values, high levels of scientific uncertainty (see Section 1, “Diagnosing the Need”), and a pressing need for immediate and long-term solutions (Pielke, 2007). These characteristics result in conflicting perceptions. For example, in certain planning processes, some collaborators accept science as a standard for knowing the world and others view direct experience as the foundation for valid knowledge claims. In interdisciplinary collaborations, some collaborators may perceive a problem primarily in terms of its economic importance and others perceive it in terms of its ecological significance. And in these and other situations, the distance between organizations and inadequate communication technologies can reinforce differences. From these experiences, the group identified a series of recurring tensions and trade-offs. The discussion then moved specific questions and design principles that can provide useful tools to identify and work through context-dependent issues.

Results

The group described seven common tensions and trade-offs and highlighted questions that can be used to grapple with them:

1. Multiple ways of knowing and scientific credibility

Sustainability science and boundary-spanning often aim to connect multiple ways of knowing to understand and govern complex issues. This is challenging for at least two reasons. First, productively combining diverse perspectives requires some judgment about the relevance and legitimacy of expertise. An important question here is: which perspectives and people represent viewpoints in a way that leads toward effective collaboration and meaningful and rigorous outputs? The second challenge concerns the tension between maintaining credibility by staying true to the science while “meeting communities where they are”. Whether these are local communities who do not ‘believe in climate

¹ The cases included: the Western Water Assessment as part of the Regional Integrated Sciences and Assessments Program in Colorado, Utah, and Wyoming; the New England Sustainability Consortium’s projects on linking science with decision-making for water resource management in Maine, New Hampshire and Rhode Island; multiple efforts from the State of California focused on climate change adaptation and science-based adaptive management for marine protected areas; and research and resilience planning in urban and coastal areas that are a focus of the Science and Resilience Institute at Jamaica Bay, a watershed that encompasses the heavily urbanized region in and around New York City.

change', or advocacy or political groups that want to push a particular agenda or try to produce a "learning moment", boundary-spanners need to be hyper-aware of the political context and constantly reflect on decisions and choices.

2. Defining and getting the right mix of expertise

While stakeholders and decision-makers often want scientific analyses and tools, defining the 'right' mix of expertise can be difficult. It is rare to find a set of scientists with both the appropriate expertise, capacity to work together, and ability to engage effectively with stakeholders. Different objectives or working styles, and inability to create the space to negotiate these differences is more common. On this topic, key questions include: who brings what type of expertise to the table? Where else might we look to find relevant expertise? What is their previous experience with this type of work? How do we create decision-making processes and learning opportunities in our project to harness the diversity in expertise?

3. Tensions between public and private spheres

This tension emerges from conflicting norms about democratic engagement and transparency and academic integrity. There is a substantial body of scholarship that underscores the importance of access and transparency to promote public participation in decision-making (e.g., Depoe and Delicath, 2004). Yet researchers are often reluctant to release methods, data or results before they are peer-reviewed and published. Audiences may not appreciate the reasons for such delays and caution.

4. Issues of power and participation

The tensions that emerge at the intersection of power and participation relate to defining who participates, when, how and with what frequency. What is an appropriate balance of persuasion and deliberation? Who, what, where, when, how and why participants are being engaged? How much work is needed to help prepare participants to contribute usefully rather than push their agenda? How do you bring an engagement phase to a close? And what do you with perspectives that don't 'make the cut'?

5. Tensions in timing

Some interventions require long-term commitment, but funding and research priorities can redirect scientists. On the other hand, many policy windows require rapid results or synthesis. Key questions here are: how to balance long-term vision, planning, and commitments with momentary opportunities? Who needs what information, when, and can regular updates satisfy shorter- and longer-term information needs?

6. Funding cycles, pressures, and expectations

Funders shape how boundary-spanning occurs. They may directly participate or maintain the right to influence how priorities are defined, or they may insist that research projects be adaptive and overseen by both researchers and users. For organizations receiving funding, there is also a tension between advancing a specific mission and maintaining basic capabilities through staff and facilities. Pursuing funding may come at the expense of mission creep. Key questions are: who 'buttered our bread'? What are the missions of the funding, research and partner agencies? Can missions be productively linked to promote mutual benefit and capacity building, and how?

7. Conflict as challenge and opportunity

Because boundary-spanning occurs in complex sustainability related issues, some level of conflict is inevitable. Effectively working through conflict can be intimidating and, at the very least, time consuming. Turning conflict from a challenge into an opportunity takes time, effort and substantial skill. Questions that can help in this regard include: Are opposing groups open to change? Do they show a willingness to learn from difference? Who might be best positioned to serve as an “honest broker” of alternatives (Pielke, 2007) in the situation?

In addition to the key tensions above, the group also briefly discussed issues that require further attention, and are reflected in Section 1, “Diagnosing the Need”, and Section 2, “Organizational Structure”:

- Decision making in conditions of uncertainty
- Finding the right approaches for the right job/problem
- Stability and dynamism in institutions and policy
- Incentivizing risk taking and accountability for consequences – support systems for learning from failure

Recommendations

Across cases, the group identified a need to pay attention to actors, information needs, institutional arrangements, resources, and constraints that shape a problem and decision making context.

The following is a general list of recommendations and design principles for projects and programs based on the group’s conversation:

- Establish clear expectations for all parties involved
- Plan for senescence and transition
- Use a portfolio approach, for example:
 - strategically link with other organizations to leverage collective effort
 - define our roles and positions and work within a network
- Commit to a long-term process, including longer funding cycles
- Mind the integrity of your organization
 - Consider how particular stakeholder group might perceive your involvement
 - Be fair in how you make compromises along the way
- Build in appropriate internal firewalls between different entities

4. Professional development

Facilitators: Melanie Ryan and Margaret Krebs

Focus

This working group discussed the skills used and needed by a wide range of professionals who explicitly or indirectly engage in boundary-spanning. There are rarely job titles or roles within an organization that are described as requiring a ‘boundary’ skill set. This group discussion focused on four tasks related to skills and training needed at the interface of science, policy and practice:

- 1) defining the kind of skills and mindsets that are commonly associated with and/or desirable in a boundary-spanner;
- 2) identifying the conditions that make certain skills more or less necessary;
- 3) mapping existing resources to support the development of capacity within these skill sets; and
- 4) identifying next steps for creating a centralized, accessible resource space for boundary practitioners/spanners to support staff development, the creation of position descriptions for new roles and avoid ‘reinventing the wheel’.

Importance

Skills for work at the boundary are often learnt on the job, by trial and error, or by emulating the actions of others. Yet they are some of the most significant precursors to program or project success. This group was driven by concrete needs and immediate issues for participants in the workshop, as well as many other organizations. Some of these issues included:

- How boundary-spanning staff can justify requests for training and development to senior managers?
- How to write a position description to recruit a new boundary-spanner?
- What resources could be accessed or existed already to support team or staff development in ‘boundary’ skills?
- What a training program to meet the demands of ‘boundary-spanners’ might look like?

Results

The brainstorming session identified a large variety of skills and traits of boundary-spanners (Figure 3).

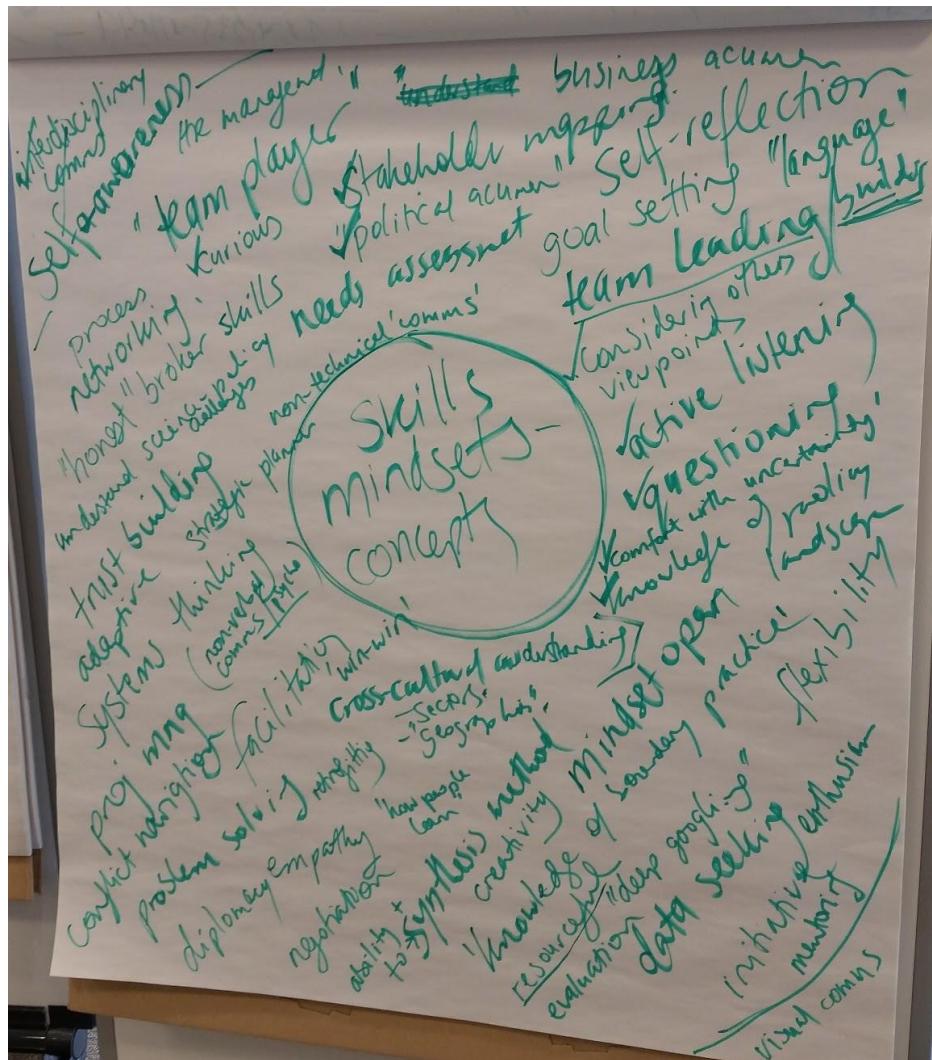


Figure 3: Skills brainstorming output. There was a common understanding of the wide range of skills, mindsets and capacities required to successfully undertake boundary-spanning activities.

The degree to which these skills are needed was discussed as depending on a variety of attributes of the work place, type of boundary-spanning, and kind of issue, including:

- **Workplace environment:**
 - the extent to which 'enabling conditions' promote boundary-spanning (e.g., work culture, values, incentives, boundary-spanning skill-sets within workplace)
 - role within a team (e.g., facilitators, team leaders and senior managers require different core skills)
- **Type of boundary-spanning work**
 - the types of boundary or boundaries being spanned (e.g., whether these are between science, policy, practice, and society or across all of these)

- requirements for expertise in content rather than boundary-spanning skills (e.g., facilitating deliberations among fisheries scientists and managers requires substantial relevant content knowledge; between scientists and lay-people might require local knowledge)
- **Issue area and context**
 - political, geographical, and scientific context (see discussion on “Diagnosing the Need”)

The group agreed that there are no ‘core’ or ‘periphery’ boundary-spanning skills. However, there was consensus that the range of skills or competencies identified through the brainstorming activity could be usefully linked to thematic types of skills, capacity or knowledge. Four overarching themes were identified by the group with a fifth (‘intra-personal’ skills) being added in plenary with the larger workshop group:

Communications/ Interpersonal (HOW to communicate or engage with others)	Community/Situation/Stakeholder (the WHO - the specific context and system looks like that the boundary spanner is working in)
Co-design/Co-produce (the HOW - actually making boundary spanning happen in phases or the implementation)	The knowledge base (the WHY) - why would you use co-design, why does it matter, the context or philosophy
‘Intra-personal’ skills (within oneself) or self-reflection; humility; open mind-set	

Some specific skills fall into multiple categories depending on the specific context. For example, the individual skill-sets that underpin ‘trust-building’ or ‘networking’ could be sorted into either the ‘Communications/interpersonal’ theme as a ‘how’ to engage with others at a personal level, or into ‘how to do co-design/collaboration’ as a consensus building activity. Thus, the strength of some boundary-spanning skills may be based on roles, activities and experience over the duration of a career.

Overall, the group felt comfortable with these five themes as a framework to begin thinking about training and development programs for boundary professionals.

Recommendations

Boundary-spanning and its associated skills and mindsets are not new or limited to the contemporary workplace. Many members of the group could point to ‘boundary’ type activities and case studies from the last hundred years. The group did not want to ignore history or existing resources, but rather create a centralized resource pool that could be accessed by anyone identifying with boundary skills and activities. The recommendations from this group were to:

- Review, catalogue and collate the many existing resources for capacity development for ‘boundary spanning’
- Collect concrete case studies of ‘boundary’ type activities to assess common linkages and highlight good practice
- Support a range of target audiences (early career professionals, researchers, graduate students, managers, etc.) in their roles in boundary spanning
- Create a clear, recognizable resource/database of resources relating to ‘boundary’ work, employers/managers/recruiters to justify training and capacity development, as well as easy access resources to address some of the ‘low-hanging fruit’ in terms of team member needs
- Maximize access to existing materials rather than create new content

- Seek funding or formalized mechanism to support development of centralized resource or hub, perhaps as a collaborative effort
- Create a set of guidelines or framework to guide boundary-spanners in professional development planning

Next Steps

The working group proposed the following next steps:

1. Send out a statement of intent and survey to the broader group of attendees from this workshop to ascertain:
 - a. the demand for such a centralized ‘knowledge platform’
 - b. the key target audiences
 - c. the resources that participants were already aware of, including: literature; courses; funding opportunities; individuals; website links; modules; boundary spanning ‘boot camps’
2. Collaborate with other working groups to create a single online space where the outputs from this group, among others, could be realized
3. Following survey results, create an action plan and assign responsibility for moving vision forwards
4. Create a place where people could share case studies
5. Assess whether there are any funding opportunities available that could be used to resource this in the short to medium term
6. Determine if there are any existing resources to assist in demonstrating the value of such learning and training

5. Assessment and learning

Facilitators: Carina Wyborn and Helen Fox

Focus and importance

Defining success of boundary-spanning and boundary organizations is difficult. Success relies on formal activities such as brokering, knowledge exchange, translation, and less formal elements such as networking, relationships and attributes of individuals within networks. An ultimate marker of success may be a policy outcome, but there are many intermediate steps that culminate in this outcome. Or the goal may not be policy change at all but the creation of an improved deliberative process. For example, there may be changes in how people use science, new relationships forged between different groups, or new conceptions of problems and options for addressing. There may be a need to remove or find a way around barriers to informed decision-making, whether these are related to organizational culture, resources, rules or even individuals. Final desired outcomes can take a long time and be the result of differing trajectories of work. Yet markers of success are needed to justify the value and effects of boundary-spanning, and to support learning and improvement.

Discussion

This working group discussed many issues related to assessment, evaluation and learning through an open exchange about practices, challenges, successes, failures and lessons learnt across many settings. The rich descriptions cannot be represented well in this short summary.

However, it is worth briefly recounting one example of the stories that were told that speaks both to the potential success of boundary-spanning activities and the challenges of monitoring, evaluation and learning.

The Center for Biodiversity Conservation at the American Museum of Natural History did a substantial amount of work in The Bahamas through the NSF-funded Bahamas Biocomplexity Project, supporting science on marine systems and bringing together scientists with government agency staff and fishing communities. They demonstrated that marine protected areas (MPAs) were important for species in the area, and had ripple effects for fisheries and livelihoods in The Bahamas. Fifteen years later the Government of The Bahamas set aside around 5 million hectares as MPAs. An official within a government agency sent a note, thanking the museum and saying that this development was instigated by their seminal work. The note is the only evidence that the museum's substantial investment led to an even more impressive outcome. That it arrived at all was down to the good will of a single person, involved in the long process of planning and implementing the MPAs.

This story speaks to value of convening dialogue, grounded in science, with groups of key stakeholders. Yet it also emphasized the long and tenuous pathways by which science and boundary-spanning can contribute to meaningful outcomes, let alone the challenges in being able to track those contributions.

Below we have synthesized **key insights, challenges**, as well as **visions for change** and **practical options** for moving forward.

Visions

Incorporating evaluative thinking into project design and planning to support boundary work can help support structured learning and to assess progress throughout often long time-frames between activities, outcomes and impact. This learning leads to improved practice and performance of boundary-spanning and a greater shared understanding of how to achieve meaningful change or outcomes through well-targeted boundary-spanning.

Challenges

In traditional research, ‘impact’ is attributed to individuals or groups through metrics such as counting publications or citations. Boundary-spanning focuses on process-oriented activities, such as coordinating among diverse contributors, fostering collective knowledge and strengthening relationships. These distributed or collective contributions are difficult to map and measure.

- Learning among boundary practitioners tends to be informed by qualitative or anecdotal information. This information is distinctly different from more formal quantitative measures of success that many funders and organizations want, and will fund.
- Scaling up successful programs from local or regional levels to larger scales is challenging. Contingencies and uncertainties are much more complex at large scales, and contribution to outcomes is harder to account for.
- It can be difficult to be convinced of the value of evaluation data, or convince others. They are often case studies ($n=1$) and therefore not very rigorous. However, there are ways of using existing frameworks and methodologies, for example to record and analyze data about ecosystems and governance in a coherent and consistent manner.
- The impacts of projects often happen years after the projects themselves, and are not tracked or attributed (see example above).
- Dedicated resources for monitoring, evaluating and learning are often non-existent, but they can be a very good investment.

Key insights

- It takes time and effort, and a degree of trial and error to develop monitoring and evaluation that results in learning within any specific program or organization, but a lot could be learned by sharing experiences, successes and mistakes – the group had a lot of these in common.
- A sound theory of change, or strategy to achieve goals, should inform boundary-spanning activities in a purposeful way. Boundary-spanning work has a central role in the moving from identifying problems to establishing goals, then to developing strategies, implementing activities and monitoring outcomes.
- It is especially important when building boundary-spanning activities into a theory of change to coordinate effort, roles and responsibilities. For instance, investment in new research to understand systems has very different demands from investment in research or synthesis that aims to inform specific decision-making, or to evaluate policy options.
- Dedicated resources (see Challenges above) are needed to ensure learning happens and is formalized within organizations, and can thereby result in adaptive management and ongoing improvement. External evaluation can also enhance learning as well as providing substantial evidence to partners and funder to support claims of success or impact.
- A key to learning is creating ‘safe spaces’ within projects, programs and organizations to be critical and self-reflective. Deeper learning can be informed by many domains where different

practices are being developed, which are likely to be relevant to boundary-spanning in the environmental domain.

Practical options

- Through a theory of change or strategy for achieving goals it is useful to identify intermediate outcomes, rather than just focus on final outcomes such as policy or behavior changes. Tracking achievement of intermediate outcomes identifies barriers to change and tests the theory/strategy allowing assessment of its adequacy, and thus learning.
- Monitoring can look to intermediate signs of change in perspectives or public /policy debate. For example, a project might track narratives among partners to track changes in perspectives about a specific issue, problem or process. A program might track public and policy debate to identify its impacts via content or discourse analysis.
- Some organizations may be able to resource evaluation with partners to track impacts of work at different intervals during and after project.

Next steps

Ultimately the rich discussion highlighted the need for boundary-spanners and organizations to invest in telling their story well, supported by good monitoring, data collection and analysis. It was widely accepted that both qualitative and quantitative data had their places in a mix of approaches. However, it remains a substantial challenge to map the contribution of boundary-spanning over long time-frames that are often needed to achieve environmental outcomes.

Substantial challenges to achieving this goal range from institutional support and funding for evaluation to the existence of efficient and effective methodologies that can be used in formative evaluation (oriented to learning during a project) to summative evaluation (end of project/program, oriented to demonstrating outcomes). The group was keen to see advances across these areas to enable them to tell compelling and credible stories about successes, failure, learning, and how boundary-spanning contributes to outcomes. Embedding the above issues, next steps include:

- Collate stories as a resource for describing and evaluating boundary practice;
- Distill further recommendations for practice, including innovative funding models, and incentives to support evaluation;
- Consider other domains that can share experience and learning (e.g., health, education, agricultural extension);
- Share approaches, metrics and methodologies that are used by different organizations and individuals to support monitoring, evaluation and learning to distill key insights and principles.

Workshop evaluation

A month after the workshop an online evaluation survey was conducted to assess participants' sense to the value of the workshop and whether it had achieved its objectives. Only ~20% of (n=9) participants responded. However, along with reflections on feedback during and directly after the workshop, we have drawn some lessons from these qualitative and quantitative data.

For instance, from the qualitative data and comments at the meeting, it was clear that participants were generally pleased to have both a forum for open discussion about issues that many were privately struggling with, and to link up with others working 'at the boundaries'. Most survey respondents agreed or strongly agreed that the group was sufficiently diverse for the purpose of the meeting and that the group actively participated to achieve outcomes. There was less agreement about the meeting structure and its facilitation. Some suggested the open structure of discussions was empowering, while others suggested that "we were talking in a void".

Although the organizers wanted to empower participants to draw on their own experience and knowledge and therefore avoided framing the workshop very specifically, a variety of feedback about the need for more background and structure indicates that we erred too far in the direction of open discussion. Key lessons learnt were that the practitioners present would, on the whole, prefer greater structure and attention to facilitation in order to develop clearer ways forward, action plans and future collaborations.

Table 1: Outcome oriented evaluation questions (Likert responses ranged from 1- strongly agree, to 5 – strongly agree)

QUESTION	MEAN	SD
The insights I gained at this meeting will help me in my work at the boundaries across science, policy and/or practice.	4	1.22
The meeting was run in such a way that we were able to reach meeting objectives	3.33	1.41
This meeting allowed me to generate new connections and networking opportunities	4.44	0.88
There is clarity on the next-steps and the road map emerging from the meeting	2.89	1.17

Nevertheless, many participants expressed that they were able to explore and develop new networking opportunities and collaborations through the workshop, and that they were keen for this work and the discussion to continue. A clear challenge identified was maintaining interest and momentum, especially as there were diverse interests and options identified through the workshop and subsequent feedback (e.g., training, developing funding models, productively maintaining a community of practice, etc.) .

The authors are committed to keep working on practical aspects of boundary-spanning generally and supporting this community of practice. We will draw on feedback and insights from this workshop in considering our future work, but also want to extend an invitation to others to engage with us directly if you are interested in being actively involved in organizing events, networking, writing, or pulling together a body of training and capacity building materials.

Concluding comment

The high level of interest in this workshop and the enthusiastic and concerted work of participants attest to a demand for greater exchange and thinking through practice at the boundaries between science, policy, and practice. This workshop and summary represent one step in a continuing effort to improve boundary-spanning. Our hope is that the workshop and summary have helped to define key issues that can be addressed in months and years to come, as well as collated some of the shared knowledge, techniques and practical wisdom of boundary practitioners.

Across this open community of practice, we will need to continue to build and share skills, capacity and knowledge. We will need to continue to negotiate complex tensions and trade-offs, and to consider how different aspects of our organizational structures, rules and norms are best serving our ability to contribute to environmental outcomes. Not least, we will need to document, learn from and tell credible stories about our successes, challenges and lessons learned to diagnose the need for this work. This summary provides preliminary guidance on all of these issues, but also notes that:

- There is substantial expertise within this community of practice that can be drawn on
- There is a great deal of literature that can inform practice (see extended reference list below) and it will be important to maintain dynamic connections between scholarship and practice
- There are no panaceas, cook books or simple approaches that consistently work, rather a lot of practice is needed. But this can be guided by principles, adapted to different approaches, and by informed deep and critical reflections and conversations
- Such boundary-spanning often takes time and a specialized skillset.
- There is substantial work to do in refining the value proposition for investing in developing these skillsets and using these boundary-spanning approaches.

This workshop highlighted and created a space for open discussion about the work that many organizations and individual participants have been doing for decades, often under the radar and without much recognition. The value of sharing stories, experiences and lessons cannot be detailed in this summary, but we hope to have captured some of the key lessons across the group.

It was broadly accepted that the work of bringing diverse groups of scientists, decision-makers, practitioners and citizens together to create useful knowledge is essential for addressing complex or wicked environmental challenges where science alone provides only a small contribution to collective knowledge for decision-making. It is also difficult work, and will require concerted effort and commitment from practitioners, funders, and science and policy communities.

Recommended Reading

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