

Getting to the Meaning of Meaningful Engagement

by

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Introduction

Engagement between researchers and their partners is widely acknowledged to be a foundational component of collaborative and participatory approaches to scientific research. Engaging with intended users of research outcomes during the scientific research process can lead to more relevant and impactful scientific research (Mach et. al. 2020).

Engagement, and what it entails, is of particular concern to the National Estuarine Research Reserve System (NERRS) Science Collaborative. The NERRS Science Collaborative is a national funding program that supports engaged research across thirty coastal reserves encompassing the National Estuarine Research Reserve System (NERRS).¹ Research funded by the Science Collaborative must be developed and carried out in collaboration with intended users of the research outcomes. Funded project teams are expected to engage with all project participants, including intended users of the research outcomes, “meaningfully before, during, and after the project to inform project design, execution, and products” (NOAA NERRS Science Collaborative, 2022).

The meaningful engagement of intended users and other project participants has been a frequent topic of discussion among project teams funded by the NERRS Science Collaborative. The Science Collaborative’s conversations with project teams have revealed that when participants engage meaningfully during projects, they are better able to exchange ideas, there is greater participant “buy-in,” valuable partnerships are more likely to emerge, and project outcomes are more useful and durable to participants.

However, the Science Collaborative has also received repeated requests from project teams and their partners for additional guidance on what engagement, and in particular *meaningful* engagement, looks like within a collaborative science process. These requests have indicated a need for the Science Collaborative to examine and illuminate the defining features of meaningful engagement in a deeper and more systematic manner. Addressing this need was the impetus for the study described in this report.

The notion of “engagement” is not new. Sometimes called “participation” or “involvement,” engagement and related activities have been popular topics for decades in certain scientific research traditions² as well as in other fields, including planning, public governance, health care, and education (Susskind and Elliott, 1981; Mach et al., 2020; Murunga, 2022;). Scholarship on engagement has matured over several decades with some of the earliest conceptualizations of the topic dating back to the 1940s (Mach et al., 2020). Scholars have since defined engagement in a variety of ways, for example as “a state, a strategy, a professional activity (practice), a process, or all the above (Murunga, 2022).

¹ The NERRS was established by the Coastal Zone Management Act in 1972 and is managed collaboratively by the National Oceanic and Atmospheric Administration (NOAA) and state partners (NOAA, 2024).

² For example, “action research,” coined in the 1940s, is an approach to research that is carried out with practitioners and in pursuit of transformative social action (Lewin, 1946; Masters, 1995). Action research has spurred the emergence of additional engaged research methodologies such as community-based participatory research, participatory action research, interactive research, research co-production, and collaborative science. Engagement is relevant in varying ways to each of these research approaches.

Engagement activities are often described along a continuum to highlight certain qualities of interactions between engaging parties. For example, Sherry Arnstein's seminal paper on democratic public participation outlines a metaphorical "ladder of participation" to theorize power dynamics of various approaches to engagement (Arnstein, 1969). Subsequent work has extended the framework provided by this continuum. For example, in "Teetering at the Top of the Ladder," Wondolleck et al. (1996) describe challenges of engagement in collaborative public processes represented at the "top" of Arnstein's ladder. A more recently developed continuum is the International Association for Public Participation's 2018 "Spectrum of Public Participation" (IAP2, 2018). This spectrum posits that higher levels of engagement provide the public with greater impact on decision making. Finally, a widely used typology of engagement identifies three main types of public engagement: public communication, public consultation, and public participation (Rowe and Frewer, 2005).

As these continua suggest, not all engagement is equal. The occurrence of engagement does not guarantee the occurrence of *meaningful* engagement. However, there has been limited empirical research clarifying what makes engagement meaningful and effective in practice. Studies that have sought to characterize the defining features of meaningful engagement reveal that "meaningful" engagement is understood, and practiced, in a myriad of ways (Protection of the Arctic Marine Environment, 2019; Hobson et al., 2021; Hamilton et al., 2017; Murunga, 2022). This plurality is perhaps unsurprising given the normative qualities of the concept. Engagement that is "meaningful" is by necessity tied to the values, goals, and perceptions of those engaging.

Ambiguity about the meaning of the meaningful engagement concept can be limiting in practice. Without a shared understanding of engagement and what makes it meaningful, engagement risks becoming little more than tokenism (Murunga 2022; Fournier et. al, 2024). The need for a shared understanding of meaningful engagement is especially tangible in the field of scientific research as funding programs and academic publishers are increasingly implementing standards requiring meaningful engagement of research partners and participants (Smylie et al., 2020; Miyamoto, 2024; Fournier et al., 2024).³ Without a working definition and shared understanding of the phrase, it will be difficult for researchers to adhere to these standards.

An abundance of literature, with authorship ranging from non-profit organizations to federal agencies, attempts to provide practical guidance on meaningful engagement within research and public governance sectors. However, this guidance seldom delves systematically into the processes that enable (and constrain) meaningful engagement. Moreover, there is a lack of guidance on how to assess whether engagement activities have been meaningful, or not. For example, the U.S Environmental Protection Agency's 2023 report on their "Meaningful Involvement Policy" provides a cursory overview of meaningful engagement by enumerating important elements of engagement (e.g. decision-making processes, inclusivity, accessibility). However, the report falls short of distinguishing engagement in general from *meaningful* engagement in particular. There is clearly a need for more practical and evidenced-based research and guidance on what makes engagement meaningful and why.

³ For example, the Canadian Journal of Public Health (CJPH) became the first academic journal in Canada to put forth submission standards requiring the "meaningful engagement of First Nations, Inuit, Métis, and Indigenous peoples in publications about them" (Smylie, 2020).

The study presented in this report was initiated by the Science Collaborative to advance understanding of the many dimensions of meaningful engagement in the specific context of collaborative research occurring within the NERRS. By drawing on the experiences and insights of collaborative science teams and others affiliated with the Science Collaborative, this study probes questions such as: what does meaningful engagement mean in practice for collaborative science teams; what are the tell-tale signs when it is being achieved; what factors help advance it; and what are the challenges to realizing it?

Findings from this research support existing theory that indicates that meaningful engagement is highly context dependent. There is no one-size-fits-all prescription for advancing meaningful engagement within collaborative science projects undertaken across the NERRS. What meaningful engagement looks like and the practices that may be used to foster it often vary from project to project depending on who is involved and the project's objectives. However, this research has also revealed a set of key factors that often influences whether project participants are engaged in ways that are meaningful to them. While these key factors provide a bedrock for meaningful engagement, how each is realized varies by context.

This report describes this study's findings and their implications for fostering meaningful engagement in collaborative science. A primary objective of this report is to provide a framework for advancing meaningful engagement within the context of collaborative science. As one individual who was interviewed during this research commented, "I find a lot of times with engagement, it's the type of thing that's like, oh, of course! Of course you treat people nicely... [but it's helpful] to have a framework to really think through [how to do that]."

While the framework developed through this report may have broader applicability, it is primarily intended to offer guidance to collaborative project teams and their partners as well as the Science Collaborative in its supportive role for these projects. Understanding what makes engagement meaningful will help project teams and their partners more effectively and meaningfully collaborate over time.

Research Approach

This study investigates what constitutes meaningful engagement and the notable ways in which it may vary within collaborative science conducted at the National Estuarine Research Reserve System (NERRS) by addressing the following research questions:

1. What are the key characteristics, or tell-tale signs, of meaningful engagement?
2. What factors make engagement meaningful?
3. What factors make engagement *not* meaningful?
4. What challenges hinder the achievement of meaningful engagement?
5. What strategies have project teams used to engage participants and intended users in a way that is meaningful to them?

To answer these research questions, insights were collected from interviews with individuals affiliated with projects funded by the NERRS Science Collaborative, individuals attending

workshops and webinars hosted by the Science Collaborative, and an online survey of funded project teams and participants.

Notably, this study draws exclusively on insights from those affiliated with the NERRS Science Collaborative. This scope was chosen for several key reasons. First, this study was initiated by the Science Collaborative as part of their ongoing efforts to learn from project teams and share lessons across teams. Over the past twenty years, these efforts have allowed the Science Collaborative to adapt and innovate its program design to better support collaborative science for coastal management. Echoing the user-focused research approach embodied by Science Collaborative-funded projects, this study was carried out in response to a need identified by the Science Collaborative for more actionable knowledge on meaningful engagement. The findings of this study are intended to be used both by the Science Collaborative and by their funded project teams.

Second, projects funded by the Science Collaborative represent a unique pool from which to draw insights about meaningful engagement more broadly. Science Collaborative projects are awarded funding based on their close alignment with the Science Collaborative's core principles, including principles related to participant engagement. Project teams are expected to "engage intended users meaningfully before, during, and after the project to inform project design, execution, and products" (NOAA NERRS Science Collaborative, 2022). Further, project teams are expected to "pursue equity and project-appropriate representation among intended users and rights holders so that all who are involved reciprocally benefit from their engagement." (NOAA NERRS Science Collaborative, 2022). Hence, projects and participants funded by the Science Collaborative represent a pool of research informants who are deeply familiar with the concept of meaningful engagement.

Interviews

Interviews were conducted with fifteen individuals who currently participate, or have participated, in collaborative research projects funded by the Science Collaborative. These individuals were recommended for interviews by the Science Collaborative because they currently fulfill, or previously fulfilled, a leadership role in collaborative science projects and were deemed to be particularly reflective practitioners. All interviewees had five years or more of experience designing and managing collaborative research processes.

Interviews were conducted in a semi-structured manner and were intended to probe interviewee's past experiences facilitating meaningful engagement within the context of collaborative research projects. Interviews varied from approximately 30 to 60 minutes in length and were conducted virtually, via Zoom or by phone, as well as in-person between July and October 2023.

Each interview was transcribed and coded, and a qualitative analysis was conducted to determine the ways in which interviewee responses addressed the study's research questions.

Interactive webinars and workshop polls

As part of the program’s exploration into the topic of meaningful engagement, the Science Collaborative hosted two virtual workshops and one webinar focused on meaningful engagement between June 2023 and February 2024.

The workshops, held in June 2023 and June 2024, were attended by principal investigators (PI), project leads, and collaborative leads associated with projects currently receiving project funding from the Science Collaborative.

The webinar, held in January 2024, was attended by over 200 individuals affiliated with federal and state agencies, local governments, universities, NGOs, community-based organizations, for-profit organizations, and the National Estuarine Research Reserves.

As is typical of the Science Collaborative’s programming, which often draws on peer-to-peer learning methods, the Science Collaborative posed several questions to attendees during or before the webinar and workshops to prompt thinking and encourage conversation. Attendee answers provided valuable insights into how people understand and experience meaningful engagement. These insights were analyzed for common themes and used to inform research findings.

Online survey

To understand perceptions of meaningful engagement more fully across various project participant roles, additional data were collected via an online survey. The survey was distributed via Qualtrics in April of 2024 to 42 projects currently receiving funding from the Science Collaborative. The survey protocol was comprised of 6 multi-part questions that focused on demographic information, motivations for joining a collaborative science project, and factors that influence ability to engage meaningfully during a collaborative science project. A total of 33 individuals completed the survey. Table 1 shows the number of responses received by project role. Survey data were used to validate insights drawn from the interviews, webinar, and workshops.

Table 1: Count of survey responses by project role

Project Role	Number of Responses
Technical advisor	9
Other*	9
Intended / end user of project outcomes	6
Collaborative lead	5
Principal investigator / project lead	4
Technical lead	0
Total	33

*Answers that were described by respondents under the “Other” category included: “all”; “all above”; “CTP coordinator”; “grad student”; “interested citizen”; “partner advisory committee”; “PAC member”; “steering group”; and “support.”

A note on language

Project Teams and Project Participants

Projects funded by the Science Collaborative typically involve two core groups of people: the project team and project participants.

Project teams consist of people who are responsible for managing and coordinating project logistics. This might include individuals fulfilling roles like principal investigator, technical lead, or collaborative lead. The term “collaborative lead” is used in this report to denote an individual on the project team who is primarily responsible for leading, designing, managing, and otherwise coordinating the collaborative process (including engagement) during the project.

Project participants include people or organizations that are the intended users of the project’s final outcomes. Examples of intended users include, but are not limited to, reserve staff, public, private, or nongovernmental decision/policy makers, Indigenous governments, landowners, regulators, resource managers, land use planners, leaders of impacted communities, and educators at all levels. The Science Collaborative requires their funded projects to engage meaningfully with all project participants and intended users.

Not all projects have a strict delineation between the project team and participants. For example, in some projects, intended users of the research may be a part of the project team. However, in this report, the phrase “project team” is used in a narrow sense to refer primarily to individuals who are responsible for managing and coordinating the logistics of a project and its process. The phrase “project participants” (or simply “participants”) is used to refer to intended users.

Because certain sections of this report discuss engagement beyond project timeframes (i.e., before or after a project) the word “partner” instead of “project participant” is used when appropriate to refer to ongoing working relationships that occur outside of projects.

Interviewees and Respondents

Data for this study were collected through interviews, the polling of workshop / webinar attendees, and an online survey. For the purposes of this report, individuals who were interviewed are referred to as interviewees while workshop / webinar attendees and survey participants are referred to as respondents.

Report Format

This report is organized into two main sections. Section I presents the study’s findings, including findings related to tell-tale signs of meaningful engagement, factors that make engagement meaningful, and factors that undermine meaningful engagement. Section II of the report covers implications of the study for advancing meaningful engagement in collaborative science projects. It provides an overview of practical considerations for project teams, then concludes with program management recommendations to the Science Collaborative based on study findings.

Section I. Research Findings

This section presents four areas of research findings on meaningful engagement:

- A. Participant motivations for engagement
- B. Tell-tale signs of meaningful engagement
- C. Factors that make engagement meaningful
- D. Factors that undermine engagement

A. Participant motivations for engagement

Drawing on the assumption that motivations for participation are linked to meaning that is derived from engagement, this study examined why people choose to become involved in collaborative science projects. Interviews revealed that participants' motivations for initial engagement with collaborative science projects are likely to vary widely.

Interest in the project topic was the most commonly cited motivation for participant engagement. Some interviewees specified that interest in project topic is often tied to applicability and relevance of the topic to personal or professional goals and challenges. Specifically, engagement may be motivated by the desire to learn new information or skills. For example, one interviewee suggested that communities may be motivated by the desire to acquire new information that could help them make informed decisions and advance their goals and priorities.

Long-standing and established relationships was another commonly cited motivation for intended user engagement. Interviewees implied that established relationships and relationships characterized by trust may motivate intended users to engage because intended users can presume, based on past experiences, that further collaboration will be beneficial. In addition to established relationships, the prospect of building new relationships and networking with others in a similar field may motivate engagement.

A strong sense of place motivates the engagement of some participants. One interviewee commented, "[Intended users] want to see their place improve... their sense of place is so important." Another interviewee shared, "People are really place connected. We're pretty remote. It's a community that's not really close to any other communities. And so there is a real deep sense of responsibility to [the estuary]." Similarly, a sense of belonging or commitment to community can motivate engagement. One interviewee stated that some participants are motivated because of "the value they place on their community."

Finally, less commonly cited but notable motivations reported by some interviewees included **job responsibilities** and **financial compensation**.

Because there was some hesitancy among interviewees to generalize about the motivations of the diverse participants who join collaborative science projects, additional insight on participant motivation was gathered from a survey of current project teams and participants. Survey results were concordant with motivations identified during interviews. All survey respondents (n=33) indicated that they were motivated to some degree by interest in the project topic, desire for new

information or assistance to address a challenge, and a sense of personal responsibility to contribute. The single most highest-ranking motivation was interest in the project topic; 83% of respondents (n=25) were motivated “a great deal” by interest in the project topic. The lowest ranking motive was financial compensation; 77% of respondents (n=24) were “not motivated at all” by financial compensation.

These motivations provide preliminary insight into the various ways that participants expect to derive value and meaning from engagement with collaborative science projects.

B. Tell-tale signs of meaningful engagement

A persistent question that project teams have posed to the Science Collaborative is “how do we know if we are achieving meaningful engagement in our projects?” To examine this question, this research attempted to uncover “tell-tale” signs of meaningful engagement. Specifically, interviewees and workshop / webinar attendees were asked to describe the signals they use to assess participant engagement.

While the specifics of what engagement looks like vary by context, there was a sense expressed by interviewees and respondents that it is often quite evident when people are engaging meaningfully. Interviewees and respondents delineated various signs that are plainly observed (i.e., they are seen, heard, communicated, or felt). These “tell-tale” signs are often indicative of meaningful engagement.

Tell-tale signs of meaningful engagement shared by interviewees and respondents fall into three broad categories: emotional signals, interpersonal behavioral signals, and signals related to interaction with a project’s substance. Each is described below, supplemented with comments shared by interviewees or respondents.

Expressions of emotion

Project participant may demonstrate emotional signals that indicate that they are engaged in ways that they find meaningful.

- **Interest:** Participants are interested, curious, and “happy to hear from [the project team].” They demonstrate excitement.
- **Enjoyment:** Participants are enjoying themselves. They are smiling, laughing, or “having fun.” They “light up” or demonstrate enthusiasm.
- **Investment:** Participants are emotionally invested, indicating they care deeply. People are “adamant” or passionate. They may share strong emotions, including emotions that might be cast as negative, such as anger or frustration. Participants want their feedback and input to matter.

Interpersonal behavior

Behaviors that participants display while interacting with each other during engagement activities can indicate that participants are engaging meaningfully.

- **Responsiveness:** Participants seem eager to engage. There is no need to “chase anybody” down. Some participants might show up early or “linger after meetings.” They “respond quickly” when help is needed.
- **Attention:** Participants are attentive and present during engagement. They are listening to each other, responding, and reacting in the present time. They are fully immersed in project activities.
- **Communication:** There is lively, animated, and engaged conversation among participants. Participants ask questions and offer opinions or feedback to each other. They are engaging in honest and forthright ways. Participants work through conflict constructively. Some participants might “stick around after a meeting because they want to keep talking.”
- **Connection:** Participants work easily and comfortably with each other. Participants are able to “put their guard down.” Strong working relationships or friendships emerge. Participants are “following up and making further connections.”
- **Sustained engagement:** There is continued or repeated involvement from participants. They consistently show up to project meetings, gatherings, and events. They stay engaged.

Interaction with project substance

Meaningful engagement may sometimes be evidenced in the ways that participants interact with the substance of the research.

- **Innovation:** Participants ask insightful questions or generate spinoff ideas. Participants explore new and unanticipated project directions. New ideas are shared freely. The project takes on a life of its own.
- **Individual transformation:** Participants are changing the way they think and adopting new perspectives. The project “has obviously been on their minds” and they are “recollecting the experience or referring to it.”
- **Use:** Participants use project outcomes or products. They are seeking out more information, for example: “hey, can you gimme that report?” Participants apply learning outside the project (e.g., to other tasks or their job).
- **Diffusion:** Participants are sharing about the project with others, expanding their collaborative network. Participants are connecting new people to the project. Impacts are evident beyond the immediate scope of the project.

C. Factors that make engagement meaningful

Examining the defining qualities of meaningful engagement, including what makes engagement meaningful and why, was a central objective of this research. Both interviewees and workshop / webinar attendees were asked to reflect on the factors that make engagement feel meaningful.

To learn from the unique expertise of interviewees and workshop / webinar attendees, slightly different questions were posed to each group. This approach allowed us to explore what makes

an interaction meaningful to individuals in general as well as what makes meaningful engagement specifically within the context of collaborative science projects.

Workshop / webinar attendees were asked the following question: *what makes an interaction with others feel meaningful?* Interviewees were asked to reflect on a similar but modified question: *what makes interactions in a collaborative science project meaningful for project participants?*

Answers shared by both interviewees and workshop / webinar attendees offered a consistent set of factors that characterize how a meaningful interaction feels or what it offers to those involved. As to be expected, answers shared by interviewees were embedded more specifically in the context of collaborative science projects. Factors that make engagement feel meaningful can be categorized into three broad themes: the way that individuals feel treated, the value that the project, process, or interaction holds for participants, and patterns of communication or group dynamics that emerge from engagement. The table below summarizes the number of responses from workshop / webinar attendees that reflected each theme (Table 2).

Table 2: Count of workshop / webinar responses by theme

Theme	Response Count
How individuals feel treated by the behavior of others	48
The value derived from the project, process, or interaction	32
Patterns of communication or group dynamics	30
<i>Total*</i>	110

*Several responses encompassed more than one theme and were counted more than once. Responses were collected from 91 unique workshop / webinar attendees.

The following section delves deeper into the factors that make engagement meaningful. Factors are organized by theme (the way that individuals feel treated; the value derived from the project, process, or interaction; and patterns of communication / group dynamics that emerge from engagement). Findings from workshop / webinar attendees and interviewees are presented alongside each other. Workshop / webinar attendees are referred to as respondents while interviewees referred to as such.

How individuals feel treated

Interviewees and respondents consistently indicated that meaningful engagement is inextricably tied to how individuals feel treated. When people feel treated well by others, their engagement is more likely to be meaningful. The qualities of meaningful engagement that are associated with how people feel treated include feeling heard, respected, cared for, and treated with sincerity.

People feel heard.

Feeling heard, listened to, and understood by others was the one of the most frequently cited factors across all themes for what makes engagement feel meaningful. One respondent explained

that meaningful engagement is “feeling like I was truly listened to.” Other respondents shared that meaningful engagement involves having their “voice heard,” “being seen,” and “active listening.”

People feel treated with sincerity.

A strong recurring theme in many respondents' answers was the importance of sincerity for engagement. Interviewees and respondents indicated that participants value knowing that the project team has an authentic desire to engage and is engaging with participants on “genuine terms.” Interviewees and respondents repeatedly used words like “sincere,” “genuine,” “authentic” and “honest” to describe engagement that feels meaningful. One interviewee explained that “people want to feel valued, and part of a team. Not just like someone that you have to check a box and involve in some way.”

People feel respected.

Respondents stressed that when participants feel respected, valued, appreciated, and treated with dignity by others, engagement is more likely to feel meaningful. Respondents highlighted the particular importance of:

- *Respect and gratitude for participant contributions:* Interviewees noted that engagement is meaningful to participants when they “feel their input has been valued.” One interviewee shared that for many participants “a mutual respect” for “each other's work and background and contributions” is an important part of meaningful engagement.
- *Respect for participant ways of knowing:* Noting that “science is only one way of knowing,” one interviewee commented that engagement is more meaningful when it affirms multiple sources of knowing and ways of experiencing the world.
- *Respect for participant time:* Respondents indicated that participants are more likely to feel treated well when they feel that their time is being respected. Participants do not want to “feel like they're wasting [time].”

People feel cared for and comfortable.

Multiple interviewees and respondents explained that a sense of care, comfort, and security fosters meaningful engagement. Participants find engagement more meaningful when engagement creates “safe space for contributions” or when they are able to “be real” and “put their guards down.”

Some interviewees and respondents spoke to the way that compassion, care, commitment, and community fosters meaningful engagement. One respondent noted that engagement is meaningful when it provides opportunities “to have community, space, [and] place to be aware of [one's] own vulnerability.”

One interviewee contemplated a particularly meaningful experience, sharing “one of my big reflections was just how much I value the people I work with and how much they really are my community...A genuine respect and care for the people that you are working with really underpins the most successful engagement.”

Other respondents specifically commented on the role that trust plays in fostering a sense of care and comfort. One interviewee explained that when there is trust among participants “[you know] that your ideas are not going to be ridiculed...you're going to feel comfortable and taken care of by the people that you're working with.”

The value derived from the project, process, or interaction

Interviewees and respondents indicated that participants are more meaningfully engaged when they find the project and its process to be valuable in some way. One interviewee summarized this plainly: engagement is more meaningful when “everyone has fun and takes away something.” While what participants “take away” from engagement may vary widely, respondents overwhelmingly indicated that participants find value in learning new things and engaging with projects that feel impactful, generative, and relevant. Responses also emphasized that engagement is more meaningful when it is mutually beneficial to all involved instead of to a subset of partners or participants.

Engagement fosters learning and shared understanding.

Learning new things was most frequently cited by respondents as a factor that makes engagement more meaningful. Specifically, interviewees and respondents highlighted that meaningful engagement often involves:

- *Learning from others:* Learning from fellow participants and developing a deeper understanding of others’ experiences can be particularly meaningful. Respondents often used phrases like “learning about other people” and “learning about other’s experiences” to describe meaningful engagement
- *Perspective-taking:* Participants value opportunities to gain new perspectives and to learn about the perspectives of others. One respondent summarized succinctly that engagement is meaningful when it “makes me think.”
- *Deepening actionable knowledge:* Participants tend to value learning information or skills that are relevant and applicable to their personal or professional work. One interviewee described engagement as meaningful when there is “some nugget I can take home and put to use.”
- *Coming to a shared understanding or goal:* Many of the respondents who reflected on the value of learning also emphasized that engagement is more meaningful when it facilitates the development of a shared understanding. Respondents used phrases like “finding common ground,” “commitment to a shared goal,” and “building a shared understanding” to describe engagement that feels meaningful. One respondent expanded further, describing meaningful engagement as “an ‘ah-ha’ moment when you realize you're both talking about the same thing from different angles, and [you] actually share similar values.”

Engagement feels impactful, purposeful, and empowering.

A sense of purpose and impact often characterizes engagement that feels meaningful. Specifically, respondents highlighted the value of:

- *Generative impact and progress*: The outcomes of engagement can make the process of engagement itself feel more meaningful. Respondents and interviewees noted that participants value “getting things done” and feeling “invested and effective.” Several respondents emphasized that meaningful engagement feels generative of next steps. For example, engagement is more meaningful when participants are “coming away from an interaction with concrete action items” or when engagement “leads to a follow-up action.”
- *Relevance of engagement*: Respondents implied that participants tend to find engagement more worthwhile when it is directly relevant to their work. Participants appreciate projects and the processes that align closely with their interests and needs. One interviewee noted that participants are motivated when “they believe that [the project] is relevant enough, timely enough, [and] salient enough.”
- *Engagement that “makes a difference”*: Participants find engagement more worthwhile when they feel that they are part of something that truly matters. One interviewee shared that “people were jazzed when they knew the work would be useful to people.” Another respondent explained that engagement is more meaningful when “the project that we are working on together [is] something that will make a difference in one or both of our careers, fields, or [to] an audience that we are working with.”
- *Decision-making, efficacy, and agency*: Participants value having the agency to make decisions both about the terms of engagement and the direction of a project. For example, one interviewee noted that involvement in a project is more meaningful and engaging to participants when they feel that “they have a hand on the steering wheel.” Another interviewee shared that engagement is meaningful to participants “when they can see the needle move. They can see progress happening on these projects, and a lot of it's because of them... like, they speak it, and then it happens.”

Engagement is mutually beneficial.

Interviewees and respondents emphasized that engagement is more meaningful when it feels beneficial to all participants involved. For example, respondents shared that engagement is meaningful “when both sides get ‘something’ out of it” or when it “benefits all partners in some way.” Numerous respondents specifically noted that a sense of reciprocity among all involved characterizes meaningful engagement.

Patterns of communication and group dynamics

Lastly, interviewees and respondents identified communication patterns and group dynamics, particularly those that promote a sense of connection, as important factors in making engagement feel meaningful for participants. Interviewees in particular emphasized that various types of relationships are important for meaningful engagement, including relationships between project leaders and participants, relationships among participants, and relationships between project teams and NERRS staff.

Engagement feels bidirectional.

Many respondents linked “feeling heard” to interactions that feel bidirectional. They noted the value of things like “back and forth engagement,” “two-way communication,” and conversations that are “not just one-sided.” Other respondents emphasized that engagement is more meaningful if all participants involved have “an opportunity to meaningfully express their views on the topic on hand.”

Engagement offers a sense of connection.

For many participants, a sense of belonging and connection to others is essential to engagement that feels meaningful. Respondents explained that a meaningful interaction is “one where we both come away with a feeling of connection” or one that leaves participants with “a mutual desire to interact again.” Interviewees used phrases like, “we’re all in this together” and “we’re all doing this together” to describe the way meaningful engagement is often characterized by interpersonal connection. Several respondents and interviewees invoked “chemistry,” explaining that meaningful engagement is characterized by a “chemistry that happens when people are interacting with each other.”

Engagement builds, strengthens, and sustains relationships.

Respondents noted engagement is meaningful when it serves to build new relationships and strengthen existing ones. One interviewee noted that engagement can feel more meaningful when both participants and researchers feel like they are on the same team or belong to the same community, instead of researchers “just [being] there to do research.” While discussing relationship building, respondents also shared that there are certain qualities of relationships that foster meaningful engagement, including trust, consent, reciprocity, humility, gratitude, commitment and accountability.

D. What undermines meaningful engagement?

To further examine the characteristics of meaningful engagement, the differences between engagement that feels meaningful versus engagement that does not feel meaningful were probed. Again, distinct questions were posed to interviewees and workshop / webinar attendees in order to explore what undermines meaningful engagement in general, as well as specifically within the context of collaborative science projects.

Workshop / webinar attendees were asked to consider the following question: *what makes an interaction with others not meaningful to you?* In contrast, the interviewees were asked to consider a slightly modified question: *what challenges meaningful engagement in collaborative science projects?*

70 responses to the former question were received from workshop / webinar attendees. Unsurprisingly, many of the defining features of engagement that is *not* meaningful are the inverse of features that characterize engagement that *is* meaningful. Factors that constrain meaningful engagement can be categorized into the same three themes presented in the previous section: patterns of communication / group dynamics that emerge during engagement; the way that individuals feel treated; and the value derived from the project, process, or interaction. Table

3 summarizes the number of responses from workshop / webinar attendees that were relevant to each of these three themes.

Table 3: Count of workshop / webinar responses by theme

Theme	Response Count
Patterns of communication / group dynamics	35
How individuals feel treated by the behavior of others	29
The value derived from the project, process, or interaction	8
<i>Total*</i>	72

*Several responses encompassed more than one theme and were counted more than once. Responses were collected from 70 unique workshop / webinar attendees.

Interviewee responses largely reiterated the same themes and factors that emerged from responses of workshop / webinar attendees. However, interviewee responses also pointed to an additional set of contextual factors that have the potential to undermine meaningful engagement. These contextual factors, which are mostly external to any one collaborative project, characterize the backdrop for many collaborative science projects.

Factors that undermine meaningful engagement are presented in detail in the two subsections that follow. The first subsection (*Factors that make engagement less meaningful*) synthesizes responses from workshop / webinar attendees about general factors that hinder meaningful interaction. Where relevant, select quotes and key concepts from interviewee responses are included alongside findings from workshop / webinar attendee responses.

The second subsection (*Contextual challenges to meaningful engagement*) focuses on a set of external contextual factors that can potentially undermine meaningful engagement within collaborative research projects specifically. That subsection presents findings that were conveyed exclusively by interviewees.

Subsection I. Factors that make engagement less meaningful

This subsection provides a summary of comments offered by workshop / webinar attendees in response to the following question: *what makes an interaction with others not meaningful to you?* It is important to note that this question encouraged reflections drawn from attendees' personal experiences in general and not from collaborative science projects in particular. Hence, their responses identify the dynamics that *could* undermine a project participant's ability to feel meaningfully engaged and should be guarded against in collaborative science projects. While interviewees were not directly asked this same question, some of their observations were relevant and are included here when applicable. Webinar / workshop attendees are referred to as respondents while interviewees are referred to as such.

Patterns of communication and group dynamics

Factors related to communication patterns and group dynamics were most commonly cited by respondents as undermining meaningful engagement. Respondents' answers emphasized several factors that are symptomatic of weak working relationships among those involved, including an unwillingness to collaborate, dominating behavior, and conflict or tension.

Others are perceived as unwilling to collaborate or closed-minded.

Respondents highlighted that meaningful engagement is hindered when others lack a collaborative spirit. They expressed that engagement is less meaningful when others seem "unwilling to work towards a common goal," "unwilling to listen," or "unwilling to see the big picture and work with others." Respondents also commented that meaningful engagement is constrained when others display "a sense of superiority," for example if they seem "condescending," "standoffish," or "entitled."

Relatedly, respondents identified a closed-minded attitude as a factor that undermines meaningful engagement. A closed-minded attitude can marginalize the knowledge, ideas, or experiences of others. For example, one interviewee explained that sometimes certain people "are adamant that there's some technical reasoning behind why we have to do XYZ... That can be really problematic because then you're disenfranchising anybody else who's bringing a different way of knowing the world or a different perspective to the table."

Interactions feel one-sided or dominated by a few.

Meaningful engagement may be constrained when interactions are dominated by a few individuals; for example, when, "the loudest voice is the one that is driving the project." Many respondents further emphasized that engagement is less meaningful if it feels "one directional" or "one-sided."

Conflicts or tension.

Unless managed, conflict or tension among individuals can constrain meaningful engagement. Respondents shared that engagement is less meaningful when others are "argumentative" or "looking for a fight." One interviewee shared a story about participants of a project who were involved in litigation proceedings outside of the project. Participants were concerned that project leadership might prioritize input by some over others during the project. If left unaddressed, this tension could have undermined engagement.

How individuals feel treated

Many respondents indicated that whether or not engagement feels meaningful to individuals is determined in part by how they feel treated. Respondents' answers conveyed that when people feel they have been treated poorly by others, their engagement is less likely to be meaningful. The following subsections summarize how engagement is constrained when people feel unheard, excluded, dismissed, or treated disingenuously.

Individuals don't feel heard or listened to.

Not feeling heard, listened to, or understood was frequently cited by respondents as a factor that undermines meaningful engagement. Respondents used phrases like "talking past each other"

and “not being heard” to describe these interactions. One interviewee reflected on instances when participants of a project “don’t feel like they’re heard” because “they’re bringing stuff up that is important to [them] but the project team doesn’t really incorporate that into what they are doing.” Another interviewee noted, “there’s nothing more frustrating than somebody who asks for feedback and you just get the sense that they don’t care.”

Feeling excluded or dismissed.

Meaningful engagement is undermined when individuals feel excluded, dismissed, or irrelevant to the discussion. Respondents and interviewees explained that engagement is less meaningful when people feel “talked over,” “ignored,” or like others “don’t have time for” them. One interviewee reflected on a specific engagement event that felt dismissive because some people literally, and figuratively, lacked “a seat at the table.”

Engagement feels disingenuous.

Sincerity emerged as a key factor for what makes engagement feel meaningful, so it was unsurprising that many respondents identified disingenuousness as a factor that undermines meaningful engagement. Respondents and interviewees used words and phrases like “fake,” “shallow,” “superficial,” “inauthentic,” “pro forma” and “a token effort” to describe interactions that were not meaningful for them.

Some respondents noted that engagement can feel disingenuous if some involved are just “trying to say all the right things” or if there are ulterior motives involved. For example, meaningful engagement may be undermined if it feels like scientists are just “trying to get their science done,” or when they come into an interaction “with an agenda.”

Another interviewee shared, “I’ve worked with a lot of academic institutions where they are very driven by the publish or perish, and by grants. It will almost always not be meaningful engagement if [publications and grants are] the sole focus of the principal investigator.”

The value derived from the project, process, or interaction

A smaller number of respondents indicated that meaningful engagement is hindered when there is a lack of value derived from the project, process, or interaction. Respondents’ answers highlighted several factors that diminish the value associated with engagement, as discussed below.

Engagement feels like a poor use of time.

Several respondents noted that engagement that feels like “time is being wasted” is often not meaningful to those involved. One interviewee shared: “everybody’s so busy that if there are frivolous things or things that just feel like busy work, those things can take away from the overall satisfaction.”

Engagement doesn’t feel relevant, impactful, or beneficial.

Meaningful engagement is undermined when individuals perceive the topic or the interaction itself as irrelevant or unproductive. One interviewee underscored this point, noting engagement can feel less meaningful when the “project team [gets] a little bit off focus, a little bit tangential to the original scope and [it] starts to feel not as relevant.” Another interviewee reflected on the

challenges of engaging people on issues that have less immediate pertinence. The interviewee noted that “for instance, in climate adaptation, I can't get anything done in almost any community right now without addressing affordable housing. If you don't have a place to live, you just really don't care if the community is going to be there in a hundred years, right?”

Lack of a consequential role in the process / outcome.

Respondents noted that individuals who feel that their input has no bearing over the direction of the discussion may find engagement to be less valuable. Respondents shared that engagement feels less meaningful if some involved are just “paying lip service” to the idea that individual input will shape the outcome. Respondents used phrases like “no follow-up,” or “validation with no follow-through” to describe when engagement doesn't feel meaningful.

Public comment meetings, often used in regulatory processes, were cited by one interviewee as an example of engagement that leaves people feeling powerless to influence outcomes. The interviewee explained, “we've all been to public meetings ...[where] they already know what they're going to do. They hold a public comment meeting because they have to, and they really don't give a ‘hooley’ [about] what anybody has to say... That is a disrespectful form of engagement.”

Feeling out of the loop, disconnected, or uncertain.

It can be difficult for people to engage meaningfully if they feel out of the loop or unclear about the discussion's process or progress.

One interviewee described an example of a time that engagement was constrained because project participants found the collaborative process to be vague or unclear. Specifically, participants were uncertain of the role they were expected to play in the project: “a big holdup that I think impacted the engagement with [the] property owners... was that it was difficult for them to grasp the idea that they have complete control over [the] project.”

Another interviewee gave an example of participants that felt disconnected from a project due to infrequent project engagement: “the community members realized, ‘wait, I used to see so-and-so quite a lot... So-and-so used to come and take samples. But then I haven't heard from them in over a year. What's going on with the project?’”

Feeling overburdened or “over-researched.”

People can get frustrated if they feel overburdened by an interaction or if they feel like the leader is “over engaging.” One interviewee commented that engagement “is resource intensive on everybody... And it's just not fair to ask people to keep showing up to meetings, you know?”

Several interviewees also noted that some communities face a daunting amount of research interest from outside organizations. This can be time-consuming for communities that must field repeated offers of assistance or requests for partnerships. Such requests can place undue onus on intended users who must bear the burden of educating partners about community interests, needs, or challenges. For example, one interviewee paraphrased the reflections of a particular partner, who shared:

“All of these federal entities, state entities, local government entities come to us, and they say, ‘what do you need? What do you need?’ We tell them what we need, and then we never hear from them again. Why? Because what we need isn't necessarily what they can offer. What we would actually like is for [them] to come and just tell us what is possible for [their] agency. And if we don't need it, goodbye, that's fine. But for us to bare our souls over and over again about what we're struggling with, and to not necessarily be talking to the right people, is problematic.”

Interactions like this can leave communities feeling over-researched by researchers with no stake in the people and places they research. People may feel taken advantage of or like their time has been wasted by engaging with the research process.

Subsection II. Contextual challenges to meaningful engagement

To probe the unique expertise of interviewees, they were asked to respond to consider: “what challenges meaningful engagement in collaborative science projects?”

Many of their responses echoed the factors identified by workshop / webinar attendees. However, interviewee responses also touched on broader contextual influences that can hinder meaningful engagement within collaborative science specifically. This section provides a summary of interviewee insights on these contextual factors. In particular, interviewees commented on how unfamiliarity with collaborative science, as well as negative perceptions of scientific research and researchers, can affect engagement of participants. Interviewees also spoke to certain challenges that may arise when bridging different sources of knowledge and working in an interdependent manner.

Unfamiliarity with the collaborative science approach

Many researchers who are new to collaborative science lack familiarity or experience with the mindset and strategies that guide the collaborative approach. Lacking familiarity, researchers, as well as project participants, may misunderstand or be unaware of how significantly collaborative science approaches differ from more conventional non-collaborative research.

Collaborative science is guided by normative principles that distinguish it from more "conventional" approaches to science. The NERRS Science Collaborative has identified four core principles that characterize collaborative science projects. Successful collaborative science projects:

1. “respond to a management need defined by the socio-ecological system
2. engage with intended users and build reciprocal relationships.
3. tailor processes to context.
4. create relevant and usable products” (NOAA NERRS Science Collaborative, 2022).

While a collaborative lead is typically responsible for designing and managing the collaborative process during Science Collaborative projects, interviewees highlighted that all project leaders

and participants need to understand the principles of collaborative research and what they mean for their project. One interviewee commented emphatically “everybody needs to be fluent in what it [takes]” to do collaborative science.

Unfamiliarity with either the collaborative mindset or collaborative process strategies can hinder meaningful engagement. Specifically, interviewees noted that unfamiliarity can result in an underappreciation of the need to consider local or Indigenous sources of knowledge, insufficient tending of relationships before, during, or after projects, and ineffective management of group dynamics. In a survey of 33 individuals currently involved in collaborative science projects funded by the Science Collaborative, almost 40% of respondents reported that having little experience with collaborative projects challenged their ability to engage meaningfully to some extent.

Perceptions based in prior experience

The perceptions and past experiences that participants bring to collaborative science projects affect the ways in which they engage, or even if they choose to engage at all. Many interviewees commented on the ways that participant perceptions of researchers and the research process can constrain participants’ ability or willingness to engage. Both positive and negative perceptions of research and researchers can exacerbate power dynamics and make it more difficult to build the trusting and reciprocal relationships required for meaningful engagement.

Negative perceptions of research and researchers are often rooted in past or contemporary failures of researchers to account for the impacts of their research. Due to past interactions with researchers, participants in collaborative projects may distrust researchers or worry about potential harm created during the research process. Participants may experience researchers as patronizing, ill-intentioned, or meddling. Such dynamics undermine meaningful engagement, making participants feeling wary of sharing their interests, ideas, or local knowledge.

Many interviewees shared stories about participants whose perceptions of science were shaped by prior engagement with researchers whose funding came from sources other than the Science Collaborative. These stories highlighted issues that resulted from a lack of accountability, follow-through, or commitment by researchers.

One interviewee shared that previous experiences with researchers have left community members feeling frustrated: “scientists come through our wetland and watershed, and we see them taking measurements, but we don't see the results until three years later, or maybe never.” Such interactions may leave community members feeling like research subjects rather than true collaborators.

However, perceptions of research and researchers need not be negative to challenge the collaborative process. Even positive perceptions of researchers held by participants can constrain meaningful engagement. For example, one interviewee shared that perceptions of researchers as “experts” can cause participants to be more hesitant to speak up or contribute input.

Challenges associated with integrating different ways of knowing

The strength of collaborative science lies in harnessing diverse and differing sources of knowledge. However, these very differences can challenge engagement since achieving a common understanding of the project and its process can require more effort and commitment.

Due to varying areas and levels of expertise, participants may lack a shared lexicon, making communication more difficult. One interviewee noted “it's harder when you have a more diverse [participant] group because you got to hit different levels of specificity and how much background information they need.”

Further, participants may bring differing or conflicting worldviews and approaches to science. As one interviewee commented, “institutional science is only one way of experiencing and knowing the world.” Failure to see the need to consider local or Indigenous sources of knowledge can marginalize participants and impede the collaborative process.

Challenges associated with project pace and timeline

Engaging participants meaningfully may be more challenging when participants have differing needs and expectations for project pace. Many interviewees shared stories about challenges that arose when projects felt too rushed or too slow-moving to participants.

Sometimes project timelines move at a pace that feels too slow for participants. Slow project timelines can mean that project outcomes are not available in a timeframe that is relevant for intended users and their organizations. Sometimes participants expect or need to use project outcomes sooner than they are available.

Slow project timelines can be a consequence of lengthy scientific processes, including data collection and analysis. Unforeseen obstacles in the scientific process can further delay a project's pace and create lulls during the process. Interactions between the project team and participants may become infrequent or intermittent, leaving participants feeling like they're “waiting and waiting” on the project.

On the other hand, sometimes project pace can feel too rushed to participants. Interviewees noted that expedited project pace often occurs when the project team is beholden to funding requirements and other institutional constraints. One interviewee shared, “I think that one of the problems with grant funding as a way of making projects happen is that it is by necessity on short timelines.” Accelerated project pace can sometimes come at the expense of the time needed to establish the relationships necessary for meaningful engagement.

Dependence on time-limited, project-based funding models

While this research primarily investigates meaningful engagement within collaborative science projects, some interviewees gently pushed back against interview questions that appeared to probe meaningful engagement strictly within the context of an individual project versus longer term efforts. To these interviewees, meaningful engagement during projects is achieved from engagement during longer-term partnerships that transcend the boundedness of projects.

However, scientific research, including collaborative scientific research, is often carried out within, or adjacent, to institutions and funding models that operate on a project-by-project basis. Research projects, particularly those funded by grants may be marked by discrete timelines with a beginning and end. In contrast, meaningful relationships, such as those that facilitate meaningful engagement, lack a prescribed timeline, and often have an element of continuity to them. Many interviewees emphasized that the mismatch between the nature of relationships and project-based research paradigms can make it difficult to establish and maintain relational qualities (particularly long-term commitment and continuity) that facilitate meaningful engagement. As a result, intended users may experience project-based engagement as “helicopter science” or research that involves “parachuting” in or out of communities.

Several interviewees pointed to grants-based funding mechanisms as particularly challenging to fostering continuous partnerships that have the capacity to enable meaningful engagement. Grant-based funding mechanisms can reinforce project-based research styles. Interviewees noted that unless partnerships previously have been established, it can be difficult to create meaningful connections in the window of time between a notice of grant funding and the funding application deadline. Interviewees recounted times when academic researchers, driven by funding deadlines and other institutional constraints, approached prospective partners with unreasonable timelines for partnerships. One interviewee commented, “sometimes our institutions and systems don't recognize that you cannot get a notice of funding opportunity and . . . , parachute [into a marginalized community] and be like, “you want to be on this thing? We need you.’ That's how we're set up a lot of times and, it's not effective.” Another interviewee shared “one of the problems with grant funding as a way of making projects happen is that it is by necessity on short timelines and so to do things well, you have to anticipate what's coming ahead of time.”

Finally, the unreliability and intermittence of grant funding can present challenges for establishing long-term relationships with new partners. One interviewee spoke to the tension between wanting to engage people early on during a project and being unable to guarantee the funding needed to pursue the project. The interviewee shared, that project teams ideally involve “partners when the idea [for the project] is being generated. [But] you burn bridges this way too, because if people are interested and think that there's funding available and you don't get the funding, it can be tricky.”

External events that cause shifts in participant priorities

Finally, external events can cause unexpected shifts in participants’ priorities or capacity for engagement. For example, public policy changes, personal life events, or urgent public issues such as natural disasters may redirect intended users’ attention or availability. Public elections can even cause a change in the individuals who represent an organization as an intended user. As a result, participant commitment or capacity to engage may wane, causing disengagement and disrupting interdependent team dynamics.

Section II. Implications of Research Findings for Practice

Engaging meaningfully with participants is central to the success of collaborative science projects. This research has distilled the factors that make engagement meaningful versus not meaningful. Prior sections have described what meaningful engagement looks like (tell-tale signs); the factors that help make it happen; and the challenges and constraints that undermine it.

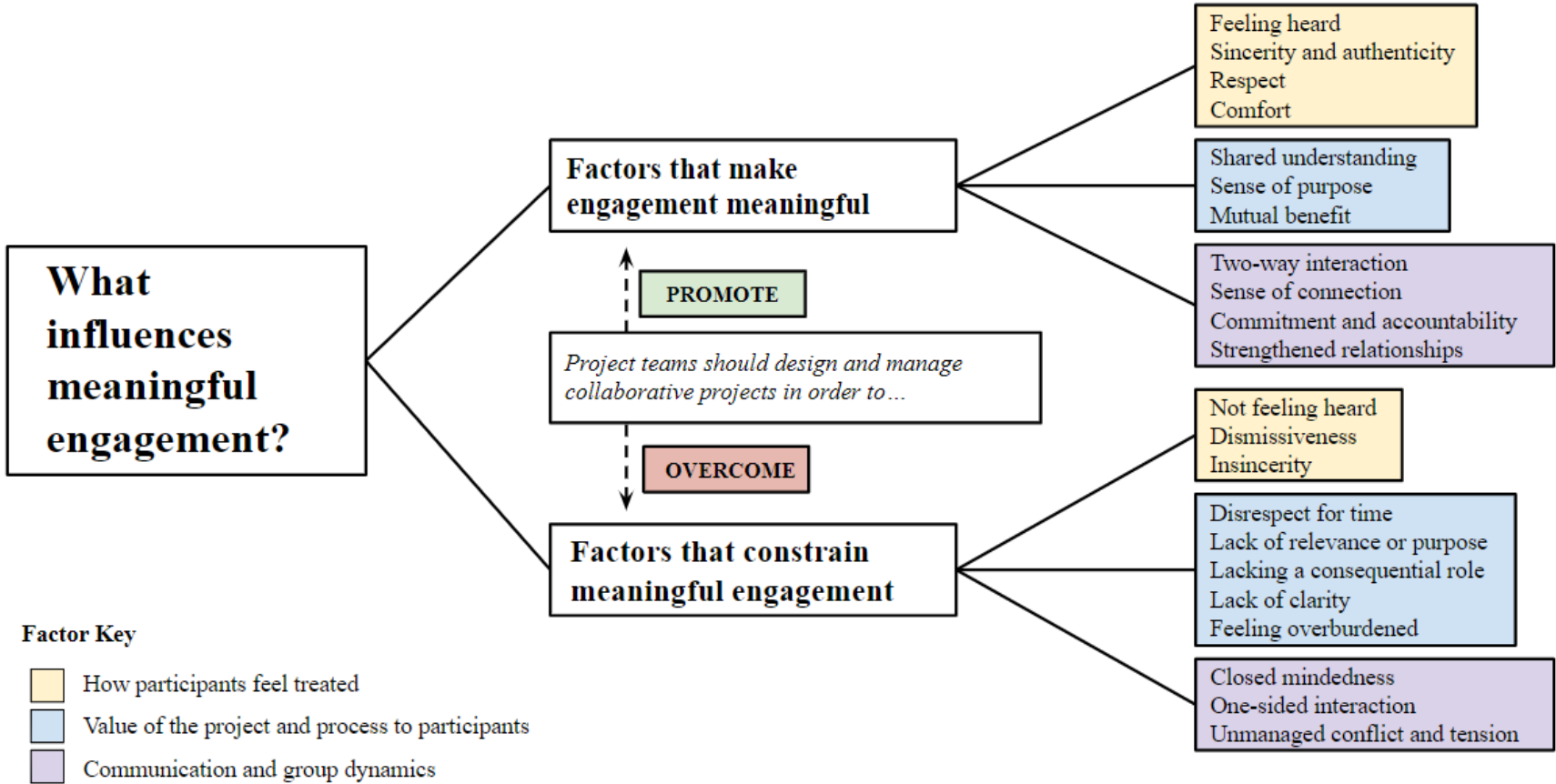
An essential objective of this report is to help project teams apply these findings in practice. Thus, the remainder of this report describes the major implications of this study's findings for those leading collaborative science projects as well as for the Science Collaborative team in its role administering the NERRS Science Collaborative Program. In the following sections, the study's findings are presented in a simple diagrammatic framework that summarizes an approach for advancing meaningful engagement in collaborative science projects. Then, a series of practical implications are given as further guidance to projects teams interested in ensuring engagement is meaningful. Lastly, implications for funding program management by the Science Collaborative are outlined.

A. A framework for advancing meaningful engagement

Project teams can play an active role in advancing meaningful engagement by thoughtfully designing and managing their projects' collaborative processes. As detailed in earlier sections, whether engagement is experienced as meaningful or not by participants is influenced by a set of factors that relate to how individuals feel treated, the level of value that participants find in the project and process, and the communication patterns, group dynamics or relationships that develop during engagement. The context within which collaborative projects are carried out also impacts the ability of participants to engage meaningfully.

To foster meaningful engagement in practice, project teams should consider two main objectives: first, to promote those factors that make engagement meaningful and second, to avoid or overcome those factors that constrain meaningful engagement. The diagram in Figure 1 offers a visualization of these objectives relative to the factors that were found to make engagement meaningful or not meaningful. The diagram can be used as a reference for project teams as they scope, design, and manage their projects' collaborative processes.

Because meaningful engagement is often context dependent, the diagram is intended to prompt reflection rather than serve as a prescriptive checklist. For example, a project team might step through the factors represented on the diagram iteratively and reflect on how each is present or absent in their projects' collaborative process. Because meaningful engagement with partners and participants is an ongoing process that should be accounted for over the entire course of a project, this diagram holds potential relevance to projects at all stages.



B. Practical implications for those leading collaborative science projects

To further support teams in applying the framework in Figure 1, additional practical implications for advancing meaningful engagement are discussed below. This section summarizes the rich reflections interviewees offered on the strategies they have taken to promote (or overcome) factors that make engagement more (or less) meaningful when leading their collaborative science projects.

Many interviewees described process-related strategies that they frequently employ to design and manage their collaborative processes. However, interviewees' remarks were also imbued with references to particular mindsets and attitudes that enable meaningful engagement. Interviewees conveyed that meaningful engagement is fostered both by thoughtfully leveraging process-related strategies and by approaching collaboration with a collaborative mindset. Several interviewees were also careful to point out that meaningful engagement is not a matter of mere "box checking." Adherence solely to a simple checklist of "best practices" is unlikely to achieve meaningful engagement.

This section describes practical implications of this study's findings for project teams that aspire to advance the meaningful engagement of participants in their collaborative research projects. They are meant to be applied in tandem with the framework presented in Figure 1. Five categories of practical implications for project teams emerged from this study: 1) Embrace a collaborative mindset; 2) Tailor the process to context; 3) Set the stage for clear and efficient collaboration; 4) Manage the process in ways that foster engagement that is meaningful; and, 5) Tend to relationships. Each implication category is discussed below.

1. Embrace a collaborative mindset

The Science Collaborative asserts that the "mindset with which teams approach their work is fundamental to successful collaborative science" (NOAA NERRS Science Collaborative, 2022). Interviewees confirmed this sentiment, and consistently highlighted several defining qualities of a collaborative mindset that fosters meaningful engagement, including humility, open-mindedness, care, and commitment. To embrace a collaborative mindset, project teams should strive to:

Practice humility. One interviewee commented, "institutional science is only one way of experiencing and knowing the world. And I'll editorialize that, and it doesn't always help us get out of our problems. So, it's really important to be humble about your training."

Maintain open-mindedness. Be receptive to learning new things from and with participants through the research process. As one interviewee noted, "You have to respect that [participants] have something worthwhile to contribute."

Foster care for people and place. Meaningful engagement is "all relationship building," emphasized one interviewee. "You have to care about the issue and the people you're working with." Another interviewee commented that meaningful engagement is more easily achieved when "everybody has a general mindset of 'we want what's best for the whole.'"

Commit fully and genuinely. Bring one’s full self to the collaboration. Treat collaborative relationships as more than just “project engagement.” One interviewee noted, “what I look for in meaningful collaborative research is that it's not a one-off project. The most successful projects are the ones that don't treat their research as a project.”

Be mindful of when collaboration is and is not welcomed. Participants should not feel that a project is being imposed on them by researchers, or by “outside actors.” One interviewee commented, “don’t be pushing your science on people... Don’t push somebody to be an end user if they actually aren’t going to use [science].” Another interviewee warned that “if you have too many people that just *have* to be there [because of a job responsibility, not by choice or interest],” it’s harder to build trust among participants.

2. Tailor engagement to context by “doing your homework”

There is no-one-size-fits all prescription for meaningful engagement. What meaningful engagement looks like, and the practices that may be used to foster it, often varies from project to project.

Interviewees repeatedly used the phrase “do your homework” to refer to steps project teams can take to better understand unique participants and partnering communities. “Doing one’s homework” at the outset of a project can support a collaborative process that is tailored more appropriately to context. Prior to, or at the start of a project, teams should consider the following:

Participant priorities, values, and goals: what is important to participants; what do participants want to “get out of the project”; how can the project be made more relevant to participant priorities; how does the project fold into longer term efforts or goals?

Participant engagement preferences: how do participants want to be involved in the project; how much capacity do participants have for engagement; how do participants prefer to communicate or convene?

Participant accessibility needs: what accommodations do participants need for engagement to be as inclusive as possible; what manners of engagement are best for participants?

Relevant community organizations, institutions, and leaders: what can the project team learn from the efforts of organizations that are already working on related issues; “who’s who”; what organizations or community champions are concerned about the project’s topic?

Previous research experiences: what research efforts have partners already been involved in and what were the outcomes; how can the current project build on past research efforts; if the community has had negative experiences with prior research efforts, how can positive impact of the current project be ensured?

Sociopolitical context: what policies and historical treaties are in effect in the project’s area; who are rights holders in the project’s area and what rights do they hold; in what ways does the project affirm tribal nations’ rights to sovereignty and self-determination?

3. Set the stage for clear and efficient collaboration

Building a common understanding of both the project and its process from the project's outset is essential to lay the groundwork for meaningful engagement. Clarifying the collaborative process, including expectations and responsibilities of all involved, helps to increase confidence in the process, promote accountability, and make participation feel more comfortable. "Everybody needs to be fluent in what it [takes]" to do collaborative science, commented one interviewee emphatically. The following steps can set the stage for more meaningful engagement:

Provide participants with a clear explanation of why they have been asked to participate and how their contributions to the project will matter. One interviewee commented, "[The project team should be] intentional about why we're asking [for participant input], how we think it's going to help, and how their answers will help inform [the project]."

Ensure project objectives and scope are clear to all participants to avoid confusion or conflicting expectations. This clarity can be accomplished through a thoughtful orientation at the beginning of the project, or co-development of formal problem statements. As one interviewee noted, "super clear purpose/problem statements and objectives...can go such a long way." Be honest and upfront about the project's scope and participation expectations and avoid overpromising "what the science can do." Overpromising can distort participants' expectations for the project and its outcomes.

Clarify participant roles and responsibilities so everyone has common expectations. Some projects co-develop the group's norms and expectations at the beginning of the project. Others use a "living document" that enables a group to outline and revise "roles, responsibilities, group expectations, ways to handle conflict, and decision-processes" as issues arise during the process. One interviewee shared that clarifying roles and responsibilities helps ensure participant "buy-in because [participants] are committed and are going to hold each other accountable to those expectations."

Be transparent about how project decisions will be made. It is helpful for participants to understand what aspects of a project can and cannot be shaped by their input. Some projects establish formal decision criteria: "we wrote down...the criteria that we're going to use whenever somebody has a suggestion for [project] methods." Make sure that participants are included in decisions about terms of engagement and direction of the project. One interviewee commented that it is not "true collaborative science" if "somebody in a technical role or a principal investigator role is making all the decisions."

Manage power dynamics proactively to mitigate conflict and promote more inclusive engagement. Set ground rules for group discussions. Consider group norms that help foster a collaborative mindset, including humility, open-mindedness, respect, and power-sharing. Facilitate discussions equitably and dissuade dominating behaviors. Consider using tools like spreadsheets to formally record ideas and ensure that all input is being considered equally.

Develop science communication norms to make the discussions accessible to all participants. Build a shared lexicon by clarifying unfamiliar terminology, or terminology that is used differently across disciplines. Make sure that technical communications are "respectful to

the audience.” One interviewee shared a strategy used by their project: “when we’re working with pretty technical people, we make them practice their presentations before they go in front of [others]. We put boundaries on the way they can respond.”

4. Manage the process to foster engagement that is meaningful

Thoughtful and tactful management of the collaborative process is critical to providing opportunities for participants to engage meaningfully. Interviewee reflections encompassed an abundance of insight into the practical matters of meaningful engagement; for example, the practicalities of when and how to incorporate engagement opportunities into the process. A synthesis of interviewees’ recommendations for managing the collaborative process is presented below. Process management recommendations are clustered into three groups: organizing project logistics; determining the scale, timing, and frequency of engagement; and facilitating knowledge exchanges that are mutually beneficial and compelling.

Organize project logistics.

Do not underestimate the value of collaborative expertise. Interviewees emphasized that it is helpful for project leadership to be experienced in collaboration, facilitation, and project management. Engagement is more likely to be meaningful when it is organized by “someone who’s done it before,” commented one interviewee. When appropriate, consider seeking out additional resources or assistance from practitioners who are experienced in collaboration and facilitation. One interviewee remarked, “the biggest mistake that people make is they don’t avail themselves of expertise” in collaborative methods.

Account for extra time and resources to manage the collaborative process. Collaborative projects typically have more “moving pieces” than traditional research projects. One interviewee framed it bluntly, “for collaborative projects, there’s a lot of organization... and when it’s not done well, it’s a waste of everybody’s time.” Effective coordination of project logistics can facilitate team cohesion and help make sure that participants are “on the same page.” Take time to ensure that “project parts are moving in sync” especially when working on projects that have “multiple disciplines coming together that don’t normally talk to each other.”

Determine the scale, timing, and frequency of engagement.

Engage participants during early project stages to facilitate meaningful engagement during later project stages. Early engagement can help ensure the project’s relevance for participants, develop a shared understanding of the project and process, strengthen relationships, and foster a sense of ownership or connection to the project. Allow for ample time to codevelop the project proposal with participants before the project begins. “Engagement starts with the project idea,” said one interviewee.

Strive for consistency and reliability when setting the scale and frequency of engagement. Consistent and reliable opportunities for engagement can help foster trusting relationships that are based on commitment and accountability. This in turn can help participants feel like a valuable member of a team. One interviewee recommended the project team: “be consistent about doing actions that show that [its] intentions are true and genuine.” Repeated and iterative check-ins also allow for ample opportunities for participants to shape the project and its

outcomes. “When you work with end users it’s not a one and done approach,” commented one interviewee.

Scale engagement to participant preferences to avoid overburdening participants. The level of engagement desired during the collaborative process is likely to vary from project to project or even over the course of a single project. Be mindful not to overbuild the collaborative process. More engagement doesn't necessarily equate to more *meaningful* engagement. Engage with participants only when it will be mutually beneficial to participants and the project team (e.g., when it fosters reciprocal relationships, or involves useful exchange of knowledge). One interviewee commented “in depth engagement for every step of the science is resource intensive on everybody. And it's just not fair to ask people to keep showing up to meetings... if we don't have something meaningful for them to do.”

Demonstrate respect for participants’ time. Regardless of engagement timing, frequency, or scale, being mindful of participants’ time helps participants feel respected and appreciated. Participants often have busy schedules and commitments outside of the project. It is important to keep in mind that “every time [participants] sit in a meeting with [the project team], it's taking away from the work that they need to do on a daily basis.” Some project teams tap into synergies to make engagement more time efficient. For example, some teams take advantage of standing meetings, participant events, and other opportunities that reduce the time burden of engagement. One interviewee explained: “try to engage or meet with [partners] during already scheduled meeting times or if there's something that they regularly go to...just to show that you're respectful of their time.”

Facilitate compelling and mutually beneficial knowledge exchanges

Think “beyond the meeting” by offering varied modes of engagement. Providing a variety of opportunities for engagement can help ensure that engagement is inclusive, comfortable, and mutually beneficial for all participants. For example, some participants may be more comfortable collaborating in smaller group settings. One interviewee commented that breaking out into small discussion groups can help people feel “more comfortable giving their input and opinions.” The interviewee commented, “I leave those sessions with everybody ...always seeming happy at the end. They're always like, ‘oh, that was fun.’ Everybody gets to say what they want to say.” Another interviewee commented that for some participants, “the only [way] you're going to get [any input] from them is if they talk to you one-on-one after the meeting.”

Many participants find engagement particularly meaningful when they are learning something new. One interviewee recommended planning engagement opportunities that “let people have access to a place or a technique or a lab that they wouldn't really have access” to otherwise. Field trips can also be especially conducive to participant learning. “The best thing you can do is to throw an event in a place that people are going to find interesting and enjoyable,” shared another interviewee.

Follow up on participants’ contributions to demonstrate accountability and keep the project true to participant priorities. “When you ask people's input, do what they say to do... Give them what they want!” said one interviewee, emphasizing the importance of project teams pursuing participants’ desires for the project.

Be responsive to all input. Reiterate the value of participant ideas, even if they cannot be incorporated into the project due to the project scope or timeline. One interviewee shared the following strategy for participant input that is beyond the scope of the project. They keep track of “stuff that we can't do within this project, but people have said is really important. [We] hold onto this document and see how we can turn it into something in the future.”

Finally, express gratitude for participants' ideas to affirm that participants are “a critical part of the team.” When crediting project members, do not overlook intended users: “oftentimes you acknowledge your science team who have helped develop the science, but giving that same sort of acknowledgement to [intended] users who have provided use knowledge and their everyday knowledge...is an important aspect.”

Honor participants' choices not to divulge certain types of knowledge or information.

Respecting participants' refusal to share certain types of knowledge can deepen trust and consent within collaborative relationships. Understand that “just because you ask a question doesn't mean someone has to answer it.” Decide together how knowledge and data outcomes will be shared and obtain consent from all involved prior to dissemination of project findings. Make appropriate arrangements for data sovereignty and keep participants informed of potential dissemination of project findings that might occur after the project's conclusion (e.g. will findings be published in a peer reviewed journal; will they be presented at conferences?) Some project teams incorporate confidentiality into the collaborative process when it is important to do so for one or more of the participants, for example by preserving participant anonymity in project notes and limiting meeting recordings. Because of these practices, participants are better “able to put their guards down.”

5. Tend to relationships to build capacity for meaningful engagement

Interviewees overwhelmingly emphasized that meaningful engagement, and collaborative science more broadly, is facilitated by relationships. One interviewee was unequivocal about the importance of relationships for collaborative science: “sacrifice the research for the relationship if you have to.”

Strong working relationships build capacity for engagement. One interviewee explained that at her reserve, they “don't really ever have to chase anybody to show up” because there are “existing connective structures” that have emerged out of established relationships.

Investing in meaningful relationships can also lead to more meaningful engagement and continued collaboration. Relationships that foster meaningful engagement often have certain qualities, including trust, consent, reciprocity, humility, gratitude, and accountability. Building and maintaining a relationship based on these qualities is an ongoing process that requires time and commitment.

To advance meaningful engagement by attending to relationships, the project team should:

Dedicate adequate time to building trusting relationships. Design the collaborative process with the understanding that relationship building “takes a long time and [is] absolutely essential.” Interviewees shared that project teams sometimes underestimate the amount of time and resources it takes to build new relationships and strengthen existing ones. “Relationships and

reputation [are] not something somebody can just come in and establish right at the start of a project,” emphasized one interviewee. Another interviewee joked, “you can't just start with, ‘alright, I need this information from you’” at the beginning of a project.

Remember that tending to and maintaining relationships is an ongoing and continuous process. Time for relationship building should be accounted for over the entirety of a project, not just at the beginning. One interviewee reflected: “relationship building is emphasized at the beginning [of a project] but making sure that you sustain it is really the key.” Ultimately, collaborative projects “are on the timeline of the people you're trying to engage with.”

Foster connection by creating opportunities for unstructured or informal interactions.

Unstructured time offers opportunities for participants to connect with each other informally or on a personal level. One interviewee commented that informal interactions are helpful because they are a time when “you’re not asking anything from anyone, you're just there to give and to be immersed and be fully present.”

Many interviewees stressed that in-person engagement often allows for more spontaneous relationship building. Face to face interactions have a certain “chemistry” that cannot be reproduced virtually “despite best efforts and all the technology we've thrown at it.”

Sharing food and drink can also help create low stakes settings for participants to get to know each other. Sharing food together is “where the trust happens, especially when [a group has] a lot of different perspectives,” commented one interviewee. Another interviewee shared playfully, “what does meaningful engagement look like? It looks like don't skimp on the coffee... ...don't underestimate the value of the coffee break.”

Sustain engagement with partnering organizations and communities outside of the project timeframe if appropriate. Remember that relationships don't follow grant funding timelines. Instead of investing in relationships “on a project-by-project basis,” strive for continuity by tending to relationships over the long term. One interviewee commented, “I've been here [at the reserve] close to fifteen years and we are still in the process of building relationships and exploring ways that our relationships can take different shapes and forms.” Project teams and participants that maintain long-lasting partnerships often better understand each other's priorities and realities beyond the scope of the project (“where we've been and where we're going” or “the landscape view,” as some interviewees described it.) As a result, long-term partnerships help build capacity for meaningful engagement and are often generative of future collaborative efforts.

C. Implications for the NERRS Science Collaborative

This study's findings also offer several implications for program management by the Science Collaborative. Interviewees made clear that funding programs like the Science Collaborative can play an important role in fostering meaningful engagement through the creative and adaptive administration of their funding program and requirements.

While this study was not intended to evaluate the extent to which the Science Collaborative Program has contributed to meaningful engagement in funded projects, study findings nevertheless pointed to areas where the Science Collaborative is currently excelling as well as

potential opportunities for the program to leverage program resources to further advance meaningful engagement. In a survey of 33 individuals currently participating in projects funded by the Science Collaborative, very few respondents had encountered challenges that constrained their ability to feel meaningfully engaged. Interviewees similarly spoke highly of the Science Collaborative's program management. One interviewee remarked,

“The NERRS Science Collaborative is the only [funding program] I've seen in this country at this level that upfront demands that end user needs be evaluated, addressed, and that you have a dedicated funded person on the project who's going to ensure that happens. I feel like NERRS Science Collaborative is already way ahead of the game.”

Implications of this study's findings for the Science Collaborative are threefold: there is a need to enhance familiarity with collaborative science; provide adaptive project management support in key areas; and evaluate the influence of funding practices on meaningful engagement. Each of these implications is described below.

1. Enhance familiarity with collaborative science

Both interviewees and survey respondents indicated that unfamiliarity with collaborative science influences how project teams and project participants engage with each other. A lack of familiarity with collaborative science may be caused, or compounded by, an institutional bias toward more conventional approaches to research. Institutional emphasis on more conventional scientific methods can make it difficult for science practitioners to access formal training related to engagement during collaborative research. Some interviewees noted that they've had to personally advocate for a greater emphasis on collaborative methods and relationship building within their institutions and programs.

The Science Collaborative can help address this issue by offering resources, guidance, and training opportunities to increase familiarity with the mindset and methods of collaborative science. The Science Collaborative already offers several opportunities for project teams and other practitioners to learn about collaborative science. For example, the Science Collaborative offers monthly webinars about collaborative science, an online guide to collaborative science, and workshops that support funded projects. While not explicitly interrogated through this research, the accessibility of these resources likely contributes to meaningful engagement occurring within projects currently funded by the Science Collaborative. The Science Collaborative should continue to offer and expand upon opportunities to ensure that project teams continue to build the knowledge and skills needed to engage meaningfully with participants. In pursuing development of additional resources, the program might focus on several key areas that were frequently discussed by interviewees, including, but not limited to:

- What are key differences between collaborative research and more conventional research approaches?
- What are the characteristics of a collaborative mindset and how can they be embodied?
- Why does relationship-building matter for meaningful engagement, and collaborative science more broadly?

- What practices can project teams use to:
 - address differences in worldviews?
 - manage power dynamics and imbalances?
 - ensure data sovereignty?
 - communicate science accessibly to promote a shared understanding?
 - plan accessible events?

Tailor resources about collaborative science to all project participants and prospective participants. Most of the Science Collaborative’s resources and training opportunities are intended primarily for those leading collaborative projects teams. However, interviewees noted that meaningful engagement is more easily achieved when all involved in collaborative projects know what to expect during the process. Further, interviewees noted participant engagement may be influenced by perceptions of research that have been shaped by previous experiences with research and researchers. Project participants and prospective participants are likely to benefit from more opportunities to learn about collaborative science and how it differs from more conventional approaches to science. The Science Collaborative may consider developing more tailored resources for project participants, including project partners and intended users.

Facilitate information-sharing through the National Estuarine Research Reserve network.

The National Estuarine Research Reserves and their staff play a central role in many collaborative science projects funded by the program. The 2018 *NERRS Science Collaborative Interim Evaluation Report* suggests that most reserve staff already demonstrate familiarity with collaborative approaches to science. The report indicates that “collaboration and end user engaged research are not new to most in the reserve system and are, in fact, appreciated by most as central to reserve programs and the mission of the system” (NOAA NERRS Science Collaborative, 2018). This sentiment was echoed by some reserve staff interviewed during this research on meaningful engagement. For example, one interviewee shared that the reserve seldom partners with research teams unless they use a collaborative approach.

Given their familiarity and appreciation for collaborative research methods, reserve staff are well-positioned to share information about collaborative science with a variety of audiences. The Science Collaborative should consider how they can best support reserve staff capacity to carry out such a task. For example, the program might consider resources that help reserve staff communicate about collaborative science and meaningful engagement with established or potential partners.

2. Maintain and enhance adaptive project management support in key areas

Emphasize the importance of project teams tailoring engagement practices to context. What meaningful engagement looks like, and how it may best be achieved, will vary by project. The Science Collaborative should encourage project teams to “do their homework” to learn about what engagement practices will work best for their participants. Avoid standardization of project requirements related to meaningful engagement.

Support project teams and their participants in setting appropriate project timelines.

Meaningful engagement requires meaningful relationships, and meaningful relationships require time to build. Many interviewees indicated that researchers who are newer to collaborative science are often unfamiliar with how time intensive relationship building can be. One interviewee alluded to tension that can arise when there are varying levels of collaborative expertise among project leaders: “sometimes PIs can get frustrated with the time we [collaborative leads] insist be spent on [relationship building.]” Encourage teams to develop timelines that allow for adequate time for building trust and fostering connections before, during, and after the project. “Slowing down and not putting pressure on things” can be beneficial for meaningful engagement.

Continue to offer adaptable support for project teams experiencing unexpected shifts in project priorities. Collaborative research projects are dynamic. Projects sometimes encounter new research questions that the team and participants deem to be “equally as important, or more important than the original research questions,” but which take the project “down a different rabbit hole.” One interviewee expressed appreciation for the Science’s Collaborative’s adaptability: “fortunately, the NERRS Science Collaborative is adaptable enough to allow us to... chase for those rabbits,” the interviewee commented. The Science Collaborative should continue maintaining adaptable support for projects experiencing unexpected shifts in project priorities. The program may also consider offering project teams clear guidelines for adapting a project’s topic to ensure that the project remains as useful as possible to participants while maintaining project feasibility.

Guide project teams through accounting for qualitative impacts of meaningful engagement.

One interviewee explained that it can be difficult to justify devoting resources to activities that promote meaningful engagement, such as relationship building, because “it’s too hard to quantify the results of relationship building on a daily basis.” Help project teams establish the value of meaningful engagement for their project by assisting them in accounting for the qualitative impacts of their work, both during and after the project.

3. Evaluate how funding practices influence project teams’ capacity for meaningful engagement

Communicate about regular funding opportunities with adequate lead time. Unless partnerships have been previously established, it can be difficult to create meaningful connections in the window of time between a notice of funding and the funding application deadline. One interviewee commented “one of the problems with grant funding as a way of making projects happen is that it is by necessity on short timelines. To do things well, you have to anticipate what’s coming ahead of time or just have been in it because you care.” Help teams “anticipate what’s coming” by maintaining a regular schedule of funding opportunities. Announce funding opportunities and their requirements well in advance of funding application deadlines.

Communicate transparently about how projects are selected for funding to help manage applicant expectations. The unreliability and intermittence of grant funding can present challenges for establishing long-term relationships with new partners. One interviewee spoke to the tension between wanting to engage people early on during a

project and being unable to guarantee the funding needed to pursue the project. She shared that while it's important to engage “partners when the idea [for the project] is being generated, you burn bridges this way too, because if people are interested and think that there's funding available and you don't get the funding it can be tricky.” Manage expectations of applicants by communicating transparently about the funding process.

Ensure projects have adequate funding to support key activities of meaningful engagement, including relationship building. Teams often benefit from access to funding to support engagement and relationship-building activities e.g., field trips, travel, volunteer workdays, food and drink expenses etc.

Assess the impact of funding timelines on meaningful engagement. The time that it takes for meaningful relationships to develop does not always align with funding timelines. Some projects may need longer funding timelines to allow for the emergence of relationships that support meaningful engagement. Further, compared to more conventional approaches, collaborative research may involve more unpredictability, making rigid timelines especially challenging to the advancement of meaningful engagement. One interviewee shared that funding programs that are interested in advancing meaningful engagement must “throw the timeline out the door with these grants” and “acknowledge that the timeline means nothing.” The interviewee shared that, on this front, the program is “still learning” how to accommodate project timelines that foster meaningful engagement. The Science Collaborative may consider undertaking an assessment of how current timeline requirements are impacting the collaborative process undertaken by funded projects.

Consider offering funding opportunities that support sustained engagement beyond project timeframes. Several interviewees identified grants-based funding mechanisms as particularly challenging to fostering continuous partnerships that enable meaningful engagement. Grant-based funding mechanisms often reinforce project-based research styles that are at odds with continuous partnerships. The Science Collaborative may consider offering additional funding opportunities that are intended to support project teams' capacity for maintaining sustained partnerships.

Final remarks

There is no single prescription for the advancement of meaningful engagement in collaborative science. The specifics of what meaningful engagement looks like and how to achieve it varies by project to project. However, the findings of this study revealed remarkably consistent themes for what often makes engagement meaningful. These findings help us piece together a common understanding of meaningful engagement. The need for a common understanding is increasingly urgent as the value of meaningful engagement becomes recognized more widely by scientific institutions and funders.

This study proposes that engagement is more likely to be meaningful when people feel respected and heard; their knowledge and interests are understood; they have agency in, and clarity about, the process, its objectives, and their role in it; they feel a sense of purpose; and they are able to

foster genuine connection with others. While this understanding of meaningful engagement is unlikely to be universal, it may serve as a useful starting point for practitioners of collaborative science.

Above all else, this study underscores the importance of researchers and practitioners becoming familiar with their partners in order to understand what makes engagement meaningful within their unique contexts. We expect this familiarity to support the flourishing of collaborative relationships from which more useful science may emerge.

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