James Arnott

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Date: January 23rd, 2019
Time: 3.00 (EST)

National Estuarine Research Reserve System Science Collaborative

What usable science means and how it can be achieved: Lessons from NERRS through the years

Summary Points:

James Arnott is a Ph.D. candidate at the University of Michigan and Associate Director of the Aspen Global Change Institute. James's PhD advisors include one of the Co-Investigators of the Science Collaborative – Maria Carmen Lemos. His research has been informing the way we manage the Science Collaborative program, especially the way we work with project teams and try to track impacts.

James has worked closely with the Reserve System during the completion of his doctoral thesis on topics related to science funding, the use of science, and climate change adaptation. In 2011, James was awarded the McCloy Fellowship in Environmental Policy and in 2009 he received a B.A. in Political Science and Economics from Principia College.

One more question…

Introductory poll questions:

- Poll 1: How familiar are you with the NERRS?
- Poll 2: Are you familiar with the NERRS Science Collaborative program?
- Poll 3: What is your current sector affiliation?

Poll Question 4: Which of these rolls have you played in the past? Choose all that apply.

- I've led a collaborative research project (40.54%)
- I've been a team member of a collaborative research project (75.68%)
- I've provided non-financial support (54.05%)
- I've helped review, select, or fund collaborative research (45.95%)
- Other/Not-applicable (13.51%)

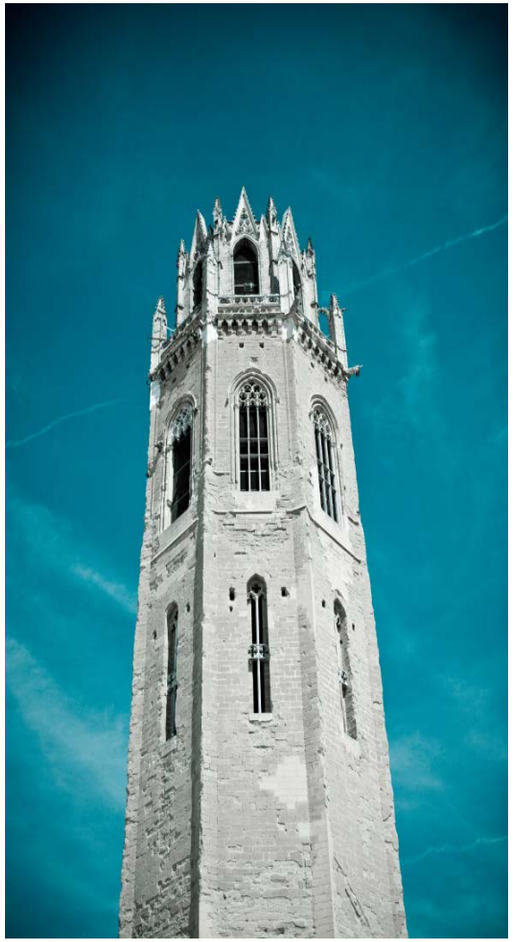
Summary Points:

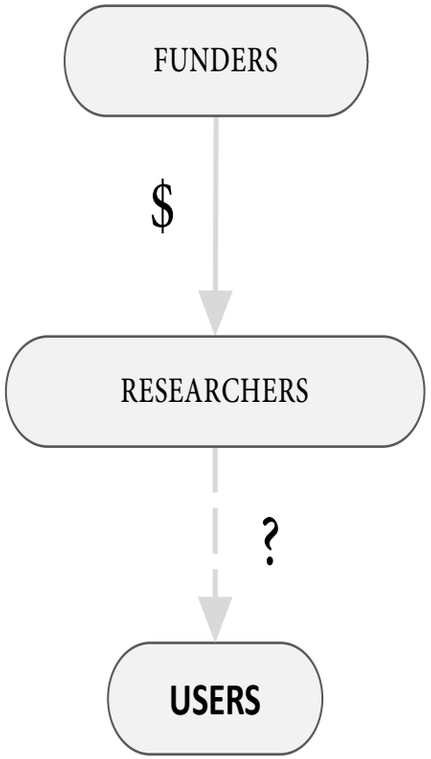
1. Share updates and new results from ongoing research about usable science that is focused on the NERRS.
2. Highlight some of the practical ideas from this work and what will hopefully be useful to take into new or ongoing projects.
3. Invite attendees to think of themselves as collaborators in an effort to puzzle over one of the most important issues of our time: how can science better support the solving of society's most urgent problems, particularly those related to sustainability?

We are all participating in a grand experiment that is testing how science can achieve more benefit for society than it already does.

Why these results provide value: To help us justify the extra effort that strategies such as collaboration incur; to better recruit the time and effort of stakeholders to participate alongside us in research; and to communicate the value of our research to the broader public.

Why are we asking this question?





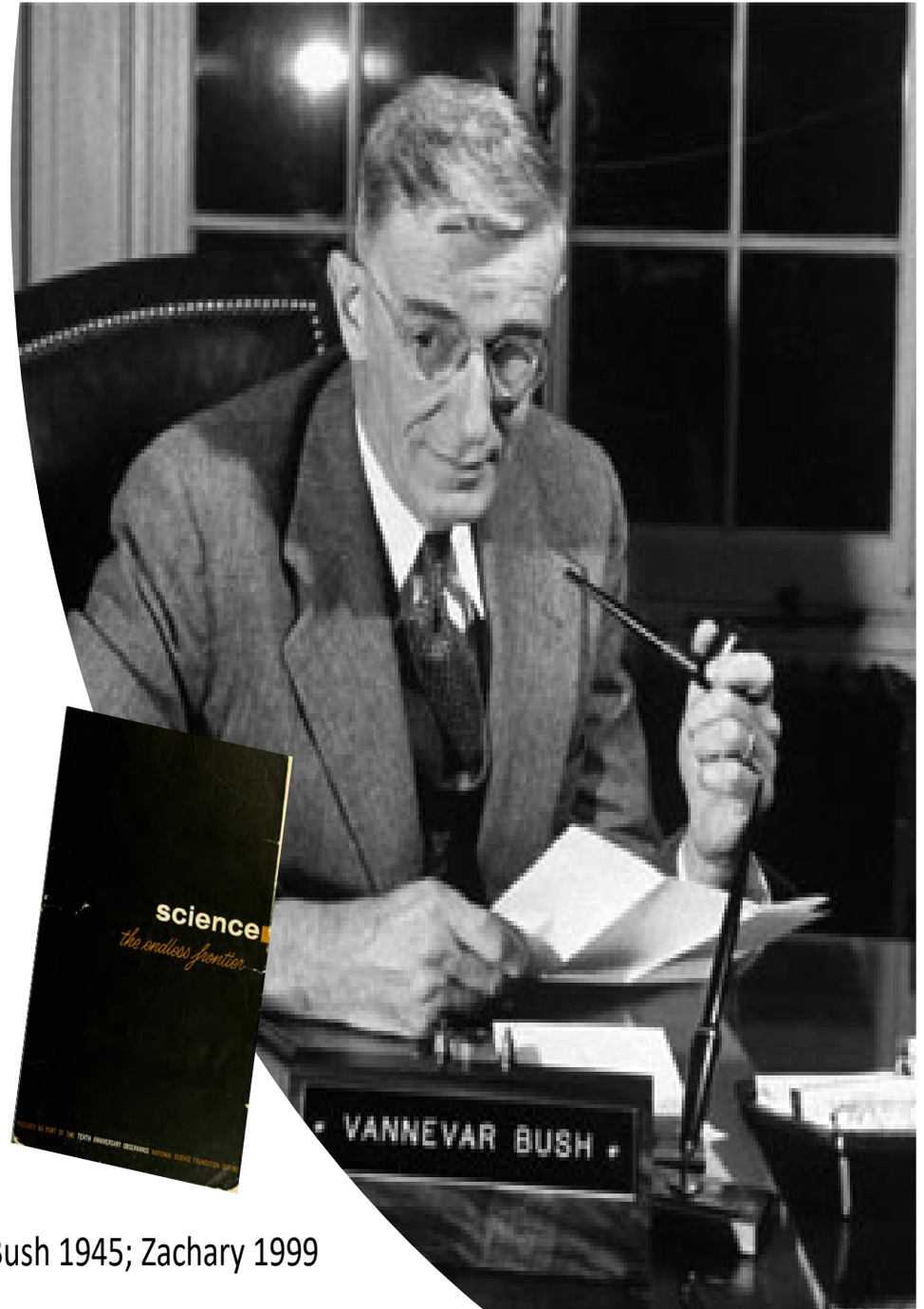
Summary Points:

For much of the history of publicly-supported science, a different paradigm held sway. This paradigm was a product of two related ideas about science:

- **Ivory tower metaphor**: Under more traditional scientific research models, there is a preconception that science exists in a silo, separated from society; i.e., scientific advancement occurs more rapidly when scientists are granted the utmost independence in advancing their research.
- **Loading dock metaphor**: A metaphoric model of knowledge transfer describing a one-way directional flow of usable knowledge from researchers (production) to end-users (application). This is a linear “fund and forget” model in which funders give money to researchers and impact on use is left as an unanswered question.

How did we get here?

"The responsibility for the creation of new scientific knowledge rests on that small body of men and women who understand the fundamental laws of nature and are skilled in the techniques of scientific research."



See Bush 1945; Zachary 1999

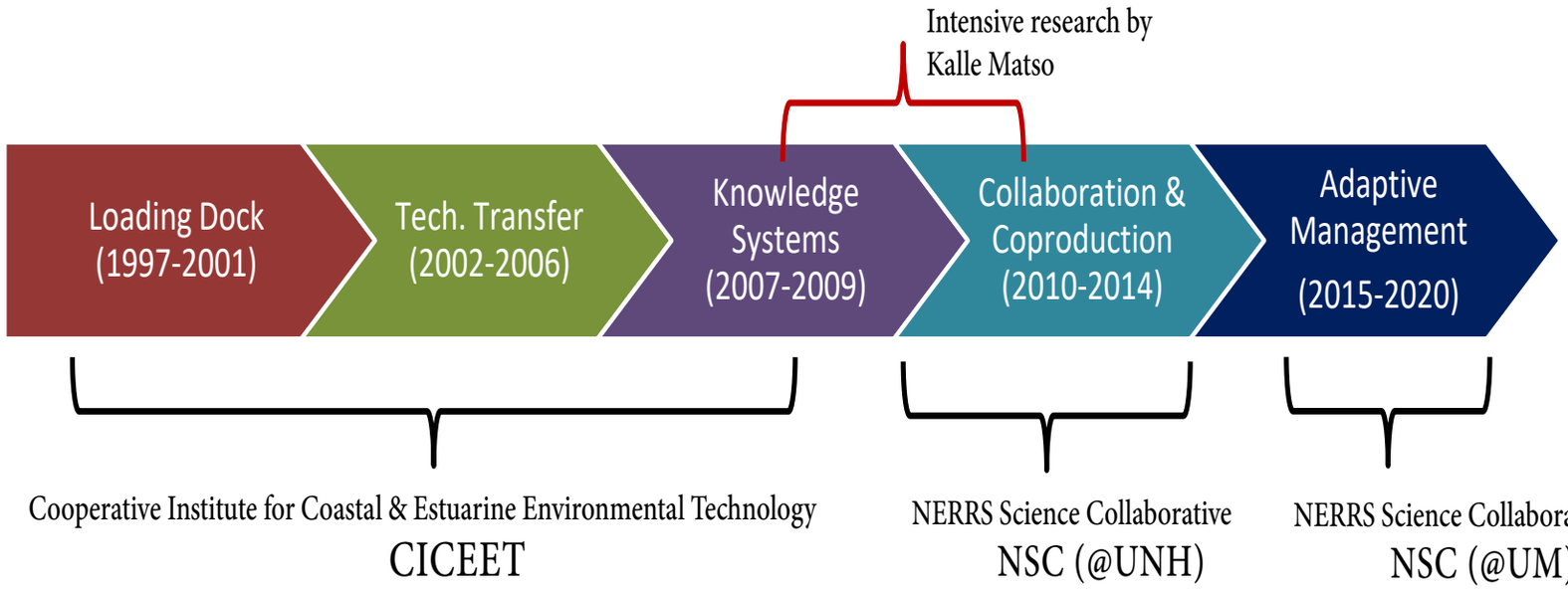
Summary Points:

The traditional research funding model we just discussed did not come from nowhere: Just after World War II, the U.S. wanted to develop a scientific enterprise that could be publicly-funded, but protected from politics and other influences that could limit the ability of science to serve society.

Summary Points:

There is a longstanding expectation – deeply embedded in both scientific and political cultures – that science can achieve more for society by relative independence from it. And despite growing calls for more collaborative science and more science to support end user needs, we don't actually have as much empirical evidence as we would like to guide changes in science. But how can we systematically learn from our experience? Can we have a more inclusive, collaborative, and non-isolated system, while at the same time increasing our ability to solve sustainability and other societal problems?

What can we learn from NERRS?



Natural experiment: What strategies best support the creation of usable science?

Summary Points:

The history of competitive funding within NERRS starts in the late nineties with an approach that reminds us of the loading dock model, where program managers expected that if they funded the best researchers, they would produce cutting edge science that would be utilized by coastal and estuarine resource managers.

Not long after that, under the now-closed Cooperative Institute for Coastal & Estuarine Environmental Technology (CICEET) program, program managers began to think about different ways to connect the research teams that they were funding to the context for use; this included requirements such as naming an end user on the proposal, obtaining letters of support, and other ways to make research teams think about how their knowledge would transfer into a context for application.

By 2007, program managers intensified their aspiration for demonstrably usable products from projects and started to think about how the context in which information and tools would be used might be brought more into conversations with research teams through advisory committees and other requirements for slightly more intensive engagement.

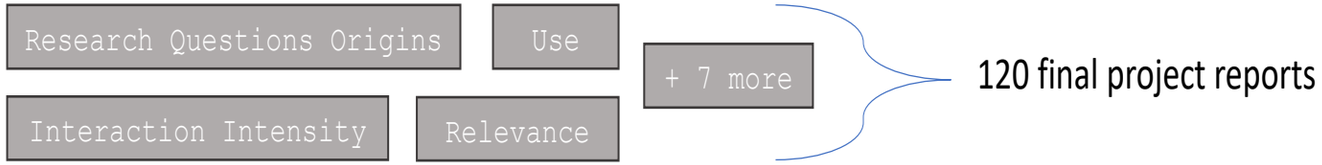
2010 marked the start of the collaboration and co-production phase, in which these inquiries were further refined. The NERRS Science Collaborative at the University of New Hampshire began requiring a collaboration lead and a detailed collaboration plan, developed by the research team and end users, to increase the likelihood that knowledge would be taken up and put into practice.

A natural experiment in funding knowledge for use

1. Random sampling

n = 120

2. Content analysis



3. In-depth telephone Interviews
(project team + end-user)

n = 41

Summary Points:

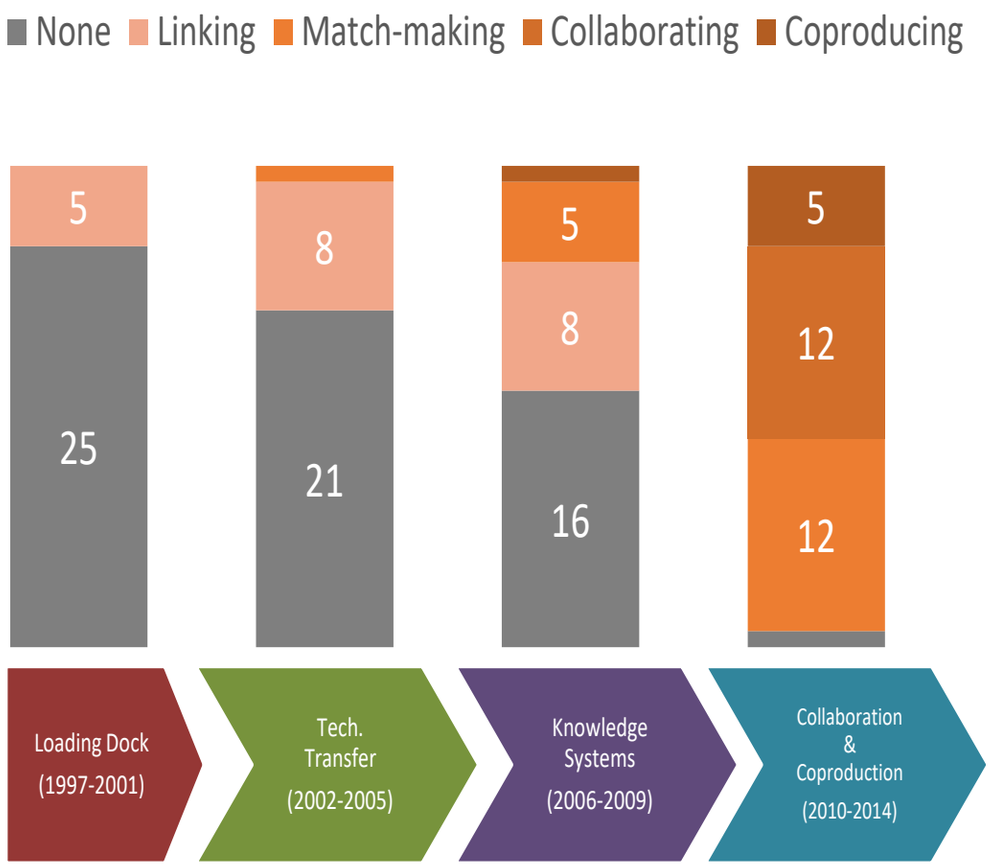
A unique aspect of the collaborative research model is that it provides the framework for a natural experiment where we can investigate which strategies, used by funders or by researchers, best support the creation of usable science.

The nature of the collaborative research environment provides the basis for this research. Random samples of 30 projects from the four generations yielded a total sample size of 120 reports. Systematically analyzing the 120 reports enabled follow-up interviews with 41 project participants, and enabled identification of a number of variables that appear to influence how easily research is used by end users.

This presentation does not examine all of the data in-depth, but it will highlight some key points to illustrate the kinds of changes that can be documented and what they suggest about the role of interaction in shaping the utilization of knowledge.

Research practice

INTERACTION INTENSITY



Arnott, Neuenfeldt, & Lemos, *under review*

Summary Points:

Interaction intensity was one of the variables of most interest. Each column represents one generation in the formative history of collaborative research in the NERRS. The columns partition the 30 projects for each generation among five categories of interaction between the research teams and end users. The five categories essentially represent a five-point scale where “none” corresponds to the lowest interaction intensity and “co-producing” corresponds to the highest interaction intensity; i.e., co-producing represents an interaction in which researchers and end users are co-leading and collaborating throughout the whole project.

What’s striking: By the third generation, when there was an aspiration for closer ties between science and practice, more than half of the project teams were still not demonstrating interaction. By the fourth generation, nearly all the project teams were showing some form of interaction, with most gravitating toward the higher levels of intensity.

Funding influence on research practice

"Because the early days of CICEET, you didn't have to [collaborate]. You could fake it. **You could fake it, and you could get support**. But as time went on, they became more and more attuned to importance of those aspects and **I think [program management] became more and more cognizant of how the RFP structure itself could improve those outcomes."**

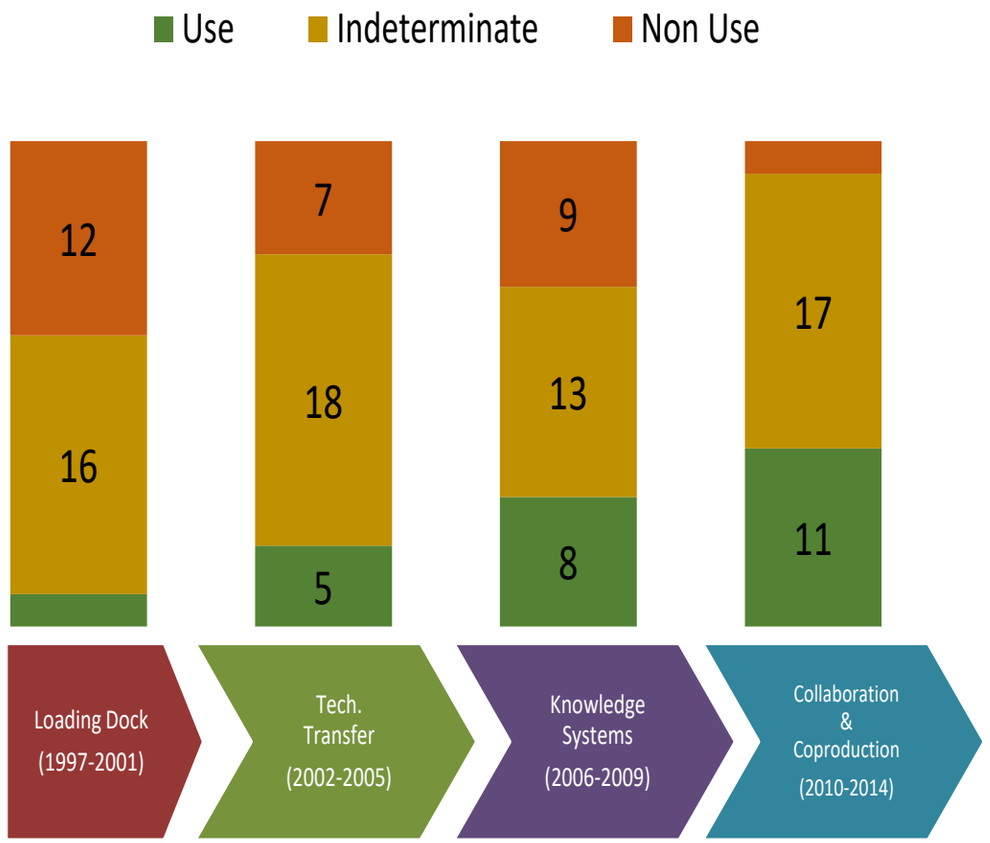
"We really got our, I think, inoculated with [collaboration] in phase one and it was just such a successful model that we've continued."

Summary Points:

Funding has a strong influence on research practice. Some of it, as past participants stated candidly, was driven by craven opportunism to win funding (see first quote on slide).

There is evidence of an evolution in attitude towards collaboration from the people responding to the requests for proposals opportunistically, for whom the experience of conducting collaborative research had a positive impact on their future careers. This was supported by other interview participants who stated that, even when it was not required of them by funders, they continued a collaborative practice just because they found it more enriching and, from their standpoint, more successful.

Knowledge use



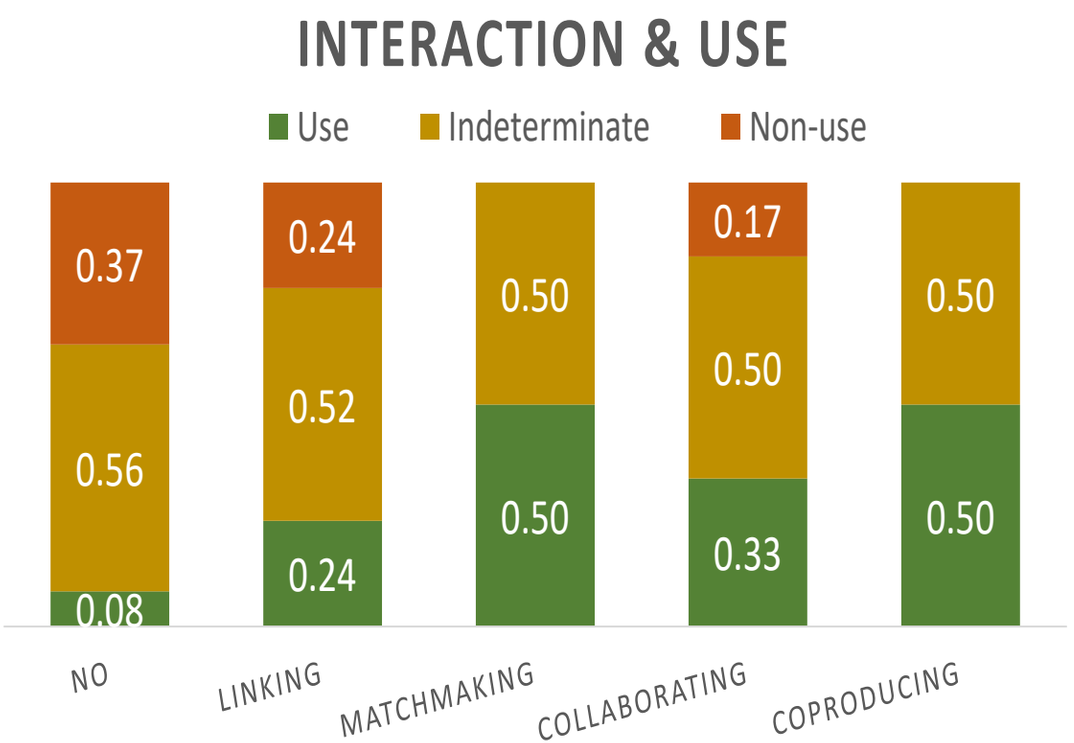
Arnott, Neuenfeldt, & Lemos, *under review*

Summary Points:

The green partitions show increasing evidence of direct utilization of knowledge from the projects across the four generations, as represented in the project reports. The orange parts of the bars show an overall trend of decreasing evidence that use did not occur.

What has been striking is the continuity of the middle range (i.e. indeterminate evidence of use), which represents instances where there was insufficient evidence within the project reports to identify whether or not use occurred. This indeterminacy of use will be explored more during the second half of the presentation.

Knowledge use



- Interaction increases the likelihood of use but is not its guarantor.

Summary Points:

Interaction increases the likelihood of use, but is not its guarantor; at least not in terms of the evidence that James and his team were able to examine. Particularly, at higher levels of use, it may not be the case that more interaction is always better.

A few key points of understanding emerge from this work:

- Funders can stimulate meaningful changes in research practice;
- Interaction increases the likelihood of use; and
- There is an opportunity for a model with more multi-directional interaction among sponsors, researchers, and end-users; i.e., no more “fund and forget.”

A. Traditional Funding Model

B. Impact-oriented Funding Model

Arnott, Neuenfeldt, & Lemos *under review*

Summary Points:

Toward the end of the project, an insight prompted the emergence of a different model for supporting science.

The model on the right, termed the "impact-oriented funding model" by the research team, shows more interaction between researchers and end users, but also between sponsors and end users and sponsors and researchers. For example, the current Science Collaborative has been making efforts to contact end users and hear their perspectives on how the context for using science is changing over the course of their involvement with projects.

These new practices reflect a change that is happening not just within NERRS but within the broader science funding landscape; not in every instance, but particularly in areas where there is a sentiment that we want to organize science to be more useful and impactful for society.

Questions:

Can you explain the knowledge systems approach more?

The phrase 'knowledge systems' was labeled as such because we've heard anecdotally that one of the instigating factors for the change between what we call the tech transfer and the knowledge systems period was a person that was working for CICEET at the time reading an article about knowledge systems. The article was focusing on how end users' perception of the credibility, the legitimacy, and the relevancy of knowledge are important contributors to whether or not they will utilize it. An "a-ha" moment for program managers at the time, this realization led them to think more intensively not just about the context in which research is happening, or what researchers are doing, but also the context in which research is being used, and how to bring that context more in conversation with the research teams.

Summary Points:

The second half of presentation is more exploratory, and is based on further analysis of the interviews. A guiding question: can we critically examine practices of collaborative research to guide ourselves and support a community of learning on impact-oriented research?

Additional polling questions

On a scale from 1-5, with 5 being highly confident and 1 being not at all confident: **how confident are you in IDENTIFYING THE USERS of the research projects that you support or participate in?**

On the same scale from 1-5: **how confident are you in identifying what KIND OF USE (may) occur(s) in research project that you support or participate in?**

On a scale 1-5: **how confident are you in your ability to TRACK THE USE of the research that you support or participate in?**

On a scale 1-5: **how confident are you in identifying the SOCIETAL BENEFITS of the research that you support or participate in?**

Summary Points:

How confident are you in IDENTIFYING THE USERS of the research projects that you support or participate in?

- 5: 22.86%
- 4: 51.43%
- 3: 22.86%
- 2: 2.86%
- 1: 0.00%

How confident are you in identifying what KIND OF USE (may) occur(s) in research projects that you support or participate in?

- 5: 14.29%
- 4: 17.14%
- 3: 57.14%
- 2: 8.57%
- 1: 2.86%

How confident are you in your ability to TRACK THE USE of the research that you support or participate in?

- 5: 5.71%
- 4: 8.57%
- 3: 34.29%
- 2: 34.29%
- 1: 17.14%

How confident are you in identifying the SOCIETAL BENEFITS of the research that you support or participate in?

- 5: 13.89%
- 4: 25.00%
- 3: 38.89%
- 2: 19.44%
- 1: 2.78%

5 simple questions, many possible answers

Who are the users?	The public	Decision-makers	Practitioners	Flood plain managers	Storm water regulators in NW Ohio
What is use?	Taking possession*	Comprehending	Referencing	Acting/ deciding	Implementing
How is use tracked?	With support from a future grant!	Second hand accounts	First hand accounts	Survey	Longitudinal tracking
What causes use?	Good science	Collaboration	Right people	Windows of opportunity	Incrementalism
What benefits result?	The change you want to see in the world….				

Landry, Lamari, and Amara 2003; *Knott & Wildavsky 2003

Summary Points:

Interviewees spoke to the kinds of issues raised by the questions in the colored boxes on the slide. The table shows a crude representation of the breadth of possible answers to these questions. Interestingly, the answers to these questions generally changed, sometimes quite dramatically, over the course of the project.

If we want to be more effective participants in research projects, or if we want to demonstrate our effectiveness to people that sponsor us, we need clear thinking about some of the most fundamental things:

- Who are the users? (Is “user” the correct term in the first place?);
- What are the uses? (As a tool? As an idea? As a justification?);
- How is use accounted for? (As an anecdote? By systematic evaluation? By other means? Not at all?);
- To what do we attribute use? (What leads to what?); and
- What are the benefits of use? (What are we really after?).

If we knew the answers to these questions with perfect certainty at the outset of a particular project, there would be no intellectual excitement nor would it justify the allocation of the time or of capable people. On the other hand, if there are no clear goals for each of these five areas, we lose the ability to think systematically about what we are doing, what we are achieving, and why it matters.

Why bother?

Who are the users?

What is use?

How is use tracked?

What causes use?

What benefits result?

- Adding precision and clarity to your own theory of change. What are you trying to achieve, for whom, and how?
- Recognizing when changes in one assumption result in changes to other assumptions.
- Reducing indeterminacy, enabling better communication (and learning) among users, funders, and fellow co-investigators.

James' Thoughts:

I think pondering these questions might be helpful because it might slow us down just enough to more critically, and ultimately more scientifically, examine if we are achieving as much impact as we could through our effort.

Perhaps in switching from a more traditional to a more impact-oriented, collaborative mode of research, we have become/tend to be over confident in the benefits of collaboration and assume the answers to these questions are self-evident? In particular, when seeking to make usable knowledge and tools, fundamental assumptions are often implicit and may be too broadly, or narrowly, defined or unwittingly changed as the project progresses.

In the absence of clarity about these assumptions and how they change during the collaborative research process, it's difficult to know if the benefits were as significant as anticipated, why they accumulated in the way they did, and whether they could have been even greater.

Like policy-making, collaborative research is a complex social process. If we want to leverage it for our benefit, we can do better in understanding how it works.

When collaboration drives results (a few)

Building upon pre-existing collaborations

- "…the work prior to the project helped developed the need or the justification for it. Then the work that occurred during the project was directed towards producing the outcome."

Motivation and readiness of users

- "If the federal government hadn't required the state to deal with storm water then I think…it would have been the rare local governments that were doing a really robust management of storm water."

Demonstrated feasibility of knowledge or technology

- "Let me just say, if this project and the projects we have put in, if they physically had failed, it would've been a whole different ball game."

Participation/collaboration (in a different sense)

- "Before we can get anything through our elected officials or through our governor appointed commissioners, there's a specific requirement for public involvement, for stakeholder engagement. I view that slightly different from collaborative learning."

Expertise in collaboration within team

Opportunities for different levels of intensity of engagement

Summary Points:

Collaboration is not a panacea, and it's not an end in itself. However, it can be used to achieve a result. Some factors that help drive results are listed in the table.

Some things that I’m doing in my own work

- **Constantly remind myself that the knowledge deficit model is wholly inadequate (and inaccurate)**

Summary Points:

Note that there are no silver bullets.

Clarify a ‘logic model’ of the kind of impact sought, whom will it benefit, by what means it will be achieved, when will it occur, what will be examined for verification. There is a need to move past the thinking that interaction with users will solve everything and to think critically about the pathways to use for the specific project and user. There is a plethora of “marginal effects” affecting implementation that must be addressed alongside the idea that a scientific enterprise more engaged with society will lead to greater societal benefit.

The knowledge deficit model

Summary Points:

Some things that I'm doing in my own work

- Constantly remind myself that the knowledge deficit model is wholly inadequate (and inaccurate). It's a trap!
- **Be more explicit about the assumptions I am making. Recognize when changes to those assumptions happen along the way. Updating theory of change. Don't use collaboration as a smokescreen for a theory of change.**

Summary Points:

Recognize when changes happen along the way, and how they will affect the architecture of the logic model. For example:

- When "expected users" changes from a specific, targeted group or individual to a generic class of stakeholders;
- When "expected uses" moves from developing a functional tool to illuminating decision-making about a problem and its consequences (or vice versa); or
- When the "maximal benefits" achieved from a project are discovered to be unrelated to the particular use of a tool or to an idea, but instead achieve some other benefit about which we can take pride but may mean something different than usable science.

Making & updating assumptions

Who are the users?

What is use?

How is use tracked?

What causes use?

What benefits result?

Summary Points:

Some things that I'm doing in my own work

- Constantly remind myself that the knowledge deficit model is wholly inadequate (and inaccurate). It's a trap!
- Be more explicit about the assumptions I am making. Recognize when changes to those assumptions happen along the way. Updating theory of change. Don't use collaboration as a smokescreen for a theory of change.
- **Contributing insights as data points to this grand experiment (NAF, AGU S2A, NERRS AM, etc.)**

Summary Points:

Be aware of the important contribution that collaborator experiences can make to the grand experiment underway; by clarifying assumptions at the start, taking steps to re-assess assumptions, and reporting on how those assumptions changed and the resulting impact, researchers contribute valuable insight to help future collaborators learn more.

Science funding in the U.S.

"The responsibility for the creation of new scientific knowledge rests on that small body of men and women who understand the fundamental laws of nature and are skilled in the techniques of scientific research."

Summary Points:

A new **social contract** for science

"I believe that academic scholars have a responsibility to be proactive in engaging directly with society. I believe that part of our obligation, our social contract if you will, involves a two- way communication with society. Specifically, in exchange for public funding, our jobs are both to create new knowledge and to share it widely with transparency and humility."

Jane Lubchenco, 2017

Summary Points:

Recommended reading!

Funding Science that Links to Decisions: Case Studies Involving Coastal Land Use Planning Projects

Kalle E. Matso · Mimi L. Becker

Matso & Becker 2013
"Funding science that links to decisions…"

Developing Evaluation Indicators to Improve the Process of Coproducing Usable Climate Science

Wall et al. 2017
"Developing evaluation indicators…"

comment

To co-produce or not to co-produce

Lemos et al. 2018
"To coproduce or not to coproduce"

Thank you!

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Questions:

Did you observe or hear about any inadvertent use of research for possibly unintended or even negative ends (i.e. misuse of science)?

In terms of use of research for negative ends, I did not hear about this in interviews or in reading the project reports. That is another reason to be skeptical of the knowledge deficit model; i.e., sometimes knowledge can be misused to achieve ends that are not desirable. I think that, given the kinds of interactions I was having, it's possible that if there were negative impacts, I wasn't hearing about them.

In terms of inadvertent uses, it's an interesting question but I think I'd have to go back and look. I don't recall any serendipitous discoveries off the top of my head. One of the things you sometimes hear is that, when research becomes more applied, you limit the possibility of serendipitous discoveries.

Thank you for joining us

Question and Answer

Questions:

Do you have any guides for organizing your theory of change for a project? a template?
I have a very simple logic model I use as a template any time I'm starting a project. It has things like inputs and outcomes, over short/medium/long term. There are more enhanced templates for theories of change out there.

Attendee Comment: It is important not to confuse logic models with theories of Change. I would point people to GrantCraft (grantcraft.org) for some great short resources on all that.

What was the biggest surprise for you from this work?
The biggest surprise I think, when I started to understand this program more and how it had been managed, was the inadequacy of standard models of research reporting and evaluation for getting at the issue of knowledge use. Nothing I saw over that time was able to give concrete guidance that could easily answer questions in a systematic way; e.g., who are the users, how are they using it, how did they track it, etc.

Thank you for joining us

Question and Answer

Summary Points:

Sets of researchers often have their science interests, and diverse end-users have their interests, which are usually somewhat, if not very, different. Depending on the source/type of funding, negotiations between researchers and end-users go in different directions. Do you have any thoughts on how to best manage these negotiations to find the greatest level of consensus on research goals?

First, what we're starting to see in this impact-oriented model is that having the interaction be solely between the researchers and the end users is something to be wary of, not that this relationship shouldn't be protected. I think there's a lot of benefit to having this triangulated approach where sponsors can get feedback from end users about what topics they would most like to see competitively funded. Sponsors and researchers can have two-way conversations, and sponsors can be involved in this conversation not just by writing checks or collecting final project reports, but by being a supportive anchor in this system. End users can provide input over the course of the project about how their ability to use knowledge is changing over that time.

Another thing to point out: we often talk about end users and researchers as different entities and different institutional roles; but more and more I'm finding people that are bridging the gap between science, or research sponsorship, and practice in their professional lives. In the case of the opportunities I've had as a PhD student, I've been funded by a sponsor to do research, I'm a researcher that's funded by other sponsors to do collaborative science, and I'm also an end user of a tremendous amount of physical science related to climate change impacts that's valuable to my work.