

Enabling Impacts: Building a Broader Impacts Community of Practice at a Land-Grant University

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Abstract

The Broader Impacts (BI) activities required of researchers funded by the National Science Foundation (NSF) often involve public engagement, including K–12 outreach, informal science education, public exhibits and performances, advocacy and policy change, and business and entrepreneurship. The ARIS Broader Impacts Toolkit (Advancing Research Impacts in Society, 2024) is an online resource designed to help researchers develop BI plans for their NSF proposals. Several elements of the Toolkit address critical aspects of public engagement, making it a valuable resource for researchers new to BI or public engagement, especially when it is integrated into wider BI communities of practice. We discuss how the national-level BI Community of Practice (BI-CoP) developed and sustained by the NSF-funded Center for Advancing Research Impacts in Society (ARIS) contributed to the development and continuing evolution of an institutional-level BI-CoP at a large land-grant public university. The personal narratives of institutional-level BI-CoP members reveal how the ARIS BI-CoP has supported their learning, fostered collaboration around BI at their institution, supported the development of an institutional BI-CoP, and increased their capacity to help researchers develop and implement BI plans using the Toolkit. The experiences of consultants and researchers demonstrate that supportive and well-resourced BI-CoPs at the national and institutional level are essential for making effective use of the Toolkit and developing BI plans that are innovative, inclusive, and impactful.

Regular readers of the *Journal of Community Engagement and Scholarship* encountering this special issue on the Center for Advancing Research Impacts in Society (ARIS) Broader Impacts Toolkit might reasonably ask: What does a Broader Impacts Toolkit have to do with community-engaged scholarship? The answer to this question is found at the intersection of Broader Impacts and community-engaged scholarship (Gelmon et al., 2013). Every proposal submitted to the National Science Foundation (NSF) is reviewed according to two criteria: intellectual merit and Broader Impacts (BI). Here, we focus on the BI criterion, which is “the potential of a proposed research activity to benefit society or achieve desired societal outcomes” (NSF, n.d.). Most BI activities involve some form of public engagement, such as K–12 outreach, informal science education, public exhibits and performances, community-engaged research and learning, advocacy and policy change, or commercialization and entrepreneurship (Aurbach et al., 2020).

The ARIS Broader Impacts Toolkit (henceforth, the “Toolkit”; Hotaling et al., 2024) is an online resource designed to help researchers develop BI plans for their NSF proposals. Several elements of the Toolkit address critical aspects of public engagement, such as the following:

- identifying focal groups or populations, their interests, and their needs
- identifying community partners and establishing cooperative relationships with them
- using effective and inclusive engagement strategies and techniques
- collaborating with community members to design and implement activities
- delivering meaningful benefits to communities

The BI criterion can be daunting for researchers in science, technology, engineering, and math (STEM) fields who are new to BI or public engagement. To what or to whom should they turn for information and advice on how to develop a BI statement for their proposal, identify

This article is included in a special issue focused on the Implementation and Evaluation of the ARIS Broader Impacts Toolkit project, which is designed to advance the understanding of mechanisms and supports needed to develop effective Broader Impacts (BI) statements. The full issue can be found at <https://jces.ua.edu/37/volume/17/issue/2>

audiences, locate appropriate campus partners for reaching those audiences, or collaboratively design effective engagement activities with community members? Although the Toolkit is a good place for researchers to start, is it enough? In this paper, we argue that the Toolkit is a valuable resource for researchers new to BI or public engagement. However, to increase its effectiveness, we recommend integrating the Toolkit into wider BI communities of practice.

Communities of Practice

Communities of practice (CoPs) are “groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis” (Wenger et al., 2002, p. 4). CoPs contain three essential elements: a “domain of knowledge, which defines a set of issues; a community of people who care about this domain; and the shared practice that they are developing to be effective in their domain” (Wenger et al., 2002, p. 27). Below, each element is described in relation to Broader Impacts Communities of Practice (BI-CoP) organized at institutional to national levels.

A CoP’s *domain* consists of a body of knowledge that its members develop and preserve. It is not a fixed repository but evolves along with the community’s environment. It is not abstract but instead consists of problems community members have faced and how they have resolved them. In the case of a BI-CoP, this body of knowledge extends beyond knowledge of how to craft a BI plan that meets reviewer expectations for originality, feasibility, and potential for impact. It includes knowledge of how to establish reciprocal and trusting relationships with community partners, how to create inclusive STEM learning environments, and how to design BI activities that promote participant learning. BI professionals (i.e., those who help researchers develop and/or implement their BI activities) are among the primary holders of the BI knowledge domain. McDonnell and colleagues (2023) have identified the essential competencies BI professionals must master for effective practice.

A CoP involves *community*, with regular interactions among its members to share knowledge and improve practice. Interactions occur at different scales, from the national BI-CoP that is cultivated by ARIS through online resources, webinars, programs, and annual conferences, to institutional BI-CoPs.

The *practice* component of a CoP involves applying domain knowledge to solve problems. From BI professionals’ perspective, this entails the challenges of (a) helping researchers new to BI or public engagement write BI statements and craft BI plans that meaningfully connect their science with innovative, inclusive, and impactful public engagement activities and (b) helping researchers implement their BI plans.

Above, we refer to “BI professionals” as primary holders of BI knowledge, key members of BI-CoPs, and principal practitioners in supporting researchers’ BI efforts. However, by most definitions, the BI field has yet to fully achieve “profession” status. Professions are characterized by specialized knowledge and skills acquired through extensive education and training, credentialing, professional autonomy, established standards of ethical conduct, a shared professional identity and culture, a commitment to continuous learning, professional organizations, and recognition by others as professionals (Callaghan, 2014). The incomplete development of the BI field regarding the first characteristic—specialized knowledge and skills acquired through extensive education and training—elevates the importance of BI-CoPs. Absent extensive formalized BI training for beginning, intermediate, and advanced practitioners, BI-CoPs serve as critical spaces for BI professionals to share knowledge, effective practices, and problem-solving strategies.

As noted earlier, BI-CoPs have both institutional and national elements. Michigan State University (MSU) has developed an institutional BI-CoP that includes BI consultants, research development professionals, research administrators, campus-based public engagement facilities and programs (e.g., the MSU Museum), researchers experienced in BI, and the community partners they collaborate with to design and conduct their public engagement activities (Figure 1). A subcomponent of this MSU BI-CoP is the MSU BI Network, an informal group of BI professionals who collaborate regularly to provide researchers with BI-related online learning resources, workshops, retreats, conferences, and individual consultations. The MSU BI Network includes BI consultants, research development professionals, research administrators, and the staff of public engagement facilities (e.g., museums, planetarium, and Extension, etc.). Members of the MSU BI Network participate both in the MSU BI-CoP and the national BI-CoP. The national BI-CoP includes the

NSF; national organizations that anchor the professional communities and identities of grant consultants and BI professionals, such as the National Organization for Research Development Professionals (NORDP), ARIS, and ARIS’s predecessor, the National Alliance for Broader Impacts (NABI); institutions of higher education; and non-university-based science partners (e.g., community-based museums, science centers, gardens, etc.).

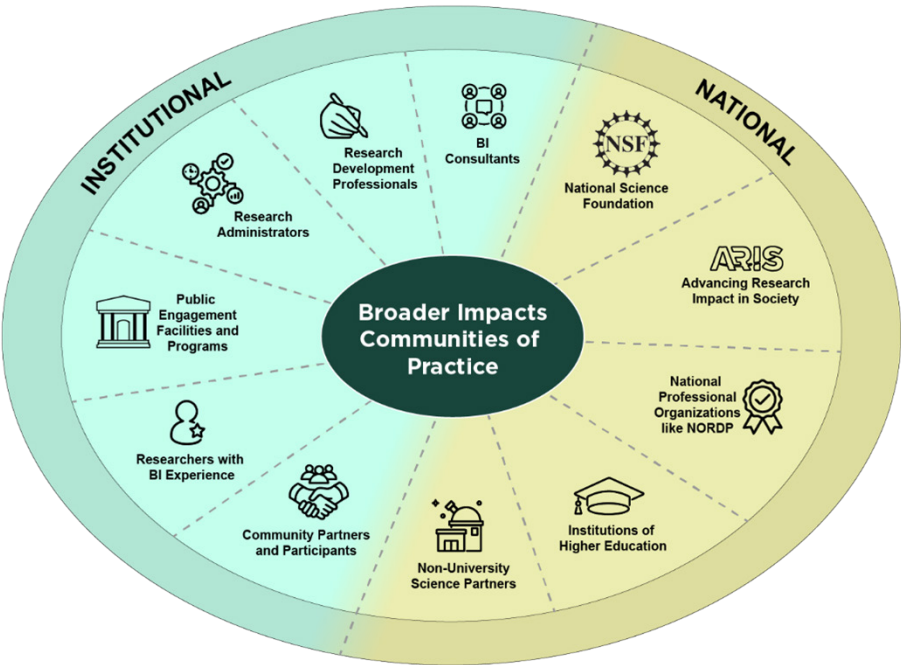
This study focused on the critical role that national and institutional BI-CoPs played in the professional development of members of MSU’s BI Network and their ability to effectively meet researchers’ BI needs. In addition, it describes how the members of MSU’s BI Network co-constructed an institutional BI-CoP to support researchers’ BI efforts at MSU. In the first section of this paper, five members of the MSU BI Network share their personal narratives of how they came to their BI work, their first exposure to and use of NABI/ARIS resources and tools, and their current roles in supporting the BI efforts of researchers within the MSU BI-CoP. In addition, they describe how their involvement in the ARIS Organizational

Research Impacts Capacity (ORIC) project led to greater collaboration between their offices and the formation of the MSU BI Network. Finally, they discuss how their involvement in the ARIS BI-CoP project changed their BI consulting practices and enhanced their capacity to effectively help researchers develop their BI plans. In the second section of this paper, we discuss how the national BI-CoP facilitated our co-construction of an institutional BI-CoP and how this institutional BI-CoP supported researchers’ use of the BI Toolkit and increased their confidence in their ability to develop BI plans.

In this study, we address three research questions:

- 1. How have the BI training, tools, and other resources offered by NABI/ARIS contributed to a BI-CoP and supported the development of BI professionals at MSU?
- 2. How has the use of the BI training, tools, and other resources offered by NABI/ARIS affected the capacity of BI professionals at MSU to develop an institutional BI-CoP to support researchers’ efforts to develop BI plans using the BI Toolkit?

Figure 1. BI-CoPs



Note. Figure 1 displays the institutional and national BI-CoPs. The institutional BI-CoP (green background) includes BI consultants, research development professionals, research administrators, campus-based public engagement facilities and programs, researchers with prior BI experience, and community partners and participants. The national BI-CoP (yellow background) includes the NSF, ARIS, professional organizations like the National Organization of Research Development Professionals (NORDP), institutions of higher education, and non-university-based science partners.

3. How has researchers' use of the BI Toolkit in the context of an institutional BI-CoP affected their confidence in developing BI plans?

Answers to these questions will offer lessons to BI professionals at other institutions on how best to leverage national and institutional BI-CoPs to support the development of their BI competencies as well as the BI competencies of the researchers they assist.

Methods

This study used a concurrent, nested, mixed-methods design (Creswell et al., 2003). In such designs, qualitative and quantitative data are collected concurrently, with the less dominant method “nested” inside of the predominant method. In this study, quantitative online surveys of researchers were nested within the dominant qualitative method of narrative research. Narrative research involves the collection and analysis of individuals' personal narratives about their lived experiences (Creswell, 2013; Polkinghorne, 1995). Narratives reveal aspects of participants' professional or personal identities, are typically organized chronologically, frequently contain key turning points, and usually occur within specific locations or circumstances (Creswell, 2013). Although in narrative research researchers typically gather data from participants to construct

narratives, in this study the researchers and participants are one and the same.

Procedures

For the narrative research component of this study, the members of our research team, who are also members of the MSU BI Network, collaboratively developed a sequence of prompts (Table 1) designed to elicit our personal narratives. These prompts are organized chronologically from our entry into the BI field to our current roles in supporting the BI efforts of researchers, and they include key turning points in our professional trajectories. In response to the prompts, each member of the MSU BI Network wrote a portion of their personal narrative in their own words.

In nested mixed-methods designs, it is common for different methods to address different research questions (Creswell et al., 2003). In our study, while we addressed Research Questions 1 and 2 with a narrative research approach, we used a combination of quantitative and qualitative methods to answer Research Question 3.

To assess MSU researchers' experiences with the BI Toolkit, we conducted online pre- and post-training surveys with 21 participants in our BI writing retreats to gather data on their BI needs, use of Toolkit tools, perceptions of the tools' utility, and changes in confidence in their ability to draft BI statements and plans aligned with NSF values. The online surveys contained a combination of

Table 1. Narrative Elicitation Prompts

Collaboratively Developed Prompts	
Points of Entry Into BI	
<ul style="list-style-type: none"> • What was your point of entry into assisting researchers with Broader Impacts? 	
First Exposure to and Use of NABI/ARIS Tools	
<ul style="list-style-type: none"> • What was your first exposure to NABI (2014–2017) or ARIS (2018–present) BI resources? 	
<ul style="list-style-type: none"> • What did you learn from them? 	
<ul style="list-style-type: none"> • How did you use them to support the BI efforts of researchers? 	
ORIC Project	
<ul style="list-style-type: none"> • How were you involved in the ORIC Project? 	
<ul style="list-style-type: none"> • How did it contribute to your organizational and individual ability to support BI efforts? 	
Current Roles	
<ul style="list-style-type: none"> • How do you assist researchers with Broader Impacts now? 	
ARIS Toolkit Project	
<ul style="list-style-type: none"> • How has your involvement in the Toolkit Project influenced your use of the tools in the ARIS Broader Impacts Toolkit in your efforts to support the BI efforts of researchers? 	
<ul style="list-style-type: none"> • How has your involvement in the BI Toolkit Project affected your capacity to support researchers' BI efforts? 	

closed and open-ended questions. Additionally, we asked participants who were interested in participating in a follow-up interview to share contact information; two participants did so. In follow-up interviews, we asked researchers about their awareness, use, and perceived utility of the BI Toolkit prior to, during, and after the training.

Ethics and Consent

The MSU Institutional Review Board determined that this study (#00008529) was exempt under 45 CFR 46.104(d) 2ii. Prior to the administration of the online pre- and post-training surveys and interviews, BI writing retreat participants were informed verbally of their rights as research participants. Consent was indicated by proceeding with the online surveys or interviews. For the narrative research component of the study, because the authors were the participants, consent was unnecessary.

Narrative Analysis

Polkinghorne (1995) identifies two approaches to the analysis of narratives. The more common approach, paradigmatic analysis, uses thematic analysis to identify themes that hold true across different stories. The less common approach, narrative analysis, involves collecting experiences related to a particular topic, issue, or event and organizing them into narratives by means of a plot or story line. Narrative analysis is the approach we used in this study. The narrative prompts we cocreated were designed to elicit sequential narratives of our personal development as BI professional in the context of local and national BI communities of practice. The stories themselves and the variations and commonalities across them were the intended products of this analysis.

Participants

Our study involved two sets of participants: the five members of the MSU BI Network and 21 researchers who attended one of two BI writing retreats in 2023. The MSU BI Network is composed of two research development professionals and a research administration manager from the Office of Research and Innovation (ORI: Lauren, Sara, and Angie), a BI consultant from the office of University Outreach and Engagement (UOE: Miles), and the Director of Education at the MSU Museum (MSUM: Denice). This network formed as a direct result of our institution's involvement in the ARIS Organizational Research Impact Capacity (ORIC) project, as we discuss below.

Pathways of BI Professional Development

In this section, we summarize the narrative research results pertaining to the MSU BI Network members' pathways of professional development. The narratives illustrate how those pathways were influenced by members' participation in national and institutional BI-CoPs. Our individual stories of moving from BI novices to BI professionals skilled in helping faculty develop BI plans for NSF proposals, connect with on- and off-campus partners, and implement and evaluate BI activities have different starting and inflection points. Each of us contributes to MSU's BI capabilities in unique ways.

Points of Entry Into BI

What Was Your Point of Entry into Assisting Researchers with Broader Impacts?

Our points of entry into helping researchers develop their BI plans or design, implement, and evaluate BI activities were quite different. As research development professionals, Lauren and Sara's entry points were assisting researchers with overall proposal development. Lauren writes,

Our office [ORI] provides grant editing and consulting services to help faculty develop grant proposals to any agency, and many of the proposals that come through our office are NSF proposals. I developed an understanding of what a strong BI plan looks like through reading and editing many NSF proposals, from conversations with colleagues, from attending ARIS webinars, and from attending BI workshops hosted by UOE.

Because of his background as a program evaluator, Miles's entry point into BI began with a workshop he offered in 2018 for MSU's Division of Engineering Research on how to evaluate BI activities. As director of education at the MSU Museum and BI coordinator since 2017, Denice helps researchers design, implement, and evaluate museum-based BI activities. Denice writes,

I have worked with over 30 faculty members to submit NSF applications. Together, we have designed innovative, museum-based projects such as exhibitions, public programs, interactive gallery modules, Science On a Sphere® datasets and animations, and more.

Before Angie became the Research Administration Manager in ORI, she was the director of operations for an autism research center within ORI. In this position, she reported to the vice president of research, who served as her BI mentor.

First Exposure to and Use of NABI/ARIS Tools

What Was Your First Exposure to NABI (2014–2017) or ARIS (2018–present) BI resources? What Did You Learn from Them?

Although our entry points into BI were quite different, NABI's Broader Impacts Guiding Principles (ARIS, 2024) was the first NABI/ARIS resource to which we were exposed. From this document we learned about the nine (now 10) areas of impact (e.g., increasing the participation of women, persons with disabilities, and underrepresented minorities in STEM) and the five questions every BI statement must address. Learning about the impact areas helped us educate researchers about the broad scope of impacts they might target in their BI plans. We also were aware of the Broader Impacts Wizard and learned from it the core elements of a BI plan (i.e., goals, audience, partners, budget, and evaluation).

How Did You Use These Resources to Support the BI Efforts of Researchers? The Guiding Principles document served as an essential learning tool for us as BI professionals and as a critical resource for educating researchers about the requirements for BI plans. It continues to be an essential resource in our individual BI consultations with researchers. Sara's experience encapsulates how the Guiding Principles document helps her simultaneously conceptualize how to integrate existing institutional and community resources (e.g., public engagement facilities and programs) into BI plans and educate researchers about the essential elements of a complete BI plan:

As I learned about the myriad of resources available both at the institution as well as in the community, the Guiding Principles document was instrumental for helping me envision how one might incorporate those resources into a BI plan. During my subsequent consultations with researchers, I would regularly refer to the NABI Guiding Principles document to guide discussion. This document served as an essential reference for helping faculty understand how to best develop a thorough plan for implementing

meaningful BI activities. In addition, I would regularly include Guiding Principles in follow-up communications so that they would have it as a reference.

For Denice, the Guiding Principles document facilitates collaboration and shared understanding among partners as they work together to develop BI plans. As she writes, the Guiding Principles "helped keep everyone focused and asking the right questions."

As useful as the NABI/ARIS tools were to our individual development as BI professionals, two ARIS projects—the ARIS Program to Enhance Organizational Research Impact Capacity (ORIC) and the ARIS Broader Impacts Toolkit Community of Practice (henceforth, the "Toolkit Project")—were instrumental in our further development as BI professionals. Equally important, these two ARIS projects catalyzed the development of our internal BI-CoP, leading to increased collaboration among our offices in providing researchers with an array of BI supports and resources.

Organizational Research Impact Capacity (ORIC) Project

In 2020, ARIS established ORIC to help institutions enhance their capacity to support BI activities. One of our MSU BI Network members (Miles) was fortunate enough to participate in the 2020–2021 pilot cohort of this program.

How Were You Involved in the ORIC Project and How Did It Contribute to Your Organizational and Individual Ability to Support BI Efforts? ORIC offers BI professionals opportunities like workshops, resources, and mentoring on BI fundamentals and best practices for effectively supporting researchers in developing their BI plans. ORIC also helps institutions take stock of and develop their BI infrastructure. The ORIC Landscape Analysis tool led to a much greater understanding and appreciation of the enormous array of BI assets already available at MSU, which are now documented on a BI website and in resource sheets that are shared with BI workshop participants. These resource lists help us connect researchers to on-campus partners who can assist them in reaching external audiences and co-designing innovative BI activities. Attending the ORIC training with two research development professionals from ORI also catalyzed greater collaboration between ORI and UOE. Since our participation in the ORIC project, our BI Network

has worked together to develop a comprehensive BI-CoP for researchers that includes a BI website, a series of virtual BI workshops, on-demand individual BI consultations, and day-long BI writing retreats.

Current Roles in the Institutional BI-CoP

How Do You Assist Researchers with Broader Impacts Now? Members of our BI Network play different but complementary roles in providing BI support for researchers. As research development professionals, Lauren and Sara's primary responsibilities are to support the entire proposal development process and help researchers write competitive proposals. Both are also well-versed in the NSF BI criterion and can help researchers develop high-quality BI plans. Lauren explains,

Two of my primary responsibilities are helping faculty hone their grant writing skills and helping them revise and edit their proposals to be clear and responsive to the funder's solicitation. A big part of this is assisting faculty with writing and editing BI plans so that they are clear, thorough, and responsive to the questions written in the Guiding Principles document.

Lauren and Sara provide BI support in a variety of ways. As Sara shares,

The two primary ways in which I work with researchers are through individual or small group consultations and developmental editing of grants. I meet with faculty or provide written feedback to ensure that their BI plans are thoughtful, creative, thorough, and include sufficient detail. Based on the needs of the researcher, I also refer them to BI professionals in UOE to help them further develop their BI plans.

As a result of ORIC, Lauren and Sara also collaborate with the members of the BI Network to develop and deliver BI workshops, conferences, and retreats throughout the year. Sara runs a cohort-based NSF CAREER proposal writing group that includes several dedicated sessions on BI and related Education Plans. During these sessions, researchers learn about the elements of successful BI plans, become familiar with tools and resources for writing a strong BI plan, review

examples of successful BI plans, and receive feedback on BI plans in progress.

Because Miles is not responsible for assisting researchers with the entire proposal development process, he is able to focus more narrowly on helping researchers with the BI component of their proposals. He also contributes to the MSU BI-CoP by maintaining a university-wide BI website, collaborating with the other members of the BI Network to offer BI workshops, and offering individual BI consultations to researchers.

From her position in a public-facing institution and drawing on her expertise in best practices in informal education, Denice works directly with researchers and community partners to design creative and effective public engagement activities. Denice writes,

As both a collaboration partner and experienced BI application developer, I assist faculty members throughout the entire application process by helping to develop project ideas, mentoring them in informal education best practices, identifying audiences, and focusing project scope. I also collaborate on narratives and budgets. If a project is awarded, we work together from start to finish to complete the BI project. The goal is to provide the best engagement program match for the researcher.

One of Angie's most important roles in the MSU BI Network is to monitor requests for proposal development support and refer researchers requesting BI support to Miles and Denice, who are able to assess faculty members' needs and provide assistance and resources. Angie's point of contact keeps faculty members from "falling through the cracks" and missing out on the benefits of the BI-CoP.

As our individual narratives reveal, each of us plays a critical and complementary role in maintaining a robust institutional BI-CoP that supports researchers from initial proposal development through the design and implementation of BI activities by means of online resources, workshops, BI writing retreats, and individual consultations.

ARIS Toolkit Project

Following the ORIC Project, members of our BI Network participated in the ARIS Toolkit Project, the purpose of which was to "learn how institutions support the development and

facilitation of BI plans, and the tools they use to do so, especially during the proposal development phase” (ARIS, 2024). Below, members of the MSU BI Network discuss how the Toolkit Project has influenced how they support researchers.

How Has Your Involvement in the Toolkit Project Influenced Your Use of the Tools in the ARIS Broader Impacts Toolkit in Your Efforts to Support the BI Efforts of Researchers? Prior to the BI Toolkit Project, our use of the Toolkit was limited to one or two tools, primarily the Guiding Principles and the Broader Impacts Plan Checklist (ARIS, 2024). It was rare for us to use tools like the BI Wizard in direct interaction with researchers. Lauren writes,

While helping faculty develop and revise drafts of their grant proposals, I primarily and frequently relied on the BI Plan Checklist tool. When faculty sought resources to help them develop their BI plans, I pointed them to the BI Wizard, the BI Plan Checklist, and Guiding Principles document, but did not provide demonstrations to show them how to use these tools or assist them with navigating the use of these tools.

Participating in the Toolkit Project improved our familiarity with the various tools and increased our likelihood of using them with researchers. Lauren writes,

Since participating in the Toolkit Project, I am much more familiar with and comfortable using both the BI Wizard and the BI Project Rubric (ARIS, 2024). I now demonstrate and recommend using different features of the BI Wizard during consultations with faculty (e.g., the Target Audiences and Literature Connections components of the BI Wizard). These faculty can now better utilize the full slate of BI tools to write and refine their BI plans.

Sara’s involvement with the Toolkit Project afforded her the opportunity to view the process of developing a BI plan with the Toolkit’s tools from the perspective of a researcher, gain familiarity with the tools, and become more likely to recommend their use to researchers. She comments,

By working on the Toolkit Project, I gained insights into the user’s experience when trying to develop a BI Plan. When

we first were asked to use the BI Wizard and provide feedback, I found myself struggling in ways I hadn’t anticipated. It’s easy to forget how challenging some aspects of BI planning are. By using the Wizard and putting myself “in the shoes” of a researcher trying to build a BI plan from scratch, I gained insights that help me support the researcher more effectively. By participating in the project, I also became more confident with the Toolkit in general and am more likely to recommend it as a starting point for developing a BI plan.

The Toolkit Project offered participating institutions the opportunity to provide feedback to ARIS on the BI Wizard, resulting in changes that in our view made it more user-friendly and increasing the likelihood that we would recommend researchers use it on their own. Denice notes,

The most impactful part of working on the Toolkit Project was helping to refine the BI Wizard. While at the beginning it had some elements that needed to be improved, it was clear that these BI products were going to allow researchers to develop their applications in a user-friendly and effective manner. As a certified Project Management Professional, I appreciate tools that encourage scaffolded dialogue among stakeholders. I believe one of the best things about the BI Wizard is how it can help facilitate discussion as people work together to develop an application, ensuring that everyone involved understands the content, questions, and concerns.

Our involvement in the BI Toolkit Project increased our familiarity with the Toolkit’s tools and the likelihood that we would recommend researchers use them to develop their BI plans. Next, we consider how our involvement in the Toolkit Project influenced our capacity to help researchers develop their BI plans.

How Has Your Involvement in the BI Toolkit Project Affected Your Capacity to Support Researchers’ BI Efforts? For all of us, the Toolkit Project increased our familiarity with and confidence in using a set of high-quality tools to help researchers develop BI plans. Lauren’s involvement in the Project “expanded [her] professional repertoire for helping faculty

write competitive NSF proposals.” For Sara, “The BI Toolkit is truly a Swiss Army knife for the BI practitioner. I can calibrate my consultations with researchers based on their level of expertise and connect them to the tools that will be most useful.” Similarly, Denice writes,

I now have more supports to offer researchers as we collaborate. Instead of just sending someone a list of requirements, I can connect them to these dynamic, web-based resources that provide a framework for all elements of the process. Additionally, the professional design and interactivity of the Toolkit help engender user confidence in the tools.

Sara notes how helpful it is for researchers to be able to create draft plans in the BI Wizard, expediting the editorial feedback and editing process:

Perhaps the most transformative aspect of the BI Toolkit (and in particular, the BI Wizard) is that researchers can quickly generate a relatively complete first draft of a Broader Impact plan in a short amount of time. Often, researchers struggle with how to get started, especially if it is their first time writing a BI plan. This tool helps the researcher overcome issues of writer’s block and enables subsequent consultations and editorial feedback to progress more quickly and efficiently.

Finally, our involvement in the Toolkit Project has enhanced our appreciation for what each of us contributes to supporting researchers’ BI efforts. Lauren writes, “It has given me a stronger understanding of how each unit in our network supports BI capacity for faculty. This has enabled me to make referrals and recommendations more confidently to faculty seeking help with the BI components of their grant proposals.”

As a result of participating in the Toolkit Project, the members of our BI Network feel we have more and higher-quality tools (as Sara wrote, “a Swiss Army knife”) to support researchers as they develop their BI plans. We are now more likely to use the tools directly with researchers in individual consultations or BI writing retreats and confidently encourage researchers to explore the tools on their own. As such, we feel that our participation in the Toolkit Project has significantly enhanced our individual

and collective capacity to assist researchers with their BI efforts.

Researcher Experiences With the Toolkit

Although our experiences suggest that the NABI/ARIS training, tools, resources, and CoP have increased our capacity to effectively serve researchers, we believe it is important to substantiate our impressions with data from researchers themselves. Using pre- and post-training questionnaires and follow-up interviews with researchers who attended two full-day BI writing retreats organized by the authors, we gathered data on their BI needs, their use of the Toolkit tools, their perception of the tools’ utility, and their confidence in their ability to write BI plans.

In April and November 2023, we offered day-long in-person BI writing retreats for MSU faculty, staff, and students. Because of our involvement in the Toolkit Project, we made the Toolkit central to the retreats. Due to our uncertainty about researchers’ ability to successfully navigate the Toolkit on their own, we structured the workshop to introduce them to all four tools and guide them step-by-step through each element of the BI Wizard. After introducing each element of the BI Wizard, we gave participants time to work individually to answer the questions associated with each Plan Element, ask questions, and participate in peer discussions. By the end of the workshop, most participants had completed a draft BI statement in the Wizard that they could download for additional editing.

At the start of the retreat, we invited the participants to complete a pre-training questionnaire that asked them about their confidence in their ability to write a BI statement that aligns with NSF values, their confidence in their ability to successfully develop a BI plan, and with which aspects of developing a BI plan they most needed help. In addition, we asked them for their academic rank and college. Across the two retreats, all 21 participants completed the pre-training questionnaire. After the retreat, we invited participants to complete a post-training questionnaire that asked them again about their confidence in their ability to write a BI statement that aligns with NSF values and their confidence in their ability to successfully develop a BI plan. The questionnaire also asked participants how easy the BI Toolkit Plan Elements and BI Wizard steps were to follow, which Toolkit tools they used to develop their BI plans, and how useful those tools

were in developing a BI plan. Of the 21 writing retreat participants, 18 (85.7%) completed the post-training questionnaire. Seven were academic staff (research associates or academic specialists), 11 were tenure-stream faculty members (six assistant professors, two associate professors, and three professors), two were graduate students, and one identified as a “research scholar.” Participants came from a diverse range of colleges including agriculture and natural resources, arts and letters, communication arts and sciences, engineering, natural sciences, nursing, and social sciences.

In reviewing researchers’ responses to the pre-training and post-training questionnaires, it was important to bear in mind that researchers were learning to use the Toolkit not on their own but in the context of a day-long BI writing retreat that provided them with a guided tour of the Toolkit tools and a structured walk through the BI Wizard with multiple opportunities to ask questions and discuss their developing plans with peers. Furthermore, these BI writing retreats were but one component of a larger BI-CoP co-constructed by the members of the MSU BI Network that included online resources, university-wide BI conferences and workshops, and individual BI consultations. In addition, at the end of each BI writing retreat, we offered to review and provide feedback on participants’ draft BI plans and help them identify on- and off-campus partners to connect them with their target audiences.

Researcher Needs

Table 2 displays the kinds of BI assistance that BI writing retreat participants reported needing in the pre-training questionnaire. The most

commonly reported need was for assistance in designing BI activities to be creative, original, and potentially transformative (90%).

Utility of the Toolkit Tools

In the post-training questionnaire, all participants who rated the utility of the Toolkit tools rated the Guiding Principles, BI Plan Checklist, BI Plan Rubric, BI Wizard, Plan Elements, and My Summary Page as either “useful” or “very useful.” Tools that received the most “very useful” ratings were the Wizard (86.7%), the Checklist (80.0%), and the My Summary Page (80.0%). Endorsing the overall utility of the BI Toolkit, one participant wrote that “The Broader Impact toolkit is an important resource for guiding researchers on how to write [a] broader impact proposal. I find [it] very informative and useful.” Addressing the usefulness of the BI Wizard specifically, another participant wrote that the Wizard allowed them to “sequentially engage and address each key component of the BI framework.” Similarly, another researcher noted that the structure of the Wizard helped guide his thinking:

I find the tools helpful ... because it guides my thinking, it’s well structured, and it’s helped me to kind of focus my study. ... So I was able to dissect my study in terms of who [is] my target audience, who should be my partner? How will my study benefit ... society? Those things are well demarcated in the toolkit. ... That structure for me is a huge help because it helped me to kind of structure the story.

Table 2. Researcher BI Support Needs

Researcher Needs	Percent Reporting
Designing BI activities to be creative, original, and potentially transformative	90%
Designing BI activities so that an audience is clearly defined and how the activities contribute to benefiting societal outcomes is clearly stated	81%
Ensuring that the qualifications of those conducting BI activities are well described and suited to the anticipated roles	71%
Ensuring their BI plan addresses one or more targeted BI priorities, goals, or outcomes as outlined by NSF	67%
Ensuring the BI goals, BI budget justification, and BI plan are clearly articulated	67%

Although is it helpful to know that researchers perceived the Toolkit and its tools as useful, a more important consideration is the extent to which the use of the tools increased researchers' confidence in their ability to develop plans that would meet reviewer expectations.

Change in Researcher Confidence

In the pre- and post-training questionnaires, we asked participants about their confidence in their ability to write a BI statement that aligns with NSF values and their confidence in their ability to successfully develop a BI plan. A comparison of the responses before and after the retreats shows that the retreats increased their confidence in both areas. Whereas before the retreats, 52.4% of participants tended to agree or agreed with the statement “I am confident in my ability to write a Broader Impacts statement that aligns with NSF values,” after the retreats, 100% of participants tended to agree or agreed with the statement “I am confident that my Broader Impacts statement will align with NSF values” (Table 3).

Similarly, whereas before the retreats, 47.6% participants tended to agree or agreed with the statement “I am confident in my ability to successfully develop a Broader Impacts plan,” after the retreats, 100% of participants tended to agree or agreed with the statement “I am able to successfully develop a Broader Impacts plan” (Table 4).

Discussion

The experiences of BI professionals and researchers at our institution indicate that the BI Toolkit is a valuable resource for researchers new to BI or public engagement, especially when integrated into wider BI-CoPs. The BI-CoP and related resources, professional development opportunities, conferences, and programs established and sustained by NABI and its successor ARIS at the national level have benefited both BI professionals and researchers at MSU in several ways. The BI Guiding Principles document and the BI Wizard were critical resources for enhancing our own understanding of the BI criterion as developing BI professionals ourselves,

Table 3. Confidence in Ability to Write a BI Statement

	Before Retreat (N = 21)	After Retreat (N = 18)
	I am confident in my ability to write a Broader Impacts statement that aligns with NSF values.	I am confident that my Broader Impacts statement will align with NSF values.
Disagree	14.3%	0.0%
Tend to Disagree	33.3%	0.0%
Tend to Agree	52.4%	33.3%
Agree	0.0%	66.7%
Total	100.0%	100.0%

Table 4. Confidence in Ability to Develop a BI Plan

	Before Retreat (N = 21)	After Retreat (N = 18)
	I am confident in my ability to successfully develop a Broader Impacts plan.	I am able to successfully develop a Broader Impacts plan.
Disagree	14.3%	0.0%
Tend to Disagree	38.1%	0.0%
Tend to Agree	47.6%	55.6%
Agree	0.0%	44.4%
Total	100.0%	100.0%

and they have served as essential resources for educating researchers about NSF's requirements for their BI activities.

MSU's participation in the ORIC project was pivotal in the establishment of an institutional BI-CoP. The ORIC Landscape Analysis tool led to a much greater understanding and appreciation of the enormous array of BI assets already available at our university, which are now documented on websites and in resource sheets that are regularly distributed to BI workshop attendees and faculty contacts. Having a broader understanding of institutional BI resources has helped us connect researchers to on-campus partners who can help researchers reach external audiences to co-design and implement innovative BI activities. The joint participation of representatives of our Office of Research and Innovation and Outreach and Engagement in ORIC led to much greater collaboration across offices, leading to the formation of the MSU BI Network and the development of a comprehensive institutional BI-CoP for researchers that includes a BI website, a series of virtual BI workshops, on-demand individual BI consultations, and a day-long BI writing retreat.

As a result of MSU's participation in the Toolkit Project, the members of the MSU BI Network feel they have more and higher-quality tools with which to support researchers in developing their BI plans. For example, researchers have the Checklist to consult as they build their BI plans to ensure it contains the expected elements and the Rubric to assess the quality of their draft BI plans. As a result of the Toolkit Project, we are now more likely to use the tools directly with researchers in individual consultations or BI workshops and encourage researchers to explore the tools on their own. Overall, we believe that our participation in the Toolkit Project has significantly enhanced our individual and collective capacity to assist researchers with their BI efforts. Survey and interview responses from researchers who participated in our BI writing retreats validate our perception of our growing capacity to effectively support researchers' BI efforts, with researchers reporting substantially greater confidence in their ability to develop BI plans that align with NSF values after attending the retreats.

As valuable as the BI Toolkit is, we believe its utility is greatest when embedded within larger institutional BI-CoPs. Although it is possible for researchers to use the Toolkit on their own to develop sound BI plans, our experiences suggest that researchers also need training in the basics

of BI, opportunities to ask questions and receive feedback from BI experts as they develop their BI plans, assistance in identifying on-campus and off-campus partners who can connect them with their target audiences, and assistance in designing, implementing, and evaluating BI activities. The BI Toolkit alone cannot fulfill all these needs. To support the full range of researchers' BI needs, we recommend the following strategies:

- Conduct an institutional assessment regarding the extent to which researchers and those who support their BI efforts are aware of and making full use of ARIS's resources (e.g., the BI Toolkit), programs (e.g., ORIC), and CoP (e.g., the annual ARIS Summit).
- Take inventory of your institution's BI assets and the extent to which they are connected and collaborating. This inventory should include resources for broadening participation in STEM, such as the Summer Research Opportunities Program (SROP) or national chapters of organizations devoted to increasing diversity in STEM, such as the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS).
- Build an internal, institution-wide BI-CoP to support the learning and professional development of BI professionals, researchers, and collaboration partners. Foster collaboration and co-learning among those who support researchers' BI efforts by encouraging them to collaboratively create and continually refresh a comprehensive system of BI supports that includes online resources, workshops, and individual consultations.
- Establish an internal BI referral system that connects researchers, research development professionals, engagement professionals, and those who manage programs that support diversity in STEM.
- Increase researchers' awareness of internal and external BI resources and support through multiple forms of communication and encourage engagement early in the proposal development process.
- Continuously evaluate and improve all BI resources and supports.

Study Limitations

The conclusions drawn in this paper are based on the experiences of four BI professionals, a research administrator, and a small non-probability sample of researchers at MSU and therefore are

not necessarily generalizable to the experiences of other BI professionals or researchers at our institution or other institutions. In addition, we assessed the impact of the Toolkit on researchers' confidence in their ability to develop BI plans only in the context of an all-day BI writing retreat. Although the Toolkit proved to be effective in achieving this result in this one context, our study cannot speak to its effectiveness in other settings.

Conclusion

The experiences of BI professionals at MSU demonstrate that supportive and well-resourced BI-CoPs at the national and institutional level are essential for BI professionals to make effective use of the BI Toolkit and assist researchers in developing BI plans that are innovative, inclusive, and impactful. Given this, we believe it is important for NSF and institutions of higher education to sustain support for national and institutional BI-CoPs.

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