
Grounding Institutional Partnerships in Structures for Broader Impact Design

Summative Evaluation Report
July 2021

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Note: This report was published in July 2021 and serves as the summative evaluation for collaborative NSF awards DRL: 1841974; 1612808; 1610693; 1610039; and 1611978.

Suggested Citation:

Hoke, K. L. & Risien, J. (2021). *Grounding institutional partnerships in structures for broader impact design*. The STEM Research Center at Oregon State University. doi: ...



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Executive Summary

This report presents summative evaluation results for a National Science Foundation funded project entitled Grounding Institutional Partnerships in Structures for Broader Impacts Design (BID). The project represents a collaboration between five institutions: Institute for Learning Innovation, The STEM Research Center at Oregon State University, Scicenter, University of Washington-Bothell, and University of Wisconsin-Madison. BID aimed at creating an inter-institutional structure and toolkit to assist higher education institutions (HEIs) and informal science education organizations (ISEs) in developing sustainable institutional partnerships through collaboration around the design of informal STEM education-based Broader Impacts (BI) experiences. The project built upon the Portal to the Public (PoP) framework, bringing together research support professionals, STEM education professionals and Principal Investigators at HEIs with practitioners at ISEs (i.e., BID partners) to enhance BI experiences for the public by leveraging human resources through intentional coordination and partnerships. This report addresses the impact of this collective work, serves as a record of the project, and as a resource for future partnerships that support BI.

Key Findings

Nine BID teams were created and studied over the course of the project, each composed of professionals from HEIs and ISEs. A backbone organization led coordination and accountability across the nine teams. This structure supported regular reflection and discussion within and across teams, supported partnership development, and advanced the design, use and refinement of a suite of partnership tools.

Implementation of inter-institutional partnerships across the nine BID teams was variable, ranging from partnerships that expanded out to the community creating an ecosystem, to partnerships that were nonoperational by the end of the project; this is attributed to differences in institutional buy-in and access to resources to carry out BID work. Still, the nine BID teams and backbone organization navigated challenges and devised solutions as they iterated the design and practices of their partnerships.

The project highlighted the significant challenges of institutionalization. Within the timeframe of this project, successful BID partnership implementation relied primarily on the personal and professional relationships brokered by BID team participation. Overall coordinated structures embedded within institutions to carry out this work did not manifest. While there are very few structural indicators of BID teams becoming institutionalized, the work of BID teams does appear to have built capacity for future inter-institutional collaboration. Organized around the six evaluation questions, detailed findings and recommendations to other programs seeking to develop inter-institutional BI partnerships are summarized below.

Partnership practices

Consistent communication and adaptive practices supported success considering the dynamic nature of BID teams. Relationship building was critical and created opportunity to deepen understanding of partners and institutional cultures. Attention to relationships and consistent communication created conditions that supported adaptations to teams efforts through regular reflection and re-centering activities to maintain goal alignment across HEIs and ISEs.

BID teams regularly acknowledged the large-scale BID goals of institutionalized durable partnerships while focusing their energy on attainment of small, more proximal outcomes, such as development or use of a single tool or practice to support BI activities.

Recommendations

Early establishment of consistent meetings provides partnered accountability to team goals. Partners should consider regularly re-centering the intent and partnership goals and adapt communicative and collaborative practices to align their individual and collective goals.

Effective team communication should include multiple relational touchpoints. Regular email, phone, and in-person meetings can be augmented by inter-institutional visits and networking to introduce partners to multiple colleagues

across intuitions. Such networking can provide pathways for administrator buy-in and can buffer the impact of turnover and position changes.

Tools developed by BID teams, such as the BI menu, are available through the BID online resource site (<https://popnet.instituteforlearninginnovation.org/bid-home/bid-tools/>). Inter-institutional engagement with these tools is generative of partnership development and understanding how PI needs and ISE priorities can align. Partners should consider utility of the tools as a resource to guide reflection and re-centering of BI goals.

Tool development

The process of collaborative tool development supported collaborative learning, inter-institutional understanding and use of common language and concepts. It also built capacity, particularly for ISEs, to leverage BI to proactively meet the needs of their organizations rather than shifting focus to respond to each PI request for support.

Accountability in developing tools as part of the award created an early and ongoing need for continuous communication within and among BID teams. This supported relationships and a regular rhythm of connection while working towards a final product.

Recommendation

Establish shared activities to provide opportunities for collaborative learning and understanding of inter-institutional practices and cultural norms. Pursue common outputs and outcomes to enhance shared responsibility and accountability. Practices might include co-hosting or co-presenting workshops, joint professional collaborations with national BI organizations, such as the Center for Advancing Research Impacts in Society (ARIS), and using or adapting BID tools to establish a common language and generate understanding of partners.

Support for Principal Investigators (PIs)

Investment in the partnership between HEIs and ISEs supported PIs with an emerging network that was responsive to PI needs, especially trainings on proposal development (i.e., CAREER workshops) as well as provided a structured inter-institutional pathway for BI work. As a result of engaging in the project PIs reported: improved understanding

of the nature of BI; development of relationships with the ISE and within their HEI that they intend to leverage for future BI work; and receiving support in ideating and developing BI statements for proposals. PIs reported knowing who and where partners existed within HEI and ISE, with the partnership providing an easier pathway for BI activities to occur.

While PIs valued aspects of the partnership, gaps existed between PIs improved understanding of BI and what was implemented, specifically evidence-based practices in public engagement. In general, PIs did not significantly adapt their BI practice based on the needs of their audience, nor did they have an improved understanding of how to use evidence-based public engagement strategies.

Recommendations

Proactively invest in partnership development between HEIs and ISEs. This builds the inter-institutional understanding first and enables both more informed support of PIs, such as CAREER proposal training, and better integration of BI with ISE programs and priorities.

Future work is needed to understand the use of evidence-based public engagement implementation responsive to the needs and interests of public audiences and how the inter-institutional partnerships may support the use of evidence-based practices by PIs. Formal training in evidence-based public engagement practices should also be considered for PIs involved in public engagement with science.

Institutionalization

The dynamic nature of the landscape with relatively rapid changes in staffing and administrative supports rendered institutionalization and durability goals unrealistic within the timeline of the project. Collaboration within BID teams did not lead to observable institutionalization. However, some teams expect that the foundational relationships built during the project will allow for future collaborative BI work across HEIs and ISEs. Institutionalization, moving beyond the efforts of individual advocates for BI work, takes a tremendous investment of time and was beyond the funding period for

this project. Note that although COVID-19 influenced this finding there are indicators in the data that this result would have manifest without the disturbance of COVID-19.

Recommendation

Building durability is a long-range effort subject to ever-changing staff and cultural conditions of ISEs and HEIs. There is no substitute for the practice of relationship building, especially the initial investment in building a foundation. Individual partners should consider establishing a solid understanding of partner institutions and a pathway for inter-institutional communication as foundational practices towards durability. The viability of the partnerships may be influenced by the foundation built from individual partners.

Dominant and Persistent Challenges and Constraints

Institutionalization and partnership durability is substantially constrained by a lack of support from administrators, out-of-sync workflows across HEI and ISEs, lack of agency by BID team participants, and limited time and resources dedicated to cultivate partnerships.

Recommendations

Design-based approaches, where teams design an initial plan, but intentionally reflect and iterate as the partnership progresses, can help teams with continual goal alignment and inter-institutional understanding. In order for inter-institutional partnerships to effectively support BI at scale they must move beyond individual relationship-based partnerships. Investment from administrators is, of course, necessary. Partners should leverage connections to national organizations such as ARIS and Association of Science and Technology Centers (ASTC) to help inspire share with administrators the BI activities of their peers and inspire them to invest. Connecting BI to institutional level goals and espoused values can also remind administrators of the value of BID partnerships.

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Overview

This evaluation was conducted by the research team at the STEM Research Center at Oregon State University. The team employed a design-based research approach and streamlined evaluation by integrating evaluative data collection with the concurrent research effort. This report aims to serve as a transparent evaluative record of the BID collaborative (defined below) and to document the purpose, activities, and lessons learned. The embedded participatory style evaluation, which provided the opportunity for the participants and evaluators to collaborate on the process of implementation, was integrated with the research activity. This approach allowed for rich understanding of, and engagement with, the people and organizations represented in the BID community. This report covers the project period from May 2018 through March 2021; it is preceded by a mid-way report (May 2018) and formative process that provided recommendations that were the basis for refinement of the project's trajectory.

Since the mid-way report the BID collaborative: 1) incorporated six additional BID teams by providing support and training to develop their partnerships using initial findings and the tools created in the first half of the project; 2) shifted focus from development of a toolkit with the initial three BID teams (cohort one) to assessment of relevance and refinement of the tools as they were deployed for use with the additional six site-based teams (cohort two); and 3) worked towards dissemination of the toolkit in the form of an online resource for emerging partnerships in the Broader Impacts (BI) community. This report provides a summative assessment of the collective work of nine BID teams and the backbone organization.

The BID project involved many people, organizations and partners. Below is a basic lexicon used in this report:

- **Principal Investigators (PIs)** are the HEI faculty who engaged with BID teams. Each partnership aimed to work with at least three HEI faculty as part of the BID project.

- **BID teams** were the core unit of the nine local collaborative partnerships that consistently included professional representatives from an HEI and an ISE located near each other (a full list of BID teams is in Appendix A).
- **Cohort 1 and 2** are two distinct groups of BID teams. Cohort 1 refers to the three initial teams funded on NSF collaborative grants. Cohort 2 refers to the six additional BID teams who were selected for a one-year volunteer commitment to apply, test, and contextualize the partnership practices and tools established by cohort 1.
- **Backbone organization** is the central coordinating body for the nine teams; initially situated within the Pacific Science Center before moving to the Institute for Learning Innovation in 2018.
- **Research team** conducts research and evaluation activities and is based at the STEM Research Center at Oregon State University.
- **BID collaborative** includes everyone funded on the collaborative grants to do this work (the backbone organization, the research team, and cohort one BID teams).

Background & Goals

The BID project was organized by a backbone organization. The backbone organization served as the central coordinating structure, bringing together HEIs and ISEs to develop and support a system for engaging university PIs and designing innovative broader impacts activities and experiences for communities. The research team held a synergistic research and evaluation role. The overarching research goal was to understand the characteristics, culture, and best practices of HEI/ISE collaborations to advance broader impacts design and implementation.

Goals of the BID Collaborative:

- Develop/enhance institutional connections within the three ISE/HEI BID teams funded by the grant.
- Develop a model that can be implemented elsewhere that builds ISE/HEI institutional relationships around broader impact (BI) efforts – to both have

better BI experiences in the community and to have better BI proposal components submitted to NSF.

- Improve ways to collect and measure the collective impact of BI efforts.
- Test the BID team model, especially the role of the learning scientist and community member.
- Identify ways to aggregate BI efforts.
- Increase PI's and HEI's perceived value of public engagement.

Activities

The BID collaborative, which included everyone funded on the collaborative grants to do this work, kicked off the first year of the project with a multi-day in-person workshop in Seattle, WA in September 2017. In that first year (Sep 2017-Aug 2018), the backbone organization (housed the Principal Investigator for the BID project) and cohort 1 teams (each with a Co-Principal Investigator of the BID project) in New York, Wisconsin, and Washington (see Appendix A) developed and refined tools to support enduring inter-institutional partnerships. The tools were prioritized and drafted in response to the needs that arose as the teams established their partnerships. The refined tools were then shared and used with cohort 2 BID teams in the second year of the project.

In the second year of the project (Aug 2018 - Jul 2019), a call for applications was sent to Portal to the Public Network (PoPNet) sites. PoPNet sites were chosen because of their existing model of HEI-based STEM researchers conducting materials-rich public engagement through connections with ISEs. Thirty-five ISE/HEI partnerships applied to become volunteer BID teams, indicating a strong appetite for the work of developing ISE/HEI partnerships around BI. The applications included letters of support from organizational administrators and details about any previous work or planned partnership approaches. Applications were reviewed by the entire BID collaborative. The six BID teams in cohort 2 (see Appendix A) were selected to represent a diversity of partnership situations so the tools and collaboration could be tested within the context of a variety of partnership models. In November 2018, the cohort 2 teams participated in a 2-day orientation led by the BID collaborative. Having already established a

partnership through the application and orientation, Cohort 2 was then charged with strengthening their partnerships and testing and refining the developed BID tools.

Each of the nine BID teams in the two cohorts received ongoing support from the backbone organization to develop their partnerships and establish a BI plan with at least three PIs. In addition to the individual team support, the backbone organization coordinated the collaborative effort to identify practices likely to result in enduring and robust partnerships between the HEI, the ISE, and additional local partners. These additional local partners were envisioned as community organizations that partnered to provide a broader array of BI options for PIs beyond the scope and capacity of the ISE represented in the BID team. The initial idea behind involving local community partners didn't account for the ISEs and HEIs being far enough along the partnership process and feeling secure as a BID team before engaging with other organizations. Towards the end of the project BID teams began to engage local community organizations, however, even at the end of the project's funding the local organizations were seen more as local stakeholders in the BI ecosystem rather than BI partners.

The second half of the project (Jul 2019 - Feb 2021) was significantly impacted by the COVID-19 pandemic. For ISEs this meant job loss, furloughs, and dramatic shifts in the programming and workflow for those who remained. Meanwhile, HEIs faced unanticipated budget challenges and shifted priorities to managing outbreaks and serving the immediate needs of students and faculty. All of this in the context of a lack of in-person communication. Despite this, the backbone organization continued to provide support to the teams, and all nine teams were able to continue their partnership activities in some form (i.e., continued use of the tools, virtual partnership meetings, or advocating for buy-in from BI stakeholders). Collaborative discussions processing success and challenges the cohorts experienced using the BID tools evolved how the BID collaborative approached packaging resources for dissemination. Via virtual connections, cohort 1 and the backbone organization collaboratively organized the set of tools (Figure 1) into an interactive online resource which includes a series of vignettes and partnership timelines (See Appendix J). Cohort 2 reviewed the online

resource and provided feedback to enhance the usability for future partnerships. The online resource was a significant shift from the original static conception of a toolkit. This new approach contextualized the tools in the timelines and lived experiences, taking care to represent both the successes and challenges of the partnerships.

Figure 1

The BID online collection of resources organized by three phases of the partnership development



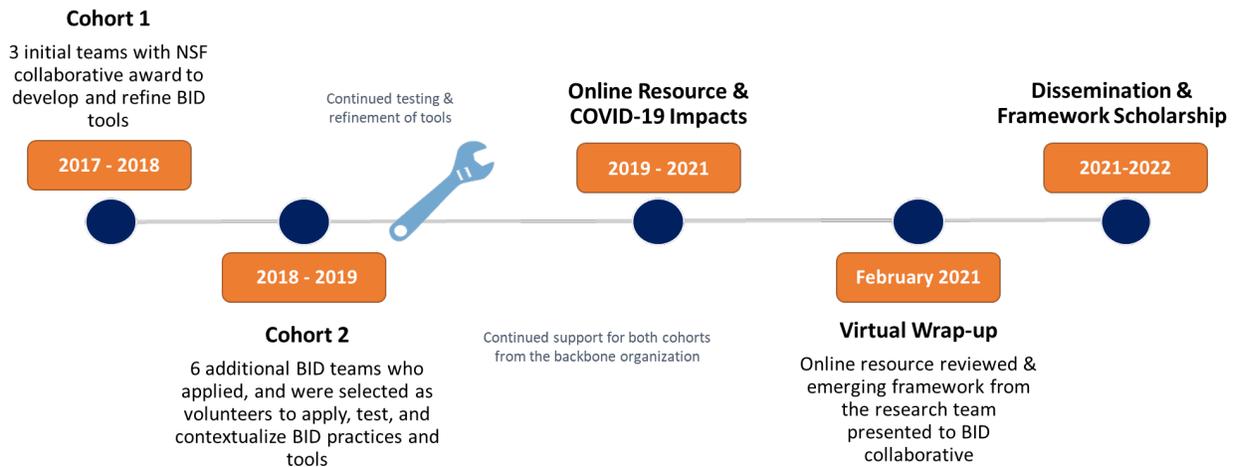
In February 2021 the backbone organization hosted a two-day virtual reflective wrap-up meeting with the entire BID collaborative and extended invitations to cohort 2 participants. Twenty-three attendees, including three members from the research & evaluation team, and two members from the backbone organization attended the two-day meeting. Cohort 1 had six members from the collective present, and 12 attendees represented cohort 2. During the wrap-up, a final review of the online resource was conducted. In addition, the research team shared their emerging conceptual framework and held focus group conversations with cohort 1 to discuss how well the draft framework and model reflected ISE and HEI actors' experiences of partnership. In March of 2021, the cohort 1 teams concluded their work and submitted final reports to NSF for their portion of the project.

In the final year of the project (Mar 2021-Mar 2022) the backbone organization and research team focused on: refining and disseminating the suite of tools; collecting data

to further iterate, improve and validate the conceptual framework; and generating relevant publications.

Figure 2

Chronological Order of BID Activities



Methods

The evaluation made use of data collected in tandem with the research, but analyzed the data in the context of five guiding evaluation questions (see below). A summary of the data collected and used to develop this summative evaluation is presented in Appendices (F, H, and I). The research team used two quantitative self-report instruments, a team pulse check (Appendix E) and a PI follow-up survey (Appendix G). Qualitative data collection included observational field notes from monthly virtual team meetings and a larger facilitated virtual workshop led by the backbone organization, annual partnership map revisions, semi-structured interviews with individuals and BID teams, and focus group conversations with ISE and HEI participants in peer organizational groups.

The below questions guided evaluative data collection and analysis. The findings are presented as narrative synthesis of the themes represented by each of these guiding questions.

1. **Partnership practices:** *How do BID teams communicate internally and productively adapt their structures and practices?*

2. **Tool development:** *In what ways did the process of tool development facilitate partnership for cohort 1 BID teams? To what degree is the toolkit relevant and useful for cohort 2 BID teams?*
3. **Support for PIs:** *In what ways does the implementation of BID team partnerships support PIs in successful broader impacts?*
4. **Institutionalization:** *What, if any, indicators point to partnership institutionalization?*
5. **Dominant and Persistent Challenges and Constraints:** *What challenges dominate and/or persist for the BID teams?*

The results are presented in aggregate across all nine BID teams, or by cohort 1 and cohort 2, to reduce the possibility that individual participant information is identifiable. It is important to note that each institution and team has distinct characteristics and dynamics (e.g., size, geography, staffing, turnover, programming, buy-in, resources, relationships, authority, autonomy, etc.) that impact how they designed, implemented and experienced the partnership. While aggregation of data makes some of these variations opaque, unique institutional and individual characteristics will factor into deeper analyses conducted as part of the research.

Findings

1. Partnership Practices

How do BID teams communicate internally and productively adapt their structures and practices?

	<p>65 BID team meetings between 2018- 2020 organized by backbone organization and observed by research team</p> <p>Cohort 1- Average of 11 meetings observed from 2018 – 2020</p> <p>Cohort 2- Average of 5 meetings observed during 2019</p>
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The formative evaluation indicated challenges for cohort 1 in understanding the substantially different organizational structures and daily work practices, such as those associated with grant proposal development, across different (HEI and ISE) institution types (Hoke & Risien, 2018). This challenge existed for cohort 2 as well; however, cohort 2 teams were able to build on the reflective practice recommendations (i.e., consistent communication and relationship-building activities) that emerged from formative evaluation of cohort 1. The importance of consistent communication and relationship-building was reflected across all data points for cohort 1 at the formative evaluation. For example, one BID team participant in cohort 1 shared the advice, “Talk a lot and talk early on, even if you have worked together before,” a clear indication of value for consistent communication regardless of existing partnership structures and practices.

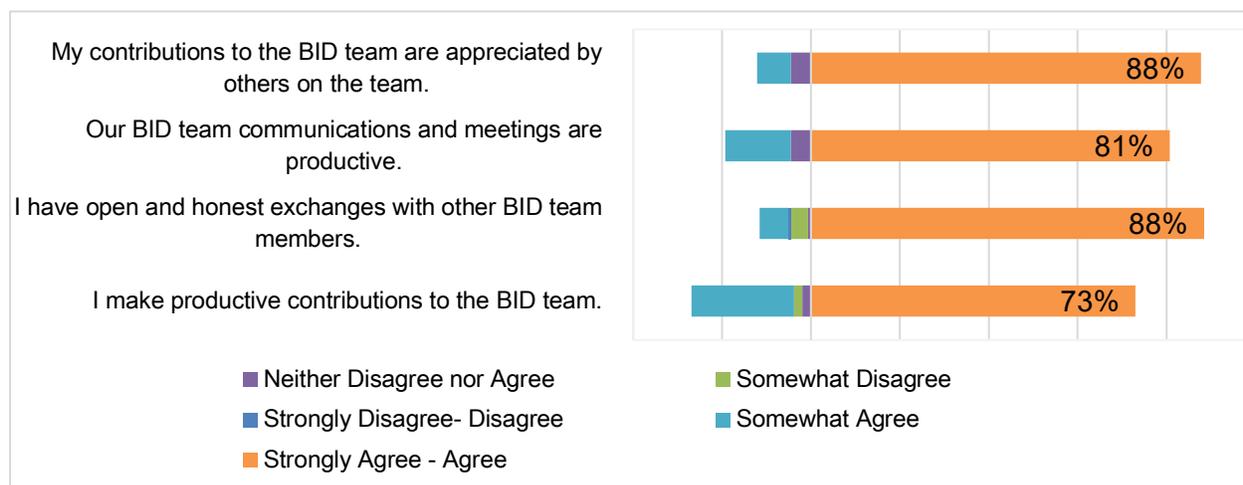
In the second year of the project, BID teams in both cohorts adapted communication practices, beyond routine team meetings organized by the backbone organization, as a way to build relationships and move towards the goal of institutionalization. These communication practices included relationship-building touchpoints (e.g., meetings or email communication), networking in similar professional circles, and introducing BID partners to institutional colleagues as a way to leverage support for the partnership across institution types. BI workshops also became a practice with seven of the nine teams co-hosting workshops for PIs. The workshops emerged as a relationship-building mechanism that strengthened the BID partnerships through co-developing and co-presenting within the common goals of encouraging and supporting quality BI activities.

Some teams intentionally shifted partnership practices to deepen inter-institutional understanding or to focus on shorter within-reach goals, rather than the long-term goal of institutionalization. The BI Menu (described in the next section) was one tool used by all the teams, many of which referenced the process of developing, as one that built a deeper understanding of what an ISE could offer. This also represented a practical within-reach goal to work towards rather than setting a goal of institutionalization which

many participants identified as requiring a level of agency, authority and buy-in beyond the team.

It is clear from both cohorts that consistent communication is a pathway to productive partnerships. Results of a quarterly pulse check survey, which monitored the health of the partnerships, showed high levels of agreement with two items we interpret as correlated: *My contributions to the BID team are appreciated by others on the team*; and *I have open and honest exchanges with other BID team members* (Figure 3). These responses suggest that BID teams have found valued communication practices, beyond the team meetings arranged by the backbone organization, which support BI work.

Figure 3
 BID Collaborative Pulse Check: Partnership Practices



Note. This figure illustrates the self-reported agreement on a Likert scale. Scale is on a divergent stacked bar graph, diverged between "Somewhat Agree" and "Strongly Agree – Agree." N=156.

2. Tool Development

In what ways did the process of tool development facilitate partnership for cohort 1 BID teams? To what degree is the toolkit relevant and useful for cohort 2 BID teams?



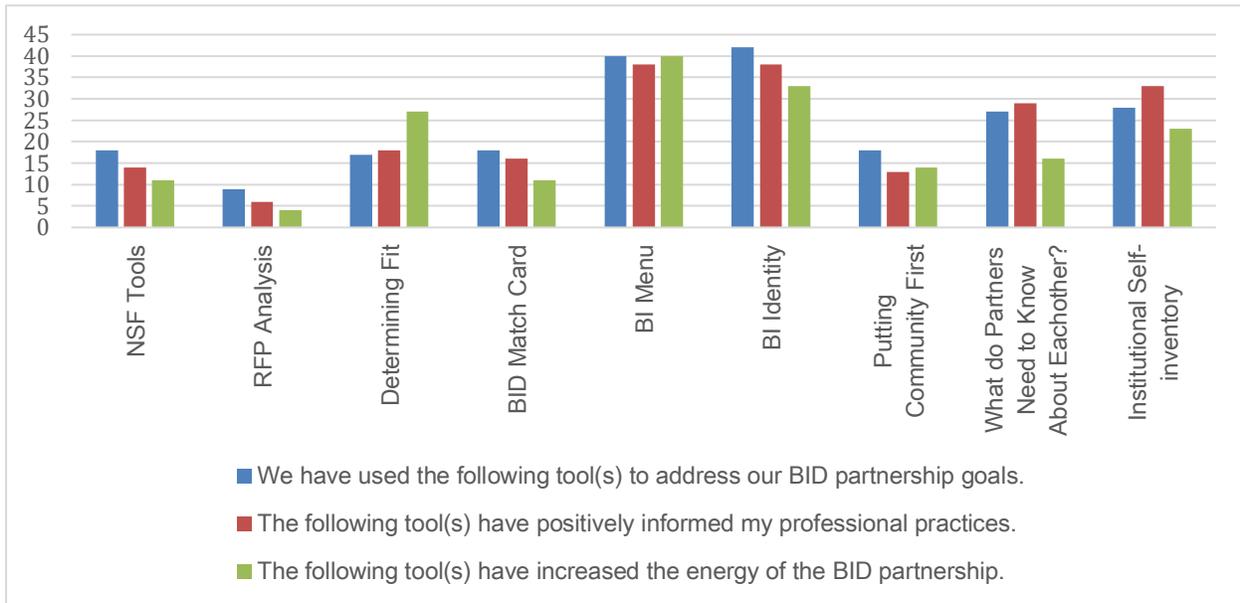
9 tools developed by Cohort 1 in year one and tested by all site-based teams in year two.

The tool development effort was consolidated in the first half of the project. The mid-way evaluation reported that cohort 1 expressed value in the collaborative process of developing the tools. During the development of the tools, cohort 1 referenced how a deeper dive into the roles and cultures within institutions provided an opportunity to better understand their partner institution by discussing practices that would support the partnership (e.g., communication, capacity, and navigation of cultural dynamics). While cohort 2 teams did not discuss these partnership practices in the context of developing the tools, they did benefit from using and reviewing the tools, which provided opportunities to better understand dynamics of partner institutions.

Following the November 2018 orientation with cohort 2, the six teams began reporting tool use on monthly pulse checks (Figure 4). Two tools emerged as the most used for cohort 2 teams. The BI Identity tool provides a framework to help PIs make a conceptual shift in thinking about BI as a burden to considering BI as an opportunity to express themselves, their strengths and values. The BI Menu encourages teams to collaboratively explore a breadth of BI options they can support and articulates the critical information (including the depth of implementation required for each option), and thus helped PIs gain a clear understanding of ISE capacities. In addition to usefulness in partnership development, the BID teams often commented on the relevance of these tools as a way to provide a common language and understanding between partners and PIs.

Figure 4

Frequency of Tool use among cohort 2 BID Teams.



Note. This graph illustrates the frequency of tool use among cohort 2 BID teams for one year of the project. Beyond use of the tools, BID team participants indicated the use of the tool to address goals, inform professional practices, and increase energy of the partnership during quarterly self-reports (n=72).

An example of this is how the BI Identity tool was associated with goal alignment for the teams. Cohort 2 participants who used the BI Identity tool also responded with high agreement on the two pulse check items *I clearly understand our BID team goals and current status* $r(71)=.32, p=.007$ and *Other BID team members clearly understand the BID team goals and current status* $r(71)=.35, p=.003$. The high agreement of both items were positively correlated with the BI Identity tool.

For newly developed partnerships, the tools were credited with establishing a common BI language both across and within organizations. Tools designed using BI terminology commonly used by the National Science Foundation provided an inter-institutional understanding of needs and goals and provided a template for teams to clarify and streamline the partnership-building process. The process of developing a BI Menu, a tool that outlines

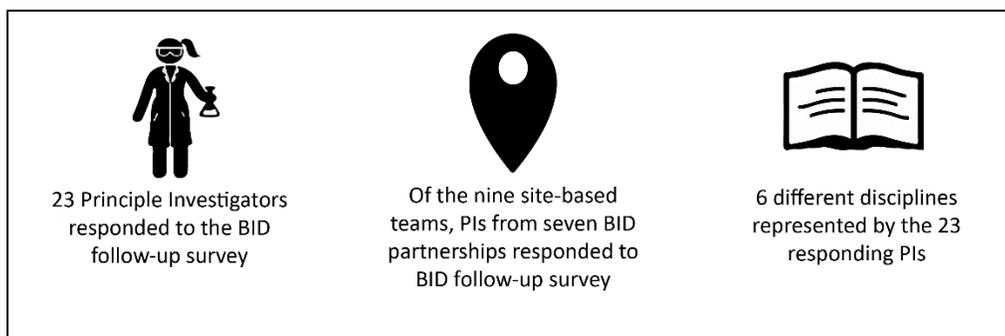
“We are not always sure what to charge or how to go about this, so [internal leadership] are excited about having some structure. So...create the menu...share what our scope is, then manage how the requests come in”. –ISE Partner

BI activities offered at an ISE, is another example of teams establishing clarity and commonality in BI language during the partnership process. Within organizations, the tools were also used as a way to socialize common NSF and Broader Impacts language in the process of collaborating on proposals. The featured quote from an ISE characterizes the common sentiment for ISEs around benefits of the tools as proactive measures to streamline BI activities and promote themselves as a partner to the HEIs. Beyond a common language, the tools provided ISEs a way to leverage their existing capacity and missions to support BI work and engage PIs in programs well aligned with their organization. The opportunity for ISEs to provide a formalized structure to support BI activities and PIs, rather than being responsive and adapt their programs and capacities to each PI request was just one way ISEs felt the power dynamic shift in the partnership.

The BI Menu created a starting point for BI ideation between the PIs and the partners. One partner described the BI menu as a boundary object, "... a discussion piece more than just a menu, a better way to get in touch with us." This further supports the idea that a newly developed online resource could serve as a mechanism to establish better understanding between partnering institutions through generated discussions around partnership practices.

3. Support for PIs

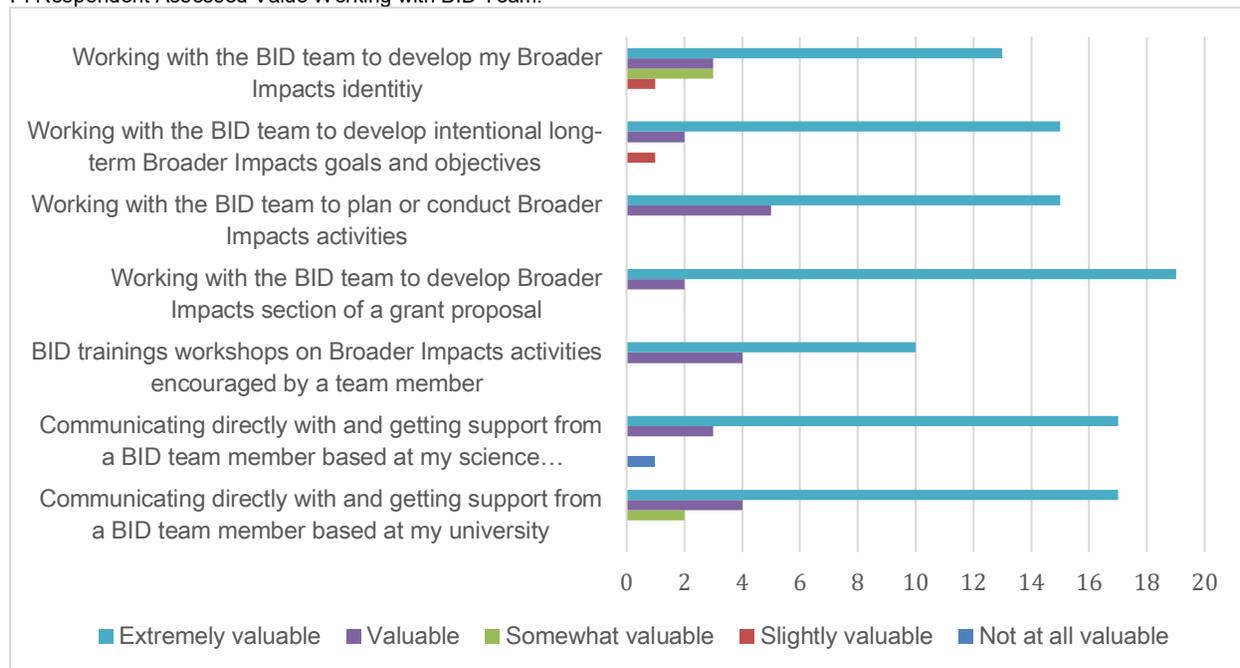
In what ways does the implementation of BID team partnerships support PIs in successful broader impacts?



PIs perceived the BI support from the BID teams as valuable. Responding PIs (n = 23) (See Appendix B) reported positive outcomes concerning support for ideation or development of BI statements for proposals, and BI implementation (Figure 5). Most responding PIs indicated that they had previous experience writing a BI statement for a NSF proposal (n=18). However, before engagement with the BID team, most had not received support in developing a BI statement (n=16) or ideating or expanding the possibilities of their BI work (n=17). Additionally, only half had experienced previous support implementing their BIs activities (n=12). Most PIs who participated in the survey, responded that they will continue to reach out to their university-based BID team participant (n=19) as well as their ISE-based partner (n=15), indicating that the support provided by the BID team partnership to the PIs was mostly successful and worthwhile for broader impacts.

Figure 5

PI Respondent Assessed Value Working with BID Team.



Note. This figure illustrates the value as assessed by the 23 PIs who responded to the BID Follow-Up Survey based on their experiences working for the BID teams. N=23.

A majority of the PIs responded that collaborating with the BID team resulted in improvement in their understanding of how to design and deliver BIs (n=19), create high-quality BI plans (n=17), and access a broad array of BI opportunities with ISL partners (n=14). Around half felt that they had an improved understanding of how to

evaluate broader impacts activities (n=13) and adapt their BI activities for the needs of their audience (n=10). Fewer felt that they had an improved understanding of how to use evidence-based public engagement strategies (n=6) indicating this is an area for future growth in partnership activities around PI professional development. It is worth noting that there is potential participant selection (by teams) and self-selection bias embedded in the PI survey (see Appendix B for more detail).

4. Institutionalization

What, if any, indicators point to partnership institutionalization?

	Prior to BID, 3 out of the 9 site-based teams had individuals who had worked collaboratively together on previous BI projects. All of the partnered HEIs and ISEs had some BI connection prior to BID, but had not worked as a partnership.
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The dynamic nature of these institutions, both at team and institutional levels highlighted that, while there were indicators of small shifts in institutional culture or practice, they fell short of supporting durable institutionalized partnerships. Through interviews and observations, BID teams emphasized some key themes that grounded the institutionalization goals in lived reality of partnership experiences. Each team entered into the BID effort with different sets of institutional and relational antecedents and BID team representatives with different levels of both positional and dispositional agency and power. For example, one team preceded the BID grant with robust professional relationships built over years of previous collaboration. This team spent less energy developing understanding and shared language than others. Another team that benefited from previous working relationships also benefited from dedicated BID staff time, active engagement of an HEI administrator, and higher-level decision-makers at the ISE. This team was able to quickly develop strategies for BI support across the HEI and ISE. They moved well beyond the ISE/HEI partnership to engage other community groups and build a local network of BI supports for PIs. The variety of institutional cultures, structures, and personal dynamics, existed regardless of teams' starting

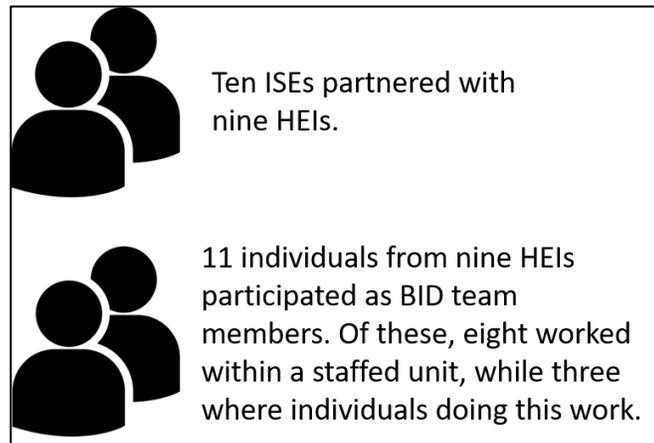
points. This highlighted that each partnership, while supported by the backbone organization and the same suite of tools, had to navigate and foster their partnership based on present and changing circumstances.

Having a long-standing relationship, however, does not ensure durability. The conclusion of the project brought retirement, staff changes, and shifted priorities for many teams, any one of these contributing to an unraveling of years dedicated to BI work between two individuals. Indeed, a key reflection of many BID teams is that the landscape is dynamic and partnerships are sometimes subject to swift changes in partnership conditions, staffing, and level of support from administrative leadership. While the BID grant funds enabled dedicated staff time to develop tools and nurture partnerships for the cohort 1 teams, significant staffing changes occurred throughout the project. Durability was a fragile and far-reaching concept; even in the well-established partnerships, it was not guaranteed. Among ISEs we observed promotion, a job loss (without replacement), and a broadening or shifting of portfolios. Among HEIs there was a retirement (without replacement), a job loss, shifting priorities of the employing unit, and substantial job insecurity related to COVID-19. Overall investment of administrative leaders did not guarantee durability. For the cohort 2 teams, the dedicated time of engagement and support from the backbone organization, just over a year, appears to not have been long enough to establish durability. However, during final reflections most teams indicated an intention, and residual capacity, to continue working together citing that individual, over institutional relationships, provided a basis for future partnership.

“...planting seeds... [to create] a self-feeding ecosystem.”

5. Dominant and Persistent Challenges and Constraints

What challenges dominate and/or persist for the BID teams?



Timing and capacity were continual challenges for the BID teams. Participants reported challenges in HEI and ISE institutional workflows as being out of sync (e.g., increased programming during the summer meant additional demands on ISE staff, while decreased teaching responsibilities during the summer meant PIs had more time for research, professional development, and BI activities). Teams reported losing momentum because of competing demands or lulls in BID activities. There was often a long duration between working with PIs on BI ideation and opportunities for implementation. ISEs may invest significant early effort at the grant planning stage, but it could be years before implementation and ISE conditions can change significantly in that time. Team participants indicated that they did not always feel that their counterparts clearly understood the goals or current workflow, which is likely a result of these out-of-sync challenges. All cohort 1 teams reported that occasional physical co-location (e.g., HEI professionals working or meeting at the ISE, or participating in ISE programs) helped to mitigate these issues, especially when the HEI partner could witness the daily workflow of the ISEs. The BID mid-way report recommended design-based project planning to help the teams with continual goal alignment, and the pulse-checks suggest slight improvement in goal alignment and organizational understanding. However, the interruption of COVID-19 created unforeseen challenges (i.e., staff loss, capacity changes, and interrupted focus) for many of the teams.

The BID teams represent a broad set of arrangements of how institutions support BI work, from a network of individuals to an office of one, and from staff dedicated to this work to staff doing BI work in addition to many other obligations. This array of structures either supported or limited the capacity to grow and institutionalize partnerships beyond person-to-person interactions. Capacity to invest in the partnership was often limited by institutional commitment of staff time to build BID teams and associated partnership activities. BID partners often negotiated competing demands, balancing multiple roles in their organizations. In addition to competing demands, feelings of agency to make decisions varied widely among BID actors in both HEI and ISE organizations. Both ISE and HEI representatives reported a lack of buy-in from “gatekeepers” or administrators stifling both agency and capacity. The pulse check item with the lowest level of BID team participant agreement was, *“I have opportunities to share what I have learned through BID with others at my institution.”* This indicates that the capacity of the BI partnership and BI activity was limited to individuals or small team endeavors. Furthermore, institutionalization and partnership durability are constrained by a lack of consistent support from administrators and persistent challenges of timing and capacity.

The BID Model

The BID research proposed a hypothetical initial BID model (Figure 6) as a prediction of a functional inter-institutional partnership structure. This included three central roles around Broader Impacts Design. In addition this model included two peripheral roles: a learning scientist as an expert advisor connected to the HEI; and a community partner connected through the ISE. The findings, however, support a different and more complex BID partnership structure to more explicitly consider the context around which the various connections in the BID teams existed (Figure 7). The key differences are responsive to the observations and emphasis of BID teams during their reflective meetings and interactions with the research team. The landscape (represented in Figure 7 as top-down stimulus, field and community support infrastructures, HEI and ISE supports) turned out to be a prevalent part of the process of interinstitutional understanding and contextualizing BI work in a way that resonated with administrators.

Community partners were considered important to the backbone organization and HEIs, however ISEs in particular were guarded about engaging a community partner organization. They reported that social capital with existing or potential partners was precious, and they wanted to avoid asking those organizations to work in service to the emergent BID partnership, when the value and return on investment was undetermined. Instead they opted to focus on understanding and collaborating between the ISE and HEI and only later engaging local organizations as BI stakeholders, not partners. While the RS professional is not specifically addressed in the second model (Figure 7), the RS professional and the STEM education professional are recharacterized as HEI brokers. The learning scientists are also missing in the second model. This is a function of logistical challenges in finding a learning scientist who might happen to have the same focus area and both the ISE and HEI representatives feeling the team indeed already had the expertise on learning through public engagement needed, and as a result learning scientists were not engaged as part of the BID team. Figure 7 represents an aggregate model as observed across the 2 cohorts. It is a precursor to the more dynamic conceptual framework under development that will capture structure, but also change over time and flows in and out of the system.

Figure 3

Initial Proposed BID Partnership Model. Community partners were meant to include local NGOs and other BI-serving organizations beyond the ISE. RS Professional were meant to represent a research development and/or administration professional. The Learning Sciences Advisor was intended as a university-based researcher to serve as the expert on learning in the design of BI activities. The STEM PI was meant as a PIs representative.

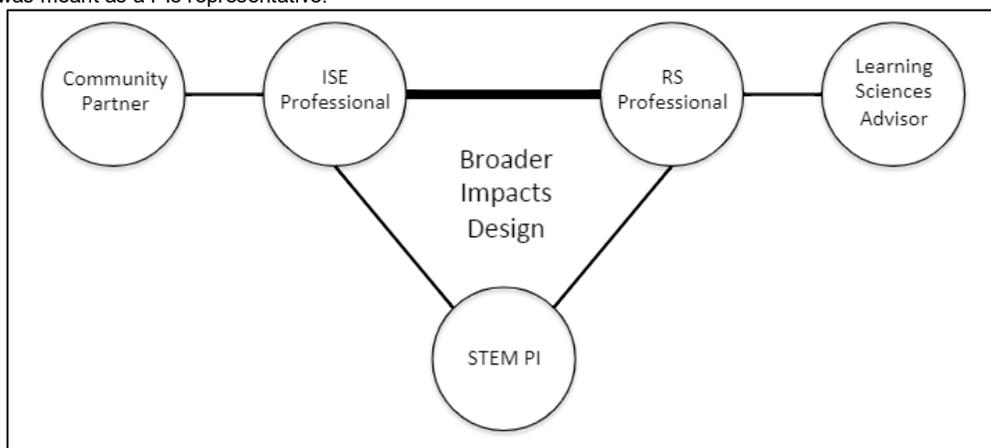
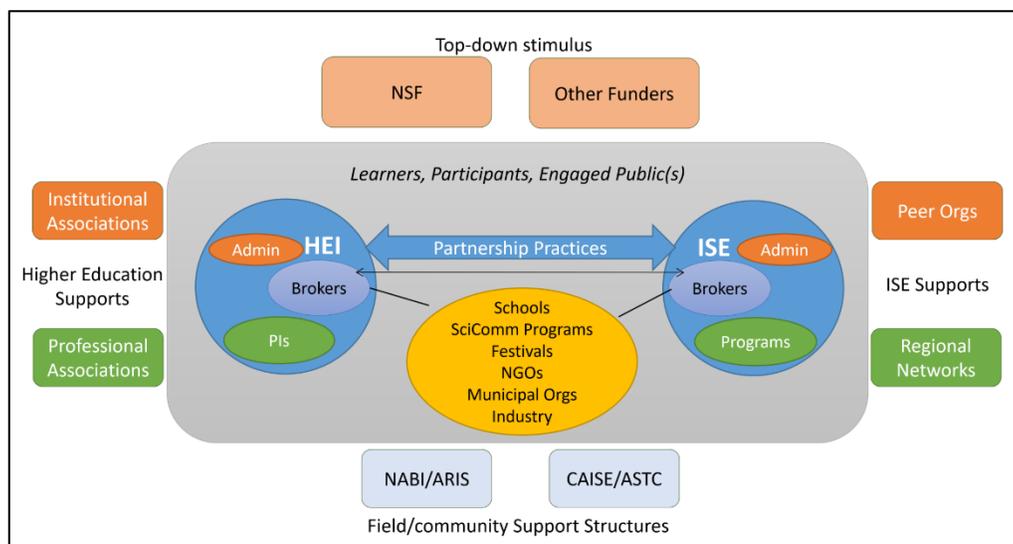


Figure 4

Conceptual BID Partnership Model presented as an iteration on the original. This model identified the larger landscape within which the BID team operated and the different roles within the ISE and HEI. Partnership practices were emphasized, community partners were specified.



Conclusions

Overall the BID effort supported the development of inter-institutional relationships and understanding resulting in significant support for PIs in their BI efforts. The iterative nature of the teams, adapting and refining roles and partnership practices, revealed the importance of communication, reflective practices around goal alignment, and understanding inter-institutional culture. Teams were able to build a strong foundation built by relationship tending activities that ultimately supported a pathway for PIs to enhance their BI activities.

The findings from this evaluation point to the online resource with the BID tools, timelines, and vignettes (See Appendix J) as an important resource to support inter-institutional partnership practices, between HEIs and ISEs, around the design of education-based BI experiences. The findings highlight the importance of the tools

themselves and the process of tool development to develop productive partnership practices and shared understanding and language across HEIs and ISEs, a central element of the BID model.

More broadly, the project revealed some key structural barriers to durable and institutionalized partnerships between HEIs and ISE. The barriers include capacity for this work, buy-in from administrators, and the variable timing and cadence of workflows between ISEs and HEIs. The project overwhelmingly reveals that nurtured relationships between individuals are a driving force in collaboration across institution types. Any aspirations for “institutionalization” are unlikely to be successful without attending the agency and connections between those who broker the relationships.

The teams provided feedback on a second-generation model (Figure 7), suggesting more complexity and dynamism would better represent the experiences of the changeable nature of the diverse set of partnerships. This feedback will guide the research team's development of a conceptual framework intended to generate and disseminate new knowledge around inter-institutional partnerships to support BI. Additional work and long-term investments are needed to understand the lifecycle of such institutional partnerships, including how they build durability over time, despite interruptions, in a dynamic landscape of BI.

Recommendations

The below recommendations are intended to assist HEIs and ISE in development and sustainability of partnerships to support BI.

Partnership Practices

Early establishment of consistent meetings provides partnered accountability to team goals. Partners should consider regularly re-centering the intent and partnership goals and adapt communicative and collaborative practices to align their individual and collective goals.

Effective team communication should include multiple relational touchpoints. Regular email, phone, and in-person meetings can be augmented by inter-institutional visits and networking to introduce partners to multiple colleagues across institutions. Such networking can provide pathways for administrator buy-in and can buffer the impact of turnover and position changes.

Tools developed by BID teams, such as the BI menu, are available through the BID online resource site (<https://popnet.instituteforlearninginnovation.org/bid-home/bid-tools/>). Inter-institutional engagement with these tools is generative of partnership development and understanding how PI needs and ISE priorities can align. Partners should consider utility of the tools as a resource to guide reflection and re-centering of BI goals.

Tool development

Establish shared activities to provide opportunities for collaborative learning and understanding of inter-institutional practices and cultural norms. Pursue common outputs and outcomes to enhance shared responsibility and accountability. Practices might include co-hosting or co-presenting workshops, joint professional collaborations with national BI organizations, such as ARIS, and using or adapting BID tools to establish a common language and generate understanding of partners.

Support for Principal Investigators (PIs)

Proactively invest in partnership development between HEIs and ISEs. This builds the inter-institutional understanding first and enables both more informed support of PIs and better integration of BI with ISE programs and priorities.

Future work is needed to understand the use of evidence-based public engagement implementation responsive to the needs and interests of public audiences and how the inter-institutional partnerships may support the use of evidence-based practices by PIs. Formal training in evidence-based public engagement practices should also be considered for PIs involved in public engagement with science.

Institutionalization

Building durability is a long-range effort subject to ever-changing staff and cultural conditions of ISEs and HEIs. There is no substitute for the practice of relationship building, especially the initial investment in building a foundation. Individual partners should consider establishing a solid understanding of partner institutions and a pathway for inter-institutional communication as foundational practices towards durability. The viability of the partnerships may be influenced by the foundation built from individual partners.

Challenges and Constraints

Design-based approaches, where teams design an initial plan, but intentionally reflect and iterate as the partnership progresses, can help teams with continual goal alignment and inter-institutional understanding. In order for inter-institutional partnerships to effectively support BI at scale they must move beyond individual relationship-based partnerships. Investment from administrators is, of course, necessary. Partners should leverage connections to national organizations such as ARIS and ASTC to help inspire share with administrators the BI activities of their peers and inspire them to invest. Connecting BI to institutional level goals and espoused values can also remind administrators of the value of BID partnerships.

Appendices

A. Partnership List

Cohort 1 (2017 - 2020):

- Wisconsin - Wisconsin Institutes for Discovery and University of Wisconsin, Madison;
- Washington - Pacific Science Center and University of Washington, Bothell; and
- New York - Sciencenter and Cornell University, Ithaca.

Cohort 2 (2018 - 2019):

- Minnesota - Minnesota Zoo and University of Minnesota;
- Colorado - Science Discovery and University of Colorado, Boulder;
- California - Fleet Science Center and University of California, San Diego;
- North Carolina - North Carolina Museum of Natural Sciences and Museum of Life and Science and Duke University;
- New Hampshire/Vermont- Vermont Institute of Natural Science and Dartmouth Guarini School of Graduate and Advanced Studies; and
- New Mexico - Explora and University of New Mexico.

B. Data Collection & Sample

Data collection and analysis for the evaluation encompassed all of the qualitative and quantitative data for the research and informed consent was obtained. Periodic reminders about the study were given with receipt of pulse checks as well as during interviews and focus groups.

Qualitative data for the project was gathered from observational field notes, interviews, partnership maps, and a focus group meeting. Throughout the project, observations were done by the research team during monthly team calls, all-hands calls, and the kick-off for cohort 2 BID teams. Field notes were maintained for all observations. Quantitative data for the project included quarterly pulse checks and a PI survey.

Partnership Maps. Starting with the cohort 1 BID teams, partnership maps were created during the 2017 kick-off and were then revised six months later. The six cohort 2 teams created their baseline partnership map during the 2018 kick-off meeting. All nine teams completed a revised map one year later, along with a short Q & A with a member of the research team. The baseline and two set of revised maps for Cohort 1 are found in Appendix G.

Pulse Checks. A Qualtrics link for the pulse check was emailed quarterly to BID team participants to collect feedback on team dynamics. The modified pulse check consisted of three open-ended questions, 18 Likert rating-based items for five different scales from Koepflefer & Koepflefer, 2011 and Taylor-Powell, Rossing, & Geran, 1998, and 27 dichotomous (yes/no) questions related to the tools developed in the first year of the project by the BID Collaborative (Appendix C). The eight participants from cohort 1 BID teams received a total of 11 pulse checks, while 14 participants from cohort 2 BID teams received a total of 7 pulse check surveys. Staff turnover occurred at each of the three initial teams during the length of the project, so accounting for the absence of staff over the 11 quarterly pulse checks, there was a 96% response rate. Cohort 2 participants responded 72 times for a 73% response rate.

PI Surveys. An anonymous Qualtrics link for the PI survey was emailed to the BID teams who then sent it out to PIs they worked with during the project. The PI survey consisted of 15 questions, including one open-ended question focused on prior BIs experience and how their BIs work/activities changed or improved while working with the BID teams.

The target sample size was 3 PIs per each of the 9 BID teams for a total of 27 responses. In total, 55 invites went out, a majority of these were from the NY team (24) and the WA team (19), and three of the teams did respond to the requests or send out invites. We received 23 responses, a 42% response rate, however, the distribution was not even across the nine teams, with more representation from the 2 of the 3 cohort 1 teams.

C. Pulse Check Instrument

Default Question Block

Thank you for your participation in the quarterly BID partnership questionnaire. **This version of the survey should display your answers from the last questionnaire and allow you to update your responses where needed.**

If you have not already done so, please review the [Explanation of Research](#) and click below to start the survey when you are ready.

Scale questions

Considering your Broader Impacts Design partnership, please select the appropriate level of agreement for the following statements.

The pre-selected response options display your answer from the last check-in. Please update each response as needed based on your current situation.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I feel energized by the current BID partnership activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel optimistic about the long-term potential of our BID partnership.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other BID team members seem energized by the current BID partnership activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our BID partnership has clear goals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I clearly understand our BID partnership goals and current status.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other BID partnership members clearly understand the BID team goals and current status.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our BID partnership focuses efforts appropriately to address our goals.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Considering your Broader Impacts Design partnership, please select the appropriate level of agreement for the following statements.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I make productive contributions to the BID partnership.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have open and honest exchanges with other BID partnership members.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Our BID partnership communications and meetings are productive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My contributions to the BID partnership are appreciated by others on the team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am accessing new tools and resources through participation in the BID partnership.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Considering your Broader Impacts Design partnership, please select the appropriate level of agreement for the following statements.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I am applying new professional practices as a result of participation in the BID partnership.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am gaining new insights about my work through my involvement in the BID partnership.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My engagement in the BID partnership is supported by my supervisor(s).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
BID activities are gaining recognition at my institution/organization.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have opportunities to share what I have learned through BID with others at my institution.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
My institution/organization views me as a resource on broader impacts because of my involvement with BID.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Tools

Can you indicate how the tools are informing the health of your BID partnership?

	We have used the following tool(s) to address our BID partnership goals. Choose all that apply	The following tool(s) have positively informed my professional practices. Choose all that apply	The following tool(s) have increased the energy of the BID partnership. Choose all that apply
Self-inventory	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BI Design Assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BI Partnership template	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BI Identity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BI Menu	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BI Evaluation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
BI Project Development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Partnership Development (ISE-PI)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
RFP Analysis Tool	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NSF Proposal Tools (LOS, NSF Guidance, Checklist, Proposal Development)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Open ended

Please complete the following statements.

On the last check-in, we asked you about one **change or action** your BID team should consider.

Do you have any updates about the suggestion you provided? You may delete or edit the answer below.

If you did not complete the last check-in, you may provide one **suggestion of one change or action the BID team should consider.**

On the last check-in, we asked you about one thing your BID team should **absolutely continue.**

Do you have any updates about the suggestion you provided? You may delete or edit the answer below.

If you did not complete the last check-in, you may provide one **suggestion of something the BID team should absolutely continue.**

Is there anything else you would like to share or explain about your answers?

D. Pulse Check Summary

Inter-Item Correlation Tables for all Five Scales

Table D1

Reliability Statistics of the Five Pulse Check Scales (Energy, Goals, Communication, Professional Capacity and Institutionalization).

Scale	Cronbach's Alpha	N of Individual-Level Items	N of Group-Level Items	N of Scale Items
Energy	.812	2	1	3
Goals	.928	1	3	4
Communication	.760	3	1	4
Professional Capacity[1]	.794	3	-	3
Institutionalization[2]	.715	4	-	4

[1] Elimination of the item "I am accessing new tools and resources through participation in the BID team; $\alpha=.89$, [2] Elimination of the item "My engagement in the BID team is supported by my supervisor(s); $\alpha=.82$ (Table F5).

Table D2

Reliability and Descriptives for Energy Scale Items in the Pulse Check

	<i>M (SD)</i>	1.	2.
1. I feel energized by the current BID team activity.	5.74(1.27)	-	
2. I feel optimistic about the long-term potential of our BID team.	6.18(0.97)	.54	
3. Other BID team members seem energized by the current BID team activity.	5.79(1.06)	.68	.57

$\alpha=.81$

Table D3

Reliability and Descriptives for Goal Scale Items in the Pulse Check

	<i>M (SD)</i>	1.	2.	3.
1. Our BID team has clear goals.	5.48(1.34)	-		
2. I clearly understand our BID team goals and current status.	5.59(1.10)	.80	-	
3. Other BID team members clearly understand the BID team goals and current status.	5.23(1.24)	.73	.82	-
4. Our BID team focuses efforts appropriately to address our goals.	5.52(1.18)	.67	.80	.81

$\alpha=.93$

Table D4

Reliability and Descriptives for Communication Scale Items in the Pulse Check

	<i>M (SD)</i>	1.	2.	3.
1. I make productive contributions to the BID team.	5.93(.86)	-		

2. I have open and honest exchanges with other BID team members.	6.24(.97)	.44		
3. Our BID team communications and meetings are productive.	6.02(.77)	.26	.50	
4. My contributions to the BID team are appreciated by others on the team.	6.05(.69)	.58	.08	.37

$\alpha=.76$

Table D5

Reliability and Descriptives for Professional Capacity Scale Items in the Pulse Check

	<i>M (SD)</i>	1.	2.
*1. I am accessing new tools and resources through participation in the BID team.	5.70(.96)	-	
2. I am applying new professional practices as a result of participation in the BID team.	5.65(1.29)	.44	-
3. I am gaining new insights about my work through my involvement in the BID team.	5.99(1.09)	.41	.81

$\alpha=.79$

*If deleted, $\alpha=.89$; A Principal Component Analysis further indicates that the item "I am accessing new tools and resources through participation in the BID team", has little variance and is not well represented.

Table D6

Reliability and Descriptives for Institutionalization Scale Items in the Pulse Check

	<i>M (SD)</i>	1.	2.	3.
*1. My engagement in the BID team is supported by my supervisor(s).	5.88(1.14)	-		
2. BID team activities are gaining recognition at my institution/organization.	5.41(1.22)	.22	-	
3. I have opportunities to share what I have learned through BID with others at my institution.	5.53(1.20)	.11	.61	-
4. My institution/organization views me as a resource on broader impacts because of my involvement with BID.	5.61(1.19)	.13	.57	.63

$\alpha=.72$

*If deleted, $\alpha=.82$; A Principal Component Analysis further indicates that the item "My engagement in the BID team is supported by my supervisor(s)", has little variance and is not well represented.

E. PI Follow-up Survey Instrument

Is this the first time you have been supported in...(check all that apply)	
	Yes
...writing a broader impact statement?	<input type="checkbox"/>
...ideating or expanding the possibilities of your broader impacts focused on public engagement with science?	<input type="checkbox"/>
...implementing your broader impacts work focused on public engagement with science?	<input type="checkbox"/>

Is your partnership with the BID team part of an NSF CAREER award or proposal?

Yes

No

Prior to working with the BID team, what was your experience with the following Broader Impacts (BI) work (check all that apply)?
I have...

...considered how you would address the BI statement in a NSF proposal.

...written a BI statement in a NSF proposal.

...implemented BI work focused on public engagement with science as a result of a NSF award.

...implemented BI work focused on public engagement with science not as a result of a NSF award.

Prior to working with the BID team, what was your experience with public engagement with science?
I have conducted...(check all that apply)

...either a lecture or discussion with audience interaction.

...a hands-on activity in which the audience directly manipulates objects.

...a tour (e.g., lab tour, nature walk, etc...).

...a demonstration in which the audience observes but does not directly manipulate objects.

...a citizen science project.

none of the above

Other:

How did you come to partner with the BID team (select one)?

- A BID team member who I know well reached out to me.
- A BID team member who I don't know well or at all reached out to me.
- Another researcher (not part of the BID team) recommended that I partner with the BID team.
- An institutional leader (not part of the BID team) recommended I partner with the BID team.
- I learned about the BID team at a training or other event.
- Other...

How did the BID team support you (check all that apply)?

The BID team supported me...

- ...at the beginning of the project phase (prior to writing the Broader Impact statement).
- ...while I was writing the proposal/Broader Impact statement.
- ...after I had been awarded funding that included Broader Impact work focused on public engagement with science.
- ...in developing and delivering public engagement with science unrelated to a proposal.
- ...in identifying and delivering a Broader Impacts identity or legacy (Here we mean how your Broader Impacts activities intersect with your own values and identities).

What is the nature of the project you developed with the BID team (check all that apply)?

- Lecture or discussion with audience interaction.
- Hands-on activity in which the audience directly manipulates objects.
- Tour (e.g., lab tour, nature walk, etc..).
- Demonstration in which the audience observes but does not directly manipulate object(s).
- Citizen science.
- None of the above.
- Other:

Please share how you regarded the following support from BID team members on the following:

	Not at all valuable (0)	Slightly valuable (1)	Somewhat/Moderately valuable (2)	Valuable (3)	Extremely valuable (4)	Not applicable

	Not at all valuable (0)	Slightly valuable (1)	Somewhat/Moderately valuable (2)	Valuable (3)	Extremely valuable (4)	Not applicable
Communicating directly with and getting support from a BID team member based at my university.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communicating directly with and getting support from a BID team member based at my science center/zoo/museum.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
BID trainings or workshops on Broader Impacts activities encouraged by a BID team member.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Working with the BID team to develop a Broader Impacts section of a grant proposal.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Not at all valuable (0)	Slightly valuable (1)	Somewhat/Moderately valuable (2)	Valuable (3)	Extremely valuable (4)	Not applicable
Working with the BID team to plan or conduct Broader Impacts activities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Working with the BID team to develop intentional long-term Broader Impacts goals and objectives.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Working with the BID team to develop my Broader Impacts identity (Here we mean how your Broader Impacts activities intersect with your own values and identities).	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Not at all valuable (0)	Slightly valuable (1)	Somewhat/Moderately valuable (2)	Valuable (3)	Extremely valuable (4)	Not applicable
Other: <input type="text"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please indicate your level of agreement with the following statements.
Because of my engagement with the BID team process, I...

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
...know who or where in the university I can access resources to plan and conduct Broader Impacts activities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...know who or where in the science center/zoo/museum I can access resources to plan and conduct Broader Impacts activities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...am able to expand or create new Broader Impacts activities by building on the ones I developed with the BID team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
...will continue to reach out to the university-based BID members and/or organizations to plan and conduct Broader Impacts activities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...will continue to reach out the science center/zoo/museum to plan and conduct Broader Impacts activities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
...will expand or create new Broader Impacts activities by building on the ones I developed with the BID team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Since engaging with the BID team I have an improved understanding of how to...(check all that apply)

- ...design and deliver Broader Impacts.
- ...adapt my public engagement to the needs of audiences.
- ...evaluate Broader Impacts activities.
- ...create high quality Broader Impacts plans in future NSF proposals.
- ...use evidence-based public engagement practices.
- ...access the broad array of broader impacts opportunities working with science center/zoo/museum partners.

Is there anything else you would like to share about engaging with the BID partnership or Broader Impacts in general?

Would you be willing to participate in a 30-minute interview to talk more about your experiences planning and implementing Broader Impacts. If so, please share contact info below.

Name

Email address

Phone number

Thank you for your time.

F. PI Follow-Up Survey Summary

Table F1

PI surveys total count and percent of responses per BID team state

<i>BID Team State</i>	<i>n</i>	<i>Percent</i>
CA	1	4.3
MN	2	8.7
NC	1	4.3
NM	4	17.4
NY	6	26.1
WI	1	4.3
WA	8	34.8
Total	23	100.0

N=23

Table F2

PI survey total count and percent of represented science disciplines

<i>Discipline of PI</i>	<i>n</i>	<i>Percent</i>
Computer science	2	8.7
Design science	1	4.3
Engineering	6	26.1
Natural science	10	43.5
Physical science	2	8.7
Social and Behavioral science	2	8.7
Total	23	100.0

Note. There were no PI's who responded in the Arts/Humanities discipline. N=23

Table F3

PI survey total count and percent of responses per PI's self-reported career stage

Career Stage	<i>n</i>	<i>Percent</i>
Early career Researcher	14	60.9
Mid-career Researcher	6	26.1
Senior Researcher	3	13.0
Total	23	100.0

Note. There were no PI's who responded that were either Extension Faculty, Graduate students, or Post-Doctoral students. N=23

Table F4

Experience of PI on BI-related experiences, including BI statements and public engagement with science

Experience	<i>n</i>
Considered how to address the BI statement in a NSF proposal	16
Written a BI Statement	18
Implemented BI work focused on public engagement with science as a result of a NSF award	6
Implemented BI work focused on public engagement with science not as a result of a NSF award	7
Had conducted either a lecture or discussion with audience interaction	12
Had conducted a hands-on activity in which the audience directly manipulates objects	10
Had conducted a tour (e.g., lab tour, nature walk, etc...)	11
Had conducted a demonstration in which the audience observes but does not directly manipulate objects	8
Had conducted a citizen science project	7

N=23

G. Cohort Partnership Maps (three sets)

New York Partnership Maps:

Figure G1

New York Concept Map, September 2017

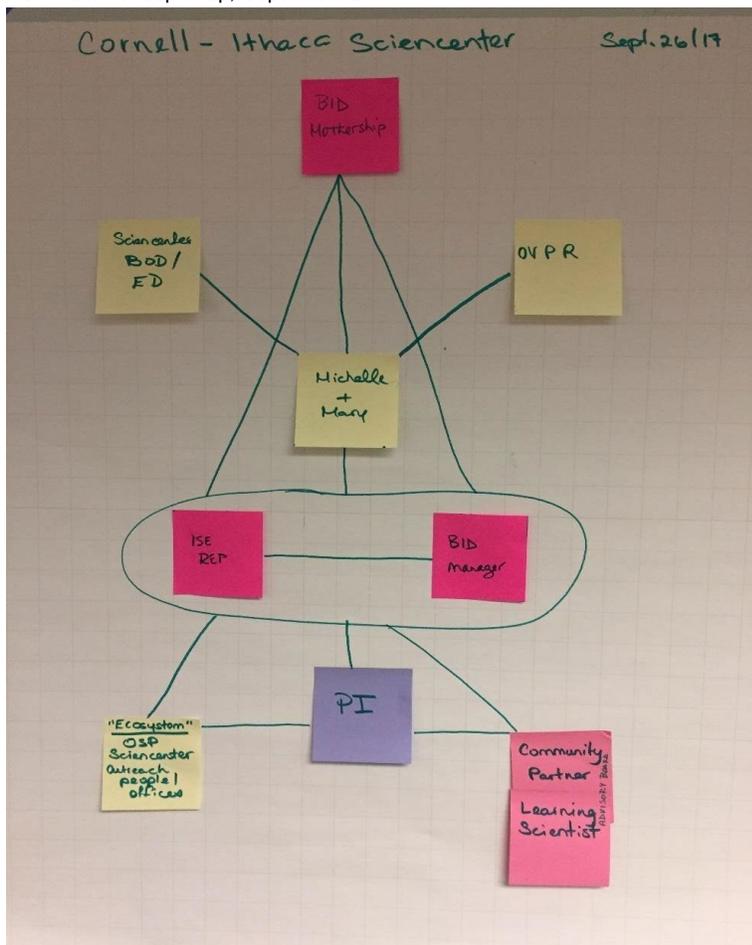


Figure G2

New York Concept Map, April 2018

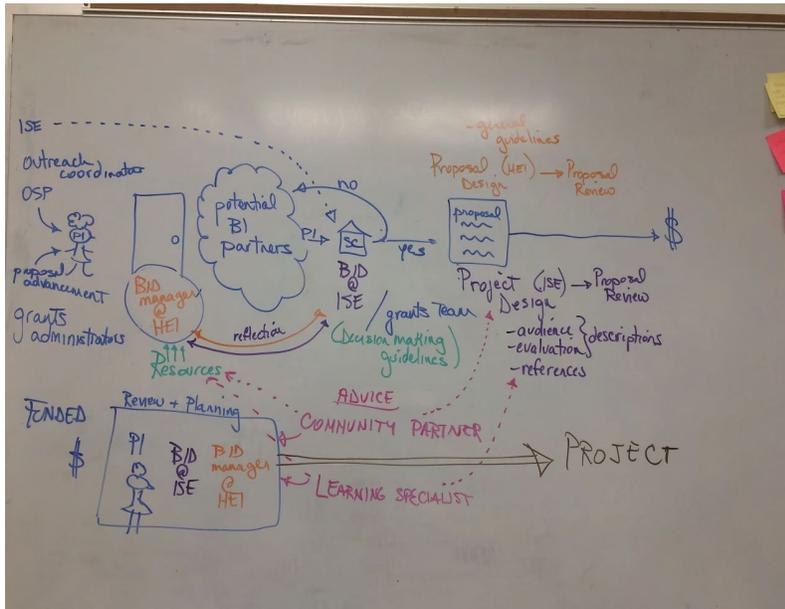
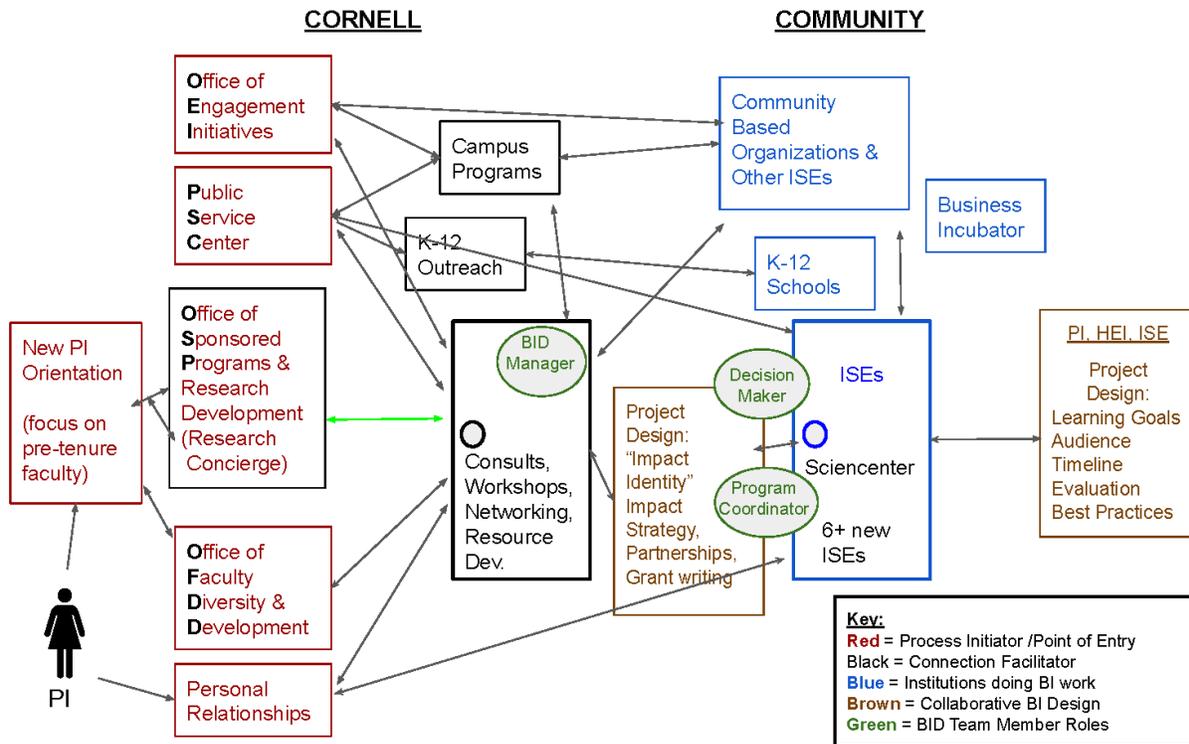


Figure G3

New York Concept Map, October 2019



Wisconsin Partnership Maps:

Figure G4

Wisconsin Concept Map, September 2017

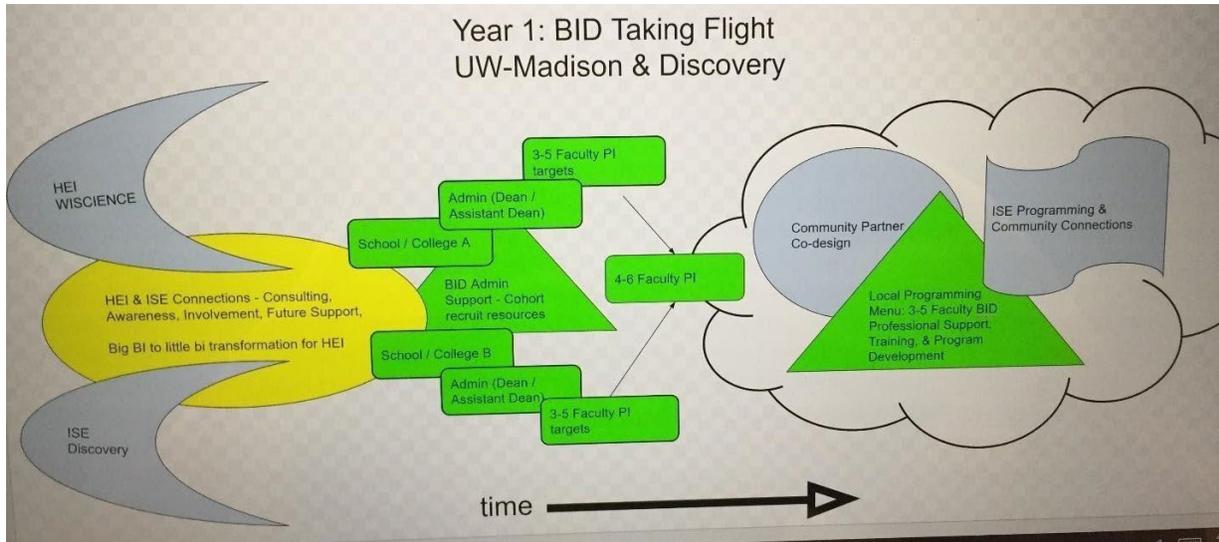


Figure G5

Wisconsin Concept Map, April 2018

BID Taking Flight April 2018 UW-Madison & Discovery

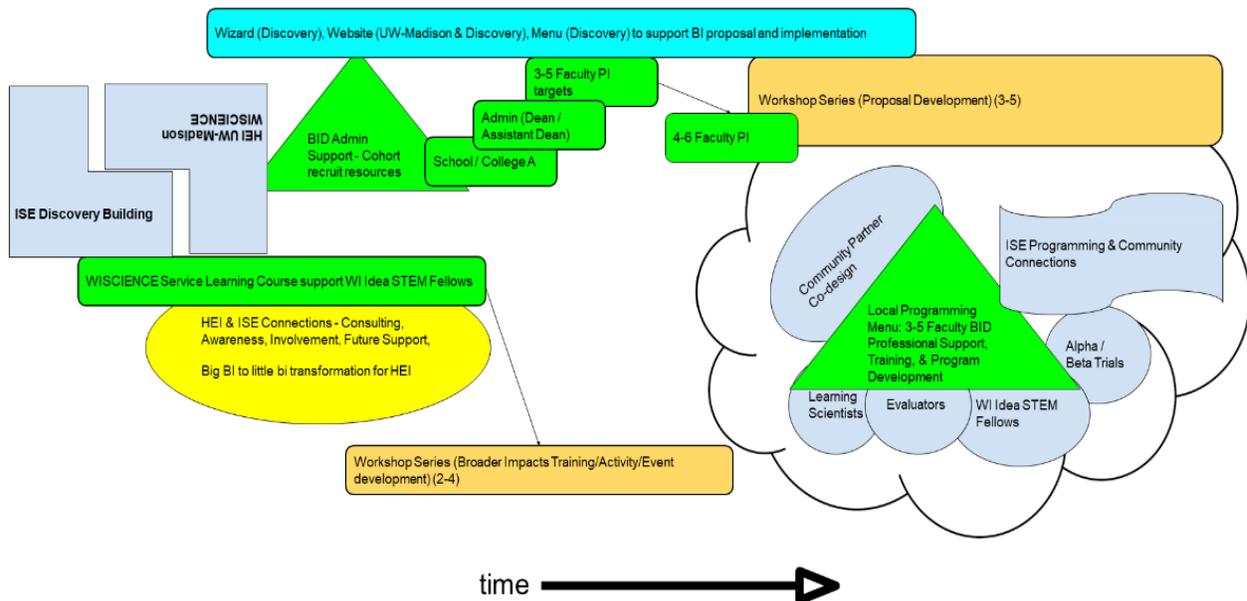
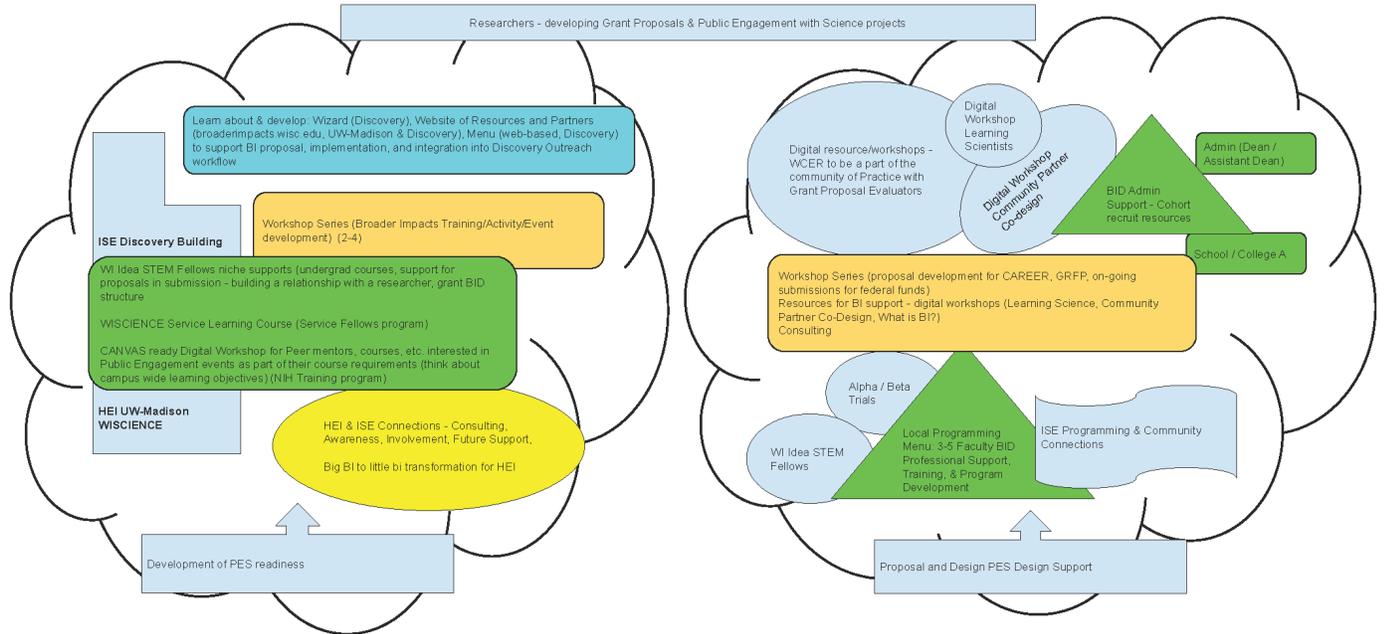


Figure G6

Wisconsin Concept Map, November 2019

Broader Impacts Design - Current State - Dec 2019 UW-Madison & Discovery
 Grant Proposals and Institutional Commitment supported by Public Engagement with Science Proposal development



Washington Partnership Maps:

Figure G7

Washington Concept Map, September 2017

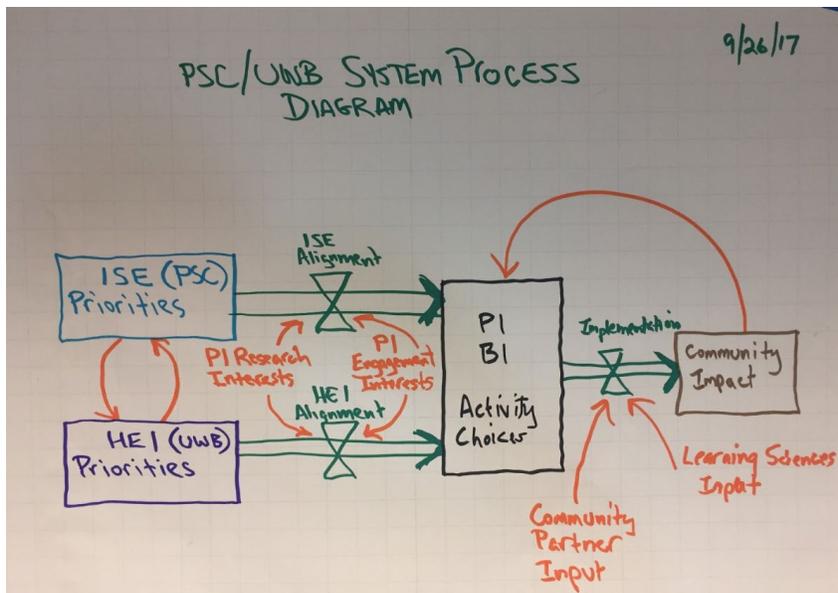


Figure G8

Washington Concept Map, April 2018

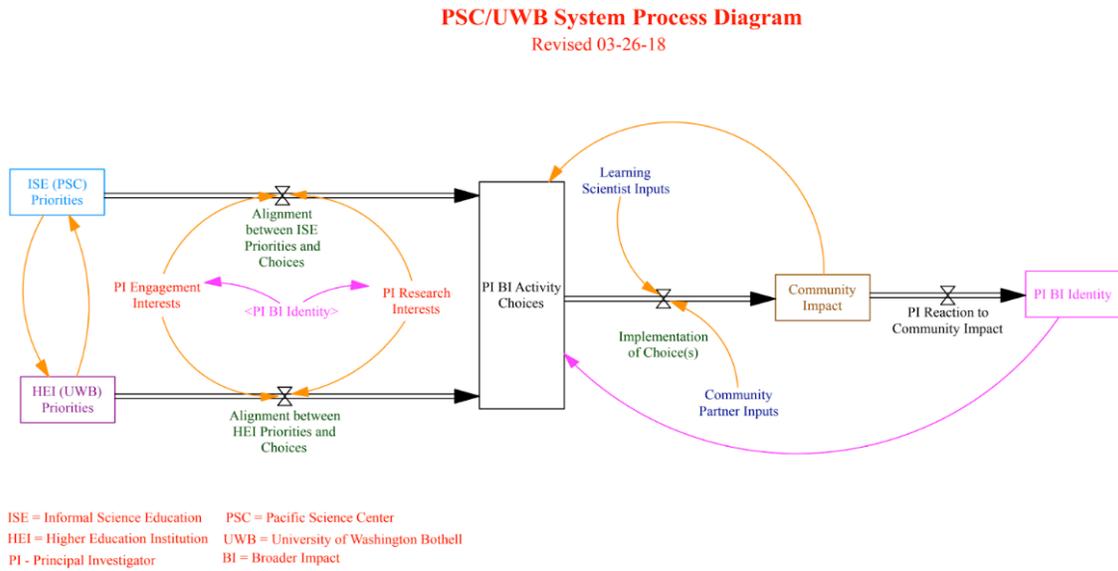
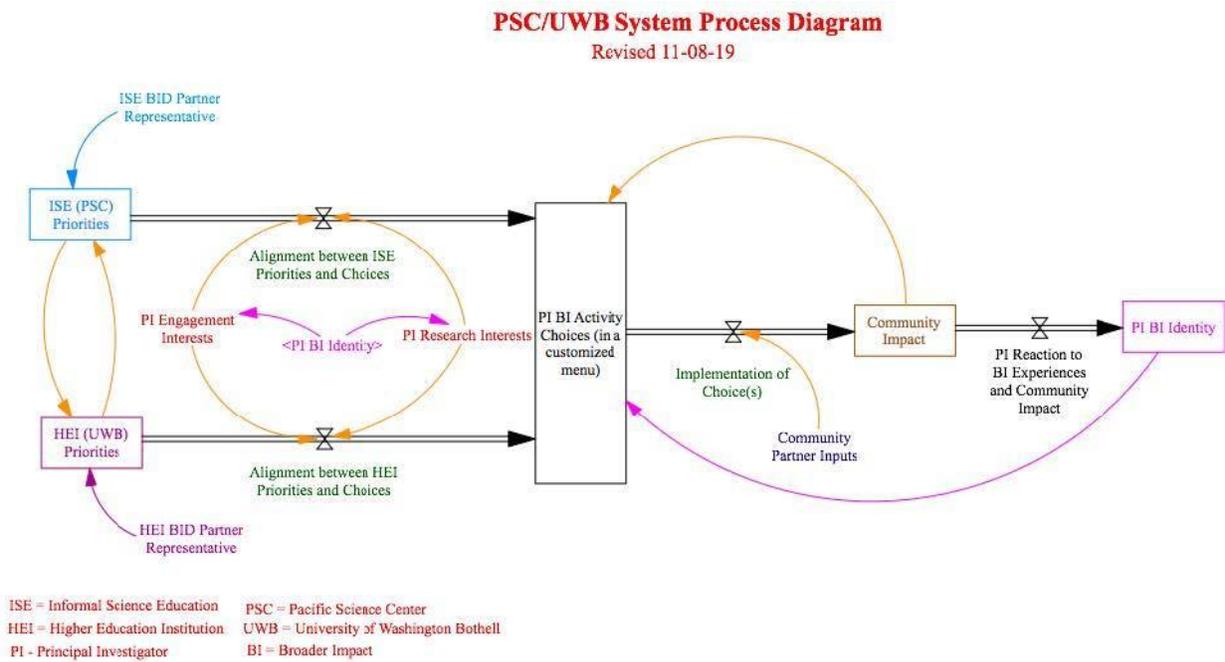


Figure G9

Washington Concept Map, November 2019



J. BID Online Resource with tools, timeline & vignettes

<https://popnet.institutelearninginnovation.org/bid-home/bid-tools/>

References

- Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16, 297–334.
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- Taylor-Powell, E., Rossing, B. and Geran, J. (1998). Evaluating Collaboratives: Reaching the Potential. Madison, WI: University of Wisconsin–Extension, Cooperative Extension, Program Development and Evaluation. Retrieved on April 18, 2019 from :<https://learningstore.uwex.edu/Assets/pdfs/G3658-08.pdf>.