

RESEARCH ARTICLE

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# The creation of inclusive governance infrastructures through participatory agenda-setting

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## Abstract

Though a stronger orientation of research and innovation with a focus on societal needs, demands, and preferences has recently become the main argument under the header of responsible research and innovation, the processes by which community members are included in studies of the future, as well as forward-looking science, technology, and innovation are underexplored. This paper explores the role of participatory agenda-setting in creating governance infrastructures that reflect community participation, boundary object creation, and experimental innovation for increased understanding of future decision tradeoffs. Drawing upon the authors' leadership and participant observation of two participatory agenda-setting projects, this paper contributes to our understanding of what participatory agenda-setting looks like in practice at a boundary organization in higher education. Though not a traditional research study with control and experiment groups, we seek to share our insights and lessons learned from our leadership of two projects with inherent participatory agenda-setting components. The paper culminates in recommendations for future projects which seek to incorporate laypeople into future-oriented research.

**Keywords:** Governance infrastructures, Boundary organizations, Participatory modeling

## Introduction

As cities become “smart” [9, 27], their governments are increasingly looking to leverage big data and information to address problems ([5, 6, 14, 31];). The current Information Age is characterized by the use of data and technology in daily life, to support social organization, interpersonal communication, and dissemination of information. And yet, as cities and nations grow, voices may become proportionally diminished and additional layers are added to hierarchies of representation so that individuals are increasingly separated from the feeling that they have an influence on government decisions [7, 18, 21]. In light of the ubiquitous public use and consumption of data and information technologies, governing bodies seek to leverage such resources toward

inclusive public participation, collective action, and future planning.

In addition to governing bodies, over the past decade, funding agencies and research universities, in particular, have renewed prioritization of the notions of interdisciplinary, cross-sectoral, integrative, and convergence forms of research [28, 41] that leverage data and information, though these forms of collaborative work are not without their challenges. Research on collaborative work has refined the definition and use of various tools and approaches to support cross-sectoral collaboration and maintain a productive tension between science and other forms of life in modern society [13, 26]. However, despite the increased attention and research into mechanisms of support for transdisciplinary research arrangements, the vast majority examine before and aftereffects of the use of collaboration support tools, rather

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than the process by which collaboration happens [1, 17, 22, 42]. New governance infrastructures include advances in informatics that create new opportunities for participatory agenda-setting, citizen engagement, and representation.

A governance infrastructure is the collection of technologies and systems, people, policies, practices, and relationships that interact to support governing activities [18]. Indeed, governance is but one social system among many which enables and constrains interactions between people at individual, organizational, and global scales. The key to envisioning a healthy governance infrastructure today and into the future is to frame the challenges of governance appropriately. Problems transcend jurisdictions, and individuals belong to many communities. Indeed, though the European Union is technically one union, it is also a dynamic, adaptive, and complex system of systems that should be viewed as an organic whole, including diverse people, technologies, rules, and relationships [18].

This paper contributes to our conceptual understanding of the process of participatory agenda-setting by describing two cases in which the authors collaborated with non-academic community stakeholders to model, visualize, critique, and conduct future-oriented brainstorming about education and health governance infrastructures in the southwestern United States. In so doing, we retroactively examine the role of participatory agenda-setting in supporting governance infrastructures that include community participation and innovative experimentation and provide reflections on best practices for future participatory agenda-setting work.

### **Boundary organizations as sites of participatory agenda-setting**

One context of particular interest in studying participatory agenda-setting processes is that of the boundary organization. Boundary organizations involve participation by researchers and policymakers, as well as professionals mediating between these groups, and are accountable to both research and policy communities [8, 10, 13, 42]. Boundary organizations offer sites for collaboration, the formation of new relationships, and the infusion of research and scientific information into the policy [36]. Rather than shoring up boundaries between research, policy, and the public, boundary organizations exist instead to maintain a productive tension between the multiple, diverse forms of life in contemporary societies [26].

Our ability to understand the processes which support constructive participatory agenda setting within boundary organizations is arguably more necessary than ever in light of the trend toward tripartite research relationships which include university, industry, and government collaborators. Such “Triple Helix” arrangements

inevitably create a blurring of boundaries which need to be managed [15]. By their nature, the complex problems facing society touch all three sectors within the Triple Helix and thus demand participation from each in a collaborative process to ideate potential future solutions. The convergence of diverse forms of expertise, methods for conducting research, competing for incentive structures, and disparate value systems are just some of the challenges facing collaborative ventures which seek to execute projects spanning the Triple Helix. The complexity of the current research landscape and its application to communities of interest demand additional methods and tools which support the cross-sectoral work of the Triple Helix and the trend toward convergent, use-inspired research.

If the management of the participatory agenda-setting process within a boundary organization is successful, it results in a less politicized collaborative environment wherein members of different social groups can work together to co-produce knowledge, meet on relatively neutral grounds, and more effectively promote the use of knowledge to inform future decision making [10]. Because Triple Helix arrangements signal the increased role of universities in the Knowledge Age [11, 34], we examine the participatory setting agenda processes of two projects in a university setting. Both projects were housed in a boundary organization operating out of a university in the southwestern United States. Our examination is retroactive. During each project, we conducted participant observation as part of a general quality control and adaptive project management approach to maintain constructive engagements and encourage feedback from participants, but we did not go into the project with the explicit goal of assessing and observing participatory agenda-setting in practice. During the course of project execution, we experienced differences in the projects and contemplated the implications of different approaches to including the public in conversations about the future of education and healthcare. What follows is a description of the site of study, an overview of each project's participatory approach, and our reflections for best practices in future participatory agenda-setting work.

### **The decision theater: a boundary organization in higher education**

Arizona State University's Decision Theater® (DT) is housed within the university's Office of Knowledge Enterprise Development (OKED). The DT partners with community stakeholders and researchers to build computational models and convene diverse groups of decision-makers across academia, government, and industry. The computational models integrate machine learning and predictive analytics to digest structured and

unstructured data. DT models are built by an expansive team of software developers, data scientists, graphic designers, and faculty affiliates. The interactive and predictive nature of the DT's computational modeling invites decision-makers to consider future pathways and experiment with change. The DT Drum (Fig. 1) is a 26-foot wide circular room that immerses participants in a data-rich environment by presenting interactive models across seven panoramic HD monitors in a 270° display.

The DT fits all three characteristics of boundary organizations as identified in the relevant literature [8, 10, 13, 42]. First, it involves participation by researchers, policymakers, the public, and professionals mediating between these groups. Second, it provides opportunities and incentives for the creation of boundary objects—objects such as conceptual or mathematical models which facilitate communication between these disparate groups [37, 38]. Third, it is accountable to both the research and policy communities.

The DT provides expertise in software development, data science, graphic design, and facilitates engagement between data informatics and communities for the purposes of informed decision-making. In addition, DT provides a facilitative element to engage stakeholders in complex systems thinking, to understand how multiple social systems interact with each other and support more transformative conversations about the large-scale implications of research findings. To this end, the DT collaborates with university faculty, industry experts, practitioners, and policymakers to support the legitimacy, relevancy, credibility, and usability of the models it creates [42]. For the DT to create data-driven, interactive models of use to communities in exploring alternative futures, it is necessary for the research team to integrate

the expertise and perspectives of stakeholders in the model development and testing process.

The integration of stakeholders as co-creators exemplifies DT's transdisciplinary approach to addressing complex problems and convergence research. The DT upholds the convergence paradigm [29] by intentionally bringing together intellectually diverse researchers and stakeholders to frame research questions, develop effective ways of communicating across disciplines and sectors, adopt common frameworks for sustainable solutions, and, when appropriate, develop new scientific vocabulary. Throughout this process, the DT works with collaborators to develop novel ways of framing related research questions and co-create governance infrastructures which enable communities to detect changes in their environment, deliberate about potential interventions, and discover new ways of being in the world. The framework through which DT conducts these activities has three key dimensions (Fig. 2).

#### Mapping the landscape of interrelated social systems

The DT examines complex problems in a variety of content areas which allow for many different entry points into discussions around the interplay of social systems. Each entry point provides different and legitimate insights as to the nature of system connectedness. Thus, rather than looking at education as a single social system, there is a deliberate and conscious effort to connect education to other social systems, such as health and well-being, civic participation, workforce readiness, infrastructure, and others. The process of making these connections happens in collaboration with diverse community stakeholders over time. The connections between different social systems vary widely depending on



**Fig. 1** Example engagement between a model and stakeholders in the DT Drum. Source: ASU DT



**Fig. 2** The Decision Theater Convergence Framework

the research question or issue being addressed and the person or community being represented in the room. Connections might be strong or weak, explicit or implicit, constructive or deconstructive, healthy or unhealthy, uni- or bidirectional, from the perspective of whichever community member is in the room. Mapping the landscape of interrelated social systems in collaboration with researchers, policymakers, and the public is critical to gaining a more holistic, multifaceted understanding of the system of systems influencing the research question or issue at hand.

#### **Iterative analysis and narrative development**

At its heart, the model creation process is guided by an analytic approach which attends to questions of social justice, access, representation, efficiency, and resilience, as well as questions of longevity and weighing the status quo over potential interventions. This lets users explore tradeoffs of maintaining current investments in things like infrastructure, education, and natural resource planning versus more a strategic intervention approach. For example, if we maintain the status quo, what does the future look like versus if we make changes? Narratives for future scenarios are then created and tested among various community audiences to gauge legitimacy, relevance, and salience of the analysis. The data, analytic methodologies, and expertise to inform these analyses and narrative development come from a broader ecosystem within the university and surrounding community. DT facilitates engagement and blurs the boundaries between different perspectives, stories, and points of view to engineer curiosity and promote empathy between community stakeholders with contrasting values who care deeply about similar problems.

#### **Participatory processes, engagement, and co-creation**

A significant component of the work which is created collaboratively at DT is that it must be made useful to communities and groups outside of DT, and outside of the university whenever possible. Our experience has shown that when stakeholders and researchers have an intellectual stake in a model's development and are part of its creation, they are much more likely to advocate for its legitimacy, credibility, and saliency in applicable situations. Thus, the DT engages in focus stacking, co-production, participatory modeling, and facilitation of complex systems thinking with stakeholders in industry and government, external to the academic sphere. During the mapping and iterative analysis described above, members of the public and affected groups are invited to be part of the process of understanding the complexity of a given social issue, as well as the many different ways in which we can analyze a situation and infer future prospects. Many collaborators who have worked with DT report that the process of working with other collaborators on creating a data visualization or interactive model is just as valuable as using the final model, if not more so. Indeed, the focus of DT engagement between the public and the data-driven models is not meant to be on the models themselves. The models are meant to serve as a backdrop for conversations, brainstorming, future-oriented implications of decisions, and relationship development among participants in the room and lead to future collaborations outside of the DT.

#### **Participatory agenda setting projects at the decision theater®**

Drawing upon the authors' leadership and participant observation of two participatory agenda-setting projects,



this paper contributes to our understanding of what participatory agenda-setting looks like in practice. The first project included a series of workshops to co-design a potential future model of existing health systems and explore future policies regarding greater continuity of care for people with behavioral health issues in a large southwestern city. These workshops elicited input from representatives in the following service health and social sectors: primary healthcare; behavioral healthcare; mental health consumer-operated services programs; law enforcement and the courts; mental health advocacy organizations; and state and county government. The ensuing model mock-up supported conversations around cross-sectoral data sharing and transparency, as well as prospective healthcare policies and their likely effect on different patient populations.

The second project developed a data-driven model to quantify and forecast the relationship between increased educational attainment, economic outcomes, and workforce alignment in Arizona. The research team conducted over 30 community engagements with educational stakeholders, such as teachers, principals, and superintendents of early childhood through upper secondary education, as well as local city council members, economic development specialists, state government representatives, and non-profit educational organizations. The ensuing interactive model allows users to create, compare, and discuss attainment and economic futures for different populations at state and regional levels. Both projects were facilitated out of the DT. Table 1 summarizes key comparative elements of the two projects, discussed in more detail below.

#### **Project one: cross-sector continuity of care for patients with serious mental illness**

In February 2019, the first author joined a research team working out of DT which sought to reduce healthcare

data fragmentation in Arizona and create a more holistic system for continuity of care for patients with behavioral health issues, specifically serious mental illness (SMI). The first author's role in this project was to assist in the evaluation of the workshops' success in eliciting and collecting participant feedback. The research team had convened a community stakeholder meeting the previous December to engage representatives from various sectors that interact with individuals with serious mental illness, inform them of the project's goals and timelines, obtain feedback about the projects general goals and objectives, assess levels of interest in engagement, and most importantly, patient-level data capacity and willingness to share those data with the research team (with all appropriate administrative safeguards).

#### **Participant recruitment**

Approximately 50 community and state-level stakeholders were identified through a combination of convenience and snowball sampling and included representatives from the following service health and social sectors: health care; behavioral healthcare; mental health consumer-operated services programs; law enforcement and the courts; mental health advocacy organizations; and state and county government. As a result of past projects, the research team was generally aware of the patient-level information capacities of these various sectors. Attendees provided the project with specific feedback, recommendations, and differential levels of interest and engagement in the project. After the December kickoff meeting, stakeholders were encouraged to sign up for one of four follow-up Data Design Workshops, each addressing a specific topic area such as social determinants of health, mental health in the criminal justice system, and high utilizers. Expertise in the topic area was not required for attendance;

**Table 1** Summary of key comparison items between two participatory agenda setting projects

	<b>Continuity of care</b>	<b>Achieve60AZ</b>
<b>Decision support area</b>	Where are opportunities to increase continuity of care for patients in Arizona with serious mental illness within the health, law, and government systems?	What are the tradeoffs of different pathways to achieving 60% adult postsecondary attainment in the state of Arizona by the year 2030?
<b>Timeframe</b>	Dec 2018–May 2019	Nov 2017–Feb 2019
<b># of workshops, participants</b>	5, 50	32, 200+
<b>Role of researcher</b> [16]	Facilitator, reflective scientist	Facilitator, change agent
<b>Level of citizen participation</b> [2]	Placation	Partnership
<b>Role of data visualization/model</b>	Support discussion of possible connections between data sets in siloed sectors, potential design and use of a future interactive tool, and the data sets necessary to drive it	Model interrelated social systems, visualize population biases, quantify and drive conversations regarding the connection between education and economy, workforce
<b>Ownership of final visualization/tool</b>	Research team	Community partner

stakeholders could select topics which were of tangential interest to learn more about data and approaches among other sectors. The general agenda for each workshop was to orient stakeholders to the overarching objective of combining data sets into a comprehensive, interactive data visualization and then present them with a semi-interactive mockup, eliciting feedback through a series of facilitated conversations both with the research team and with each other.

### **Workshop structure and evaluation**

Each Data Design Workshop lasted approximately 2 h to allow for in-depth discussions about the types of analyses and graphical visualizations of the data they would find informative and actionable in enhancing their understanding of service delivery trends. During these workshops, the research team provided the stakeholders with an update on data acquisition and data curation activities and provided each with a series of documents that detailed the data elements that were contained in the various data files represented on screen. Stakeholder feedback was then integrated into the visuals for the next workshop, and so on. In addition to the research team presenting and observing, each of these Data Design Workshops (approximately 7–10 stakeholders per workshop) were assigned a project staff facilitator and note-taker to capture the ways stakeholders discussed data arrays and data visualizations that could make use of the cross-sector data, as well as the ways in which they contemplated real-world, actionable service delivery issues. Research team members conducted participant observations during each Data Design Workshop. After each Data Design Workshop, the research team met to debrief what they had seen and heard and compared observations about individual stakeholders as well as the ideas and themes which dominated differentially themed workshops. In addition to participant observation during the Data Design Workshops, the research team conducted semi-structured summative interviews with a select group of stakeholders after the final workshop, including 11 men and women from behavioral health, public health, criminal justice, and community liaison programs. All of the stakeholders who consented to be interviewed served at a directorial position or higher within their respective organizations. Each interview lasted between 30 and 90 min, resulting in over 100 pages of interview transcripts. An in-depth analysis of these interviews is explored in a separate report, but they inform the implications for participatory agenda-setting discussed below.

### **Resultant data visualization**

The data visualization which resulted from the Data Design Workshops was semi-interactive; that is, some

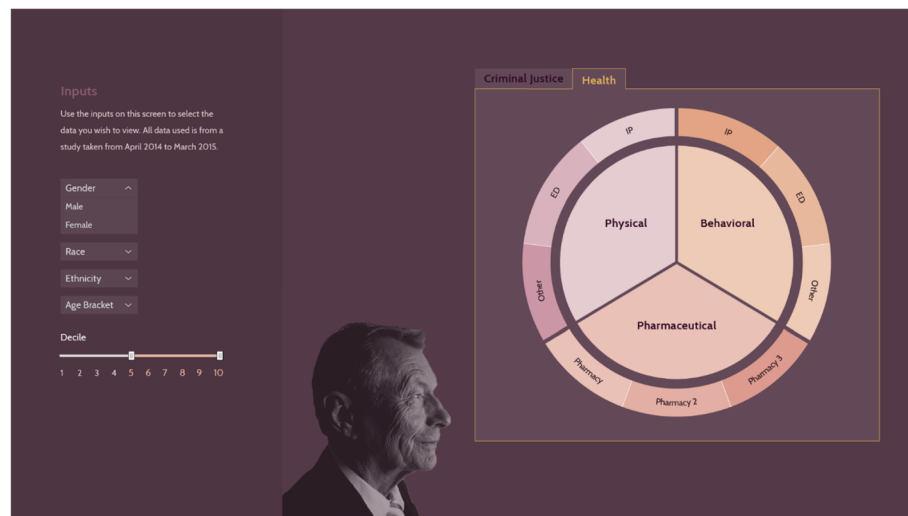
screens were only conceptual in nature whereas others were connected to real data sets supplied by the research team. Arizona State University's Center for Health Information and Research maintains one of the most comprehensive Medicaid claims data sets in the state and thus used it as a starting platform for participants to imagine where their data could contribute to a larger, more comprehensive model connecting healthcare to public safety, criminal justice, and so on. In its final form, the model sought to connect these conversations by allowing users to select a population and see the distribution of physical, behavioral, and pharmaceutical claims (Fig. 3), visualize the differences between those with and without serious mental illness within this sub-population, understand the relative cost of different claims for SMI and non-SMI populations (Fig. 4), compare the number of claims by illness, gain a geographic understanding of how the location of illnesses claimed overlap with crime and housing data (Fig. 5), examine social network connectedness of patients across different sectors and governmental programs, and high-level costs for different programs.

In contrast to the Achieve60AZ model described in the next section, the healthcare visualization served primarily as an imagineering mechanism to enable stakeholders to imagine where and how their data could contribute to a higher resolution picture of the current connections between various sectors which all treat patients with serious mental illness. This project was still in the design stages of what a future model could look like, what research questions were of interest to the various stakeholders involved, and what data would be required to support the future creation of such a model.

Whereas the Achieve60AZ model was supported by publicly available data sets from the US Census, Bureau of Labor, and Office of Economic Opportunity, there are a number of additional data privacy and sharing conversations which would need to occur to connect sensitive health and criminal justice data across the state. While stakeholders in the workshops were aware of the privacy demands, the focus within the workshops was on what kind of model would be useful to them and the kinds of questions they would want to ask of it. If and when the project moves beyond this imagineering stage, requirements regarding data sharing and privacy would be essential.

### **Roles of researchers and level of citizen participation**

The Continuity of Care project was funded by an external public health philanthropy program to which the research team had proposed in early 2019. As such, the research question and plan had already been determined and approved for funding, creating constraints for the direction of any future development guided by

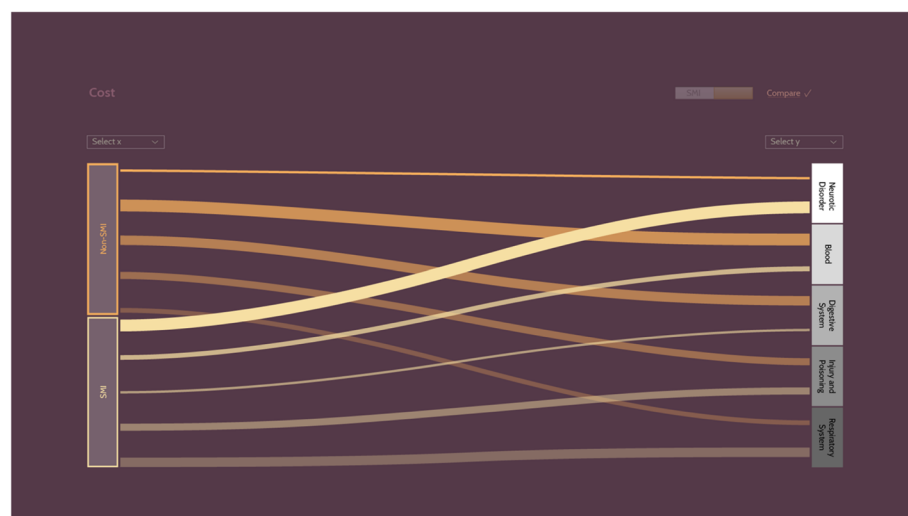


**Fig. 3** Continuity of care screen to select a population and see the distribution of health claims

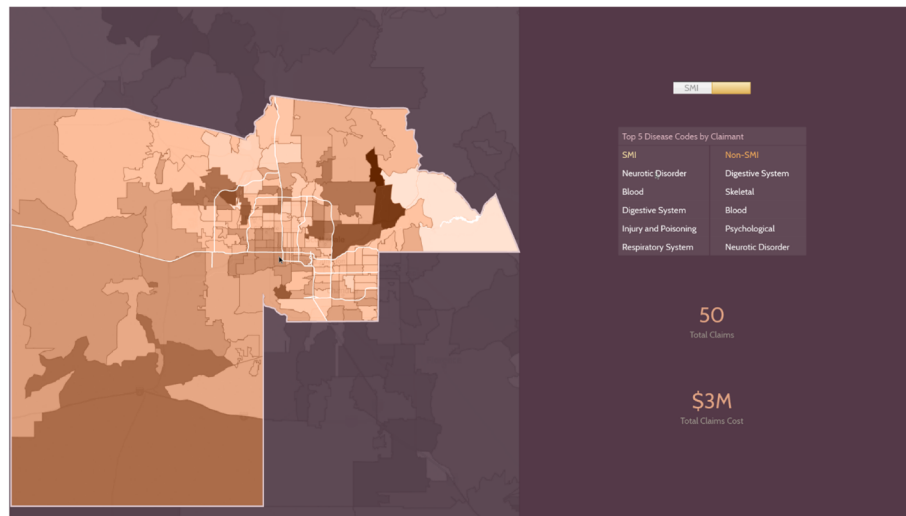
community members and stakeholders participating in the Data Design Workshops. It is for these reasons that the roles of the researchers were primarily that of facilitator and reflective scientist [16]. That is, the research team selected participants, facilitated and encouraged expressions of diverse viewpoints within the workshops, and sought to balance competing interests within the context of the workshops when, for example, the public health official's narrative regarding ambulance drop-offs in emergency rooms contradicted that of the emergency medical technician. Throughout the workshops and the debrief process, other members of the research team were reflective scientists, analyzing the outcomes of the ongoing data analysis in light of observations and

reflections regarding how the analysis and data visualizations were received by the stakeholders. In this capacity, the reflective scientists sought to connect application-oriented knowledge vocalized by the stakeholders into possible best practices for future cross-sector engagement and data sharing, as well as the provision of continuity of care, and to connect these insights back to existing academic knowledge and policy.

Given the constraints of the research plan set forth by the research team and approved by the funding agency, the level of citizen participation which best describes that of the stakeholders and community representatives in the Continuity of Care project is that of placation [2]. The workshop attendees were recruited specifically for



**Fig. 4** Continuity of care screen to visualize the relative cost of different claims for SMI and non-SMI populations



**Fig. 5** Continuity of care screen to overlap the location of health claims with crime and housing data

their expertise in matters of serious mental illness and its relation to primary healthcare, behavioral healthcare, mental health consumer-operated services programs, law enforcement and the courts, mental health advocacy organizations, and state and county government. Placation is characterized by citizens “hav[ing] some degree of influence through tokenism is still apparent...[they] advise or plan but retain for powerholders the right to judge the legitimacy or feasibility of the advice.” The strategic selection of organizational representatives from the social sectors listed above could be interpreted as tokenism, though the funding schedule and workshop plan put legitimate constraints on the research team such that the priority was to include as many expert opinions as possible, from as many community organizations as possible which reflected the diversity of social sectors necessary to understand challenges of continuity of care across those sectors for people with serious mental illness. These experts were recruited for their applied, on-the-ground knowledge of serving people with serious mental illness, as well as their insights regarding best practices and existing policy for coordinating across social sectors in regard to data sharing. However, at the end of the workshops, it was at the discretion of the research team which elements of stakeholder knowledge or insight would be included in the data visualizations, as well as ongoing analysis of continuity of care from academic and policy standpoints, a power dynamic characterized by the placation rung of Arnstein’s ladder.

#### **Project two: Achieve60AZ and the impact of postsecondary attainment**

Founded in 2016, Achieve60AZ is a community-based initiative to increase educational attainment for all

Arizonans, guided by the belief that a more highly trained and educated population will attract more business, boost economic well-being, and increase social gains. As of 2019, the Achieve60AZ Alliance was comprised of 40 local Arizona governments, as well as over 75 community, business, philanthropic, and education organizations. The central goal of this effort is to reach 60 percent adult postsecondary attainment in the state of Arizona by the year 2030. The state is currently at 35 percent postsecondary attainment for adults aged 25–64, according to the most recent U.S. Census. This percentage includes associate’s, bachelor’s, and graduate degrees and does not currently include certificates and licenses. The organization funding the project, the Arizona Board of Regents (ABOR), is a leading member of the Achieve60AZ Alliance. As the governing board of the state’s three public universities, ABOR seeks to provide leadership and a unifying voice on key higher education issues, as well as influence public policy through advocacy and initiatives founded on evidence-based research ([www.azregents.edu](http://www.azregents.edu)). The research team was charged with examining education and learning as a dynamic, interdependent, nonlinear process and not just as an outcome variable. The authors led the project and managed model development, data collection and analysis, design of the user interface, and facilitation of stakeholder engagement with the model.

#### **Participant recruitment**

In November 2017, ABOR formed a collaborative partnership with DT to create a data-driven model and interactive visual display to explore and quantify trade-offs of different pathways to achieving 60 percent adult postsecondary attainment in Arizona. The first



opportunity to understand existing conversations regarding postsecondary attainment among education stakeholders came in December 2017, when the Arizona Commission for Postsecondary Education hosted a two-day conference titled “Developing Arizona’s Human Capital: Acceleration to 60.” The authors attended the conference to listen to the ways in which thought leaders conceptualized and described the state of Arizona’s education system, as well as capture perceived barriers and solutions to educational attainment. The conference also provided an important network opportunity for the authors to identify key stakeholders who could provide subject matter expertise regarding the state’s education system and history of existing interventions geared toward increasing postsecondary attainment. Though the first several stakeholder engagements were with attendees of the December conference, the authors engaged in snowball sampling to elicit additional viewpoints and areas of expertise regarding Arizona’s education system, how the education stakeholders currently conceptualized barriers to, as well as benefits of, attainment, and what data existed to support a model which explored alternative pathways to attainment in Arizona.

#### ***Stakeholder engagement structure and evaluation***

Over the next 14 months, the research team facilitated 32 participatory agenda-setting engagements with over 200 stakeholders from education, economic development, and local government representatives and community groups in the DT Drum (Fig. 1) to model different pathways to achieving 60% adult postsecondary educational attainment by the year 2030. Consistent with the DT Convergence Framework described earlier, ABOR and the research team wanted the model to be informed by stakeholder ideas, questions, and input. Thus, the goals of these engagements were to (1) create a preliminary model which attended to conversations captured during the Arizona Commission conference, (2) facilitate stakeholders’ interaction with the evolving model, (3) elicit their feedback on the relevance and usability of the data, display, and analysis, and (4) observe how the model contributed to the depth and complexity of conversations between stakeholders. The iterative process of model development and stakeholder engagement required constant coordination and communication between the research team and the software developers, data scientists, and graphics designers within DT. Thus, in addition to the 32 stakeholder engagements, the authors and DT team met every other week to clarify expectations and make sure stakeholder interests were reflected in ongoing model development and visualization. The participatory agenda-setting process unfolded for over a year between November 2017 and

February 2019. The authors each spent over 100 h in the field with stakeholders and collected over 350 pages of meeting minutes and feedback, in addition to field notes and photographs cataloguing the evolution of the model.

#### ***Resultant data model***

Throughout the model development process, the research team sought to understand the collaborative process by which researchers and laypeople integrated diverse forms of expertise and information to create a coherent boundary object of use to Arizona’s education communities. In this case, the boundary object was a model of the relationship between Arizona’s attainment percentage, economic outcomes, and workforce alignment (Fig. 3). To do this, we needed to understand how stakeholders in education communities conceptualized education’s public value, framed its implications for communities’ health, prioritized different actors (teachers, students, parents, policymakers) within the education system, discussed challenges related to data collection and transparency, and brought to light any other issues regarding Arizona education about which we were unaware. Thus, we engaged in an iterative process of education data analysis, model development, stakeholder engagement, integration of stakeholder feedback, and updating the user interface.

Throughout the course of our participatory agenda-setting process, two questions dominated stakeholder engagements and ultimately shaped the final version of the model (Figs. 6, 7, 8). The first was, “What is the impact of increased attainment on Arizona’s economy and workforce?” Stakeholders did not want to conceive of education for the sake of education. They wanted to understand the impact of education on economic well-being and the ability of people to find occupations which could provide income stability far into the future. The second question was, “Which 60%?” In the effort to get from 35 to 60 percent educational attainment, did it matter who comprised the 25 percent necessary to reach the state goal? Stakeholders wanted to be able to examine the relative impact of increased attainment for one sub-population or geographic region versus another and explore alternative economic and workforce futures as a result. Figure 3 shows the final version of the Achieve60AZ model, wherein users select sub-populations of interest (Fig. 6), examine each sub-population’s descriptive statistics compared with the state average, compare geographic locations of each sub-population, increase attainment for each sub-population and see the relative impact on the state goal (Fig. 7), compare economic outcomes (Fig. 8) and workforce alignment as a result of the attainment increase, and explore differences in attainment-occupation pathways for

Create Population Scenarios - ages 18+

	Population 1	Population 2
Age	None selected	None selected
Income	None selected	None selected
Region	None selected	None selected
Household Language	English	Spanish
Household Type	None selected	None selected
Hispanic	None selected	None selected
Food Stamps Recipient	None selected	None selected
Cluster	None selected	None selected
Presence of Children	None selected	None selected

Reset Submit Reset Submit

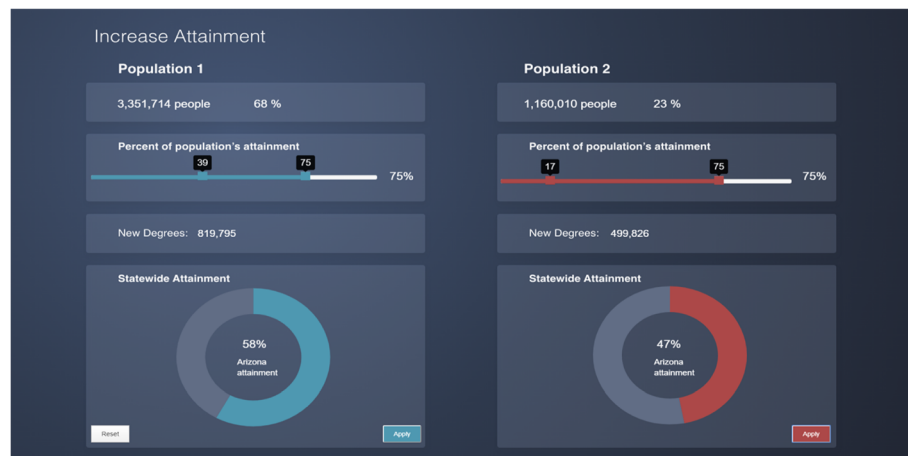
**Fig. 6** Achieve60AZ screen to select sub-populations of interest regarding multiple socioeconomic indicators

each. Though the immediate end-user of the model is ABOR, other educational stakeholders are welcome to engage with the model at DT in a facilitated environment before it is made available to the public online.

#### ***Roles of researchers and level of citizen participation***

Whereas the Continuity of Care project took a deductive approach characterized by predetermined directives and deliverables approved by an external funding agency, the Achieve60AZ project was an inductive endeavor which began with a much more open-ended line of inquiry to understand phenomena of interest surrounding the Achieve60AZ Alliance goal of increasing postsecondary attainment. For the first 9 months of the project, the research team served a largely facilitative role, initiating conversations with education, industry, and governmental organizations to solicit diverse ideas, perspectives,

and viewpoints regarding the role and potential impact of education on society, as well as continuously updating the data visualizations and model interface to reflect the ongoing maturation and focus of conversations. As the data analysis and visualization began to coalesce into a coherent, interactive model, the role of the researchers shifted to that of change agent. In this role, the research team sought to empower ABOR representatives and the Executive Director of Achieve60AZ, with whom they had worked closely for over a year, to own the model, learn to lead community engagements using it as a tool, to present and interpret its findings for lay audiences, and use it within their own organizations to develop information and policy interventions without the need of the research team. The research team identified such transition of ownership of the model as a goal of the project since its inception.



**Fig. 7** Achieve60AZ screen to increase attainment for sub-populations and compare the impact on the state goal



**Fig. 8** Achieve60AZ screen to compare the economic impact and decreased reliance on government programs

Though both Achieve60AZ and Continuity of Care were externally funded, the research team for Achieve60AZ set forth criteria for ABOR that in addition to financial resources they needed the time and intellectual involvement of ABOR representatives as co-creators of the model which was being developed. The collaborative infrastructure created and maintained by the research team and ABOR reflects more of a partnership level of citizen participation. At this rung of Arnstein's ladder, power is "redistributed through negotiation between citizens and powerholders. They agree to share planning and decision-making responsibilities... after the ground rules have been established through some form of give-and-take, they are not subject to unilateral change" (1969). ABOR representatives and the Achieve60AZ Executive Director met with the research and model development team every 2 weeks for almost a year to assess progress, provide feedback regarding the possible use and relevance of the model, and make suggestions for community groups whose voices they felt should be included in the model development process. If ABOR and the Executive Director felt that the analysis and visualization had drifted away from questions and areas of interest, the research team course-corrected to make sure the model reflected stakeholder and community concern. As the research team began to develop layperson data analysis briefs, ABOR and the Executive Director had final editing power over what would be shared in any communication material related to data analysis resulting from the model.

### Discussion: insights for creating inclusive governance infrastructures

Our time spent leading the aforementioned projects gave us an intimate look at the processes of making stakeholders' tacit knowledge explicit and visible, reflecting

stakeholder perspectives in data analysis, discovering how to elicit public input, realizing successful public engagement strategies, and facilitating complex systems conversations with an orientation toward uncertain futures. What follows is a general discussion of recommendations and insights for future projects which seek to incorporate laypeople into future-oriented research.

### Roles of researchers in boundary organizations

Existing research supports the notion of depoliticized arenas to lower cultural barriers between stakeholder groups and align their interests [10, 30]. In both projects described here, the DT served as a boundary organization to help organize, facilitate, and analyze both the data and human interactions which occurred over the course of the projects. Rather than isolating itself from external political authorities, the boundary organization described here played an important role in negotiating knowledge between the science and policy realms [42] while also including input and potential future scenarios from the public. While the existence and role of this boundary organization carry implications for future work, it is important to note that this role does not have to be filled by a university. There are a number of non-academic research organizations and think-tanks interested in complex questions facing society with the resources to support facilitated design workshops like the ones described here. The projects described above are not limited to academic contexts. Our observations regarding the importance of how boundary organizations inform participatory agenda-setting, multi-sectoral data sharing, and collaboration in diverse forms of collaborative work are evident in each of the additional recommendations described below.

As a boundary organization in higher education, the DT leverages numerous faculty researchers within the

university to serve as organizational members. Within the two projects described above, the researchers adopted different roles depending on the goal of the project and the expectations set forth by different funding agencies. Researchers' adoption of different roles in participatory processes has been established and refined in recent years [16, 32, 35, 43], though for the most part these roles reflect a continuum of researchers conducting unbiased observational analysis of participatory proceedings to empowering participants to enact change through ownership of a process, outcome, or tool for their own self-benefit. In comparing the two projects above, we noticed a possible correlation between lower levels of citizen participation on Arnstein's [2] ladder and researcher role falling on the continuum closer to that of reflective scientist. Future studies might explore a more explicit connection between researcher roles identified in the current literature and the potential for higher levels of citizen participation. These roles might also apply to boundary organization management, to clarify the extent to which a boundary organization manages tensions between researchers and community partners.

#### **Convene stakeholders for collaborative initiatives with strategic intent**

When deciding to include members of the public in scenario planning and research development, it is important to consider when, how, and to what extent such publics will be included [4, 23]. Although there is a general consensus that community members and stakeholders should be included in discussions about public policy and future planning, it is not always clear how to go about the inclusion process. How to thoughtfully navigate the competing tension between inclusion speed and process commitment, particularly in the early stages of a collaboration, is a choice with serious consequences [19]. The two projects described above followed different inclusion processes, each with their own tradeoffs. Whereas the Achieve60AZ project co-created a notion of reality in collaboration with stakeholders to define the problem and guide the refinement of the research question [40], the Continuity of Care project was already funded to research a predetermined research question, setting up different approaches to stakeholder inclusion.

In the health project, the ultimate end goal was to get community groups thinking about how they could better align across sectors for greater patient continuity of care. The research team reflected long-standing expertise in combining data sets, as well as decades of experience working with community groups around cross-sectoral alignment of care. Thus, the approach to stakeholder convening was highly transdisciplinary, purposely putting contradicting or competing for viewpoints into the

same room to elicit and highlight points of difference, making such differences visible so that they could be overcome or at least made clearer to all other participants. The health project operated over a period of 6 months, whereas the education project held engagements over the course of 14 months. These different timelines, as well as different starting points and end goals of the projects, affected the stakeholder inclusion processes employed by each. Because of the constraints of the research plan goals and timeline, forms of participation for the Continuity of Care project were closer to information and consultation [23].

In the education project, a primary goal was to create a multifaceted, complex systems level understanding of the impact of postsecondary attainment on the state of Arizona. The research team did not hold subject matter expertise on education policy and interventions and so elicited this expertise from various community groups and conferences. Community groups were included one at a time and the research team facilitated their engagement with the model, asking questions about their perception of the impact of postsecondary attainment and the background behind previous public policy interventions. Given the sensitive and politicized nature of education in the state of Arizona, as well as the nascent stages of model development, the research team chose this approach so that each community group could tell its own story without equivocation, interruption, or argumentation from a perceived competing group, as well as feel that they were able to tell their story and see it captured by the research team. The request on the part of the research team to have a regular time and intellectual investment from the funding agency, as well as the Achieve60AZ director, indicated forms of participation closer to collaboration and empowerment [23].

#### **Create opportunities for relationship development and perspective-taking through regular face-to-face interaction**

Though reduced transaction costs, increased computational power, and new communication technologies are shifting many interactions from the physical realm to the virtual [18], we found that the physical co-location of stakeholders and members of the public on a recurring basis led to increased participation and innovative thinking. The context for the design of information technology is increasingly an interconnected mosaic of responsive adaptive systems (MoRAS) including people's ideas, organizations, communities, markets, and culture [12]. Future studies that seek to support cross-sectoral, interdisciplinary complex problems should attend to the interpersonal components of these forms of work [17]. Prosocial behaviors that contribute to trust, idea sharing, team building, and collaboration stem from



interpersonal relationships developed among collaborators. The dedicated time and space to allow for such interactions to occur and relationships to form were a significant contributor to the positive experience of stakeholders in both projects described above. Work that seeks to support participatory agenda-setting, particularly when the publics may support competing agendas, should include resources to support these relational development processes.

The research team sought to create contexts for the stakeholders to be in contact with each other and drive the tone of the workshop, with the research team playing supportive, facilitative roles when necessary. This allowed the stakeholders to engage with each other and use the time to have interactions with people they may have never met before, on a topic which directly affected each of them. Prior research has shown that the use of politically neutral boundary organizations, such as the DT, can facilitate the growth of social networks, lower cultural barriers, and align the interests of diverse social groups who are attempting to collaborate [10].

In each of the projects described above, the research team held regular meetings with several influential stakeholders to maintain a close connection with communities of key interest to the research questions at hand. In the education project, the executive director of the Acheive60AZ Alliance was a fixture at bi-weekly meetings with the research team. She held regular engagements with community groups and elicited their ideas, thoughts, and ideas regarding postsecondary attainment in Arizona. At meetings with the research team, she represented their interests and helped the research team think through policy implications through the eyes of community members, helping the research team maintain perspective during model development. In the health project, the Data Design Workshops gave community members the opportunity to interact with each other in a facilitated setting with researchers prompting and asking follow-up probes when necessary. Rather than one-off engagements, the series of workshops provided a sense of stability as participants built off of previous conversations through subsequent workshops. The attendance list was not always the same, but there was a core group of public participants that attended every workshop, providing continuity for relationship development and discussion.

#### **Support complex systems thinking through data analysis and visualizations**

The data visualizations and model created in each of the respective projects served as a boundary object to orient and organize diverse perspectives and opinions regarding the decision support area under study (Table 1) and support complex systems awareness among participants.

Boundary objects [37, 39] are objects which are plastic enough to adapt to immediate, local needs yet robust enough to maintain a common identity across time and space. Lee [24, 25] builds on the concept of boundary objects and argues that perhaps boundary negotiating, in her case through the use of museum artifacts, is itself part of a process by which methods of collaboration are developed. Though the push to define and differentiate the concepts of boundary objects and artifacts has advanced our understanding of which tools support the integration of expertise, much less is known about the process by which this integration occurs. Star [37] argues that the creation of boundary objects is a community phenomenon requiring at least two actors with contrasting viewpoints. What is not well understood is how actors with seemingly opposing goals overcome their conflict and integrate ideas while sustaining divergent interests [30]. Even less considered within the boundary community are ways in which these objects can be intentionally created. While this study served more as a comparison of different researcher roles and levels of citizen participation within a boundary organization, the extent to which the differences in boundary object creation affected roles and participation are a potential area of future study.

All three components of the DT convergence framework described above contribute to collaborators' ability to conceptualize the world in complex systems and gain a better understanding of the multiple competing influences which the future. Indeed, the model building process is critical in leading to knowledge generation [20], particularly during the process of participatory agenda-setting. One of the most significant parts of the process is to make phenomena visible, whether through quantitative data, analysis, qualitative storytelling, model interpretation, and use, or a myriad of other ways which help the public see and understand a question or issue that they face. Mapping the landscape of interrelated social systems is a significant step in the DT participatory agenda-setting process so that people in academia, industry, government, and the public gain a more holistic, multifaceted understanding of the system of systems influencing the research question or issue at hand. It is critical that community members and stakeholders be involved in each of the three framework components so that the ensuing models are legitimate, relevant, and salient among relevant publics.

#### **Understand the accountability horizons of different publics**

A key element when engaging with community stakeholders and members of the public is understanding to whom they are most accountable. Contrasting accountabilities and loyalties may affect the extent to which



participation changes as discussion nears what we term “accountability horizons.” An accountability horizon is the point at which participants may no longer be willing to accept responsibility for ensuring policy or action taken as a result of their involvement in participatory agenda-setting. Though it is widely understood that participants’ acceptance of participatory research processes is key to their implementation [3], accountability horizons may help us understand unbalanced problem ownership [33] in participatory agenda-setting processes.

The emergence of accountability horizons was particularly evident in the Continuity of Care project, in which the health sectors addressing serious mental illness are still very siloed and compartmentalized in Arizona. Whereas participants demonstrated general awareness of the many systems which touch patients with serious mental illness, there were clear accountability horizons and differentiation between who was responsible for which aspect of patient care, as well as the tipping points when patients seemed to cross from one sector into the other. Though each sector seemed aware of their own accountability horizon, the process of engaging in the participatory model creation process helped to highlight and make visible accountability horizons of all groups involved and where they may overlap to provide continuity of care in the future. Future participatory agenda-setting projects should incorporate ways to make accountability horizons visible so that all participants know where they stand in relation to others, and so that facilitators understand the constraints which stakeholders may be facing in the participation process.

## Conclusion

Because governance infrastructures are socially constructed, they will inevitably grow and change over time to reflect the state of interaction and relationships between people, policies, and practices. The two projects described here sought to make visible some of the elements contributing to governance infrastructures in education and health, respectively. As a boundary organization, the DT sought to facilitate conversations and the imagination of alternative futures in each area, through data analysis, data visualization, and community engagement. In particular, the DT supports the creation of data-driven boundary objects in the form of data visualizations and interactive models which provide an organizing, sensemaking mechanism for participants with diverse viewpoints to establish some degree of common understanding, if not shared meaning. Through the use of the ensuing data-driven models, community members can test their own hypotheses about potential futures and realize the consequences of decisions being made in the present.

The refinement of participatory agenda-setting processes can support the development of governance infrastructures that maintain inclusion and accountability of the public in the decision-making process. In particular, the comparison of the two projects described here raises new lines of research for best practices in how to leverage participatory processes to create models and tools which can ultimately be of use in establishing and leveraging inclusive governance infrastructures. If the Convergence Framework used by the DT is executed well it should result in tools which can be of use to governance actors, but the extent to which participants feel a sense of ownership in both the process and the end result—be it a tool, model, policy, intervention, or new deliberation process—may play a role in determining their accountability horizon. The comparison of these two projects may have additional implications for the most constructive researcher role to be played by boundary organization members and researchers, as well as the potential connection between researcher roles and the extent to which they enable or constrain levels of citizen participation. Governance infrastructures which make data analysis and use access to the public and attend to issues of accountability horizons and ownership of the tools and models which result from the participatory process stand a greater chance of creating new opportunities for participatory agenda-setting, citizen engagement, and representation.

## Abbreviations

ABOR: Arizona Board of Regents; DT: Decision Theater; HD: High definition; MoRAS: Mosaic of responsive adaptive systems; OKED: Office of Knowledge Enterprise Development; SMI: Serious Mental Illness

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## Authors’ contributions

MH conducted participant observation, analyzed and interpreted data from both projects and was a major contributor in writing the manuscript. EJ provided conceptual guidance and background theory on governance infrastructures. The author(s) read and approved the final manuscript

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## Availability of data and materials

The datasets analyzed during the current study are not publicly available under the terms of the IRB approval but may be made available in anonymized form from the corresponding author on reasonable request.

## Ethics approval and consent to participate

Data from interviews was obtained through an agreement with the Institutional Review Board of the home institution.

## Consent for publication

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Competing interests

There are no competing interests.

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