

Decision Theater

Collaborative Research Methodology



Contents

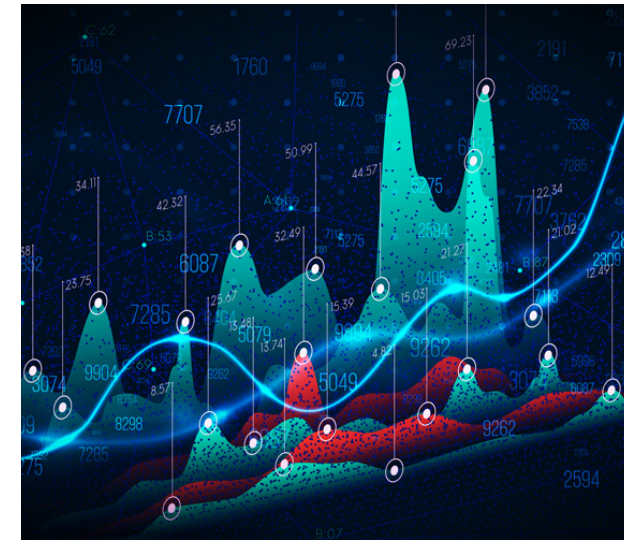
1	Decision Theater	04
2	Informed Decision Making	05
3	Convergence Framework	05
4	Mapping Complex Systems	06
5	The Decision Theater as a Boundary Organization	07
6	Information Technology Boundary Objects	08
7	Participatory Agenda Setting	10
8	Operational Process	12
9	Joint Research Initiative	14
10	Problem Identification	16
11	Iterative Design and Analysis	18
12	Model Development	20
13	Approval and Use	22
14	Future Research Potential	23



Decision Theater

The Decision Theater (DT) is a convening and collaboration facility that designs scenarios for complex problems in order to improve community outcomes. As an initiative within Arizona State University's Knowledge Enterprise, the DT plays a critical role in advancing the research mission of Arizona State University and embodies the guiding principles of the New American University to conduct use-inspired research, fuse intellectual disciplines and co-develop solutions to the critical social, technical, cultural and environmental issues facing the 21st century.

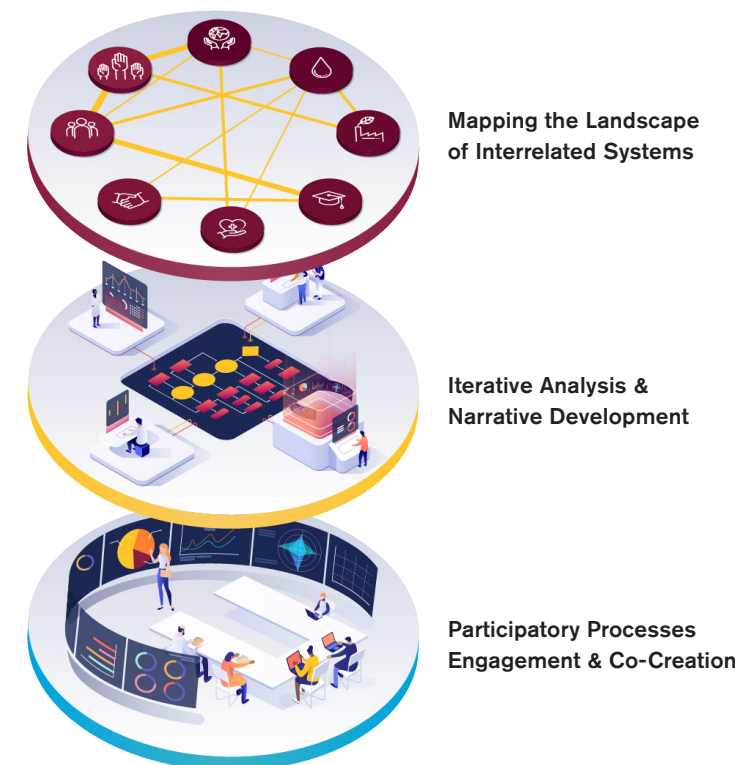
DT develops technological tools by collaborating with researchers, subject-matter experts and communities to build shared understanding of mutual problems and map sustainable what-if scenarios that offer beneficial impacts to all parties. Through the DT research process, decision makers across academia, government and industry convene to build computational models that demonstrate the interconnected workings of a complex system.



Informed Decision Making

Complex systems by their nature are multi-dimensional and cross domain boundaries. Problems within these systems cannot be solved or fully understood through a single perspective approach that does not consider consequences on other related domains. While research and practical knowledge on the interrelated functions exists, it is challenging to communicate their relation to non-expert audiences or decision makers. The DT applies a mathematical data visualization approach to analyze the function of a system, project outcomes and communicate their consequence to leaders, practitioners and community members in related domains.

Convergence Framework



The integration of stakeholders as co-creators exemplifies the Decision Theater's transdisciplinary approach to addressing complex problems and convergence research. The DT upholds the convergence paradigm set forth by the National Science Foundation 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 and deliberate about potential interventions.



Mapping Complex Systems

The Decision Theater 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.

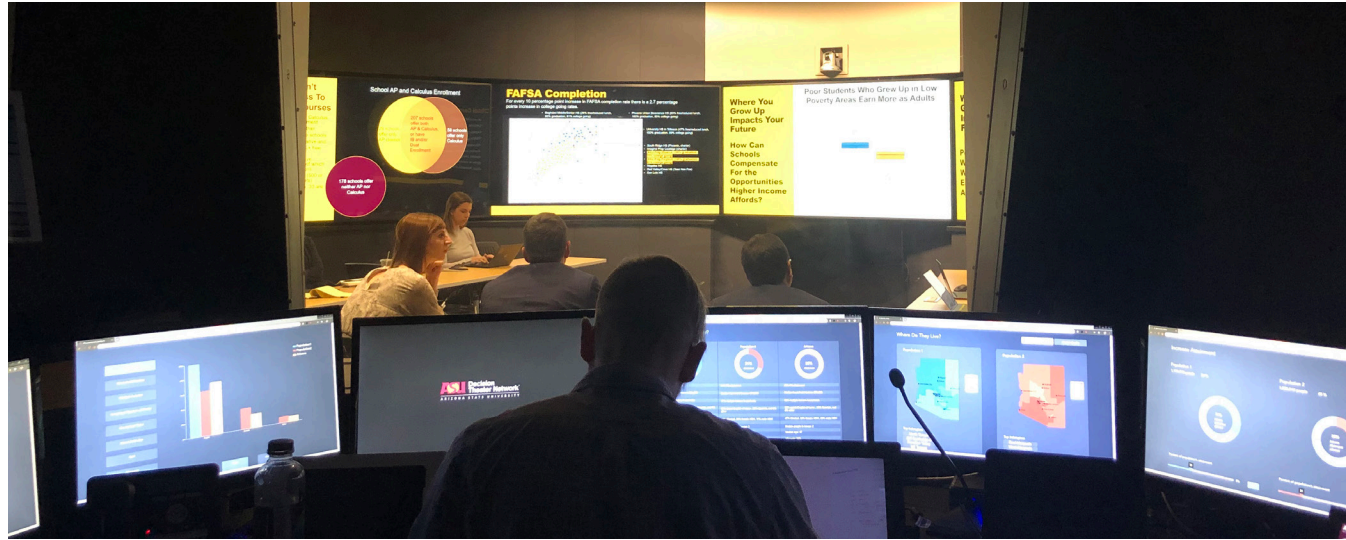
The connections between different social systems vary widely depending on the research question or issue being addressed and the person or community being represented in the room. Connections might be strong or weak, explicit or implicit, constructive or deconstructive, healthy or unhealthy, uni-directional or bi-directional, 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.



The Decision Theater as a Boundary Organization

In the early 1990s, the concept of the Triple Helix of university-industry-government relationships began to grow in research and practice, signaling the increased role of universities in the Knowledge Age. Today, more and more complex research is being conducted at the intersection of academia, industry and government. Intuitively, it is known that such an arrangement should yield more innovative, sustainable and holistic interventions than each sector working in isolation from the other. The mitigation of complex problems requires theoretical understanding, practical implementation and equitable policies to support sustainable interventions.

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 solutions. The Decision Theater is uniquely positioned to address this need and helps support future-oriented constructive, data-driven conversations.



Information Technology Boundary Objects

The Decision Theater involves participation by researchers, policy makers, the public and professionals mediating between these groups and provides opportunities and incentives for the creation of boundary objects—objects such as conceptual or mathematical models which facilitate communication between these disparate groups. The DT provides expertise on 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.





Participatory Agenda Setting

A significant component of the work which is created collaboratively at the Decision Theater is that it must be made useful to communities and groups outside of DT, and outside of the university whenever possible. Past 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. 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.



For many partners, the process of working with other collaborators on creating a data visualization or interactive model is just as valuable as using the final model. Indeed, the focus of DT engagement between the public and the data-driven models is not always meant to be on the models themselves. The models are meant to serve as a backdrop for conversations, brainstorm, future-oriented implications of decisions and relationship development among participants in the room and lead to future collaborations outside of the DT. 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.

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.

Operational Process

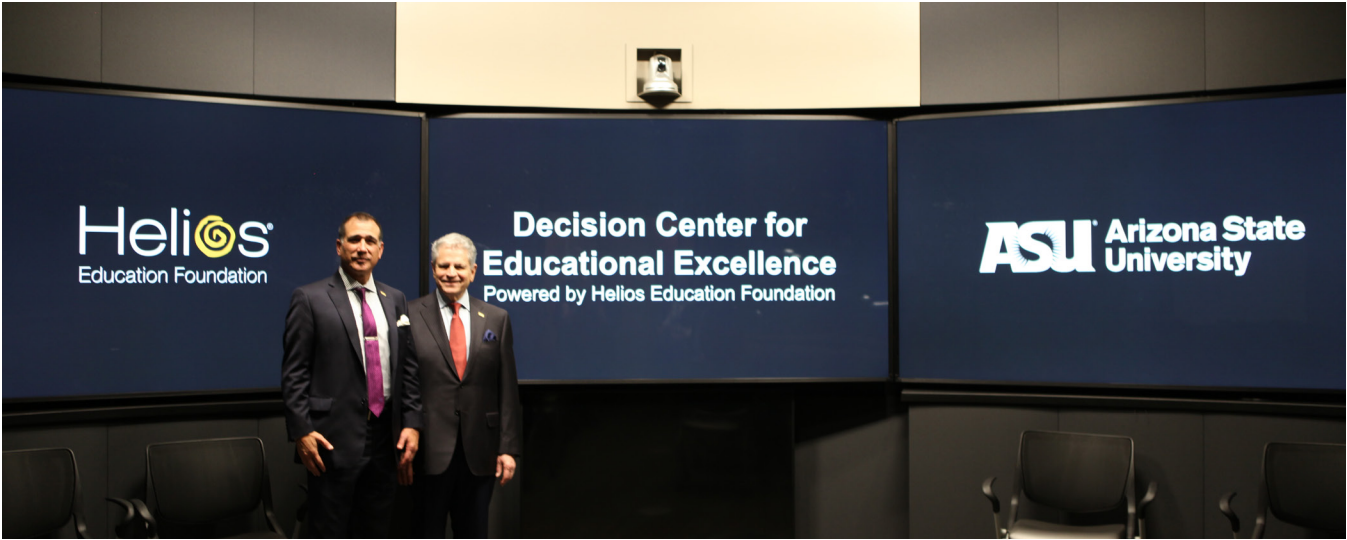


The Decision Theater's integrative models analyze system functions and consider trajectories across the many focal points of a complex problem. Researchers, government agencies, industries and non-governmental organizations bring forward initiatives to better understand transdisciplinary problems and possible futures. The DT works with these partners to apply its technologies and complex systems methodologies. Together, all parties build a product that promotes shared problem understanding, prompts new research questions and delivers analytic insight from big data.

To facilitate the development process, the DT has constructed a set of procedures to carry out the collaborative, joint research design of its projects. The DT brings forward its staff of Data Scientists, Software Engineers, User Experience Designers, Applied Researchers, Graphic Designers and Project Managers to participate in each level of the development process. Through this continuous collaboration, DT staff gathers domain knowledge and project goals and reinforces the development of a useful technology.

Operational Methodology





Joint Research Initiative

The Decision Theater operates as a research support mechanism. Because of this, DT projects are dependent on external collaborators and their initiatives to better understand a problem and seek solutions. A prospective DT partner will come forward with a proposed research initiative, problem or system to explore. Through initial conversations, parties will determine if a DT joint research project is a relevant approach to their needs. Through these engagements, parties discuss how a project's objectives and goals align with relevant DT capabilities.

Robust collaborations with the DT follow several key guidelines. These include the nature of the problem and its complexity, availability of data and existing computational models, the presence of cross-disciplinary stakeholders and relevant research in the domain. DT staff works with prospective partners to determine the overall scope of a project. This may result in a contract, memorandum of understanding or a joint research proposal to an external funding source.





Problem Identification

After a contract or MOU has been established between parties, The Decision Theater hosts a series of workshop engagements to establish shared understanding of the problem and develop an approach that employs DT technologies. During this participatory agenda setting process, disparate ideas, perspectives and problems surrounding the topic of focus are brought forward and elicited from researchers, community stakeholders and subject matter experts in relevant domains whose functions are involved with outcomes and workings of the subject matter.

The purpose of this stage is to develop shared understanding of the problem's ecosystem, discuss objectives and goals of the problem-solving initiative, identify key drivers of change and consider future "what if" scenarios. This process determines the audience and complexity of the model and sets expectations for an end product. DT staff from each team are present during these engagements to carry out functions toward project development specific to their domain.

The Community Engagement Specialist

works with the lead DT partner to identify relevant stakeholders and subject matter experts to engage in these workshops. They are responsible for coordinating engagements, facilitating participation and documenting conversations and key points that will inform the design and development of the project.

Researchers and Relevant Parties consider and bring forward data, statistical analyses and mathematical models that speak to the workings of multiple pieces of the system. During the workshop functions, all parties discuss the questions this project should address, and how data and statistical models can inform their solutions.

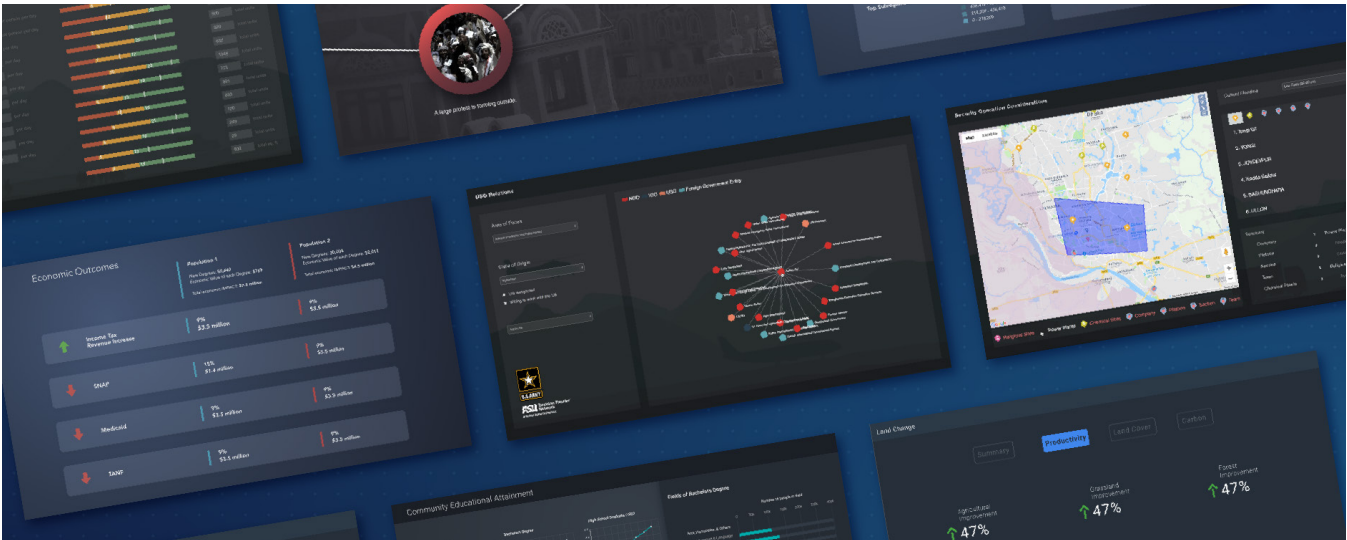
The Data Science Team works with participants to identify available data sources and identify the right data platform for data collection. This process works to ensure that the data quantity, quality and its fit to the identified problem are appropriate. When considering the objectives of the solution, the team illustrates the conceptual process and mental model to ensure the solution is robust when considering the data. The team identifies limitations of current solutions in the research domain and practitioner's needs.

The User Experience Team (UX) captures the participants' needs and objectives from a human-computer interaction design perspective. They consider the eventual end use of the model, its function, audience and display to inform the development of a software platform.

The Applied Research Team gathers subject-matter insight to inform their ongoing research on the problem system as the project advances through development. The Research Analyst considers how data and models will translate and support the contextual setting of the system and problem.

The Software Engineering Team considers project feasibility from a software development perspective. They work with stakeholders to understand the desired complexity of the model, database connections and appropriate software frameworks. As these workshops progress, the Software Engineer is present to discuss possible functionalities and manage expectations.

The Project Management Team works closely with the lead Decision Theater partner to set up logistical infrastructure for the proposed activities and identifies and organizes the DT staff necessary to execute this project. During initial workshops, the Project Manager digests the project's goals and metrics for success and translates requirements into an actionable plan.



Iterative Design and Analysis

Once the problem has been identified, and all parties have agreed upon the scope and parameters the model will address, the project moves into the design and analysis phase. This stage determines the model's function, information flow, analytic findings and technical implementation. An iterative feedback process loop is standard in this stage of model co-creation. Consistent discussions with researchers, domain experts and stakeholders on data analysis and rapid visualization validate and drive the direction of the eventual model infrastructure and use.

The Data Science Team employs methods, algorithms and tools to collect, pre-process and analyze data. They measure and analyze collected data through statistical analyses, machine learning algorithms and tools to generate results.

The team leverages domain expertise and literature to identify relevant frameworks, models and methods for analysis. Iterative process and human intelligence collection construct the framework for scrutinizing artifacts to understand their contributions from a solutions perspective and consider possible limitations.

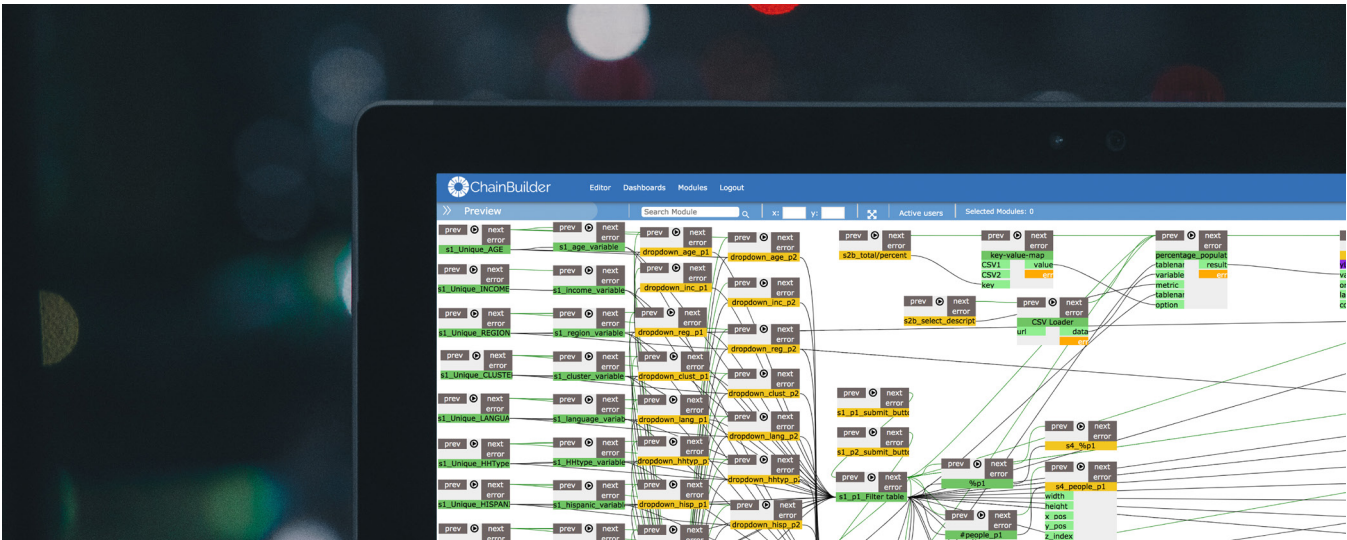
Data Scientists build small modules and analyze small datasets iteratively until all puzzle pieces are found and put together. Implementation of agile and frugal development methods ensures that the design, development and evaluation are completed in a quick turnaround.

The Rapid Visualization Team generates graphic visualizations to demonstrate how data may change as users interact with it in a visualized format. This increases research accessibility and enables an iterative process with stakeholders and research partners to accurately represent findings in the final tool. Rapid data visualizations can take the form of interactive dashboards, exploratory maps and timelines.

The User Experience Team (UX) questions how users will interact with the software tool and the types of findings they are hoping to gain. The UX team works with the Software Engineering team to determine feasibility of development and works with the Graphic Design Team to develop wireframe dashboard mockups. This demonstrates possible information flow, interactivity and usability of the software tool. Stakeholders provide feedback and propose changes.

The Software Engineering Team constructs the technical foundation for the project to include the server, database, and framework. The Development Lead puts together the team that will carry out the project. Software Engineers work with the UX team and stakeholders to translate functional requirements into software framework.

Stakeholders and Researchers review wireframes and provide feedback. Feedback at this point can request changes to the design, types of graphs and information present or not present on the screen. This process can include several iterations with Decision Theater to integrate adjustments and feedback until the stakeholder has agreed to the final wireframes.



Model Development

The Decision Theater software models demonstrate interconnections within complex systems that may be overlooked or miscommunicated in regular discourse. These software models package and route information into a usable format that visually demonstrate impacts of change across a series of connected variables. To reflect the interrelated functions of a social system, the DT links relevant databases and analytics to graphic dashboards through its custom software infrastructure, ChainBuilder.

ChainBuilder presents a complex systems framework approach to decision-support tools that enable the use of multi-screen environments and distributed synchronization of content and interactions across dashboards.

Modules of different languages and libraries are connected through wrappers across a workflow manager to integrate models and allow them to communicate. DT Software Engineers map the data integration and flow of modules in ChainBuilder's workflow manager to direct the model's information flow and analytics.

During the Model Development stage, Software Engineers work iteratively with the Graphic Design team to craft prototype dashboards for stakeholder input and develop the final product for delivery.

The Graphic Design Team builds visual dashboard mock-ups based on finalized wireframes and puts them in a software that will give input to the development team for the look and feel of the model.

The Software Engineering Team follows agile methodologies and scrum processes. The team moves forward with software development, creating dashboards and visualizations for the model. This can be done in Chainbuilder for a multiscreen model or other front-end frameworks, such as Laravel, for a single-screen model. The Software Team uses Github for source code version control and develops internal software to manage applications.

The Quality Assurance Team tests individual visualizations and dashboards as the development team completes them. Once they complete all the dashboards, end-to-end testing is carried out to catch any data or development issues.

The Development Team works closely with the graphic design team to implement the look and feel, generally done with the assistance of software such as Zeplin, which provides code output from the mock-ups to the development team. This is done as the last step in the process, and the QA team conducts the final round of end-to-end testing.





Approval and Use

The Decision Theater presents the interactive software product to stakeholders and researchers for review. This stage is intended to be the presentation of a final product; however, minor aesthetic edits can be achieved, which provided to the graphic design and development team. At this point, the groups discuss how the model will be used moving forward, and stakeholders can begin to schedule demonstrations to audiences of interest. The DT will provide technical support throughout these engagements.



Future Research Potential

Each Decision Theater project builds new technologies, analytics and insights into a particular research domain. As a project life cycle completes, new questions may arise from the model's findings to prompt future initiatives for exploration and research. Due to the interrelated nature of complex problems, insights into the workings of one system may be applied to better understand the functions of another. In this application, DT projects have the power to continually develop new paradigms of complex systems understanding and offer the structures and tools to navigate their functions.

As new projects arise, DT staff and research partners look to previously developed models for the possible re-use of their software frameworks, analytic models and visualizations.

The ability to apply capabilities from the DT Technology Shelf streamlines time and cost of future projects and affords the opportunity to advance the capability's function to another level.

The DT at Arizona State University operates on a multi-project timeline. Its staff works with various stakeholders on projects simultaneously while managing prospective and emerging research opportunities. This results in a continuous flow of new research partnerships, developing technologies and finalizing products that supports momentum and awareness of cross-cutting research potentials and applications of new capabilities to emerging functions.



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