CHAPTER 4: DEMONSTRATIONS OF HOW ANALYTICS CAN INFORM NATIONAL TECHNOLOGY STRATEGY

The Pilot Year Demonstrations

The pilot year demonstrations of the value of analytics to inform investments in S&T addressed the following questions:

- How can the United States effectively track worldwide investment, production, position, and trajectory in critical science and technology (S&T)? Specifically, can we develop **situational awareness** of relative national capabilities in S&T? Where are the next scientific discoveries and technological disruptions most likely to occur? Who, domestically, has capabilities but is left out of scientific discovery and commercialization?
- What are the most effective ways to measure the implications of innovations in **artificial intelligence** for prosperity, jobs, and equity? What is the potential for AI to drive advances in scientific research? Which firms adopt AI-related technologies and what are the effects of adoption? What does the US AI workforce look like and how can it be leveraged and expanded?
- What is the optimal implementation of CHIPS funding in **semiconductors** to achieve the legislation's stated objectives, given financial, technical, and human capital constraints? What is the potential value of investments in next-generation (beyond-CMOS) semiconductor technologies and what investments are needed to overcome bottlenecks to commercialization and scale-up of these technologies?
- In **biopharmaceuticals,** are there innovations in advanced manufacturing technologies that could improve supply chain resilience in critical medicines? What products are "critical" and "vulnerable" from patient, provider, and public health perspectives and amenable to technological intervention? How might expert and public perceptions of criticality differ? What are the most effective strategies for communication with the public?
- In **energy** and **critical materials,** what would be the impacts of future battery material supply issues on the US automotive industry, consumers, and manufacturing jobs? What potential actions could mitigate these supply issues?

A Whole Greater Than the Sum of the Parts: Integrating Disciplines, Methods, and Data

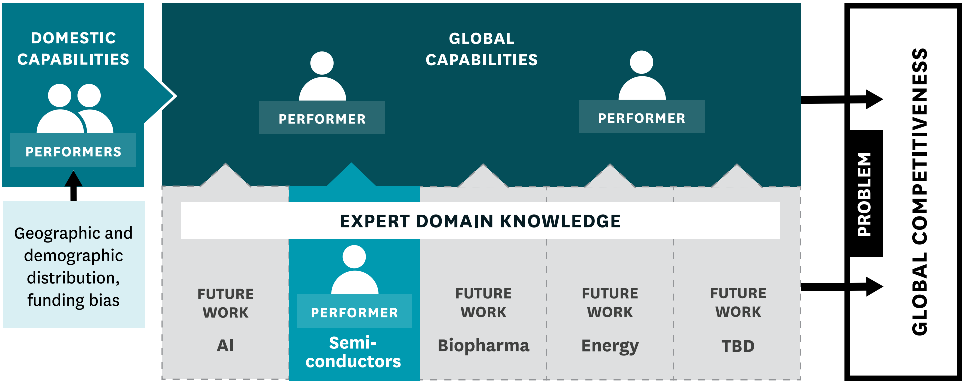
The analytic approaches to these questions were crafted to include contributions from researchers in different disciplines with different data and methodological expertise. Most of the researchers (more than 80%) had not interacted before the award. Indeed, a significant benefit of the Network approach is the side-by-side focusing of different disciplinary, analytic, and data lenses on specific policy problems as well as interdisciplinary collaboration and discovery among researchers who have not interacted in the past. **Figure 4-1** unpacks how each question brought together researchers from different disciplines and with different methods and data to provide insights where the whole was greater than the sum of the parts. Individual investigator summaries of their contribution to each area are in **appendix 4A-1.**

Demonstration of Cross-Cutting Methods and Themes

The aim during the pilot year was to demonstrate in one topic area selected themes and types of analytic methods that could eventually be applied to multiple areas. Cross-cutting themes that were demonstrated in selected cases but could be applied throughout included assessments of human capital constraints (labor) and geographic and demographic diversity (equity). Cross-cutting methods demonstrated in a single case included expert and public surveys about bottlenecks to commercialization and access. (Other methods such as scenario modeling, industrial organization, large language models, and econometrics were also used by researchers throughout.) In addition, the research questions demonstrated in one area how situational awareness could inform an area demonstration and vice versa, and in two areas how analytics could inform the relationships between area demonstrations. (See **table 1-1** in chapter 1.)

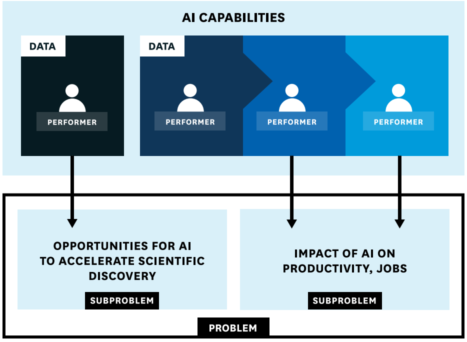
GLOBAL COMPETITIVENESS

30,000 foot search by algorithms informed by and interpreted through expert domain knowledge.



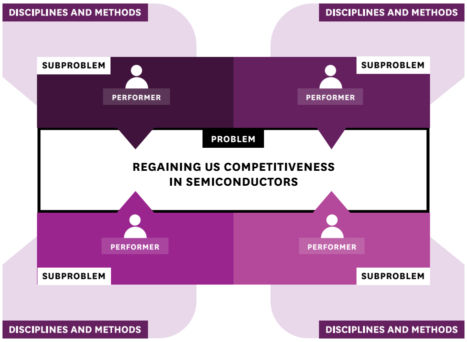
ARTIFICIAL INTELLIGENCE

Different data point in same direction (complementing weaknesses)



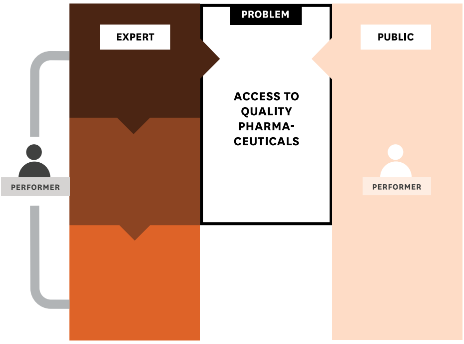
SEMICONDUCTORS

Different disciplines, methods solve different aspects of policy problem



BIOPHARMACEUTICALS

Different disciplines, methods offer different perspectives on same problem



ENERGY AND CRITICAL MATERIALS

Combination of disciplines, methods produce novel findings

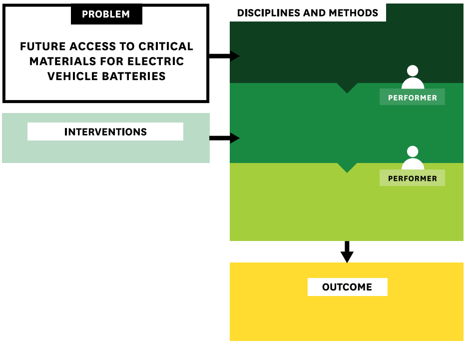


FIGURE 4-1. Dimensions of integration: Bringing together multidisciplinary lenses for a whole greater than the sum of the parts.