

## Experiments in Practices: A Few General Lessons

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- **Societal goals must be driving, not subservient to, technical goals.** If this is not recognized across the many levels of agenda setting then we are probably doomed.
- Sustaining a societal research agenda, and the multi-disciplinary teams to drive that agenda, requires **organizational and power structures that promote (not discourage) critique.** Otherwise, uncomfortable knowledge can lead to disempowerment, and even worse, rejection.
- For institutions to mature (i.e. learn, adapt), they must include **mechanisms for (1) identifying emerging issues, and (2) changing their practices in response to new knowledge.** Leadership must co-develop and revisit agendas and not restrict activities to pre-defined issues.
- We should **expect and embrace persistent and fundamental tensions** regarding the relevance of societal research agendas, as they are functions of changing values and politics. Tensions may well *exacerbate* as technologies and investments mature. Acknowledging and creating space to explore and (re)balance tensions may help protect against polarization and gridlock – and are functions foundational to democratic processes.
- **Societal research should be flexibly organized, both intellectually and operationally, to include both components integrated with technical work, and components independent of technical work, with transitions over time.** The model for organization will vary with the questions/goals pursued and the interests at play. Some problems require primarily social science or technical expertise; some require a mix of disciplinary expertise. Supporting a combination of activities both within and outside any given mission-driven research center, with support for active communications between them, is necessary to allow both learning and oversight. There is a need for more rigorous empirical work on how different organizational forms have fared so far– with a recognition that the results of such studies are will be sensitive, and their scholars vulnerable.
- Societal research agendas require **institutional support for unique but complementary types of activities**, including research, education, strategy and management, communications, and brokering. Too often ‘brokering’ functions are neglected and under-resourced, but they are essential to catalyzing and managing relationships between interdisciplinary groups and interests.
- Bolstering a now-weak infrastructure for societal aspects of research requires **long-term sustained attention, leadership and resources.** The often-longer return time on investment for these efforts means they are often neglected under resource constraints.

- **These lessons are not unique to synthetic biology.** The organization and governance of science and technology has been, and continues to be, a subject of study in many fields (not simply those that are “emerging”) by scholars and practitioners across a variety of disciplines. Unfortunately, there is a dearth of scholarship and practice that recognizes connections between these fields. Advances in the study and manipulation of living systems allow us to test our conceptual and operational models for the governance of science and technology. In particular, along with other areas like cyber and advanced manufacturing, they challenge whether existing models can account for quickly proliferating and globalized technologies and practices that may not be shaped through traditional hierarchical institutions or market forces. Rather, we need to develop our conception of network governance and how institutions, infrastructure, and management that can balance centralized and decentralized control in global contexts.