



The Public-Purpose Consortium

Enabling Emerging Technology with a Public Mission

Jake Taylor

Imagine a speculative technology, one that is destined to change lives and improve the world, but also one where many scientific and practical questions remain to be answered. Companies and entrepreneurs, already seeing the potential, have begun spinning up new efforts and launching startups to realize products and services. You know that investors are likely underestimating both the difficulty posed by the technology and the long-term impact. The science and engineering remain far from that necessary to achieve those goals, much less understand the unintended consequences. You are now tasked with enabling the economic growth implied by these opportunities while ensuring both scientific progress and minimizing unintended negative outcomes. What do you do?

Faced with this challenge in the still esoteric field of quantum information science, leaders in the Government and I worked with stakeholders from across the United States and around the world to build a foundational approach for this new technology. Rather than using a roadmap with product or milestone driven development, we instead focused on building a community around the emerging

technologies and scientific challenges necessary to build quantum computers.¹ These are devices that operate at the very limits set by nature in what and how they compute and are fantastically hard to create – so much so that their basic operation and architecture are areas of active research.² And their impact is fantastically broad, thus the need to both temper expectations and enable cooperation. In executing a program to enable this new sector, we developed a specific approach for solving the challenge of blending profit motive and public good that leverages the mechanism of consortia.

We are at a moment in time where cooperation between public-purpose stakeholders and profit-motive stakeholders can be an effective means of integrating public purpose into technology as it emerges. This brief covers the basic concept of a public-purpose consortium (PPC), examination of what combination of factors lead to their use for emerging technologies, and considers the key principles for organizing PPCs and enabling their success: **Build Community, Enable Cooperation, Ensure Value, Institute Governance, and Keep It Lightweight.**

Public-purpose consortia: a starting point

In the quantum information science domain, we not only focused on building community. We enabled on tight integration of development, research, and early commercialization, along with building long-term institutional support of the community approach, by the use of a consortium. We learned from past Government-led integration efforts such as SEMATECH³ and MCC⁴, where Government funding and sharing of intellectual property and capital had led to moderate developments in other aspects of computing. We worked on maintaining a shared space for dialogue, so that competitors could share the load and jointly benefit for lessons learned. We connected both profit motive and the Government's stake in both the direction and outcomes of the technology, such that the overall purpose of growth and security could be realized. And we built a lightweight institutional structure to sustain the effort.

This platform for technology development, scientific exploration, and community engagement was recently launched as the Quantum Economic Development Consortium (QED-C).⁵ A public-pur-

1 <https://www.whitehouse.gov/wp-content/uploads/2018/09/National-Strategic-Overview-for-Quantum-Information-Science.pdf>

2 <https://www.sciencemag.org/news/2016/12/scientists-are-close-building-quantum-computer-can-beat-conventional-one>

3 <https://www.technologyreview.com/2011/07/25/192832/lessons-from-sematech/>

4 Smilor, R.W., Gibson, D.V. & Avery, C.M. R&D consortia and technology transfer: Initial lessons from MCC. *J. Technology Transfer* 14, 11-22 (1989). <https://doi.org/10.1007/BF02371384>

5 <https://quantumconsortium.org>

pose consortium, the QED-C represents a very different approach to integrating profit motive and public purpose than the traditional public-private partnership. It enables a competitive approach to research and development before markets exist, while not undercutting progress via duplicated effort or the reduction of scientific transparency. Its focus is on enabling a rapid pace of research, while private sector efforts accelerate both the outcomes and the efficiency of exploration.

However, looking past the launch of the QED-C, we must ask: how, and where, can this approach be applied to help America going forward? As a Nation we are confronting substantial challenges where science is likely to both provide new answers and pose new questions.

- In biotechnology, gene editing is moving to a new level of application while the scientific community and the profit-driven movers are already finding paths to work together, but no institutional approach for maintaining that community is in place.⁶⁷⁸
- Carbon technologies that are likely to be employed around the world to reduce carbon emissions or to remove carbon from the atmosphere,⁹¹⁰ but their understanding remains nascent at best, and the technological consequences of their deployment uncertain.
- General purpose artificial intelligence technologies are likely to transform the very fabric of our economy and society, and yet we know little of how or when they will arise, nor which technological path will presage their emergence.

In all of these areas, a sustained, community-driven method of technology and science development may be the right next step for ensuring positive outcomes for the future of America and the world.

Rather than focusing on regulation and top-down decision making, here I focus on the question of community-led and capital-oriented decision making. Clearly many aspects of the bottom-up approach are not functioning efficiently or effectively at fighting the problems of this century. New or improved mechanisms for integrating citizen-oriented needs and missions with government and private funding to enable innovation for the long term are necessary. This will require building and expanding means of cooperating on these and related challenges.

6 <https://www.nationalacademies.org/our-work/international-summit-on-human-gene-editing>

7 Capps, B. et al. Falling giants and the rise of gene editing: ethics, private interests and the public good. *Human Genomics* 11, 20 (2017). <https://doi.org/10.1186/s40246-017-0116-4>

8 <https://www.ncbi.nlm.nih.gov/books/NBK343651/>

9 <https://www.weforum.org/agenda/2020/01/in-the-fight-against-climate-change-public-private-partnerships-are-the-only-way-to-go/>

10 <https://ppp.worldbank.org/public-private-partnership/climate-smart/climate-smart-ppps>

Emerging technologies and consortia

- What is emerging technology, and how does a PPC encourage responsible development?
- What are pathways for PPC action?
- What does success look like?

Emerging technologies represent new tools and approaches for human endeavors where scientific efforts are intermixed with engineering and commercialization. A key difference from other areas of technology is the complex dynamics and uncertain consequences, both positive and negative, to society due to the immaturity of the science and its application behind the technology. In many respects, the biggest impact of the technology is impossible to predict from its current stage, and thus emergent behaviors and opportunities come to define the area as it develops.

This begs a natural question: as innovation and exploration of an emerging technology continue, what approaches can we take that will encourage inclusion of public purpose in technology throughout its lifecycle? Too often the purpose at conception is defined narrowly by the scientific and early adopter communities, and may suffer from narrow thinking or conflicted interests. Outsiders and those working in adjacent areas may not be aware of the advances being made nor be included in the dialogue around their consequences. Furthermore, some of the dramatic uncertainties inherent in scientific exploration mean that prediction can be impossible for key aspects of technology.

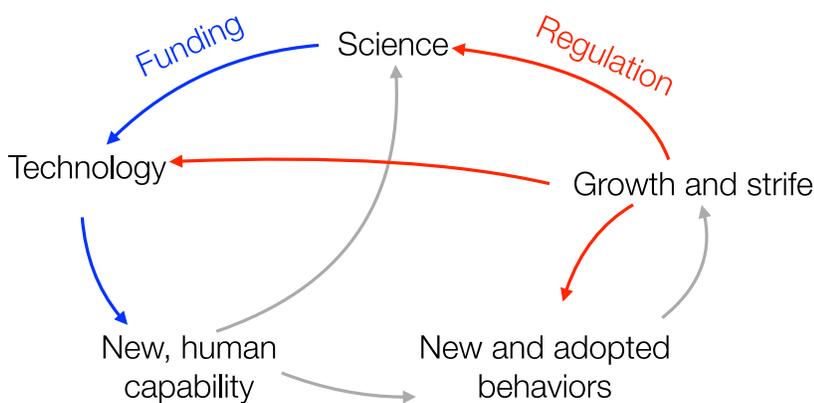


Figure 1: The Innovation Cycle in action. Science and technology lead to new human capabilities, but emergent behavior and new technologies in turn can cause strife and turmoil as the enable society's growth and improvement. A public-purpose consortium can play a key role in moderating this cycle by more tightly coupling the development cycle and the deployment and impact elements, with focused research and development and deep community integration.

However, decades later, the unforeseen consequences of the science-driven technological innovations can come to affect a broad class of stakeholders. By this time, vested interests vie with the greater public's concerns in the theaters of political, legislative, and regulatory constraints and focusing. Pandora's box has been opened, and it takes sustained collective will to contain the negative consequences.

Other paths are possible that more firmly integrate the changing landscape of public good for a technology by connecting the profit-driven and mission-driven institutions and agencies together in a mutually beneficial relationship. Recognizing that individuals play a key role in the next steps of each technological development, a focus on maintaining a community bridging science, technology, and impact can ensure mission and public-purpose are integrated into the attendant technologies. Actions also including entering into the prototyping and development of supporting or enabling technologies, as well as connecting technologies and early products to both nascent markets and further research. Furthermore, shared costs and discoveries can be used by members with reduced costs or other privileges, giving them a competitive advantage in the global market. The public-purpose consortium (PPC) is thus a key institution for achieve this goal, joining public- and private-sector entities with a shared vision to enable the integration of public purpose in the development of technology.

The specific focus of this style of partnership on emerging technologies reflects the interplay of uncertainty and need intrinsic to these domains. Such technologies develop where the scientific exploration remains vigorously active, where scientists are intersecting with innovators and entrepreneurs to yield initial outputs that may in turn translate to products, and where future consequences cannot be well estimated until further scientific exploration occurs. In emerging technologies, I contend that the unanswered scientific questions make top-down regulation premature, while the profit-driven sector may make ill-informed choices that do not account for the impact deployment will have, particularly negative impacts. Thus, there is a substantial public purpose in focusing and enabling choices within the private sector actors. At the same time, the uncertainties in the scientific landscape translate into risks for investors and innovators. This is an area that the government and non-profits have often come in to reduce such risk and such partnering provides a clear value proposition for the private sector. Thus, the success of a PPC is in both its ability to enable new research, development, and early market opportunities and its ability to ensure community values and the implications of deployment are continuously engaged and encouraged in the process of technological maturation.

Public-purpose consortia in action

- What is a PPC in the context of emerging technology?
- How are resources developed and allocated?
- How does governance work?

Public-purpose-oriented funding and organizing bodies (Agencies, NGOs, Philanthropies, etc.) can provide a forum for discussion, mediate agreements between competitors, yield insight, share costs, and shape regulation. At the same time, private sector teams have capital, talent, IP, drive, and can realize risk-taking opportunities. Furthermore, with substantial cash reserves and the existence of low interest rate capital and R&D-related tax credits, many private sector entities already have incentives to invest in research with the potential for game-changing outcomes. Thus, emerging technology is a key area for such entities to work together to reduce risk while improving public outcomes. A public purpose consortium can be vehicle for achieving these goals.

Specifically, such consortia create funding and organizing bodies where you can build technology together while exploring the next round of science, simultaneous with shaping from bodies with public purpose missions in their core. They act as a platform for technology funding and development, scientific exploration and understanding, and policy integration. Furthermore, by providing an institution that enables these activities, the long-term focus is both made clear and sustained, ensuring that parties can reap appropriate benefits by continued participation. An example conception is shown in the Figure, drawn from the stand-up of the QED-C.

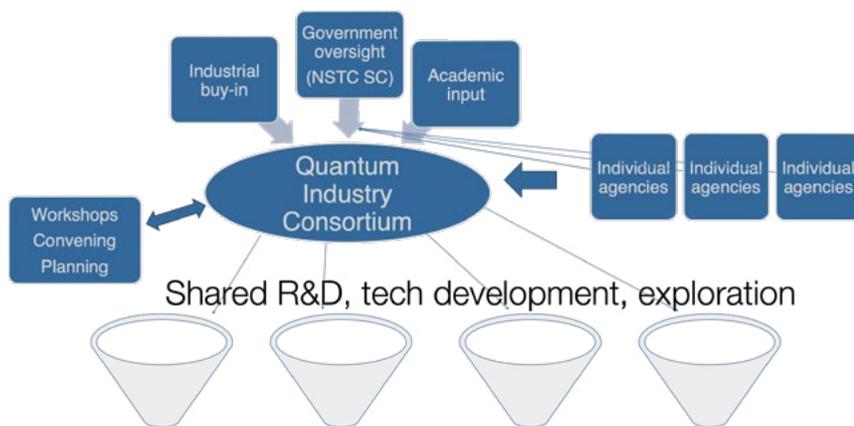


Figure 2: Structure of the QED-C, a public-purpose consortium, for developing new technology. Stakeholders work together to identify promising areas for development, share costs and knowledge, and have intersection and responsiveness to sponsors, the scientific community, and the public at large.

The convening of such a consortium requires careful thought and effort to ensure long-term success. From this analysis and perspective, I suggest the following key principles for a successful public-purpose consortium, reproduced from the introduction. Now, however, we will substantiate each of these.

- 1. Community:** Build a community around the key topics for the public purposes of a technology and its connections to revenue and citizens. Enable an intellectual ferment driven by purpose and dialogue, and ensure stakeholders are contributors.

First, and foremost, is the building and maintaining of the research, development, and early adopter community. In many respects, the community of scientists, engineers, entrepreneurs, innovators, and users of a technology form a microcosm of the larger market emerging technology may one day address. This enables this proto-community to act as a dynamo for early market adoption and testing. At the same time, tight integration of those focused on product and those focused on future scientific questions ensures that long-term considerations continue to be included into decision making and product assessment.

- 2. Cooperation:** Define, with stakeholders, the cooperative areas upon which joint effort will be beneficial and which does not negatively impact existing stakeholder business models. Enable quick testing of hypothesis and premises, improving the ground truth through research.

Healthy support for the proto-community requires regular discussion, agreed upon means of deliberation and sharing and agreed upon structures for conversation and collaboration. This can take the form of technical groups or committees; workshops and reports; or other asynchronous means of discussion. Critically, members of the PPC must agree to contribute key talent and effort to these discussions, to ensure progress is made and trust maintained.

- 3. Value:** Understand the value proposition for private sector and public sector partners. Be clear regarding the benefits and costs of their engagement and strive to build and maintain a trusted space for negotiation and understanding.

Cooperative research requires understanding who has rights to both the intellectual property, but also to the knowledge developed during the research. Having an open and fair perspective between members is critical for achieving this type of community. At the same time, members coming from different perspectives must continue to have their value proposition demonstrated through regular reporting of outcomes and examination of opportunities. To achieve these goals without favoritism, a PPC may be constructed by using a neutral body,

such as a not-for-profit or an independent Government entity, as the holder of the legal instruments and representation of the consortium.

- 4. Governance:** Develop effective governance, including a steering committee or board; an executive team; clear funding for consortium operations; and active sub-community mechanisms such as committees, workshops, or other convening and reporting approaches.

Defining both the values and mission at launch, and refining these elements over the course of operation, is critically important. The governance structure of the consortium provides a central mechanism for these efforts. One may expect a variety of technical committees to come together within the consortium, which will continue to explore impacts and opportunities. These in turn will be passed to members of the consortium, but also the governing body, be it a steering committee, executive board, or something else, which in turn can lead to refactoring of the overall mission as the scientific and technical space continues to evolve. Crucially, public purpose mission-oriented entities must have strong involvement in the governance, as a minority stakeholder, to continue to maintain public purpose. I recognize the strength of profit motive and encourage both active participation of mission-oriented entities in dialogue, but also in funding.

- 5. Lightweight:** Choose the lightest legal instruments for the purposes above.

When in doubt, less is more in legal agreements setting up a consortium. Community standards and values must of course be backed up for critical elements where negotiating a legal agreement can provide the most clarity. For example, in developing next technical directions through, e.g., a technical advisory committee, the consortium may have a broad agreement that such conversations are kept within consortium members, but not have specific legal protections around the intellectual property that could later be developed based in part upon knowledge developed during the conversation. At the same, joint technology development work may require basic operating principles shared by all members, with the specific IP agreements not held by the consortium but rather by the funders of the development work and by the executors of the work. Where possible, letting individual parties choose mutually beneficial terms that do not harm the community is preferred.

Next steps

In this brief, I described the concepts behind public-purpose consortia (PPCs) and their application to emerging technology. This included principles of operation and areas of applicability. I intend to address two key open questions in work to follow this. First, what other areas of emerging technology will a PPC advance the future for the benefit of the public? While I identified carbon tech, general purpose artificial intelligence, and advanced gene editing as promising directions, others may be even more appropriate. The other key question: what previous models worked, and why, in this space? In answering this second question, I can examine several case studies; explore the National Security model and approach for public purpose integration; detail transitions in the private sector enabling the success of PPCs; and propose specific policy options to enable the success of public purpose in emerging technology.



Technology and Public Purpose Project

Belfer Center for Science and International Affairs
Harvard Kennedy School
79 JFK Street
Cambridge, MA 02138

[belfercenter.org/TAPP](https://www.belfercenter.org/TAPP)