

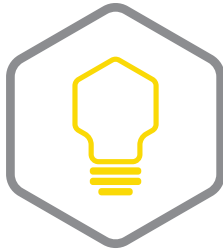
INDUSTRY ECOSYSTEMS AND BLOCKCHAIN

What Enterprise Leaders Should Know about Consortia

Anthony Williams
DEEP Centre

February 2020





Realizing the new promise of the digital economy

In 1994, Don Tapscott coined the phrase, “the digital economy,” with his book of that title. It discussed how the Web and the Internet of information would bring important changes in business and society. Today the Internet of value creates profound new possibilities.

In 2017, Don and Alex Tapscott launched the Blockchain Research Institute to help realize the new promise of the digital economy. We research the strategic implications of blockchain technology and produce practical insights to contribute global blockchain knowledge and help our members navigate this revolution.

Our findings, conclusions, and recommendations are initially proprietary to our members and ultimately released to the public in support of our mission. To find out more, please visit www.blockchainresearchinstitute.org.



Blockchain Research Institute, 2020

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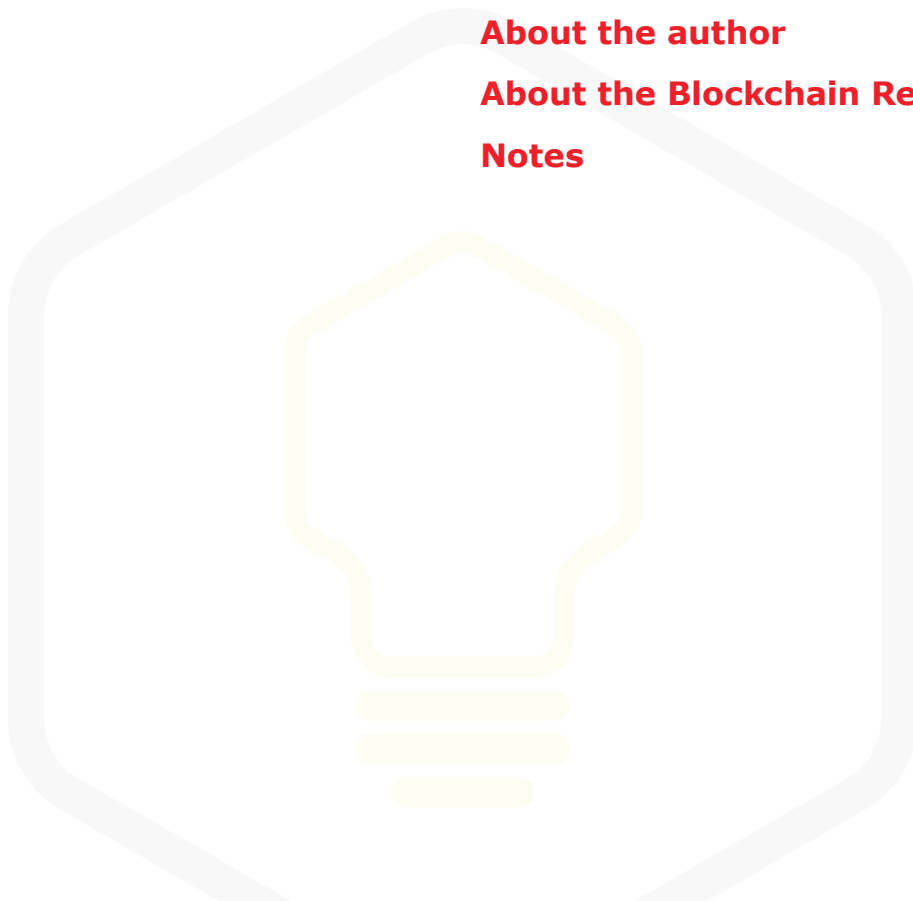
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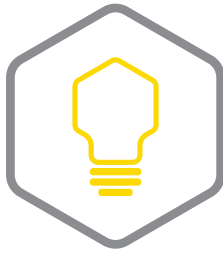


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Foreword

"Blockchain—it's a team sport!" said Dale Chrystie of FedEx at the Blockchain Research Institute's second all-member summit in June 2018. He was talking about *co-opetition*, the strategy of cooperating with competitors in some areas for defined purposes to cultivate a new economic ecosystem that would benefit both—a true win-win way of operating and looking at the marketplace as more than a zero-sum game.

One of the obvious areas of co-opetition is standards development. Chrystie stressed the need for open-source standards as prerequisites to building a blockchain for the global supply chain. FedEx was a founding member of the Blockchain in Transport Alliance (BiTA), and Chrystie was elected chair of its standards council.

Less than a year later—at Blockchain Revolution Global—Chrystie was on stage with Eugene Laney of DHL and Mahesh Sahasranaman of UPS. The three were reinforcing each other's message, that competitors need to collaborate on standards. BiTA provided a forum for doing just that.

This research describes many such industry consortia within the blockchain enterprise space and describes the goals of three in particular—the Blockchain Insurance Industry Initiative (B3i), the Enterprise Ethereum Alliance (EEA), and Hyperledger, hosted by the Linux Foundation.

The project involved interviews with twenty-five executives and thought leaders who are innovatively deploying blockchain technology in industries ranging from artificial intelligence to healthcare. It lays out the business case for joining blockchain consortia including developing standards for technologies and solutions, building trust and confidence in new technology solutions, and probing the industry's future. It also distills the best practices of building industry consortia including organizational design, attracting high-caliber participants, and running high-impact projects.

This work is a must-read for everyone interested in leveraging innovation and thought leadership beyond their organizational boundaries. It happens to be Anthony Williams' sixth project with the Blockchain Research Institute. Anthony is the co-founder and president of the DEEP Centre. He adds this project to his portfolio of case studies and in-depth research.

If you're interested in joining an industry consortium, if you want to make the most of your current membership in a consortium, or if you're thinking of forming an alliance in your domain, then this project is for you.



DON TAPSCOTT

*Executive Chairman and Co-Founder
Blockchain Research Institute*

This work is a must-read for everyone interested in leveraging innovation and thought leadership beyond their organizational boundaries.



A sure sign that the blockchain ecosystem is maturing is the extent to which industry consortia are forming around the technology.

The classic image of innovation proceeding from the investments of a lone firm seeking standalone technological prizes is not today's reality.

Idea in brief

- » A sure sign that the blockchain ecosystem is maturing is the extent to which industry consortia are forming around the technology. This project seeks a better understanding of what companies are trying to gain from consortia projects and what industries and competitors need to accomplish to get a win-win.
- » The paper presents a series of best practices for enhancing industry engagement and collaboration and for maximizing the commercial outcomes associated with consortia projects.
- » Research included 25 interviews with executives representing an international mix of consortia projects and Fortune 500 companies, and an in-depth analysis of over 20 technology consortia in advanced manufacturing, artificial intelligence, blockchain, clean technologies, healthcare and life sciences, and the industrial Internet.
- » Section 2 presents a taxonomy of industry consortia and a discussion of the various design options and organizational models for consortia projects. Section 3 makes the business case for consortia projects. It synthesizes executive insights into the outcomes that companies are seeking to achieve through consortia projects.
- » Section 4 presents three case studies of industry consortia—the Blockchain Insurance Industry Initiative (B3i), the Enterprise Ethereum Alliance (EEA), and Hyperledger, hosted by the Linux Foundation—that are at the forefront of the blockchain ecosystem.
- » Section 5 features a set of insights and best practices for designing industry consortia, attracting high-caliber companies to participate, and, more broadly, running high-impact collaborations that will accelerate commercial success in the blockchain ecosystem. Section 6 offers conclusions and a summary of recommendations.

Introduction

Not long ago, firms developed all their differentiating technology in-house. Proprietary standards and technologies, patent protection, and secrecy helped them realize returns from deep investments in research and development (R&D). This innovation strategy worked in the days when innovators worked alone on discrete and entirely novel inventions. But the classic image of innovation proceeding from the investments of a lone firm seeking standalone technological prizes is not today's reality.



From consumer electronics to aerospace, co-opetition is the new norm.

Science and technology are evolving at great speed and delving into ever more complex domains. Even the largest companies can no longer research all the fundamental disciplines that contribute to their products. Nor can they control an end-to-end production process or seek to retain the most talented people within their corporate boundaries. In most industries, innovation increasingly depends on dense networks of public and private actors and large pools of intellectual property (IP) that routinely combine to create end products.

From consumer electronics to aerospace, *co-opetition* is the new norm.¹ With companies across sectors seeking to harness the transformative potential of distributed ledger technologies (DLT), the blockchain ecosystem is the exemplar of these new models of industry collaboration. Some companies undertake R&D in public-private consortia to enhance the scale, scope, and speed of innovation. Others are embracing open standards to enhance interoperability and encourage collaboration. In short, companies invest in consortia projects because they are instrumental—and, in many cases, essential—to realizing their innovation objectives.

Whether probing the future or developing new products and solutions, sharing responsibility for research and innovation is often faster, more efficient, and less risky than conventional approaches to technology acquisition and R&D. Consortia projects not only spread the costs and risks of development, they can also expand the pool of talent that can participate in solving problems, which produces a diversity of thought that, in turn, can lead to breakthrough results.

In the technology industry, companies most frequently join consortia to collaborate on initiatives that will establish and grow a market for new products and services. Scientific consortia such as the World Wide Web Consortium (W3C) and the Internet Engineering Task



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Common objectives for technology consortia include setting standards to enable the development of new infrastructures, products, software, and services.

Force, for example, were instrumental in building the infrastructure and standards that gave rise to the World Wide Web in the early 1990s. Many similar industry efforts followed in their footsteps to advance critical components of the Internet as we know it today.

Common objectives for technology consortia include setting standards to enable the development of new infrastructures (e.g., for telecommunications and the Internet), products (e.g., wireless peripheral devices and high-definition television), software (e.g., Hyperledger for business users), and services (e.g., web services). Most consortia also market and promote these new technologies to educate potential customers and create demand. Some even engage in advocacy and policy-related work to influence or participate in the development of regulatory frameworks that govern their industries.

Companies also use consortia to scale and speed up their early-stage R&D activities. Common activities in science-intensive sectors include collaborating with scientific communities to conduct precompetitive research. In emerging domains, like the industrial Internet, companies work with researchers and each other to test new technologies in an industrial setting before bringing them to market. Depending on the type of consortia, firms can identify and act on discoveries more quickly, focus on their area of competence, facilitate mutual learning, and spread the costs and risks of research.

"Today's industrial revolution is use case driven," said Sandor Albrecht, vice president of corporate innovation at Research Institutes of Sweden (RISE):

Blockchain, cloud, IoT [Internet of Things], 5G, and AI [artificial intelligence] all herald the arrival of revolutionary new capabilities. Five years ago, they were the province of researchers and geeks. Today we are putting these technologies in context, and companies are super eager to work with each other to test out and prove the viability of new ideas. If you are working in healthcare and life sciences or autonomous vehicles and systems, you cannot make progress as an individual player. You have to build a network and ecosystem. You are impacted by other technologies and applications areas and supply chains.²

Consortia projects represent an opportunity to attract investment, foster innovation, and create the jobs and companies of the future.

Consortia projects are equally important to other key actors in innovation clusters. For universities, consortia projects are vehicles for translating scientific discoveries into marketable products and services, for generating spin-off companies, earning licensing revenues, and training the next generation of scientists. Start-ups and small and medium-sized enterprises (SMEs) join consortia projects to secure a first sale or gain access to industry value chains. For national and subnational jurisdictions, consortia projects represent an opportunity to attract investment, foster innovation, and create the jobs and companies of the future.

A sure sign that the blockchain ecosystem is maturing is the extent to which industry consortia are forming around the technology.



This project seeks a better understanding of what companies are seeking to gain from participating in blockchain consortia.

Two prominent examples include Hyperledger and the EEA. Both entities were established to advance cross-industry blockchain technologies and platforms, and each organization hosts several hundred members operating across a range of sectors. In addition to these broad umbrella endeavors, blockchain consortia have formed in a variety of niche domains as well. Among many others, these include Trusted IoT Alliance (blockchain technologies to connect and secure the next generation of smart IoT products), B3i (blockchain solutions for the insurance industry), Project Jasper (blockchain and central bank infrastructure), and the Accounting Blockchain Coalition (blockchain and the future of accounting).

This project seeks a better understanding of what companies are seeking to gain from participating in blockchain consortia. The report presents a series of best practices for enhancing industry engagement and collaboration, and for maximizing the commercial outcomes associated with consortia projects. The report will also offer a more in-depth understanding of how consortia projects can further the commercial success of the blockchain ecosystem. It includes a discussion surrounding what companies are seeking to gain from participating in consortia projects and what industries and competitors need to accomplish to get a win-win. Drawing on a series of executive interviews, a review of secondary sources, and an analysis of leading consortia projects, the report highlights a suite of best practices for attracting companies to consortia projects, along with strategies for designing and running high-impact collaborations.

A taxonomy of industry consortia

Consortia are often set up to advocate on behalf of their members, to set standards and influence policy and regulation, and to build shared infrastructures that serve the industry as a whole.

A consortium is a group of organizations that join together to accomplish a shared goal or participate in a shared activity. Consortia members also frequently include government agencies, nonprofit research institutions, and major universities. When joining a consortium, each participant retains its separate legal status, and the consortium's control over each participant is generally limited to activities associated with the joint endeavor. In practice, a consortium can be anything from a loose, unincorporated affiliation of companies, organizations, and individuals, to an incorporated entity with offices, marketing, technical and administrative staff, and a multimillion-dollar budget.

Consortia are closely related in structure and purpose to a variety of other industry groupings, including business/trade associations, governance bodies, and communities of practice. Like other industry associations, consortia are often set up to advocate on behalf of their members, to set standards and influence policy and regulation, and to build shared infrastructures that serve the industry as a whole.





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Innovation activities

One way to parse the landscape of consortia is to delineate the various innovation activities that companies undertake through these collaborative ventures. The academic research on consortia has identified two broad collaboration goals or activities: to build enabling platforms and to conduct R&D. These goals can be further subdivided into four key innovation activities or outputs, including:

- » **Developing standards, platforms, and tools.** Standards and platform consortia are established to create industry standards (e.g., for products and communications protocols) and to develop shared platforms and tools that are required to conduct research or advance other industry interests. Such consortia are common across all sectors but are especially prevalent in technology-based industries where standards for communications and interoperability are essential. Examples of standards and platform consortia include open standards efforts such as the Hyperledger Consortium and the Genomic Standards Consortium to closed, proprietary standards network such as the Car Connectivity Consortium in the automotive sector and SEMATECH in the semiconductor manufacturing technology sector.
- » **Generating and disseminating data.** Data consortia are established to create and aggregate data at a scale required for advanced research or commercial exploitation in a broad industry context. Such discovery-enabling consortia provide a critical mass of data for innovation that cannot be achieved by the individual participants alone. Examples of discovery-enabling consortia include the Human Genome Project, CERN (European Organization for Nuclear Research), and Moody's Analytics Data Alliance.

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Precompetitive research consortia are established to explore territories where technologies are either immature or very expensive to develop.

- » **Creating new knowledge.** Precompetitive research consortia are established to explore territories where technologies are either immature or very expensive to develop. They typically emphasize the research components of the innovation process and view collaboration to share the costs and risks of building the fundamental knowledge base of the industry. The explicit aim of such consortia is the expansion of technical or scientific knowledge, rather than the development of patentable or commercialized products. Examples of precompetitive research consortia are numerous and include the Structural Genomics Consortium, the Partnership on AI, and the University Blockchain Research Initiative.
- » **Developing and commercializing products.** Downstream product development consortia are established to help founding firms and institutions develop a strong commercial position in a new market. Such consortia concentrate on applied research (product development, prototypes, test beds, and pilot projects) and commercialization stages, including product marketing. Some product development consortia focus on commercializing research and new technologies in a particular sector or technological niche on an ongoing basis. In other cases, product development consortia are undertaken to work on a singular project of limited duration and terminate after reaching their goals. Examples of product development consortia range from open-source hardware initiatives like Arduino to proprietary business consortia like B3i to public-private consortia such as Project Jasper.

Structure, tactics, and organizational design

Another way to parse the landscape is to focus on the structure, tactics, and organizational design approaches that consortia projects use to achieve their goals. The DEEP Centre's research suggests that consortia projects can be organized or structured differently, depending on the objectives of consortia members. Some of the key differentiating factors include membership (i.e., is participation open to everyone or restricted to a defined group?), beneficiaries (i.e., who gets access to the consortia's outputs?), and governance (i.e., how are critical decisions made?).

Consortia differ significantly in the degree to which membership is open to anyone who wants to join.

- » **Membership:** Consortia differ significantly in the degree to which membership is open to anyone who wants to join. Most consortia place restrictions on membership and many charge fees for participation. Restricted participation makes sense when there are significant barriers to entry (e.g., the specialized expertise or cost of equipment needed to participate), it's important to exercise control over the quality of inputs, and when there is a desire to restrict access to the consortia's outputs or benefits. However, consortia and innovation communities where everyone (suppliers, customers, designers, research institutions, inventors, students, hobbyists, and even competitors) can participate



have been highly successful and are driving innovation in several sectors and technological pursuits.

- » **Beneficiaries:** The degree of access granted to the consortia's benefits, and specifically its intellectual outputs, is another key differentiator for consortia projects. Consortia focused on product development and commercialization are likely to restrict the beneficiaries and keep their outputs proprietary, as are consortia that require significant funding by participants, so as to avoid the free-rider problem. However, providing open access to IP and other outputs can be advantageous when there is a benefit to attracting a vast number of problem solvers and, consequently, a vast number of ideas or other inputs. Open-access consortia models have become more frequent and are found in everything from software development to drug discovery.
- » **Governance:** Consortia can also be differentiated based on their governance models, with flat and hierarchical governance being the two primary options. The fundamental distinction between a flat and hierarchical form of governance is who gets to define the problem and choose the solution. In hierarchical governance, a specific organization assumes the authority for making decisions, which means it controls the direction of the innovation efforts and captures more of the innovation's value. In the flat form of governance, leadership and decision-making are decentralized to some or all collaborators. The advantage of flat governance is the ability for consortia members to share the costs, risks, and technical challenges of innovating.

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Four types of models

Different configurations of these design factors give rise to four key consortia models.

Open-source communities are typically flat networks of contributors that invite contributions from everyone and provide free access to their outputs or benefits. Open innovation networks work on open-source software, open standards, open-data initiatives, and other public domain projects. Though less common in product development, open-source communities are active across the full spectrum of innovation activities. They are especially active in developing standards and platforms, generating and aggregating data, and conducting precompetitive research.

Public-private consortia are hybrid networks that involve diverse participants with varying degrees of participation and access to outputs. Within this model for organizing consortia projects are two distinct subtypes:

- » **Public-private consortia with open access/restricted participation:** A significant number of consortia projects restrict participation to a selective group—usually as a means



to control the quality of inputs—but place their outputs in the public domain. Such hybrid efforts are common in standards development, data aggregation, and precompetitive research networks, and less common in product development because of their open-access philosophy.

- » **Public-private consortia with open participation/restricted outputs:** A smaller number of hybrid consortia projects invite open participation, but limit access to the outputs to a select group or an individual sponsor. Examples of such consortia include those that host innovation challenges and incentive prizes (e.g., Challenge.gov or XPRIZE Foundation) where the public at large are invited to contribute solutions, but the challenge/prize sponsor retains the benefits or outputs. Governance models for public-private consortia vary according to the size and nature of membership and the objectives of the group.

A smaller number of hybrid consortia projects invite open participation, but limit access to the outputs to a select group or an individual sponsor.

Figure 1: Taxonomy of innovation consortia

Participants/ beneficiaries	Build enabling platforms		Conduct research & product development	
	Develop standards and tools	Generate and disseminate data	Create new knowledge	Develop and commercialize products
Open participation/ open output	Open-source community			
	<ul style="list-style-type: none"> Linux Foundation Genomics Standards Consortium Open Geospatial Consortium TensorFlow 	<ul style="list-style-type: none"> DBpedia OpenStreetMap Wikipedia 	<ul style="list-style-type: none"> American Gut Project Public Library of Science Zooniverse 	<ul style="list-style-type: none"> Arduino Project Medicines for Malaria Venture
Restricted participation/ open output	Public-public consortia: Open access/restricted participation			
	<ul style="list-style-type: none"> Hyperledger Trusted IoT Alliance W3C 	<ul style="list-style-type: none"> Data.gov SNP Consortium 	<ul style="list-style-type: none"> Partnership on AI Structural Genomics Consortium 	<ul style="list-style-type: none"> OpenAI
Open participation/ restricted output	Public-private consortia: Open participation/restricted outputs			
		<ul style="list-style-type: none"> Gengo.AI Tutela Waze 	<ul style="list-style-type: none"> Challenge.gov InnoCentive Qmarkets 	<ul style="list-style-type: none"> Local Motors P&G Connect & Develop XPRIZE Foundation
Restricted participation/ restricted output	Proprietary business consortia			
	<ul style="list-style-type: none"> Car Connectivity Consortium Project Jasper R3 SEMATECH 	<ul style="list-style-type: none"> Big Medilytics Global Data Consortium Moody's Analytics Data Alliance 	<ul style="list-style-type: none"> Accounting Blockchain Consortium Advanced Vehicle Technology Consortium 	<ul style="list-style-type: none"> ARM Institute B3i CUTRIC Evok Innovations SOSCIP Vector Institute



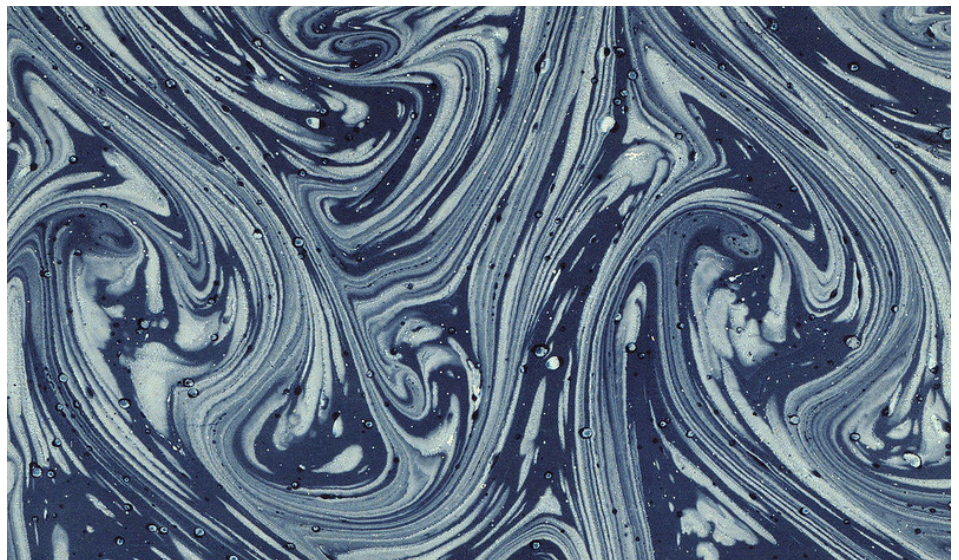
Proprietary business consortia are commonly deployed for product development.

Proprietary business consortia are closed networks that both restrict participation to a highly selective group and control access to their outputs. Proprietary business consortia often implement a formal governance structure with centralized decision-making processes and formal controls and communication channels that are used to decrease the risk of undesired spillovers and information leaks. Proprietary business consortia are commonly deployed for product development, but also work across the full spectrum of innovation activities with many involved in developing standards and creating precompetitive knowledge.

Combining the four innovation activities with the different organizational design considerations for consortia projects yields a taxonomy of innovation consortia that is useful in thinking through the strategic options for developing consortia projects in the blockchain ecosystem. The taxonomy also provides a valuable rubric for identifying the organizational design options and success factors that are key to each consortia model defined in the taxonomy.

The business case for joining blockchain consortia

Business is supposed to be competitive, even cutthroat, in the pursuit of growth and profits. And yet, companies increasingly collaborate to open up new markets, create economies of scale for shared commodities, and build synergies between complementary products and services. Consortia represent a typical vehicle for formalizing such collaborations. The fact that consortia are such a prominent feature of the business landscape raises an intriguing question: why do companies choose to join these cooperative efforts?



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The consortia projects focused on emerging technologies such as AI, autonomous vehicles, blockchain, the industrial Internet, robotics, genomics, and clean technologies.

To answer this question, the DEEP Centre conducted a review of the management literature (Appendix A), analyzed over 20 emerging technology consortia, and interviewed 25 executives representing an international mix of consortia projects and Fortune 500 companies. (See Table 1, next page, and Appendix B for an overview of methodology).

Collectively, the interviews cover companies operating in sectors ranging from bioprocessing, construction, transportation, and natural resources to biotechnology, pharmaceuticals, information technologies, and manufacturing. The consortia projects discussed during the interview process included those focused on emerging technologies such as AI, autonomous vehicles, blockchain, the industrial Internet, robotics, genomics, and clean technologies.

During the interviews, we asked executives with Fortune 500 companies about their corporate innovation strategies, the competencies that will be vital to transforming their businesses in an era of technology-driven disruption, and the role of consortia projects in helping companies achieve their innovation objectives. Corporate executives also reflected on how and why they engage with consortia projects and what they look for when evaluating opportunities to join a consortium. We asked executives leading consortia projects about the factors that are contributing to the success of their consortium, their strategies for attracting large anchor firms to the project, and their approach to keeping these firms engaged in the work of the consortium.

The findings from these interviews provide a baseline understanding of how consortia projects fit into contemporary corporate innovation strategies and why more and more companies are using consortia projects to accelerate, strengthen, and scale up their innovation efforts.

Develop standards for technologies and solutions

DEEP Centre research suggests that companies are seizing opportunities to collaborate, but there is equal recognition among executives that much more could be done.

Historically, most private sector investments in research and innovation have been made in corporate silos. However, there is a growing recognition among top global firms that a multilateral approach to innovation can lower the costs and risks associated with developing, testing, refining, and adopting new standards and technologies that can be applied broadly across an industry. For consortia projects, the low-hanging fruit includes areas like setting interoperability standards and developing technologies and platforms that serve industry needs but don't necessarily contribute to competitive advantage.

DEEP Centre research suggests that companies are seizing opportunities to collaborate, but there is equal recognition among executives that much more could be done. "Companies see everyone as their competition, but they should rethink that," said Dan Wicklum, CEO of Canada's Oil Sands Innovation Alliance.



Table 1: Interviews conducted by the DEEP Centre

Consortia project	Interviewee	Title	Organization
Advanced Robotics for Manufacturing Institute	Byron Clayton	Former CEO	Carnegie Mellon University
	Carolina Gallo	VP, Government Relations	ABB
Advanced Vehicle Technology Consortium	Bryan Reimer, PhD	Research Scientist MIT AgeLab	MIT
B3i	Ken Marke	Chief Marketing Officer	B3i
Bio-based Industries Consortium (BIC)	Dirk Carrez	Executive Director	BIC
Canada's Oil Sands Innovation Alliance (COSIA)	Dan Wicklum	CEO	COSIA
	Joy Romero	VP, Technology and Innovation	Canadian Natural Resources
	Gary Millard	Senior Advisor, Energy and Climate Change	Suncor
Canadian Food Innovators	Tim Faveri	VP, Sustainability and Shared Value	Maple Leaf Foods
Canadian Mining Innovation Council (CMIC)	Carl Weatherell	CEO	CMIC
Canadian Urban Transit Research and Innovation Consortium (CUTRIC)	Josipa Petrunic	CEO	CUTRIC
Carbon Impact Initiative	Andrew Bowerbank	Global Sustainability Leader	WSP
Construction Digital Transformation Alliance	Ellis Talton	Director of Growth Marketing	Briq
	David Bowcott	Global Director, Growth, Innovation and Insight	AON Risk Solutions
Enterprise Ethereum Alliance (EEA)	Ron Resnick	Executive Director	EEA
Evok Innovations	Jonathon Rhone	CEO	BC Cleantech CEO Alliance
	Marty Reed	CEO	Evok Innovations
	Judy Fairburn	EVP, Environment and Strategic Planning	Cenovus
FPIInnovations	Bruno Marcoccia	Director of Research and Development	Domtar
Hyperledger	Brian Behlendorf	Executive Director	Hyperledger
Volta Labs	Nestor Gomez	Start-up and Entrepreneurship Program Lead	McCain Foods
Research Institutes of Sweden (RISE)	Sandor Albrecht	VP, RISE SICS	RISE
Structural Genomics Consortium (SGC)	Aled Edwards	CEO	SGC, University of Toronto
	Maxwell Morgan	Chief Legal Officer	M4K Pharma Inc.
	Andrew Witty	Former CEO	GlaxoSmithKline



Technology giants set a context for innovation and then invite their customers, partners, and other third parties to co-create their products and services.

A cohort of management could get further ahead through collaboration. They can make collective investments in technology but still compete on implementation, culture, and strategy. Collaboration benefits everyone by boosting the technological competence of the industry.³

The world's largest and most successful technology companies—like Amazon, Apple, Facebook, Google, and Microsoft—have long recognized the power of permitting large developer ecosystems to build new applications and extensions that interoperate with their software platforms. Rather than build all of their software in-house, these technology giants set a context for innovation and then invite their customers, partners, and other third parties to co-create their products and services. Consortia projects provide an opportunity to get multiple companies to unite their efforts around a common set of standards and a shared technology stack that will improve the capacity of participating member companies to bring complementary products and services to market.

Forging this kind of industry-wide collaboration can be difficult. As Brian Behlendorf, executive director of Hyperledger, explained:

A significant challenge with the existing open source blockchain efforts is the tremendous levels of tribalism among developers. While invigorating, it can also make sharing code between efforts, or talking about common challenges and how to meet them, notoriously tricky. This is true even when the payoff would be less duplicated code and more eyes looking for security holes and other issues.⁴

However, the payoff for collaboration is significant. As Behlendorf put it:

If Hyperledger could not only forge common ground between different software development efforts, but also encourage a gradual detachment between standards, implementations, and global governance, then we will also accelerate the adoption of blockchain tech widely and further reduce needlessly duplicated engineering efforts.⁵

Consortia projects can help industry value chains increase R&D productivity and get products to market more quickly.

Boost R&D productivity

Even in highly competitive domains of technology development, consortia projects can help industry value chains increase R&D productivity and get products to market more quickly. An executive in the automotive industry, for example, has long been an advocate for collaboration among competitive manufacturers in the race toward autonomous vehicles. "Companies that tried to go it alone are realizing the immense costs of R&D and the daunting technological challenges and are deciding to partner up," said Bryan Reimer, executive director and research scientist with MIT's Advanced Vehicle Technology Consortium.⁶ He continued:



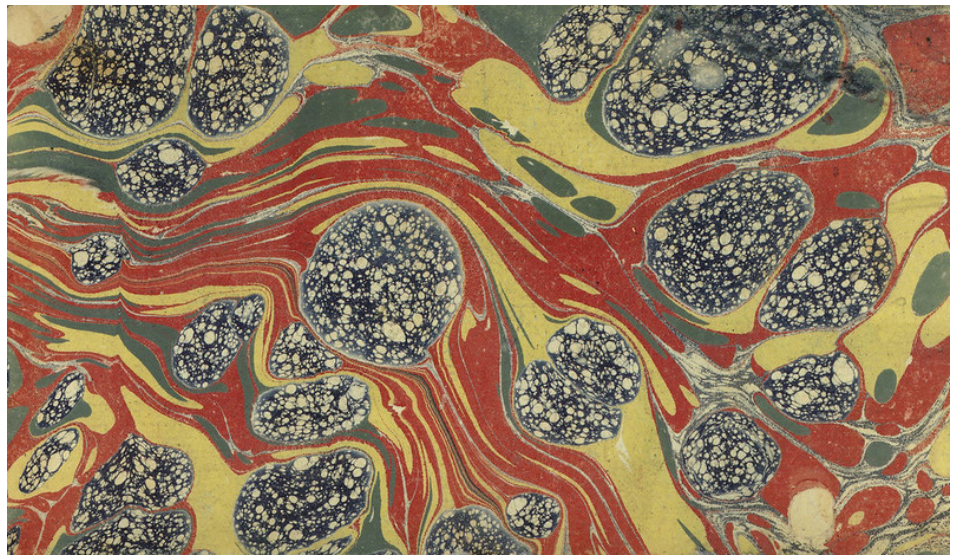
The first generation of technology for autonomous driving systems cost about \$1 billion to produce and can still serve as building blocks for future iterations Car companies that spent this and are now deciding to partner have realized they will have to abandon earlier versions of their technology and replace it with jointly developed software.⁷

"When we looked at how to tackle the R&D productivity, it became obvious that discovery is a profoundly individual phenomenon."

 **ANDREW WITTY**
Former CEO
GlaxoSmithKline

Other R&D intensive sectors, such as electronics and healthcare, face similar productivity concerns. "In the R&D space, it's obvious in hindsight that the pharmaceutical industry lost its way on R&D productivity somewhere during the mid-1990s," said Andrew Witty, former CEO of GlaxoSmithKline. He continued:

When we looked at how to tackle the R&D productivity, it became obvious that discovery is a profoundly individual phenomenon. The notion that a corporate entity can somehow legislate discovery is completely false. It's about how you empower, inspire, energize, and connect individuals both within your corporate boundaries and increasingly across institutional boundaries.⁸



Vintage 19th c. marbled paper, Gloster pattern (26) by Paul K, 2010, used under CC BY 2.0, rotated 90 degrees.

The blockchain ecosystem still has work to do to win the full trust and confidence of the enterprise market.

Build trust and confidence in new tech solutions

New and untested technologies always have significant barriers to market adoption until enterprise users are satisfied that the solutions can meet their requirements for security, cost, performance, and scalability. While there have been significant enterprise blockchain deployments, it is fair to say that the ecosystem still has work to do to win the full trust and confidence of the enterprise market. Industry consortia like Hyperledger and the EEA are playing this role in the blockchain ecosystem by establishing standards, educating the market, and demonstrating the viability of new technologies through use cases and test deployments.

"At Hyperledger, we are forging a brand that will be seen widely to reflect the accepted default 'safe' deployment platform for enterprise teams."

 BRIAN BEHLENDORF
Executive Director
Hyperledger

"At Hyperledger, we are forging a brand that will be seen widely to reflect the accepted default 'safe' deployment platform for enterprise teams. We want to be a great home for active collaboration around new technologies," said Behlendorf.⁹

In this sense, there is a close parallel between what the EEA, Hyperledger, and others are striving to do with blockchain today and what the Linux Foundation did for Linux (and open-source software generally) in the early 2000s. As Don Tapscott and I described in *Wikinomics*:

When Linus Torvalds first posted a fledgling version of Linux to an obscure software bulletin board in 1991, no one would have predicted that open-source software would be much more than a short-lived hacker experiment. Even after Linux became a serious global movement, large software companies denigrated it, arguing that open-source code would never offer the completeness or reliability of proprietary software.¹⁰

IBM saw things differently, recognizing early that open source represented a new model of software production that could potentially upset the balance of power in the industry. The computing giant joined the Linux Foundation and began donating large volumes of proprietary software code and setting up teams to help the Apache (Web server) and Linux (operating systems) open-source communities. Industry peers such as Fujitsu, Hitachi, Hewlett-Packard, Intel, and Oracle soon joined the bandwagon, and together, they did a lot to help standardize Linux, support its growth, and promote commercial adoption of open-source software in general.

At a time when reliability and trust were big question marks surrounding Linux, IBM, and other large companies not only contributed the bulk of Linux Foundation funding but also helped to indemnify client risk. This maturation, in turn, paved the way for Linux to go into all sorts of new products, including set-top cable boxes, mobile phones, home appliances, and even some automotive control systems.¹¹

Leverage corporate assets

Many companies with significant R&D operations generate far more IP than they can ever commercialize. In other instances, the inventions they do commercialize have applications far beyond what they originally envisioned. To leverage their R&D investments better, smart companies want every invention to solve not only the problem for which it was designed, but many others. They hunt for opportunities to deploy IP in adjacent industries and different regions of the world. Rather than do it all themselves, they strike partnerships with other companies that may be better positioned and motivated to exploit the opportunities. As Pat Patnode, president of licensing at GE, put it:

No matter how strong and deep one's research organization is, we've learned that great ideas on how to use inventions are just as likely to emerge from outside a company as



from within. Fostering collaboration within our company and bringing in people from outside the fold gives us the chance to look at our inventions from fresh perspectives. By working with start-ups, we can test hypotheses faster than ever before, moving innovative products to market faster or halting costly development at the earliest sign of failure.¹²

Consortia projects provide a venue for companies to contribute more effectively to tackling the thorniest and most intractable issues facing society.

Solve intractable problems

Consortia projects provide a venue for companies to contribute more effectively to tackling the thorniest and most intractable issues facing society. From slowing climate change to curing disease and increasing food security, there is no shortage of extraordinarily difficult problems to solve. Up until recently, companies and other institutions have primarily carried on independently, trying to solve these problems by working behind closed doors. Aled Edwards, CEO of SGC, said:

The effort being deployed to solve the industry's most intractable problems are fundamentally insufficient. So, our approach to breaking the deadlock was to fundamentally reduce the barriers to discovery because the market is not creating the energy required to leap over existing hurdles. We had to foster that energy by opening up our intellectual property and our labs and industrial facilities to individual scientists who could drive progress.¹³

Similarly, Witty has called on the pharmaceutical industry to rethink its approach to grand challenges in medicine like cancer, diabetes, and Alzheimer's. These costly and often devastating afflictions are crying out for more collaboration, he said:

To solve Alzheimer's, we need a herculean effort to find the targets against which the drug companies can look for drugs. At the moment, we're all dividing our efforts, and there have been many, many failures in the field, mostly because you have to go through hugely expensive trials on poorly validated targets, only to prove that they don't work.¹⁴

Consortia projects could yield better results in antibacterial research, developing more intelligent approaches to assessing drug toxicology, and reducing the industry's reliance on animal testing.

In the open model, a precompetitive consortium, including big pharma, biotech firms, and university researchers, would pool efforts to validate targets responsible for producing Alzheimer's brain crippling effects. Competition ramps up in the subsequent phase where drug companies compete around molecular selection against the targets. "You would typically expect six to ten companies to go racing after that target, you would expect three or four to succeed, and you would end up with a very good contribution to solving the problem," said Witty.¹⁵

Treating Alzheimer's is just a start, according to Witty, who cites a range of industry problems where consortia projects could yield better results: antibacterial research, developing more intelligent approaches to assessing drug toxicology, and reducing the industry's reliance on animal testing. For example:



Executives see consortia projects as an opportunity to cross-fertilize their collaboration efforts with companies in other sectors, especially when industries face similar challenges.

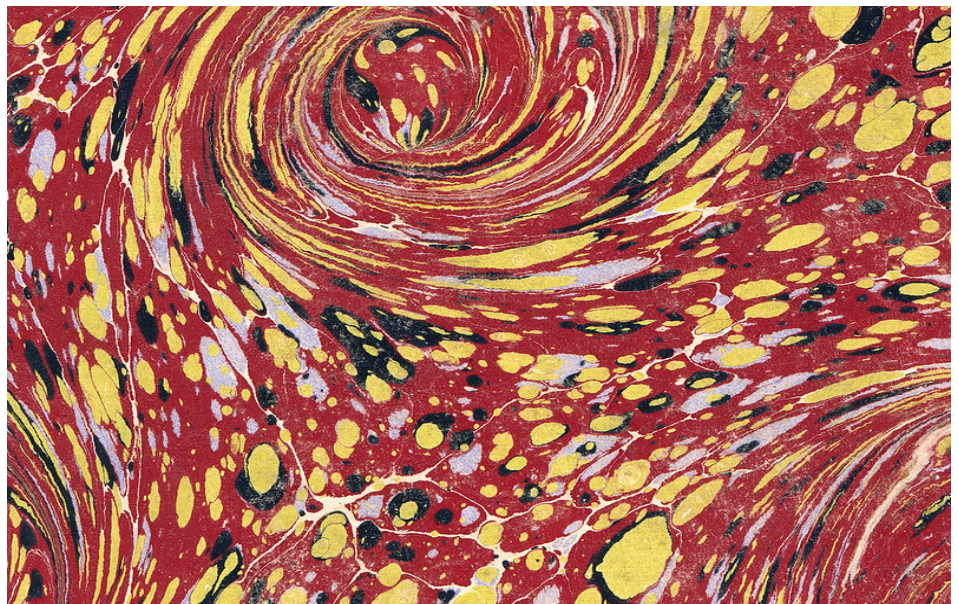
There are whole areas of medical and pharmaceutical research where we ought to fundamentally do things differently, recognizing that companies that choose to be engaged do so because they understand that the pooling of knowledge and capability is necessary to stimulate the breakthroughs we need to take in the next step toward developing medicines.

It's like climbing Mount Everest. Sometimes you need some help to get to base camp, and once you get there, you have an opportunity to climb the mountain. But if you never get to base camp, you have no chance of reaching the peak. In those areas where the problems are beyond the reach of any individual firm or institution, we think there is a phase where open sharing makes sense, and there is a phase at which you want to reinsert the profit motive to drive speed and competition in terms of developing new medicines.¹⁶

Although Witty was reflecting on significant challenges in medical and pharmaceutical research, his call for greater collaboration and sharing of IP through consortia projects could easily apply to other sectors and challenges.

Cross-fertilize innovation efforts

Executives see consortia projects as an opportunity to cross-fertilize their collaboration efforts with companies in other sectors, especially when industries face similar challenges. Other times, consortia projects form around emerging technologies that have applications across cross-sector technologies like AI, blockchain, and the IoT. "We're not just telecom and IT," said Ron Resnick, executive director of the EEA. "We're everything. ... We have participants in all of the key sectors, from health care to agriculture."¹⁷



Vintage 19th c. marbled paper, French Curl on Turkish Pattern (31) by Paul K, 2010, used under CC BY 2.0, rotated 90 degrees.

Opportunities for innovation were only realized when companies from different sectors pooled their competencies.

In several cases examined, opportunities for innovation were only realized when companies from different sectors pooled their competencies. The Carbon Impact Initiative's plan to design, build, and run several large-scale commercial buildings that produce net-zero emissions is a case in point. Getting to the point where a sizable proportion of the built environment produces net-zero energy will require a massive, multistakeholder effort.

For example: building codes will need to require higher standards; innovative lifecycle financing models will need to incent building owners to pursue sustainable, low-carbon approaches; construction companies will need to invent and incorporate greener building materials; building operators will need to work with tech companies to install smart building technologies that deliver comprehensive analytics and automatically conserve the use of resources like water and energy.

Pursue early-stage research

In a context where companies face tight constraints on capital, and some are scaling back internal R&D operations, there is also broad interest from companies across sectors in partnering with universities to conduct precompetitive research with a much broader base of skilled practitioners.

"At a time when many firms are cutting back on R&D, especially science-based R&D, it's worth remembering that advancing the basic sciences is the only way to guarantee that industries will continue to be innovative over the long term," said Dirk Carrez, executive director of the BIC. "Imagine farming without organic chemistry or medicine without microbiology or electronics, computing, and semiconductors without quantum mechanics."¹⁸ In short, without new insights and advances in the underlying science disciplines, our stock of knowledge becomes stale. If the well of knowledge dries up, so too does innovation. Supporting precompetitive research collaborations is one way to make sure this doesn't happen.

Several interviewees commented that continued government support for targeted funding programs is critical to bringing companies together with the broader innovation infrastructure at publicly funded research labs, universities, and colleges. Said Carolina Gallo, vice president of government relations at ABB:

Continued government support for targeted funding programs is critical to bringing companies together with the broader innovation infrastructure.

We need to innovate, and we need to change our products. So, the only sensible way out of that box is open innovation, where you're dealing with a broader subset of experience and skills. Internal innovation didn't work, it was unaffordable, and we looked outside and realized we could get a lot more done through collaborative partnerships with universities, colleges, and research institutions, and with end-users.¹⁹

From research on AI and autonomous systems through to smart grids, energy storage, and blockchain, executives are keen to help influence the direction of research on transformational technologies. Many are also optimistic that precompetitive research consortia



provide companies with a means to make progress on innovation priorities, despite having limited access to R&D budgets and private capital.

Tap new and bigger talent pools

A bigger and more diverse talent pool helps boost discovery rates and reduces the risk that investments in technology development will fail.

Further collective benefits can be derived from relationships with researchers, supply chain partners, and start-up companies that expand the pool of talent that can participate in solving problems. A bigger and more diverse talent pool, in turn, helps boost discovery rates and reduces the risk that investments in technology development will fail. Witty argued that the power of diversity in the talent pool shouldn't be underestimated:

The key for a corporation to succeed is to ensure that it harbors a diversity of individual approaches. In our world, to have a group of individuals that all think the same way, have been trained the same way, and operate under the same norms will be less likely to succeed than a diverse portfolio of individuals who operate from a diversity of pressures and approaches.

That's why we have done so much to open up collaboration with universities—there's a different gene pool for us to leverage. The same can be said of biotech companies and consortia projects. And it's also why we spread our bets across the world culturally.

For example, we've taken the concept of sharing beyond intellectual property into the real world. We've opened up one of our research facilities to African scientists. There are lots of very talented scientists that have grown up in an environment without many resources, but with good ideas, so why not let them join us in our labs with our team so they get a chance to develop their idea in a way that they couldn't otherwise do.²⁰

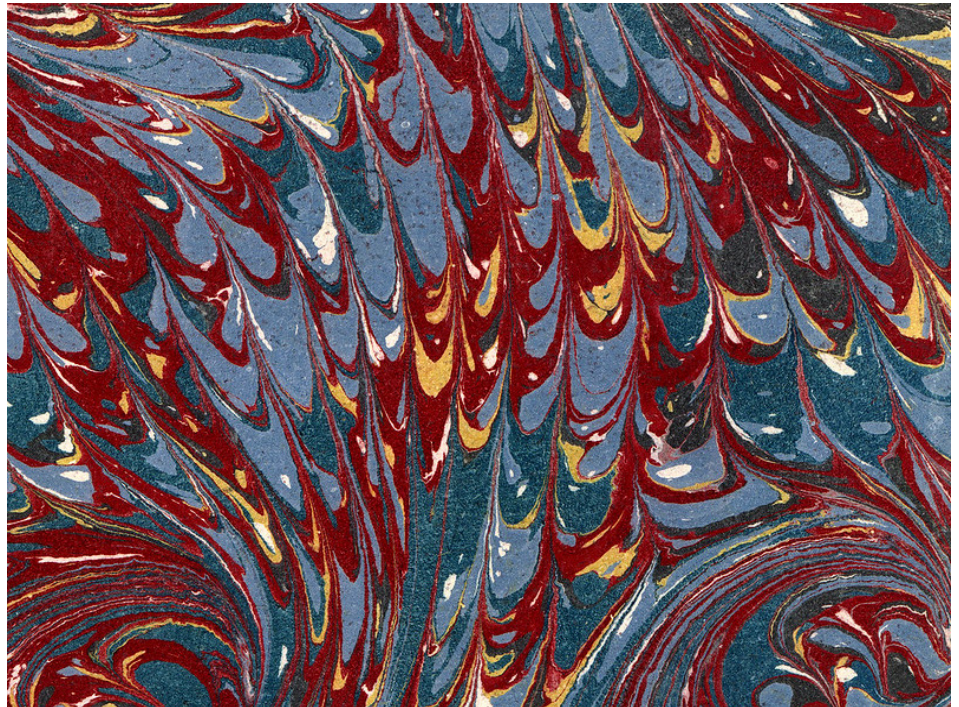
Probe the industry's future

Consortia projects provide an excellent venue for convening senior leaders and facilitating discussions about long-term industry trends.

Consortia projects provide an excellent venue for convening senior leaders and facilitating discussions about long-term industry trends. As Byron Clayton, former CEO of the Advanced Robotics for Manufacturing (ARM) Institute, put it, "We spend a lot of time convening discussions on forward-looking questions: What do we want to look like in 10 years. What are the gaps? What do we need to get there?"²¹

Enabling dialogue at the leadership level is seen as especially powerful. "Most consortia projects are good at facilitating great technical exchanges. We've seen less exchange at the leadership level, and this is an area we want to improve going forward," said Reimer at MIT. "There are so many fundamentally important questions, and company leaders don't often get enough time to discuss them with one another."²²





Vintage 19th c. marbled paper, French Curl on Fountain pattern (32) by Paul K, 2010, used under CC BY 2.0, rotated 90 degrees.

David Bowcott, global director of growth, innovation, and insight with AON, agrees and has recently joined a global consortium focused on digital transformation in the construction sector. The executive noted that the growing abundance of data from the built environment provides an opportunity to probe the future and build industry road maps in a more sophisticated and evidence-based manner. He said:

Stakeholders in the engineering, construction, and infrastructure sector were highly siloed and very competitive. Making money was the preeminent driver. Increasingly, we are thinking more carefully about when and where we need to compete and what can we share and collaborate on.

There are huge megatrends that are reshaping our sector, and thanks to the Internet of Things, we have unprecedented access to new data streams that can feed into predictive analytics and help us probe the future. Collectively, we are all better off if we share our data and use blockchain and machine learning to help us establish longer-term industry roadmaps for investments and technologies that can boost productivity and efficiency and lessen risk.²³

Companies invest in consortia projects because they are instrumental—and, in many cases, essential—to realizing their innovation objectives.

In summary, companies invest in consortia projects because they are instrumental—and, in many cases, essential—to realizing their innovation objectives. Whether probing the future or developing new products and solutions, the key takeaway is that sharing responsibility for research and innovation is often faster, more efficient, and less risky than conventional approaches to technology acquisition and R&D.



Table 2: Blockchain consortia projects

Consortium	Location	Year	Description	Members
Accounting Blockchain Coalition	Wakefield, MA	2017	The coalition is focused on blockchain applications for accounting.	XBRL, Microsoft, Deloitte, Ernst & Young, KPMG, PwC, ConsenSys
Blockchain Insurance Industry Initiative (B3i)	Zurich	2016	B3i is exploring the potential of blockchain applications in the insurance value chain.	Aegon, Allianz, Munich Re, Swiss Re, and Zurich are among its 40 companies
Blockchain in Transport Alliance (BiTA)	Chattanooga, TN	2017	Members are driving education and developing a common framework and standards for blockchain and DLT applications in their industries.	Over 370 companies and organizations primarily from freight, transportation, logistics, and affiliated industries
Belt and Road Blockchain Consortium (BRBC)	Hong Kong	2016	Organized by Pindar Wong, BRBC is building the “digital silk road” (i.e., layers of digital infrastructure). It meets monthly in Hong Kong.	22 companies representing financial and professional services, port and line operators, and logistics and freight forwarders
Cybersecurity Consortium for Financial Services	Geneva, CH	2018	This concerted effort to strengthen cybersecurity for fintech and data aggregators is developing universal principles for assessments, implementation, and scoring framework.	Led by World Economic Forum; Citigroup, Zurich Insurance Group, Mastercard, J.P.Morgan, Kabbage, Hewlett Packard Enterprise, PayPal, VISA, Depository Trust & Clearing Corporation
Enterprise Ethereum Alliance (EEA)	Wakefield, MA	2017	EEA is creating enterprise-ready solutions, open standards-based architecture, specifications, testing, and certification programs to accelerate enterprise adoption of Ethereum.	Member-led industry organization, includes large enterprises and start-ups; 190+ blockchain start-ups, research groups, and Fortune 500 companies
Fundchain	Luxembourg	2016	Fundchain explores the potential of blockchain technology to improve efficiency and create new business opportunities in asset management.	BIL, BNP Paribas, CACEIS, European Fund Administration, HSBC, ING Luxembourg, Pictet, RBC Investor & Treasury Services, Société Générale Bank & Trust, and PwC Luxembourg
Global Blockchain Business Council (GBBC)	Geneva	2017	GBBC is a Swiss-based nonprofit launched to further the commercial adoption of blockchain technology.	Undisclosed; introduced at the World Economic Forum
Hyperledger , hosted by the Linux Foundation	San Francisco, CA	2015	This open-source collaborative is advancing cross-industry blockchain technologies.	230+ start-ups, Fortune 500 companies, universities, and other organizations
Industrial Internet Consortium (IIC)	Needham, MA	2014	This global consortium focuses on industrial IoT with use of blockchain in smart cities, manufacturing, and supply chains.	Led by Object Management Group with ABB, Bosch, Dell EMC, Fujitsu, GE, Huawei, and Microsoft among its 200 members
Project Jasper	Toronto, ON	2016	This consortium project is exploring the possibility of issuing, transferring, and settling central bank-issued assets on a distributed ledger network.	CIBC, Bank of Montreal, Royal Bank of Canada, TD Bank, Scotiabank, Bank of Canada, Payments Canada, R3
R3	New York, NY	2014	R3 is an enterprise blockchain software firm leading development of Corda, an open-source blockchain platform.	200+ public and private sector partners across industries
Trusted IoT Alliance	Berkeley, CA	2016	This consortium is working to create a secure, scalable, interoperable, and trusted IoT ecosystem.	BNY Mellon, Bosch, Cisco, Telekom Innovation Labs, Gemalto, HCM, Swiss Re, US Bank, and 30+ blockchain SMEs
University Blockchain Research Initiative (UBRI)	San Francisco, CA	2018	This collaboration supports academic research, technical development, and innovation in blockchain, cryptocurrency, and digital payments.	Ripple-organized network of 30 leading universities around the world



The case studies provide insight into the role of consortia projects in helping companies achieve their innovation objectives.

Closer look at three consortia

At the outset of the research project, the DEEP Centre conducted a landscape analysis to identify prominent consortia efforts in the blockchain arena throughout North America, Europe, and Asia. Most of the consortia identified (Table 2, previous page) focus on R&D and commercialization activities, including the creation of new products, services, demonstration projects, start-ups, and spin-off companies. Several consortia are focused on other activities that promote innovation, including the development of enabling platforms and standards, the aggregation and dissemination of data, and the creation of new knowledge and forums for education and discussion that will promote growth and innovation across the sector as a whole.

To obtain a more nuanced and qualitative understanding of the dynamics that underpin successful consortia projects, we examined three consortia in greater detail: B3i, EEA, and Hyperledger, hosted by the Linux Foundation. The case studies provide insight into the role of consortia projects in helping companies achieve their innovation objectives, the strategies consortia leaders use to attract large anchor firms to their projects, and the strategies consortia projects deploy to create value and keep their members engaged

B3i: Transforming catastrophic loss insurance

When it comes to blockchain use cases, banking and finance are usually top of mind, including cryptocurrencies, customer-facing payment technologies, and financial trading and exchange services. While insurance firms are often slower than banks to adopt new technologies, they are also poised to benefit from blockchain technology. As McKinsey & Company argues, “Blockchain can address the competitive challenges many incumbents face, including poor customer engagement, limited growth in mature markets, and the trends of digitization.”²⁴

Given the nascent stage of blockchain awareness and adoption in insurance, a consortia project is precisely the kind of vehicle that can enable insurance firms to explore industry-wide applications for blockchain without having to shoulder the costs and risks alone. B3i was the first such project out of the gate.

When it comes to blockchain use cases, banking and finance are usually top of mind.

The consortium was launched by five insurers and reinsurers in October 2016 to design and implement blockchain applications for insurance. The original five insurers included Aegon, Allianz, Munich Re, Swiss RE, and Zurich. By December 2017, another ten firms joined the five founding companies, including Achmea, Ageas, Generali, Hannover Re, Liberty Mutual, SCOR, Sompo, RGA, Tokio Marine, and XL Catlin.²⁵

The 15 insurers surmised that blockchain technology held the potential to cut costs and make industry processes more efficient. They proceeded to test this assumption by launching an industry



"We agreed that by acting together, we could optimize and automate market-wide processes, generating significant savings in time and cost that could not be achieved by insurers or intermediaries acting alone."

 KEN MARKE
Chief Marketing and
Communications Officer
B3i

pilot project. "We agreed that by acting together, we could optimize and automate market-wide processes, generating significant savings in time and cost that could not be achieved by insurers or intermediaries acting alone," said Ken Marke, the chief marketing and communications officer for B3i.²⁶

A decision was taken to focus the pilot project on simplifying and streamlining transactions in the Catastrophe Excess of Loss Reinsurance market. As Marke explained, in the reinsurance marketplace, the primary insurer routinely cedes some of its risk exposure to reinsurers, including catastrophic risks such as hurricanes or extreme weather events, which are covered in agreements between insurers and reinsurers. The primarily paper-based process is managed by brokers, with all of the transacting parties reconciling amounts owed on their independently managed ledgers. By the time exchange rates are calculated across multiple currencies, and funds are freed up in the right amount, nearly two-thirds of a quarter could elapse before the customer receives compensation for their loss.

"Catastrophic loss insurance was the perfect place to run a pilot," said Marke. "The volume of transactions is low, there are normally a small number of counterparties, and the possible triggers (i.e., hurricanes and extreme weather events) are relatively rare."²⁷ At the same time, the benefits of reducing friction in the insurance value chain included decreased transaction costs resulting from more efficient foreign exchanges, savings of working capital as a result of more efficient controls over premium collection and claims reimbursement, and fewer operational risks arising from data gaps and errors made within the network of insurers, brokers, and reinsurers.

The proposed blockchain pilot was designed to link all parties in the insurance ecosystem participating, including brokers, into a shared data network. With a DLT-enabled system, real-time transactions would speed up communications and increase the visibility of the risk exposure of each party. More importantly, insurers could significantly reduce, if not remove, the need for reconciliations altogether, because all parties could share the same data.

To run the pilot, each member of the consortium put money on the table and dedicated 1.5 full-time employees, including a mix of business, strategy, and technical people. The consortium opened a small lab in Munich and engaged IBM to build the initial proof of concept (POC) on Hyperledger Fabric. The POC was completed by October 2017, and a further 23 insurers were invited to participate in the market testing.

The consortium asked participants in the testing phase two essential questions: would you use the blockchain solution? And, if you use it, would it save you money? According to Marke, the response to both questions from its consortia members and industry partners was overwhelmingly positive. The results included greater efficiency, transparency, contract certainty, and accelerated payments.



"Blockchain technology will have an immense and cascading effect that will impact not only the insurance industry but commerce globally."

 KEN MARKE
Chief Marketing and
Communications Officer
B3i

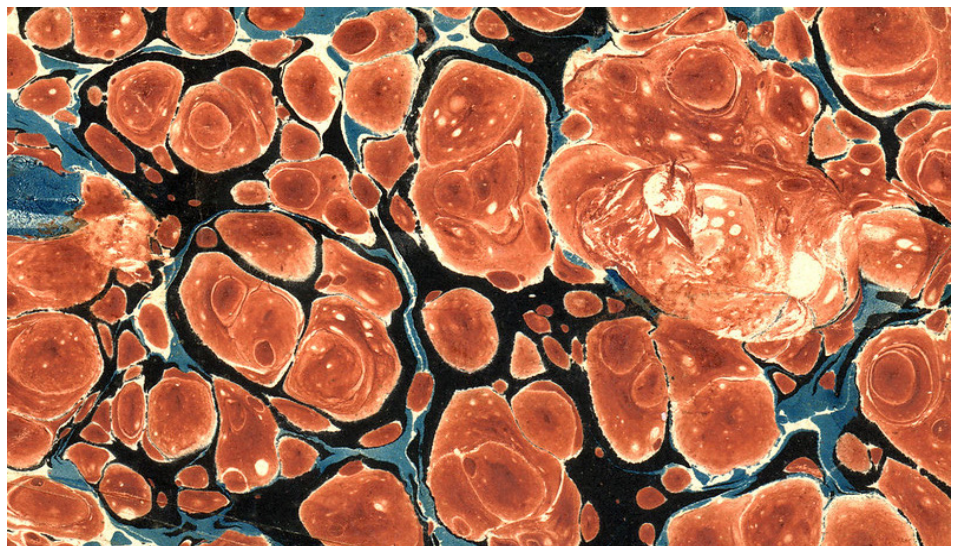
The streamlined services also provided much greater value to clients, said Marke.²⁸

At this point, B3i reached a fork in the road. The POC had been a success, and the members wanted to build a full-fledged commercial product. There was value in continuing the industry collaboration, but a consortium was not the right vehicle for a commercial enterprise. A decision was taken to incorporate, and the original 15 members were invited to convert their IP into shares in the new company. Two parties decided to go their own way, while 13 joined the new company, several of which elected to increase their stake by contributing additional capital.

B3i Services AG officially incorporated in March 2018. Following a further fundraising round, its shareholders now include 18 insurance market participants around the world. B3i claims that more than 40 companies are involved in its ecosystem as shareholders, customers, and community members.²⁹

Around the same time, the B3i team took a second look at their technology options and decided to rebuild the solution on R3's Corda. According to Marke, Hyperledger Fabric required further development to secure the confidentiality of its messaging, and Corda was purpose-built to manage contracts and handle the insurance sector's workflow.

Fast forward to Q4 of 2019, and the new B3i catastrophe excess of loss product has enjoyed its official market launch. Marke sees the broad and far-reaching implications of the new B3i blockchain product: "Businesses can operate in the face of big risks because they can insure against their risk exposure. Moreover, they can feel confident that, should disaster strike, insurers will honor their policies promptly. Blockchain technology will have an immense and cascading effect that will impact not only the insurance industry but commerce globally."³⁰



Vintage 19th c. marbled paper, Shell pattern (10) by Paul K, 2010, used under CC BY 2.0, rotated 90 degrees, cropped to fit.

Looking forward, B3i sees an opportunity to work on better integrating its software with other enterprise systems for banking and supply chain management.

B3i's innovative approach to data sharing means that insurance clients that incur catastrophic losses from natural disasters will be less likely to sustain further losses because of data errors or disagreements between insurers and reinsurers. If insurers are required to pay out on a policy, questions around who owes what amounts are never in doubt because the data and contracts are encoded in B3i's shared blockchain.³¹

Looking back at the evolution of B3i, Marke attributes the success to efforts of the consortium members to rally behind a single common interest in removing the inefficiencies in the reinsurance market. "Consortia don't usually work," said Marke. "Members often don't agree on the strategy, and there are competitive issues and disputes over intellectual property. But everyone could get on board with a project to address those inefficiencies. And everyone wanted to come up with a better way to handle data and transactions between multiple parties."³²

There was also a need, in Marke's view, to tread carefully at first in light of some of the misconceptions and question marks hanging over the blockchain space. "We see the transformative potential," said Marke:

In fact, there is tremendous potential to use blockchain and other emerging technologies to reinvent and redesign the insurance business. But we started by taking the existing process of reinsurance and trying to make that work better. And that's a much easier sell when you have legacy infrastructure and legacy mindsets to contend with.³³

Looking forward, B3i sees an opportunity to work on better integrating its software with other enterprise systems for banking and supply chain management. The company is also seeking to leverage a broader network of contributors to accelerate innovation. "We have realized that we can only build so many applications internally," said Marke. Since opening up its platform to external developers this year, B3i has seen growing interest from partners who want to build compatible applications for the insurance market. "We continually review new technologies that can help to deliver our vision," he said. "In fact, the bigger the network, the better. More applications create more choice and better capabilities. It will make the insurance market more efficient, and that's ultimately good news for insurance customers."³⁴

Ethereum has been touted by enthusiasts as a better Bitcoin—a fully programmable blockchain with smart contract capabilities that could give rise to a radically decentralized Internet.

Enterprise Ethereum Alliance: Driving commercial adoption

Launched in 2015, Ethereum has been touted by enthusiasts as a better Bitcoin—a fully programmable blockchain with smart contract capabilities that could give rise to a radically decentralized Internet. Like other blockchains, Ethereum has a native cryptocurrency called ether. However, Ethereum's champions see its principal value as an alternative Internet-based infrastructure for building and running *decentralized applications* (Dapps) for digital payments, lending and investment, social networking, and much more.³⁵



The Ethereum Foundation plays an ecosystem-wide orchestration role by funding R&D and steering the evolution of the Ethereum blockchain.

Like other large-scale open-source projects, much of the heavy lifting of maintaining and improving Ethereum is accomplished by a diverse global community of contributors who work on everything from the core protocol to consumer applications. However, while Ethereum is highly decentralized, there are a couple of key actors that are instrumental in shaping the ecosystem: the Ethereum Foundation and the EEA.

The Ethereum Foundation plays an ecosystem-wide orchestration role by funding R&D and steering the evolution of the Ethereum blockchain.³⁶ The EEA, on the other hand, is a member-led industry organization whose primary objective is to help guide large-scale commercial adoption of Ethereum-based services. In other words, the EEA's mission is to make blockchain-based enterprise services palatable for large corporate players that have technical and operational needs that are challenging to reconcile with Ethereum's open and decentralized infrastructure.³⁷

The EEA's members include an eclectic mix of large and established organizations in their respective industries as well as start-ups. For example, JPMorgan Chase, Microsoft, and British Petroleum are among the founding corporate members.

According to its Executive Director Ron Resnick, the EEA will facilitate enterprise adoption of blockchain by delivering on two key mandates: (1) creating a standards-based architecture to serve the needs of large commercial users, and (2) rolling out a certification program that will ensure trust and interoperability across multi-vendor solutions.³⁸ Above all, Resnick sees the availability of validated and trusted solutions as essential for Ethereum to win over enterprise and consumer confidence and penetrate the most important world markets.

"The market doesn't fully understand or trust blockchain right now," Resnick said.³⁹ Security breaches at exchanges and ether thefts have generated headlines and negatively impacted adoption even as the Ethereum Foundation works out the kinks within its system. "Our ability to validate and certify blockchain solutions will create a higher level of confidence in the solutions and can help drive adoption," said Resnick. "Banks, automotive companies, and other supply chain companies should be able to source solutions from anyone without having to worry about interoperability and performance."⁴⁰

A critical role for the EEA is convening industry-focused interest groups and developing use cases for Ethereum-based permissioned blockchains.

Another critical role for the EEA is convening industry-focused interest groups and developing use cases for Ethereum-based permissioned blockchains. Vitally, the work on fleshing out use cases for Ethereum provides an opportunity to involve end-customers directly in the efforts to refine and validate blockchain solutions before they are implemented at scale. "What's missing in blockchain community is the voice of the end customer," said Resnick. "You can't just have infrastructure guys and developers run the conversation."⁴¹

In financial services, J.P.Morgan is collaborating with the EEA on a permissioned-variant of Ethereum blockchain dubbed Quorum, "an open source platform that combines the innovation of the public



Telecommunications members are working with the EEA on a variety of use cases.

Ethereum community with enhancements to support enterprise needs,” including privacy controls, strong permissions, and a variety of consensus algorithms.⁴² In another example, Royal Bank of Scotland (RBS) has built a *clearing and settlement mechanism* based on the Ethereum distributed ledger and smart contract platform. In a test of the system, RBS engineers concluded, “A distributed ledger solution applied to the cross-border clearing and settlement process is expected to enhance visibility, minimize settlement risk, lower costs, and increase transaction speed.”⁴³

Telecommunications members are working with the EEA on a variety of use cases. Among others, these include a blockchain-enabled approach to roaming authentication, which would speed up the provisioning of telecom services for users roaming between networks, and a digital rights management system for tracking the distribution of digital content and remunerating content producers.



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In the real estate arena, EEA members are investigating the potential for blockchain to accelerate the digital securitization of real estate properties.

In the real estate arena, EEA members are investigating the potential for blockchain to accelerate the digital securitization of real estate properties. Also known as “tokenizing” real estate, this advance would simplify the buying and selling of properties or shares of properties by making it easier to record property transactions and process revenue streams. The benefits, according to a working group of real estate members, include the potential to “open up [commercial real estate] markets for new investors and let a greater number of parties manage ownership, liquidity, and risk much more effectively.”⁴⁴

In addition to vertical use cases, the EEA is working on developing specifications to address cross-cutting challenges such as security, privacy, and supply chain management. One example includes the recently launched Token Taxonomy Initiative, an independent,



If Ethereum's smart contracts are to reach their promised business potential and change the way we conduct transactions, then its public blockchain must include contributions from a diverse set of stakeholders, including enterprise users.

member-led organization formed to develop a modular, industry-neutral, and technology-neutral Token Taxonomy Framework (TTF) that will set the standard for tokenizing anything of value. The TTF will drive business-level interoperability between tokens by aligning the underlying technical specifications across different networks and platforms. The initiative will also provide a venue for participants to identify use cases for tokenization and work together on solving regulatory challenges.

Finally, while the Ethereum Foundation has stewardship of the public Ethereum blockchain, there is a role for the EEA to play in channeling business input into Ethereum's road map and participating in future enhancements. Indeed, if Ethereum's smart contracts are to reach their promised business potential and change the way we conduct transactions, then its public blockchain must include contributions from a diverse set of stakeholders, including enterprise users. As Joseph Lubin, co-founder of Ethereum, put it during the EEA launch event: "Enterprises represent mindshare, they represent resources. In order to get the technology out, in order to make it ubiquitous, we need to speak to everybody and make Ethereum inclusive."⁴⁵

Co-opetition is the secret to getting enterprises engaged and making collaboration work, according to Resnick. "They have to give up something to get something," he said. "And, they are starting to come around. They are seeing the value of working on a standard and realizing they can't go it alone. You also have to show up to meetings and participate in the process. You can't complain after the fact."⁴⁶

The EEA also employs convenors and program managers to help drive initiatives forward and resolve disputes when they arise. Nevertheless, Resnick admits that member engagement is the hardest part. "They have to be willing and active participants in the ecosystem," he said. "To get value out of the organization, you have to put value in."⁴⁷

Hyperledger: Collaborating on innovation

Hyperledger is a consortium of companies working together to accelerate the development and adoption of blockchain technologies.

Hyperledger is a consortium of companies working together to accelerate the development and adoption of blockchain technologies. Housed within the Linux Foundation, Hyperledger members include industry participants from sectors such as finance, healthcare, manufacturing, and technology. Launched in 2016 with the help of 30 founding corporate members, Hyperledger has since grown to nearly 200 members under the leadership of Apache Software Foundation co-founder and Hyperledger Executive Director Brian Behlendorf.⁴⁸

According to Hyperledger, the consortium has five key goals:

- » *Create enterprise-grade, open source, distributed ledger frameworks, and code bases to support business transactions.*
- » *Provide neutral, open, and community-driven infrastructure supported by technical and business governance.*



The most valuable role Hyperledger can play is to serve as a trusted source of innovative, quality-driven open-source software development, creating modular, open-source components and platforms.

One of Hyperledger's current priorities is a suite of training and certification programs that will help swell the ranks of software developers and service providers with the skills to work on enterprise blockchain projects.

- » *Build technical communities to develop blockchain and shared ledger POCs, use cases, field trials, and deployments.*
- » *Educate the public about the market opportunity for blockchain technology.*
- » *Promote the development of a global blockchain community.*⁴⁹

According to Behlendorf, the most valuable role Hyperledger can play is to serve as a trusted source of innovative, quality-driven open-source software development, creating modular, open-source components and platforms.⁵⁰

"Blockchain and smart contracts are still in the early stages of a 20-year, if not a 50-year, adoption and maturation cycle," said Behlendorf. "Some have compared it to 1994 and the Web."⁵¹ Thus, while blockchain-enabled technologies such as Bitcoin and Ethereum have seen widespread adoption and scale, Behlendorf stresses that blockchain is by no means a mature industry. "We are still seeking better consensus mechanisms for both permissioned and permissionless chains, a better range of choices for smart contract platforms, and still exploring the right identity models," he said.⁵²

Joining forces with other blockchain pioneers provides an effective way for companies to pool their resources, especially software developers, to expedite progress on shared challenges. Said Behlendorf:

*There is a global talent shortage for developers who understand not only cryptocurrency and blockchain engineering challenges, but who also understand distributed systems. Given the amount of duplication of effort we see today on the same core functions, we need to continually be looking for opportunities for developers to be working on shared code and roadmaps whenever possible.*⁵³

One of Hyperledger's current priorities is a suite of training and certification programs that will help swell the ranks of software developers and service providers with the skills to work on enterprise blockchain projects. "One of the key limiters to adoption is whether you have enough people who know how to build and use enterprise blockchain solutions effectively," said Behlendorf.⁵⁴

As with other emerging technology domains, Behlendorf worries that people easily get overinflated expectations for what blockchain can achieve relative to what the talent on the ground can ultimately build and deliver at a reasonable price point. "This is about professionalizing the space," said Behlendorf, who hopes training and certification programs will build up the bench strength of developers and services providers who credibly claim to work with Hyperledger Fabric and Sawtooth.⁵⁵



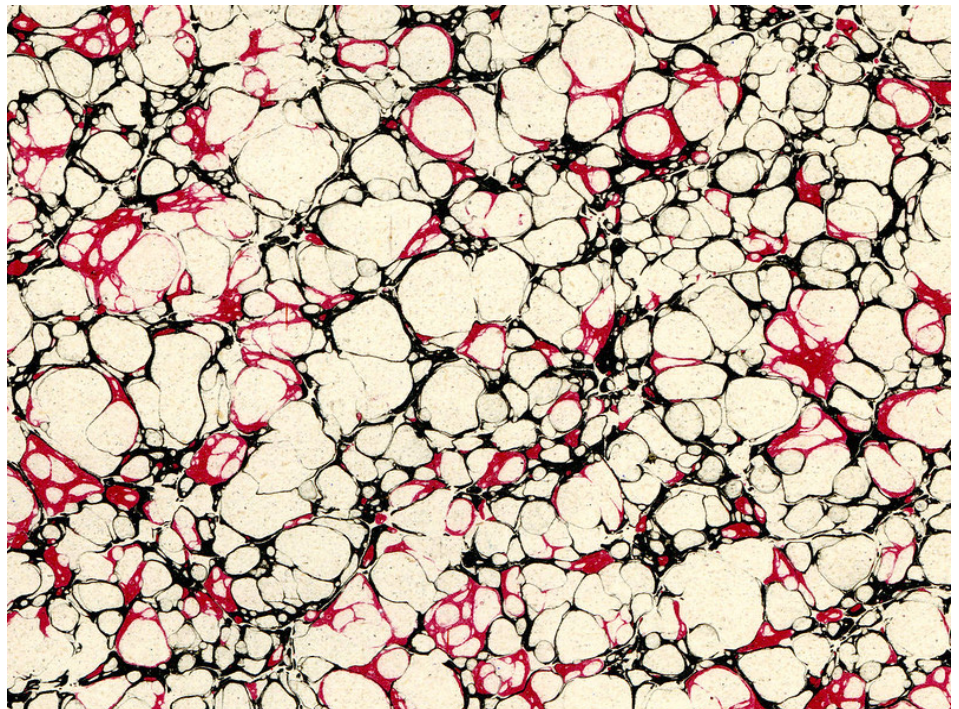
The improved visibility created by recording the data on a shared blockchain is helping major retailers confront a wide range of food quality issues.

One of the most successful enterprise applications built on Hyperledger Fabric is IBM's Food Trust network. Developed initially as a pilot project in partnership with Walmart, the food traceability solution is now helping over 50 food producers and retailers trace and authenticate objects as they move through the supply chain.⁵⁶ For a single head of lettuce, the array of data captured along the way can include its origin, packaging date, the temperature of the shipping container, and the date it was stocked on the supermarket shelf.⁵⁷

The improved visibility created by recording this data on a shared blockchain is helping major retailers confront a wide range of food quality issues. Indeed, while food safety concerns provided the original justification for the Food Trust network, other benefits include the ability to reduce food waste and boost consumer confidence in the authenticity of the products they buy.

In addition to supply chain traceability, Behlendorf thinks the public sector represents a largely untapped frontier for powerful blockchain solutions. "There's a dearth of trust between citizens and their governments, and wherever there is an overreliance on centralized actors, there is often an opportunity for blockchain to create value," he said.⁵⁸ Land title registries, permitting, paying taxes, and even electronic voting are among the processes that are ripe for reinvention using DLT.

Industry consortia like Hyperledger not only offer a means to develop talent, reduce duplication, and pool resources to advance use cases like these but also can enhance ecosystem productivity by providing an efficient and effective platform for collaboration.



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A consistent approach to IP and community collaboration lets developers and solution providers focus on their design and implementation efforts.

For example, the Linux Foundation provides Hyperledger members with many services, from project coordination and developer collaboration tooling to hosting and conducting virtual and physical meetings, to handling developer contributor agreements and trademarks and other legal issues. A consistent approach to IP and community collaboration, in turn, lets developers and solution providers focus on their design and implementation efforts. "If we do this," said Behlendorf, "it will remove barriers to collaboration, encourage developers to find opportunities to work on common code, and address the potential for confusion and wasted duplication of efforts without requiring a top-down single architecture or personality to dominate."⁵⁹

Like Resnick at the EEA, Behlendorf also sees his efforts to establish trustworthiness as an essential function of the Hyperledger community. Efforts to ramp up training, education, and certification are all part of making sure the Hyperledger brand is associated with high-quality enterprise solutions. So, too, are Hyperledger's plans to consolidate its diverse stable of projects around a core product suite that will help make blockchain solutions easier to understand and more readily accessible to the enterprise market. As Behlendorf put it, "There's a perception that there are too many options right now. Part of our job is to make the space a bit more predictable. We don't want mid-level managers feeling like they are taking a business risk by implementing blockchain technology."⁶⁰

One constant, however, is Hyperledger's commitment to open-source software. "All good software eventually becomes a commodity," said Behlendorf. "Enterprise users want to turn on the tap and see that it works."⁶¹ Indeed, enterprises are joining the Hyperledger community, in part, because they see the value in contributing to and harnessing a joint code base. The shared resources free up enterprises to allocate more of their valuable R&D resources to building the differentiating products and services that they can take to market.

Enterprises are joining the Hyperledger community, in part, because they see the value in contributing to and harnessing a joint code base.

Ultimately, Hyperledger's success rests on this synergy between open-source platforms and components and the ability of member companies to build profitable new business lines around blockchain. As Behlendorf put it, "We won't be a success as an open source project if our members can't make money. It's just that the commercial value is derived from the applications and services members build on top of our open source foundation."⁶²

As for measuring success, Behlendorf concedes that Hyperledger still has work to do to get the hard numbers that will substantiate the business case for blockchain solutions. For now, much of the value proposition for DLT rests on the ability of enterprise users to avoid that systemic risk of running critical systems on centralized infrastructures. And, as blockchain solution providers have found, it's hard to put a definitive number against less tangible outcomes like transparency, trust, and immutable data.

Nevertheless, Behlendorf draws encouragement from the growing volume of enterprise deployments of Hyperledger Fabric and



Sawtooth. In a list of the top 50 enterprise blockchain deployments compiled by *Forbes*, 32 were built on Hyperledger platforms.⁶³ Said Behlendorf, "If Hyperledger can forge a brand that is accepted as the default 'safe' deployment platform for enterprise teams, and provide a great home for active collaboration, then I think we can say 'mission accomplished.'"⁶⁴

Consortia require leaders who can orchestrate collaborative activities that bring large and small companies together with world-class researchers to achieve outcomes that none of the parties could realize on their own.

Harnessing industry consortia to accelerate blockchain innovation

Orchestrating successful consortia in the blockchain ecosystem requires considerable skill and ingenuity. Success is often determined by the ability of the lead organization or organizations to bring together a diverse range of players, successfully coordinate various interests, and identify the goals and vision to which all partners can commit. Consortia require leaders who can orchestrate collaborative activities that bring large and small companies together with world-class researchers to achieve outcomes that none of the parties could realize on their own.

To attract the right players in the first place, consortia leaders need to frame a compelling innovation challenge, demonstrate a unique and persuasive value proposition for engagement, and structure agreements around IP and other shared assets that will maximize productivity and commercial outcomes.

This section will synthesize findings from the research to highlight factors that contribute to the success of industry consortia. Companies will find insights into how they can leverage consortia projects to complement and accelerate their blockchain innovation efforts. Consortia projects in the blockchain ecosystem will discover ideas and strategies for achieving win-win outcomes and for keeping their member firms engaged in the work of the consortium.

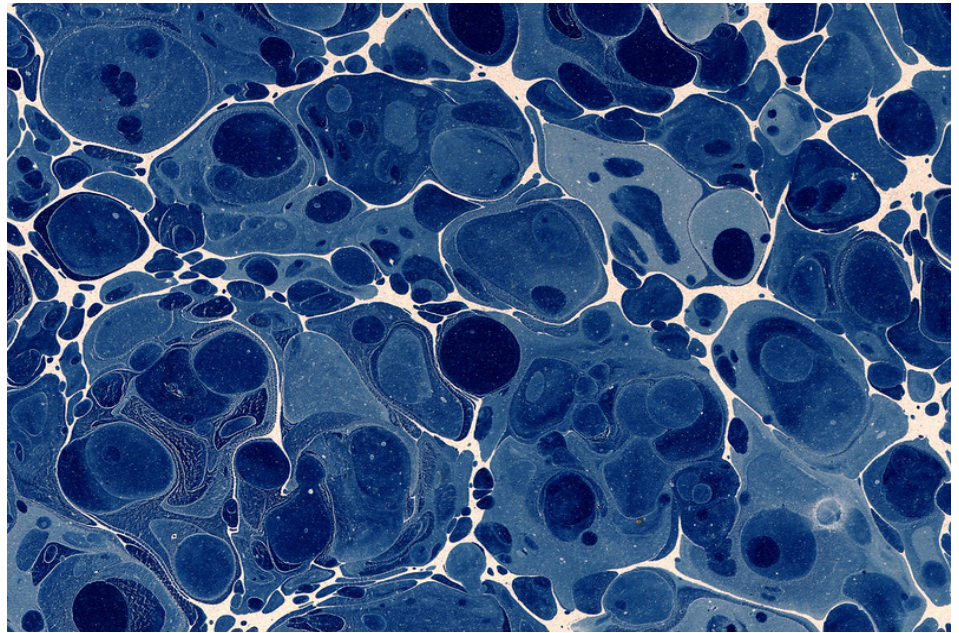
Designing blockchain consortia

Each of these consortia models represents a set of choices about how to select consortia members, distribute the benefits, and govern the network's activities. This section includes a brief discussion of these key design considerations, including the advantages and disadvantages of open and closed membership models and different arrangements for managing IP and governing consortia projects. This discussion complements the insights and best practices for running high-impact consortia projects that we distilled from the DEEP Centre's interviews and case study research.

Adapt the membership model to the ecosystem's innovation dynamics

Consortia differ significantly in the degree to which membership is open to anyone who wants to join. Most consortia place restrictions





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The significant advantage of encouraging open participation in a consortia project is the potential to attract a vast number of problem solvers and, consequently, a considerable volume of ideas.

on membership and many charge fees for participation. However, open consortia models have become more frequent in everything from software development to drug discovery. Gary Pisano and Roberto Verganti argue in their *Harvard Business Review* article “Which Kind of Collaboration Is Right for You?” that project sponsors should consider the nature of the problem they are solving and the dynamics of their innovation ecosystem before choosing the membership model that is most appropriate for their project.⁶⁵

In open collaborations, anyone can take part. For example, a consortia project sponsor may issue a public challenge and seek input from an unlimited pool of problem solvers. Customers, suppliers, hobbyists, inventors, students, research institutions, and even competitors can contribute solutions if they believe they have the right knowledge and capabilities to offer.

Closed consortia projects, by contrast, are similar to private clubs. One or more parties are selected to tackle a problem because the consortia sponsors or initiators deem them to have assets and capabilities crucial to achieving the commercial objectives of the project. As the network of participants grows, the costs of searching for, screening, and selecting contributors can become prohibitive.

Pisano and Verganti argue that by choosing a closed approach, companies and other institutions are making two implicit assumptions: that they have identified the sector or discipline from which the best solution to a problem will come, and that they can pick the right collaborators in that domain.⁶⁶

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With an open consortia project, the sponsors don't need to know their contributors. Indeed, not knowing them can be particularly valuable; interesting solutions can come from organizations or individuals one might never have imagined had something to contribute.

Open modes are useful under certain conditions. First, the cost of evaluating proposed solutions must be low. In open-source software, for example, the screening process for workable code is extremely cheap and fast. In other cases, only expensive and time-consuming experiments can determine whether an idea is worth pursuing. In those cases, consortia projects will want to evaluate fewer (but better) ideas. The best way to filter out bad ideas is to solicit contributions from the people that have the knowledge and capabilities to provide valuable input. That is, to opt for a closed model of innovation.

Another requirement for open consortia models is that participation must be easy and straightforward. Consortia projects are most accessible when they partition problems into small, well-defined chunks that participants can work on autonomously at a reasonably low cost.

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Several blockchain consortia have successfully blended closed and open models of participation. Trusted IoT Alliance, for example, is an alliance of enterprises, software developers, and blockchain technology companies that are supporting the creation of a secure and trusted IoT ecosystem. The coalition draws from its core membership to run pilots, develop open-source code bases, and coordinate standards and reference architecture.

However, Trusted IoT Alliance also hosts open innovation challenges where design and implementation organizations compete to provide winning solutions that meet real-world customer requirements such as:

- » The Smart E-Mobility Challenge, run with Bosch and MachNation, which focused on the development of blockchain solutions that could enable electric vehicles in Europe to find charging stations easily, pay for their electricity, learn about relevant additional services for their vehicles, and receive a single invoice rather than multiple ones.
- » The Smart Buildings Challenge, which focused on blockchain technologies that could optimize commercial building performance for security, automation, and efficiency, with such initial use cases as smart metering of energy, demand-oriented control of equipment, and digital twinning of building assets.
- » The Smart Logistics Challenge, which calls for the development of identity mechanisms that can facilitate secure sharing of data among participants in logistics value chains on a need-to-know basis.



Create IP rules that enable all stakeholders to harvest the value of collaboration

Increasingly, firms in electronics, pharmaceuticals, and other fields find that maintaining and defending a proprietary system of IP can cripple their ability to create value.

According to conventional wisdom, companies should control and protect proprietary resources and innovations—primarily IP—through patents, copyright, and trademarks. If someone infringes your company's IP, get the lawyers out to do battle. For most consortia projects, proprietary IP models are also the default. However, in today's hyperconnected world, a new economics of IP is prevailing.

Increasingly, and to a degree paradoxically, firms in electronics, pharmaceuticals, and other fields find that maintaining and defending a proprietary system of IP can cripple their ability to create value. Encumbering the innovation process with property rights can erect barriers to participation, increase transaction costs and lawyer time, and impede or slow down the rate of technological change and improvement. So rather than keeping everything secret, smart companies are sharing some of their IP to increase research productivity, foster relationships, and stimulate progress in other areas where they will see profits.

The bottom line is that companies and consortia projects are adopting a more nuanced and sophisticated approach to IP management. Indeed, for both companies and consortia projects, a competitive strategy now means making smart decisions about IP acquisition/licensing (what/how) and openness/sharing (or not). It also means identifying opportunities to pool IP across industries and sectors when a broad ecosystem of participants stands to benefit.

In most instances, open-access models are deployed to lower barriers to participation in a consortia project, thereby increasing its access to talent and good ideas. Open-access models make sense when consortia projects are seeking to shift the focus of competition in an industry (e.g., from operating systems to applications by open sourcing the OS) or build an innovation ecosystem around products and platforms to boost demand for complementary offerings. Hyperledger and the EEA are classic examples of industry players (many of which are direct competitors) coming together to support open standards and shared infrastructures that will enhance their ability to develop and market customer solutions.

The most successful open-access consortia projects typically occur in the precompetitive realm of research.

Some companies are using open-access models to encourage customers and other partners to modify, repurpose, or improve existing products and services. Others are leveraging open access to accelerate downstream product development with a precompetitive "information commons," as in a case of early-stage biomedical research. Open access can also make sense when supporting a free standard or enhancing interoperability with ecosystem partners, or when proprietary approaches are failing and companies are seeking to enlarge the pool of scientific talent addressing a particular R&D problem.

The most successful open-access consortia projects typically occur in the precompetitive realm of research. In other words, research



Within the closed-access model, consortia projects often exercise some flexibility by granting consortia members fair-use research exemptions and royalty-free licenses to evaluate technologies developed by other consortia participants.

that is strategically important to industry but far enough away from market-ready applications that companies will set aside IP rights and competitive rivalries to reap the benefits of collaboration. The closer R&D activities get to commercialization, the more closed-access models are likely to be appropriate.

Closed-access models make sense when IP ownership rights are required to attract significant R&D investments from companies, especially when those investments are focused on developing competitive products and services or proprietary process innovations for manufacturing, for example. However, within the closed-access model, consortia projects often exercise some flexibility by granting consortia members fair-use research exemptions and royalty-free licenses to evaluate technologies developed by other consortia participants.

The consortia projects analyzed by the DEEP Centre have a variety of philosophies and models for managing IP. On the more conventional end of the spectrum, the Advanced Robotics for Manufacturing Institute grants ownership of the IP to the companies that invest in and lead individual technology projects.

However, the companies must grant royalty-free licenses to other consortia members that wish to evaluate the commercial and industrial potential technologies that they did not participate in developing. If a member subsequently chooses to deploy the technology commercially, it must negotiate a licensing agreement. This compromise limits free-riding by consortia members while promoting access to the network's full stock of technologies and solutions for research and evaluation purposes. EEA, R3, B3i, CUTRIC, the BIC, and the Industrial Internet Consortium follow broadly similar models.

On the other end of the spectrum, we see large-scale open-source projects like Hyperledger, Blockchain in Transport Alliance, and the SGC. Edwards at SGC insists that a dollar invested in open science will have a better return on investment (ROI) than a dollar invested in closed science:

Edwards at SGC insists that a dollar invested in open science will have a better return on investment than a dollar invested in closed science.

By putting our science in the public domain, we let the world participate in the discovery process. For example, we make chemical probes available for other scientists to experiment with. These groups can participate in helping understand the protein's role in disease and determining what chemistry could inhibit the protein. This crowdsourcing de-risks the project. While other competitors will develop their own chemistry, they will be much further behind because of the know-how, capabilities, and relationships that are generated by companies participating in our network.

Openness gives our partners speed, and that makes a big difference. If we put patents on the chemical probe or proto drug, it's 12 months of legal work to get the agreements in place. Competitors could be active at that point. The companies that work side by side with us have a significant advantage. They start the commercialization strategy in



parallel with the open science, and they test their proprietary chemical probes developed internally. If they discover something valuable, they are ready to seize on it. It would be far more cumbersome and time-intensive to start from scratch at another pharma company [outside of the SGC network]. There are many decision points and layers of approval required to initiate a new drug development project.⁶⁷

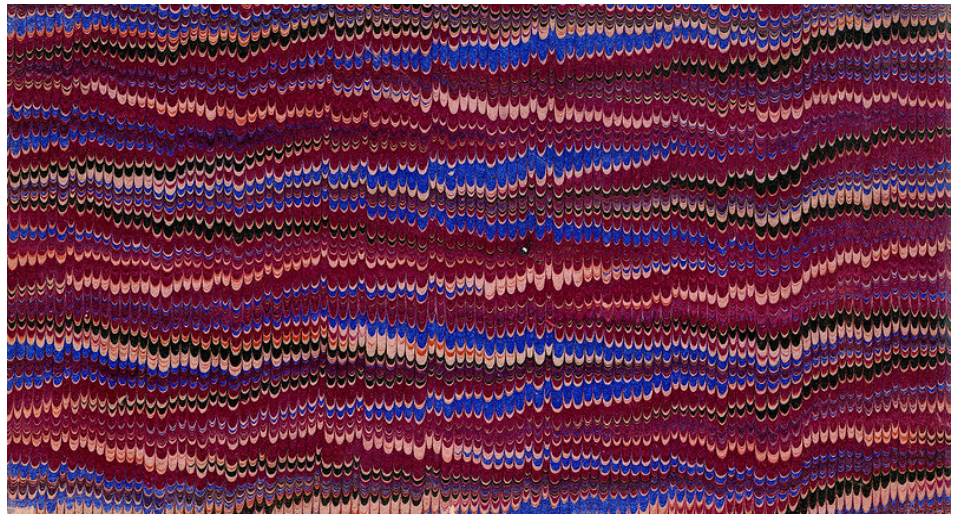
In some cases, consortia leaders will open up access to their outputs in a bid to enhance the scale, scope, and speed of innovation.

In short, openness gives the SGC speed and access to a larger talent pool. At the same time, it cuts down on costs and lawyer time, without precluding the ability of industry partners to make money. “They paid up front to get involved but then are free to do what they want with the results,” said Edwards. “Plus, they benefit from the cost-share on figuring out problems that no one could solve individually.”⁶⁸

This approach cannot work for every innovation challenge or scientific question. But there are many essential innovation challenges in which the long-term needs of industry align with the talents of academic researchers and where unrestricted access to the research results would benefit everyone.

For consortia leaders, the art of IP management is about balance, timing, and relationships. It’s about sensing a commercial opportunity and bringing the right combination of knowledge, skills, and IP together to deliver a solution.

In some cases, consortia leaders will open up access to their outputs in a bid to enhance the scale, scope, and speed of innovation. In other cases, it will mean restricting access to the consortia’s outputs to protect the commercial viability of its investments. In other words, consortia projects should treat IP like a mutual fund and manage a balanced portfolio of IP assets; some protected and some shared; some with short-term payoffs and some that may pay dividends for decades to come.



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Create a governance structure that fosters stakeholder engagement

The governance structure of a consortia project is integral to determining how it operates. Among other things, the consortia agreement defines the organizational structure of the consortium and the differentiated roles of its member; consortium's method and process (e.g., consensus, majority) for making different types of decisions; its protocols for accepting new members or for sanctioning member exits from the consortium; and its plans for managing and dispersing funds.

In a hierarchical structure, a specific organization is vested with the authority to set the ground rules for the consortium. This provides the lead organization with the advantage of being able to control the direction of the R&D efforts and capture more of the innovation's value.

In most instances, however, consortia projects deploy a flatter, membership-based structure, in which decisions are either decentralized or made jointly by a subset of the collaborators. The advantage here is the ability to spread the costs, risks, and technical challenges of innovating across the network. Flat models, with boards of directors composed of key stakeholders, work well when collaborators all have a vested interest in how a particular objective is achieved and will participate if they get some say in the decisions. Most of the consortia projects examined by the DEEP Centre fall into the latter category.

Active participation in consortia governance by all major stakeholders is the best way to sustain engagement and maintain member alignment around the consortium's goals.

Executives and consortia leaders maintain that active participation in consortia governance by all major stakeholders is the best way to sustain engagement and maintain member alignment around the consortium's goals. At the same time, they advised against "friends and family" governance bodies that advise, but do not govern. As Edwards explained:

Our board includes executives from every major funder. It can change leadership, direct strategy, and even halt a project. Any meaningful change to our budget requires unanimous board approval. Because of these responsibilities, in-person attendance has been nearly 100 percent for every quarterly board meeting for more than 12 years.⁶⁹

Ron Resnick at the EEA describes the organization as "member-driven," where every participant has a vote and can participate in proposing and approving projects.⁷⁰ Josipa Petrunic at CUTRIC talked about how a board that is representative of the consortium's key investors can help align projects with the consortia's objective. "Everyone on CUTRIC's board has a vested interest in success," said Petrunic. "They have skin in the game, and that's the key to maintaining an active role in steering the project's success."⁷¹

In larger and more complex consortia projects, effective governance may require multiple layers of oversight and engagement by



Consortia leaders also agree that performance and impact measurement is an essential component of effective governance.

members and contributors. At Hyperledger, for example, two governance systems operate in parallel.

There is a technical steering committee (TSC) that is responsible for overseeing the technical direction of Hyperledger, which is open to member companies and anyone in the technical community that contributes code to the Hyperledger codebase. The TSC's responsibilities include developing standards, managing working groups on cross-cutting issues, approving project proposals, and establishing community norms, workflows, or policies for releases. In addition to the TSC, there is also a governing board consisting of representatives from up to 21 premier members (i.e., the primary funders). The board oversees the Hyperledger budget, all business and marketing matters and the executive director.

According to Behlendorf, the Hyperledger leadership team expends a great deal of effort to forge consensus at both levels of governance, including much public conversation on GitHub and other forums. "Sometimes in the blockchain community, they believe you need only a 51 percent majority to move forward on a given decision—that we can just vote with our stakes and manage the governance process algorithmically," said Behlendorf. He continued:

But that's the wrong model for our community. We see great value in forging consensus, having explored different options and getting to the point where people can see that we are making well-considered decisions, and they can stand behind them. Let's walk into the conversation with a tone of inquisitive inquiry. ... That's governance, with real participation and engagement.⁷²

Consortia leaders also agree that performance and impact measurement is an essential component of effective governance. Performance measurement systems help to ensure that consortia projects have timely, strategically focused, objective, and evidence-based information on their performance to produce better results and remain high-performance organizations.

A performance measurement framework should be established from the outset and revolve around the key outcomes, with quantifiable milestones.

A performance measurement framework should be established from the outset and revolve around the key outcomes that the project is seeking to achieve, with quantifiable milestones. For the SGC, this meant tracking the number of high-quality scientific publications and the amount of 3D protein structures deposited into the Protein Data Bank. For the ARM Institute, the quantifiable metrics include the creation of commercially viable IP and, ultimately, the number of robotic technologies that move from their test beds into real production environments.

However, like other organizations that receive funding from multiple entities, often including numerous agencies and levels of government, consortia project leaders find it challenging to reconcile the reporting requirements of disparate stakeholders. "The definition of success depends on the stakeholder. You need to understand the audience and purpose," said Clayton of the ARM Institute. He continued:



Consortia project leaders recommended that the board of directors invest time in defining the consortium's metrics for measuring impact.

The Department of Commerce has specific metrics that are focused on workforce training and employment. The Department of Defense [DOD] has certain measures that appeal to the DOD research and engineering community and its supply chain. Our internal metrics are focused on creating IP that has commercial potential and, ultimately, on how many technologies coming out of these projects are getting put on the factory floor. We can't have an impact unless we get stuff on the factory floor.⁷³

SGC also found that the measures of success and impact varied according to the audience. "Public and charitable funders emphasized high-quality publications and scientific novelty," said Edwards. He continued:

Industry wanted research relevant to drug-discovery efforts. For example, companies insisted on studying the structures of human proteins rather than proteins from other species, even though many of these would have been of significant scientific interest. Our funders demanded unrestricted use of data and reagents, quantifiable milestones, and the right to withdraw support from the project if it underperformed. From the get-go, we were operating within a system that ties continued funding to research that proved useful.⁷⁴

Consortia project leaders recommended that the board of directors invest time in defining the consortium's metrics for measuring impact. Having reached a consensus on how to measure impact at the executive level, consortia project leaders can work to create alignment and agreement around those metrics with different stakeholders. This alignment can alleviate the need to issue multiple reports to multiple funders, all with varying definitions of what constitutes success and different metrics for measuring impact.

Find credible and competent leaders who understand industry dynamics

Executives and consortia leaders alike remarked on the importance of finding the right leader for the consortium.

Executives and consortia leaders alike remarked on the importance of finding the right leader for the consortium—someone with the vision, experience, competence, and insight to work effectively with some of the largest and most sophisticated enterprises in the world. Consortia leaders need to understand the industry's competitive landscape, its pain points and challenges, and its unique vocabulary and nuances.

At the same time, they need sufficient technical depth to oversee the consortium's R&D work. In this sense, Behlendorf's deep experience and credibility in the open-source software community made him the perfect candidate to lead Hyperledger.

It is a similar story at the most successful consortia projects examined in our research. Reflecting on her company's experiences with several large consortia projects, Carolina Gallo had the following to say about Josipa Petrunic's leadership role at CUTRIC:



You can't run a successful consortia project off the corner of your desk.

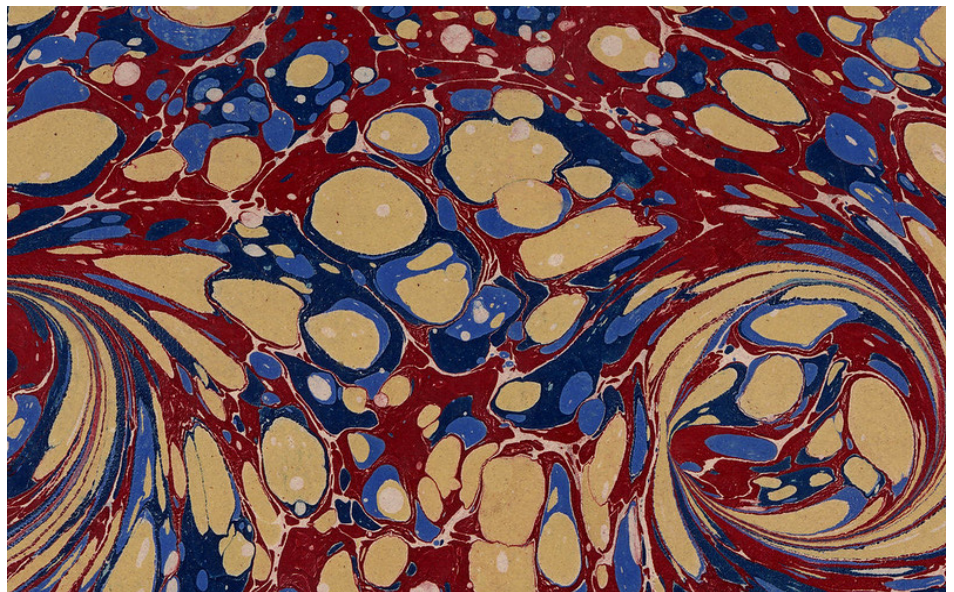
She has the macro vision for enabling green transit in Canada. But she also brings a deep science and engineering approach based on the importance of standardization across a full caseload of green energy sources. She brought global competitors together to enhance functional performance of these technologies. She also brokered a very significant market opportunity that convinced us to come to the table with other key players in the industry.⁷⁵

Feedback from executives and consortia leaders confirms that you can't run a successful consortia project off the corner of your desk. Interviewees agreed that the best leaders need a competent, full-time professional staff to help run their operation. All of the consortia projects reviewed by the DEEP Centre had a full-time, professional secretariat.

"We couldn't run this as an academic operation with a team of graduate students," said Bryan Reimer, who works out of MIT but employs a full-time team of professional staff. "Companies want answers to their problems and pain points. The path to the solution is as important as the solution itself. They want timely answers and not on an academic schedule."⁷⁶ Clayton at ARM put it this way:

We have companies that have problems that need to be solved, but we need to present the business case. We need to understand more about their sectors. We need to attack real problems and deliver practical solutions. We need to see robots doing real work: welding an automotive part or working in a biopharmaceutical manufacturing assembly line. That takes a team with real know-how and deep expertise.⁷⁷

Consortia leaders spoke of hard lobbying efforts, elbow grease, working networks, and building relationships, often over a period



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Leaders need a combination of talent, extensive personal networks, and a sustained effort to get a transformational consortia project off the ground.

of years, to get a successful consortia effort off the ground. Reimer spent two years reaching out to companies to build the Advanced Vehicle Technology Consortium, and this was after ten years of relationship-building in the industry, and after having already assembled and run a successful consortia effort. Petrunic described 28 months of planning, lobbying, and groundwork to establish the conditions for CUTRIC to be successful. In other words, leaders need a combination of talent, extensive personal networks, and a sustained effort to get a transformational consortia project off the ground.

Of course, the elbow grease does not end once the consortia project is up and running. Behlendorf said his unofficial title is “nerd diplomat” and describes spending one-third to half of his time on the road, going to conferences, and meeting with member companies. “The advocacy, engagement, and communications components are significant,” he said. “I spend a lot of time getting the message out about the enterprise value of blockchain.”⁷⁸

Attracting high-caliber participants

In its interviews, the DEEP Centre asked corporate executives about their criteria for joining consortia projects. What characteristics do they look for? And, what possible reservations cause them to decline invitations to join a consortium? We posed a similar set of questions to consortia project leaders, except the focus was on their strategies for attracting large anchor companies to their projects and their approach to keeping these firms engaged. We synthesized the answers from both corporate executives and consortia project leaders into a series of best practices for attracting large anchor companies to consortia projects.

Target the C-Suite with a compelling ROI for engagement

There was agreement among consortia project leaders that attracting global anchor firms to do something transformative in a consortia project means getting the buy-in of executives in the C-suite. “All sectors, the higher you go up in the organization, the more willing they are to work in the open,” said Edwards. “They understand the difference between core and non-core business, between where they need to compete and when they should collaborate. They will carve off areas of science and R&D that will work in the open.”⁷⁹

Obtaining C-suite buy-in also means access to resources, a commitment of time and attention from senior managers, and validation for the consortia project’s goals. There are several ways to get C-suite buy-in.

Although collaboration is the *modus operandi* for a consortia project, the outcome must serve the corporate bottom line. To win the engagement of C-suite, consortia leaders must articulate and demonstrate a compelling ROI for engagement. It should be crystal clear how the activities of the consortium will translate into

Although collaboration is the modus operandi for a consortia project, the outcome must serve the corporate bottom line.



meaningful commercial outcomes for the companies involved. As Gallo at ABB put it:

The best way to give security to the companies that there is an ROI on joining a consortium is to create a significant market opportunity as an outcome of the project.

Everyone needs to be up front about the fact that we are trying to make money from this venture and, if we are, how are we going to do it. You need to go into a collaborative venture with a clear view of how participants are going to be rewarded and or given a chance to make money. You can't go in with a fairy tale type approach and expect everyone to do all this work absolutely for free—that's not a tenable position. Once you've worked out the economic basis on which this work is being done, participants for the consortium will appear, and you will get different types of participants depending on the problem and on the economic proposition.⁸⁰

While there are different ways for consortia projects to demonstrate value, executives were also quick to point out that some outcomes are more valuable than others. Follow-on procurement or market opportunities are generally the most important, followed by opportunities to demonstrate the commercial viability of new technologies at scale.

According to executives and consortia leaders alike, the best way to give security to the companies that there is an ROI on joining a consortium is to create a significant market opportunity as an outcome of the project. As Petrunic recounted:

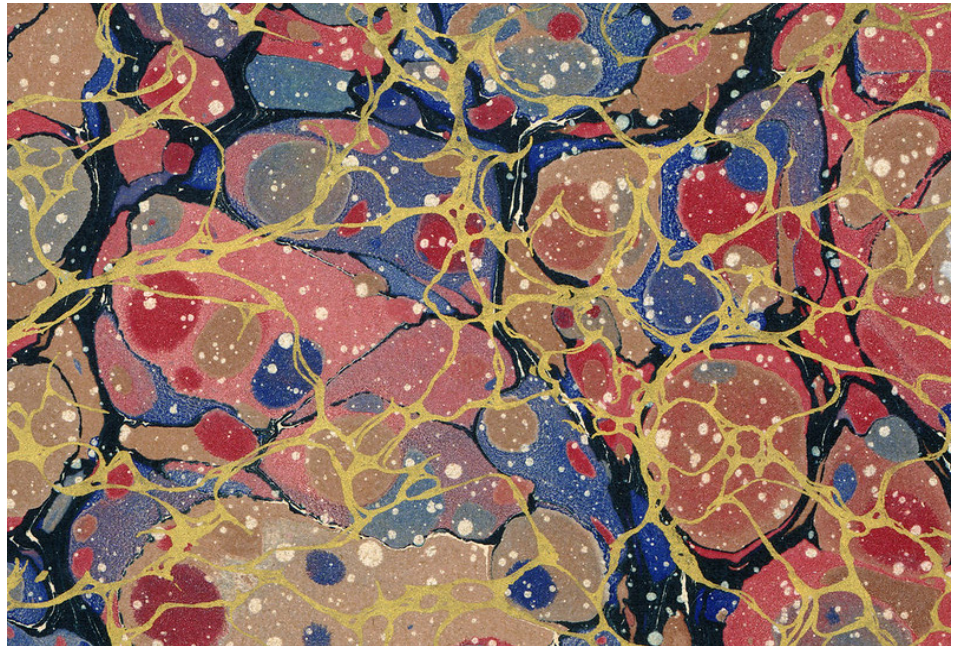
Companies are dedicating considerable time and using valuable human resources like VPs to make this kind of project happen. The magnet for getting them on board is the procurement opportunity. The manufacturers can only justify the substantial R&D spend with a significant sales opportunity. The fact that we have excellent academics around is helpful. And although talent is important, it's not the fundamental carrot that attracts global anchor firms to consortia projects.⁸¹

For CUTRIC, the ability to create a significant sales opportunity as an outcome of its electric bus demonstration project required some substantial changes to business as usual for government:

We needed to bring enough transit systems together to make a significant volume purchase. We also needed to change procurement behavior. The OEMs don't want to compete for an RFP with other manufacturers who didn't invest in building the standardized high-powered charging systems. We had to convince the transit agencies to not go to an RFP. In short, if we want global anchor firms involved, we have to be willing to protect the core industry that is participating in the standardization and technology integration trial.⁸²

In the end, both the transit agencies and OEMs are getting what they want. The transit agencies wouldn't commit to buying a large fleet of electric buses without a standardized charging infrastructure that will work for buses built by competitive manufacturers. The OEMs, on





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the other hand, would not commit to doing the standardization work without a commitment to purchase their fleet.

If a consortia project can't create or offer an immediate sales opportunity, it must, at the very least, help to significantly de-risk innovation investments. Deployments of new technologies and solutions in many sectors are often capital intensive, requiring large sums of human and financial capital to achieve even a single implementation. Companies interviewed for this study expressed a reluctance to shoulder these costs on their own, particularly when they have yet to demonstrate the benefits of a given technology at an industrial scale.

Deployments of new technologies and solutions in many sectors are often capital intensive, requiring large sums of human and financial capital to achieve even a single implementation.

Executives at smaller companies said that the up-front cost associated with pre-feasibility and feasibility studies makes it hard to get projects off the ground. Many such companies find that their innovation projects get stuck in the pilot phase. Consortia projects can share the costs of building prototypes, operating test beds, and running large-scale demonstration projects. The results get shared across the network, which dramatically lowers the cost of assessing the viability of new technologies.

Examples of getting far enough down the commercialization pathway to make participation worthwhile for global firms include the work done by B3i to launch a POC for a blockchain-enabled catastrophic loss insurance solution. Indeed, the POC was so successful it led to the spin-off of a new commercial company whose shareholders include 18 of the world's largest insurance firms.

Other examples include the test beds operated by the Industrial Internet Consortium and the ARM Institute, the BIC's efforts to



The opportunity to share the cost of testing new technologies at scale is a worthwhile investment in moving toward the full commercialization stage.

co-fund the development of new flagship production facilities for biomaterials, and the work of the SGC in advancing pharmaceutical research and drug development through the pre-clinical phase.

"The consortium model is the best way to de-risk project delivery and guarantee success once we are ready to go to market," said Gallo at ABB. "An integrated project means that you need all the players from the beginning to create the roadmap and supply the capabilities to get where you want to go. We don't need one-off pilots. They don't accomplish much. At the very least, we need large scale demonstration projects."⁸³

Clayton agreed that the opportunity to share the cost of testing new technologies at scale is a worthwhile investment in moving toward the full commercialization stage. "The ARM Institute enables us to put new robotics technologies into a low volume production environment and test it," said Clayton. "Once it's commercially ready and we can move it into a real production environment. Once it's out there and working, we can license it or manufacture it."⁸⁴

Do something cutting-edge and transformative that others can't replicate

Consortia leaders often make a distinction between "run-of-the-mill" R&D work and "game-changing" innovation projects. The former includes prototype development, small-scale pilot projects, and routine industry-academic collaborations involving a university and a large company and its suppliers. These may be the bread and butter of many consortia, but they are not the kind of projects that attract the interest and serious investments of market-leading global firms.

"Most of the value is not in the run-of-the-mill work," said Petrunic of CUTRIC. "It's in the [technology readiness] 6-8 levels—the valley of death. The value is getting to the commercialization stage, or it's getting large-scale demonstration projects off the ground."⁸⁵

In other words, to attract large anchor firms, consortia projects need to do something bold and unique that even the largest and most sophisticated firms cannot achieve acting alone. Edwards, who successfully engaged nine of the world's top pharmaceutical firms in SGC, also talked about the importance of offering a value proposition that can't easily be replicated anywhere else in the world:

Industry wants to be at the cutting edge. They like the fact that the open network gives them access to key opinion leaders on the conference calls. But most importantly, they appreciate that we are doing work that nobody else is doing. We ask the questions that academics can't answer, and industry can't answer on its own either.

Most of the proteins in the human genome aren't studied. Industry can't do it because there is no clear business model. Universities can't do it because they can't get funding. We

To attract large anchor firms, consortia projects need to do something bold and unique that even the largest and most sophisticated firms cannot achieve acting alone.



take risks that they can't take, and we share the risks across a community of funders.⁸⁶

"Consortia must have a goal and a clear commercial objective with opportunities for investments in projects that are scalable."

 **RON RESNICK**
Executive Director
Enterprise Ethereum Alliance

An essential aspect of being bold and transformative is ensuring the consortia projects deliver on their commercial objectives. According to several interviewees, R&D consortia that lack well-defined projects frequently fail to meet this fundamental criterion. "Unfortunately, many people confuse innovation with having spent a lot of money on R&D," said Joy Romero, vice president of technology and innovation with Canadian Natural Resources. "But you have to get the R&D to market. When the consortia mandate is too high level, and you don't have a concrete project, things can easily get stalled."⁸⁷

"Consortia must have a goal and a clear commercial objective with opportunities for investments in projects that are scalable," said Resnick of EEA. He expects that the EEA's work on certification and standards will help drive large-scale adoption of enterprise blockchain.⁸⁸

Several executives noted that there is a tendency to fund thematic and sector-specific consortia with broad, high-level goals like "commercializing new technologies and creating spin-off companies." They are not grounded in specific projects with real outcomes. "The pan-Canadian electric bus demonstration project is an exception," said Gallo. She continued:

They are building infrastructure, demonstrating technologies at scale, and setting standards. Most importantly, there is a guaranteed market deployment at the end of the project. Yes, we want to contribute to social goods, but we are not running a charity. There has to be value for shareholders, and we have a fiduciary responsibility to deploy our resources strategically.⁸⁹

The people you attract to the table early have a significant bearing on the ability to attract large anchor companies.

Another way to differentiate a consortia project is to build a unique infrastructure for members to leverage. Several consortia leaders were quick to point out the value of the research and experimentation infrastructure they had created. "We have many assets," said Albrecht of RISE. "These include full-scale data research facilities, testbeds for IoT applications, drones and AI-enabled logistics, and operations centers. We have a great deal of capacity that would be expensive for individual companies to replicate."⁹⁰

Several executives concurred, noting that postsecondary institutions have access to tremendous technical experience and a research and experimentation infrastructure that would be too costly for individual companies to create from scratch. "We don't [conduct 75 percent of our R&D with university partners] for sentimental reasons," said Bruno Marcoccia, director of R&D with Domtar. "We do it because what we find is that strategic innovation with universities provides us with better access to a robust innovation system and a rich array of resources, including people and research facilities, and better access to infrastructure, public policy, and sponsorship programs."⁹¹



Companies want to see individuals and organizations with strong competencies that can deliver on the stated goals and objectives of the consortium.

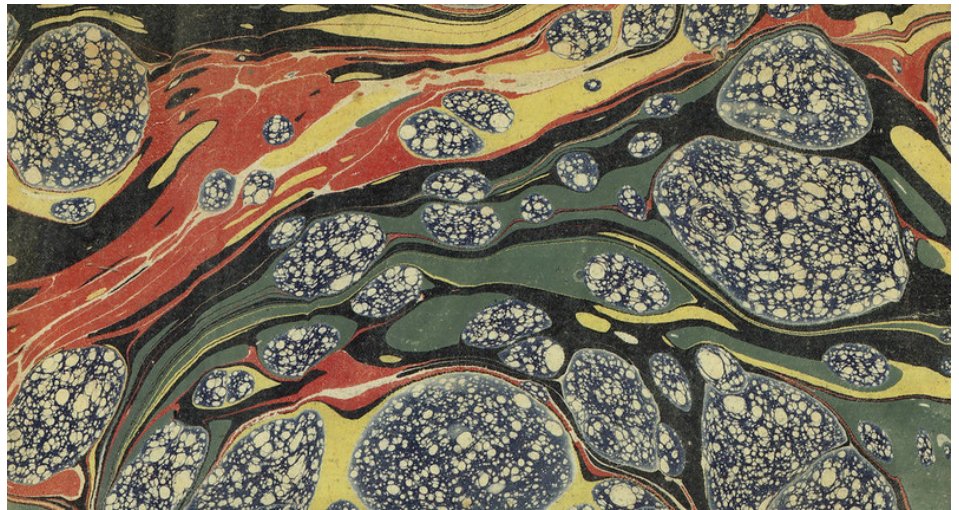
Build a network of competent people and organizations

Numerous executives and consortia leaders noted that the people you attract to the table early have a significant bearing on the ability to attract large anchor companies. "We look at the identities of the key players," said Judy Fairburn, executive vice president of environment and strategic planning with Cenovus. "We will partly base our decision to participate or not on the leadership of the consortia and the peer group around the table."⁹² The research and scientific talent can be an essential driver (if not the fundamental carrot, as noted above), especially when the talent consists of world-renowned leaders in their fields.

SGC has world-leading genomic scientists like Chas Bountra at the University of Oxford and Cheryl Arrowsmith at the University of Toronto. The Vector Institute has deep learning pioneer Geoff Hinton. Hyperledger has open-source software veteran, Brian Behlendorf, at the helm. However, the industry talent that participates in the consortium is also important. Do their peers respect these companies and their executives? Above all, companies want to see individuals and organizations with strong competencies that can deliver on the stated goals and objectives of the consortium.

Many consortia project leaders noted that corporate executives tend to value and appreciate the networking opportunities that consortia projects create. Well-curated communities introduce executives to new ideas, talent, and technologies; and the "but also" conversations they generate help companies parse a complex and rapidly evolving technology landscape.

"They get to meet researchers from around the country who are world leaders in robotics," said Clayton. "We also have a lot of smaller companies in our orbit that are working on exciting technologies. These companies usually fly under the radar, but we help bring them to the surface."⁹³ While new technologies are



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Some consortia project leaders believe that it is easier to entice companies to join cross-sector consortia, especially those organized around value chains.

While large companies in resource-based industries tend to be very conservative, the consortia model provides a lower-risk environment for experimenting with new approaches to innovation.

inevitably accompanied by hype, consortia projects differentiate themselves by helping companies cut through the noise. "There is so much going on right now," said Reimer. "We can help vet the information and differentiate what is new, what's real, and what really works."⁹⁴

Link consortia projects to sector-specific technology road maps and end-customer needs

Close consultation with industry to link consortia projects to validated end-customer requirements and sector-specific technology road maps is an essential part of the value proposition according to numerous executives.

There is a concern, however, that university-based consortia projects tend to get it backwards. "When I look at the successful formula emerged from the Valley, you take someone from an MBA program and marry them with an engineering person, and you find a problem and build a solution," said Marty Reed of Evok Innovations.⁹⁵ "Too often, we fund a scientist to invent a widget, and then we struggle to figure out why that widget isn't being bought. Rather you've got to start with questions like who is the customer? Why are they buying this? Why is what we are doing better? And what do we need to get there?"⁹⁶

Consortia leaders were mostly sympathetic to the need to integrate their efforts with the requirements of industry. As Edwards put it, "We are working with the industry to set the agenda and push that agenda out to our partners in the labs. Industry will only pay for it if we ensure that research is meeting real industry needs."⁹⁷

While many consortia projects focus on industry verticals, there is an argument from some consortia project leaders that it is easier to entice companies to join cross-sector consortia, especially those organized around value chains. "Our goal is to fully exploit the potential of the new bio-economy by fostering collaboration across sectors. And rather than deal with competitive rivalries, we bring complementary companies together into new value chains," said Carrez with the BIC.⁹⁸

BIC, for example, brings biotech companies together with companies in chemicals, agriculture, pulp and paper, and automobiles to develop new bio-based materials and manufacturing processes. In a typical collaboration, an agriculture or pulp and paper company will supply the feedstock. The biotech and chemical companies will convert the feedstock into new fuels and new materials, while the automotive companies adapt their engines and combustion systems to work with the new fuels.

"The whole value chain can work together on proof of concept (POC) and a demonstration project to get access to further financing to launch a flagship production facility," said Carrez. While large companies in resource-based industries tend to be very



High-value domains linked to cutting-edge technologies like AI, autonomous systems, blockchain, the IoT, and regenerative medicine are worthwhile and understandable targets for consortia projects.

More consortia projects would not only benefit large anchor firms; they would also open up new markets and partnership opportunities for technology start-ups.

conservative, the consortia model provides a lower-risk environment for experimenting with new approaches to innovation. “They usually work in their silos, but they are breaking down barriers, and now they are working across sectors.”⁹⁹

Having identified customer needs and defined a technology road map, it’s also essential to think carefully about where consortia projects intend to operate on the spectrum of technology maturity. “Early-stage exploratory efforts are important and comparatively easy to convene, but they use more of a scattergun approach to advance enough ideas,” said Reimer at the Advanced Vehicle Technology Consortium. “Later-stage projects that are moving towards commercialization are where the real value is, but the commercial sensitivities make them harder to execute.”¹⁰⁰

Consortia projects that invite participation from competitors must strike the right balance. As Reimer put it,

*The consortium has to be orchestrated around projects, technologies, and market opportunities that are early enough in the development cycle that companies are willing to share. If it’s too late, or too close to commercialization, competitors are not going to collaborate.*¹⁰¹

Apply consortia models to untapped opportunities

High-value domains linked to cutting-edge technologies like AI, autonomous systems, blockchain, the IoT, and regenerative medicine are worthwhile and understandable targets for consortia projects. However, executives at some companies were keen to point out that there are untapped opportunities for innovation in more traditional sectors that remain essential sources of growth and employment.

“The non-ICT and biomedical sectors are where we see a gap,” said Tim Faveri, vice president of sustainability and shared value with Maple Leaf Foods. Faveri points to domains like energy efficiency, agricultural innovation, food product innovation, and low-carbon transportation solutions. “There are many opportunity spaces, but there is less government support,” said Faveri. “We are trying hard to get better access to food innovation, and we have access to innovation around the world, but we would like to see more in our backyard.”¹⁰²

Executives like Faveri believe that consortia projects could help traditional sectors integrate new technologies like AI and blockchain that will lead to new product development and address long-standing productivity challenges. More consortia projects would not only benefit large anchor firms in sectors like agriculture, food processing, forestry, transportation, and energy; they would also open up new markets and partnership opportunities for technology start-ups.

McCain Foods, for example, has been working with a cluster of companies that are helping the company achieve efficiencies and even expand into new markets. One of those companies is Resson



Aerospace. The Fredericton, New Brunswick-based company's predictive agricultural analytics solution recently attracted a \$14 million investment from two very significant players in the global food and agriculture sector, with Monsanto claiming that Resson's "impressive data-driven technology ... could benefit the entire global agriculture industry." "That's a huge validation and huge value creation," said Nestor Gomez, start-up and entrepreneurship program lead with McCain Foods. "The global revenues could be very significant for this company."¹⁰³

Bolster private sector investments with public funding and public procurement

At the most basic level, money, subsidies, and leveraging opportunities are always attractive, even for big companies. Achieving the same innovation outcome for a fraction of the cost of doing it alone makes consortia projects an attractive financial proposition. Consortia leaders cited investment leverage ratios ranging from 10:1 up to as much as 50:1, depending on the project and size of the network. According to Carl Weatherell, CEO of the Canadian Mining Innovation Council, the organization's collaborative structure offers a significant degree of leverage on investments in innovation: "In some of our projects, we have 54 different partners, all pitching in resources."¹⁰⁴

At the most basic level, money, subsidies, and leveraging opportunities are always attractive, even for big companies.

The leverage on private investments is even more significant when one matches project budgets with public funding. The exact value and structure of the funding from public sources depends on the nature of the project and, for several consortia projects, the technology readiness level (TRL), where *level 1* means "basic principles observed" and worth studying further and *level 9* means "total system used successfully in project operations" and ready for commercialization.¹⁰⁵ For CUTRIC, the funding structure is 25 percent CUTRIC, 25 percent industry, 50 percent federal funding for TRL 2–3 projects (early-stage precompetitive research) and 20 percent CUTRIC, 50 percent industry, 30 percent federal funding for TRL 4–6 projects (precompetitive simulation, testing, and prototyping). (See Figure 2, next page.)

The ARM Institute, on the other hand, accepts project proposals for technologies in TRLs 4–7 and has a minimum 1:1 cost-share formula between industry proponents and funding from the US DOD. In most cases, industry bears a greater proportion of the project costs as technologies, or products, get closer to commercialization. The government can also play a significant role in de-risking technology development and adoption through public procurement and by running large-scale demonstration projects through public agencies and crown companies.

Running a high-impact consortia project

Interviews with consortia project leaders highlighted several insights about the factors that are contributing to the success



of their consortium and their strategies for keeping large anchor firms engaged in the work of the consortium. We synthesized the answers from consortia project leaders into a series of best practices for running successful projects with a high level of corporate engagement.

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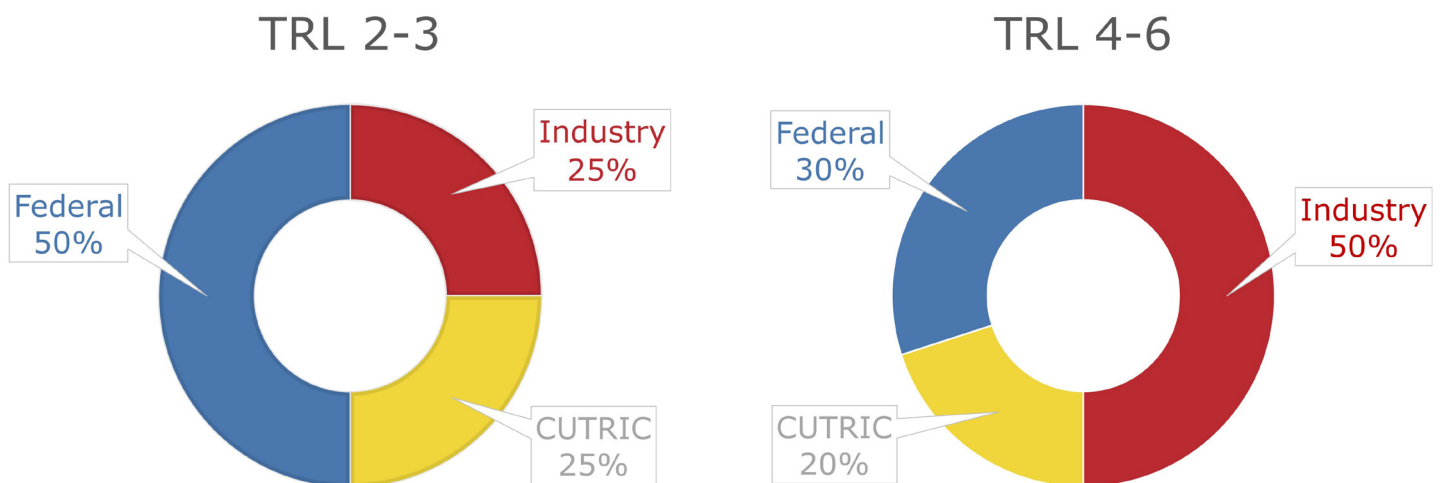
Forge alignment around stretch goals for the consortia

If the consortia project aims to do something transformative, it is vital to define ambitious objectives that existing methods and technologies cannot achieve. According to consortia leaders, doing so pushes members to innovate and reach beyond their comfort zone. "In our case, funders provided a list of 2,000 human proteins and asked us to solve the structures of 350—knowing full well that that goal was not achievable with the technologies of the day," said Edwards. "This worked. To meet these and subsequent milestones, SGC scientists developed new methods and research tools and have published more than 800 peer-reviewed papers."¹⁰⁶

Consortia leaders were adamant that building alignment around the stretch goals and objectives for the consortium is critical to success. Consortia projects need to be clear about their aspirations for the collective, but they also have to work hard to maintain alignment between the collective interests of the consortium and the needs and interests of individual participants. "The single greatest success factor," said Marke of B3i, "is maintaining a singular focus on the common interests on the consortium. Otherwise, there is a potential for disagreement, and that could be a recipe for disaster."¹⁰⁷

Sandor Albrecht stressed that consortia leaders also need a keen understanding of the motives of member companies. "Are they

Figure 2: Mix of private and public funding

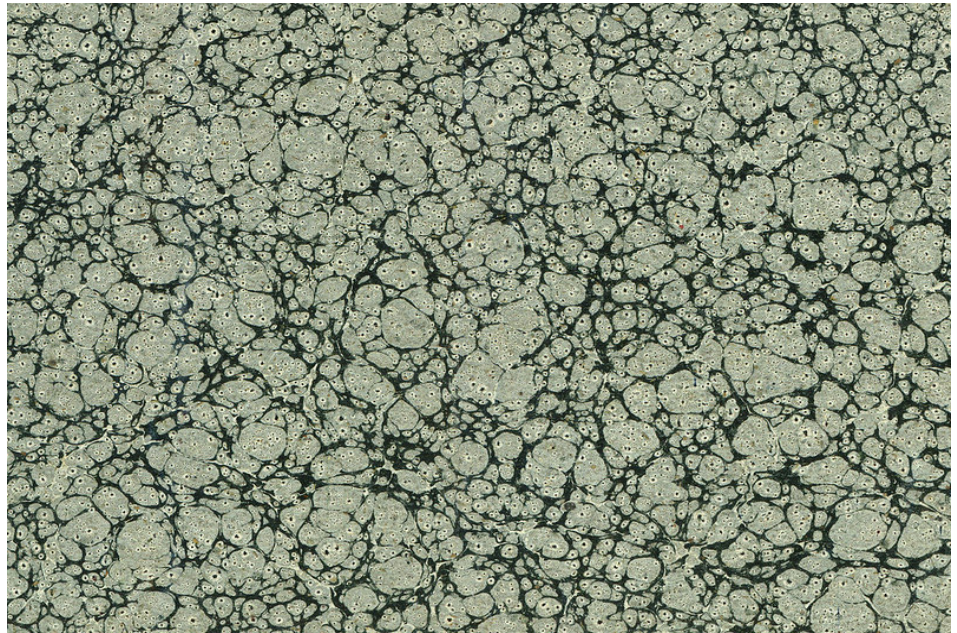


Source of data: "Funding," Canadian Urban Transit Research and Innovation Consortium, as of 7 July 2019. Internet Archive, accessed 31 Jan. 2020.



looking for patents? New product development? Or, are they more interested in probing the future? You have to understand the purpose for the consortia and the purpose for each of the individual players,” said Albrecht. “You need an alignment. It can’t be loose.”¹⁰⁸ Another executive insisted that the organization also needs a clear view of how the capabilities of different participants can be harnessed to deliver a successful project. “You also need to understand the competencies of the different players and ensure that the competencies of the players support the objectives,” said Gallo.¹⁰⁹

Similarly, several of the consortia leaders commented on the challenge of balancing core innovation objectives of the consortium with the desire of member companies to insert their custom projects into the agenda. Most consortia projects address this tension by hosting a series of member-led projects, each of which must engage several other members of the consortia. The consortium’s leadership retains control over the agenda by carefully selecting projects and ensuring each project aligns with the consortia’s broader objectives.



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The importance of using the early period of the consortia project to lay the research foundation and to establish clear parameters for the work that will follow was highlighted.

A number of the interviewees highlighted the importance of using the early period of the consortia project to lay the research foundation and to establish clear parameters for the work that will follow. “You start by ensuring that your vision drives the structure of the research,” said Reimer. “As the project grows, you start to get more cognizant of the member needs, and you try to establish a balance that is palatable from their perspective. You have to establish a baseline first, and then get more responsive to their needs. As the agenda broadens, you start to have clusters around which companies will naturally focus.”¹¹⁰



The business development work is among the most critical components in delivering meaningful commercial outcomes and market opportunities.

Attend to the business development component of commercialization

There was a concern voiced by some executives and consortia leaders that consortia projects focus intensively on the technology development and pay insufficient attention to the commercial applications, the market opportunity, and the voice of end-customers. “For too many programs, the focus is all about the technology. They will never put a dollar towards business development,” said Reed.¹¹¹ And yet, according to several executives and consortia leaders, the business development work is among the most critical components in delivering meaningful commercial outcomes and market opportunities. “As an investor, I’ll fund the guy who identifies the business problem before I fund a scientist to invent a widget,” said Reed. “Advancing up TRL levels is the wrong metric. It works if you’re in NASA, which is where TRL was invented. Instead, we should start thinking about customer readiness levels. It changes your filter and your focus.”¹¹² Doing so would suggest that consortia project leaders spend much more time in the planning phases talking to customers and understanding the market before defining detailed R&D plans.

Forge effective partnerships across disciplinary, organizational, and sectoral boundaries

Most consortia projects strive to create multistakeholder projects that get industry and academic collaborators working together. While consortia leaders admitted that it could be challenging to get organizations to work outside of their silos, they agreed that breaking down organizational boundaries is a critical success factor. “We run 50 or 60 collaborations at a time, and our industry scientists work side by side with us in the lab,” said Edwards. “It’s vital that industry provide expertise as well as funds. We get real active engagement.”¹¹³ Edwards elaborated on the value of this engagement:

Collaboration with industry scientists engenders a shared desire to succeed and creates a sense of ownership of a project. The different motivations also create productive tension. For example, scientists in academia have strong incentives to publish rapidly. Unfortunately, this can lead to the publication of stories that are true only under narrowly defined conditions.

By contrast, industry scientists push for validation using a range of orthogonal experiments; these alternative ways of evaluating the same research tool ensure that the results are broadly useful. By balancing these desires, we achieve an optimal combination of innovation, timely dissemination and reproducibility.¹¹⁴

Most consortia projects strive to create multistakeholder projects that get industry and academic collaborators working together.

For other consortia projects, there were clear benefits to getting researchers and industry executives together with regulators and public policymakers. For example, Joy Romero at Canadian Natural



Each institutional type typically brings unique interests, organizational cultures, capabilities, and potential encumbrances to the equation.

Resources argued that having regulators engaged with consortia projects that are working on new technologies in highly regulated sectors could speed up the deployment of innovations:

All of us have the same goals. We want to be able to reduce our environmental impact and walk away without liabilities. We also want to be able to move more quickly when new opportunities arise. For example, we want to use AI and digital technologies to achieve better outcomes, but the current regulations are too prescriptive and don't take these measures into account. The regulatory processes have not kept up. Innovation is required in the regulatory process and how we work together with the government. They need to understand the production processes better and can't continue to develop these regulations in isolation.¹¹⁵

It is one thing to bring complementary partners to the table. It is quite another to enable diverse organizations—including universities, large companies, and SMEs—to forge partnerships that will drive significant commercial outcomes for the respective parties. “Trying to convince member companies to work together is still more art than science,” said Behlendorf. “In these communities, you establish some core objectives, and you ask people to self-organize around the things that need doing.”¹¹⁶

Each institutional type typically brings unique interests, organizational cultures, capabilities, and potential encumbrances to the equation. Start-ups, for example, often fail to understand the intricacies and economics of large-scale industrial processes and are ill-equipped to enter into serious business negotiations with a larger and more sophisticated partner. They may be unable to share the financial risk or burden of demonstrating or piloting new products. Or, they may lack the human or manufacturing capacity to provide solutions at scale. Large companies and universities, on the other hand, could be encumbered by bureaucracy, or may not fully appreciate how to work with start-ups without quashing the very qualities that make them agile and innovative.

A compelling vision and road map will attract industry attention.

This shortage of innovation know-how on all sides highlights the need for education, culture change, and capacity building within consortia projects to support effective commercialization partnerships. “We have a common culture and methodology,” said Behlendorf. “But we also allow a diversity of approaches to flourish. We commit to seeing ourselves and our members as part of a distributed team. In some cases, we will collaborate, and in other cases, we are free to compete with each other and to meaningfully differentiate.”¹¹⁷

Marry a compelling vision and road map with strong convening and facilitation skills

A compelling vision and road map will attract industry attention. Strong facilitation and convening skills are part of what keep industry players engaged and renewing their funding commitments year after year. “It’s as much about convening as it is about ideas,” said Reimer.



Consortia projects can play a role in providing exposure to powerful new ideas and educating executives about the forces that are reshaping their industries.

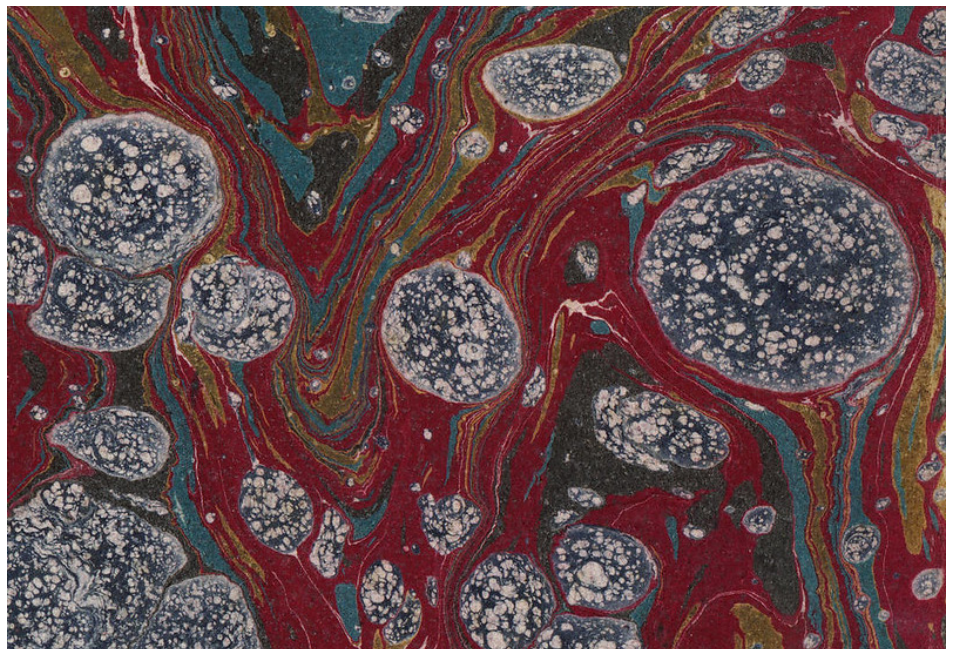
"You need both, but if the facilitation is correct, the conversation among consortia members is as important as the research itself."¹¹⁸

Behlendorf agrees, noting that making sure "interesting people show up to the party" is a vital component of his leadership role. "We also need to create a structure around their contributions and make members and contributors feel like they are effective in the contributions they make," he said.¹¹⁹

In doing so, consortia projects can play a role in providing exposure to powerful new ideas and educating executives about the forces that are reshaping their industries. "You need to work daily on the research and communications mechanisms that allow consortia participants to learn and derive value from your efforts," said Reimer. "The research and R&D activities will not only lead to cool new tech; they should also educate executives about breakthrough opportunities. Part of our mission is to develop educational material that will fuel company growth."¹²⁰

Keeping busy executives engaged is part of the nuts and bolts of running a successful consortium and, according to consortia leaders, it's easy to underestimate how hard it can be to hold people's attention over the lifespan of a long and complicated project.

"We hold regional events and invite executives to sit on committees and councils. We have meetups and working groups and an online platform for communication," said Clayton. "The corporate engagement part is a challenge. We have to work very hard at it."¹²¹ Clayton stressed the importance of leveraging the entire membership. "They are a national ecosystem of innovators. We need to tap the power of the network. They have a lot of expertise."¹²²



Vintage 19th c. marbled paper, Gloster pattern (28) by Paul K, 2010, used under CC BY 2.0, rotated 90 degrees, cropped to fit.



Broker growth opportunities for start-ups and SMEs

Executives and consortia leaders agreed that consortia projects could create compelling opportunities for entrepreneurship by forging collaborations between large companies, universities, and start-ups. Among other things, such partnerships can provide an injection of new thinking and productivity into mature businesses while offering young tech firms access to the deep domain expertise required to build a scalable solution that meets validated industry needs. Many suggest that there are several concrete measures that consortia projects can implement to help broker partnerships between large companies and start-ups.

One option is to provide curated matchmaking services that link large corporate members to a vetted pool of high potential start-ups. The ARM Institute, for example, has built detailed profiles and an online platform for the most promising start-ups working in robotics at Carnegie Mellon University and MIT, and plans to add more companies from leading technology hubs across the country. The secretariat also invites a select group of start-ups to attend its regional meetups and makes targeted introductions on the request of its corporate members.

A consortium can provide unique opportunities for start-ups to demonstrate the viability of technologies in the development stage.

Another option is to have experienced executives offer mentorship opportunities and product development support to young entrepreneurs. For example, Evok Innovation, a cleantech consortium in Canada, connects company founders at cleantech start-ups to experienced business executives at large industrial companies. The seasoned business leaders provide advice at critical pivot points, shape product development, and help mold vital management competencies.

Finally, a consortium can provide unique opportunities for start-ups to demonstrate the viability of technologies in the development or POC stage. Consortia projects such as CUTRIC, the Carbon Impact Initiative, and the BIC provide opportunities for SMEs to test and refine new technology solutions in a commercial setting and then share those results with a broader community of potential customers. "In a consortia project, small and large firms can provide complementary capabilities," said Carrez. "SMEs are the engines of innovation, but they need the demonstration projects and POCs to make it easier to get to the next stage of commercialization. Large companies are essential for large-scale manufacturing know-how and capability. They can also make large investments in flagship projects."¹²³

Conclusion and summary

For most of the last century, the critical advances in technology were happening inside large, well-funded industrial R&D machines that dotted the Western world. The labs of firms like AT&T and IBM or



Even the largest and most sophisticated corporate leaders can no longer dominate their fields or dictate the pace of development.

Biota-Sediment Accumulation Factor and Bayer attracted the most talented PhD graduates from the leading universities from which they harnessed the revolutionary developments in biology, chemistry, and physics to pump out life-changing products and services.

Today's landscape is different—very different. Industrial era knowledge monopolies are breaking down rapidly. The means of creation are open and proliferating. Innovations that once germinated in the R&D labs of large Western firms now flourish in a variety of settings. Western nations can no longer expect to monopolize advanced scientific research. Even the largest and most sophisticated corporate leaders can no longer dominate their fields or dictate the pace of development.

Consortia projects are a vital fixture in the modern innovation landscape, in large part because collaboration is the new norm. When large companies define the boundaries of their enterprises, they think not just about the people in full-time employment, but about a broad array of individuals and partner organizations that can enrich their value proposition, wherever they may be in the world. Staying globally competitive means monitoring business developments internationally and tapping a much larger global talent pool. Consortia projects are attractive because they can provide access to new markets, ideas, and technologies.

Consortia projects are equally important to other key actors in innovation clusters. For universities, consortia projects are vehicles for translating scientific discoveries into marketable products and services, for generating spin-off companies, earning licensing revenues, and training the next generation of scientists. Start-ups and SMEs join consortia projects to secure a first sale or gain access to industry value chains. And for the jurisdictions that host them, consortia projects represent an opportunity to attract investment, foster innovation, and create the jobs and companies of the future.

Consortia projects are a vital fixture in the modern innovation landscape, because collaboration is the new norm.

While strategically important, consortia projects are also hard. It can be challenging to convince diverse institutions and companies to work together. Other challenges include maintaining alignment on crucial goals, avoiding disputes over IP, and sustaining engagement and regular communication among consortia members. As Ron Resnick put it, "You need disciplined processes, persistence, patience, a tolerance for some politics, and lots of maturity."¹²⁴

Consortia projects can also run into challenges. Some firms may choose to free ride, hoping that their competitors will waste their resources going down blind alleys, while they take advantage of whatever information has been divulged to avoid doing the same. Even when firms join with the best of intentions, it can be challenging to ensure that all participants honor their commitments to devote resources to fulfilling a consortium's objectives.

Alternatively, firms can contribute significant resources to a project, only to have the consortia project leader or funding partners change direction concerning the project mandate or focus. Managing timing



Successful consortia projects deploy a combination of strategies and resources to attract high-quality participants and avoid pitfalls.

and project scope are also key challenges. In today's world, where innovation proceeds at breakneck pace, consortia projects need a relentless focus on project execution to avoid being overtaken by competing innovation efforts.

Successful consortia projects deploy a combination of strategies and resources to attract high-quality participants and avoid pitfalls such as these. Among some of the most important practices, leading consortia projects in the blockchain arena should do the following:

1. Offer a compelling value proposition for engagement, either by creating a significant market opportunity as an outcome of the project or by helping de-risk innovation investments.
2. Link consortia projects to sector-specific technology road maps and end-customer needs to ensure that the project is delivering technologies and solutions that the market participant can and will adopt.
3. Structure consortia activities into concrete objectives and deliverables and facilitate opportunities for making investments in projects that are scalable.
4. Create a community of competent people and organizations, including the full-time professional team that runs the consortium, and the network of research and business leaders that come to the table.
5. Build unique infrastructure, offering a breadth of technical and academic experience and a research and experimentation infrastructure that would be too costly for individual companies to create from scratch.
6. Create ambitious stretch goals that push technological boundaries and work hard to forge alignment between the collective goals of the consortium and the needs and interests of the individual members.
7. Build the capacity to forge effective partnerships between institutions with unique interests, organizational cultures, and capabilities.
8. Invest resources into the business development components of technology commercialization, paying close attention to the commercial applications, the market opportunity, and the voice of end-customers.
9. Create IP rules that enable all stakeholders to harvest the value of collaboration, striking a balance between the desire to enhance the speed, scale, and scope of innovation and the need to protect the commercial viability of its members' investments.

Create IP rules that enable all stakeholders to harvest the value of collaboration.



10. Acquire strong convening and facilitation skills to help run the network, recognizing that when the facilitation is effective, the conversation among consortia members is as important as the research itself.
11. Meet regularly and create active governance structures that invite meaningful and sustained engagement from key stakeholders in setting and achieving goals together.
12. Broker growth opportunities for SMEs and start-ups by publicizing technology road maps, providing visible entry points for the product development and marketing efforts, and staging demonstration projects that will validate the viability of capital-intensive technologies at an industrial scale.

Appendices

A: Review of literature

The literature on consortia projects indicates that the design of innovation consortia is largely determined by the objectives and expectations of the participating institutions and firms, and this variation may lead to differences in their outcomes.¹²⁵ According to the academic literature, corporate motives for participating in consortia and cooperative R&D projects can be delineated into two broad categories: a desire to exploit an existing capability or a desire to explore new opportunities.¹²⁶ The literature reveals an extensive list of more specific motives for entering into cooperative relationships within these two categories.¹²⁷

When it comes to using consortia to explore new territory, firms are typically motivated by opportunities to:

- » Improve their ability to recognize
- » Assimilate and apply new knowledge to commercial ends
- » Gain access to attractive yet unfamiliar lines of business¹²⁹
- » Diversify their products and services portfolios while hedging the risk of being either locked into old technologies or products, or locked out of critical new technologies¹³⁰

Firms seeking to exploit existing capabilities are often seeking to gain access to:

- » Complementary resources and capabilities difficult to find in open markets¹³¹
- » Increase market power¹³²
- » Reduce the costs of innovation via economies of scale and scope, while avoiding the risks of full-scale merger¹³³



Leveraging a 2019 study by the DEEP Centre, this report builds on an in-depth analysis of over 20 technology consortia in advanced manufacturing, AI, clean technologies, healthcare and life sciences, and the industrial Internet.

The case studies provided insight into how leading blockchain consortia have structured their projects and programming to attract firms to the consortia.

B: Project methodology and approach

Our approach to this research focused on identifying options for increasing corporate participation in blockchain consortia and strategies that will maximize the economic benefits derived from these efforts, such as the development of innovative products and technologies, the creation of new spin-off companies, and the growth and success of the blockchain ecosystem as a whole.

However, early in the project, we determined that there was much to learn from looking at consortia in other technology-driven fields. Leveraging a 2019 study by the DEEP Centre, this report builds on an in-depth analysis of over 20 technology consortia in advanced manufacturing, AI, clean technologies, healthcare and life sciences, and the industrial Internet.

To fulfill the objectives of this research, we pursued a four-step methodology.

- » *Step 1:* We conducted a landscape analysis of leading consortia projects around the world in five key technology domains or clusters, including advanced manufacturing, clean technologies, emerging technologies (e.g., AI and blockchain), and health and life sciences and network generation networks (e.g., broadband and wireless network and the IoT). In addition to the landscape analysis, the DEEP Centre performed a review of secondary sources to provide a brief overview of the extant knowledge regarding corporate participation in consortia projects.
- » *Step 2:* We conducted a series of one-to-one interviews with 25 executives representing an international mix of consortia projects and large anchor companies. The interviews provided insight into the evolution of corporate innovation strategies, the motives for corporate participation in consortia projects, and the strategies that consortia leaders use to attract and enhance the engagement of member companies with other consortia partners, including start-ups, SMEs, research institutes, and postsecondary institutions.
- » *Step 3:* We conducted a more detailed analysis of three blockchain consortia projects to better understand the role these entities play in propelling the success of the blockchain ecosystem. The case studies provided insight into how leading blockchain consortia have structured their projects and programming to attract firms to the consortia, maximize the interaction between key participants, and drive key economic outcomes.
- » *Step 4:* We synthesized the case study research and the findings from the executive interviews to develop a suite of best practices for attracting companies to consortia projects, along with a series of considerations and strategies for enhancing the economic impact of industry collaboration.



Among other things, these strategies and best practices provide insight into how to:

- › Define an innovation challenge and market opportunity for consortia projects that will attract large anchor firms to the project.
- › Structure consortia efforts in a way that will maximize corporate participation and enhance the commercialization outcomes of the consortia.
- › Integrate SMEs and start-ups into consortia projects and broker growth opportunities and partnerships with anchor customers.
- › Craft an approach to governance and IP management that will foster engagement and collaboration among key participants.



About the author

Anthony D. Williams is co-founder and president of the DEEP Centre and an internationally recognized authority on the digital revolution, innovation, and creativity in business and society. He is co-author (with Don Tapscott) of the groundbreaking bestseller, *Wikinomics: How Mass Collaboration Changes Everything*, and its sequel, *Macrowikinomics: New Solutions for a Connected Planet*. Among other current appointments, Anthony is an expert advisor to the Markle Foundation's Initiative for America's Economic Future, a senior fellow with the Lisbon Council in Brussels and the Institute on Governance in Ottawa, and chief advisor to Brazil's Free Education Project, a national strategy to equip two million young Brazilians with the skills required for a twenty-first-century workforce. His work on technology and innovation has appeared in such publications as the *Huffington Post*, *Harvard Business Review*, and the *Globe and Mail*.

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About the Blockchain Research Institute

Co-founded in 2017 by Don and Alex Tapscott, the Blockchain Research Institute is an independent, global think tank established to help realize the new promise of the digital economy. For several years now, we have been investigating the transformative and disruptive potential of blockchain technology on business, government, and society.

Our syndicated research program, which is funded by major corporations and government agencies, aims to fill a large gap in the global understanding of blockchain protocols, applications, and ecosystems and their strategic implications for enterprise leaders, supply chains, and industries.

Our global team of blockchain experts is dedicated to exploring, understanding, documenting, and informing leaders of the market opportunities and implementation challenges of this nascent technology. Research areas include financial services, manufacturing, retail, energy and resources, technology, media, telecommunications, healthcare, and government as well as the management of organizations, the transformation of the corporation, and the regulation of innovation. We also explore blockchain's potential role in the Internet of Things, robotics and autonomous machines, artificial intelligence, and other emerging technologies.

Our findings are initially proprietary to our members and are ultimately released under a Creative Commons license to help achieve our mission. To find out more, please visit www.blockchainresearchinstitute.org.

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