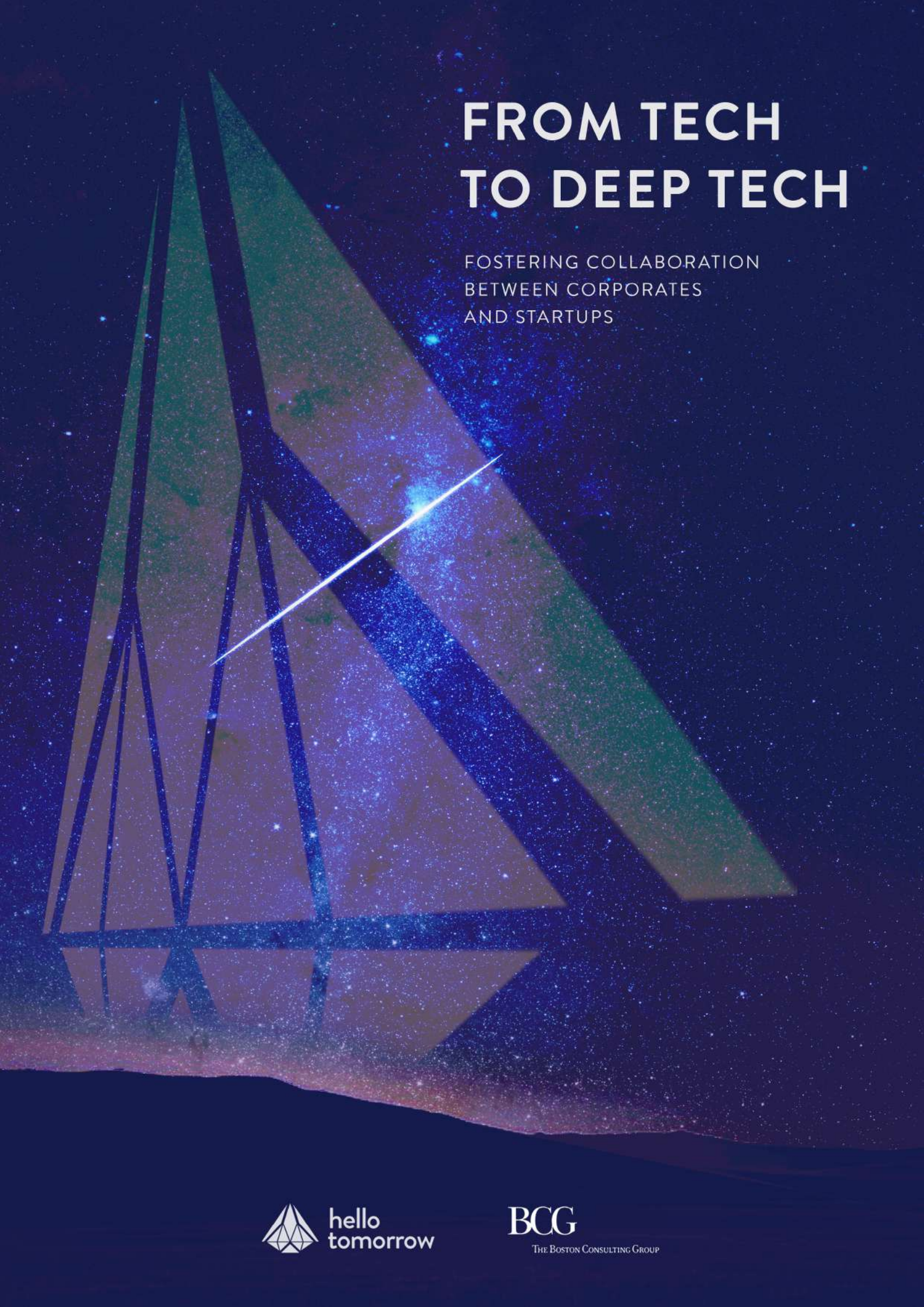


FROM TECH TO DEEP TECH

FOSTERING COLLABORATION BETWEEN CORPORATES AND STARTUPS

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BCG
The Boston Consulting Group

From Tech to Deep Tech

Fostering collaboration between corporates and startups

Arnaud de la Tour, Philippe Soussan,
Nicolas Harlé, Rodolphe Chevalier,
and Xavier Duportet

Executive Summary 4

Introduction: Deep Tech Is the New Tech 6

- **The Shift Has Begun** 7
- **Specifics of Deep-Tech Innovation** 8
- **Toward a Well-Functioning Deep-Tech Innovation Ecosystem** 8
- **Methodology and Sample** 10

Deep-Tech Startup Challenges, Needs, and Key Partners 11

- **Challenges: Time-to-Market, Capital Intensity, and Technology Risk and Complexity** 11
- **Needs: Market Access, Technical Expertise, and Business Knowledge** 12
- **The Broad Scope of Corporate Collaborations** 13
- **Preferred Partners for Funding, and the Role of Other Partners** 16
  - *Public sector: Funding and market access*
  - *Business angels: Funding and business expertise*
  - *Venture capital: Funding and market access*
  - *Universities: Technical expertise, talent, and access to facilities*
  - *Accelerators and incubators: Business expertise, talent, and access to facilities*
- **Startup Needs, Based on Maturity and Market Readiness** 18
  - *Potential quick wins*
  - *Demand bets*
  - *Development bets*
  - *Technology bets*
  - *Different countries, different ecosystems [box]*

Designing a Platform for Corporate Collaboration with Startups 23

- **Define a Clear Mandate** 25
- **Adopt an Agile Environment and Involve the Business Units** 25
  - *Ensure lighter, faster processes*
  - *Set up adapted governance to ensure fast-track decision making*
  - *Derisk the technology before involving the business operationally*
  - *Give startups easy access to corporate resources*
  - *Adapt KPIs to track long-term results, with a portfolio approach*
  - *Foster the right mindset*
- **Initiate a Win-Win Relationship** 28
- **Move the Collaboration to the Next Level** 29
  - *Set up a partnership to reach specific business goals*
  - *Weigh the value of an exclusivity-based relationship*
  - *Leverage corporate venture capital to reach financial and strategic goals*
  - *Key questions for corporate partners*
- **Create an Ecosystem Around Your Projects** 34
- **Questions to Answer Before Building a Collaboration Platform** 34

Scouting Deep-Tech Startups 36

Appendixes 49

- *Appendix 1. Interview list*
- *Appendix 2. Definitions and descriptions of the nine technology readiness levels (TRLs)*
- *Appendix 3. Specifics of the French ecosystem*

Executive Summary

Technological innovation is not new. Over the past decade, however, a powerful wave of innovation based on digital platforms and apps has arisen and become synonymous with the tech industry.

Investors and companies are now looking for the next source of deep technological innovations (deep tech), which will fuel the next industrial revolution. Deep-tech innovations are defined as disruptive solutions built around unique, protected or hard-to-reproduce technological or scientific advances.

Deep-tech companies have a strong research base. They create value by developing new solutions, not only by disrupting business models. Because they are advancing the technological frontier, they face unique challenges. In a survey conducted by Hello Tomorrow and BCG, and answered by more than 400 deep-tech startups, the challenges that respondents identified most frequently included lengthy time-to-market (27%), high capital intensity (25%), technology risk and complexity (17%), and yet-to-be-developed commercial applications (14%).

To address the challenges, deep-tech startups need go beyond funding (which 80% of the startups surveyed ranked among the top three challenges they faced) to such issues as market access (61%), technical expertise (39%), and business expertise (26%).

To access the resources that they don't have internally, they rely on several stakeholders, each of which addresses specific needs. Such collaborations are especially important for deep tech since it lies at the crossroads of fundamental research and industrial application. For any company—and especially for a young one—performing multiple, very different tasks in-house can be quite difficult.

Universities, the public sector, business angels, and venture capitalists may have crucial roles to play in the development of deep-tech startups, but corporates—whether midsize, large, or enterprise-size companies—are the only potential partners that can meet all of the startup's needs, combining technical, industrial, and commercial visions and skills. That fact explains why 97% of deep-tech startups are interested in collaborating with corporate partners. Simply applying the same methods and thinking that corporates and startups use when they partner to develop digital platforms and apps, however, will not work. Corporates need to take into account the specific challenges and needs of deep-tech startups if they are to establish mutually rewarding relationships.

Instead of following a standard formula developed outside the deep-tech milieu, corporates should define a clear mandate for the startup collaboration, creating a favorable environment that brings agility, ensures buy-in from top management (to validate key decisions), and involves whole business units. The collaboration platform may be a dedicated function or a simple set of adapted processes and key performance

indicators. In all such efforts, corporates should follow a few key principles.

From the outset, both sides should be transparent about their objectives and should involve R&D and relevant teams in commercial and operational efforts early on. Doing so will encourage the partners to check project's alignment with strategy, avoiding disappointment and loss of time on both sides.

The right partnership model to use in setting up a deeper partnership with a deep-tech startup around R&D or commercialization depends on the corporate's operational and strategic interests and on the startup's maturity. It is not possible to define a standard process capable of driving all collaborations. Nonetheless, corporates need to assemble a specific array of qualifying questions—and have a set of main success indicators in mind—before entering the next stage of the relationship.

To support the startup financially or to gain a seat on its board, corporates can complement the startup partnership with corporate venture capital. If the goal is simply to get a deal flow or financial return on investment, an option such as becoming a limited partner in external funds might be more suitable.

This report is the first in a series examining the dynamics underlying deep-tech innovation. The series will offer practical recommendations on how to foster interactions between the different stakeholders of the ecosystem (startups, corporates, VCs, business angels, universities, the public sector, and others).

This report has been prepared through a partnership between **Hello Tomorrow**, a global initiative with a mission to accelerate the deep-tech innovation through accelerating the connections in the ecosystem, and **Boston Consulting Group**, a global consultancy.

BCG

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The Boston Consulting Group (BCG) is a global management consulting firm and the world's leading advisor on business strategy. We partner with clients from the private, public, and not-for-profit sectors in all regions to identify their highest-value opportunities, address their most critical challenges, and transform their enterprises. Our customized approach combines deep insight into the dynamics of companies and markets with close collaboration at all levels of the client organization. This ensures that our clients achieve sustainable competitive advantage, build more capable organizations, and secure lasting results. Founded in 1963, BCG is a private company with 85 offices in 48 countries.

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Hello Tomorrow is a global organisation which gathers together a community of thousands of the world's brightest talents, who leverage science and deep technologies to create a better future. Hello Tomorrow initiates and propels collaborations between the world's most promising projects and leading entrepreneurs, executives and investors, to bring breakthrough technology to market. The annual Startup Challenge and Global Summit, as well as numerous international events all around the world, have become a unique platform to connect local deep-tech ecosystems with a global innovation network.

Introduction: Deep Tech Is the New Tech

Technological revolutions are not new to the world. Instances include the emergence of the steam engine at the end of the 18th century, railway and steel in the 1830s, electricity and chemistry during the late 1800s and early 1900s, automobiles and petrochemicals in the early 20th century, and information and communication technologies (ICT) at the end of that century.

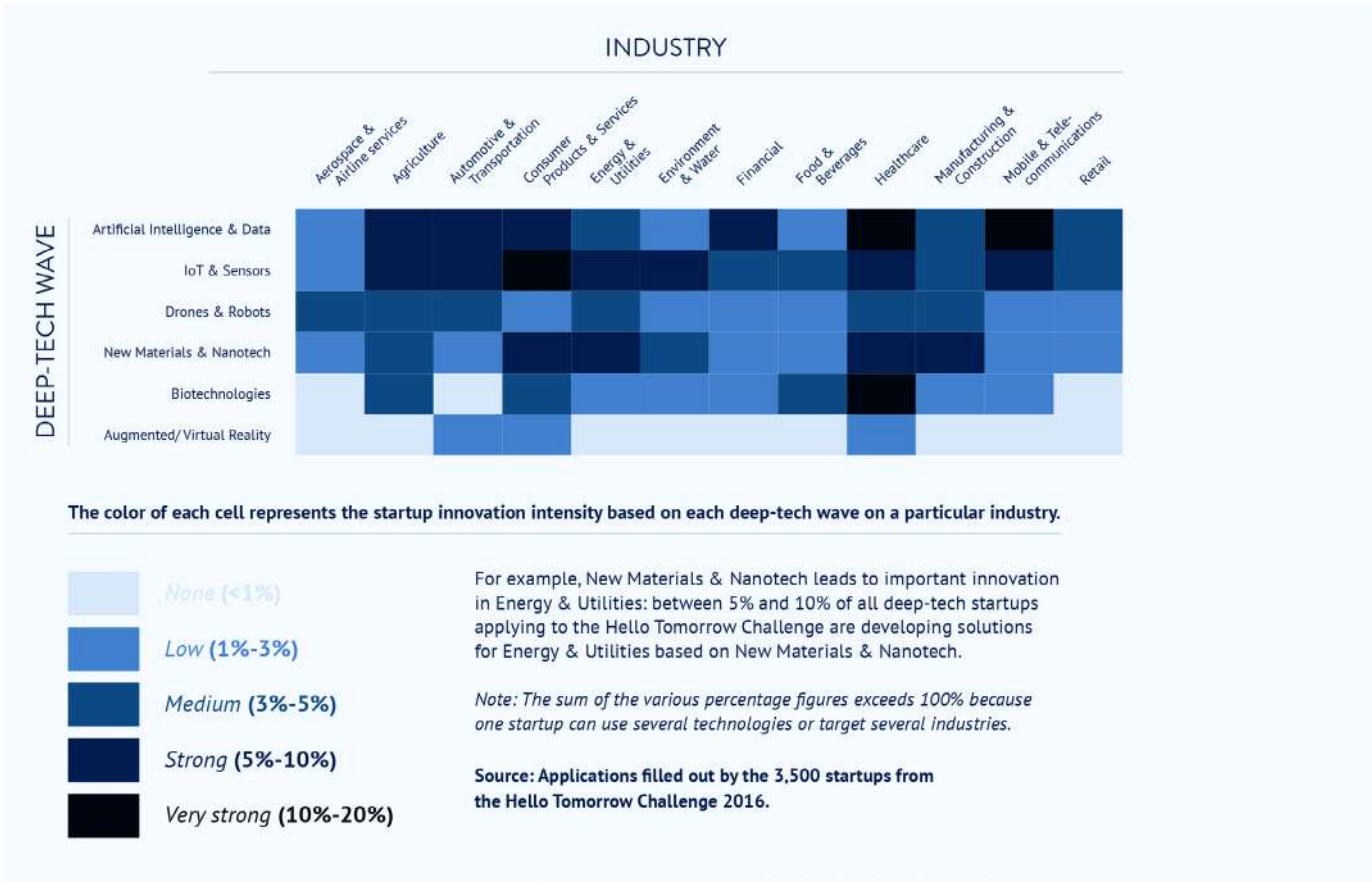
Digital platforms and apps that arose during the ICT wave are so closely associated with the innovation hype of the past decade that they are often treated as being synonymous with the tech industry.

Today, however, the main potential of platforms and apps involves their wider dissemination, rather than additional radical innovations. Consequently, investors are looking elsewhere for "the next big thing"—the enabling technologies that will be at the heart of the next industrial revolution, solve major societal and environmental issues, and drive economic growth by improving on current products and services, creating new markets, and reindustrializing developed countries.

Unlike existing digital platforms and apps, future "deep" technologies will advance the technological frontier. Deep-tech innovations are disruptive solutions built around unique, protected or hard-to-reproduce technological or scientific advances.

Deep-tech innovations lie at the crossroads of massive shifts in demand led by megatrends (such as global climate change, demographic shifts, resource scarcity, and an aging population) and scientific progress (such as the discovery of the CRISPR-Cas microbial adaptive immune system) and are impacting all industries. *(See Exhibit 1.)*

Exhibit 1. Heatmap of deep-tech innovation intensity in each industry



The Shift Has Begun -

Investors and corporate have already started to move toward deep tech. In 2016, total funding in biotechnology reached $7.9 billion compared to $1.7 billion in 2011.[1] Investments in environmental equipment such as recycling, remediation, and environmental cleanup, as well as in solid waste technologies have increased from $100 million in 2009 to $416 million in 2016.[2] For their part, augmented and virtual reality, space, and drone companies raised a combined $3.5 billion in equity financing in 2015 compared to $104 million in 2011.[3]

Companies that began as ICTs and digital businesses are increasingly reshaping their innovation strategies toward deep tech, too. Google recently created Google Life Sciences, now known as Verily. In addition, Google, Facebook, Amazon, IBM, and Microsoft created a partnership in artificial intelligence research. Uber is implementing its driverless car services, as are both Apple and Google developing ones.

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[1] "Financing in Biotechnology," CB Insights. Last accessed on December 6, 2016 at **https://www.cbinsights.com/search/**

[2] "Financings in recycling, remediation & environmental, cleanup & solid waste," CB Insights. Last accessed on December 14, 2016, at **https://www.cbinsights.com/search/deals/**.

[3] "The Future of Frontier Tech: Analyzing Trends in Drones, Space, and AR/VR Technology," CB Insights, 2015. Available at **https://www.cbinsights.com/research-frontier-tech-report**.

Facebook is also investing in Artificial Intelligence, drones and virtual reality.

Accelerators that once had a narrow digital focus are opening their doors to deep-tech startups as well. Y Combinator formerly emphasized software-centric partnerships with startups such as Dropbox and Airbnb; but it is now incubating a commercial fusion reactor startup and a startup that produces chemicals from natural gas. In fact, of the 192 startups included in Y Combinator's 2016 batch, 32 were from deep tech (including nine in biotech, four in drone development, and three in advanced hardware).[1]

Specifics of Deep-Tech Innovation

Companies today can start, test and scale their solutions with fewer resources and considerably faster than ever before. Deep-tech innovation also benefits from technological advances that have substantially lowered the costs of starting a company. Even so, a deep-tech startup is slower and more expensive to get off the ground than a digital startup, for several reasons:

- Strong research base: In deep tech, product development depends on fundamental research and/or advanced R&D, which require support from a strong set of advanced skills, knowledge, and infrastructure, and lengthen the products' time to market.
- Heavy industrialization process: Aside from deep tech based on ICT, most products in this field are hardware—often based on advanced materials and resources—requiring highly developed industrial skills to procure, manufacture, and scale. Such products are much more difficult to scale than products associated with internet and mobile technologies tend to be.
- Large investment needs: The infrastructure, skills, and resources needed by a deep-tech startup require substantial funding capacity over an extended period.
- Yet-to-be-defined commercial application: The end product specifications may be undefined well into the process. The blockchain developed as a specific technological solution for Bitcoin, for example, opened the door to a new market in finance that its developers did not foresee.

Toward a Well-Functioning Deep-Tech Innovation Ecosystem

Research has established that innovation depends on smoothly functioning innovation ecosystems—combinations of people, companies, infrastructure, and government policies linked through informal and formal

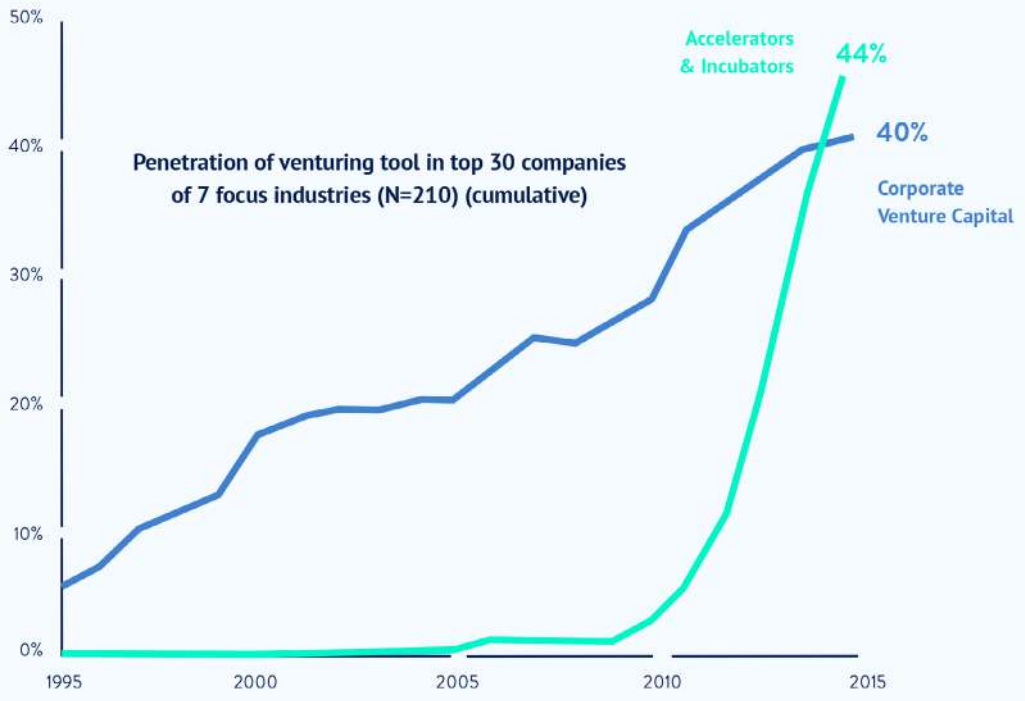
[1] "Y Combinator Companies." Last accessed January 9, 2017. Available at **https://www.ycombinator.com/companies/**.

networks.[1] Collaborations are crucial to the concept of Open Innovation, which—unlike closed, in-house innovation processes—requires that companies source and collaborate with others.[2]

Open innovation is not a new paradigm. Already a number of established companies have created strategic partnerships with each other to develop new, innovative solutions.[3] On the university side, tech transfer centers that seek to collaborate with businesses have almost become the norm.

The most notable rising trend, however, is the growing role of startups and their increasingly important collaborations with corporates. Startups today bet on long-term and high-risk deep-tech innovation—such as storage of information in DNA, or antimatter propulsion—that used to be the prerogative of public research. Collaborations between startups and corporates began in ICT and biopharma but are now spreading through all industries. BCG's report, "Corporate Venturing Shifts Gears" (BCG article, April 2016) noted that among top 30 companies in seven industries, the percentage of companies using CVC rose from 27% in 2010 to 40% in 2015. During the same period, the percentage of companies using accelerators and incubators surged from 2% to 44%. *(See Exhibit 2.)*

Exhibit 2. Use of CVC, incubators, and accelerators by top 30 companies in seven industries



Note: Sample includes TOP 30 companies by market value for 7 industries, n=210 (Technology, Communication, Media & Publishing, Automotive, Chemicals, Consumer and Financial Institutions); Accelerator and Incubator counted as one single vehicle.

Source: "Corporate Venturing Shifts Gears" (BCG article, April 2016).

[1] See Victor Mulas, Michael Minges, and Hallie Applebaum, "Boosting Tech Innovation Ecosystems in Cities" (2015), available at **https://openknowledge.worldbank.org/handle/10986/23029**, for a review of innovation ecosystems and innovation districts.

[2] See Henry Chesbrough, *Open Innovation: The New Imperative for Creating and Profiting from Technology* (Harvard Business School Press, 2003).

[3] See the review of different industry collaborations in Theresa Turner and Susanna Cros, *Co-Business: 50 Examples of Business Collaboration, 2013.*

The role of startups in the innovation ecosystem is increasing, especially within the field of radical innovation. Collaborations between corporates that tend to implement incremental innovation and academic centers that focus on radical innovation can be cumbersome due to strategic misalignments. Interviews conducted by Hello Tomorrow and BCG indicate that collaborations with startups offer a way to externalize the high risks associated with implementing radical innovation products, enabling corporates to innovate faster and at far lower risk.

Collaborative ecosystems and open innovation are crucial in deep tech. This is due to the aforementioned specifics of deep-tech innovation, which pose daunting challenges for a young company. Because of those specifics, corporates and other stakeholders need to apply new approaches to the task of accelerating deep-tech innovation.

This report examines the dynamics of deep-tech innovation and provides practical recommendations on how to foster interactions between different stakeholders in the ecosystem. The first section addresses the challenges and needs faced by deep-tech startups; the second focuses on collaborations between startups and corporates, offering practical advice on how to help ensure that these efforts succeed.

Methodology and Sample

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We collected the data in two stages: first from a survey of deep-tech startups, and second from in-depth interviews with deep-tech startups, corporates, investors, and support organizations.
As a first step, Hello Tomorrow and BCG conducted an in-depth survey of deep-tech startups that participated in the Hello Tomorrow Global Challenge.

This survey took place from October 1 through October 31, 2016. A total of 400 startups took part in it. Of these, 25% were early-stage, 45% were middle-stage, and 30% were late-stage startups, representing ten different sectors in more than 70+ countries:

- Aerospace
- Air quality
- Beauty and wellbeing
- Artificial intelligence and data sciences
- Energy
- Food and agriculture
- Healthcare
- Industry 4.0
- Transportation and mobility
- Water and waste

The survey asked 50 questions about the startups' needs and challenges, as well as about partnerships. Researchers then conducted in-depth interviews with key ecosystem stakeholders to learn their views on and experiences with deep-tech support and partnerships. (See *Appendix 1* for a full list of the people interviewed.)

Deep-Tech Startup Challenges, Needs, and Key Partners

Challenges: Time-to-Market, Capital Intensity, and Technology Risk and Complexity

Based on the survey results mentioned above, we concluded that startups' most critical challenges involve time to market, capital intensity, and technology risk and complexity. *(See Exhibit 3.)* Uncertain commercial application and regulatory framework are additional important roadblocks.

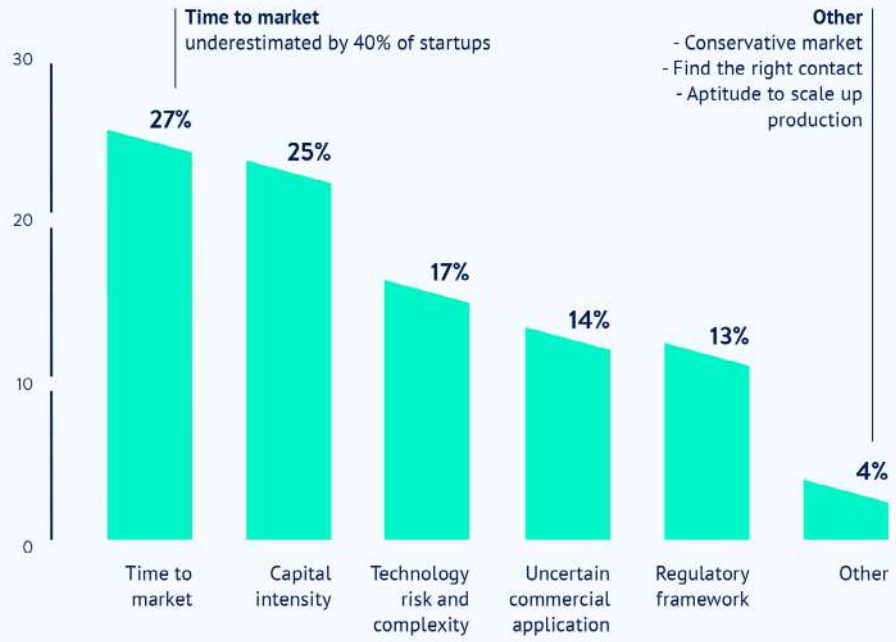
The time to market that deep-tech startups face is usually longer than that for other startups because their products are based on a new technology that requires a long development time. For example, they may have to conduct years of clinical trials in order to turn a new molecule into a legal drug.

The high level of capital intensity arises not only from having to develop products over extended periods, but also from the expensive infrastructure. Early experimentation and prototyping often rely on specific and costly equipment (such as a DNA sequencing machine) that is not needed in developing, say, a mobile app. Testing and scaling are also more costly for hardware than for software.

Technology risk and complexity arise from the fact that deep-tech startups often use technologies at a low technology readiness level (TRL, as defined in *Appendix 2*). After proving a technology in lab conditions, a startup still faces a long road in turning it into a demonstrated and tested solution.

Often, stakeholders in the ecosystem—including many deep-tech startups themselves—do not properly anticipate the heavy demands on them. Half of all deep-tech startup founders who thought they would reach market in less than three years now acknowledge that they underestimated the time required.

Exhibit 3. Key challenges faced by startups



Source: Hello Tomorrow and BCG survey of 400 deep-tech startups.

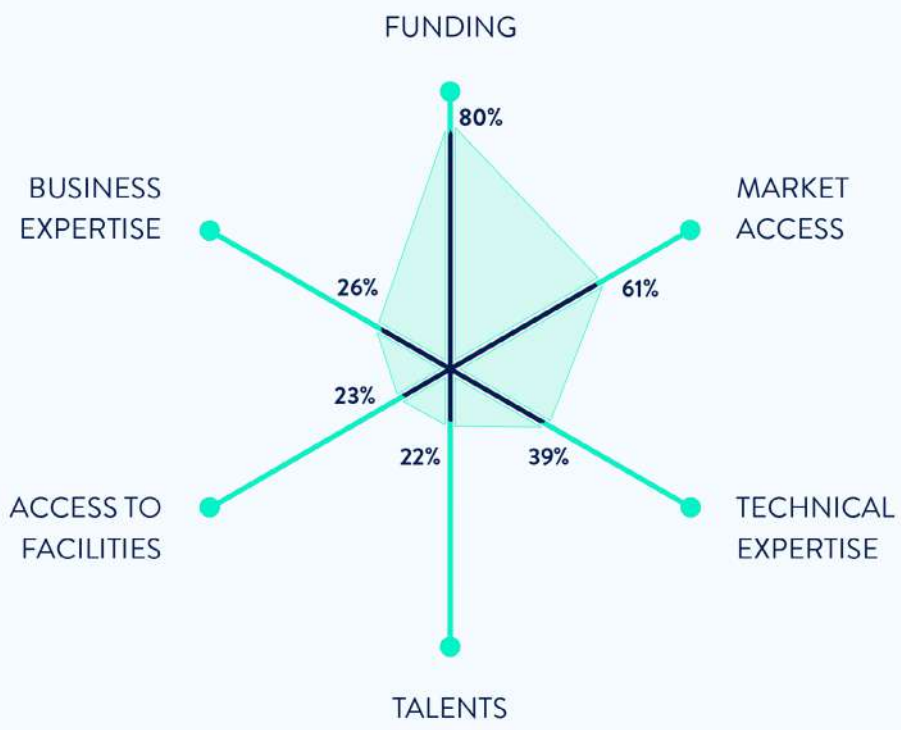
Needs: Market Access, Technical Expertise, and Business Knowledge

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Funding is the most important resource; but market access, technical expertise, and business knowledge are crucial, too, startups say, when asked about the resources they need most. *(See Exhibit 4.)*

Approximately 60% of the deep-tech startups that we talked to identified funding as their most critical resource, and 80% ranked it in their top three. But 61% of survey respondents ranked market access (a distribution network, for example, or access to a database or customer base) as crucial, 39% cited access to technical expertise and knowledge, and 26% named business expertise. Although only 22% of startups listed talent acquisition as critical, investors emphasize it when choosing where to invest, and one-third of corporates view it as one of the biggest challenges in driving innovation. As *Appendix 3* details, the perceived hierarchy of needs varies from country to country. Moreover, as individual startups move from one level of maturity to the next, their needs change significantly.

Exhibit 4. Most critical resources



Note: Importance of each resource for startups, as measured by the percentage of startups that listed the resource among their top three priorities.

Source: Hello Tomorrow and BCG survey of 400 deep-tech startups.

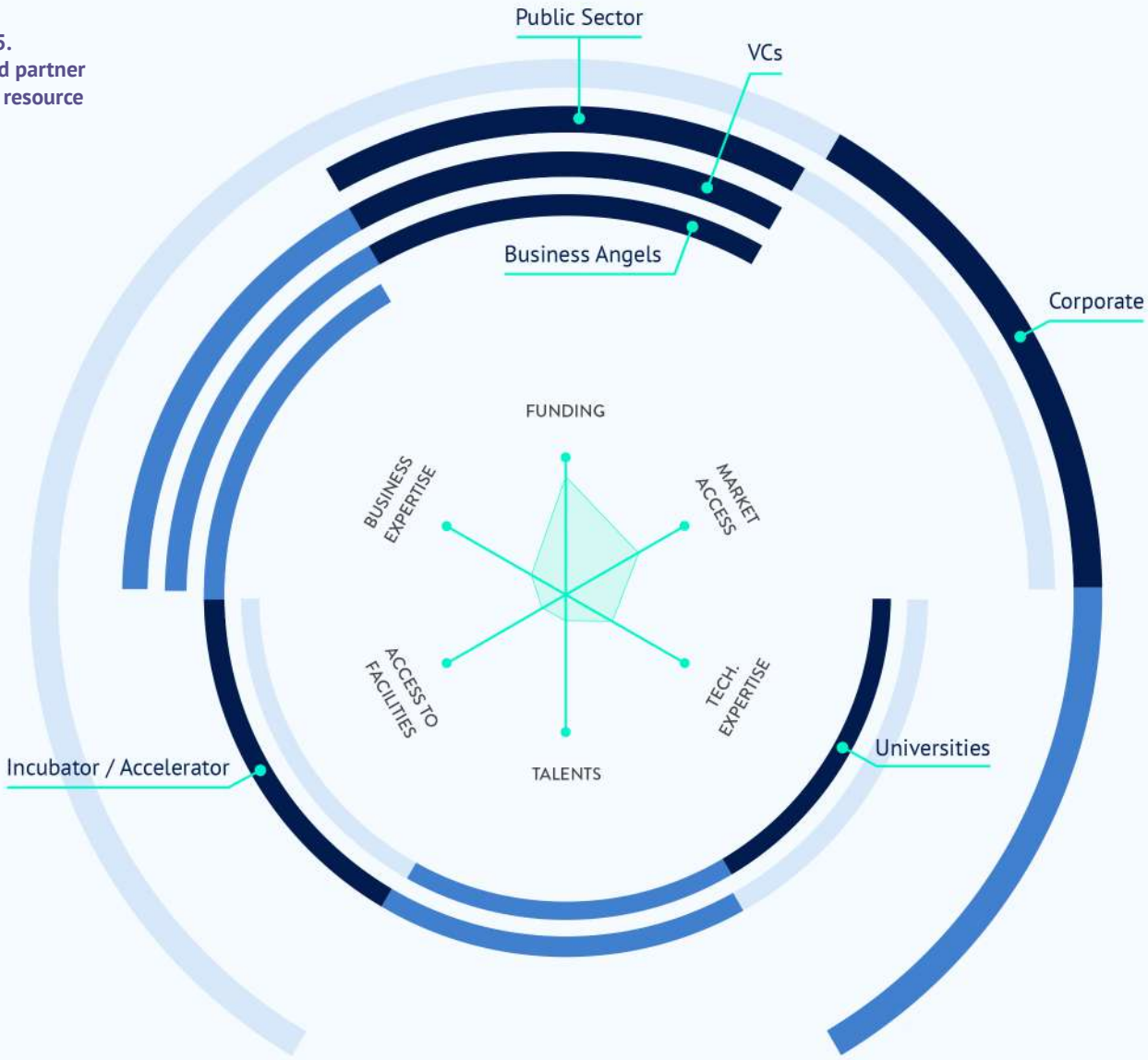
The Broad Scope of Corporate Collaborations

Deep-tech startups look for key resources through their interactions with venture capitalists and angel investors, universities, accelerators/ incubators, government, and corporates. On the deep-tech startups' horizon of needs, each stakeholder has a specific role to play. *(See Exhibit 5.)* Still, corporate partners can help startups across the widest range of activities.

Startups view corporates as potential funding channels, but they don't consider access to funding to be their primary appeal. Rather, the high value that corporates have to startups is due to their being the only actor that combines technological, market, and industrial expertise and capabilities, which deep-tech startups need to gain as early as possible but rarely possess in-house. In cooperating with corporate, deep-tech startups are aiming for access to the market (via the corporate's data, distribution network or customer base), and technical expertise.

More than 95% of startups in the survey wish to develop a long-term partnership with a corporate, and 57% of them have successfully established one.

Exhibit 5.
Preferred partner for each resource



Colored arcs show the expected scope of support from each partner. For example, corporates are among the preferred partners for every listed need except talent—most particularly, market access.



Funding
Preferred funder depends on maturity and market readiness

Public / Social Sector
Mainly considered as a funding partner

Incubator / Accelerator
Mainly offering offices, business expertise, and networking opportunities with other entrepreneurs

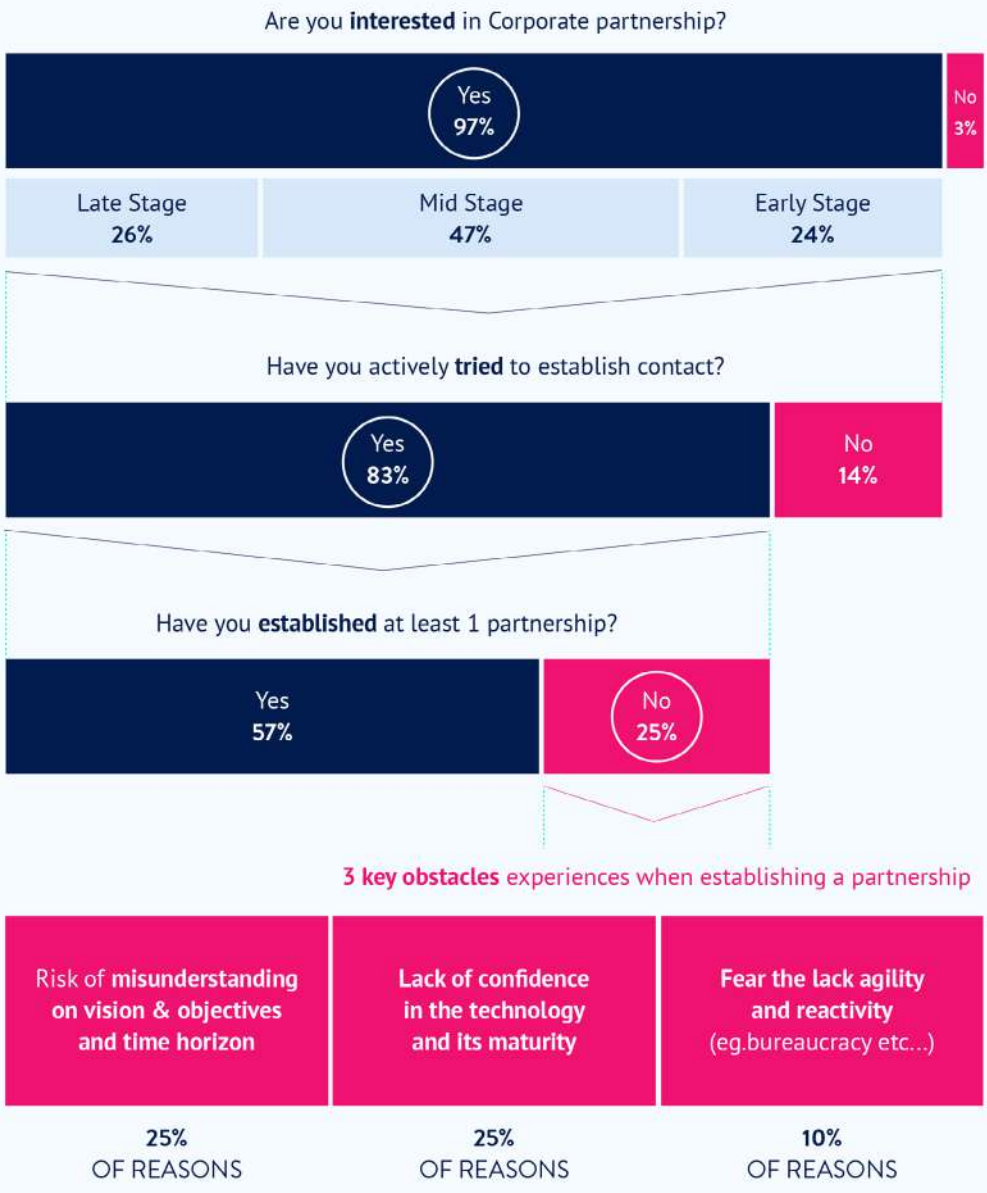
Corporates
Corporates are one of the preferred partners to support the full scope of needs

Mainly for market access and technical knowledge; funding is not at the top of startups' expectations, although corporates include it in their offer

Source: Hello Tomorrow and BCG survey of 400 deep-tech startups.

However, about 25% failed to turn discussions into real partnerships. *(See Exhibit 6.)* The main obstacles to such partnerships include lack of confidence in the technology and/or its maturity (which can be addressed through efforts to clarify the value proposition, application, or proof of concept), misunderstanding of the parties at the outset (owing to insufficient alignment of vision, or of business, knowledge, or HR objectives), misalignment of timing and processes (complex and slow decision process, or startups lost in the corporate organization), lack of a high-level sponsor within the corporate, or lack of buy-in from businesses.

Exhibit 6. 97% of startups are interested in a corporate partnership, and 57% have established one



Source: Hello Tomorrow and BCG survey of 400 deep-tech startups.

Interviews revealed that establishing partnerships is easier through indirect recommendation at early stages because that arrangement enables both parties to build trust in the relationship by engaging in free discussion, without consideration of any immediate commercial application.

Other stakeholders have more-specific areas of specialization and appeal.

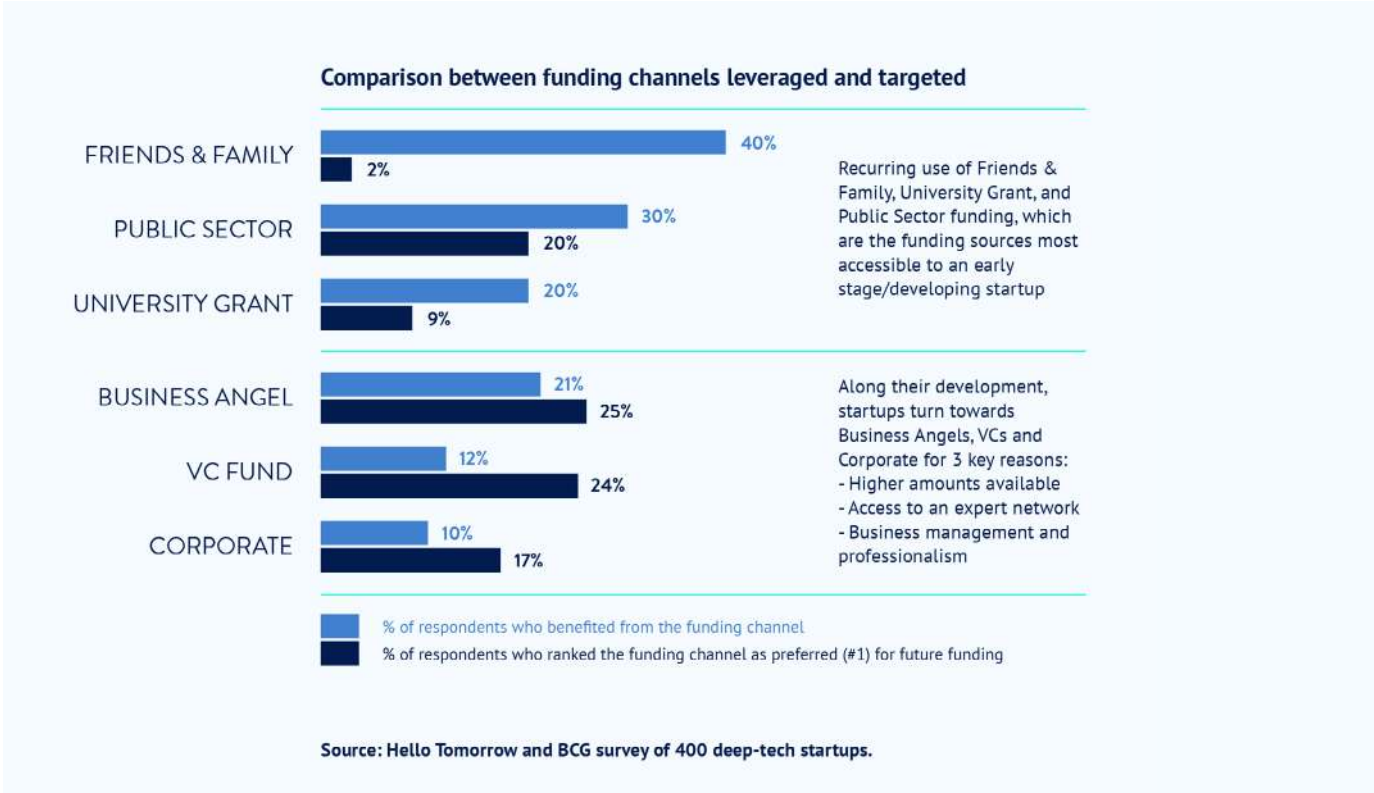
Preferred Partners for Funding, and the Role of Other Partners

Deep-tech startups seek funding from a wide range of stakeholders at different development stages of the startup. Each source provides a different quantity of funding, is willing to take different types of risks, and offers different resources in addition to funding. *(See Exhibit 7.)*

Friends and family provided seed funding for 40% of the surveyed startups that raised less than €400,000 (approximately $430,500) in equity funding, and the public sector contributed such funding to 30%, with large discrepancies between countries (from 45% for French startups to 25% for US startups).

At the second stage, startups turn toward professional funders such as VCs, corporates, and business angels: two-thirds of respondents targeted them for future funding. These sources bring business intelligence, professionalism, network access, and credibility, along with larger amounts of funding. Business angels are known to accept less mature (and therefore higher-risk) startups.

Exhibit 7. Leveraged (previous) funding channels and targeted (future) funding channels



Public sector: Funding and market access

Deep-tech startups often seek government support for initial funding, but less often for market access. Yet the application procedure and potential benefits (besides financial support) associated with public funding contrast sharply with those of early-stage-funding alternatives such as angel investor support.

Although surveyed startups did not generally view government as a go-to source of access to markets, public policies can help shape legislation and regulations that encourage the market for innovations and advance innovation use in the economy overall, provided that the policies are adapted to the startups' business model and needs.[1]
In many instances, governments also help companies access the markets—through export support programs, for example.

Business angels: Funding and business expertise

Angel investors are individuals who invest in startups at an early stage, usually in exchange for equity or convertible debt. More than 20% of the surveyed deep-tech startups said that they had benefited from angel capital, and 25% rated angel investors as their preferred funding partner.

As experienced entrepreneurs who have built successful companies and want to remain in the scene, angel investors are familiar with the field and may be especially good at identifying potentially successful companies at an early stage, having survived the ups and downs of their own entrepreneurial path.

Many angel investors actively advise young entrepreneurs, too. As mentors and advisors they provide valuable business knowledge, and offer access to their networks.

Venture capital: Funding and market access

In view of the high risk and massive investment needs associated with deep tech, VC funding is a natural choice for many startups. However, we found evidence of a recurring mismatch related to VC funding. Among startups that have not received any VC funding yet, 35% said that they considered the possibility of misalignment with regard to vision and objectives to be a key roadblock to such partnering. Still, only 20% of startups that actually had received VC funding experienced friction on the subject of vision and objectives alignment. The importance of transparency emerged as an important issue in the survey.

Universities: Technical expertise, talent, and access to facilities

Deep-tech startups tend to view universities as sources of tech expertise and talent, and to a lesser extent as places that provide access to facilities.

Universities have long pondered how to increase the knowledge transfer from their research. Today, the primary conduits are tech transfer centers; but universities can also unite alumni with current students and researchers. Accelerating those networks and fostering interdisciplinary efforts can help ensure linkage between the university's expertise and people who are building companies and looking for talent.

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[1] See Innovation Policy Platform, "Innovation Procurement Schemes," available at **https://www.innovationpolicyplatform.org/content/innovation-procurement-schemes**; Elvira Uyarra, "Opportunities for Innovation Through Local Government Procurement" (NESTA, May 2010), available as a PDF download at **https://www.nesta.org.uk/sites/default/files/opportunities_for_innovation_through_local_government_procurement.pdf**; and NESTA, 2007, "Driving Innovation Through Public Procurement (NESTA, February 2007), available as a PDF download at **https://www.nesta.org.uk/sites/default/files/public_procurement.pdf**.

Accelerators and incubators: Business expertise, talent, and access to facilities

Incubators and accelerators develop program to help startups develop, in exchange for equity or money. Incubators help startups develop disruptive ideas into a business model, while accelerators accelerate the growth of an existing company.

In interviews, startups identified visibility as one of the main benefits of partnering with incubators or accelerators, especially famous ones—a limited notion of their attractiveness that may reflect a mismatch between incubators' value proposition and deep-tech startups' specific needs. In the US, startups prefer them across a wider range of activities (50% of startups for access to facilities, 30% for talent, 25% for business knowledge, and 20% for technical expertise) than in France (50% for access to facilities, 30% for talent, 15% for business knowledge, and 5% for technical expertise).

Startup Needs, Based on Maturity and Market Readiness

-

We developed a framework to help potential partners better understand the needs and challenges of deep-tech startups, focusing on two main dimensions: the technological maturity of the startup, and the readiness of the targeted market.

As a deep-tech startup progresses from a technology bet (with no product and no clear market) to a potential quick win (with a product ready for commercialization on a well-identified market), it goes through different stages of development, each with its own resource needs and with a preferred partner to best answer them.

To illustrate this journey, we can represent startups on a matrix with two major dimensions: technology or product maturity and market readiness for the product or technology that the company is developing. *(See Exhibit 8.)*

The maturity of the startup's technology or product, represented by its TRL, is of crucial importance.[2] We can identify three main stages: early, middle, and late. The early and middle stages are research stages (with the research focused on technology during the early stage, and on the product and business model during the middle stage).
The late stage is essentially an execution stage. *(See Exhibit 9.)*

Market readiness reflects how close the product or technology is to commercial application and how advanced its existing customer base is. To gauge market readiness accurately, one must take into account expected customers but also external factors such as regulation and industry trends.[3]
Our analysis divides market readiness into high and low categories. High market readiness exists when an established market, surrounding infrastructure, and customer base are already in place for the specific technology or product.

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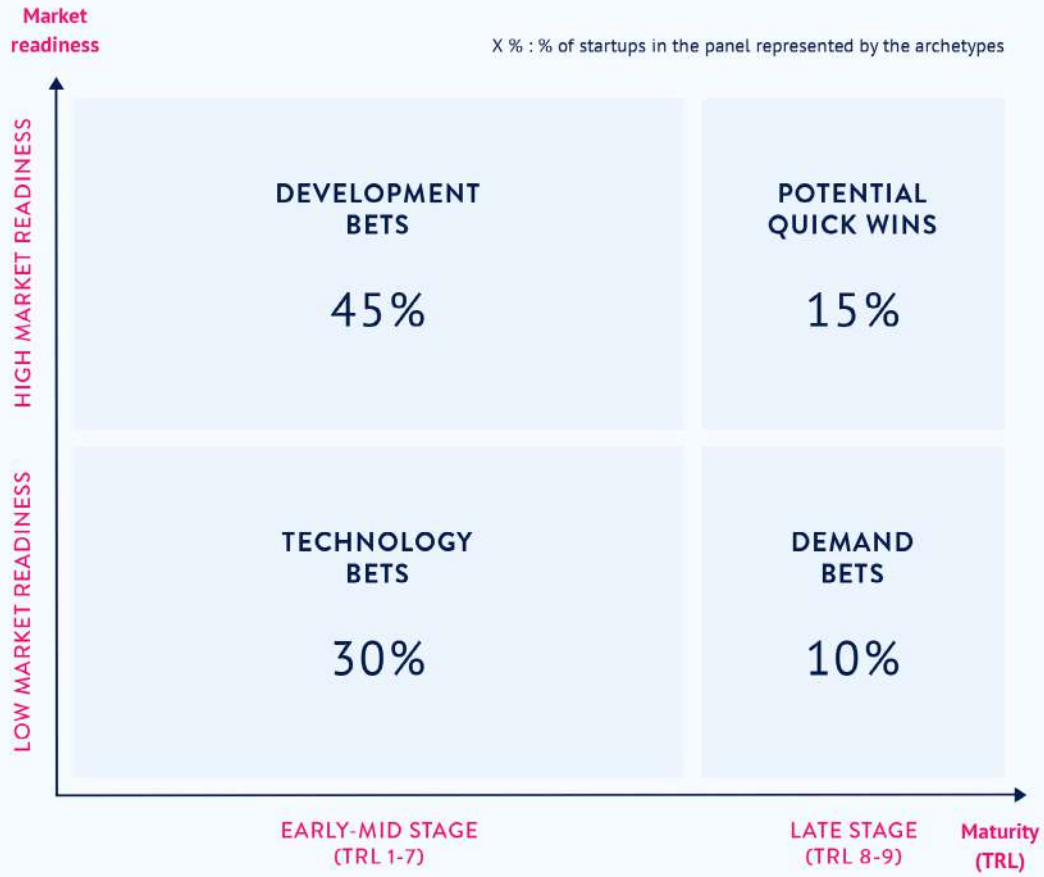
[2] See NASA, "Technology Readiness Level" (2012) at **https://www.nasa.gov/directorates/heo/scan/engineering/technology/txt_accordion1.html**. Last accessed January 9, 2017.

[3] We assessed a startup's market readiness on the basis of its answers to two questions in the survey: "Is limited commercial application a critical roadblock?" and "Is market readiness considered as a key challenge?"

Low market readiness prevails when the necessary market and supporting infrastructure for the specific technology are nascent or nonexistent, and the customer base is limited.

Exhibit 10 provides descriptions of four real-world startups—two with a high level of market readiness, and two with a low level of such readiness.

Exhibit 8. Deep-tech startup archetypes



Source: Hello Tomorrow and BCG survey of 400 deep-tech startups.

Exhibit 9. Startups maturity stages definition

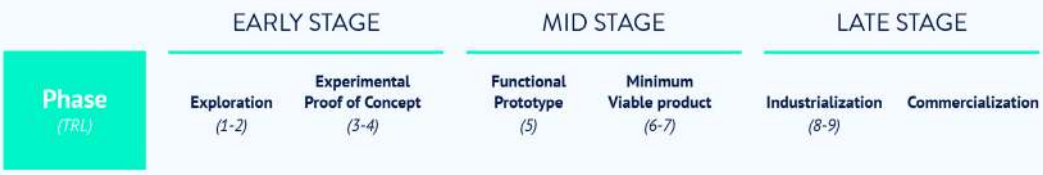


Exhibit 10. Examples of high and low market readiness

HIGH MARKET READINESS

Apeel Sciences offers pre- and postharvest coatings made from 100% plant materials derived from discarded agricultural by-products. According to Apeel, nearly 40% of fresh produce is lost to spoilage; the company's natural coatings promise a two- to fivefold extension in shelf life.

Total funding: $7 million
Select investors: Upfront Ventures, Tech Coast Angels

Ava Winery is engineering wine without using grapes or fermentation. The startup aims to disrupt high-end wines by offering bottles of chemically identical but much-lower-priced wine that is more sustainably because it uses far less water (by a factor of 50 to 100). Currently 90% of people fail Ava's blind taste test.

Total funding: $2.7 million
Select investors: Horizons Ventures

LOW MARKET READINESS

Zee Aero is a stealth startup focused on building a small, all-electric plane that can take off and land vertically. The flying car project currently employs nearly 150 people.

Total funding: $100 million
Select investors: Larry Page (angel)

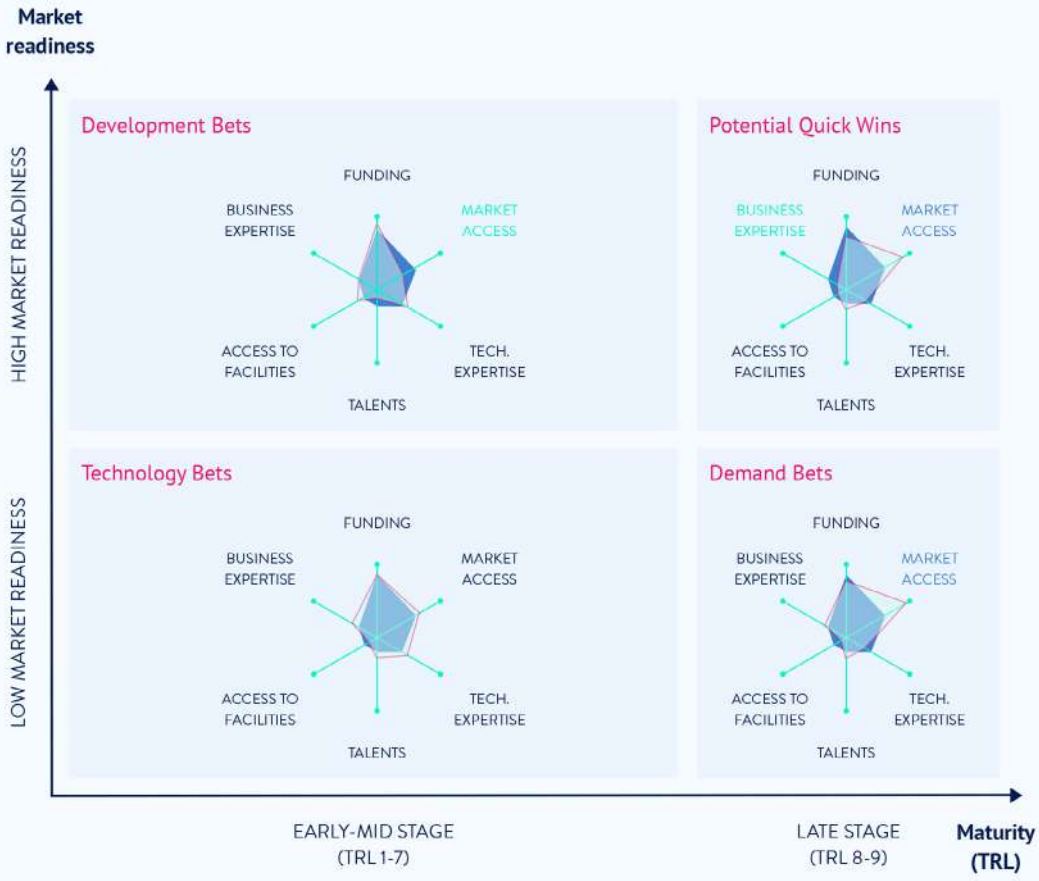
Cambridge Quantum Computing is building a quantum operating system and developing quantum algorithms, with a specific focus on quantum cryptography, for its secure currency platform. Quantum encryption techniques will become necessary because quantum computers will be powerful enough to use brute force to break all existing forms of encryption, rendering those encryption methods useless.

Total funding: $50 million
Select investors: Grupo Arcano

Source: CB Insights, Game Changers, 2015.
Available at *https://www.cbinsights.com/blog/cb-insights-game-changers/*

We have identified four archetypes for deep-tech startups of different maturity and market readiness. These correspond to the four possible combinations of the two primary variables: late-stage maturity and high market readiness ("potential quick wins"); late-stage maturity and low market readiness ("demand bets"); early- or middle-stage maturity and high market readiness ("development bets"); and early or middle-stage maturity and low market readiness ("technology bets"). As *Exhibit 11* illustrates, each of these four startup archetypes has its own critical needs.

Exhibit 11. Critical needs of the four deep-tech startup archetypes



Source: Hello Tomorrow and BCG survey of 400 deep-tech startups.

Potential quick wins

These are startups that have a commercially ready product and a market that is ready to adopt the technology or product. For such startups, the immediate challenge is to scale up (to initiate large production volumes, for example, or major PR and marketing campaigns), and they need fresh funding, market access, and talent. Among startups in this class, 40% consider VCs the preferred funding channel (versus 25% overall). VCs bring more generous funding, which startups can use to scale up their operations. To develop the customer base and the distribution network, startups often turn to corporates, although only 25% of them expect to get funding out of this collaboration. They may expect to get visibility (25%) or credibility, business knowledge, or technical knowledge (20% each).

Demand bets

These comprise startups with a product that is mature enough to be launched but that does not have a broad commercial application yet. The main challenge for these startups is to identify and create a market for their technologies. The two key roadblocks are lack of a distribution network (42% of startups in this class mentioned it as a challenge, compared with 16% overall) and market resistance to change for (37% of them cited it as a challenge, compared with 20% overall). Besides funding, their most important resource needs are market access (a customer base and a distribution network) and business knowledge, for which the preferred partners are, respectively, corporates and VCs.

Development bets
These consist of startups that have identified a market opportunity and defined a value proposition, and are developing a technology to deliver it, but have not created a market-ready product yet. They are focused on accessing technical expertise (critical for half of these startups, compared with 40% overall) and overcoming technological uncertainty (expressed as critical by 25% of them). To obtain the technological expertise they need, they consider collaborations with corporates and universities; but less than half of such startups have actually established partnerships with corporates (compared to 57% overall). Of the collaborations that startups in this class did establish, 60% were research partnerships to share the costs and risk of R&D and to accelerate the development of the product

Technology bets
These are startups that have identified a promising (though not fully developed) technology that as yet lacks a market application. Their objective is to develop a viable product and to ensure that it will efficiently answer a market need. The two chief roadblocks that startups in this class face are long development time (a major problem for 30% of them) and technological uncertainty (noted by 25% of them). Because the attendant uncertainty makes funding risky, the main sources tend to be universities and public funding. Obtaining access to corporate knowledge and support is relatively difficult for this group of startups, owing to the larger risk factor. Survey participants from this class express stronger needs on all dimensions. They need to turn a technology into a solution for a problem, and they need to develop a marketable product in order to reach the "potential quick win" stage. This entails working on both technology/product development and market identification.

Different countries, different ecosystems

Although the 400 startups that participated in our survey do not exhaustively represent the deep-tech startup community worldwide, they do capture a few trends associated with the types of businesses and technologies that have developed in different parts of the world.

In the early-stage category, the US and the UK host a disproportionate number of startups that combine developing technologies with high market readiness (40% in the US and the UK versus 20% in the rest of the world). France, meanwhile, is overrepresented by startups that have low market readiness. It thus appears that France has been successful in facilitating fundamental research and the creation of early-stage startups, but has been less so in supporting the scale-up of those startups.

Designing a Platform for Corporate Collaboration with Startups

In recent years, corporate-startup partnerships have become more numerous, with mixed results. A survey conducted by Mass Challenge and Imaginetic found that 50% of startups rated their experience in interacting with corporates mediocre or worse.[1]

In this section we propose a set of recommendations to help corporates build a framework adapted to collaboration with deep-tech startups. *(See Exhibit 12.)*

We will go beyond generic suggestions for cultural change ("bring a more entrepreneurial mindset") or communication ("send a signal of innovative company to the ecosystem") and focus on collaborations that have a practical business goal (such as turning an early-stage challenger into a business partner, or entering a new market and business model by accessing external specific skills and talent, or reducing R&D cost or time to market).
This approach amounts to a long-term journey that will improve incrementally, for corporates that start small but continually adjust and expand as they learn from earlier experimentations. To enhance this learning process, corporates should implement key performance indicators (KPIs) and focus on tracking results (such as number of proofs of concept co-developed), not only on actions (such as number of startups entering the program).

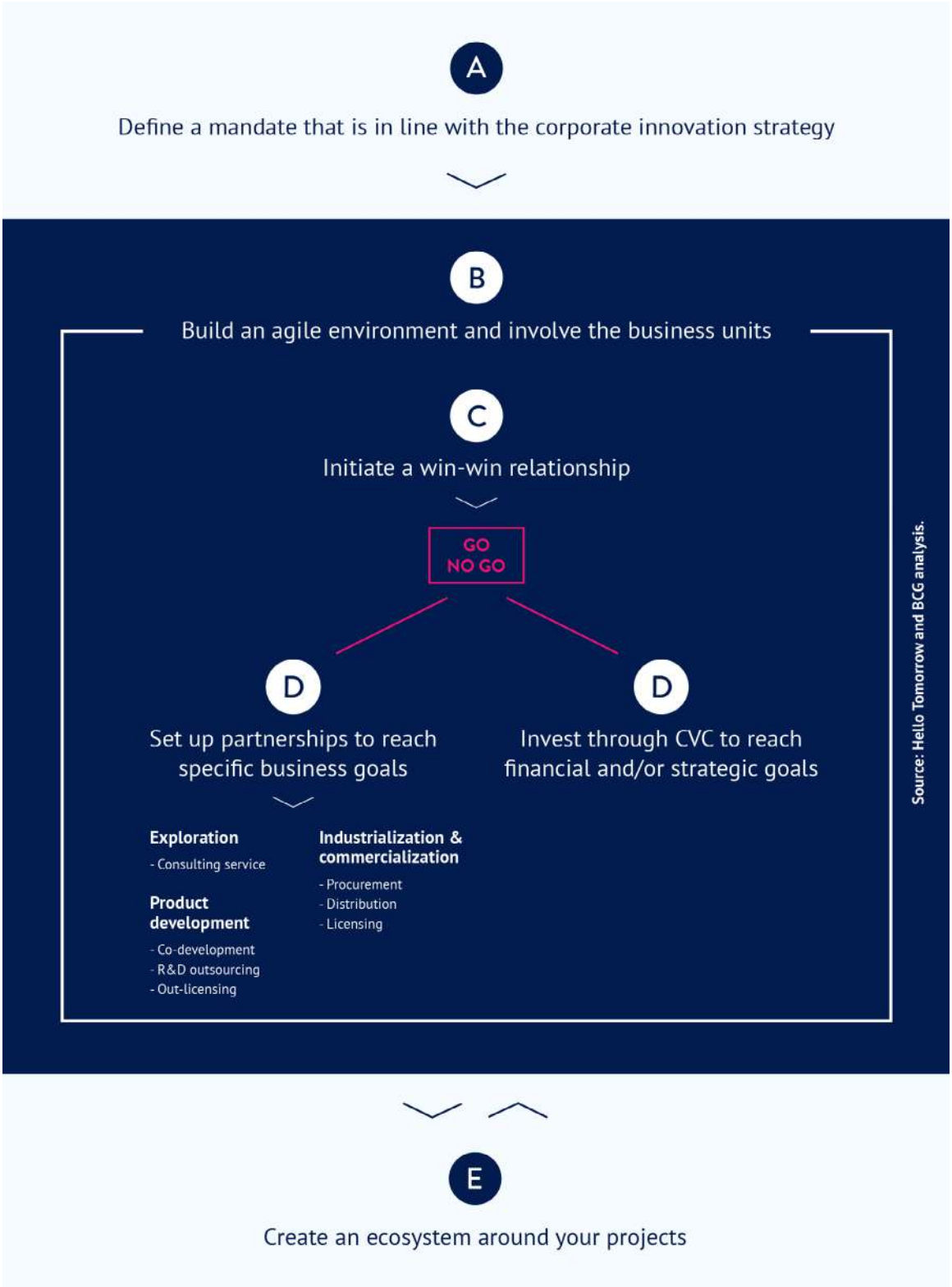
The first step is to define a clear mandate for collaborating with startups *(A, in Exhibit 12)*. Once the objectives and R&D fields are clear, corporates need to develop their own platform reflecting the relevant objectives but also the internal resources and maturity of the organization, starting by creating an agile environment and facilitating business units' involvement (B). The next step is to initiate the relationship (C), emphasizing from the outset the importance of transparency on both sides with regard to the objectives. At the next level, two options are available: a partnership focused on R&D or commercialization (D.1), or investment through CVC (D.2). For the partnership option, if defining a standard process is impracticable, the corporate

[1] See Imaginatic and Mass Challenge, "The State of Startup/Corporate Collaboration 2016."
Available at **https://cdn2.hubspot.net/hubfs/1955252/SCC_2016/Startup_Corporate_Collab_2016_Report.pdf**.

should identify key success factors for each collaboration stage before entering the relation or advancing to the next stage. The CVC can turn the startup into a sound business partner, and access publicly unavailable information about the company and the market. Finally, those collaborations should aim to create an ecosystem and not merely one-to-one relationships (E).

As for startup sourcing, many options exist for accessing thousands of startups. The more serious issue is how to cut through the noise than how to access a large deal flow.

Exhibit 12. Framework to collaborate with startups



Define a Clear Mandate

To ensure sponsorship, it is important to define the platform mandate so that it aligns with corporate innovation strategy.

Companies interested in collaborating with deep-tech startups must find an appropriate balance between internal sourcing of innovation, using company's own capabilities (R&D, internal idea contests, and innovation labs) and external sourcing of innovation (including partnering with startups).

Four issues in particular need to be addressed, through a mix of strong leadership (to ensure consistency) and a bottom-up approach (to retain the agility to adjust to unanticipated opportunities on the field):

- **Innovation objectives** from the corporate perspective, which may focus on one or more of the following: strengthening the core business; expanding into adjacent areas related to current business; and exploring and preparing for future entry into currently unrelated business areas
- **Search fields** and associated innovation domain priorities
- **Maturity profiles** of the startups that the corporate entity wants to partner with (early stage, middle stage, or late stage)
- **Required resources** (dedicated budget, people, and so on) for delivering the platform mission

Once the mandate objective is clear, corporates should develop a platform based on this objective and on the existing internal resources and maturity of their organization, as to both hard aspects (such as processes and KPIs) and soft, cultural aspects (such as willingness to accept a solution invented outside the company, to accept risk and failure, and to collaborate with startups as equals).

Adopt an Agile Environment and Involve the Business Units

Startup incubators (to help a startup identify its business model) and accelerators (to accelerate the startup's growth) owe their popularity in large part to the success of Y Combinator and Techstars (founded in 2005 and 2006, respectively); they reached corporate in the early 2010s. Successful programs in software companies such as Microsoft helped spread the concept in the corporate world as a way to engage with startups, and today 44% of large companies are using internal or external accelerators and incubators.

Corporate partners should be cautious, however, about applying any turnkey solution. The model works for large international ICT companies that leverage the scale effect of large batches of startups following a similar development cycle, requiring similar mentorship, and helping each other. But the model is not suitable for most companies, especially in the area of deep tech, where different needs and development paths may prevent participants from benefiting from the scale effect of large batches.

Embracing a standard methodology may also veil serious problems in need of fixing. The better strategy is to focus on agility and on engaging relevant people at the top management, project management, and operational levels. The optimal approach to take depends on your organization, your objectives, the number and profile of startups you want to work with. You can delimit this environment within your organization by treating it as a special function. Alternatively, the environment can be a set of transverse

processes, KPIs, and identified points of contact for startups that also have decision power, may be fully internal or rely on external organizations, and may or may not operate in a coworking space.

Once in place, such a set-up can be leveraged as a place for "intrapreneurs" to develop projects within the organization but insulated from business-as-usual processes and KPIs, and in contact with other entrepreneurs.

Ensure lighter, faster processes

To improve their interactions with small and agile startups, corporates should tailor their internal processes to handle more-agile interaction, or they should create parallel processes and dedicated staff so that the rest of the organization can remain focused on business units. The most important processes to adapt are procurement (to register startups as official suppliers, in order to pay them faster, since cash flow is so critical for them), legal (with the goal of signing a memorandum of understanding quickly, to avoid burdening startups with legal technicalities), and financial (once again, to be faster).

Set up adapted governance to ensure fast-track decision making

Top management can oversee relationships with startups when it has reached a critical level, to ensure that the framework aligns with corporate goals and receives full management buy-in. *(See Exhibit 13.)*

Engaging business—a critical task—should be based on a network of identified

Exhibit 13. Examples of governance options for driving a program to collaborate with startups

	KEY MEMBERS	KEY RESPONSIBILITIES	MEETING FREQUENCY
1 STEERING/ EXECUTIVE COMMITTEE	- Responsible board member(s) (sponsor) - CVC Managing Director - BU head(s) - Head of Corporate Controlling - Head of Corporate Development	- Define overall **venturing strategy** - Assess relevance of BU **searchfields** - Regular **performance review** of portfolio	- Meetings per year 2 x
2 INVESTMENT COMMITTEE	- CVC Managing Director - CVC Investment Manager(s) - BU head(s) - Corporate Controlling	- Decide on **single investments** - Regular **performance review** of investments - Decide on **exit timing and exit strategy** (spin-off/spin-in)	- Meetings per year 4+ x - Additional ad-hoc meetings for each investment decision
3 OPERATING COMMITTEES FOR EACH BU	- BU team (R&D, S&M, Controlling) - Ambassador of Guardian BU - CVC Investment Manager	- Define operating milestones and **monitor performance** - Ensure continuous **knowledge transfer** and cooperation by channeling information - Ensure **operating support** from corporate and BU functions to start-up	- Meetings per year 12 x - Further ad-hoc meetings as required

Source: Hello Tomorrow and BCG analysis.

and dedicated experts and champions throughout the business who can serve as project managers for the collaboration. Immersion programs enable corporate talent to work for innovative startups temporarily. The startups benefit from the corporate participants' knowledge of strategy, marketing, communication, and so on. Corporate, meanwhile, enriches the curriculum of its young talent and fosters internal cultural change toward entrepreneurship. Examples of such efforts include Telefonica's Open Future Program and Accenture's Fintech Innovation Lab.

The ability to engage operational people on top of their daily business KPIs promotes the right level of commitment. Reviewing HR policies to better take such specific objectives into account within incentives (with no short-term profit-and-loss impact), and to secure specific time slots for a target population of managers is another positive step.

Derisk the technology before involving the business operationally

One aspect of insulating the deep-tech startup collaboration from business-as-usual processes involves protecting the business from the risk of the collaboration at its earliest stage. One useful approach is to set up a team to steer and derisk projects for a defined period without putting the whole business at risk—until they can safely be handed over to the business.

Give startups easy access to corporate resources

Corporate should identify the capabilities it has that a startup can leverage through the cooperation (data, customers, network, business knowledge, facilities, mentors, technical experts, cash flow monitoring, and so on), and when possible allow startups to navigate relatively freely through these corporate resources for a specific period of time, under a protective data usage policy. Besides helping a startup become a potential business partner, giving it access to internal resources can help spread an entrepreneurial spirit in organizations and valorize sleeping IP, among other possibilities.

Adapt KPIs to track long-term results, with a portfolio approach

Successful innovators use strong processes to review projects in development and to ensure their timely completion. But collaboration with startups requires different processes and KPIs, and most corporates struggle with this, especially when the collaboration is tangential to the core business.

The right balance between financial and strategic metrics will depend on the collaboration mandate and should reflect the maturity of the startup (measuring knowledge acquisition in early technology stages and financial impact in late maturity stages). It cannot be 100% financial (such an orientation would lose the innovation objective) or 100% strategic (financial impact must be considered at some point).

The KPIs should be clear from the outset, and corporate should share the reporting with the startup and within the company through regular communication.
(See Exhibit 14.)

Foster the right mindset

Changing the hard side of the organization (governance, processes, and KPIs) is not enough. The culture and mindset of the people working with the startups must change, too, to recognize them as valuable partners. Possibilities for fostering cultural change (shared events, an ideas contest, and a mentorship program, for example) should be discussed with the HR department

The cultural gap is different for every company, but it makes sense to begin with an assessment of the current stage of the mindset.

Exhibit 14. Examples of balance between financial and strategic metrics



Source: Hello Tomorrow and BCG analysis.

Initiate a Win-Win Relationship

-

Before structuring the relationship, corporates should consider entering a less formal relationship, with limited commitment on both sides, leveraging the collaboration platform so the startup can demonstrate its potential as a business partner, clarify what it has to gain in the partnership, and test the team's complementarity. This process should function only as a temporary transition, however. Clear, ad hoc milestones for assessing how and when to decide whether further deepen the relationship should be defined quickly, using a go/no go approach with flexible timing. Several practices can be very helpful:

- **Share a common objective.** One major pitfalls that both startups and corporates report is the lack of transparency and alignment on a clear common goal from the relationship's beginning, leading to wasted time or painful renegotiations. Both parties should be transparent about

their real objectives, and if possible they should jointly define the desired endgame (who does what, who pays what, and who owns what).

- **Address IP rights and exclusivity upfront.** Ironing out who owns the IP, whether there is any exclusivity, and so on, will establish the basis for a successful future business relationship.
- **Find short-term wins.** Short-term projects help parties quickly challenge and improve the value proposition, test the complementarity of the startup and corporate teams when working in project mode, and build momentum through a short but intense period. It also helps bring financial resources to the startup prior to emergence of the final product and market.
- **Agree on a common roadmap with clear milestones.** Such a roadmap allows parties to define together the most efficient path to the common goal, and each milestone offers the opportunity to confirm or change the next milestone, go to the next level, or stop the relationship.
- **Review the target and roadmap regularly.** Agility is especially crucial in exploratory relationships driven by an opportunity (for example, both parties want to explore the potential applications of a technology) rather than a clear goal (for example, the corporate wants to find a supplier for a specific product or service).
- **Pay attention to startup cash flow.** Both parties must pay attention to cash flows. We observed that many startups sank because of bad cash-flow planning.
- **Design a suitable contract.** The goal is a contract that ensures alignment of interests and fair repartition of the value created.

Move the Collaboration to the Next Level

-

At some point the corporate and the startup must decide whether to move the collaboration to the next level to reach specific business or financial goals, or stop. The relationship should remain in the dedicated "agile environment" unless the startup is mature enough to function as a normal business partner capable of handling business-as-usual processes. Consequently, the corporate should continue to apply all of the key success factors discussed previously.

Several types of partnerships can be leveraged to reach specific business goals, each complemented by investment through the CVC arm to help the startup growth faster, and to participate on its board. *(See Exhibit 15.)*

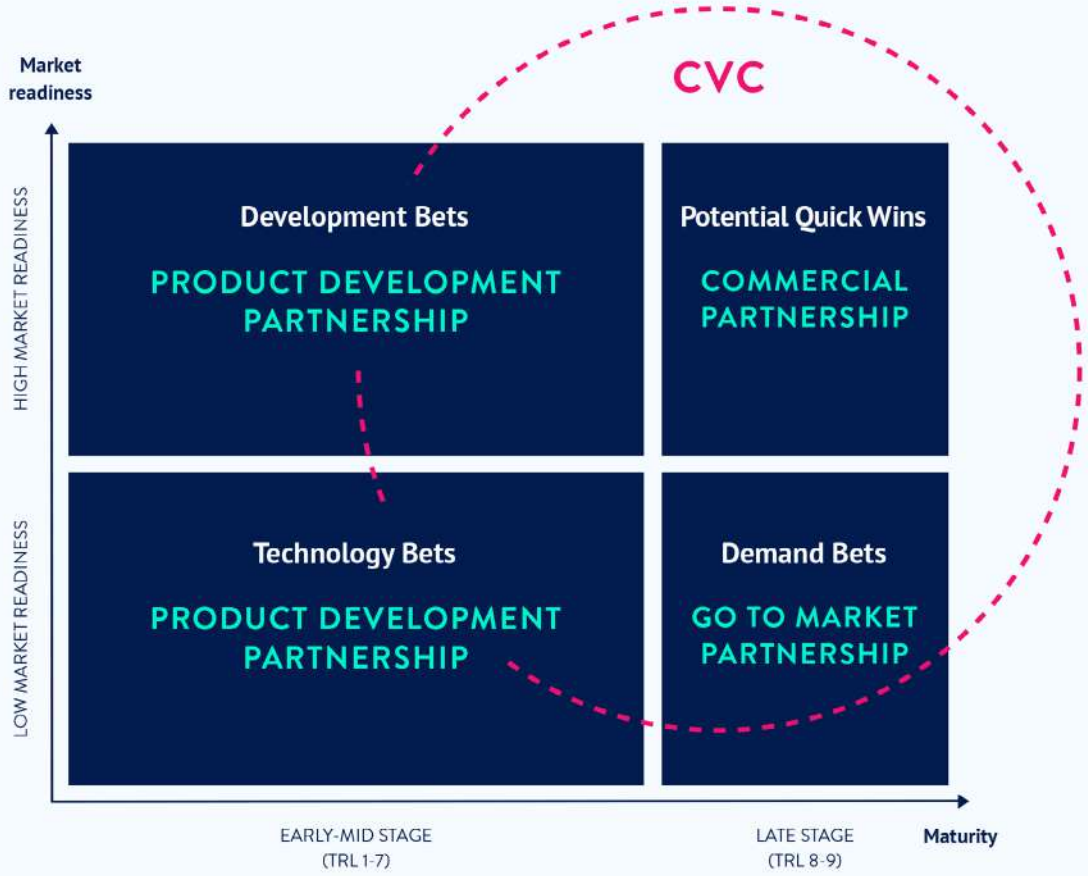
Set up a partnership to reach specific business goals

Corporates can set up partnerships with startups that identify a clear business goal for both partners. The nature of this partnership generally depends on the objective and on the maturity of the technology or product that the startup is developing.

At the earliest stage, consulting services allow the corporate to pay for R&D and to derisk the technology before engaging further.

When the technology or product becomes more mature, corporates can more easily assign internal staff to work on product co-development, where the corporate and the startup join forces with a dedicated budget, a clear time frame, and clear goals. Other product development models include R&D outsourcing (in which the startup

Exhibit 15. Most frequently used partnership for each deep-tech startup archetype



Source: Hello Tomorrow and BCG analysis.

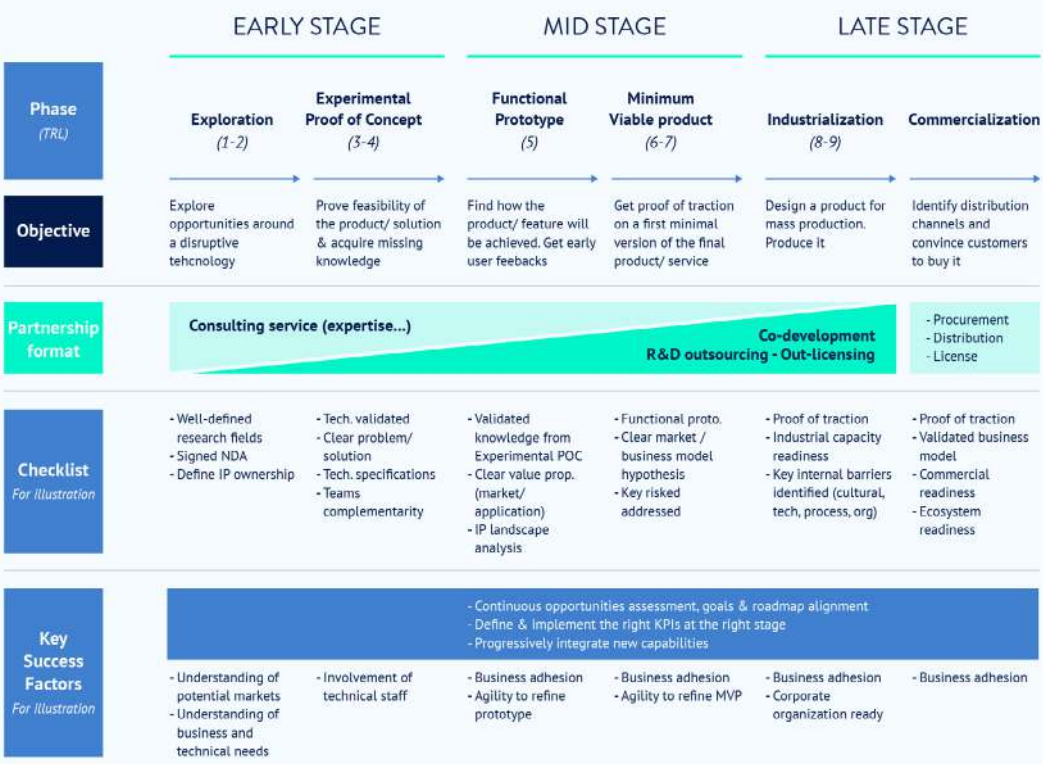
develops a product for the corporate) and valorization of corporate knowledge in the startup (in the form of out-licensing, spinoff, or intrapreneurship).

At the most mature stage, when the product is ready to be sold, commercial partnerships are possible. A procurement partnership allows a startup to procure products and services from within the corporate to meet particular needs. Such a partnership can enable the startup to scale up and get the credibility to convince other corporates to work with it. A distribution partnership is an arrangement in which the corporate leverages its marketing capabilities, customer base, and marketing power to distribute the startup's product or service, and accelerate its revenues. A licensing agreement permits the corporate to license the startup's IP while selling the product, or the other way round.

Once again, it is not possible to define a standard format or process from go/no go to end game that is suitable for all situations, but corporates should identify a framework for collaborations at each maturity stage, including a checklist to help validate go/no go at each stage gate, and a knowledge and skills framework for each stage.

The illustrative framework in *Exhibit 16* is a tool to help decision making, not a standard process. Corporates should fined-tune it to reflect their objective and capabilities.

Exhibit 16. Example of framework that can be developed to guide collaboration with startups



Source: Hello Tomorrow and BCG analysis.

Weigh the value of an exclusivity-based relationship

Many deep-tech startups cite exclusivity as a major concern. An exclusivity-based relationship limits the startup's exposure to other stakeholders in the ecosystem, hurting their chances for success. Evidence shows that more connectedness—with regard to number of clients and number of partners—correlates with greater success. The best practice might be to introduce the startup's solution to other (noncompeting) corporates; the knowledge that the startup gains from these other organizations will often benefit the original collaboration.

In specific instances, corporates that choose to pursue an exclusivity-based strategy should be prepared to limit the reach of the exclusivity agreement to a specific market or geography and period, to condition exclusivity on collaboration milestones, to offer startups specific and advantageous conditions in return for accepting this mode of cooperation, and to focus such request on late-stage startups.

Leverage corporate venture capital to reach financial and strategic goals

Many people consider CVC the cornerstone of corporate efforts to access external innovation, although startups more often look to corporates for market access and technical expertise, than for funding. CVC funding can occur internally through a CVC fund or externally through investments in a venture fund not directly tied to the company. Financial returns are an important factor in both approaches, but the two options' strategic benefits differ.

Besides supporting a potential business partner, the CVC model can be a powerful lever for aligning the strategies of the startup and the corporate, and for obtaining otherwise unavailable information about

the startup and its market by establishing an intimate relationship with the startup's management team.

By sitting on the startup's board, the corporate can influence its strategic decisions. It is important that those decisions support the startup's development—to advance the startup's financial and strategic value and to enhance the CVC's reputation of the CVC, which will strengthen its ability to attract the best startups and co-investors.

Investing in a startup and having a seat on its board enable the corporate to create a more intimate relationship with the startup's management team, which becomes a sparring partner and a source of information unavailable to companies that invest in external funds but have no direct relationship with the management board.

CVC investment can create corporate involvement during the due diligence process prior to the deal, and afterward, by giving visibility to the partnership internally; but this should not be the primary objective.

The external model does not require special in-house capabilities and is more relevant when a company would like to explore opportunities in new spaces that it has little knowledge about. The model can apply to a broad range of deal flows involving limited partnerships, with the opportunity to diversify in several funds using the same total investment that would have gone into a single CVC fund. It also allows the corporate to leverage experienced VC funds' contacts and develop close ties with VC firms to quickly gain access to deal flow and become visible in the VC community.

Our survey results indicate that the needs of deep-tech startups go well beyond funding. As investors, corporates can play a key role in helping startups develop a robust business plan. The corporate investor trains a business lens on the startup's product and identifies a sustainable model to monetize it. Beyond that, corporate may combine CVC investment with one of the partnership models defined above.

Key questions for corporate partners

The central question from the corporate perspective is, "How can we make a partnership work?" But a thorough analysis of the situation will entail addressing the following questions as well:

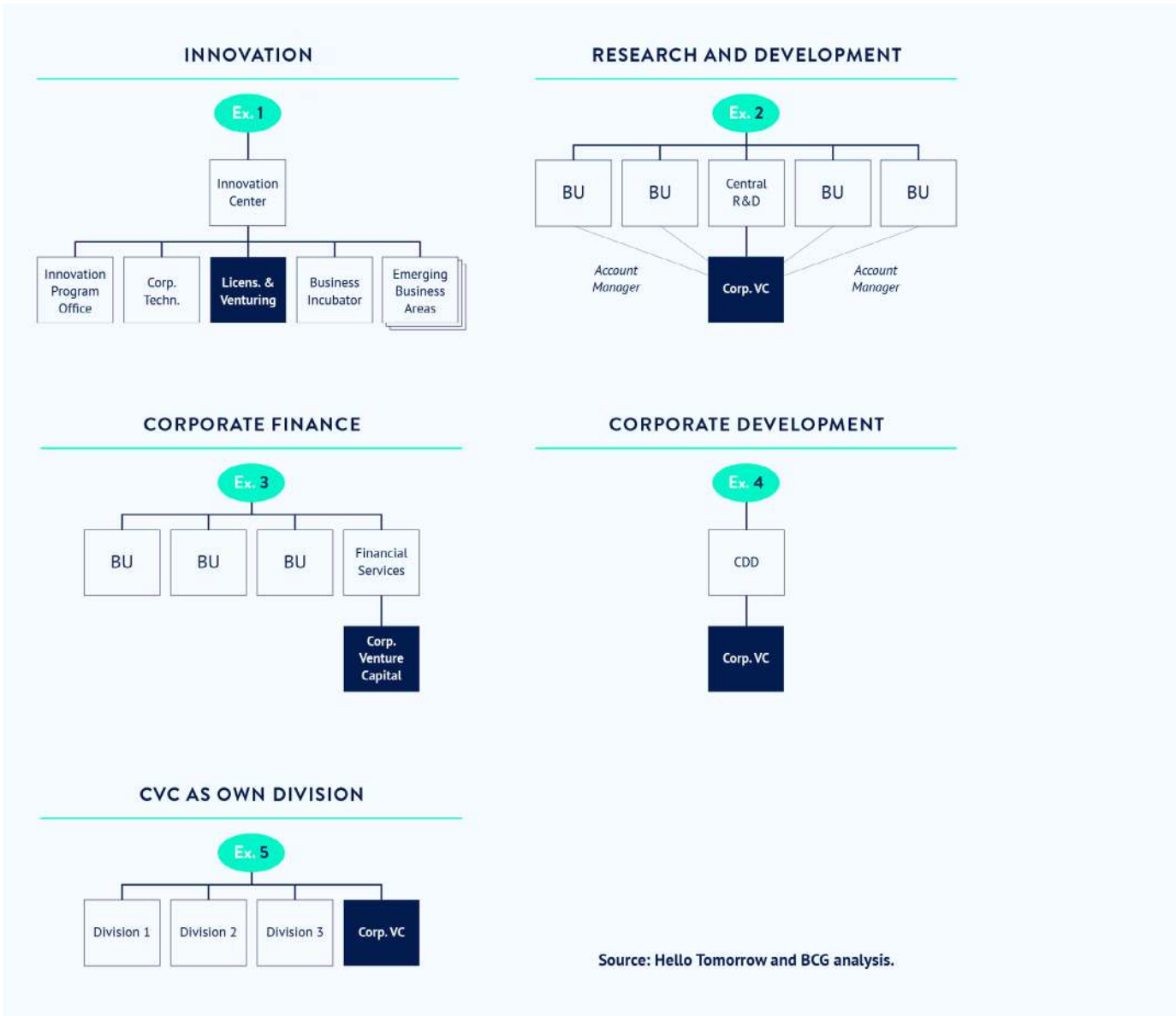
- **What are our objectives with regard to CVC?**
  Strategically oriented CVC and financially oriented CVC have different operational goals. In a strategic orientation, CVC investments reflect the corporate's strategic goal (develop the core business, extend into adjacent activities, diversify into a new area, or source innovation externally). In a financial orientation, the primary focus is a financial return on investment, as is the case with traditional VCs. A recent BCG analysis ("Corporate Venturing Shifts Gears," BCG article, April 2016) found that, in a sample of 83 CVC units from major companies, 66% were strategy focused—although positive RoI remained a prerequisite—and 34% were financially oriented. The latter often involve late-stage startups with proven products or scalable.

- **Who defines search fields within the corporate?**
  Search fields may be defined by the corporate center or by the company's business units. Definition at the corporate level is appropriate for focusing investments on innovations that could create new businesses or significantly disrupt core business. Definition at the business unit level, in contrast, is particularly suitable when the objective is to reinforce current business lines or to develop adjacencies.

• **Which entity should be the organizational home for the CVC unit in a direct CVC situation?** Corporates can base CVC units at different levels of the organization, most commonly strategy or R&D. Generally, the department that hosts the CVC unit should possess relevant technology skills and market know-how in the search fields of interest and should be able to ensure close cooperation with business units and key corporate functions. *Exhibit 17* presents different examples of organizational structures that include a dedicated CVC unit.

• **How many deals do we want to source?** CVC makes little sense if the goal is to source only a few deals. The corporate must adapt its resource allocation according to this ambition—bearing in mind that BCG analysis of various CVCs has determined that, of all business plans received, only 0.5% reached the investment stage. At that rate a corporate would have to screen about 700 business plans to close three or four investments.

Exhibit 17. Organizational structures of leading corporations with dedicated CVC units



Source: Hello Tomorrow and BCG analysis.

• Can CVC be a way to prepare for future acquisition?
CVC investment can pave the way for future acquisition from the M&A department. The corporate may build in special rights, such as right of first offer or right of first refusal, to secure an option for future acquisition, but again the corporate must be careful to avoid jeopardizing the startup's development, and the CVC's reputation. In particular, it should not use its right of first refusal to reject all offers for other companies. On such issues, a strategic misalignment between corporate and startups can easily emerge.

• When and how fast should we integrate a startup within the core business?
If the startup is at an early stage and the corporate wants to buy only the team or the technology, it can do so without delay. If the startup is still at the stage of searching for or refining its product or business model, however, it should stay independent in order to retain its agility—a crucial advantage at this stage. Integration into the corporate should occur only when the startup has reached a stage of development at which the corporate processes and organization will be not a hurdle, but a lever to increase the speed and quality of industrialization and commercialization. The corporate must assess whether to integrate the startup gradually or quickly. Interviews with different stakeholders suggest that integration should proceed at an unhurried pace, with due regard for the startup's level of maturity.

Create an Ecosystem Around Your Projects

A corporate should not limit its relationship with a startup to a one-to-one relationship. Making it part of a broader community engagement with other startups, companies (not direct competitors), investors, suppliers, customers, and scientists will help build a connected ecosystem that can accomplish several things:

- Balance the risks in a portfolio of many startups.
- Increase the platform's visibility in order to attract key actors (including startups, investors, public authorities, and others).
- Get a better understanding of the ecosystem through a broad scope of technologies.
- Enable startups to help and mentor each other.
- Propose a more complete value proposition to startups that will help the corporate attract startups from a broader range of domains, geographies, and levels of maturity.
- Acquire enough weight in the industry to impose new standards.

Questions to Answer Before Building a Collaboration Platform

Corporates should assess their situation carefully before committing to building a collaboration platform. The following questions, in particular, are important to consider:

• Do we have the necessary internal capabilities and market experience to

support our collaboration platform, or should collaboration proceed externally?
Developing a structure internally requires know-how, reputation, and market experience. Many companies prefer to partner with existing incubators or accelerators, or provide simple mentorship. When defining its goals, a corporate must be aware of the organization's internal capabilities and cultural mindset.

• Which function should oversee collaboration with the startups?
The answer to this question should reflect the TRL of the startup's product or service, and its proximity to the core business. Collaborations with low-TRL (not mature) startups far from the core business might be in a dedicated function such as R&D or open innovation, while collaborations with high-TRL (almost market-ready) startups close to core business should be in the business units.

• Should we have a dedicated physical place (coworking space)?
Whether to set up a dedicated working space depends how close you want the corporate to be with the startups. If the two entities' interaction will involve nothing more than a few meetings per month, you don't need a physical place, although a short but intense collaboration period might be useful to create momentum and build cohesion. If corporate and startup staffs need to work closely together (for product co-development, for example), a physical place is important.

• If we decide to have a physical place, where should it be?
When deciding where to set up a physical collaboration space, corporates should focus on two key factors: a location where the company can source many and high quality startups, and a location near the company's office. A number of corporates that have decided to develop an in-house coworking space have opted to locate it in a widely recognized innovation hot spot, such as Silicon Valley, London, New York, Boston, or Tel Aviv, putting them in close proximity to vibrant startup ecosystems. Other corporates have considered geographical closeness more important and have concentrated their collaboration and acceleration activities near their corporate R&D units or within certain target markets. This physical proximity facilitates a closer relationship and easier interaction between the startups and the core businesses. Either way, corporates should make an effort to source globally, to improve the quality of the startup's pipeline.

Scouting Deep-Tech Startups

When the goal of startup scouting is innovation monitoring, the central need is to transform a large amount of data into valuable information.

On the other hand, if the goal is to find new business partners, the crucial task is not to access a large deal flow but to identify the right startup—developing a solution that meets a business's or client's needs by combining with a good team, a proven technology, and a level of maturity that is compatible with the corporate's objectives.

Corporates have numerous opportunities to learn about emerging technologies and to scout startups, although few focus on identifying complementary deep-tech options.

Own network: Connections with peers, investors, incubators, and startup networks offer an excellent (and natural) way to learn about the most promising projects. Having a central role in the relevant ecosystems boosts this natural deal flow, and communicating your challenges and strategic objectives increases the value of your position.

Startup challenges: Corporates can organize competitions of this sort internally or externally. Organizing your own competition may be a useful way to initiate a cultural shift and to target specific topics. But large independent competitions will attract many more startups, since they can connect startups with many stakeholders and can bring additional benefits such as cash and visibility for the winners.

Events: These comprise deep-tech summits, research conferences, meetups, and various training and private events. Every opportunity has its own unique mix of features.

- Deep-tech summits: These gatherings have the advantage of bringing together a wide range of actors. They facilitate opportunistic encounters for corporates interested in reflecting on the future of their industry, and in widening their perspectives by identifying emerging trends. Given the many people, organizations, and topics at these events, it is important to prepare meetings in advance to ensure meeting the right people.

- Smaller and more personal events: Events with fewer than 100 participants tend to be more focused, which makes them more accessible to early-stage

companies that are ready to share their ideas with a limited set of people.

Online platforms: Startup platforms and professional networks are useful for identifying specific people and organizations. But the information that most platforms provide is automatically crawled on public sources—and that information tends not to be detailed enough to allow corporates to gauge whether to invest time in meeting the startup, especially in the case of early-stage deep-tech startups. Rarely will digital connections alone lead to landing a deal.

Scouting services: Some actors that organize competitions or events offer scouting services as well, leveraging their knowledge of their ecosystem to match corporate needs to the most relevant startups.

Corporates use in-out sourcing or out-in sourcing to scout for new ideas and for startups to collaborate with. Each method focuses on events and locales adapted to particular sourcing targets. *(See Exhibit 18.)*

Exhibit 18. Events and places that match different sourcing targets

	OBJECTIVE	TARGET	BEST OPPORTUNITIES
In-out	File a specific internal need, usually coming from business units. In this case, the business application of the technology is clear, and the scouting activity consists in finding the best fit for a specific need.	Specific technological solutions made by middle and late-stage startups that have a ready technology	- Startup challenges - Small events with specific themes - Online platforms - Tailored scouting services
Out-in	Identify emerging innovation trend and bring them inside the organization. In this case, a concrete and specific application may not be ready yet, and the sourcing/ innovation department must predict the startup's idea potential and applicability within the organization - and then must sell it internally.	New technologies and emerging trends made by early- to late-stage startups	- Deeptech summits - Innovation labs/incubators - Deeptech blogs and media - Tailored scouting services

Source: Hello Tomorrow and BCG analysis.

Conclusion

Often corporates are eager to get a collaboration program rolling as soon as possible. But developing a smooth-functioning collaboration is challenging and requires careful, methodical attention to proper assembly. The best advice is to start conservatively and focus on the core business needs of both the startup and the corporate; this ensures team mobilization from the outset and enables the participants to improve the setup progressively and to explore new territory as the business evolves and matures.

On the corporate side, major elements of the process include assessing the startup's needs (including, crucially, the maturity and market readiness of its product) and designing a platform for collaboration between corporates and startups (including adopting an appropriate mandate, establishing an agile environment to deliver operational support, ensuring business buy-in, and setting up a flexible end-to-end approach to monitor collaborations). Startups, meanwhile, must carefully assess the type of collaboration that is most suitable to their stage of development, and must ensure that their culture and that of their prospective corporate partner are compatible during the immediate process and long term.

About the autors

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Rodolphe Chevalier is a Principal in the Paris office of the Boston Consulting Group. He's a member of the Public Sector and Financial Institutions practices. Before joining BCG, Rodolphe spent 7 years working for the French Ministry of Finance.

Xavier Duportet is a deep-tech entrepreneur, CEO of Eligo Bioscience which he founded during a PhD at MIT and INRIA, and President of Hello Tomorrow. He received several international awards including Forbes 30 Under 30 in Science and Healthcare and MIT TR35. He is also a Senior Advisor on Emerging Technologies for French Ministry of Economics and Foreign Affairs.

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Acknowledgments

BNP Paribas, Worldwide Partner

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"The Bank for a Changing World" BNP Paribas encourages and supports innovation in all its forms. Technological innovations are changing the way we work and how our clients work and we believe collaboration and co creation with start-ups is key. Financing the real economy means understanding the world of tomorrow and anticipating our clients' needs, in a very fast changing environment, to innovate and deliver simple, helpful and effective products and sustainable solutions for the future. As a bank, as also a large tech company, we need to extract from all that ecosystem ideas and approaches. We like entrepreneurs and we are delighted to be Hello Tomorrow's Worldwide Global Partner, exploring innovative solutions together and building the world of tomorrow."

Jean-Laurent Bonnafé,
Director & CEO of BNP Paribas Group

BNP Paribas is a leading bank in Europe with an international reach. It has a presence in 74 countries, with more than 192,000 employees, including more than 146,000 in Europe. The Group has key positions in its three main activities: Domestic Markets and International Financial Services (whose retail-banking networks and financial services are covered by Retail Banking & Services) and Corporate & Institutional Banking, which serves two client franchises: corporate clients and institutional investors. The Group helps all its clients (individuals, community associations, entrepreneurs, SMEs, corporates and institutional clients) to realise their projects through solutions spanning financing, investment, savings and protection insurance. In Europe, the Group has four domestic markets (Belgium, France, Italy and Luxembourg) and BNP Paribas Personal Finance is the leader in

consumer lending. BNP Paribas is rolling out its integrated retail-banking model in Mediterranean countries, in Turkey, in Eastern Europe and a large network in the western part of the United States. In its Corporate & Institutional Banking and International Financial Services activities, BNP Paribas also enjoys top positions in Europe, a strong presence in the Americas as well as a solid and fast-growing business in Asia-Pacific.

With offices in Paris, San Francisco & Shanghai, its prospective vision and extensive experience in understanding the digital economy, L'Atelier BNP Paribas is strategically placed to help the BNP Paribas Group and its clients enable their digital transformation. Part of the BNP Paribas Group for more than 35 years, L'Atelier BNP Paribas is unique by its open architecture approach that extends beyond the banking sector, and its presence in three major geographical areas that are key beds for innovation: Europe, North America and Asia. Drawing on its prospective vision and experience, L'Atelier BNP Paribas actively promotes public debate (website, newsletter, radio, TV) and help the BNP Paribas Group and its clients navigate through their digital transformation. As part of its open innovation approach, L'Atelier BNP Paribas recently created the Lab which brings together disruptive innovators, corporates, resources and support networks to accelerate the speed of innovation.

The Boston Consulting Group, Global Partner

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The Boston Consulting Group (BCG) is a global management consulting firm and the world's leading advisor on business strategy. We partner with clients from the private, public, and not-for-profit sectors in all regions to identify their highest-value opportunities, address their most critical challenges, and transform their enterprises. Our customized approach combines deep insight into the dynamics of companies and markets with close collaboration at all levels of the client organization. This ensures that our clients achieve sustainable competitive advantage, build more capable organizations, and secure lasting results. Founded in 1963, BCG is a private company with 85 offices in 48 countries.

Bloomberg, Global Partner

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Bloomberg, the global business and financial information and news leader, gives influential decision makers a critical edge by connecting them to a dynamic network of information, people and ideas. The company's strength – delivering data, news and analytics through innovative technology, quickly and accurately – is at the core of the Bloomberg Professional service. Bloomberg's enterprise solutions build on the company's core strength: leveraging technology to allow customers to access, integrate, distribute and manage data and information across organizations more efficiently and effectively

French Tech, Global Partner

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"French Tech" is the term used to describe the French startup community: entrepreneurs, investors, engineers, designers, incubators, public organizations, etc. committed to the growth of French

startups and to their international prosperity. This community includes champions such as BlaBlaCar, valued at €1.2 billion, and Sigfox and Devialet, which respectively raised €150 million and €100 million in 2016.

The French Tech Initiative is an innovative public policy created in 2013. It is not about the government imposing regulations and limits; it's about the government supporting the startup community. As part of this initiative, €200 million of public funds have been set aside for business incubators and accelerator programs throughout France.

La French Tech is also about being open to the world and welcoming foreign talent. The French Tech Initiative has a strong international presence via its 22 French Tech hubs across the globe that bring together French startup communities overseas. The French Tech Ticket Program for international startups looking to set up in France is another example of this international openness.

The French Tech Ambassadors Program helps finance private projects, such as Hello Tomorrow, that promote the French Tech ecosystem internationally. The influencers behind these projects greatly contribute to the recognition of the French entrepreneurial dynamic beyond France's borders.

Air Liquide, Industry Partner

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"We are very pleased to be once again an Industry partner of Hello Tomorrow. This long term partnership contributes to better understand societal trends and identify new technologies in the field of energy and environment transition, changes in healthcare and digitization with tomorrow's champions. This initiative, part of our Open innovation approach, also aims to further strengthen our interactions with startups and high-potential entrepreneurs to accelerate our customer-centric transformation strategy. This is also a way to offer these start-ups our expertise and concrete use cases to accelerate business impact."

Olivier Delabroy,
Vice President Digital Transformation, founder of i-Lab, Air Liquide Group

The world leader in gases, technologies and services for Industry and Health, Air Liquide is present in 80 countries with approximately 67,000 employees and serves more than 3 million customers and patients. Oxygen, nitrogen and hydrogen are essential small molecules for life, matter and energy. They embody Air Liquide's scientific territory and have been at the core of the company's activities since its creation in 1902.

Air Liquide's ambition is to lead its industry, deliver long term performance and contribute to sustainability. The company's customer-centric transformation strategy aims at profitable growth over the long term. It relies on operational excellence, selective investments, open innovation and a network organization implemented by the Group worldwide. Through the commitment and inventiveness of its people, Air Liquide leverages energy and environment transition, changes in healthcare and digitization, and delivers greater value to all its stakeholders.

Airbus, Industry Partner

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The “start-up 2 partner” team within Airbus Corporate Innovation is looking to build successful partnerships with SMEs in selected domains. It aims to support start-ups working on new developments in a number of industries in becoming valuable business partners through a collaborative approach. The idea is that these partnerships will of course benefit both the start-ups and Airbus.

Embedded within the company, the team is highly connected to the business and bridges the gap by leveraging a dedicated approach with start-ups. It can facilitate de-risking and acceleration of the start-up’s technology using the company’s own prototyping spaces and expertise. These relationships provide new ideas internally and add external capabilities. Moreover “start-up 2 partner” allows start-ups access to a global network of airlines, suppliers and selected partners. Internally, it also promotes new, more flexible ways of working thanks to its exposure to an entrepreneurial culture.

The start-ups and Airbus businesses work as partners rather than adopting a pure capital investment approach. So how does this work, in real terms? The “start-up 2 partner” team begins by identifying start-ups that show high growth high business potential. The team steers the project from ideation to implementation setting up a cross-functional team of dedicated experts and applying an agile approach. The success of a project depends on the early engagement of a sponsor to ensure buy-in from the business.

Since its creation in 2014, the “start-up 2 partner” team has screened an impressive 600+ start-ups, elaborated 30 projects and currently has 10 partnerships in the portfolio.

The team recently collaborated with a Canadian company that was looking to apply a disruptive nanomaterial technology for cockpit windshields to prevent laser attacks coming from individuals on the ground. The solution has now been introduced to selected airlines to accelerate its entry into the market and Airbus’ intends to offer it as line-fit and retrofit option.

Butagaz, Industry Partner

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Established in 1931, Butagaz is a major French player in propane and butane gas distribution, and the only one in France to own a research and innovation center. A team of engineers and technicians test, create and invent solutions to better meet its customer’s needs. Butagaz provides innovative gas solutions for individuals, communities and businesses. Butagaz has been developing since 2015 a start-up accelerator program, Zagatub, focused on smart and innovative comfort. Butagaz is part of DCC Energy Group, the largest and most active suppliers of LPG in Europe, providing the highest levels of innovation and services across Europe. In addition to LPG, DCC Energy now supplies Natural Gas, LNG, Aerosol gas and renewable energies such as solar and biomass.

Carrefour, Industry Partner

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Carrefour Group is the leading retailer in Europe and the second-largest retailer in the world, employing more than 380,000 people

with more than 11,500 stores in more than 30 countries. As a multi-local, multi-format, and multi-channel retailer, Carrefour is a partner for daily life. Every day, it welcomes more than 13 million customers around the world, offering them a wide range of products and services at fair prices. Carrefour has been a pioneer in food quality for 25 years and is continuing its work with four new initiatives.

1. A program to accelerate the adoption of organic farming practices, working alongside producers: as the leading general distributor of organic products in France, Carrefour is introducing a program that will involve contractually setting volumes and prices for periods of 3 to 5 years. This program will be applied to 300 farms by 2020.

2. An agro-ecology support plan, with the deployment of new lines of products made from animals reared without antibiotics and from plants grown without pesticides: following on from its "antibiotic-free" chicken launched in 2013, Carrefour is now extending this initiative to new veal and rabbit farms in 2017. At the same time, Carrefour is experimenting with doing away with all chemical pesticides on new fruit and vegetable lines, such as apples, peaches and nectarines and potatoes, continuing with the work it has been doing since 2015 on tomatoes, kiwifruit, broccoli and strawberries.

3. The introduction in 2017 of the first certification process for animal well-being in France, working in partnership with an independent organisation, farmers and NGO Welfarm.

4. The introduction – for the first time in retail – of blockchain technology, used to enable traceability of its animal product lines, guaranteeing consumers as much transparency as possible.

Carrefour, a global partner for wellfooding locally

Groupe ADP, Industry Partner

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Groupe ADP builds, develops and manages airports, including Paris-Charles de Gaulle, Paris-Orly and Paris-Le Bourget. In 2015, Paris Aéroport handled more than 95 million passengers and 2.2 million metric tonnes of freight and mail at Paris-Charles de Gaulle and Paris-Orly, and more than 55 million passengers at airports abroad through its subsidiary ADP Management. Boasting an exceptional geographic location and a major catchment area, the Group is pursuing its strategy of adapting and modernising its terminal facilities and upgrading quality of services; the Group also intends to develop its retail and real estate businesses. In 2015, Group revenue stood at €2,916 million and net income at €430 million.

As part of its "Connect 2020" strategic plan; The ADP Group deploys its capacity for innovation through a comprehensive and ambitious program: "Innovation Hub." Today airport cities are nodes of connections between passengers, airlines, employees, and territories around a community.

In this context, the new challenge airport cities face with, is to develop an efficient ecosystem to imagine, draw and decline what the airport of the future might look like.

Leveraging on its massive experience, the ADP Group thus offers young innovative companies, an exceptional territory, expertise, visibility and financing capabilities.

The "Innovation Hub" program now embodies this challenge of transformation and

competitiveness by putting into perspective the open innovation process carried out since 2010.

This has led to the implementation of projects such as automatic luggage drop-offs, a comparator service for transport modes, and the digital mobile tool PRIMA, which allows operational teams in the aiport to go ahead Passengers to inform them.

L'Oréal, Industry Partner

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"Attending Hello Tomorrow once was enough to convince us, because we found an attitude there that matches our own: to innovate you have to cultivate interdisciplinarity and convergence. Encouraging early-stage start-ups to design inventions that are going to change the world, by adopting a less conventional line, creates an area of freedom for both them and us.

The fields that interest us are those that will define the contours of a different kind of beauty – fun, effective, surprising and respectful of cultures, people and the environment. A vast field that ranges from systemic biology to colour via augmented reality, machine learning, connected sensors, intelligent materials and respect for water and biodiversity. Everything that is beautiful and makes someone beautiful while doing good.

We are committed to introducing the notion of ethics very early on in our relationships with start-ups. There's even a special section for them in our Ethics guide, with three key words:
• Respect for start-ups
• Transparency about the aim of the partnership
• Integrity in how we behave"

L'Oréal Research and Innovation teams

L'Oréal has devoted itself to beauty for over 100 years. With its unique international portfolio of 34 diverse and complementary brands, the Group generated sales amounting to 25.8 billion euros in 2016 and employs 89,300 people worldwide. As the world's leading beauty company, L'Oréal is present across all distribution networks: mass market, department stores, pharmacies and drugstores, hair salons, travel retail, branded retail and e-commerce.

Research and innovation, and a dedicated research team of 3,870 people, are at the core of L'Oréal's strategy, working to meet beauty aspirations all over the world. L'Oréal's sustainability commitment for 2020 "Sharing Beauty With All" sets out ambitious sustainable development objectives across the Group's value chain. **www.loreal.com**

Michelin, Industry Partner

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Michelin, the leading tire company, is dedicated to enhancing its clients' mobility, sustainably; designing and distributing the most suitable tires, services and solutions for its clients' needs; providing digital services, maps and guides to help enrich trips and travels and make them unique experiences; and developing high-technology materials that serve the mobility industry.

Headquartered in Clermont-Ferrand, France, Michelin is present in 170 countries, has 111,700 employees and operates 68 production facilities in 17 countries which together produced 184 million tires in 2015. (**www.michelin.com**)

Roche, Industry Partner

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"Roche recognizes the great value that startups have in the healthcare sector. Since this is a particularly challenging sector to enter, we have developed a mentoring program. This program is provided to support startups by giving them access to experts in a variety of business units and the startup remains independent of the organization. In return, the Roche mentors are provided with opportunities to learn more about how entrepreneurs function and valuable exposure to the innovation ecosystem which supports an entrepreneurial spirit within our organization."

Padraic Ward,
President of Roche France SAS

Roche is a global pioneer in pharmaceuticals and diagnostics focused on advancing science to improve people's lives. The combined strengths of pharmaceuticals and diagnostics under one roof have made Roche the leader in personalised healthcare – a strategy that aims to fit the right treatment to each patient in the best way possible.

Roche is the world's largest biotech company, with truly differentiated medicines in oncology, immunology, infectious diseases, ophthalmology and diseases of the central nervous system. Roche is also the world leader in in vitro diagnostics and tissue-based cancer diagnostics, and a frontrunner in diabetes management.

Founded in 1896, Roche continues to search for better ways to prevent, diagnose and treat diseases and make a sustainable contribution to society. The company also aims to improve patient access to medical innovations by working with all relevant stakeholders. Twenty-nine medicines developed by Roche are included in the World Health Organization Model Lists of Essential Medicines, among them life-saving antibiotics, antimalarials and cancer medicines. Roche has been recognised as the Group Leader in sustainability within the Pharmaceuticals, Biotechnology & Life Sciences Industry eight years in a row by the Dow Jones Sustainability Indices (DJSI).

The Roche Group, headquartered in Basel, Switzerland, is active in over 100 countries and in 2016 employed more than 94,000

people worldwide. In 2016, Roche invested CHF 9.9 billion in R& D and posted sales of CHF 50.6 billion. Genentech, in the United States, is a wholly owned member of the Roche Group. Roche is the majority shareholder in Chugai Pharmaceutical, Japan. For more information, please visit **www.roche.com**.

Safran, Industry Partner

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Safran is a leading international high-technology group with three core businesses: Aerospace (propulsion and equipment), Defence and Security. Operating worldwide, the Group has 70,000 employees and generated sales of 17.4 billion euros in 2015. Working independently or in partnership, Safran holds world or European leadership positions in its core markets. The Group invests heavily in Research & Development to meet the requirements of changing markets, including expenditures of more than 2 billion euros in 2015. Safran is listed on Euronext Paris and is part of the CAC40 index, as well as the Euro Stoxx 50 European index.

Established in 2015, Safran Corporate Ventures is the Group's corporate venture capital arm. It funds startups that have developed breakthrough or disruptive technologies or business models which will help Safran to address the challenges of the aerospace, defense or security markets. This new entity clearly reflects Safran's corporate strategy based on innovation and transformation.

Safran Corporate Ventures will help agile, innovation-driven companies by funding their growth. These companies will also benefit from:

- Access to an international network of leading technology experts in Safran's business sectors.
- The global commercial and industrial reach of Safran companies.
- Commercial and development agreements to be implemented between such startups and Safran's own entities.

Sycomore, Industry Partner

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Innovation. But what for? *In our connected world - undergoing profound changes, shaken up by digitalisation, challenged by the environmental and energy transition, and with ever widening social inequalities - innovation is a matter of survival. We all agree. But what is the purpose of this innovation?*

The intensity and diversity that characterise the spirit of the Hello Tomorrow initiative naturally lead to a key question: what are these innovations all about? Not all innovation is good. We can no longer assume that "what I undertake or what I do with my money has little bearing, since I help to keep the economy going" in a Schumpeterian cycle of endless creative destruction. We now know that GDP growth is a poor indicator for measuring improvement in welfare, but is

rather accurate in assessing the pace at which we use natural resources, destroy the biosphere and weaken the climate.

Therefore selecting or adjusting a start-up company's mission, or defining a fund's investment strategy, becomes a founding act. The societal and environmental impact of a project, of an investment, is now a fundamental issue – whether the company has been recently launched or is a large publicly listed corporation.

It is our job to question the real advantages provided not only to the clients but also to society as a whole (users, residents, employees, suppliers…) and to the environment, from the very first euro we invest. If there are no benefits for the stakeholders, there can be no success, no purpose and no point. In this respect, the impact of the business model on human and natural capital provides a meaningful perspective, perfectly aligned with the interests of the capital providers.

Jean-Guillaume Péladan,
Fund Manager - Head of Environmental Investments & Research and alumni BCG 2001

Founded in 2001, Sycomore Asset Management is an entrepreneurial investment firm majority-owned by its founding partners and employees.

Specialized in the analysis of European stocks, Sycomore AM is a key player in the responsible investment sphere. Rated "High Standards" by Fitch Ratings since 2008, Sycomore AM manages 5.5 billion euros in mutual funds and segregated mandates, among which 30% in Sustainable and Responsible Investment strategies.

WDS

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Aligned with Hello Tomorrow's values and mission, We Design Services (WDS) shares its passion to make innovative ecosystems thrive. This report brings closer corporates, deep tech startups and investors by using strategic knowledge gathered from the Hello Tomorrow ecosystem and contributors. Resulting in a collaboration framework that better aligns such diverse stakeholder's intentions and objectives, the report is a step forward to better designed collaborations. The great and challenging journey from an idea to a commercial success of a breakthrough innovation won't happen without an extensive empathy between those forward thinkers all needed to bring tomorrow to life.

Christophe Tallec,
CEO of WDS

Founded in 2015, WDS is a multidisciplinary team that puts the talent of engineers, PhDs in innovation management, designers and domain experts all invested in clients and partner's ambitions.

BPI

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The Public Investment Bank (BPI) is a public group in the service of the financing and development of companies, and acts in support of the policies implemented by the State and the Regions.

The Group's corporate purpose is to:

- Promote and support innovation, particularly in the field of technology, and to contribute to technology transfer; and
- Promote the development and financing of small and medium-sized businesses.

Appendixes

Appendix 1. Interview list

STARTUPS	CORPORATE	OTHERS
• Hector Balas: Impala • Robin Berthier: Network Perception • Bjorn Dawson: Grobo • Thomas Eaton: Smart Home Technology • Tyler Evans: SilLion • Astrid Irwanto: Nalagenetics • Charles Nichols: SunCulture • Robert Nordsell: Lumenari	• François Badoual: Total Energy Venture • Xavier Baillard: Valeo • Michael Bloomberg: Bloomberg • Jean-Laurent Bonnafé: BNP Paribas • Jérôme Casamassa: bioMérieux • Hélène de Cointet: Safran Corporate Venture • Laurent Deleville: Safran • Paul-Joel Derian: Suez Venture • François Dufour: Orange • Johannes Fruehauf: Lab Central • Arnault Gournac: Carrefour • Elsa Keita: Airbus • Frédéric Leroy: L'Oréal • Franck Maistre: BNP Paribas • David Monserand: Butagaz • Yann de Parscau: Michelin • Jean-Frédéric Petit-Nivard: Roche • Matthieu Repellin: Airbus Venture • Stephane Roussel: Solvay Venture • Stephanie Sims: Roche • Christophe Tallec: WDS • Thomas Trailov: Air Liquide • Antoine Vigario: Groupe ADP	• Arnaud Bonzom: 500 Startups • Willy Brown: Daphni • Olivier Ezratty: Guide des Startups • Paul-François Fournier: BPI • Graham Hewson: Imperial College Incubator • Emmanuel Macron: former Minister of Economy, Industry, and Digital Affairs [France] • Gemma Milne: Science:Disrupt • Jean-Guillaume Péladan: Sycomore AM • Muriel Touaty: Technion France

Appendix 2. Definitions and descriptions of the nine technology readiness levels (TRLs)

Technology readiness levels (TRLs) are the components of a measurement system invented by NASA in 1989 to assess the maturity level of a particular technology. There are nine technology readiness levels, TRL 1 being the lowest and TRL 9 the highest.

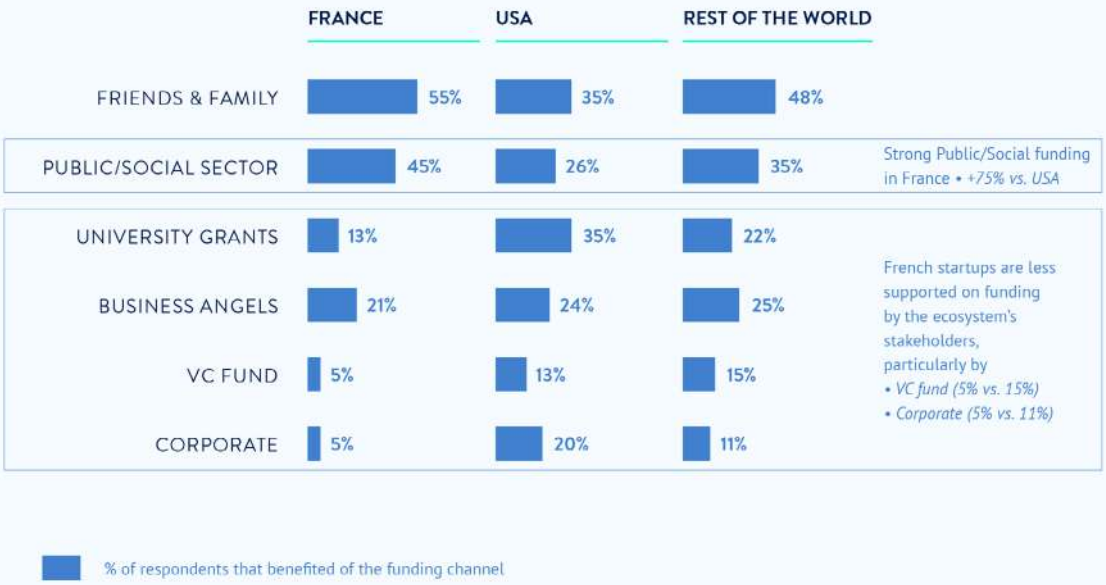
Technology readiness level (TRL)	Definition	Hardware description	Software description
1	Basic principles observed and reported	Scientific knowledge generated to underpin hardware technology concepts and applications	Scientific knowledge generated to underpin basic properties of software architecture and mathematical formulation
2	Technology concept or application formulated	Invention begun; practical application identified, but without experimental proof or detailed analysis to support the conjecture	Practical application identified, but without experimental proof or detailed analysis to support the conjecture; basic properties of algorithms, representations, and concepts defined; basic principles coded; experiments performed with synthetic data
3	Analytical and/or experimental critical function or characteristic proof-of-concept conducted	Technology placed in appropriate context by analytical studies; analytical prediction validated by laboratory demonstrations, modeling, and simulation	Limited functionality developed to validate critical properties and predictions using nonintegrated software components
4	Component or breadboard validated in laboratory	Low-fidelity system/component breadboard built and operated to demonstrate basic functionality; critical test environments and associated performance predictions defined relative to final operating environment	Key, functionally critical, software components integrated and functionally validated to establish interoperability and begin architecture development; relevant environments defined and performance in these environments predicted
5	Component or breadboard validated in a relevant environment	Midlevel fidelity system or component brassboard built and operated to demonstrate overall performance in simulated operational environment, with realistic support elements to demonstrate overall performance in critical areas; performance predictions made for subsequent development phases	End-to-end software elements implemented and interfaced, with existing systems/ simulations conforming to target environment; End-to-end software system tested in relevant environment and confirmed to meet predicted performance; operational environment performance predicted; prototype implementations developed
5	Component or breadboard validated in a relevant environment	Midlevel fidelity system or component brassboard built and operated to demonstrate overall performance in simulated operational environment, with realistic support elements to demonstrate overall performance in critical areas; performance predictions made for subsequent development phases	End-to-end software elements implemented and interfaced, with existing systems/ simulations conforming to target environment; End-to-end software system tested in relevant environment and confirmed to meet predicted performance; operational environment performance predicted; prototype implementations developed
6	System/subsystem model or prototype demonstrated in relevant environment	High-fidelity system or component prototype that adequately addresses all critical scaling issues built and operated in relevant environment to demonstrate operations under critical environmental conditions	Prototype implementations of software demonstrated on full-scale realistic problems and partially integrated with existing hardware/software systems; Limited documentation made available. Engineering feasibility fully demonstrated
7	System prototype demonstrated in space	High-fidelity engineering unit that adequately addresses all critical scaling issues built and operated in relevant environment to demonstrate performance in actual operational environment and platform (ground, airborne, or space)	Prototype software produced with all key functionality available for demonstration and test, well integrated with operational hardware/software systems demonstrating operational feasibility; most software bugs removed; limited documentation made available
8	Actual system completed and flight qualified through test and demonstration	Final product in its final configuration demonstrated successfully through test and analysis for its intended operational environment and platform (ground, airborne, or space)	All software thoroughly debugged and fully integrated with all operational hardware and software systems; all user documentation, training documentation, and maintenance documentation completed; all functionality successfully demonstrated in simulated operational scenarios; verification and validation completed
9	Actual system flight proven through successful mission operations	Final product successfully operated in an actual mission	All software thoroughly debugged and fully integrated with all operational hardware and software systems; all documentation completed; sustaining software engineering support established; system successfully operated in operational environment

Appendix 3. Specifics of the French ecosystem

Like startups in the rest of the world, French startups consider funding and access to market to be their most critical resources, but they differ from startups elsewhere on three topics:

1. **Lower need for technical expertise**, owing to the French education system and the government's support of universities
2. **Higher need for business expertise**
3. **Higher need to access talent**, to accelerate startups' development

French startups tend to receive less support from the ecosystem's stakeholders for funding, particularly by VC and corporate (5% versus 10% to 15% for the rest of the world), and they establish corporate partnerships at a slightly lower rate (50% versus 57%).



Source: Hello Tomorrow and BCG survey of 400 deep-tech startups.

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