



The ecosystem future

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Editorial

Dear Reader

Once, when someone described an ecosystem, they would be talking about a biological community where living organisms interacted with each other and their environment – such as the coral reefs in our cover illustration. Then, about 10 or 15 years ago, it became hijacked by the business management community as a descriptor for an interconnected partner network. It achieved true buzzword status rapidly.

Our theme for this second semester Prism of 2021, The ecosystem future, is about both meanings of the word. Thinking in an ecosystem way is becoming increasingly central to our strategies for the future, both to meet the critical challenges of climate change and the environment, and to grow new businesses sustainably through innovation. Indeed, there is a growing realization that, ultimately, you can't have one without the other anyway.

Our first article focuses on this point: how companies can leverage their partner ecosystems in the broadest sense to overcome key obstacles and finally bring about a true shift towards environmental ecosystem sustainability alongside business success.

Food is certainly a key issue for securing a sustainable future, and in our second article we provide some highlights of a fascinating study into the future of food, conducted together with three leading companies in the food value chain. Anticipating how consumer and technology trends are disrupting the future is key. Having a clear sense of purpose and shaping the right partner ecosystems to respond will be essential.

We then turn to healthcare and life sciences, a sector that has clearly been at the forefront of public awareness since the start of the pandemic. The success story of rapid vaccine development has been a salutary lesson in how working with partners in the right way can transform innovation speed. We look at how

hyper-collaboration – working not just with a few partners, but with many partners in highly collaborative ways – is transforming the industry as it faces a new “Future of Health” propelled by digital and data-driven technologies alongside new molecular treatments.

Decarbonization of our transport systems is already underway, but there is still a long way to go. Everyone is aware of the move towards electric vehicles, but what about vehicles fueled by green hydrogen? Elon Musk has described the hydrogen solution as “staggeringly dumb”, but the rest of the automotive industry is divided. In our article we explore the complexities of the case for hydrogen, and we conclude that the new hydrogen-based ecosystem is something that cannot be ignored by automotive companies.

Finally, we return to what is perhaps the original concept of a partner ecosystem, physical locations where diverse players can interact to co-innovate for mutual benefit – Innovation Districts. You might think that in the post-pandemic world of virtual working and digital communications, such locations are no longer so important. However, you would be wrong. Our article explains why Innovation Districts that are designed the right way will be crucial to enabling the innovation ecosystems of the future.

We hope you enjoy the issue!



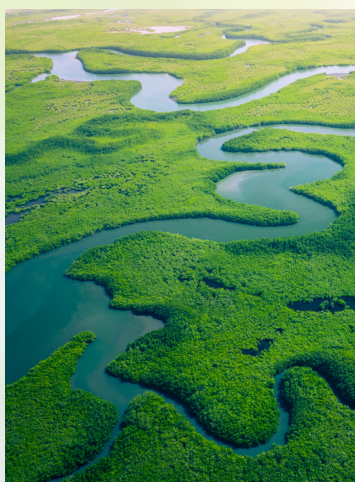
Rick Eagar
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Corporate sustainability – Using your ecosystem to sustain the ecosystem

Stefano Milanese, Stefano Decadri, Carlo Stella, Martijn Eikelenboom,
Trung Ghi, Florent Nanse, Juan Gonzalez

It has been nearly 25 years since the Brundtland Report introduced the modern concept of sustainable development, highlighting its three fundamental components – the environment, the economy, and society. Yet since then, despite the many global, regional and local goals, pledges and initiatives, society has been largely ineffective in transforming



discussions around sustainability into concrete and strategic actions. The latest UN Sustainable Development Goals (SDGs) are unlikely to be met. Even before COVID-19 it was unlikely that global poverty would be eradicated by 2030¹, as the world saw \$23.6bn in direct economic losses from natural disasters in 2018. Global average temperatures have already risen by one degree above the pre-industrial baseline, sea levels are at a record high, glaciers and polar ice are retreating and the

last four years were the warmest on record.

However, as this article explains, conditions have now changed. We explore the reasons why sustainability is now genuinely at the top of the business agenda, and why a “partner ecosystem”-led approach is the key to sustaining the “environmental ecosystem”.

Sustainability has now risen to the top of the business agenda, with a combination of technology, financial backing, and greater government and consumer pressure all making it an imperative for every organization. Our lead article explains how taking a business ecosystem approach is crucial to sustaining our natural ecosystems.

1. Source: Arthur D. Little, An unprecedented opportunity for a new start, <https://www.adlittle.com/en/insights/viewpoints/unprecedented-opportunity-new-start>

The new drivers for change

Despite the lack of progress to date, today various factors around technology, finance, government actions and consumer expectations are for the first time converging to enable real change.

Technology as an enabler

We are now seeing the fruits of innovation and research programs begun over the last decade. Areas as diverse as solar, EV/batteries, waste recycling, air/water treatment and green hydrogen (see *The role of hydrogen in building a sustainable future for automotive mobility* in this issue of Prism) are now maturing, bringing down costs, enabling scale, and opening up new opportunities. For example, the cost of solar photovoltaic energy dropped by 82 percent between 2010 and 2019², while efficiency saw a fivefold increase. Essentially, this makes being sustainable more accessible to business.

Wider digital transformation also enables sustainability – for example, the integration of 5G and the Internet of Things (IoT) can enable business use cases that impact areas such as real-time monitoring of emissions reduction, safety improvement, and other SDG targets.

Technology advances are unlocking further drivers for sustainability and creating new expectations of corporate action on sustainability performance.

Greater government action

As part of rebuilding the economy post-COVID-19, governments are investing heavily in various initiatives, including sustainability infrastructure, in order to “build back greener”. This has created significant interest in the private sector. In the US, President Biden unveiled a \$2 trillion

2. Source: IRENA, <https://www.irena.org/newsroom/articles/2020/Jun/How-Falling-Costs-Make-Renewables-a-Cost-effective-Investment>

infrastructure plan, while the EU's Green Deal Recovery Plan and China's latest Five Year Plan all put sustainability at the core of investment decisions. Gaining access to these funds requires businesses to adopt and demonstrate sustainability within their operations.

This is not limited to countries heavily impacted economically by the pandemic. Although Australia avoided recession in 2020, it is looking to rebalance its economy moving forward. For example, the state of Tasmania is supporting extensive hydro-electric power infrastructure, while the world's largest solar farm is being built in Darwin and will supply 20 percent of Singapore's electricity needs via underwater cables by 2027.

Governments are also competing to position their economies for a sustainable future. For example, Germany's plan for a 65 percent cut in carbon emissions by 2030 is a voluntary 10 percent greater than the rest of the EU. This is designed to spur its companies to innovate and build leadership positions that capture value from new circular and net zero economy businesses, and replace jobs in fossil fuel sectors.

Increasing financial services sector and investor pressure

COVID-19 has accelerated the pace of green investment. Many initiatives that link funding to sustainability have now been announced, such as the Net-Zero Banking Alliance³. Created by banks responsible for \$28.5 trillion in assets, this has set 2030 and 2050 targets, essentially looking to ensure that all their clients are sustainable businesses. The EU Taxonomy⁴ has been developed to classify economic activities and show whether they are environmentally sustainable. It is being used to guide decisions on where money from the EU Green Deal will be invested.

3. Source: <https://www.unepfi.org/net-zero-banking/media/>

4. Source: European Union, https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en

Further examples can be found in *The Green Gambit* – *Investing for corporate strategic advantage in the post-COVID-19 world* (Prism Issue 1, 2021)⁵.

Greater consumer demand for sustainability

Consumers, particularly younger generations, are increasingly focused on sustainability and driving growth. This covers sectors as diverse as tourism (where the market is expected to grow by a CAGR of 14 percent between 2021 and 2027 to \$334 billion) and consumer packaged goods (CPG). For example, a recent study by Stern found that between 2015 and 2019, sustainability-marketed CPG in the US grew over seven times faster than products not marketed as sustainable, while enjoying a price premium of nearly 40 percent.

The growing benefits of sustainability

The benefits to businesses of embedding sustainability have been often stated in the past, but have significantly increased in recent years.

1. Reduced risk/better risk management

Embedding sustainability principles within risk management strategies facilitates their timelier identification, allowing them to be addressed consistently across the organization. Demonstrating this, many insurers and re-insurers have created Sustainability Risk Frameworks that they use to assess the social and environmental risks of their transactions, even refusing coverage in some instances (for example, German energy company RWE was dropped by insurer AXA over its coal operations⁶).

5. Source: <https://www.adlittle.com/en/TheGreenGambit>

6. Source: <https://www.bloomberg.com/news/articles/2021-03-12/france-s-biggest-insurer-dumps-german-power-giant-over-coal>

2. Greater attraction and retention of talent and partners

Innovation, growth and value generation rely on the skills of an organization's people and partnerships within the wider ecosystem. An increasing number of potential staff choose their employers based on a clear sense of meaning and sustainable purpose, and are more productive and loyal to such organizations. Morale has been shown to be typically higher in genuinely sustainable companies. The same principles apply to the partnering strategies. For example, Tesla won't partner with firms it considers not to be committed to sustainability – and recently announced it would no longer accept bitcoin due to the environmental impact of mining the cryptocurrency.

3. Lower cost of attracting funding

Not only are there an increasing number of funds targeting sustainable opportunities, but sustainable businesses can also lower the cost of attracting capital due to investor demand. For example, energy company Enel, which adopted a sustainability business model in 2015, received a premium price for its sustainability bonds, saving itself a reported 20 basis points compared to a conventional bond.

4. Competitive advantage

Embracing sustainability enables organizations to create new, differentiated competitive positioning. Flavorings company McCormick is focusing on Purpose-led Performance to set itself apart from its rivals, which has resulted in it being ranked as the most sustainable food company in Corporate Knights 2021 Global 100 Sustainability Index⁷.

Benefits are not limited to the consumer space. Chemicals giant Solvay applies its Sustainable Portfolio Management (SPM) tool, which assesses comprehensive and forward-looking "sustainability performance" to all its products. This enables it to take strategic decisions that drive higher growth. It found that solutions that scored well on the SPM delivered a superior average annual growth rate of 9 percent, versus -3 percent below average for solutions with negative assessments⁸.

7. Source: <https://www.corporateknights.com/reports/global-100/2021-global-100-ranking-16115328/>

8. Source: Solvay, <https://www.solvay.com/sites/g/files/srpend221/files/2018-07/Solvay-SPM-Guide.pdf>

What has been holding companies back?

Despite the drivers and benefits, there have been multiple barriers preventing companies from making progress in sustainability.

- In the past, there has been a lack of knowledge within management teams and board members about the subject and where to start, and a prevailing company culture which was not conducive to the sort of changes required.
- Companies and their shareholders have often been poor at taking a perspective beyond the short term. This is sometimes characterized by a fear of cannibalizing the incumbent business by moving “too fast” towards sustainability. For example, this was recently shown by BP’s board and shareholders rejecting a proposal from activists to publish more aggressive short-, medium- and long-term targets to reduce emissions.
- In some territories (such as Australia and parts of South East Asia), governments have not set clear net zero targets, which means companies operating in these markets lack regulatory incentives to change.
- Achieving a meaningful impact in terms of sustainability is not easy for companies in isolation. Today, large companies exist in often complex global value chains from raw material through to consumption and disposal. There are typically many interconnections, interactions and unforeseen direct and indirect impacts with multiple parties involved. This means that solutions may be complex and difficult to realize in practice.

Becoming sustainable today

Overcoming these barriers is the starting point for becoming truly sustainable. Despite the accumulated wisdom over decades and the more recent shared realization of the urgency to take action, for some companies there is still a need to educate the board and senior managers about what a sustainable mind-set really means – looking beyond the next three to five years, rethinking the mission and setting concrete objectives.

It is vital to turn strategies and plans into action, building sustainability governance models that cover the wider ecosystem and supply chain, as well as the company, its products and its operations, for example:

- Enel achieves this by embedding its Creating Shared Value (CSV) concept into its entire value chain, led by its central Innovability function⁹.
- AENA, one of the largest airport operators in the world, recently published a Climate Change Action Plan that establishes an ambitious objective of reducing emissions per passenger by 94 percent by 2030, backed by a detailed set of measures, setting the basis for achieving net zero by 2040. It has also strengthened its governance model to be more accountable for sustainable performance. Recognizing the need to influence the broader aviation ecosystem, the plan also includes measures for airlines and handling companies.
- US carpet tile manufacturer Interface set out (and has already reached) a 25-year goal of having a net zero impact on the planet.

9. Source: Enel, <https://www.enel.com/company/stories/articles/2020/05/creating-shared-value-climate-change>

To demonstrate the benefits that sustainability is delivering, organizations must ensure they are able to quantify and monitor the value they create, beyond simple savings in compliance costs. Metrics should be defined and monitored to show the business impact of being sustainable and highlight how the organization is going beyond compliance to differentiate itself.

Companies should build a strong culture around sustainability through a common sustainability “language” that is used by the entire organization. This enables management to engage the wider business, set parameters for what is acceptable, and make targets relevant and real for all employees, partners and other stakeholders.

The importance of the stakeholder ecosystem

Apart from the above basic prerequisites, it is especially important today that in setting sustainability strategies, businesses take a wider ecosystem view based on understanding all stakeholders (see Figure 1), and go beyond engagement to enablement. This means listening to current and target customers, investors, NGOs, local communities, employees and supply chain partners to learn what is important to them and enable change. This may not just be reducing greenhouse gas emissions – it could be areas such as giving back to communities, lowering water consumption, reducing waste, or focusing on social issues such as child labor, bribery and addressing the digital divide. Businesses must then use this information constructively as part of the strategy-setting process.

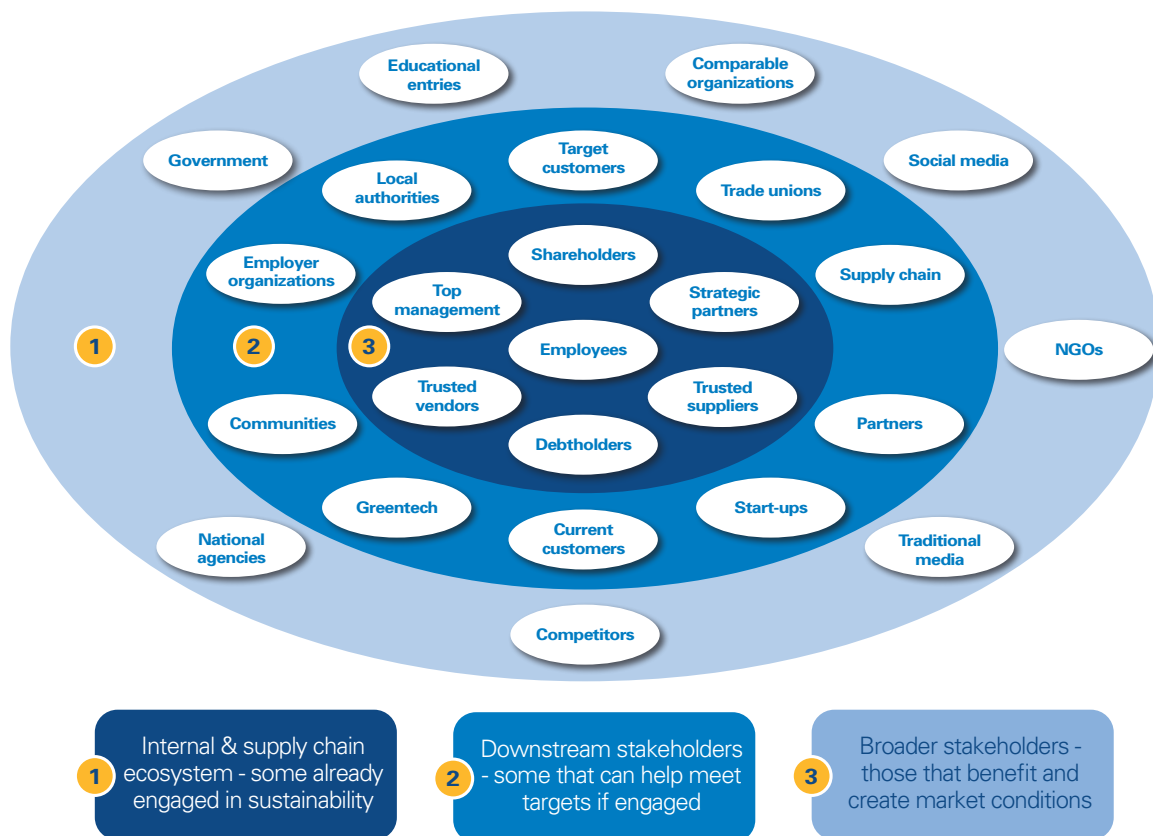


Figure 1: Stakeholders within the ecosystem

One good example of this in action is Ferrovie dello Stato, the Italian transport and infrastructure group. (See Box 1.)

Box 1: Ferrovie dello Stato Italiane Group

Ferrovie dello Stato (FS) Italiane Group operates in four key sectors in Italy and across Europe – rail, road and sea transport of passengers and cargo; rail and road infrastructure and sea link services; real estate; and other services (finance, certification, ICT). It began its sustainability journey in 2008, following a three-step approach:

1. Define the corporate ambition: To be a sustainability leader.
2. Define the group vision: “To be the company to implement an integrated and sustainable mobility and logistics service that is safe, uses shared infrastructures, and creates value in Italy and abroad.”

3. Translate this vision into strategic areas of intervention, with goals and targets across economic, social and environmental dimensions, and a longer-term roadmap up to 2050.

To help achieve its aims, FS Italiane Group worked extensively with stakeholders to define long-term goals, including carbon neutrality by 2050, as well as integrating the principles of social, environmental and economic sustainability into its current business plan. This includes linking GHG emissions targets to senior management's remuneration policies.

The group was the first railway operator in Europe to issue green bonds, in order to invest in highly energy-efficient and recyclable trains. It has extended ideas of circular economy across its assets – for example, turning over 300km of disused railway lines into cycle tracks and green routes.

“FS Italiane Group's vision – defining the long-term projection of the group's role in the economic, social and environmental context in which it operates – incorporates the ambition of building transport works and services that create long-term value for the stakeholders by driving a shift towards intermodality” [Lorenzo Radice, Head of Sustainability for the FS Italiane Group]

Insights for the executive

Taking a long-term, ecosystem-focused approach is key to successfully managing the shift to sustainability in today's new environment.

- 1. You cannot be sustainable alone.** While species evolve or perish, ecosystems are intrinsically sustainable. Take an ecosystem approach that not only covers all of your activities (customers, processes, technology and investments), but also involves your suppliers and start-ups. Ensure everyone around you thinks the same – to both learn from and pass on your own practices. For example, airports need to work towards the sustainability of aviation, even if they are only directly responsible for a small fraction of the industry's total environmental impact.
- 2. Understand your position in your ecosystem.** Your sustainability role and focus will depend on where you sit in the ecosystem, your size and your activities. For example, if you are not a large emitter but rely on materials that are not produced sustainably, your role will be to educate suppliers and enforce the need for change, rather than leading overall efforts. Equally, companies that create products responsible for large-scale emissions will increasingly be held responsible for downstream usage of their products, as the recent successful legal challenge to Shell's sustainability targets demonstrates.
- 3. Set a vision and translate it into a wider, long-term (30-/40-year) roadmap.** Understand and plan for the long-term consequences of today's actions/investments, rather than solely focusing on short-term business plans. This is a major change from existing business planning, but necessary to deal with the longer-term horizon for sustainability.

4. Set connected short-term and long-term (20-/30-/40-year) goals.

Operationalize your vision in your goals. Balance the two and be ambidextrous – don't settle for incremental targets alone.

5. Demonstrate the benefits of sustainability.

Quantify and monitor the value you create – this increases buy-in and momentum within the organization, and hence accelerates the shift.

6. Be bold and move ahead fast to reap the benefits.

Understand the pace of your own organization and investors to bring them with you. Always err on the side of the active – the pace of innovation means even the most seemingly ambitious goals can be suddenly within reach due to technological breakthroughs. Don't use local government inactivity as an excuse. For example, although Australia has not committed to a net zero target date, it is seeing renewable energy grow at a per capita rate 10 times faster than the world average.

As the world recovers from pandemic with a sharply renewed sense of mankind's connectedness and vulnerability, sustainability is taking center stage. Taking a broad perspective that includes all the stakeholders in your ecosystem is the key to ensuring that your company's sustainability efforts will really make a difference.

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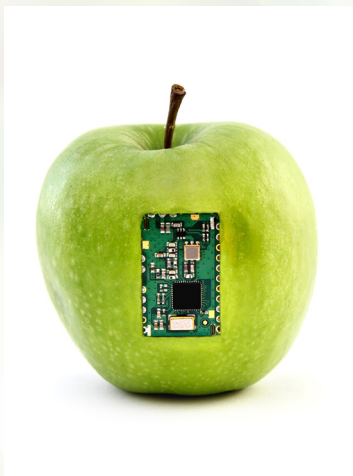
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Appetite for disruption – Making the most of the future of food

Albert Meige, Sandra Einerhand, Philippe Letellier, Phil Webster,
Kurt Baes, Maki Kurosawa, Serkan Somer, Rick Eagar

Being the leader of a global food and beverage business has been anything but easy over recent years. Going back a decade, the industry had a reputation for being fairly stable and conservative, dominated by a limited number of global brands that delivered steady growth and margins. Since then, the industry has been shaken by a succession of disruptions, including sluggish demand for traditional core products, rapidly changing consumer patterns and preferences, accelerating technological developments, and evolving attitudes towards the environmental and social impacts of food production. The pandemic has added yet another ingredient to the mix, only serving to accelerate many of the trends that already existed, such as digitalization and personalization.



The business space a large food company operates in has become more complex, with an increasing degree of convergence across the different steps of the value chain from farm to fork, associating with other industries such as pharmaceuticals, logistics, appliances and kitchen automation, as well as between relevant technologies from nutrition and gene editing all the way through to digital technologies and advanced and/or smart materials. On top of this complexity, many of these enabling technologies are so-called exponential technologies: they progress very rapidly.

The food value chain has changed dramatically over recent years – and promises to continue transforming, with ecosystems becoming ever more complex. Based on a comprehensive study carried out with three major players in the food value chain, the authors explore the trends and scenarios shaping the future of food.

Setting a strategic course in this type of dynamic environment is challenging, but looking forward there are many great opportunities for breakthrough innovation to drive new growth. With this in mind, three leading companies in the food value chain commissioned Arthur D. Little's recent acquisition, Presans, to conduct a study into future trends in the food industry, building on their own extensive knowledge. The companies were Danone, one of the top food companies in the world; Bonduelle, one of the world's top vegetable processing companies; and SEB, the global leader in small domestic appliances.

In this article we present a high-level summary of the study, which addressed some key questions:

- What are the key trends in usage and enabling technologies?
- What could these mean for future scenarios?
- What priorities are important for companies in the food value chain to focus on?

About the study



Presans, an ADL company, conducted a major study of future trends in the food industry over a period of six months during 2020, together with leading international food industry players Danone, Bonduelle and SEB. The study focused on identifying usage trends and scenarios in the context of the overall value chain, as well as enabling technologies and how they link to these scenarios.

The methodology was expert-based, following Presans' "Synergy Factory" approach comprising three stages:

- 1. Alignment of objectives:** Understanding, refining and agreeing the objectives of the study across the three companies

2. Securing experts: Identifying, qualifying and engaging top worldwide experts, starting with 935 initial expert contacts, of which 46 experts across 18 countries submitted proposals

3. Collaborative implementation: With close collaboration facilitated by Presans, a series of expert reports was developed, synthesized and integrated into an overall analysis and a set of common conclusions

Based on the analysis, 24 specific trends were identified and characterized, and four future scenarios were derived relating to both changes in usage (consumer) patterns and the nature of the food value chain. At the intersection of trends in both usage and technology across the scenarios, a series of priorities were identified for food companies to focus on for future success. In this article we are able to share only the high-level results that were deemed not confidential to the three client companies. We are very grateful to Danone, Bonduelle and SEB for their inputs, cooperation, advice and active involvement in the study.

“Beyond the content generated through the Future of Food project, the collaborative approach set up by Presans with SEB and Bonduelle, two other corporate leaders in the food industry, has been exceptionally rich. This type of synergy is at the heart of Danone’s strategy and of its execution: a recent example is our partnership with the American start-up How Good, with which we have co-developed a tool to help design our recipes to understand the environmental and societal parameters linked to the ingredients used. Complementary assets and a wealth of points of view are the keys to the success of innovation in a changing world.” [Danone]

“We can’t predict the future, but we can prepare for it. Collaboration with Danone and Bonduelle, combining our respective innovation paths, allowed us all to build a broader vision and be ready for the forthcoming challenges.” [SEB]

“The magnitude of the challenges facing the food system is huge and no single player can pretend to solve it on its own. Partnering with other players like SEB or Danone is essential to envision the future of food and what opportunities could

arise from bringing together technology and consumer expectations. It has proven to be very successful to share what each of us considers to be the certain future and to explore together what a not-so-certain future could look like.”
 [Bonduelle]

The trends shaping the future of food

It is helpful to consider the trends shaping the future of food in three categories: Usage or consumer trends, food technology trends and, considered separately because of its scale and diversity, digital technology trends¹. In the study no less than 24 discrete trends were identified, as shown in Figure 1.

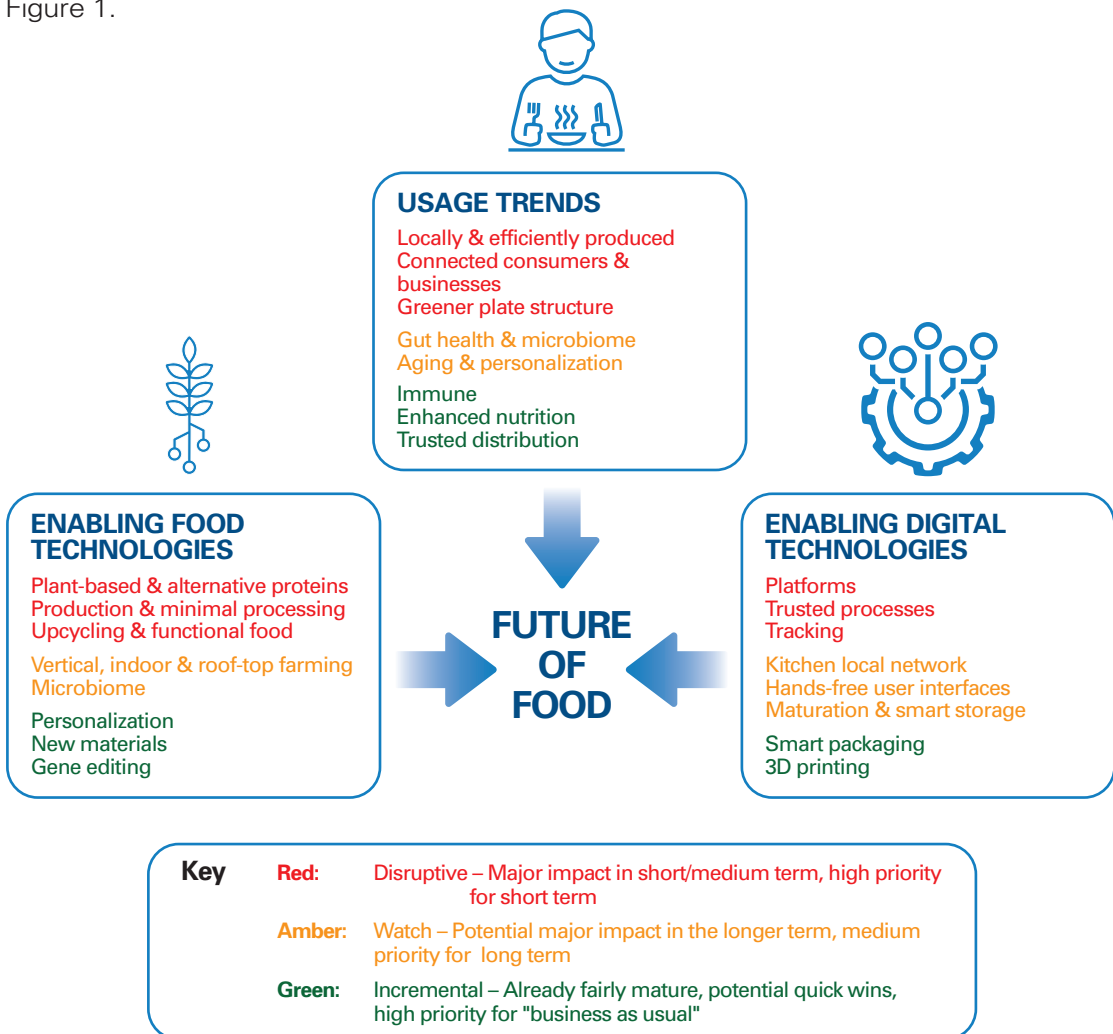


Figure 1: Trends shaping the future of food

1. Trends in advanced materials and packaging are also relevant, but were not included in this study

The trends were classified in terms of scale of disruption potential and maturity to identify those which were Disruptive (rapidly developing, key for the short term), Watch (potential for major impact in the longer term) and Incremental (already fairly mature, important for quick wins and “business as usual”). Although it is beyond the scope of this article to go into the details of all 24 trends, there were some clear overall messages about what food companies should focus on for the future.

Usage trends: To remain global, companies need to become more local and connected

Among the usage trends, the three that are most disruptive and key for the short-term roadmaps of food companies are Localization of production, a Greener plate structure and Connected consumers and businesses.

Consumers increasingly value regionality and seasonality, minimal processing and packaging, small producers, upcycling and waste stream management. They are also looking for fewer additives, more plant-based food with high quality (including gene-edited), and good-tasting plant proteins replacing meat and dairy. At the same time, consumers are already becoming much more connected and active digitally, in terms of both how they purchase and how they source information about food. They will increasingly build trust within communities and opinion formers rather than merely accepting information from global brands. For example, the “r/food” community on Reddit has 19.5 million subscribers and is the 19th most popular on the platform. Networks such as the Open Food Network and collective purchasing platforms such as Pool.Farm are extending the notion of farmers’ markets into the digital realm. Small businesses will be increasingly part of the value chain, and there will be increasing use of dark or ghost kitchens (preparing food for direct delivery). These trends, which to an extent already existed, have been further accelerated by the pandemic.

This means that to stay successful at a global scale, large food companies will need to become much more local in their operations, with greater leverage of local suppliers and distributors, more tailoring to suit local needs, and more emphasis on engaging and connecting locally with consumers. These things can be difficult for large companies to achieve at scale, requiring innovation and, in some cases, transformation to remain competitive.

Food technology trends: Taste, texture and quality of alternative foods are key drivers

The most disruptive food technology trends are shown in Figure 1 as Plant-based & alternative proteins, Production and minimal processing and Upcycling/functional food.

Ever-increasing environmental and sustainability pressures are driving food production towards the use of proteins other than meat, including plant-based, fungal or insects. For example, plant-based meat alternatives have already grown quickly at rates of up to around 30 percent in the last two years. This also means that new production and processing technologies such as fermentation technologies, gene editing, process enzymes, and soil microbiome science will become increasingly important. Upcycling and avoidance of food waste is also rising on the social and political agenda, requiring new technologies such as 3D printing to create new functional foods. However, there are still major consumer barriers towards acceptance of these alternative foods instead of conventional products – they just don't taste as good. It is therefore key for food companies to innovate around how to create the taste, texture and quality attributes that consumers value and expect as the shift towards alternative and functional foods progresses.

Digital technology trends: “There are two types of companies – tech companies and dead companies”

In the category of digital technology trends, Platforms, Trusted processes and Tracking emerge as the most potentially disruptive.

What we mean here by a platform is the ability to support the entire business with a unified digital platform infrastructure, enabled by new data analytics technologies such as artificial intelligence and machine learning. As food companies vastly increase and extend their partner networks (see also the usage trends above), as well as with ever-increasing consumer and regulatory standards and expectations, it is essential to be able to provide the necessary assurance, trust and traceability along the entire chain from farm to fork – blockchain technology has applications in this field. To maintain and improve efficiencies, companies will need to embrace technologies in remote sensing and automation. To be responsive and dynamic, they will need to be able to connect seamlessly with consumers, producers, suppliers, co-manufacturers, distributors, retailers and other value chain partners.

The quote above, “There are two types of companies – tech companies and dead companies,” from US professor Gregory Leblanc at UC Berkeley, may sound dramatic, but it is scarcely an exaggeration.

Characterizing the future

Based on these trends, an expected future in a five- to 10-year time frame can be characterized in terms of four scenarios, as shown in Figure 2.

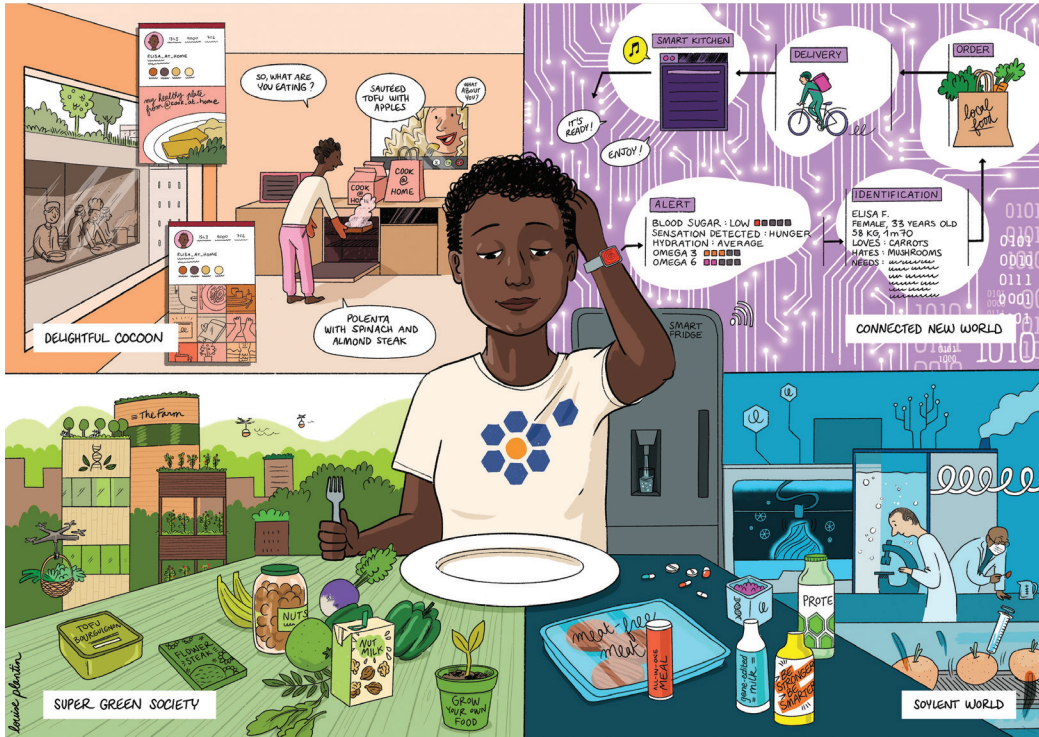


Figure 2: Future of food scenarios, © Louise Plantin, Presans (2021)

These scenarios should not be seen as alternative futures, but rather complementary and interconnected aspects of an expected overall picture. All aspects should therefore be considered in any long-term strategy, although the emphasis for each company will vary depending on its role, vision and strategic positioning.

1. Super Green Society

At the bottom left, and closest to where we are today, is the "Super Green Society" scenario. Here, environmental sustainability issues continue to rise in prominence. Awareness of the impact of eating habits on the planet

increases, and the consumer's plate becomes greener, with alternative proteins, local production, natural, and "free from" increasingly coming to the fore.

Supporting the drive towards plant-based and non-animal food is a clear priority in this scenario. The plant-based meat global market has been forecast to grow at nearly 20 percent annually over the next six years, from \$3.3 billion in 2019². There are many opportunities to innovate, such as health-beneficial foods for seniors, fermented foods, and waste reduction through new treatment technologies and packaging.

2. Delightful Cocoon

The "Delightful Cocoon" scenario reflects a significant shift in how consumers eat in the post-pandemic world. In a reflection of the increasing desire for personalization and individual well-being in a world where risks and threats are ever-present and increasing, in this scenario consumers spend nearly all their time at home, including meals. The offering for domestic meals has become increasingly sophisticated, with more use of ghost or dark kitchens and finishing at home, enabling almost any style and quality of food to be enjoyed. Some aspects of this scenario are already with us, driven by the pandemic.

In this scenario, there are opportunities to leverage the growth in on-demand food. According to Euromonitor, ghost kitchens are expected to replace 25 percent of in-store beverages and 50 percent of takeaways, growing to \$1 trillion by 2030. Companies such as Gorillas and Getir are examples of new service providers that deliver fresh groceries and local brands to the doorstep in 10 minutes. Getir, currently valued at \$7.5 billion, now operates in Turkey, the UK, Germany, France and the Netherlands, and is looking for expansions in the US and Brazil.

2. Source: Grand View Research market analysis report, September 2020

3. Soylent World

In this scenario the concept of synthetic, engineered food has become the norm. Gene editing is broadly used to bring new properties and benefits to food and raw materials, such as taste, texture, health and reduced environmental impact. Milk, meat, and vegetables are grown in vitro and 3D printed. Such food is currently a long way from consumer acceptance, although it is likely to be an increasingly significant part of the plate in light of future pressures on the environment and the world's resources. It may be some years before these pressures are sufficient to override consumer acceptance barriers.

In the meantime, there are many innovation opportunities in gene editing, also in combination with functional foods to deliver personalized health impacts enabled by digital technologies. For example, Nestlé is constructing new businesses that provide optimal nutritional solutions based on individual biological and behavioral data. Partnering is a key aspect of providing these types of solutions, including data and technology specialist companies to enable acquisition of data, development of new assays for nutritional status measurement, and development of new equipment.

4 Connected New World

Finally, the "Connected New World" scenario envisages full digitalization across the entire food value chain, from farm to fork. In this scenario, social media has accelerated the growth of narrow communities representing specific interests, concerns and food experience desires. Digital technologies have enabled the scaling up of personalization and significantly improved health and sustainability. Some aspects of this scenario are already with us today, although there is still a long way to go.

There are already many examples of digital platforms operating at the consumer interface. One such example is PepsiCo's use of integrated B2B and B2C customer engagement tools to allow consumers to participate in

promotions and awards directly from a mobile phone scan from their local mom-and-pop store. Another example is the Internet of Things technology used by Coca-Cola bottlers in smart coolers to remotely track productivity, security, and stock levels and to boost sales.

Insights for the executive – Ensure a clear innovation vision and purpose

The food value chain is facing more disruption than at any time in the past, and the pace of change is accelerating. The four scenarios outlined are expected to be complementary aspects of this future, and companies need to take action now and in the coming years to anticipate their implications. The strategy to pursue will differ depending on each company's position and role in the food value chain – it is not possible to suggest specific innovation priorities that would be generically applicable. At a high level we suggest a four-step approach to identify the way forward, as shown in Figure 3.

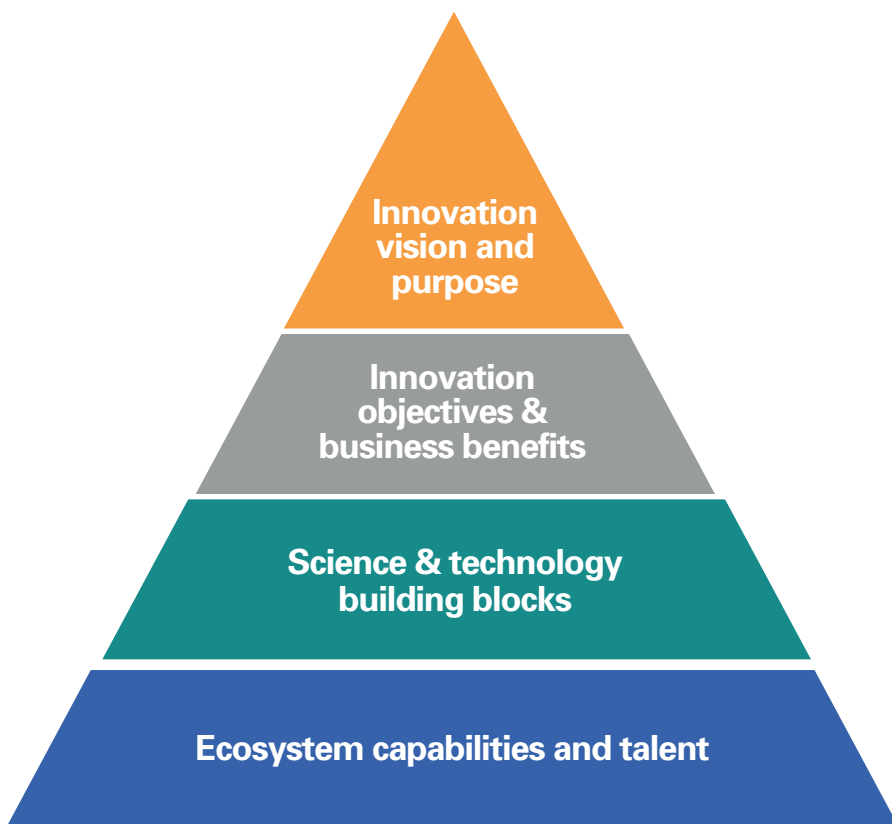


Figure 3: Innovation framework

- Define a unique and clear vision **of what research & innovation should bring to the company** and to the world. The innovation purpose should be aligned with a higher company sense of purpose or “raison d’être”. This needs to be defined at a higher level than merely the products and services that the company currently offers. Such a vision can be used to develop a strategic positioning that is focused in terms of the role(s) to be played in the value chain, yet also flexible enough to enable a stretch towards radically new products and services. Depending on the positioning, this may align with one, or a combination, of the four scenarios.
- Based on the innovation purpose, define the specific **innovation objectives** to pursue, and identify and qualify the business benefits to customers, stakeholders and society. In this sense an innovation objective could be defined around, say, improving the taste, texture and appearance of plant-based food, or reuse of food waste.
- Use the innovation objectives and scenario alignment to help guide which specific **science and technology building blocks** to pursue. These will normally form the main content of the company’s research and technology roadmaps.
- Build and engage **capabilities** and talents from within the company and, perhaps more importantly, the broader partner ecosystem to develop and pursue the science and technology building blocks.

Defining a strategic direction in a rapidly changing environment is challenging. Perhaps paradoxically, it is usually those companies with the clearest and strongest sense of purpose that are best able to adapt and transform themselves to meet the needs of the future.

“Consumers’ expectations and behaviors are moving faster than ever before and the pandemic has accelerated pre-existing shifts. It is absolutely critical for us to build scenarios of the future to inform today’s investment decisions and to be prepared to reinvent ourselves.” [Danone]

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The authors would also like to acknowledge the special contributions to the study of experts Sara Roversi, Usha Palaniswamy, Robert Comber, Rodolphe Barrangou and Geert Van Poppel.



Hyper-collaboration in the healthcare and life science industry – The new imperative

Dr. Franziska Thomas, Ben van der Schaaf, Dr. Ulrica Sehlstedt, Robert Smolander, Matilda Berg, Jacqueline Gross

The COVID-19 pandemic demonstrated the ability of the healthcare and life science industry to respond to unexpected needs with unprecedented speed. However, independent of the pandemic, the industry was already facing transformation in light of multiple, highly disruptive innovations not only in the traditional field of drug modalities, but also in related fields such as digital, AI, data and medical devices. This new “Future of Health” is driven by a multitude of new players and innovations with disruptive potential and new ways of thinking

about health, both at a large scale for population health and at an ultra-targeted level through the potentially curative treatment of individual diseases, such as for CAR-T or gene therapies and precision medicine.

The industry’s response to the pandemic and its transformation towards the Future of Health may at first seem unconnected, but they share the same foundation – innovation is no longer driven by one

or two companies, but rather, by a large number of players in an extended partner ecosystem, requiring collaboration at an unprecedented scale. Driving innovation at speed requires all players to think and act in large “hyper-collaboration” networks.

The successful rapid development and rollout of multiple COVID-19 vaccines has demonstrated the potential speed of innovation within healthcare and life sciences. Our third article explains why the same ecosystem collaboration approach is underpinning wider changes in healthcare, transforming innovation speed as we move to the Future of Health.



What does hyper-collaboration mean?

“Hyper-collaboration is based on the fundamental belief that it is innovation ecosystems, not individual companies, which will deliver the novel solutions the world is waiting for. Hyper-collaboration means seeing ecosystems for what they are: not just candy stores full of opportunities, but fiercely competitive arenas in which companies fight for the best partners, technologies, and networks to create, build and defend added value. It also implies adopting a mind-set that, until proven otherwise, someone somewhere has already figured out what works best – and that it is unlikely that this person works in your company.” [Ecosystem Innovation, Prism First Semester 2017]

Although hyper-collaboration itself is not new, it is now becoming central to success in a growing number of sectors. Companies that fail to change and adapt risk being sidelined by newer, more agile players. The remarkable success of small biotech companies in beating established players in the race for a COVID-19 vaccine is just one recent example of this trend.

In this article we look at how hyper-collaboration is now becoming a key success factor for the healthcare and life science industry, and draw some lessons on how to make it work effectively. These lessons are also relevant for other highly complex industries with new and potentially disruptive players, such as aerospace, transportation and finance.

A fast-evolving landscape creates a need for hyper-collaboration

Innovation is happening at a faster pace than ever, with digital and data-driven technologies alongside new molecular treatments disrupting the healthcare and life sciences industry and causing new players to emerge.

This is manifested through:

- A greater ability to combine basic research and large data approaches to rapidly improve understanding of the human body and diseases.
- New tools to develop and deliver medications in terms of both biological tools (such as CRISPR gene editing) and hardware such as robotics and 3D printing.

The time from discovery to clinical concepts has therefore shortened significantly, with a multitude of new concepts rapidly emerging and moving into usage.

Innovation across the sector is also becoming much more complex. The industry has moved from being dominated by seemingly simple chemical molecules that could be applied as tablets or solutions such as aspirin, to the introduction around 20 years ago of more complex biological compounds such as recombinant proteins and antibodies (e.g., insulin or Herceptin). These have been driving much improved treatments for diseases such as rheumatoid arthritis and cancer, and have been a major growth driver.

Today, the landscape is changing again, with more and more complex drug modalities, including cell and gene therapies and mRNA vaccines (as seen in COVID-19 vaccines), now becoming commercially available.

The hemophilia example below demonstrates both how innovation has accelerated over the last decade and how well-established players can rapidly be made irrelevant by new and innovative approaches that are often driven by new-entrant biotech companies. A further insight is that there are a multitude of radically different new treatment options on the horizon, with some uncertainty as to which technology will ultimately win.

Case study – Hemophilia A

The evolution of treatments for hemophilia highlights the pace of change in healthcare. This rare disease leads to uncontrolled bleeding due to a lack or reduced levels of coagulation factor VIII. The first treatments with coagulation factors purified from blood became available about 50 years ago, but were mostly used to treat acute bleeding episodes. Treatment was revolutionized in the early 90s with the production and preventive use of recombinant coagulation factors, which allowed patients to live much more normal lives and survive much longer into adulthood and beyond, although with a heavy treatment burden.

But then very little happened until, in 2014/2015, approval was given to the first recombinant factors with extended half-lives, resulting in less frequent injections and more effective treatment. However, there was still a significant population of patients for whom the treatment became inefficient through autoimmune reactions. Although this effect can be treated, it is a significant burden on patients. This effect has now been solved by Roche's Hemlibra®, a bispecific antibody that mimicked the effect of factor VIII and was initially approved in 2017/2018. This is now quickly surpassing other treatment options.

However, in parallel with traditional protein and antibody treatments, alternative treatment options such as siRNA and, most impressively, gene therapies are about to become available. The first gene therapy for hemophilia is now in regulatory review, with a potential approval this year, and promises a complete cure for this genetic disease that will – if successful – make both existing treatments and those that are still in development obsolete.

New alliance models in times of hyper-collaboration

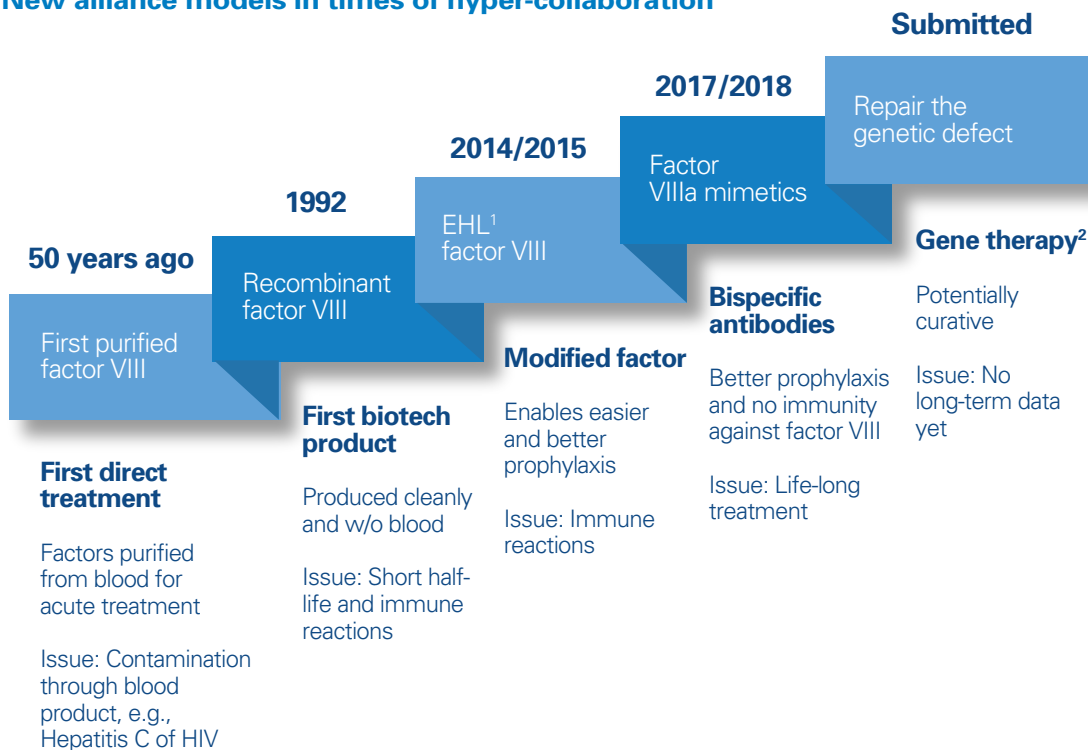


Figure 1: Haemophilia treatment developments

The same effect has also been demonstrated in the race for a COVID-19 vaccine, in which traditional methodologies competed with novel and largely unproven new approaches such as vector vaccines and mRNA vaccines. Ultimately, these were more successful, but it would have been impossible to predict mRNA’s resounding success even a year ago. As technological complexity and innovation speed increase, effective collaboration becomes central to success.

Managing greater complexity in ecosystems

Oncology (the treatment of cancers) is a further example of hyper-collaboration and gives us a taste of the future of medicine in general as we move towards the “Future of Health”. Although cancer treatments are traditionally based on a combined approach of surgery and radiotherapy or chemotherapy, newer treatments also see combinations with molecular therapies based on the characteristics of individual tumors. Additionally, in recent years, we have increasingly

seen approaches using the activation of the immune system, either in immune-oncology drugs or with the use of ultra-targeted cell therapies such as CAR-T.

For the future, there is an expectation that treatments could well entail the use of between five and seven drugs or drug modalities in combination, which will require a network of multiple players and IPs. In addition to these complex drug combinations, future treatments will require the development of the right diagnostics and tools to analyze tumors, as well as the right support to analyze and curate the data gained to predict the right treatment for the right patient (precision medicine). On top of that, we expect that, with constantly improving treatments, cancer will become a chronic disease and require treatment of patients in their own homes, supported by remote monitoring. This is where innovations such as Alexa and the logistics offered by an Amazon pharmacy can bring in additional players and innovations. Again, this is a trend that was also accelerated by the pandemic, when immune-suppressed cancer patients were rightfully scared of being treated in hospitals with COVID-19 cases.

This results in significant complexity challenges when it comes to organizing clinical trials, and also raises questions around the management of IP in order to make collaborations more attractive for small biotech or medtech players, as well as large pharma or tech companies.

How hyper-collaboration helped develop the COVID-19 vaccine in record time

As well as picking the right solution from a widening number of potential treatment options, innovation success now depends on hyper-collaboration between multiple players and biotech companies.

The development of COVID-19 vaccines is a best-practice example of how companies have tapped into new types of partnerships and technology to successfully bring novel pharmaceutical products to market in record time. During the

first half of 2020, hundreds of promising COVID-19 vaccine candidates entered preclinical trials. The majority of these candidates were co-developed by pharmaceutical companies, academic research institutes and governmental agencies, such as AstraZeneca and the University of Oxford, Arcturus Therapeutics and Duke-NUS Medical School, and Moderna and the American National Institute of Allergy and Infectious Diseases (NIAID). Partnering in such constellations secured joint access to quality research, as well as drug development capabilities and funding.

Of the four established global vaccine powerhouses (Pfizer, Merck, GSK and Sanofi), only the first actually delivered an effective solution – but solely by choosing an unproven technology (mRNA) in a new partnership with BioNTech. The other three major vaccine makers stuck with proven methods involving much longer timelines and failed to get the same results. Merck abandoned its trials, while GSK and Sanofi have some promising vaccine candidates, but are well behind the frontrunners. GSK has belatedly stepped up its efforts to build out its partnership with CureVac, another company focused on mRNA technology.

So what did Pfizer do differently to succeed, not only in the vaccine field, but also by becoming a major player in mRNA technology through its partnership with BioNTech¹?

- 1.** It acted decisively in mobilizing its resources toward developing an mRNA vaccine. It bet on an unproven technology and an untested partnership with BioNTech. The partnership was started on a handshake, and the contracts followed later – which is highly unusual in drug development. In contrast, Merck’s CEO declared early on that timelines of less than a year were unrealistic, and it stuck to its existing development methodology.

1. From “How we did it” by Albert Bourla, Harvard Business Review May-June 2021

2. Pfizer recognized that the global need and urgency changed the environment, with risk and short-term return becoming less important. It went all-in for the “moon-shot” challenge of a six-month vaccine development timeline, “doing the right thing” while also playing the new circumstances well and taking full advantage of regulatory flexibility.

3. It leveraged the partnership with BioNTech optimally, which is clearly the other big winner in this story. Well before the final terms of the partnership were hammered out, investments were made and confidential information shared because of mutual trust from working together previously.

The importance of ecosystems

However, Pfizer’s success was not due to a single partnership – there was a whole ecosystem behind it. This included the Chinese researchers who shared the genetic sequences of the COVID-19 virus (which made the fast development of all vaccines possible), the designers of the boxes that allowed vaccines to be shipped and stored at ultra-cold temperatures, and the developers of the liquid nanoparticle vesicles, which deliver the mRNA to the cells in the body.

New alliance models in terms of hypercollaboration

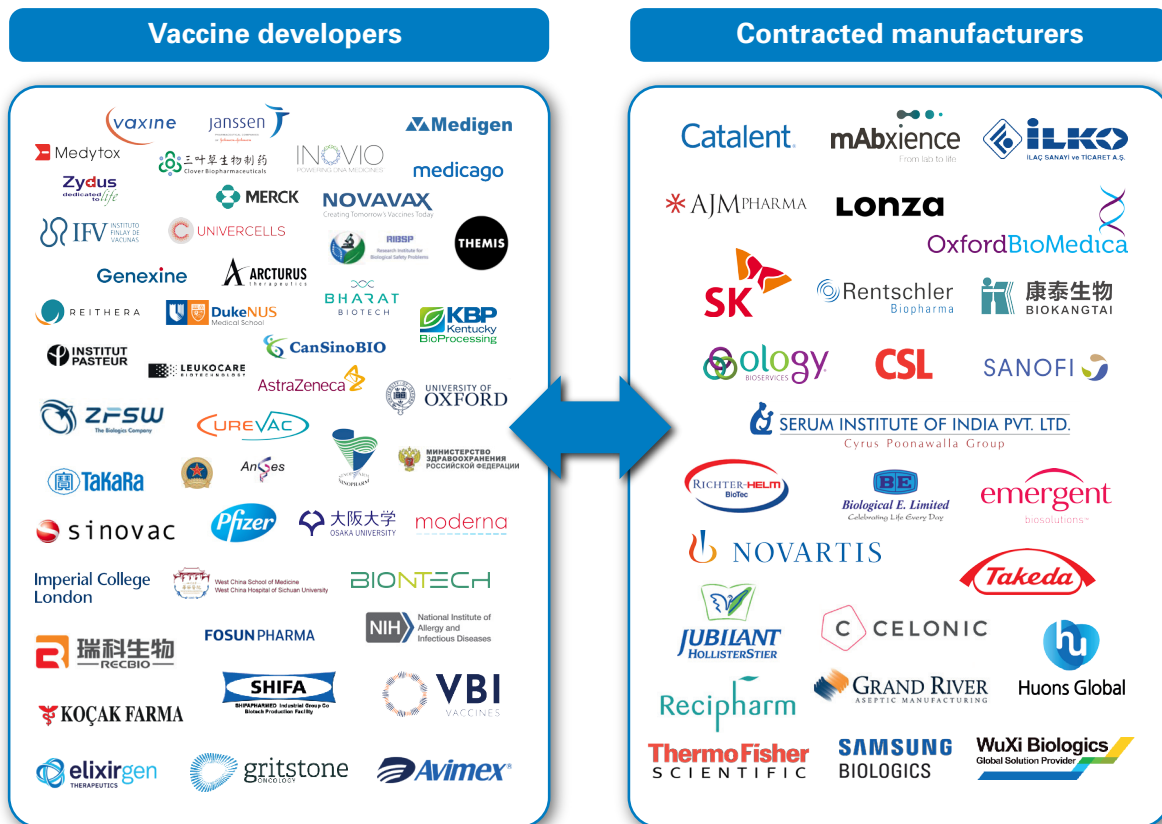


Figure 2: COVID-19 vaccine-manufacturing partnerships

Most importantly, as vaccine candidates moved from preclinical into clinical trials, their developers began to establish additional partnerships with vaccine manufacturers to secure large-scale production capabilities. Given the huge demand, this required partnerships with up to 20 different contract manufacturers for each vaccine, which brought significant challenges around complexity and scale.

The hyper-collaboration extended beyond traditional contract manufacturers, as their capacity remains insufficient. This has given rise to a new type of innovative partnership, in which pharmaceutical companies offer their spare capacity to their own competitors. For example, Sanofi conducts fill-and-finish activities for BioNTech, while Novartis, which no longer has a vaccine business, produces vaccines for Pfizer-BioNTech and CureVac.

Of course, Pfizer was not the only winner in the vaccine race, and others also achieved great success due to collaboration:

- Moderna accelerated its strategy by 3–4 years and was close on the heels of Pfizer with a highly effective vaccine. It saw its share price increase sevenfold.
- AstraZeneca was not an established name in vaccines before the pandemic, but it (rather than UK rival GSK) moved fast and quickly established a collaboration with the University of Oxford, and delivered an effective vaccine within the year.

Lessons on managing extended networks effectively

Although alliances are not new to the healthcare and life science industry, their current scale and complexity are, and this will only grow over time. Instead of traditional bilateral networks, partnerships and alliances will often require involvement of multiple players, including biotech, pharma, medical device and health tech companies, as well as academia, payers/providers and even regulators. This makes it critical to be able to successfully manage not only one or two collaborations, but a network of hyper-collaborations. The same is also true for other highly regulated industries, such as telecommunications and utilities.

Hyper-collaboration brings multiple benefits, including shared risk, reduced cost, greater utilization of unused IP, better access to funding and talent networks, more innovation capacity, and improved transparency and trust with patients.

However, there are also challenges, including alignment of goals, objectives and incentives; tracking progress across multiple partners; managing IP; standardizing processes around data collection, annotation and sharing; and logistics.

Like any stress test, the pandemic has shone a spotlight on how well – and how badly – businesses are set up to respond to disruption. Executives should be wary of writing off the pandemic experience as a “one-off”, and instead make the most of it to bring about essential and valuable change.

Alliance management is different from project management, requiring a strong focus on governance, communication, culture, problem solving, and conflict resolution. All types of partnerships and collaboration need a well-designed steering committee that oversees the research plans, governs the collaboration and ensures compliance. This is a key success factor to prevent and solve problems early on to build the relationships, agree on and manage intellectual property, and set the overall objectives of the collaboration. As the partnerships, alliances and networks grow in complexity, the role of the steering committee will become increasingly important for success, as it sets the foundation for collaboration on all levels.

We can draw some lessons from those companies in healthcare and life sciences that have been successful in pursuing hyper-collaboration:

- **Alliance purpose, strategy and vision – What to look for in an alliance**

Alliances are collective efforts to achieve a common goal, with each party contributing certain capabilities/innovations/technologies. Accordingly, it is imperative to clearly define the purpose, strategy, and vision of an alliance and the key elements needed to achieve the goal. When building or entering an alliance, each player needs to understand its role and position, as well as the role of the other parties involved and what each should contribute in terms of human resources, cash, knowledge, IP, and equipment.

- **Adequate alliance management**

With a multitude of different players involved, it will be complex to align the overall objective and make sure all players work towards the same goal. Problems that occur need to be quickly and efficiently resolved, and it is essential to ensure compliance from each party involved. The alliance management and governance structure need to be clearly defined and agreed at operational, tactical and strategic levels. Sufficient resources with the right capabilities need to be allocated to manage the partnership. Specific areas of focus

should include information and data management, IP management, commercialization of outputs, and operational models.

- **Fair risk and benefit allocation – A new business model?**

All parties involved need to be adequately incentivized to contribute. With collaboration partnerships becoming more diverse, greater attention needs to be paid to relevant risk/benefit-sharing models. With a large amount of IP and innovation involved, this will require new and innovative business models to share development, launch and production risks, while also offering fair compensation models outside traditional IP and patent approaches.

- **Cultural change – From competition to collaboration**

Collaborating in alliances requires a different mind-set and culture. To make network- and alliance-based collaboration models work, companies need to adopt an open mind-set to share knowledge, data and information, while at the same time protecting key assets. Assess whether your corporate culture encourages enough entrepreneurial risk-taking, and if not, how it can be changed.

- **Assess and improve your agility**

Companies should learn from their pandemic experience to understand their current level of agility and what can be done to improve it, as well as assess organizational set-up and culture from an “ambidextrous” perspective – can scale/productivity capabilities and speed/creativity capabilities be delivered in a balanced way?

Although none of these factors alone may seem completely novel, the need to be proficient in all of them has now become central to companies that want to remain relevant leaders in their fields. Healthcare demonstrates this – in the recent pandemic we have seen examples of big players being sidelined by small biotech companies or competitors that were able to build meaningful alliances, such as Pfizer and AstraZeneca. In the future corporate success will depend on having the capability to build, maintain and drive complex networks of alliances and collaborations that are attractive to all players – will you be able to shape the future, or will you be relegated to the margins?

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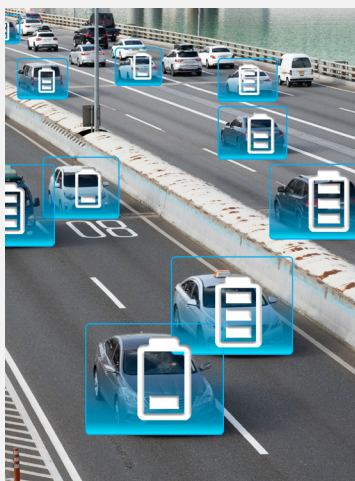


The role of hydrogen in building a sustainable future for automotive mobility

Dr. Klaus Schmitz, Dietrich von Trotha

Transportation and mobility need to decarbonize and dramatically lower the sector's emissions. This is necessary not just from a regulatory perspective, but also because only a truly sustainable transportation and automotive industry will be able to maintain its importance and prosperity in the long run.

Moving to a zero emissions future creates a once-in-a-century bet for the automotive, energy and transportation industries. The introduction of alternative powertrains and their related



energy concepts is becoming a choice between battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs) powered by hydrogen (H₂). Although they are complementary in many ways, the enormous investments required in R&D, production and infrastructure for each of them, combined with the requirements of scale for success, will mean making the wrong bet can potentially endanger the future of established automotive companies.

It is likely that investments will only pay out for one of the two approaches in specific applications if they achieve scale. Advantages in scaling will be very difficult to catch up with.

The choice for replacing fossil fuel combustion engines splits the industry. The world's largest manufacturers (VW by volume and Tesla by value), which are focusing solely on BEVs, stand against the second-largest, Toyota (plus Hyundai and some others), which has FCEVs as a core part of its

The pressing need to decarbonize mobility means automotive players are facing key choices around the fuels of the future. Taking a holistic approach, the authors explain why hydrogen is a strong candidate for powering automotive transformation and how a global green hydrogen ecosystem is likely to develop moving forward.

strategy. This divide is contentious – Elon Musk of Tesla has described hydrogen as “staggeringly dumb”. However, even a dual strategy (as pursued by the likes of BMW and Daimler) can lead to risk if it dilutes the focus, development speed and scale required for success.

At first glance, multiple factors seem to point to BEVs as the best option for a zero carbon world. They are more efficient than FCEVs, they are ahead in market penetration, and industry and infrastructure around green hydrogen are underdeveloped, which has led to supply constraints. Additionally, as green hydrogen has further vital uses for decarbonizing, some argue that limited supply should be focused on the applications with the highest immediate carbon reduction impact, for example replacing the current grey hydrogen used in industrial sectors such as chemicals, which cannot be easily transformed through electrification.

However, to gain a full perspective, a wider, more holistic approach needs to be taken, looking beyond these perceptions. In this article we argue that taking such an approach shows that hydrogen does indeed have a key role to play in building a sustainable future for the automotive sector, and we illustrate this with some example applications.

Taking a holistic view of the hydrogen economy

Three interlinked factors determine the desirability of supplying hydrogen for automotive applications: First, the global availability of a sufficient and competitive supply; second, the distribution of the available hydrogen supply between the automotive sector and other industry applications; and third, the achievable efficiency of hydrogen versus green electricity. Taking this holistic view enables players to make more informed decisions about their strategy.

1. A global hydrogen economy and ecosystem will emerge

Although renewable electricity production in Europe is continuing to grow, there are limitations in its ability to meet the continent's needs. In Northern Europe, for example, wind power is costly and available onshore space is limited. More generally, in many heavily industrialized regions with high demand, including Europe, Japan, and South Korea, renewable electricity generation is more costly than in other parts of the world. Although nuclear power remains an option, this is still expensive and a growing number of governments have, in any case, ruled it out as an energy source.

Nearly all forecasts suggest that a significant part of the energy needs of these regions will need to be imported, which will drive the development of a global hydrogen economy. The greater yield potential of key locations for renewables, such as solar in Namibia, Chile, Australia and Saudi Arabia, will create investment and drive cost-competitiveness for green hydrogen generation. Japan has already signed agreements to import green hydrogen from Australia, for example. Similar projects on exporting hydrogen¹ are evolving in Chile, Morocco, Oman, Brazil, Saudi Arabia, southern Europe² and more.

This new industry opens up opportunities for players in the wider ecosystem, including, for example, generation, distribution, fueling stations, brokerage, and electrolyzers. We expect that this will lead to a sufficient supply of hydrogen globally from 2030 onwards.

1. Hydrogen and other fuels based on hydrogen, e.g., synthetic fuels or ammonia

2. Southern Europe (e.g., Portugal, Greece) is considered "global" here

2. It is advantageous to use hydrogen in the automotive as well as industrial sectors

When comparing the various uses of hydrogen in a decarbonizing economy, two applications stand out due to their current activities and expected demand. First, the existing chemical industry, which currently uses grey hydrogen (generated from fossil fuels) as feedstock and, second, automotive mobility. Today, with not even 5 percent of current hydrogen produced from green, renewable sources, there is insufficient supply to cover both.

Given that BEVs are an available option for automotive mobility, and that their downstream consumption efficiency is higher than that of FCEVs, some therefore argue that green hydrogen use should therefore focus on where it can deliver the greatest overall carbon reduction benefit, such as replacing grey hydrogen in industry.

However, this argument misses some key points. Firstly, as we have explained above, we expect that rapidly growing demand will drive a global green hydrogen supply economy that will be sufficient to meet both industrial and automotive needs over the long term, towards 2030 and beyond.

Secondly, we expect that pricing levels for green hydrogen will be such that application in the automotive sector will still be relatively attractive versus other industries. Even with increasing CO₂ prices and tightening regulation, green hydrogen prices will be substantially higher than taxed grey hydrogen, naturally slowing its adoption. At the same time, automotive emissions regulations are likely to remain stricter than those of heavy industry, driving the use of green energy for automotive applications at even higher cost.

Ultimately, many forecasters, such as the German Energy Agency, predict that our global ambition of net zero impact by 2050 will only be met with hydrogen application in multiple sectors, including automotive as well as heavy industry.

3. The real energy efficiency of hydrogen can be much higher than is commonly assumed

The majority of studies that compare FCEV and BEV use show clear efficiency gains for battery electric – achieving approximately 75 percent efficiency compared to roughly 25 percent for fuel cells, for example, as shown by Transport & Environment and Traton. However, these studies are based on the presumption that sufficient locally generated renewable energy will always be available to meet demand. As we have mentioned above, in practice this cannot be guaranteed in many high-demand regions, such as Europe.

To understand efficiency better, a broader approach needs to be taken that considers **energy production efficiency (upstream)**, which is specific to each country/region as energy is generated differently, as well as energy consumption efficiency (downstream), which is specific to each application and depends, for example, on powertrain efficiency. This downstream consumption component has been the focus up to now, with, for example, with the “tank-to-wheel” efficiencies that are embodied in current automotive regulations. Essentially, when fossil fuel energy resources are burned, they are lost; hence, it is vital to maximize their consumption efficiency.

In the renewable world a different approach is needed. The sun comes up every day, and the wind continues to blow. They are not used up in the same way as a barrel of oil. This means it is better to define efficiency in relation to the upstream generation resource as well as the downstream consumption component. For example, solar panels or wind power plants have different yields depending on their location: a solar panel in Germany generates 1,000 kWh/kWp p.a., while the same panel generates over 2,000 kWh/kWp in sunny locations such as northern Africa. When comparing these alternatives, electricity in Germany would start off with only 50 percent efficiency. Here, we are using a “panel-to-wheel” definition of efficiency³.

3. A broader term would be “source-to-wheel”, including other renewable sources such as wind power

Moreover, if surplus renewable power is available but cannot be used or stored, then generating green hydrogen is still the best approach for this surplus. In such a situation generating hydrogen from renewable electricity may be seen as highly efficient.

Furthermore, the efficiency of electricity compared to hydrogen for automotive applications varies dramatically depending on how green energy is produced. (See Figure 1.)

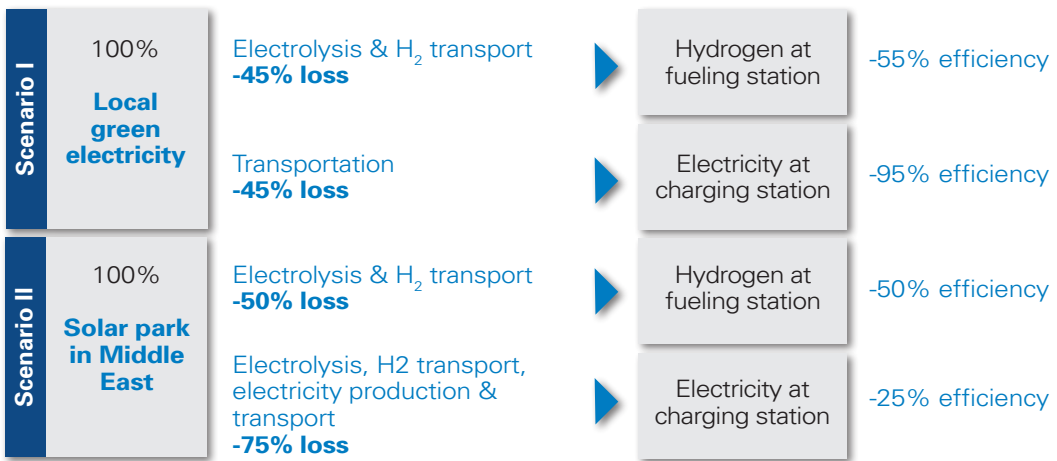


Figure 1: Upstream energy scenarios and impact on efficiency

Locally generated green electricity delivers **95 percent** efficiency, compared to **55 percent** efficiency when using this source to create green hydrogen. However, as green electricity cannot always be generated locally at the time and on the scale needed, some energy generation will be required from remote locations (such as solar parks in the Middle East). In this case, since the produced electrical energy needs to be converted to hydrogen for long-distance transport and back to electricity for local consumption, the efficiency of electrical power drops to **25 percent**, around half of the efficiency of hydrogen.

Challenging the assumption that green electricity is limitlessly available in the exact amounts, when and where needed, has an enormous impact on the applicability of BEVs and decreases their efficiency and green credentials. Green electricity production in Europe will not be enough to completely electrify the automotive sector, and even if this happened, the grid would not be able to cope with the transformation. It is also likely to have an impact on pricing, particularly around fast vehicle charging, which will significantly affect the operating costs of BEVs, such as in the heavy-duty/truck sector.

Hydrogen application in automotive mobility

This holistic approach to understanding the hydrogen economy leads us to the conclusion that hydrogen does have a key role to play in the zero carbon automotive sector of the future: there will be sufficient supply, pricing levels should not be prohibitive, and in many situations the real “source-to-wheel” efficiencies will be attractive versus BEVs.

Moving on to look at which automotive applications are likely to be the most attractive for hydrogen-powered fuel cells, heavy-duty trucks is the most obvious application for initial deployment. The large scale of the truck market is such that it can also act as enabler to other applications such as cars; hence, this will be decisive for the sector as a whole.

Assuming for now that both technologies, BEV and FCEV, will achieve technological requirements⁴, such as lifetime, range, handling of cold weather, vibration and refueling/recharging times, and further assuming that there will be an equal degree of regulation for both, four deciding factors remain:

4. 1.5 m km lifetime, range of 800 km for BEVs with 80 percent recharge in 30 min, 2,000 km for FCEVs with refueling in 15 min

- 1. Infrastructure:** If needed, both BEV and FCEV infrastructure can and will be built up, but charging and refueling need to fit well to operational processes. Rapid charging of the large batteries needed for trucks is an even bigger challenge than high-performance charging for cars in terms of the infrastructure, parking space and time required. Every minute that a commercial vehicle is off road, it is losing money, which makes minimizing charging time vital.
- 2. Energy prices:** With the decarbonization of electricity generation, electricity costs will be likely to increase substantially, potentially turning the current operating-cost advantage of BEVs into a disadvantage.
- 3. Autonomous driving:** With autonomous driving, which is expected to arrive in this decade for trucks, charging times can no longer double up as mandatory driver breaks. This makes the long-range advantage of FCEVs even more significant.
- 4. Payload:** A decrease in payload would negatively impact the business case. For high-energy demands and long-range requirements, batteries would weigh substantially more than the powertrain of FCEVs.

Strategic options for heavy-duty truck manufacturers

Coming back to the opposing positions in the automotive industry and looking at heavy-duty trucks in particular, manufacturers can take one of three strategic directions, each of which has its risks and relies on particular developments and scenarios taking place.

1. BEV-focused strategy

Successful adoption would rely on a combination of low electricity prices, a smooth charging process and substantial, transformative improvements in battery performance. The major risk to this strategy is the impact of autonomous driving on commercial range requirements and charging times.

2. FCEV-focused strategy

This relies on the fast emergence of a hydrogen economy with competitive prices and infrastructure in place. On the technology side, it requires advances in areas such as the durability of fuel cells above current development projections.

3. Dual with both BEVs and FCEVs

This is based on the belief that FCEVs and BEVs are both needed for different use cases within heavy-duty trucks, or else are adopted as a strategy to mitigate the risk of choosing one technology above the other. The main risk of this strategy is that the split focus means that insufficient resources are devoted to each, so that the scaling of FCEV (and BEV) technology cannot be achieved within necessary time frames.

Based on our analysis outlined above, which concludes that a strong hydrogen economy will be created with competitive prices independent of the automotive industry, and BEVs will be impacted by relatively high charging prices due to increasing generation costs, high infrastructure investments, and competitive market dynamics, we have determined that:

- By 2030 FCEV trucks will have a lower total cost of ownership (TCO), costing around 1.5 euro cents per km and ton, compared to 1.7 euro cents for a BEV equivalent.
- These costs are likely to fall further post-2030 as the global hydrogen economy accelerates.

Of course, there are still many other things that need to be factored in, for example, potential changes in technology such as advances in battery technology, changes in regulation that impact the current equivalence of FCEV and BEV technology, and any decisions made on the use of nuclear that could impact the local generation and wider use of hydrogen.

Furthermore, manufacturer strategies will also need to reflect the current product portfolio, regions targeted and capabilities.

Insights for the executive

Based on this broader perspective it becomes clear that commonly cited concerns around efficiency, prioritization or green hydrogen supply are not barriers to the use of green hydrogen in vehicles.

Efficiency is no argument against hydrogen

The industry needs to take a holistic view of decarbonization. Traditional efficiency measures will be different in a net zero world – inefficiencies in the use of green energy produced in the desert may yet turn out to be acceptable because of its stable, year-round supply. “Source-to-wheel” needs to be the metric to follow.

Given that many nations will rely on imported green hydrogen, the only question is whether to convert it to electric power locally in the vehicle, or centrally, and then transfer it to charge large batteries.

A new global hydrogen ecosystem will be created

Hydrogen is a third major pillar in decarbonization, along with energy efficiency and electrification, and can be used in industry and power generation, as well as mobility. For many industrial (feedstock) applications, green hydrogen is the only decarbonization option available if countries are to meet the 95 percent reduction target.

The current view, which states that in regions such as Europe green hydrogen will be produced from renewables, will change as economies switch to green hydrogen generated elsewhere. Although optimal, cost-competitive supply locations are scarce (requiring political stability, wind, sun, space and water), there will not be the same level of dependency as in oil and gas. This is because renewables can be produced in more locations – less optimal sites will simply cost more, adding to the need for fast investment decisions.

Players need to take a holistic view

Given the diametrically opposed moves of the two biggest car builders, the unpredictable nature of regulation and the dependency on scenarios involving technology advancements (such as batteries) and energy supply strategies, players may struggle to place their bets wisely. To manage this well, they need to build a holistic understanding of the situation, with focus on energy supply, regulation and technology, creating a strategic foundation for these make-or-break decisions. The optimal choice will be application-specific – essentially, hydrogen is more advisable the larger the energy demand. A BEV-only strategy based on the perceived inefficiency and unavailability of green hydrogen should be reconsidered, especially for heavy-duty applications. Dual fuel strategies must assure sufficient scaling through partnering.

Define your path now

As decarbonization is a must, every player in the sector, whether a regulator, investor or provider in the field of mobility, needs to define its specific vision and strategy for transformation. A thorough cross-sectoral understanding is needed, for example, to be able to predict future regulations. Scenarios involving energy supply, regulation and technology need to be defined. A basic strategic point of view needs to be developed, covering how much to follow certain trends or whether to rely on a pure holistic sustainability position (akin to a value investor such as Warren Buffett), as well as preferences around risk and gain.

The new ecosystem will offer a range of opportunities. Players (whether automotive, chemical or energy) need to position themselves now in the ecosystem, if necessary moving into related fields (e.g., electrolyzers, distribution).

The hydrogen race has begun, with a global green hydrogen industry becoming mature post 2030. Organizations therefore need to invest now to secure leading positions in the ecosystem as it emerges.

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This article has been published in collaboration with

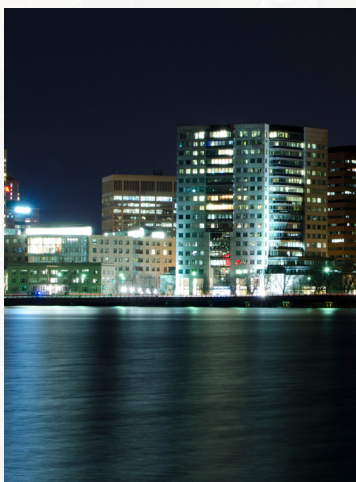
steer economic
development



The Future of Innovation Districts

Phil Webster, Simon Pringle, Elis Wilkins, Ben Thuriax-Alemán, Dr. Raymond Khoury

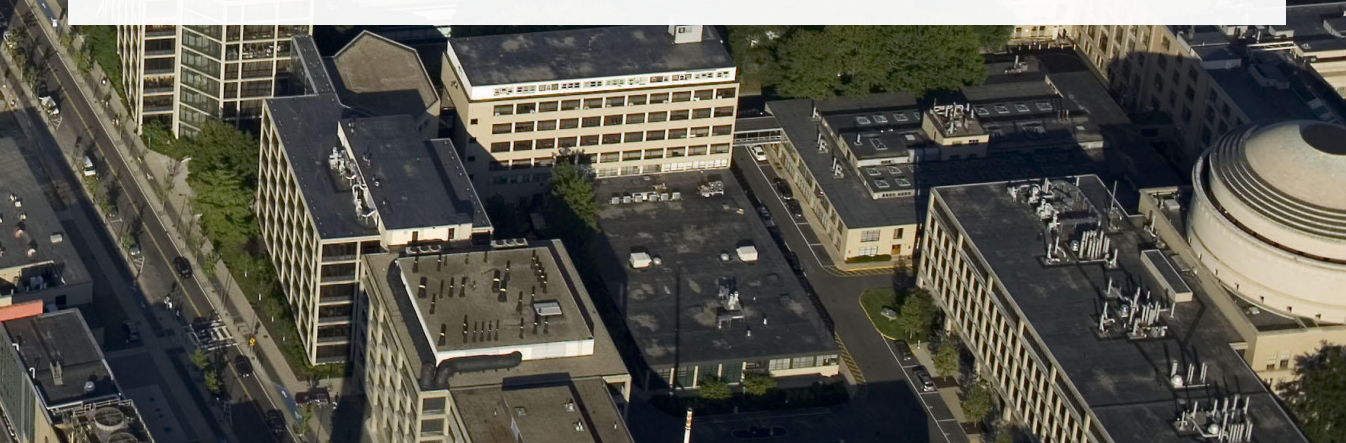
The way in which organizations innovate, and places where they are based to do this, have changed profoundly over the last decade due to two overall trends – convergence and disruption. Companies have moved away from closed innovation models to more open approaches in which organizations and places work in collaborative ecosystems and networks, forming “uncommon partnerships” between previously unrelated industries.



Enabling these partnerships is crucial as organizations look to embrace new growth paradigms. Providing the right physical location for this innovation to occur is vital. That has led to the development of the Innovation District concept. Simply put, an Innovation District (the most famous of which is Kendall Square in Cambridge, MA) is a dense

geographical area of supportive economic activity focused on innovation, which is near to one or more institutes of higher education, often in an urban environment that is ripe for regeneration. Unlike traditional science or business parks, rather than simply functioning as workplaces, Innovation Districts create places where people can live, work and play 24/7, and where you can “change jobs without changing your car park”.

Where innovation takes place has changed radically over the last decade, with the rise of physical Innovation Districts across the world that bring together researchers, start-ups and corporates to work and live in open ecosystems. Our article outlines the Innovation District concept and factors for success in a post-pandemic world.



In the new, post-COVID-19 world of work, Innovation Districts are well-positioned to thrive. Not only do they enable serendipity and foster innovation through the intensive co-location of different businesses and organizations (by offering physical space for complex supply chains such as in healthcare), but they also provide flexible, mixed-use office property with underpinning housing and entertainment offers. This makes them resilient and well equipped to grow despite the increase in virtual working – people are not only attracted to Innovation Districts to work, but also to live and access key amenities. Companies continue to benefit from a concentrated innovation ecosystem and supply chain in a single location, even if personnel are not located there full time.

To succeed, Innovation Districts need to focus on particular key success factors – or risk becoming just another business park.

Box 1: Innovation Districts and their competition

An Innovation District – sometimes referred to synonymously as an Innovation Neighborhood – is an agglomeration of economic activity that is focused explicitly on innovation and of sufficient density to achieve a critical mass in its own right, by ensuring representation from more than one part of a supply chain. It is actively managed to support the innovation imperative, but also allows the market within it to evolve to meet the needs of entrepreneurs.

Typically located in urban areas, Innovation Districts are focused on driving inter-firm linkages, collaborations and networks that are enabled and sustained by a wider ecosystem for innovation. They are usually built around large, world-renowned anchor institutions, such as universities, research institutes, and/or teaching hospitals. They offer office, residential and retail space, and sometimes access to shared research infrastructure that otherwise would not be available to a single individual business.

Innovation Districts differentiate themselves from traditional science or business parks through their urban locations, mixture of types of space, 24x7 operations and close focus on specific industries, with active management to support the right combination of tenants, networking for innovation, and close collaboration. Unlike incubators, they include a wide range of businesses across the ecosystem, from start-ups to large corporates, while they are more physically compact than potentially sprawling innovation clusters.

They lend themselves well to complex and multidisciplinary activities in areas of convergence between different sectors. Healthcare and life sciences is one such example, in which applied health innovation is being augmented by advances in materials science, robotics, telemetry, nutrition and advanced manufacturing.

Creating a successful and productive Innovation District that pulls in organizations and makes them want to stay is challenging, especially in terms of:

- **Attracting tenants:** In an environment where there are multiple competing property offers, such as lower-priced offices or science parks.
- **Time to return on investment:** For property developers, Innovation Districts are a long-term commitment that can have much slower returns than conventional property offers of offices, retail, or housing.
- **Creating diseconomies of scale:** As a District becomes larger, it also becomes more expensive for tenants and – as a result – less diverse, as smaller or less wealthy businesses are driven out of the area. For example, Silicon Roundabout in London's East End saw property prices soar and start-ups replaced by expensive housing and corporate offices.

- **Multidisciplinary stakeholder alignment:** Success requires buy-in from myriad property developers, local councils, universities, start-up founders, and the R&D departments of large, often international businesses, all of which have different priorities and expectations around risk and reward.
- **Creating a vibrant destination, 24/7:** Business and science parks often fail to fully engage with neighboring communities and shut down after office hours, becoming “ghost towns”. Bringing them to life and making them a focal point is a major challenge.

With these challenges and issues in mind, Arthur D. Little and Steer Economic Development (Steer-ED)¹ have benchmarked and engaged with some of the world’s most successful Innovation Districts over the last few years to identify the practical and tangible success factors to establish, grow and sustain a productive District for both developers and tenants. We spoke in depth to a range of successful Districts (Figure 1) and are grateful to these organizations for sharing their views. We also drew our work with a range of global innovation centers in France, Malaysia, Singapore, Chile and the Middle East, as well as with start-up accelerators and developing regional university-led innovation clusters in Japan.

1. Formed in Autumn 2016, Steer Economic Development (Steer-ED) was established to build on The Steer Group’s capabilities in transport and movement, and enhance its offer by diversifying into adjacent economic development areas such as infrastructures, enterprise, science and knowledge, skills, and low carbon. Steer-ED focuses on national, sub-national, regional, and local-level economic development, and has partnered with Arthur D. Little over several years to deliver projects within the innovation and economic development domains. <https://www.steer-ed.com/>

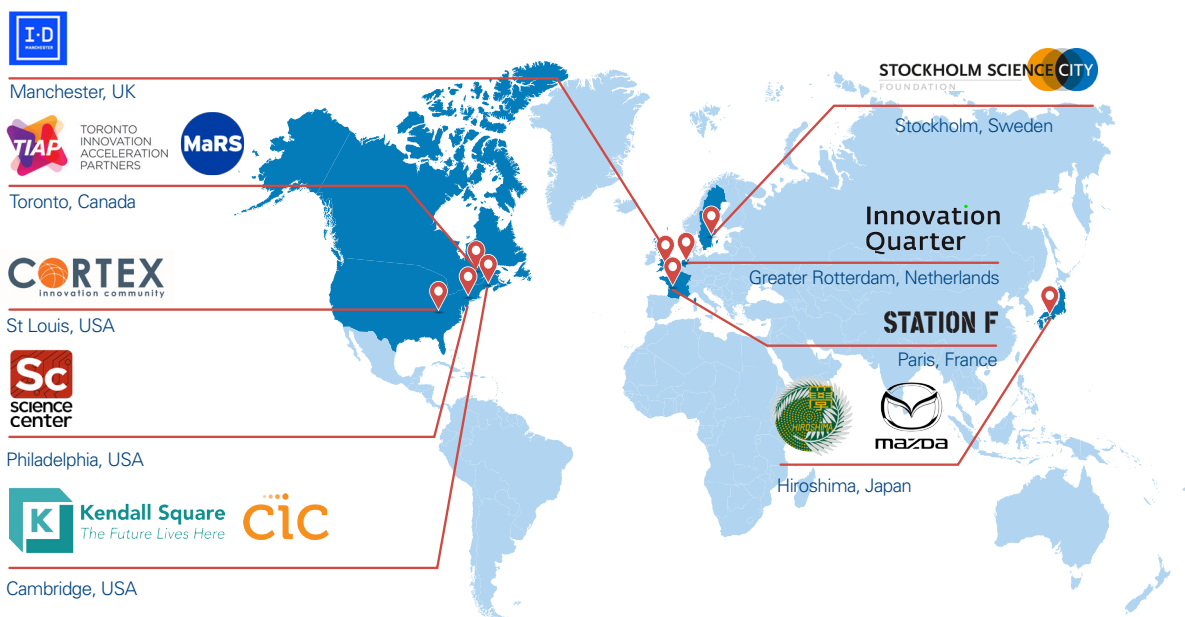


Figure 1: Leading Innovation Districts benchmarked by Arthur D. Little and Steer-ED in recent years

The essential fundamentals of an Innovation District

Successful Innovation Districts possess the same common characteristics that provide the building blocks on which they and their tenants can develop and thrive:

- **Access to talent and research outputs from one or more leading universities.** Major institutions can hold significant marketing value, particularly those that are “research intensive”. The highly renowned Karolinska Institute was one of four major institutions critical to the success of Stockholm Science City and its ability to attract major companies in the life sciences space. Kendall Square benefits from close proximity to MIT and Harvard.
- **Good transport connectivity** and flow of people around the District itself. For example, Kendall Square has a metro stop located within the District that can serve tens of thousands of people each day, enabling accessibility by foot.

- **Flexible accommodation to live, work and play,** normally facilitated by a central location and wide-ranging amenities operating 24/7. The Station F campus in Paris has become a destination in its own right thanks to its high-quality food offering, which is open to the public.
- **Proximity and density.** Innovation Districts must be located in areas of sufficient population density such that a critical mass can be achieved to drive the District's success. Being situated at the heart of Manchester (UK) will be a key feature of the recently announced £1.5 billion ID Manchester Applied Innovation District, the development of which Arthur D. Little and Steer-ED have supported over the last two years.
- **Access to the services of innovation.** The most active Districts include not just the "innovators", but also the professional services that they need to scale, including legal, finance (traditional and equity), accounting, and marketing.

However, there is a huge difference between what makes an Innovation District **functional** and what makes one **successful** in the long term. Underpinning these fundamental characteristics are eight key success factors (KSFs) that ensure that they are truly world class and differentiated in terms of attracting high-caliber talent, building a thriving community of businesses and, ultimately, becoming a success in terms of financial returns, jobs creation and, more critically, social cohesion.

What is crucial to understand is that these factors go beyond the property offer – setting the direction of the District and how the ecosystem within the physical buildings is created and curated is equally as important. Failure to understand this risks the District not delivering value to tenants and becoming merely another mixed-use development, rather than world class.

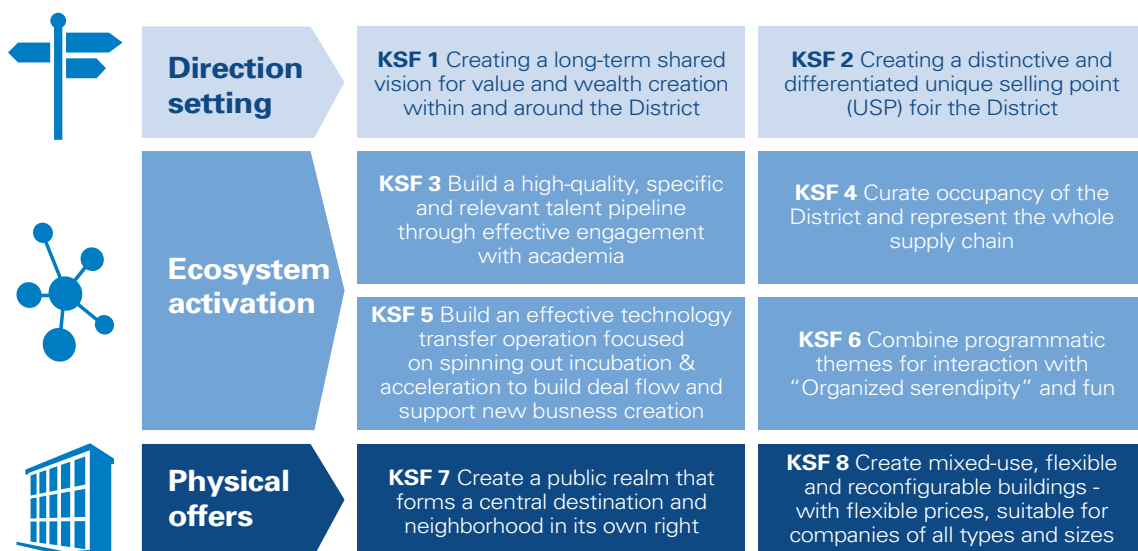


Figure 2: Key success factors in developing an Innovation District

Direction setting

KSF 1: Creating a long-term shared vision for value and wealth creation within and around the District

The greatest challenge in founding an Innovation District is obtaining alignment between multiple different stakeholders on what the District is trying to achieve. This is challenging because the value and wealth created are generally realized over a longer term compared to those of a conventional property development of retail, housing or offices, from which a quicker return can be made through property sales and rentals. This value is manifested not only in higher financial returns, through premium property rentals and other economic outputs such as company creation, intellectual property licensing and venture capital investment in new start-ups and spinouts, but also in broader value and wealth creation. These include jobs creation and knowledge generation, and wider socio-economic impacts such as health and well-being, engagement with local communities, environmental sustainability, and skills and learning.

It is key here to obtain buy-in from all types of stakeholders – research-intensive companies, local government, universities and property developers – on what a 10–20-year Innovation District vision should entail. Stockholm Science City is an excellent example of how this can be achieved by creating joint accountability and trust through defining the responsibilities of each stakeholder, regularly course-correcting vision delivery, and ensuring overall leadership by the university, with full support of the city municipality and other stakeholders. This vision does not stand still – it evolves over time to deliver on the overall objectives of the District.

Good Innovation Districts do not operate in isolation, and instead work in harmony with their immediate and wider surrounding functional economic geographies to ensure the open flow of organizations and people in and out of the District. They also engage with potential external stakeholders at the point of inception to help this permeability take place. For example, the Station F campus in Paris engaged with start-ups from the outset to identify key attractors and develop a place that could best meet the needs of its future occupants and foster innovation. Similarly, Kendall Square started out by engaging the venture capital community to establish funding mechanisms to support and attract start-ups.

KSF 2: Creating a distinctive and differentiated unique selling point (USP) for the District

To be successful, an Innovation District should initially be focused on a specific domain, providing a point of differentiation to attract tenants and then sustain occupancy. At the same time, this focus needs to be recognized and understood in the market. For example, the MaRS Innovation District in Toronto, Canada has particular strengths in fibrosis.

This point of differentiation, however, need not be static. Kendall Square maintained a focus on biopharmaceuticals for many years, but steadily evolved this USP by bringing in a complementary offer in artificial intelligence. This approach brought new organizations such as Boeing to the cluster, which otherwise would have not been attracted to a life sciences-focused District.

Box 2: Kendall Square, located in Cambridge, Massachusetts, was born out of the neighboring Massachusetts Institute

Kendall Square, located in Cambridge, Massachusetts, was born out of the neighboring Massachusetts Institute of Technology (MIT), in an area that was partly occupied by an abandoned industrial complex. It has since become one of the world's most successful and renowned Innovation Districts. MIT is well known for industry partnerships and the commercialization of the abundant ideas generated at the university. It is therefore well suited to its role as an anchor institution to Kendall Square, providing the knowledge component to the District. This, in combination with a smart and targeted urban development plan through construction projects that are both architecturally attractive and well connected, has provided a major draw to high-caliber talent and businesses alike. Kendall Square has become a major center for innovation in biopharmaceuticals and artificial intelligence, with companies from across the full biopharmaceutical value chain co-located to work at the cutting edge.

Ecosystem activation

KSF 3: Build a high-quality, specific and relevant talent pipeline through effective engagement with academia

The availability of talent is one of the biggest draws for tenants to an Innovation District – but it must be relevant and world class to encourage businesses to establish themselves in close proximity. The Jeff Bezos of the world are a key attractor. The talent pipeline must also be specific and related to the District's USP. Availability of "computer scientists" is not sufficient; instead, the presence of "X" data scientists in "Y" disciplines is a more relevant lure.

The main source of this talent pipeline is the universities or other higher education institutions embedded in, or in close proximity to, the District. Obtaining buy-in and alignment from universities on a District-relevant talent pipeline can

be difficult, as it requires senior academics to change their focus from one that covers publications, research funding, and curiosity to one that advances working directly with companies.

The solution here is to showcase the benefits to the knowledge base of working with the District, from one academic leader to another. For example, demonstrating that research in quantum technology can be relevant to Microsoft – and, hence, attract more repeat business and academic funding – can quickly change the minds of even the most recalcitrant academics. Innovation Districts can also act as a recruitment pipeline for new graduates, which helps to attract and inspire increasing numbers of students, along with their university research focus domains. They, in turn, bring new business ideas and, ultimately, money – a success found at the Cortex Innovation District in St Louis, MO. However, throughout, the “university must remain a university” – a repository for “big brains” that serve as the magnet for talent and businesses in the first place by generating world-class innovation.

KSF 4: Curating occupancy of the District and representing the whole supply chain

Although it may seem perverse to turn down prospective tenants, the selection of companies to be part of the cluster is important to determine the District’s direction. For example, over time Kendall Square has been able to achieve representation of the full biopharmaceutical value chain within the District through careful selection of potential occupants. In turn, this has further increased demand for businesses to locate within the District.

In addition, the mix of sizes of occupants within the District is important to maintain attractiveness and provide the optimum conditions for innovation to occur. Typically, an Innovation District maintains a blend of start-ups, corporations and research institutions relevant to its USP. Corporations, for example, like to be around start-ups due to their energy, access to cutting-edge technology, propensity for quicker innovations, and availability of talent.

KSF 5: Build an effective technology transfer operation focused on spinning out, incubation and acceleration to build deal flow and support new business creation

Proximity to big brains at a world-class university is critical, but just as critical is extracting knowledge from them. To support the flow of knowledge and talent from the universities associated with an Innovation District, a successful technology transfer operation must be established, supported by an effective industrial liaison function at universities. This is to avoid the possibility of core university functions being “distracted” by the District, which could impact their research and teaching excellence. Rather than seeking IP royalties from one-off patent license deals, the goal is the delivery of long-term value creation through company establishment and growth.

Leading Innovation Districts thus benefit from specific support to push technology and create spin-offs from academic institutions, as well as access to start-up acceleration initiatives, and ultimately sources of Series A and B venture capital funding, further downstream. This can often be initiated by national or regional governments, or by universities themselves. Toronto Innovation Acceleration Partners (TIAP), formerly known as MaRS Innovation, provides an example of a unified offer of technology transfer, creating deal flow across the whole ecosystem. It plays a key role in supporting technology transfer through covering the cost of IP protection, investing in business development and funding projects to get past the point of commercial inflection and beyond to commercial reality. Station F offers start-up support along a similar journey, in the form of its Founders Program for early-stage start-ups, Fighters Program for entrepreneurs from underprivileged backgrounds, and Partner Program for those in growth phase. In addition, technology transfer is not limited to start-up creation. In Japan, there are an increasing number of cases in which large “anchor” companies and universities work with local governments in a specific city to strengthen capability and build innovation supply chains through rezoning, land provisioning, and funding incubation and acceleration support.

Box 3: Innovation Districts as catalysts for developing regional cities: Hiroshima University and Mazda

In Japan, where the population is declining and concentrating into the greater Tokyo area, regional regeneration is a major component of the national agenda. Multiple projects have been launched by local governments to boost collaboration between companies and universities in Innovation Districts in smaller cities outside of the capital. In Hiroshima Prefecture, Hiroshima University is working with Mazda, an automotive company, and the local manufacturing ecosystem to build focused capability in the digitization of manufacturing. Supported by local government, this approach has created a new competency cluster to build capabilities in the local industrial supply chain and train the next generation of engineers.

KSF 6: Combine programmatic themes for interaction with “organized serendipity” and fun

The social engineering aspect of a successful Innovation District is also of pivotal importance, in order to create opportunities and environments for like-minded individuals to “collide” and form new and differentiated ideas. Good practice is to create a robust programming schedule, such as a “soft landing” program for new environments, trade missions to support international expansion of tenants, and presentations from keynote speakers District tenants want to hear from, as achieved at the Netherlands Innovation Quarter.

These initiatives are complemented by activities that allow collaborations to self-form and progress. The Cambridge Innovation Center’s Venture Café model excels at this and has been deployed at the Cortex Innovation Community as an initiative known as “The Gathering”, a weekly event that brings together tenants, academics and the wider community. Over 75 percent of participants at The Gathering come from outside the District, creating an outward-facing entity that transcends the geographical boundaries of Cortex itself.

Physical Offers

KSF 7: Create a public realm that forms a central destination and neighborhood in its own right

Successful Innovation Districts are destinations where people want to live, work and play and that can operate on a 24/7 basis. Many successful Districts have one or a few central common areas, with associated shared spaces, within a few minutes' walk of one another, which act as collision spaces for occupants to interact with people they wouldn't ordinarily meet.

Boeing at the Cortex Innovation Community has designed its workspace to allow collaborations to self-form and progress. Employees use the communal kitchens that are shared with start-ups, rather than relying on its internal catering. Others have physical assets that create a reason for people from outside the District to visit them. For example, Kendall Square is host to the MIT Museum and the MIT Press Bookstore. Station F's food court occupies one-third of the site and is open to the public.

KSF 8: Create mixed-use, flexible and reconfigurable buildings – with flexible prices suitable for companies of all types and sizes

As a District grows larger and more successful, it also becomes more expensive, and rising rents can often drive out more diverse and creative businesses. Instead, successful Districts offer highly flexible property offers, with different sizes and prices. It can be possible to offset the rents of smaller businesses by charging more to anchor tenants through intelligent cross subsidies – Kendall Square managed to raise rental prices for larger companies by 12 percent per year, as cheap rent did not attract bigger companies – instead, it was proximity to sources of talent that drove occupancy. Effective “meantime” uses for older or more dilapidated buildings can help to achieve this. Building 20 at MIT is a prime example. This temporary World War II-era structure provides a combination of cheap rent and flexible, adaptable

accommodation, exactly meeting start-up needs. Over 55 years, occupiers of the “Plywood Palace” created radar technology, microwaves, the concept of hacker culture, early cryogenics, particle accelerators, the first video games and The Bose Corporation.²

Flexibility is also important for a hybrid digital/physical model, wherein, post-COVID-19, workers are unlikely to return to the office full time. However, being able to offer the physical infrastructure required by an ecosystem (such as laboratories and small-scale production facilities in precision medicine), along with housing and 24/7 amenities, gives Innovation Districts an advantage over traditional science parks when it comes to ensuring vibrancy and occupancy.

2. Source: Massachusetts Institute of Technology. “MIT’s Building 20: ‘The Magical Incubator’”, Infinite History MIT. <https://infinitehistory.mit.edu/video/mits-building-20-magical-incubator>

Insights for the executive

Based on the key factors for realizing a successful and sustainable Innovation District, executives, university leaders and local government officials embarking on creating, operating and locating in such a District should focus on the following:

Government and university leaders:

- *Focus is key:* There needs to be a clear focus on a core subject area for the District to successfully attract the right mix of start-ups and larger corporates required to foster innovation.
- *Promote a world class proposition:* Districts need to be founded on renowned, high-class and differentiated research from a world-leading institution. Otherwise, they will not cut through in a crowded and increasingly noisy marketplace.
- *Involve local government:* In a post-COVID-19 world with greater government involvement in business, municipalities can support Innovation Districts through rezoning, land provisioning, easing regulation, and catalyzing incubation and acceleration support for start-ups as required.
- *Go beyond the physical:* Enabling innovation requires more than state-of-the-art buildings. Create opportunities for “organized serendipity” that mixes people and ideas to drive innovation.
- *Orchestrate and evolve:* Bring together disparate stakeholders, spark off new and innovative thinking from their diverse perspectives, and unite them behind a long-term plan, course-correcting it and keeping it relevant to global trends as you move forward.

- *Make it simple for businesses:* Create a one-stop shop for potential tenants of all sizes, providing them with everything they need to join and grow within the District.

Businesses:

- *Have affinity with the Innovation District:* Ensure that the USP of the District you choose to locate in is a close match to your own innovation aims, and don't solely be guided by geographic factors.
- *Embrace the opportunities:* Innovation Districts are open ecosystems – ensure your teams understand this and immerse themselves fully in the activities and mixing process that drive modern innovation.
- *Locate the right teams in an Innovation District:* Don't move your corporate HQ to a District – instead, send a relevant subset of your innovation/R&D teams that will benefit from the opportunity.
- *Take an active part in steering the future course:* Everyone involved in the District is responsible for its success – use your skills and knowledge to help the ecosystem develop, but without seeking to dominate, and contribute to shaping its vision.

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The authors would also like to acknowledge and thank Shota Mitsuya and Rich Overmoyer for their supporting contributions.

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