



## The Company of Tomorrow

How to enable the company of tomorrow – Decoupling capabilities and leveraging the ecosystem

The laboratory of the future – People-centric innovation in industrial R&D

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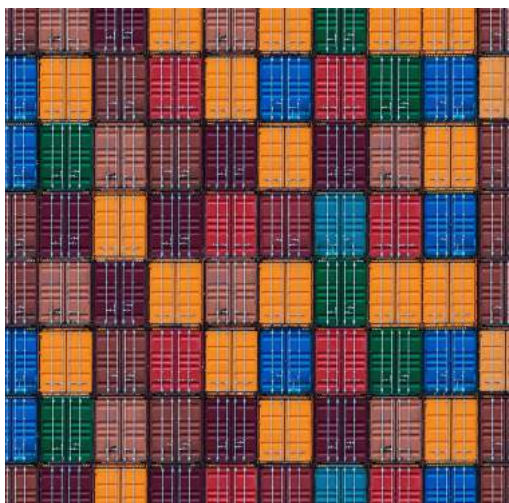
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*Petter Kilefors, Dr. Fabian Dömer, Ingrid af Sandeberg, Tomislav Andric, Philipp Mudersbach, Gustaf Samuelsson, Simon Schmidtke*





# Editorial

## Dear Reader

The COVID-19 crisis hit the world as this edition of Prism was in preparation. Needless to say, the outlook for business, at least in the short term, has changed radically in just a few weeks. Nevertheless, it's becoming increasingly clear that one effect of the crisis has been acceleration of trends that were already there, such as virtualization of the workplace, further penetration of digital technologies (for example, AI and the IoT), and "asset-light" business models that make businesses more responsive and resilient to rapid shocks.

So our original pre-COVID theme of "The Company of Tomorrow" is still pertinent, and in fact, in some ways it will be even more so as businesses focus on recovery and regrowth over the coming months and years. As we look ahead, the capacity to adapt, innovate and reinvent – as well as have a strong balance sheet – will be critical.

Our lead article challenges companies to take the first steps towards enabling the company of tomorrow: to take a fresh look at what they really are, and to shape themselves in a new, more flexible and dynamic way, in which capabilities are decoupled from corporate business functions and the external ecosystem is leveraged to the maximum. We provide a view on how to lead the change.

Our next piece zeroes in on the future of companies' R&D labs. If companies are increasingly shifting from making products to providing solutions – and many are – what does this mean for your R&D function? The answer may surprise you – and by the way, it's not just about digital technology.



Providing solutions rather than just products is also the theme of our third article. Driven by key trends around customer expectations and digital technology, many companies are finding they can multiply business value by turning their customers into long-term subscribers. However, it's easier said than done. How should companies go about it?

Up until now, words such as "democratization" and "citizen" haven't had much of an airing in corporate business speak – but in our fourth article, we suggest this might be about to change. We delve into the increasingly prominent phenomenon of no-code/low-code software development and look at how companies can use it to create "citizen developers" as a key part of their transformation.

And finally, without apology, our remaining articles address two of the most written-about – though some may say over-hyped – technologies in today's world: the IoT and blockchain. With the advent of 5G, the IoT is on the cusp of finally delivering the transformational change it always promised, and now is the time for companies to shape up their strategies, particularly when it comes to their own networks. In our final article, we cut through the hype and look at the practicalities of what is needed for blockchain to deliver its huge potential for the global transport industry.

We hope you enjoy our insight, and wish you every success in moving forward from the crisis and shaping up for tomorrow!



Rick Eagar  
Chief Editor, Prism  
Arthur D. Little







# How to enable the company of tomorrow

## *Decoupling capabilities and leveraging the ecosystem*

Carlos Mira, Juan Gonzalez, Gregory Pankert, Florence Carlot, Rafael Martinez

Based on demand from its 7,000+ shops in almost 100 countries, a prominent fast-fashion retailer ordered thousands of raincoats from its Asian suppliers. During the 11-hour flight that brought the coats to the logistics hub in Europe,



they were reassigned to markets and shops based on actualized data that leveraged big data and AI, considering weather forecasts, exchange rates and other variables. In a hyper-efficient logistics center only a few kilometers from the airport, a logistics partner received the raincoat shipments and relabeled and folded them as needed for each market, shipping them for distribution to their final destinations in only a few hours.

Businesses have traditionally organized themselves to ensure optimal effectiveness in each of their business functions. However, shorter product lifecycles, demand for customization, rising consumer expectations, and the growth of automation and data challenge this model. This article explains how success requires organizations to decouple capabilities from business functions, in order to deliver best-in-class performance and enable the company of tomorrow.

In another example, a global smartphone provider considered it strategic to achieve and maintain a leading position in display technology and manufacturing. To ensure this, it supplied smartphone displays of its archival in the market.

Inditex (Zara) and Samsung are both examples of how capabilities can be externalized or opened to the market. As data and technology are freely available and adopted by companies, collaboration with other companies to boost productivity and creativity for core and non-core capabilities can be achieved with less friction, transaction costs and risks than in the past. This is fundamentally changing how companies conceive, develop, produce, and deliver their products or integrate third-party products and services into their product build, operations, and offerings. Our analysis suggests that this externalization of capabilities – decoupling

them from the company's business functions and leveraging the ecosystem more profoundly – will transform companies, as well as the landscapes of many industries, in the next three to five years. In this article we examine what's behind the trend and identify some imperatives for leaders to consider when transforming their own organizations.

## Several trends are challenging the traditional way companies define themselves

Companies have traditionally organized themselves with the objective of ensuring optimal efficiency and effectiveness in each of their business functions (R&D, production, distribution and sales) to deliver defined products and services. However, three trends challenge this model:

1. Products and services: shorter life cycles, a customization imperative
2. Changing, more demanding customer expectations
3. The rise of automation and a data-driven world

### **1. Products and services: Shorter life cycles, a customization imperative**

With few exceptions, almost any product or service can now be replicated in months, rather than years. This makes it increasingly difficult to build sustainable competitive advantage on product features or qualities. Moreover, product customization is becoming a must in both B2B and B2C, not only around product features, but in all interactions. Blurring industry boundaries and the acceleration of time<sup>1</sup> leave companies ever-shorter time frames to set up efficient and effective processes so they can monetize shortened product life cycles.

As a result, optimizing along the traditional value chain is not enough to ensure sustainable profitability. The ability to pivot rapidly and adjust to evolving ecosystems has become all but essential.

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1. As described in "The CEO – Lost in space and time?" Prism 2 2018

## **2. Changing, more demanding customer expectations**

In today's business environment, customers expect everything to be delivered immediately, wherever they happen to be. They value experiences (with focus on how their needs are met) above products. Loyalty is increasingly driven by digital perceptions and the emotions that brands create through the purposes and values they put forward – as well as how consistent their actions are with those values<sup>2</sup>.

As a result, customer experience and trust around expertise, quality and reputation become more relevant than the physical features of products and services. BMW's memorable advertising campaign, "Do you enjoy driving?" captures the essence of this change.

Tailoring messages to customer expectations and needs is driving major change within marketing functions, forcing them to add new capabilities. Marketing has migrated from broadcasting to active listening and engaging in dialog with customers. The acquisition of Sapient (a technology integrator) by Publicis (an advertising agency) to create the "agency of the future" shows how players are responding in order to compete in this new ecosystem.

## **3. The rise of automation and a data-driven world**

Customization would not be possible without data to understand and precisely forecast customer behavior, as well as automation to effectively deliver it. The amount of data that is being collected, processed and interpreted has exploded over the last decade<sup>3</sup>. Increasing automation will put data at the core of every business process.

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2. See Arthur D. Little Viewpoint "The WHY strategy: There is no strategy without meaning"

3. The global datasphere grew by a factor of 20 over 2010–2019, reaching around 40 zettabytes (IDC)

The availability and affordability of standardized technology infrastructure (from players such as Amazon, Microsoft and Alibaba) mean companies don't need to develop their own data-related capabilities. Inexpensive information processing lowers transaction costs and further facilitates decoupling of capabilities and business functions.

Extracting value from data (whether company generated or from open data sources, third parties or ecosystems) has therefore emerged as a new capability that pervades all business functions. Beyond well-known examples such as Google and Facebook, many traditional industrial companies such as Atlas Copco (which is leveraging data for its pressured air-as-a-service business) are building business models based on data.

### **Companies will increasingly define themselves in terms of their capabilities rather than their products**

As a consequence of these trends, the companies of tomorrow are shifting from a set, linear position in a supply chain to one that dynamically adjusts within their ecosystem. They will focus more on how they conceive, develop, produce and take their products and services to market. This means decoupling business functions (aligned with what they do) from capabilities (how they do it) to deliver value. Companies will focus on what they can do best, operating in those areas at their optimal scale. They will leverage best-in-class ecosystem partners to boost their capabilities and externalize both key and non-critical ones. These innovative, adaptive companies will enjoy extra resilience in their operations and future prospects.



## Decoupling capabilities from core business functions has a long history

Decoupling capabilities from business functions is nothing new in itself, and can be traced back to outsourcing of information technology-related processes from the late 1980s<sup>4</sup>. Efficient IT operations required skills, or capabilities at a scale, that non-specialized players could not achieve. Outsourcing contracts tended to be long-term commitments and covered a handful of functions. But despite all its limitations, outsourcing showed companies how they could decouple business functions from capabilities. It also created a new breed of companies that competed based on which could best provide some of these missing capabilities.

As outsourcing became an established practice and the reach of functions grew, operational reasons evolved to more strategic considerations. For example, hotel chains recognized that the capabilities required to manage real estate no longer provided any competitive advantage. Thus, they have freed financial resources by decoupling the ownership of “their” buildings, which are frequently sold to specialized asset management players. This allows the hotel chains to focus on aspects such as operations, brand and user experience (so-called “core competencies”). Decoupling also means companies can boost production by removing bottlenecks. Following this model, high-end fashion and luxury companies focus on brand management for their perfume product lines, leveraging product-design and manufacturing capabilities of third parties. Apple took advantage of the flexible capacity provided by contract manufacturers to meet the explosive demand prompted by the launch of the iPhone.

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4. Eastman Kodak's 1989 deal with IBM is considered the birth of IT outsourcing.

Sometimes, regulators have taken the lead. In many jurisdictions, energy utilities have been unbundled, which has separated their distribution activities from their retail activities, each requiring a different set of capabilities (optimizing asset utilization versus dealing with commodity price hedging and customer management).

### **An inflection point will cause costs and risks to drop drastically – as shown by early examples**

However, whereas outsourcing and capability-based approaches have been around for decades, technology, connectivity, and the growing adoption of automation and AI are creating a new inflection point when the costs and risks of using complementary capabilities will be hugely reduced. The companies of tomorrow will therefore need to leverage new management approaches for optimal scale, cooperate with highly efficient and creative specialized ecosystem partners, or boost their internal capabilities. AI and advanced analytics will be critical.

Glimpses of these companies of tomorrow are already here, at different scales of adoption. A growing number of business decisions are aligned with this new logic. For example, Iberdrola, the number-one producer of wind power and one of the world's biggest electricity utilities by market capitalization, has decoupled its renewables and networks arms so it can develop the first of these businesses on a global scale.

Some companies are already achieving extra sources of revenue by commercializing their in-house capabilities ("opening up the capability"). This helps gain scale and competitive advantage while minimizing the risk of failure. In addition to Amazon opening its information-processing and storage capabilities through Amazon Web Services, retail bank Banco Santander recently announced that it would open its payments platform to achieve the minimum scale required to compete.

The automotive sector provides a good example of extending collaboration from non-core to core capabilities. Here, the challenges around the transition from combustion engines to electric power trains and from ownership to access have forced traditional auto makers to reconsider their approaches. Demonstrating this, Daimler and BMW are pooling their non-core mobility services to create a new global player that will provide sustainable urban mobility for customers. They have also stated that they are sharing core engineering capabilities on driverless cars.

New entrants in every industry have taken full advantage of the opportunities provided by decoupling. Challenger banks, such as N26, focus on customer experience and rely on third parties for product development, regulatory compliance or IT platforms. Aryaka, a next-generation telecoms provider, concentrates on products and leverages connectivity and go-to-market channels from partners to reach its customers. Many small online retailers use Amazon's platform to reach consumers.

Decoupling can also be used to build a new ecosystem. While Tesla's initial insistence on being vertically integrated may seem to be in opposition to this trend, it actually recognizes that dominating certain capabilities is the way to build a position in a new industry. Panasonic building batteries in Tesla's plant is another example of capabilities going beyond a firm's walls. Tesla has opened its patents and published its roadmaps, demonstrating the importance of creating an ecosystem where your capability advantages can thrive.

Finally, in the telecoms industry, Telefonica is transforming itself from an integrated network and service operator to a capabilities- and platform-based business, splitting into a NetCo and an OpCo to take the best advantage of their respective capabilities. (See Box 1.)

### Box 1 – Telefónica

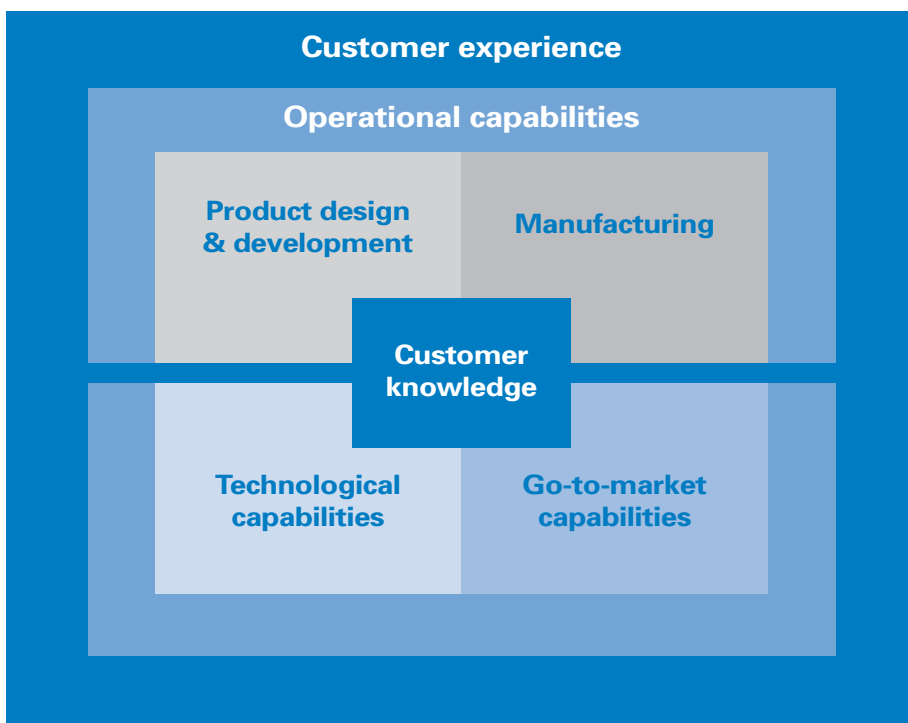
Telefónica, a leading telecom service provider operating in 14 countries with more than 340 million customers, visualizes its operations in four layers or platforms, each offering well-defined capabilities:

- Platform 1 is the network infrastructure, with mobile and fixed network equipment, access and transport, and mobile spectrum. This layer is mapped into the countries where Telefónica operates.
- Platform 2 is the network services layer; it runs virtualized software systems, functions and databases that operate the company's own and third-party network infrastructure equipment. This layer can be serviced by a single platform operating across different countries.
- Platform 3 is the applications layer, offering customers Telefónica and third-party services and applications (e.g., security, VOD from Movistar, and Netflix).
- Platform 4 is the data platform, providing information and intelligence from the massive amount of data generated in the networks.

Additionally, Telefónica announced a new organization in which two new B2B units would integrate a set of decoupled capabilities on a global scale – Telefónica Tech (focused on cybersecurity, the cloud, the Internet of Things and Big Data) and Telefónica Infra (with stakes in infrastructure vehicles serving Telefónica and third parties such as towers, greenfield fiber projects and data centers/edge networks). Telefónica Tech will leverage the muscle and local reach of the commercial teams in each country to sell its services, and through alliances, aims to export its capabilities to other countries where Telefónica is not present. Telefónica Infra's ambition is to be one of the largest telecommunications infrastructure units in the world, exploiting the value of Telefónica's and its partners' portfolios of assets.

## The successful companies of the future will be those that have mastered strategic capability management

Decoupling capabilities means changing how companies structure and view themselves. Most companies need the generic capabilities shown in Figure 1.



**Figure 1: Generic capabilities**

It is striking that leading companies of today tend to focus on excelling in at least two of these generic capabilities: Apple in product design and customer experience; Amazon in operations, technological capabilities and customer experience; and Inditex in go-to-market and customer experience. Moving forward, the leading companies of tomorrow will all need to excel at least in customer experience, as well as have technology embedded in their DNA.

Looking at themselves in terms of capability “building blocks” allows companies to take a strategic view of where and how to optimize, as well as what part the external ecosystem can play. Companies can ensure they are the right size for each capability and possess the correct internal/external combination of technology, data, infrastructures, human expertise and facilities. This will be a competitive advantage because it will make them more efficient, creative, flexible and agile than integrated organizations.

We expect three different categories of capability-based players to arise:

- **Orchestrators** attract and align players on the demand side (consumers and business customers), the supply side, or both, at a scale that generates benefits for all. The capability-driven ecosystem model favors a few orchestrators dominating a space. Amazon has chosen to open its operational capabilities to third parties to become an orchestrator, with great success.
- **Premium players** can generate superior value by offering products, services and customer experience that match the material and emotional needs of carefully segmented consumer or business customer groups. Retailer Inditex, again with superb operational and customer experience capabilities, is a premium player in its ecosystem.
- **Efficient players** can now offload big parts of their organizational structures to focus on their cores. Efficiency is their main value driver, and the capability-driven approach can deliver substantial advantages versus the classical integrated model. Tata Consulting Services excels in operations and people management and competes as the leading commodity provider of IT outsourcing services.

Decoupling capabilities from business functions and working in ecosystems brings its own challenges. Choosing the differentiating capabilities and their target scale are difficult strategic decisions. Identifying the right partners and controlling the interfaces with them adds complexity. Moving from linear supplier-provider relationships to joint development and increased dependencies requires new management capabilities that go beyond the classic command-and-control model. Balancing creativity and efficiency becomes essential<sup>5</sup>.

However, we should expect technology to continue its rapid development and become even more pervasive. This will drive further decoupling of capabilities and functions because the cost to select and connect the required capabilities to perform any business function could be driven down to almost zero. Cheap access to data provides full visibility of end-to-end processes, which means the hidden costs of collaboration decrease and confidence increases. As automation progresses from the current wave of algorithms (in which simple tasks are automated) to autonomous machines (which solve problems and take decisions in real time), machines will engage in the majority of transactions. Building on the IT outsourcing analogy, the future could resemble the Lambda service from Amazon Web Services, in which each instruction demands computing resources, optimizing performance and eliminating all waste.

All of this means that for the company of the future, virtually all capabilities could be potentially decoupled, including such core capabilities as product development and go-to-market. Indeed, we see the ability to drive innovative approaches to capability management as a critical enabler.

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5. See a deeper discussion in "Ambidextrous organizations – How to embrace disruption and create organizational advantage", Prism 1 2018

## The CEO agenda for the company of tomorrow

Getting the company ready to survive and succeed in “Tomorrowland”, only three to five years from now, is one of the biggest challenges for CEOs and their leadership teams. Although there is clearly no one-size-fits-all program, it is possible to identify some key imperatives. (See Figure 2.)

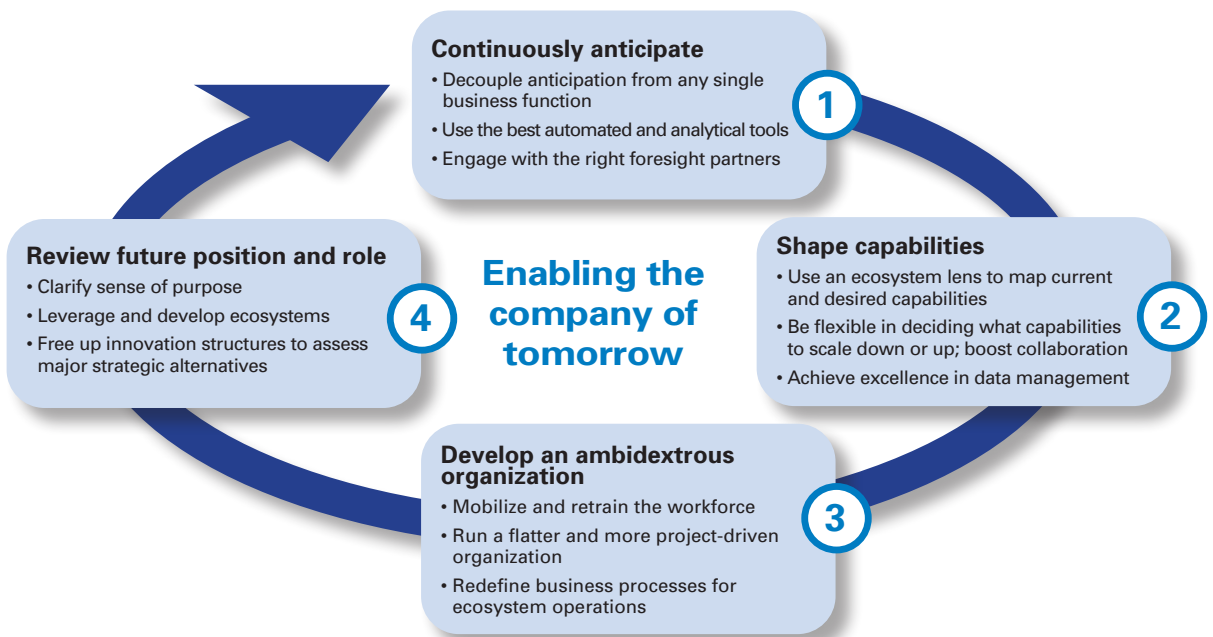


Figure 2: Priorities to enable the company of tomorrow

### 1. Continuously anticipate using the best tools and partners

Extrapolating from the past used to be a solid guide for the future. Today, companies need to learn how to continuously read the evolving dynamics of industries and ecosystems in a complex world of blurring industry boundaries. In natural ecosystems, species evolve and adapt, and the fittest thrive and survive. In business ecosystems, the clock is ticking orders of magnitude faster. In a hyper-competitive world, business ecosystems will favor three main drivers: disintermediation, collaboration, and the emergence of the best for each capability<sup>6</sup>.

6. See also “Ecosystem innovation – The growth of hyper-collaboration in a fast-moving world” Prism 1 2017



Technologies that enable fluid collaboration will change at an accelerated speed, as will their adoption, occasionally jumping rather than following a smooth path as critical mass of adopters is reached. Being an early adopter or fast follower can provide a competitive advantage. However, in most instances being first is not necessary. When considering technology adoption, deciding when to follow will be as important as choosing when to lead in order to avoid wasting money and distracting the organization. Companies need to:

- Continuously read the context – through researching customer trends, technology maturity and adoption rates, as well as the economic, global trade and geopolitical environment. Thought leadership will be key.
- Decouple anticipation from any given business function so it can achieve a broad-enough context.
- Leverage automated tools, advanced analytics, human intelligence and ecosystem partners to anticipate, as well as create, a forward- and outside-looking attitude throughout the company culture. Most trends and disruptions becoming relevant on a five-year horizon are present now with innovators and early adopters. Connecting relevant dots from close and far references will be a critical skill.

## **2. Use an ecosystem lens to shape the required capabilities**

The linear view of supply chains delivering products or services is not reflecting the multidimensional network realities of ecosystems, which are eroding and blurring industry borders and reshaping competitive landscapes. Companies must therefore now start building maps through this ecosystem lens:

- Map their organizational capabilities and then compare these to the ecosystems they are in. This will need to provide a fractal view of activities and assets of which end users and customers are at the center, how the status quo has changed, who is winning, and who is losing ground.

- Consider complementary providers and players connected with customers, either directly (B2C) or through other players (B2B2C or B2B). This will offer a new perspective of the world.
- Be flexible in adding, removing, scaling up and scaling down capabilities, as well as collaborating with ecosystem partners to boost efficiency and creativity. To decide which capabilities to own and which ones to source, companies should plan for at least two or three fractal levels below the main capability level. Dispose of assets and resources that do not provide differentiating or efficient capabilities, and source them from more efficient and creative ecosystem partners. Be willing to consider even the “sacred cows”.
- Data will be essential. Companies should be able to generate, process and share massive amounts of data securely and without friction. Only a few companies will replicate the provision of free services in exchange for data. Rather, winning companies will be able to run highly efficient operations, take better business decisions, and expand their businesses in new areas through their superior management of data.

### **3. Develop the ambidextrous organization and culture to perform in a “decoupled capabilities” ecosystem**

People will still make the difference in the company of tomorrow. In the coming years, survival and success will rely on leveraging the talent and skills of human beings who can get the most out of technology. People and machines together will build high-value organizations to achieve excellence, not only in productivity and efficiency, but also in creativity, agility and collaboration.

It is important for companies to visualize this new world in simple terms. Imagine a company having 1,000 engineers in product development, working on 50 projects. It could open 30 of these projects to co-development with ecosystem partners, with 600 of its engineers collaborating with two or five times this number from specialized partners. This would

allow the company to increase its product development capability by 60 percent, or up to 300 percent. It could also reduce headcount, freeing up expensive resources, while still accessing new projects with external resources. In any case, data, collaboration tools, an open culture, and agile and efficient project organizations will be necessary. Companies should:

- Mobilize and retrain their workforces at all levels of their organizations to shift to a new model in which teams running capabilities are highly accountable, with greater degrees of freedom to decide what to do in-house and what to leverage from selected partners.
- Through optimizing across internal and external capabilities, seek opportunities to run flatter, leaner and more project-driven organizations.
- Redefine business processes for ecosystem operations, leveraging data centricity, automation, advanced analytics, and AI/ML.

As data becomes pervasive, real-time performance measurement and adjustments will become the new normal. The organization should adopt proven approaches to become “ambidextrous” – balancing efficiency with creativity through matching the right approaches to the different jobs to be done.

#### **4. Review the future positioning and role of the company**

The respective fates of Fujifilm and Kodak remind us that companies that fail to anticipate or change will be left behind or destroyed. Ecosystems require companies to be ready to evolve so they can adjust to opportunities and threats. Companies must decide where they want to play in three to five years, and how they will reach and defend the desired position in the ecosystems. The path to becoming an orchestrator or premium or commodity player will be greatly influenced by the purpose of the company. Companies should:

- Develop a clear and shared underlying sense of purpose (raison d'être) to help guide positioning as the scope of products and services changes and evolves.
- Learn by doing and collaborating to help identify and reach preferred positions in the ecosystem. Move away from linear strategic thinking to a network, multidimensional model in which ecosystem players can be partners, competitors or both.
- Put suitable innovation structures in place to facilitate development and validation of major new strategic alternatives without their being stifled by corporate antibodies. These innovation structures will be integrated into the organization if and when needed<sup>7</sup>.

## **Insight for the executive**

Companies of tomorrow will have leadership teams with shared visions. They will be comfortable adopting and leveraging technology and have the right attitudes to deal with uncertainty, as well as the ability to evolve to incorporate data-driven decisions.

CEOs transforming their companies by decoupling capabilities from business functions should receive understanding and support from shareholders and private investors if the equity story is properly assessed and executed. Private investment (activist) funds have also spotted the opportunities around disruption of value chains. They seek companies whose capabilities, as well as the ecosystems that they develop or play in, are worth more than their existing products and services – and target them accordingly.

For each industrial revolution to happen, many changes need to occur at different levels. Today, technologies and business paradigms are ready; professionals, managers and consumers are educated; infrastructures have been deployed; and institutional enablers such as investors and regulators are starting to accommodate change. CEOs therefore need to set the agenda or be left behind.

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7. For an additional discussion see "The next generation of corporate incubators", Prism 2 2019





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# The laboratory of the future

## *People-centric innovation in industrial R&D*

Dr. Michaël Kolk, Dr. Michael Eiden

It's hard to pinpoint when the world's first private research and development (R&D) laboratory came into existence. However, it was probably during the early days of the chemical industry in Germany after 1850, and swiftly



followed by similar ventures from other leaders in the first industrial revolution, such as America, the UK and Belgium. Some of these pioneering industrial research labs remain innovation powerhouses even today, such as those of General Electric and DuPont in the US and Solvay in Belgium.

As industrial R&D has expanded and matured, so has the way it is managed. This is driven by three factors:

- Globalization demands that most large companies run their R&D using often dozens of labs all over the world. Even their most strategic technical competencies can now be distributed over several locations, close to wherever the best talent can be found or utilized. Chemicals giant BASF, for example, has around 70 labs globally, with three designated as the headquarters of their research divisions.
- Today's R&D organization is typically split between labs devoted to research and those focused on creation of products and services. Geoff Nicholson, former 3M executive and the "father of the post-it", said the former "turn money into knowledge", while the latter "turn knowledge back into money". This second phase often happens in smaller development labs or product houses sitting close to the target customer base. And as both talent and customer base have become more dispersed, so has the average company's R&D footprint. Consequently, India

Industrial research and development has been transformed by factors such as globalization, specialization and open innovation. To meet growing challenges, R&D needs to change again to create the laboratory of the future, which will focus on putting people at the heart of innovation. We explore three next practices companies can implement now to position themselves for future R&D leadership.

and China in particular have seen a spectacular rise in the number and size of industrial R&D labs over the last two decades.

- Finally, the concept of open innovation is now prevalent in almost every industry sector, including those that used be hermetically sealed, such as aerospace and defense. As a result, research labs today are often tightly networked with local innovation partners. For example, Philips operates some of its medical technology R&D activities inside large hospitals.

In this article we argue that industrial R&D will continue to evolve significantly, demanding creation of what we would like to phrase as the “laboratory of the future”. This “laboratory” (by which we mean the entire delivery engine of industrial R&D) will be driven by emerging needs to develop “mega-solutions” to meet the world’s most pressing challenges: by convergence between industries, technologies and ecosystems, and because of the digital revolution, which is already changing the way R&D is being done, and by whom.

At the center of all these developments are people: how they learn, think, originate ideas, connect and deliver. All this means the laboratory of the future has to be designed principally from a human resource management perspective, which is not how most R&D organizations have traditionally evolved. The article will therefore review the fundamental HR challenges, the main factors for success, and examples to learn from, before outlining the key implications for innovation and HR executives in large industrial firms.

## **Our case for change**

“People are our greatest asset” is probably the most overused sentence that CEOs utter. Clearly, that’s because it is true, especially when it comes to companies whose prosperity depends on R&D and innovation. Yet, at the same time, HR in industrial companies is often seen “just” as a support function, rather than a key stakeholder in managing

their “greatest asset”. Why do many companies outsource or offshore critical parts of HR support and rarely make vital topics such as digital transformation and ecosystem innovation strategic HR issues?

If this was ever an acceptable way of managing a company’s greatest assets, it definitely won’t enable a successful transition to the “laboratory of the future”. Here is why:

**1. Attracting digital thinkers and doers:** Arguably led by the life sciences sector, leading players in all industries are now engaged in a wide variety of pilot projects and programs to make their innovation functions better, faster and smarter. And as how innovation gets done becomes increasingly digitalized, so does the need for researchers and developers to think and act “digital”. But as we have shown in a recent report<sup>1</sup>, major challenges remain – the most common of which are attracting, retaining and developing the right “digital thinkers and doers” and making them productive in an industrial R&D context. It’s hard to be successful and happy as a digital native working in an analog environment optimized for the predictable and efficient evolution of physical products, when your added value and passion lie in high-speed software development. If “digital transformation” is as important as industry leaders say it is, this is truly a make-or-break obstacle to success.

**2. Diversifying team capabilities:** Companies that say they simply make products are becoming rare. Instead, businesses boast about delivering “solutions”, based on their excellent customer understanding and even “intimacy”. This is not (just) marketing speak. Across the industrial innovation landscape, the most promising opportunities are often about new formulations, smart applications and digitally enabled new business models, rather than new molecules or faster cars. But truly becoming a provider of solutions rather than of products

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1. “Innovating in the digital age”, Prism 2 2018

requires skills and capabilities that are not normally found in industry, such as design thinking, software development, customer empathy and consultative selling. The challenge is not only to recruit and develop these skills, but also to enable people with diverse experience, mind-sets and preferences to work together and be collectively successful. And this is not just about diversity for the sake of inclusiveness and fairness, but also because you can't be a successful solutions provider without employing the right mix of experiences, skill sets and mental models – and making them work together effectively.

**3. Excelling at both productivity and creativity:** The combination of the digital revolution and the world's thirst for new business models and breakthrough innovations requires many industrial companies to excel at two very different games at the same time. Firstly, they need to further optimize their cores, focusing on scale and productivity. Secondly, they must excel at disrupting their chosen markets through their (often newly found) leadership in speed and creativity. Textbooks used to say a company could only be good at one thing, but the success of Amazon, for example, shows that companies can, and should, be leaders in both "productivity" (e.g., in warehousing and logistics) and "creativity" (e.g., in constantly offering new cloud-based solutions). Leaders in industrial R&D will need to find ways to match this two-sided innovation firepower if they want to grab their fair share of next-generation solutions in markets such as mobility and the circular economy.

**4. Coping with fragmentation of critical knowledge and insight:** The largest and most attractive innovations will increasingly rely on companies' vast networks of ever-changing partnerships, as well as frequent acquisitions to provide quick access to new technologies, capabilities and ideas. Imagine running the innovation activities of a company active in security and safety solutions, for example. We estimate that there are over 5,000 companies active around the world in security alone, ranging from alarm systems to biometrics solutions and

cybersecurity software. Together, they are involved in over 500 M&A deals each year – 10 per company, on average. This implies that a company's accessible knowledge base may change vastly in just a few years – more quickly than the time to market of typical large innovation programs.

To add to this conundrum: if innovation and R&D thrive when people share, challenge and enrich their insight and ideas, will dispersion of innovation teams and ecosystems across markets and regions come at the expense of creativity, reliability and effectiveness? "Where's my water cooler?" quipped one R&D executive when we explained what her ideal global innovation team should look like. She meant certain parts of the innovation process relied on people's proximity, trust, and even camaraderie. This is obviously true for the "fuzzy front end" of idea generation and enrichment. But it also applies to downstream activities such as quality control and risk mitigation. The leading R&D labs of tomorrow will be those that have optimized this "everywhere-versus-somewhere" dilemma.

This transformation poses a significant challenge to research organizations: they are in the business of combining existing wisdom and new ideas into new, more valuable knowledge. But their repository of knowledge is changing and expanding quickly, with important information and expertise increasingly scattered and dynamic. As knowledge domains become more intertwined, monodisciplinary expertise won't get you very far. And traditional methods of making people learn (such as predefined courses) and acquire information (for example, a company's knowledge management system) require a serious makeover.

### Three “next practices” for success

These challenges may sound particularly intractable to the average CTO, who feels they are already struggling to meet the requirements of today, let alone those of tomorrow. How can they work on “next practice” innovation, if just deploying current “best practices” is hard enough? Fortunately, there are already plenty of examples of promising tools and approaches that have shown their practical value to companies on their way to making their employees (much) more effective innovators.

While the final blueprint of the lab of the future is yet to be written, there are three “next practice” trends that we at ADL already apply with our clients today. (See Figure 1.)

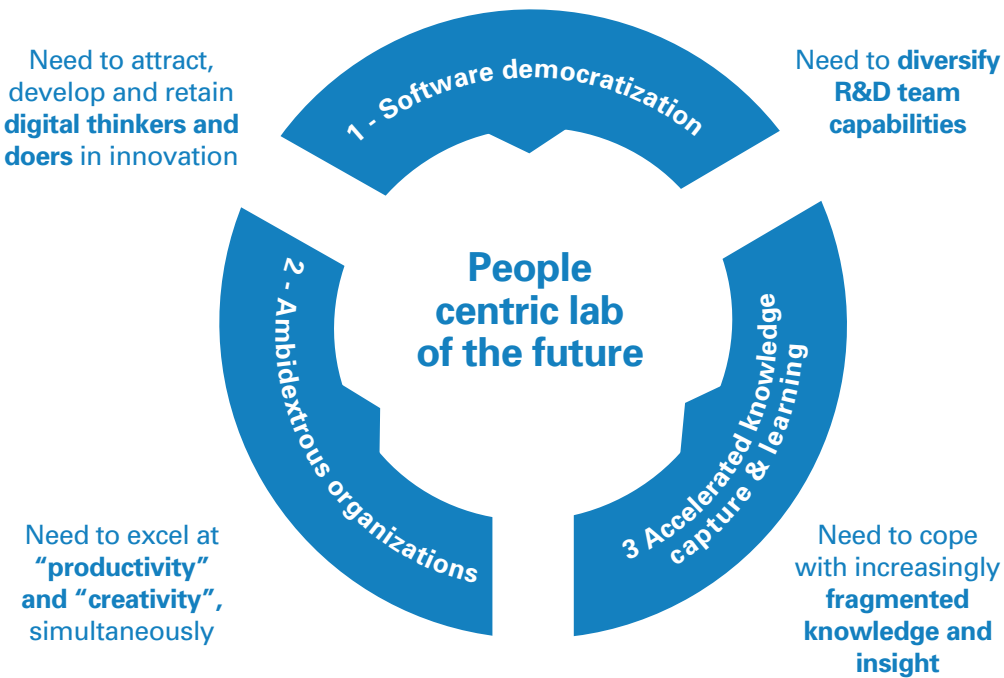


Figure 1: The trends that are shaping the people-centric lab of the future

**1. Software democratization:** When the CTO of a company active in a sector such as chemicals or advanced equipment says her lack of “digital thinkers and doers” is a major barrier to success (and many have mentioned this to us), she implies there is a chasm between digital natives/specialists and all others, often including herself. Thanks to a number of interesting developments, this chasm need not be as impassable as she thinks it is:

- Recent years have seen rapid expansion of the number and types of companies offering state-of-the-art software and analytics with easy-to-use interfaces. Are you interested in piloting artificial intelligence to identify non-obvious technology trends? Companies such as Quid and PoolParty can have the first results in a matter of days. Do you want to do advanced analytics on manufacturing or supply-chain data? Ask, for example, TrendMiner or Qlik.
- The availability of no- and low-code software allows non-specialists to do a fair deal of software development themselves, for instance, in workflow automation or creating functional prototypes of new software tools for their customers. This topic is further discussed elsewhere in this issue of Prism (“Unleashing innovation using low code/ no code – The age of the ‘citizen developer’”).
- As we have outlined in our article “The human-to-technology language challenge”<sup>2</sup>, organizations looking to acquire software used to have just two fundamental approaches – build or buy, both of which often brought their own problems and, even more commonly, costs. Using an approach we call “smart stitching”, companies can split their end-to-end innovation processes into discrete elements which can each be delivered using standard or even open-source software. And because the elements that are truly bespoke are of limited complexity, the development of these components becomes a manageable and time-efficient exercise. These commodity and custom elements can then be “stitched” together into an end-to-end solution.

We have found this approach to be particularly effective in creating a “just right” digital environment, and thereby in fostering broad user adoption of modern digital solutions. And as any R&D leader will tell you, this is a key challenge for automation initiatives among researchers and engineers, especially those that aim to bring about behavioral change.

**2. Accelerated knowledge capture and learning:** Trying to “know all that the company knows (or could know)” has been a somewhat elusive goal ever since knowledge management (KM) became an established discipline some 30 years ago. Some companies, such as Siemens and Schlumberger, have invested in building their own systems, while others rely on off-the-shelf software. But most KM solutions still have inherent flaws that will need to be overcome in the laboratory of the future. (See Box 1.)

### Box 1 – Limitations of traditional KM systems

- Owners of relevant information are assumed to be posting and updating their experience and expertise. But few follow this “ideal behavior”, and often the most valuable insight would be from or between people who have no idea that they should be sharing it.
- Almost invariably, information seekers are also assumed to be “active” – to know they need information and the KM system contains the solution. But people are often unaware of their knowledge gaps, or believe they have no time to spend on the system during their busy working days.
- Captured (documented) knowledge is assumed to be codified (tagged, categorized and compartmentalized), but such a repository will never reflect the company’s full knowledge potential. And even when the system is able to search unstructured information, the retrievability of documentation is usually limited by imperfect search-query possibilities and siloed information repositories and formats.



This is where machine learning (ML), specifically the use of so-called knowledge graphs, comes in. Knowledge graphs can be constructed in a two-step process: firstly, by extracting semantical understanding from unstructured textual information using natural language processing (NLP) technologies, and secondly, mapping the extracted entities and their relationships onto a graph representation. This approach facilitates scalable representation of complex knowledge in digital form, as well as discovery of otherwise-elusive patterns and connections. These tools have grown mature in, for instance:

- Life sciences, in which they are used for tasks such as identifying new purposes for existing drugs based on millions of scientific articles and reports.
- Chemicals companies such as BASF, which apply these methods to accelerate and improve literature assessment and interpret vast amounts of product performance data to, for example, speed up selection of novel catalysts.

Applying ML and other advanced digital technology to a company's internal and external knowledge systems is rapidly changing the state of the art in industrial R&D knowledge management. We now can link even "passive" seekers and owners of insight and information (see Box 1) and offer a digitally optimized user experience (UX) that helps find non-obvious insight and can even "prod" people into actions they wouldn't otherwise consider taking. (See Figure 2.)

Knowledge...	Enablers		
	Triggers Prompts that initiate the transfer of information or catalyze learning activities	Technology Advanced (digital) technologies to support documentation, search, transfer and learning	UX Design attributes that make interfaces “easier to use than not to use”
...seekers	e.g., <b>predicting seeker’s (future) learning</b> needs based on activity and network profiling (as example), and <b>prompting timely action</b>	e.g., recommending systems and chatbots based on <b>natural language processing (NLP)</b> that make suggestions to find “non-obvious” information	e.g., use of <b>adoption engineering</b> to make sure KM and learning solutions “go viral” and deliver behavioral change
...owners	e.g., <b>formal protocols</b> for debriefing projects at specific moments using prescribed formats	e.g., use of <b>speech recognition</b> tools to automate capture of knowledge from audio/video sources	e.g., use of <b>gamification</b> to stimulate engagement of owners in knowledge-transfer activities
...repositories	e.g., automated <b>keyword tagging</b> enables generation of “quick reference lists” for specific topics	e.g., use of <b>graph data technology</b> for discovery and extraction of topics and identification of hidden relationships within vast amounts of textual data	e.g., <b>data visualization</b> interfaces that make it easier to understand and prioritize information

Figure 2: Examples of accelerated knowledge capture and learning

**3. Ambidextrous organizations:** As we have shown previously<sup>3</sup>, shaping “ambidextrous” organizations is hard and takes time. However, it can be done. For (large) research organizations, this means continuing to serve as productive “knowledge delivery engines” (traditional R&D), while also embracing active or even orchestrating roles in market-facing discovery (as Philips does inside academic hospitals), as well as running proof-of-principle pilots with local partners as part of their breakthrough innovation portfolios.

### Insight for the executive

Companies claiming they are moving to digitally transform their entire ways of working are easy to find. And indeed, a majority of industrial companies have already shown impressive results from the rollout of “Industry 4.0” and similar principles, with more to come. It is therefore surprising to see that the very essence of most companies’ competitive advantage – innovation – is barely addressed or not included

3. “Ambidextrous organizations – How to embrace disruption and create organizational advantage” – Prism 1 2018

at all in this great leap forward. If innovation leadership is about being the best at making their people learn, think, originate ideas, connect, and deliver new business value, companies must better understand what's keeping their people from leading in these areas and what "next practices" can be deployed to remove these hurdles.

The laboratory of the future is not "just" about using clever tools to simplify or improve specific tasks – such as in designing experiments or in analyzing patent databases. Deploying such tools is necessary to keep pace in the world of today, but they will almost certainly not be enough to meet the grand innovation challenges facing the company of tomorrow: how to encourage adoption of digital thinking by *everyone in everything* related to innovation; how to forge "multi-everything" teams (such as multi-skills, multi-experience and mental models) to design, develop and sell winning solutions in a converging world; and how to fill the widening information and learning brokerage gap, ensuring that people act and think based on the understanding and insight they *could* have, rather than have already.

The future path for innovation won't just happen. The challenges mentioned above are relevant today, and so are ways to address them. As we have outlined in this article, software democratization, accelerated knowledge capture and learning, and deployment of new organizational models based on ambidexterity are already being applied. They have the potential to drive a quantum leap in innovation effectiveness, speed and efficiency.

The key to success is to start and end the creation of the laboratory of the future with people, as well as to understand:

- What would make people perfect innovators in your company, today and tomorrow?
- What is keeping them from reaching this optimal level – as individuals, teams and organizations?
- How could you stitch the right combination of the “next practices” described in this article into an augmented innovation environment and experience that removes or minimizes such obstacles?
- How can you translate these findings into discrete, must-win battles within your digitalization journey and manage them for success?
- And finally, how can you ensure that this journey brings frequent and clear improvements in the user experience for everyone in your innovation community, rather than promising future advances and benefits that will never become concrete?

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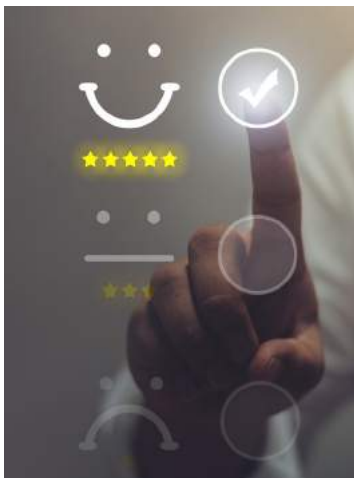
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# Turning customers into subscribers – How to successfully make the shift

Johan Treutiger, Niklas Brundin, Greg Smith, Ingrid af Sandeberg, Alexandra Nybonn, Rick Eagar

As manufacturing firms face ever-increasing global competition and pressure on margins, the prospect of capturing more value through services – rather than just products – remains a key strategic priority. Manufacturing companies that employ best practices can make 45–65 percent of their revenues through services, with EBIT margins of 18 percent or more<sup>1</sup>, and typically well in excess of product margins. There are some long-established, well-known examples of the product-to-service shift, including Rolls Royce’s Power-by-the-Hour model for jet engines and tool manufacturer Hilti’s Fleet Management model, in which customers are guaranteed availability of equipment when it is needed at a monthly fixed rate.



What customers expect from manufacturing businesses is changing, moving away from outright purchase- to subscription-based models. This offers opportunities and risks for traditional players, providing them with access to greater customer insight, but also lowering barriers for competitors. Based on case examples, this article looks at how manufacturers can make the shift to subscription-based businesses.

In recent years, trends in digital technologies, changing customer behaviors, and threats from new data-rich competitors have brought urgency for manufacturing companies to move still further into services, and to form deeper and closer relationships with customers through subscription models. However, this isn’t always as easy as it sounds. Not all customers like the idea of being tied to one supplier, and new service-based business models do not always deliver the expected returns. In this article we look at some of the challenges for companies moving towards subscription-based business models and highlight an approach they can adopt to increase their likelihood of success.

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1. Source: VDMA (2014): Zukunftsperspektive deutscher Maschinenbau; Arthur D. Little

**Why subscription models are becoming more important**

Manufacturing companies traditionally provide products that customers buy to solve problems, meet needs and perform functions. While a service model implies shifting from product ownership to product access on a reactive, pay-per-use basis, a subscription model means having a proactive, long-term customer relationship with recurring fees, as shown in Figure 1.

Aspect	Product	Service	Subscription
Customer perspective	I will solve my problem	Get my problem solved	I don't want to see the problem ever again
Offering focus	CAPEX	Occasional OPEX	Run-rate OPEX
Value proposition	Ownership	Reactive, on demand	Proactive, prevent demand
Data point access	One – at point of sale	Several – on use basis	Continuous collection
Key success factors	Be top of mind when need occurs (infrequent)		Build trust and continuously improve experience

**Figure 1: Product, service and subscription models**

In recent years, subscription models have become much more important due to a combination of powerful market-pull and technology-push factors:

- Market pull – Changing customer expectations:**  
 Customers, whether in the business or consumer market, are increasingly demanding more tailored user experiences, which means manufacturers need to achieve much deeper customer insight. Business customers are more likely to look at products as a means to achieve “jobs to be done” than as assets they need to own. Enabled by effective external-partner ecosystems, companies are increasingly keen to focus on their core differentiators (their “raison d’être”) to maintain flexibility and avoid unnecessary CAPEX, externalizing whatever is non-core<sup>2</sup>.

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2. Refer to the lead article “The company of tomorrow” in this issue for further details.



Product ownership is less important than the quality and customizability of the experience for consumers as well – hence, for example, the rise of mobility-as-a-service (MaaS) instead of car ownership and streaming services instead of recorded media.

- **Technology push – Connectedness and data:** Availability of connected, smart devices is causing value to shift from hardware to software. The ability to generate and analyze data with unprecedented sophistication provides huge opportunities for companies to gain insight and create new value within customer relationships, especially those that are long-term.

For traditional manufacturing companies, these rapidly evolving trends offer up many new opportunities to gain business advantage.

However, there is also a significant threat in terms of new competition. Previously, competitive advantage relied on manufacturing and distribution efficiency on the one hand, and customer knowledge accumulated over time on the other. However, the value of experience is eroding in an economy in which manufacturing capabilities can be outsourced efficiently (or built up rapidly) and data on customers' needs, preferences, and usage patterns can be collected elsewhere.

Therefore, now competition is not solely from companies providing similar products, but also new players that can identify and address the customer's basic need for which products are used. An example of this is the growth of subscription-based carpools and MaaS solutions, which have started to erode the tradition car-rental market. Other examples of potential new competitors include Amazon and Google, whose voice assistants increasingly tap into the wealth of information surrounding purchase decisions, such as the circumstances that may spark the idea of a purchase, what questions are important during the research phase, and what triggers the buying decision. This quality of data can enable development of new and radically different solutions that address customer needs before the customer even recognizes them as needs. Manufacturing companies need to ensure that they are not left behind in the face of these new competitive threats.

## The benefits to companies

Manufacturing companies that have operationalized subscription models which exploit their full potential can enjoy a variety of benefits, for example:

- **Greater customer insight:** Deeper understanding of customer needs and behaviors, which is fundamental to effective product and service innovation.
- **Stronger customer relationships:** Greater customer intimacy, increased loyalty and customer stickiness, higher customer satisfaction.
- **Better margins:** Increased value-add to the customer, which enables premium higher-margin services.
- **More growth:** The potential to grow revenues through broadening the service range, as well as recruiting new subscribers.
- **Greater stability:** less volatility, stabler and more predictable cash flows. For example, new AI applications enable companies to optimize offerings and pricing, and as a result, prevent churn and maximize life cycle value

Signify and SKF are two examples of companies which have monetized the subscription model.

### **Box 1 – Signify and SKF – Monetizing the subscription model**

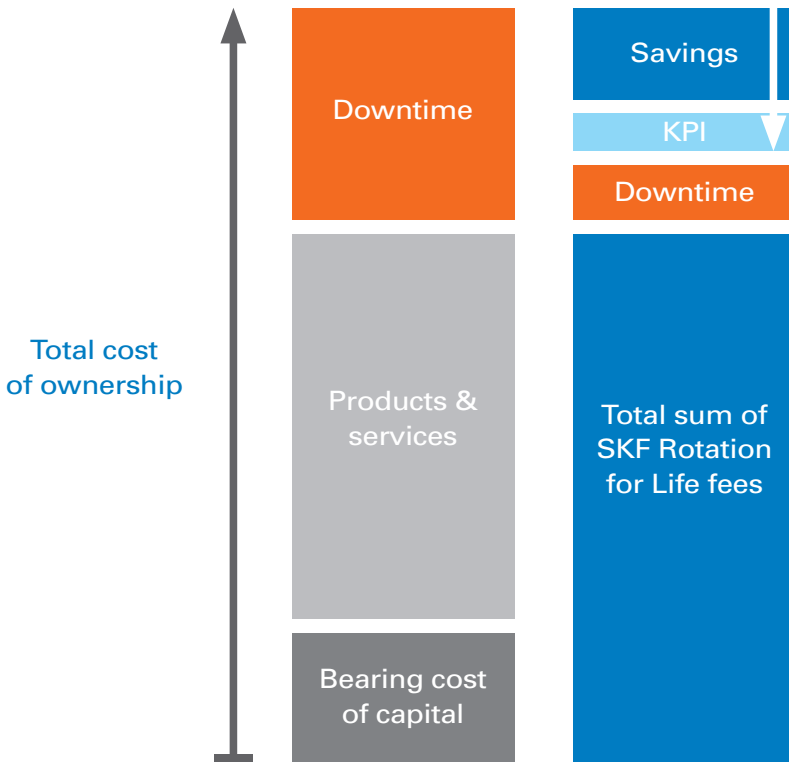
Light manufacturer Signify, formerly Philips Lighting<sup>3</sup>, offers major customers such as airports, malls, and office complexes the opportunity to subscribe to light-as-a-service through its Managed Services concept. Rather than purchasing, installing and changing lights and fixtures themselves, customers avoid CAPEX (and maintenance fees) through outsourcing this to Signify for a lower recurring (OPEX) cost. During the contract, Signify retains ownership of the products and is responsible for managing all the customer's lighting needs. Typically, customers see total cost reductions of around 50 percent, as the new business model enables tailoring the light supply based on consumption. Signify also offers connected lighting solutions in which each luminaire contains an IoT sensor that captures data – regarding not only lighting needs and “bulb-health” to enable predictive maintenance, but also activity levels and environmental parameters within buildings. This, in turn, enables customers to analyze this insight and tailor their own offerings. Signify is now targeting the consumer market with a subscription model.

Bearings company SKF also demonstrates the benefits of a subscription model. Its new Rotation for Life concept offers customers production by the hour, including service, seals, and lubrication<sup>4</sup>. Through performance contracts, SKF ensures customers' rotating machinery operates as agreed and process performance targets are met. IoT sensors, currently monitoring over 4 million measuring points, equip the bearings. This allows condition monitoring and predictive maintenance, which elongates product life spans while reducing down time and operational costs. Expected reductions in customers' TCO are illustrated in Figure 2. President and CEO Alrik Danielsson stresses the importance of data for the concept's success, but also concludes that **“there has to be a significant mind-set shift at both manufacturer and customer level for performance contracts to flourish.”**

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3. Signify website, Philips Lighting brand website

4. SKF Group website



**Figure 2: SKF Rotation for Life customer total cost of ownership (TCO) structure, adapted from SKF Group website**

The new business models from Signify and SKF share common characteristics. Both offer tailored customer experiences that are constantly updated with the latest features, with maximized up-time and often lower TCO. At the same time, they are building continuous customer relationships (and revenues) and can lower their operational costs through predictability and prioritization of efforts according to what drives value for their customers. They have refocused incentive programs so employees are no longer motivated to sell more products year on year, but rather, to develop top-quality, sustainable products – which also drives a move towards circular business models. This delivers advantages for the manufacturer, its customers, and the environment.

## The challenges of moving to a subscription model

However, as well as the success stories, there are many examples of manufacturing companies struggling to make the shift towards service-based models and failing to reach profitability, when both transforming from old business models and establishing new ones from scratch. For example, Michelin Tires launched Michelin Fleet Solutions, offering customers tires for a monthly fee, including replacements and maintenance<sup>5</sup>. The venture proved challenging due to multiple factors:

- Difficulties in demonstrating benefits for customers.
- Internal resistance through misalignment of incentives. The sales force was hesitant to adopt the new offering because its primary KPI was still the number of new tires sold.
- Complex cost structures proved difficult to manage, as did the added intricacies of the relationships and split of responsibilities with distributors along the value chain.

The combination of these challenges led to transformation of the concept. Michelin has now relaunched it with IoT connectivity, using sensors to measure pressure, temperature and speed, which allows it to provide customized data offerings to customers. Time will tell whether this reworked, improved effort will prove successful.

Other examples include German automotive supplier Dürr, which was unable to monetize its product-to-service efforts due to lack of internal cost control<sup>6</sup>. Intel's web-based services division was discontinued within a few years, and Siemens' Business Services division had difficulties generating sustainable profits.

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5. Harvard Business School; International Institute for Management Development

6. University of Cambridge; KTH Royal Institute of Technology

In general, companies that struggle to make the change often fail to:

- Spend enough time formulating deep understanding of customer perspective and benefits
- Develop the necessary capabilities to address critical data-strategy issues
- Align the whole organization behind the new business model (as opposed to just the delivery model).

Delivering on growing customer expectations, and thus remaining competitive in a converging industrial landscape, increasingly requires access to data around product usage. Yet, most traditional manufacturing companies are not set up to collect and leverage relevant data.

### **How to overcome the challenges**

To successfully introduce a subscription model, companies need to focus on four priorities:

#### **1. Develop deep insight into customer needs and desires**

The starting point for successful transformation is gaining deep understanding of customer needs, including those that may be inferred rather than expressed, and identifying whether and how a subscription model could address those needs. Typically, this means developing a truly customer-centric perspective, looking much more broadly beyond product-related services, towards customer objectives, desires and constraints. This needs to include understanding the nature of customer resistance to subscriptions – customers will not commit to subscriptions if they do not significantly help them. For example, if customers believe a company will use their data and information to create customized offerings which exceed expectations, they are more likely to commit.

#### **2. Place data at the center of the strategy**

Companies should focus on how data is to be gathered, analyzed and exploited in any move to a subscription model. Offering superior, customized products and services comes directly from customer-insight generation, which requires adequate quantity and quality of relevant data, as well as appropriate skills to analyze it. Competitive analysis from a

data perspective becomes critical, alongside reviewing the company's value proposition portfolio in relation to customer behavior to establish where the subscriptionized business model could fit in. Subscription-based models require new technological capacity, such as using sensors to capture data, data analytics, and AI capabilities to create superior, tailored offerings. They also need capabilities within manufacturing, in terms of adopting techniques such as DevOps and agile production.

### **3. Align internal functions and processes**

For a successful business-model shift, an organization's internal departments must be adequately incentivized and aligned with a shared vision that clearly recognizes the move from product oriented to data oriented. Sales, operations, and R&D must all work towards the same vision and be compensated not based on the number of products that can be pushed out – but on, for example, total profitability or number of subscription customers. Business transformation is key. A business-model shift entails a significant change in many internal processes, and often involves new sales channels.

### **4. Adopt a step-by-step approach**

As with any new business trend gaining traction, there is temptation – especially for incumbent firms – to dive in head first. After all, incumbents have the capital to make it happen and are (rightly) cognizant of the risk of being surpassed by new market disruptors. However, this often leads to focus on the delivery model itself (the what), rather than the entire business model (the how and the why). In our experience, companies that have been successful have taken sufficient time to assess the strategic position before acting (as in 1 and 2 above).

Although customization is a key value-add from the subscription model, not everything can be customized at once. Companies can prioritize and create one “wow” dimension at a time, until they gain the required amount of data to create truly tailored offerings. For example, the first step could be a set-up in which the subscription depends on use frequency and intensity, while different fee levels are trialed. By incrementally building understanding of which customers use which model, when, and how, firms can increase the level of customization per subscription step by step.

## **Insight for the executive**

To remain differentiated in an increasingly competitive and converging industrial landscape, companies must gain access to, and generate insight from, customer data in order to deliver superior and customized offerings. Adopting a subscription-based business model is a key method of achieving this. However, implementing a subscription model requires a fundamental shift in a company's overall business logic and incentive alignment, creation of new internal skills and capabilities, and agility to adjust in a transformed external ecosystem.

With data access a key competitive advantage, product companies in both B2B and B2C markets will have to re-evaluate their competitive landscapes, looking out for players with similar or better customer insight – on relevant parameters – rather than focusing on players with similar or better product or service offerings. This establishes a continuous customer relationship, which enables data generation, accumulation of customer insight, and ultimately, improved offerings. For many manufacturing companies the move to subscription models – not just services – will be the key battleground for ensuring future competitive advantage.







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# Unleashing innovation using low code/no code – The age of the citizen developer

Greg Smith, Michael Papadopoulos, Joshua Sanz, Michael Grech, Heather Norris

Over the last decade we have seen the “softwarization” of products, services and experiences. Organizations that spent decades developing and improving their business models and core capabilities have been outcompeted by those that disrupted their own business models with software. It has

been famously said that “software is eating the world”<sup>1</sup>, and in today’s highly competitive environment, organizations find it challenging to fulfill the development and operational demands needed to keep their businesses running, while continuing to expand and enhance their digital capabilities.

In this article we will explore how enterprises can leverage today’s low-code/no-code (LC/NC) solutions – declarative<sup>2</sup> development options with relatively low learning curves that provide the company’s

workforce with tools to easily create software to grow and transform the business.

As the saying goes, “software is eating the world,” forcing companies to change their business models and operations. In a highly competitive environment, ensuring they have the required software capabilities is a challenge. This article shows how adopting low-code/no-code techniques enables businesses to widen their options, providing tools for non-specialist “citizen developers” to digitize and transform their operations.



## What is low-code/no-code (LC/NC)?

Complex tasks have been progressively simplified through the use of technology and visual tools. For example, word processing has been so affected and simplified by visual programming that today’s average seven-year-old can compose a well-formatted electronic document with graphics in minutes.

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1. “Why Software Is Eating the World”, Marc Andreessen, The Wall Street Journal, 2011

2. Declarative programming is a programming paradigm – a style of building the structure and elements of computer programs – that expresses the logic of a computation without describing its control flow.

Low-code and no-code tools are the latest stage in this evolution. They allow anyone to create application software through graphical user interfaces and declarative programming. LC/NC development platforms provide tools for designing applications or systems, along with their required inputs, outputs and business logic. LC/NC takes a visual approach to build business applications more efficiently. This allows “citizen developers” – such as designers and businesspeople – to build and test applications quickly, without the need for developers.

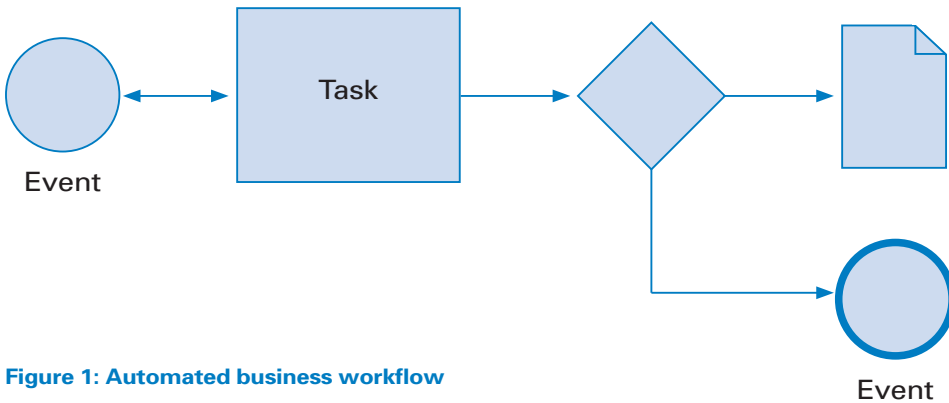


Figure 1: Automated business workflow

Low-code and no-code platforms enable average people to create apps quickly, and then layer customization and added features on top of them. With these options, enterprise users may develop their own apps without writing a line of code, or while keeping code to a minimum for any optional customization. According to Gartner’s research<sup>3</sup>, “by 2024, low-code application development will be responsible for more than 65 percent of application development activity.”

**The difference between low-code and no-code:** Whereas low-code solutions usually require some initial installation, deployment and minimal coding skills, no-code platforms are faster to set and much easier to use, and hardly require any coding for the most basic functionality.

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3. Magic Quadrant for Enterprise Low-Code Application Platforms–Gartner

No-code platforms are good for building line-of-business apps when you have limited IT resources and technically savvy businesspeople. Low-code development platforms, on the other hand, are a good choice for professional developers who want to create long-term custom applications that will help implement business requirements but have much higher customization needs – such as pixel-perfect user interfaces.

## Benefits of LC/NC

For any business undergoing a digital transformation, a LC/NC approach to development can enable a wider range of people and empower the workforce. It builds on innate creativity and entrepreneurship to automate back-office tasks, which can improve internal operations and execute ideas by quickly moving them from inception to prototyping. It allows anyone from the business without previous technical experience to become a smart software generator, which takes the pressure off IT and enables innovation to come from all sides of the business. It also solves real problems that may not otherwise get the attention they deserve by enabling the people closest to them to solve them. Why not devolve processes and capabilities back to their key stakeholders? This will also allow companies to avoid offshoring in some cases, keeping the solution closer to the problem. Furthermore, it will help address a common challenge in software creation: how to communicate requirements to developers.

Whether it is used as an innovation catalyst, to boost productivity, or to address the developer shortage<sup>4</sup>, LC/NC's intuitive user experience, low complexity, and adaptability have a double impact. It brings in new software that would not have otherwise existed, and also decreases development time for software that would have otherwise been implemented in a classic manner. This results in faster time to market and significant overall cost reduction (CAPEX and OPEX) when applied properly. For example, low-code services specialist Green Lemon Company worked with a logistics company to create a vehicle-tracking dealer portal that went from design to deployment in four weeks. The estimates using the traditional development indicated a four- to five-month effort<sup>5</sup>. Our own case studies (see Box 1 later in this article) show similar time-to-value gains.

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4. The New Frontier of Software Development—Salesforce research

5. Digital Enablement via Low Code Platform—TechMarketView

In addition, LC/NC solutions facilitate a user-centric approach with great flexibility to adapt to customer needs and evolve the solution. It skips front-end involvement of IT when starting work on business-critical apps and brings them in when it is time for live integrations, security, deployments and the like.

### When should you use LC/NC?

LC/NC solutions are ideal for non-technical staff members who understand the business context and are best positioned to drive and challenge requirements. A solution can start with the business, and then be handed over to IT for enhancements. This eliminates long IT backlogs<sup>6</sup> or having to procure services from external parties if the company does not have in-house IT capabilities. Most benefits of a LC/NC approach come when it is applied to productivity use cases that require strong business knowledge or projects that have limited initial investment and tight deadlines, and require fast turnaround and flexible approaches. Typical applications are as follows:

- **Operational efficiency improvement:** Automation of manual and paper-based processes to increase accuracy and quality while reducing costs. LC/NC platforms make it easy to create applications for capturing information and include ready-made connectors for integrating applications into core systems. Most LC/NC platforms include workflow automation. Workflow tools allow the people closest to the business, such as a business analysts, to build the processes and simple touchpoints needed for common customer and employee activities. The tools have easy-to-use graphical user interfaces to model processes, and some allow APIs and pre-built integrations for a wider range of use cases so workflows are fully integrated with in-house and third-party systems. However, one disadvantage is they can only provide part of the solution and offer limited ability to alter the user experience; hence, further work may be needed for full automation and integration with other systems.

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6. The No-Code Solution to Your Digital Transformation – Betty Blocks



- **Innovation and prototyping:** An often-overlooked capability of LC/NC solutions is innovation and “art of the possible” applications. LC/NC solutions allow business users – the people who best know and understand the challenges and the vision – to unlock value by “smart stitching” emerging technologies such as the Internet of Things (IoT), artificial intelligence (AI), machine learning, and even blockchain together with older, legacy data. This allows for an iterative test and learn-and-discover approach, in which users create functional prototypes and iterate towards fully functional applications.
- **Smart stitching<sup>7</sup>:** The availability of open APIs, microservices, and developments around function-as-a-service (FaaS) and serverless applications underline how new-generation applications are moving towards collections of connected services<sup>8</sup>. Over time, organizations often end up with big suites of tools and systems (bespoke and off-the shelf) from different vendors. This is usually the case for global enterprises that have expanded and diversified through both acquiring other companies and setting up operations in new markets by building applications quickly, without global IT growth strategies in mind. LC/NC platforms enable rapid creation of pinpoint, domain-specific applications, which, via connectors or building middle layers, can be “stitched” together with legacy applications to create end-to-end products. Businesses can use LC/NC tools as tactical solutions to integrate different components to “keep the lights on” while they decide if they need to replace potential burning platforms in the long term.

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7. Smart stitching (<http://www.digitalproblemsolving.com/meme/smart-stitching>)

| Arthur D. Little

8. Digital Enablement via Low Code Platforms – TechMarketView

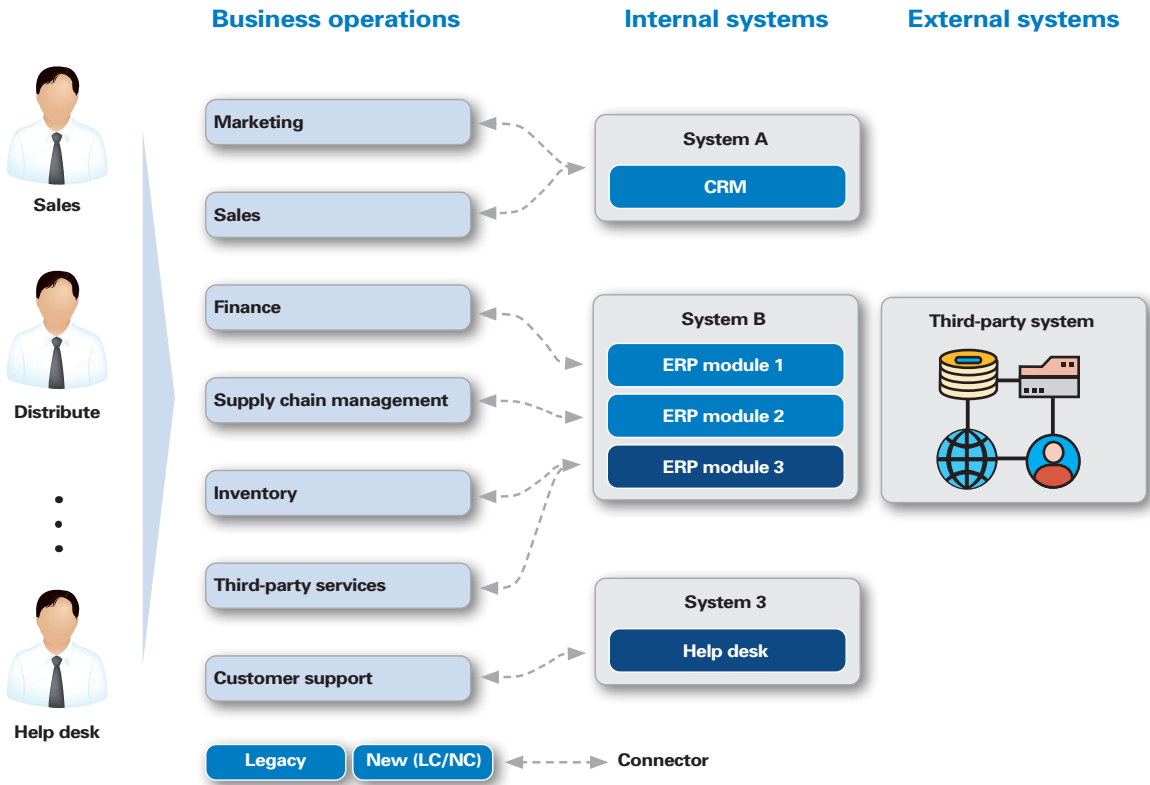


Figure 2: Easy expansion of operation systems with LC/NC tools

In Box 1, we have summarized a few case studies in which ADL has implemented LC/NC solutions to help clients:

**Box 1 – LC/NC case studies**

**Mobile network operator value-added services:** ADL used LC/NC tools to design and implement a plethora of value-added services (VASs) for a mobile network operator. These ranged from the standard services of balance enquiries, balance transfers, and credit top-ups to more innovative services such as quiz games. The services were all accessed via SMS or the USSD protocol, so there was no need for a graphical user interface. The platform used the Java Business Process Management (jbPM5) engine, with the input and

business logic designed in a workflow graphical editor. Though the technology used in this example has since been significantly superseded, the core patterns and principles have not. Engineers and developers would establish the core API calls and system API functionality, and then hand these over to business- and product people, who would use these as “Lego” blocks to build the necessary functionality. The platform served over 1 million customers, achieving speeds of over 120 transactions a second and proving LC/NC could be made efficient.

### **A robot-as-a-service (RaaS) platform for a global**

**company:** ADL used a modern LC/NC platform to smart-stitch together a number of off-the-shelf SaaS tools to enable CRM (including leads and campaigns), inventory, subscriptions and help desk. We set up a full greenfield RaaS platform for the European entity of a global corporation. The solution allowed for full customization out of the box for building flowcharts and creating logical steps for the process to make it repeatable, productive, and well structured. The solution also had out-of-the-box connectors to a variety of additional services, such as Amazon Connect, a cloud-based contact-center facility that could also be fully customized using simple drag-and-drop tools.

## **Limitations and barriers of LC/NC**

LC/NC solutions offer significant benefits, but, as might be expected, they are not a panacea. There are some limitations to consider:

- **Technical savvy:** Although LC/NC solutions make it possible for non-technical people to build applications, there could still be barriers to entry from a technical point of view. Aspiring users of LC/NC solutions need to at least know how to operate the tool itself, as well as be aware of some “technical” concepts, such as APIs and databases. For the fully customizable LC/NC options, some code will still need to be written, possibly within the LC/NC tool itself – even if they are basic requirements such as bits of Javascript, CSS and simple SQL queries. Employees need to have the basic technical skills to use the tools, or be able to acquire them, potentially with some light support from the IT team.

- **Lock-in:** All LC/NC development platforms result in lock-in, unlike conventional application platforms. For example, you can't take an app created using Google App Maker and transfer it into Microsoft PowerApps without rewriting the entire application. Some platforms, such as Camunda, allow you to port your application to a different cloud, but not generally to a different tool. Note that vendor lock-in does not have the same perfidious risk of the old days, when there was complete dependency and prices were constantly increasing. Healthy competition between vendors helps drive both innovative new features and functionality on LC/NC platforms, while keeping prices down (and, indeed, reducing year on year). In our view, this is an acceptable risk as long as the competitive differentiation enabled by the app is low.
- **Constrained performance:** LC/NC development tools decrease the amount of time needed to build an application. However, the applications that result from LC/NC development are rarely optimized for performance and efficiency due to the abstract, declarative nature of LC/NC solutions. Simply put, if you need an app that runs as quickly as possible and consumes the fewest resources, you will have to write bespoke code and go as close to the silicon as you can. However, this does not mean "low" or sluggish performance – this constrained performance refers to low parallelism, rather than an unpleasant experience. Most day-to-day users won't care or even notice that the platform showing a well-designed and well-thought-out business dashboard is consuming, for example, 10 percent more memory and 5 percent more CPU power than a non-LC/NC equivalent. LC/NC platforms will thus do very well, and modern platforms can scale to millions of users with reasonable requirements if executed correctly.

## Introducing LC/NC solutions into the organization

Companies looking to implement LC/NC solutions should consider a number of important priorities to ensure success.

### 1. Establish business value-add and link to strategic objectives

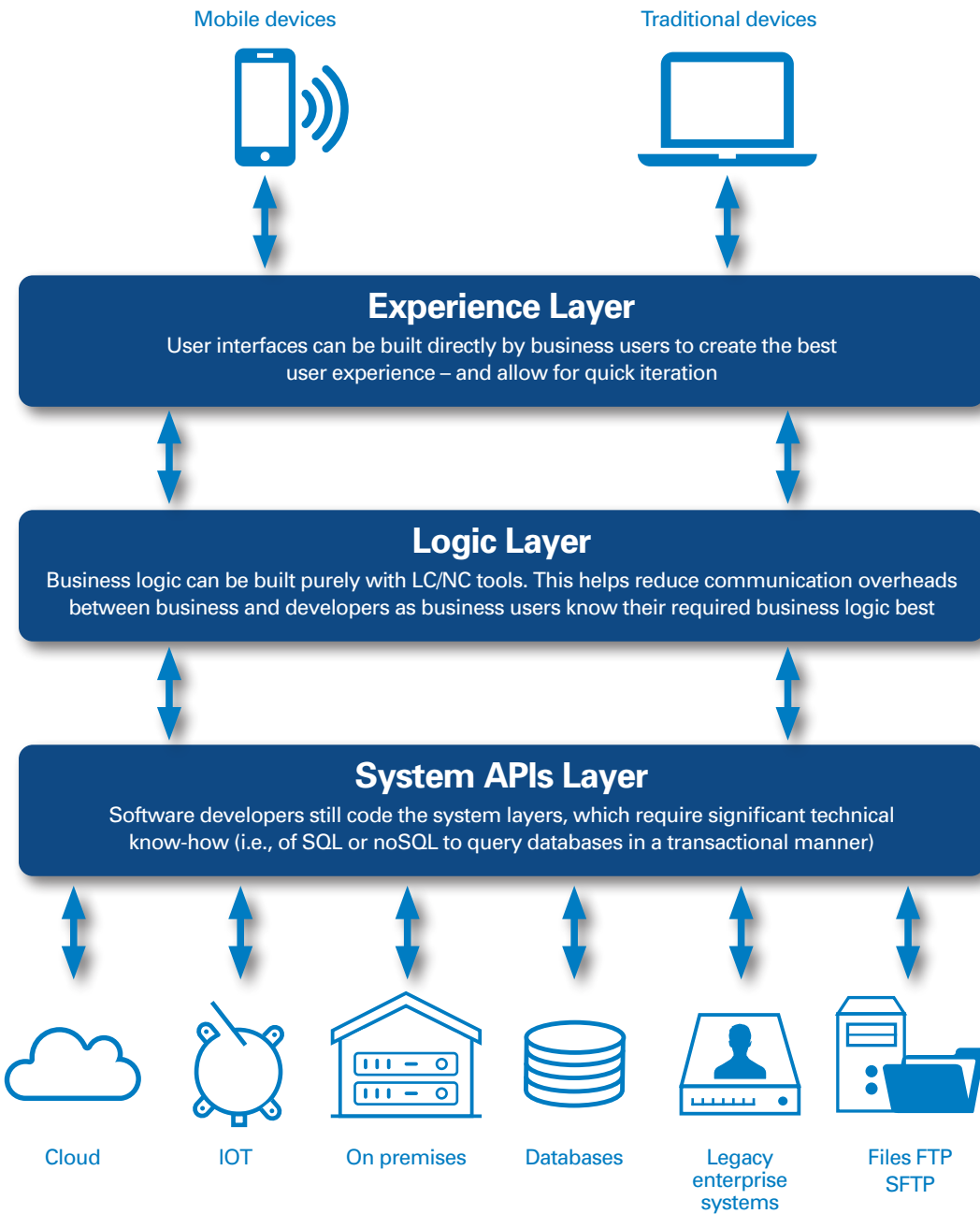
Before embarking on any implementation, it is important to understand the value that the LC/NC application will deliver to your business and how it links to your strategic objectives. Spending time in a discovery phase will not only validate

whether an LC/NC solution is needed in the first place, but also contribute to a shorter development phase later on, which will lead to savings across the life cycle. Then you will need to consider the type of application that best fits with your organization, and finally the organizational changes you will need to implement for its adoption to succeed. This is not just about having the right tool, but also knowing how to engage stakeholders and streamline processes, roles and responsibilities for them to contribute.

Determining how LC/NC tools can best serve your strategic objectives will depend on your organization's capabilities and enterprise architecture. Traditionally, there has been tension between IT and business departments. The former is incentivized to retain tight control over the application landscape to ensure stability and maintainability (which often leads to a rise in "shadow IT"), while the latter prioritizes speed of development and cost control.

## **2. Put the right system architecture in place**

The appropriate architecture and organizational structure can help facilitate the introduction of LC/NC solutions and relieve the tension between IT and business departments. The introduction of a tiered architecture can help separate the technical and non-technical aspects of a system. IT users can then focus on the technical details of the application, while others make use of LC/NC tools that focus on business logic. LC/NC tools can make use of the functionality offered by technical components of the system without being concerned with how they were implemented. Figure 3 highlights how this can be achieved with a three-tier architecture:



**Figure 3: Tiered architecture that enables citizen developers**

The system API layer will hide the complexity away from users further upstream. Developers and technical resources with intimate knowledge of databases, servers and other important components will be responsible for this layer. The team responsible for building and maintaining the system API layer will also have the tools necessary to safeguard critical systems from improper use of applications further upstream.

The Logic Layer will make use of the functionality offered by System APIs without being concerned with complex concepts such as database queries and cache management. Business users could plug into system APIs with LC/NC tools to rapidly create new applications based on their knowledge of user requirements. New insight and value can be created just by combining existing data and capabilities. The Logic Layer is where LC/NC tools shine because they allow for quick creation of complex business logic by the people who know it best. The Logic Layer is effectively protected, as the system API – created by technical people – provides the guardrails for performance and security.

Last, but not least, the Experience Layer allows users to create the UIs/UXs they need.

### **3. Use good change management practice**

Statistics show that between 60 and 85 percent of digital transformation projects fail due to lack of good change management practice and technical skills to execute<sup>9</sup>. Researchers have highlighted how critical change management is to driving a successful outcome. They stress the importance of communication and prioritization, especially during the set-up and pilot phase. Simplifying development to offer productivity gains and speed of delivery will require introducing corporate development to non-IT roles, which can be a significant change and cultural hurdle. Without the right training and governance structure, IT will be quickly overwhelmed with product quality and management challenges, and maintenance will become unsustainable. Tools should enable incremental learning, but it is also important to conduct training sessions to teach and enforce good practices. An organization might need to update some of its development guidelines to accommodate non-IT roles within the software development life cycle and make the business accountable for the quality and success of the solutions implemented. Collaboration between business and IT is key – CIOs should act as enablers and champions of change by consolidating communication tools, piloting and encouraging new ways of working, and streamlining processes to foster closer collaboration.

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9. Successful Digital Transformation. How Change Management helps you to hold course – Siemens

#### **4. Use minimum standards initially**

When working with LC/NC platforms for the first time, the organization's focus should be on meeting minimum operational process and quality standards early on. A faster pace will follow as applications shift from traditional development approaches, in which IT is fully responsible, to a model in which the business is at the center and realizing objectives is in the hands of the people on the operational front line, who have better understanding of business functions.

#### **5. Adopt an agile development approach**

If an IT capability already exists in the organization, the introduction of LC/NC does not need to disrupt the delivery framework. As an example, in an agile scrum, the principles, processes and ceremonies will still be followed, but benefits will be maximized by combining the fast decision-making of agile with the fast development speeds of LC/NC. Small adjustments will need to be made to adapt and improve the processes that come from this new way of developing, in which demands on non-IT stakeholders will increase, requiring collaboration to be tighter and more frequent. The same quality assurance rigor that is applied to traditional development should still apply. Apps need to follow the mandatory development life cycle to include testing, security checks and controlled deployments before going live.

#### **Insight for the executive**

We don't believe the skill of writing code is becoming obsolete or software developers will lose their jobs anytime soon – with low-code tools you can do something, but some skills and technical knowledge are still needed to understand how you should do it. We do believe that LC/NC platforms are finally achieving their purpose, giving citizen developers the power and simplicity to build software. They save time and money, while accelerating the pace of digital innovation and transformation within organizations.



One of the biggest strengths of LC/NC platforms is that they allow us to take advantage of the innate problem-solving skills of human beings by removing at least a significant portion, if not all, of the barriers to implementing software solutions in today's softwarized world. Simply put, LC/NC enhances the potential of innovation. This should resonate with organizations that have realized the necessity to become software driven if they are to survive, and even thrive, in the coming years. Ultimately, the benefits of LC/NC platforms are crystallized in their ability to empower entrepreneurial people in the organization to unleash their visions, ideas and creativity with minimal support through building smart software solutions.



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# Realizing the potential of the Internet of Things with 5G

Agron Lasku, Hariprasad Pichai, Rebecka Axelsson Wadman, Sean McDevitt

Despite our living in a world where more and more devices are connected, the Internet of Things (IoT) is still far from living up to its full promise in many industries. This is set to change as 5G enables many of the technical requirements that have previously been lacking. It will unleash significant industrial potential and enable realization of Industry 4.0 –

Arthur D. Little estimates the value of 5G-enabled IoT to be

USD 1.5 trillion by 2030<sup>1</sup>. So now is the time for companies to set their IoT strategies, and we believe investing in private networks is important for companies to consider as 5G becomes a reality. How should companies go about this?



## 5G will enable a broad range of advanced IoT use cases

The IoT has been a buzzword for quite some time – we have all

heard (repeatedly) how “everything will eventually become connected.” Although the number of connected things has increased exponentially over the past few years, the fact remains that in most industries the full potential of the IoT remains unproven and the major promised gains have yet to materialize.

Despite the hype, the Internet of Things (IoT) has yet to deliver its promised benefits to industrial companies. The advent of 5G removes many of the technical barriers to its successful adoption, accelerating digitalization. However, as this article explains, realizing the potential of the IoT requires businesses to focus first on their needs and then on the available options to implement the best solutions for future success.

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1. 5G Business potential from industry digitalization, Arthur D. Little and Ericsson

Several factors have influenced this:

- For a long time, supporting technology and infrastructure solutions were lacking. (See Figure 1 for key changes between selected wireless network generations.)
- Mobile network operator (MNO) models for pricing and performance were not adapted to the needs and requirements of enterprises looking to implement and scale IoT solutions.
- Many enterprises weren't quite ready to adapt to digitized business and operating models.

Wireless network generation	Year established	Enabled use cases	Peak data rates	Major network changes
2G (GSM)	1991	Digital voice calls, call and text encryption, SMS, picture messaging	50 Kbps	Replaced analog radio signals with digital signals
3G (UMTS)	1998	Video calling, web browsing, email	2 Mbps	Technology required major network equipment upgrades
4G (LTE)	2008	Video streaming, video conferencing, 3D TV	1 Gbps	Major investment required to change to IP-based packet switching



5G*	2020 (expected)	AR/VR, low-latency M2M connections, connected vehicles	20 Gbps	Massive MIMO cell sites, edge computing, network densification
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\*Note: The International Telecommunication Union (ITU) has provided "high-level" requirements for 5G, in particular through IMT-2020 standard setting requirements for 5G candidate radio access technologies; the standard is expected to be completed in 2020. Source: Arthur D. Little, ITU, 3GPP

Figure 1: Wireless network specifications by generation

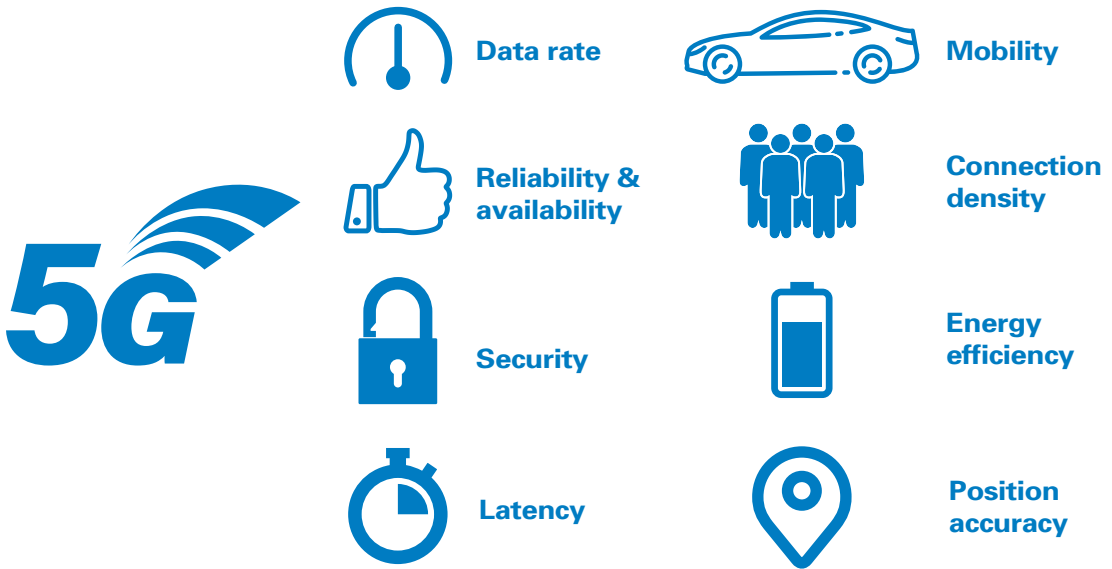
All of this is now rapidly changing. Sensors are becoming smarter, cheaper, and smaller – thus enabling broader usage and establishment of device ecosystems. Corporations are increasingly digitized and have systems in place that IoT solutions can connect to or be integrated into. Network operators (both traditional and alternative providers) have also realized that there is an unmet need for IoT-specific solutions and services; many have consequently established business-centric and/or IoT-centric divisions and offerings, such as Sprint’s Curiosity and Telia Company’s Division X.

As digitization increases, networking requirements increase as well. The emergence of the IoT has led to a need for different characteristics and technical capabilities in cellular networks, which have continued to develop and will, with the emergence of 5G, address the key needs of the IoT. 4G LTE, the latest iteration of the fourth generation of mobile cellular networks, has already enabled numerous new IoT solutions. However, while a combination of cabling and WiFi enabled many early industrial IoT use cases, 4G didn’t fully deliver in four areas:

1. It failed to provide speeds comparable to those of fixed broadband.
2. It did not meet significant bandwidth requirements.
3. Latency was not adequate for mission-critical applications.
4. It did not manage device density, which is key for a number of applications.

The next “evolutionary step” will be provided through broad implementation of 5G. In addition to being much faster than previous generations, 5G has a number of additional properties that will open up new mobile-data use cases – lower latency, improved reliability, higher connection density, low-cost and low-power capabilities, and enhanced positional accuracy. With 5G, wireless performance will be on par with fixed-line connections in many instances. (See Figure 2.)

**5G technologies aim to offer superior performance in terms of:**



Source: Arthur D. Little, 5G logo from 3GPP initiative

Note: Proposed capabilities are adapted from 3GPP initiative, which feeds into standards discussions, evaluations and adoption

**Figure 2: 5G performance specifics<sup>2</sup>**

One key feature of 5G which will significantly enable the IoT is ultra-low latency (the time it takes for data to be sent and/or received). Standards of 5G aim to reduce latency to a millisecond (ms), compared to approximately 50 ms for 4G. This might seem like a small difference, but if we compare it to human reaction times, a 50 ms lag is discernable, while less than a millisecond is faster than a human can react. If we consider an autonomous car responding to a pedestrian in its path or a connected drill reacting to unexpected vibration patterns, that millisecond can be the difference that saves the pedestrian’s life or prevents a collapse in a mine.

5G is also expected to be “ultra-reliable”, which will mean nearly no dropped calls or lost connectivity. It will thus allow for mission-critical use cases, such as those related to digital health, connected cars, and emergency response.

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2. 5G performance specifics as per 3GPP standards



Industries increasingly deploy and use connected sensors to monitor various assets in real time. Doing this economically requires devices that operate at low power levels and networks that offer low-cost connectivity options.

With more and more “things” being connected, thus leading to significantly higher connection density, the risk of interference increases. This has been another historical challenge to the IoT that will be addressed by 5G. All this means 5G will enable an entirely new range of applications. (See Figure 3.)

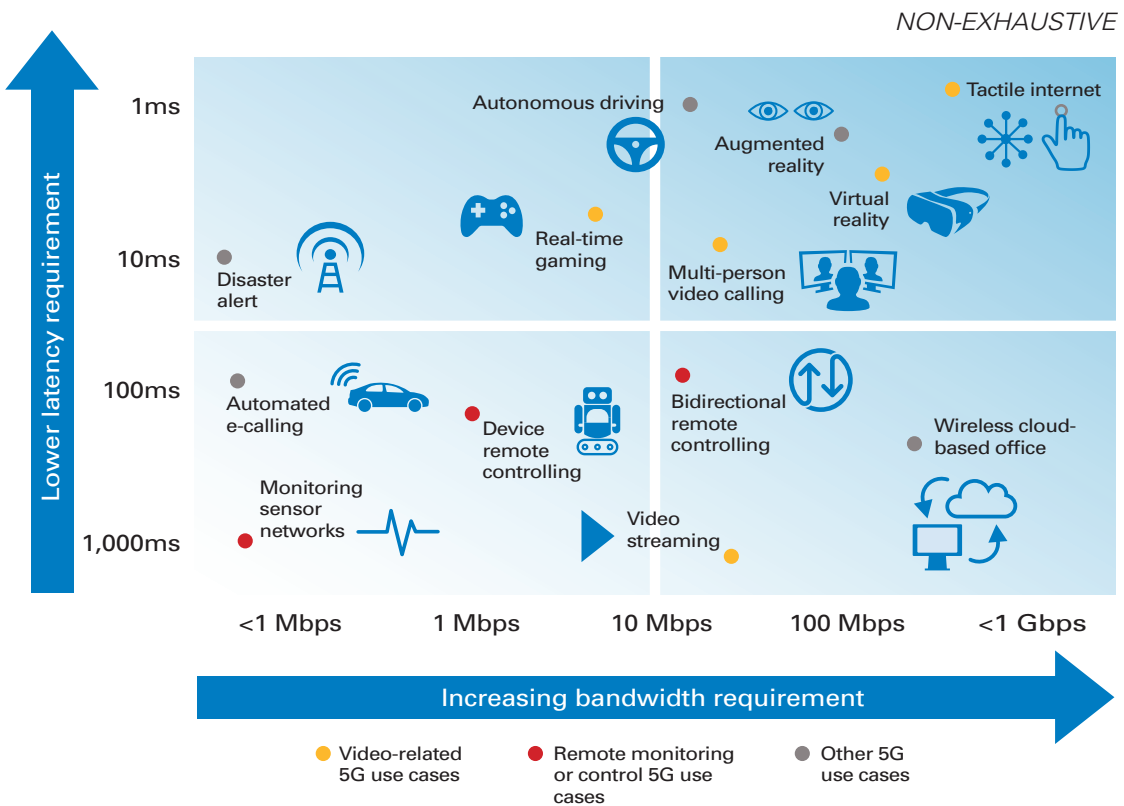


Figure 3: Advanced applications enabled by 5G

## The time to invest is now

Generational migrations from 2G to 3G and 3G to 4G required widespread upgrades of virtually all networking equipment.

These upgrades were extremely costly, but consequently provided the required capabilities across an operator's entire footprint for it to compete in an evolving market.

The migration from 4G to 5G, however, will not follow the same paradigm, as many 5G functionalities are already feasible on 4G infrastructure, which means a complete network overhaul is not required. In addition to lower migration costs to operators, this means companies that are considering investments in the IoT do not need to wait for full 5G to become available before they start to build out IoT application infrastructure. Core IoT capabilities and first use cases can be built on existing infrastructure and then gradually upgraded or improved as 5G capabilities become available.

How can they achieve this? Industrial IoT usage drives a greater need for cellular and 5G private network infrastructure. As a result, we see industries moving to localized cellular networks because of their ability to scale, future proof, and evolve over shared network infrastructure. Industrial players will therefore need to decide whether and how to play in private networks.

Private networks offer an attractive alternative for corporates. Today, the number of private networks is fairly low – expert estimates indicate 300–400 worldwide. However, Arthur D. Little estimates that the global market size will reach 60–70bn<sup>3</sup> by 2025. Technology infrastructure provider Nokia believes the opportunity could be twice as big as its current business of building wireless networks for operators<sup>4</sup>.

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3. Arthur D. Little, Private Campus Networks, February 2019

4. Nokia CTO Weldon at an investor event via <https://www.lightreading.com/mobile/5g/nokia-cto-private-wireless-could-be-2x-bigger-than-commercial-wireless/d/d-id/751839>

The advantages of a private network are many, with security and customization as the main drivers:

- **Full control** of network investments, including CAPEX and OPEX, with flexibility for ad hoc expansion.
- **Better security** as the data stays within the private network.
- **Full coverage where needed**, even where it would not be economical for a traditional wireless service provider.
- **Decentralized** architecture with multi-access edge computing (MEC) for low-latency applications.

The key question for industrial players to answer is whether they should rely on operators or vendors (such as Ericsson and Nokia) or new entrants (such as AWS) – or build the networks themselves. The solution deployed will depend on companies' business needs (including security and flexibility requirements), as well as the availability of regional spectrum for corporates or the regulatory reality around using unlicensed spectrum. In Germany, where spectrum has been made available locally (namely, for private-network use), multiple corporations are developing their own private networks. In the US there is the opportunity to use unlicensed spectrum released from the Citizens Broadband Radio Service (CBRS), while in other regions, an operator or another unlicensed spectrum will be required.

For industrial players looking to build private networks, there are now a number of options available because multiple players in the ecosystem have spotted this opportunity to

serve them. (See Figure 4.) Telecom operators, traditional wireless equipment vendors and new entrants alike are offering attractive solutions.

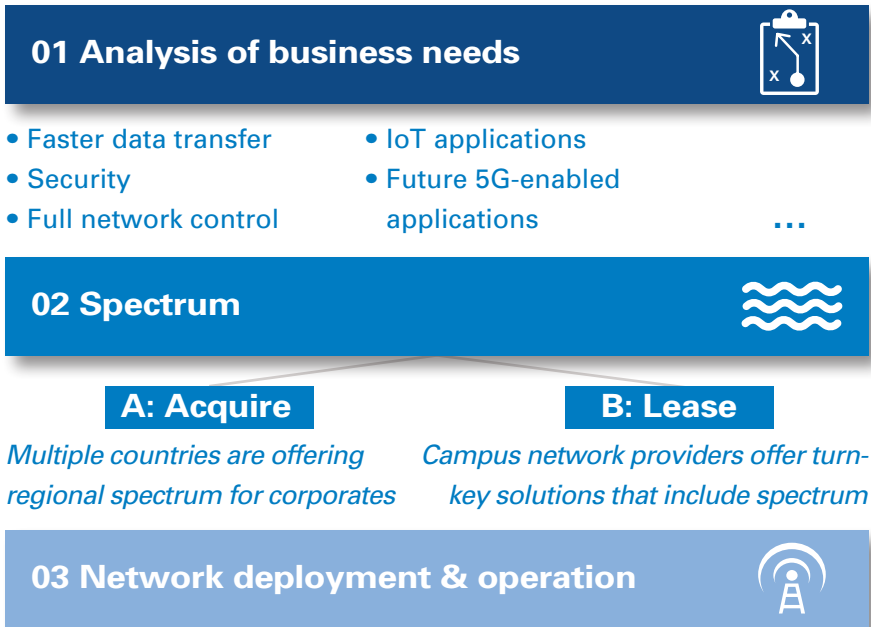


Figure 4: The recipe to create a private network

Given the availability of multiple service providers we see three main options for companies seeking to create a private network. (see Figure 5)

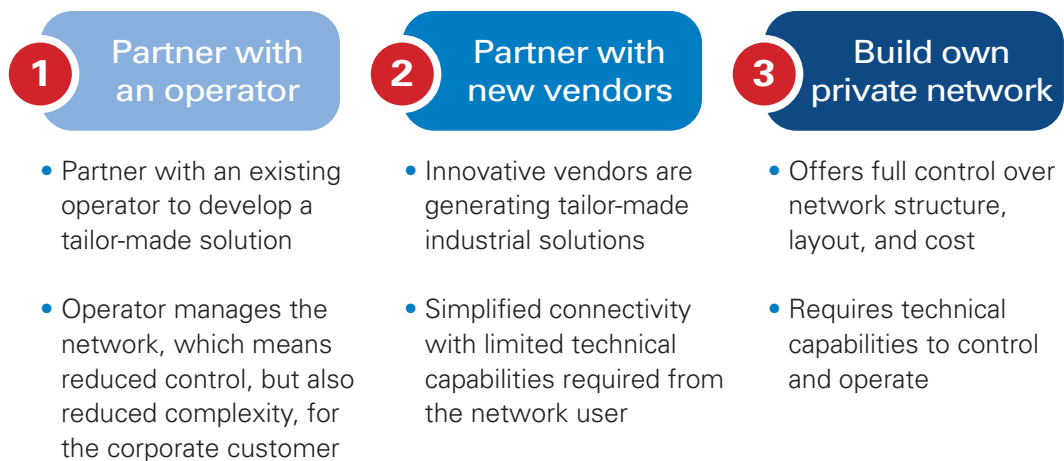


Figure 5: Private network deployment and operation options

**Option 1 – Partner with an operator:** The first option is perhaps the most straightforward – partner with an existing operator to develop a private network solution. (See Box 1.) Here the operator typically takes end-to-end responsibility for building the network and on-campus infrastructure, including bringing in the right technology partners and, once the private network is up and running, managing its operations. This means the level of complexity for the corporate customer is similar to what it would have been had it used a public network.

However, this also means the opportunity to control the network is reduced and the corporate customer is dependent on the operator for network changes and adaptations.

**Box 1 – OSRAM used its existing telco operator to provide tailored campus network solutions**

With the end goal of enabling implementation of automated (and AI-controlled) guided vehicles (AGVs) as a stepping stone towards Industry 4.0, OSRAM commissioned a campus network in its Schwabmünchen factory to prototype and test mobile robotics solutions. OSRAM's existing telco operator, Deutsche Telekom, provides and manages a dual-slice campus network solution that combines the public LTE network in the wider area of activity with a private LTE network layer within OSRAM's campus, for which Ericsson provided system technology. In addition to the campus network, a local edge cloud is being deployed, which shifts complex computing processes from a remote data center to a computer on the shop floor to enable faster data processing. This means data from the AGV's sensors can be transformed into control data so the transport system can react autonomously in real time.

**Option 2 – Partner with new vendors:** In the second option, the company partners with one of the new innovative service providers that have started offering private network solutions. (See Box 2.) Similarly to operator-run solutions, this offers customers simplified connectivity and limits the technical capability demands on the customer’s organization. Service providers such as AWS also typically offer lower prices and could be a good compromise for smaller companies that need the capabilities of a private network within limited budgets.

**Box 2 – Amazon Web Services corporate network in a box**

Together with three partners – Athonet, Ruckus, and Federation Wireless – Amazon Web Services (AWS) is offering corporates in the US a private LTE solution hosted in its cloud. The solution consists of BubbleCloud, a mobile core designed for private mobile networks, a Citizens Broadband Radio Service (CBRS) 3.5 GHz indoor LTE access point, and massive CBRS shared spectrum. It also includes full integration with the AWS IoT and plug-and-play experience, which makes it easier to connect, monitor, and manage IoT assets at scale. AWS created this solution to take advantage of “the upcoming launch of unlicensed spectrums globally, including CBRS in the USA (and later MulteFire globally), sXGP in Japan, and LAA in France.” The four partners are marketing their solution as a lower-cost, more efficient way of building a private mobile CBRS network.

**Option 3 – Build own private network:** The third option is to turn to a technology vendor such as Ericsson or Nokia to build a proprietary private network. (See Box 3.) This option gives the customer full control over the network structure, layout, and cost. However, the technical requirement for the organization is higher – having the right technical capabilities in place within the organization becomes imperative to ensure network operations. Corporates with high or very specific technical demands on their networks, as well as the organizational capabilities to design, control, and operate their networks, should consider this option.

**Box 3 – Ambra Solutions, together with Ericsson,  
provided the deepest private LTE network in the world at  
Agnico Eagle Mines in Canada**

Agnico Eagle commissioned an LTE network to work at a depth of three kilometers in the LaRonde mine in Canada to improve communication, safety, and operations. Deployed by Ambra Solutions, a provider of wireless technologies for remote areas, and Ericsson, it runs in the low-frequency 850 MHz spectrum band to allow better propagation.

With the network in place, a single LTE radio was able to cover six kilometers of tunnel, effectively replacing up to 60 active Wi-Fi access points.

In addition to establishing reliable communications, data and voice-mobility services, even in the remotest areas of the mine, the network enabled a number of critical IoT solutions, such as connected sensors that monitor air quality and remote-controlled operation of machinery. This enables more efficient operations and a safer working environment for miners.

## Insight for the executive

The time to accelerate your digitization journey is now. For industrial enterprises, 5G will solve many technical limitations impeding IoT development, and with its advent, new opportunities for IoT use cases will open up. While we are still some time away from full 5G deployment, enterprises planning to build or scale up IoT applications need not wait to invest. In order to gain first-mover advantage, IoT solutions can be built on existing 4G LTE networks and scaled up, or updated once full 5G capabilities are available.

Executives need to take a broad prospective with regard to the IoT in their planning. We envision four key questions to consider in this evolution:

- 1. What is your digital vision?** The starting point is the corporate enterprise's vision for digitalization. Which elements of the customer engagement journey, unique production environment (whether physical or virtual goods), and internal decision-making processes and procedures are to be digitized?
- 2. What roles do the IoT and network play in realizing the vision?** Next, consider the role that the IoT and network performance play in enabling the digital vision. These are necessary steps which should be rooted in improving and/or enhancing customer experience, operational efficiency, and improved speed and efficacy.
- 3. What, therefore, are the requirements for corporate network and IoT performance?** Not all devices and network operations require the same levels of security, speed, bandwidth, and responsiveness. An assessment of the desired performance attributes will show which use cases can be initially enabled and justified. It can then be determined whether public network/operator solutions are sufficient, or a more controlled, high-performance and secure internal network is necessary.



**4. What is a cogent implementation approach?** There is typically no one-size-fits-all approach – building a greenfield, private IoT corporate network from scratch may be ill advised. Instead, consider incremental use case-driven approaches to leverage technology (such as 4G initially, and then evolving to 5G) to address specific enterprise or customer use-case solutions. Typically, the next stage of investment use cases can leverage existing investments by building on shared infrastructure to enhance financial, operating and customer performance.

Once the executive team has evaluated these four steps, you can then consider how best to move forward with IoT and private network options, balancing internal capabilities, business requirements and willingness to invest.



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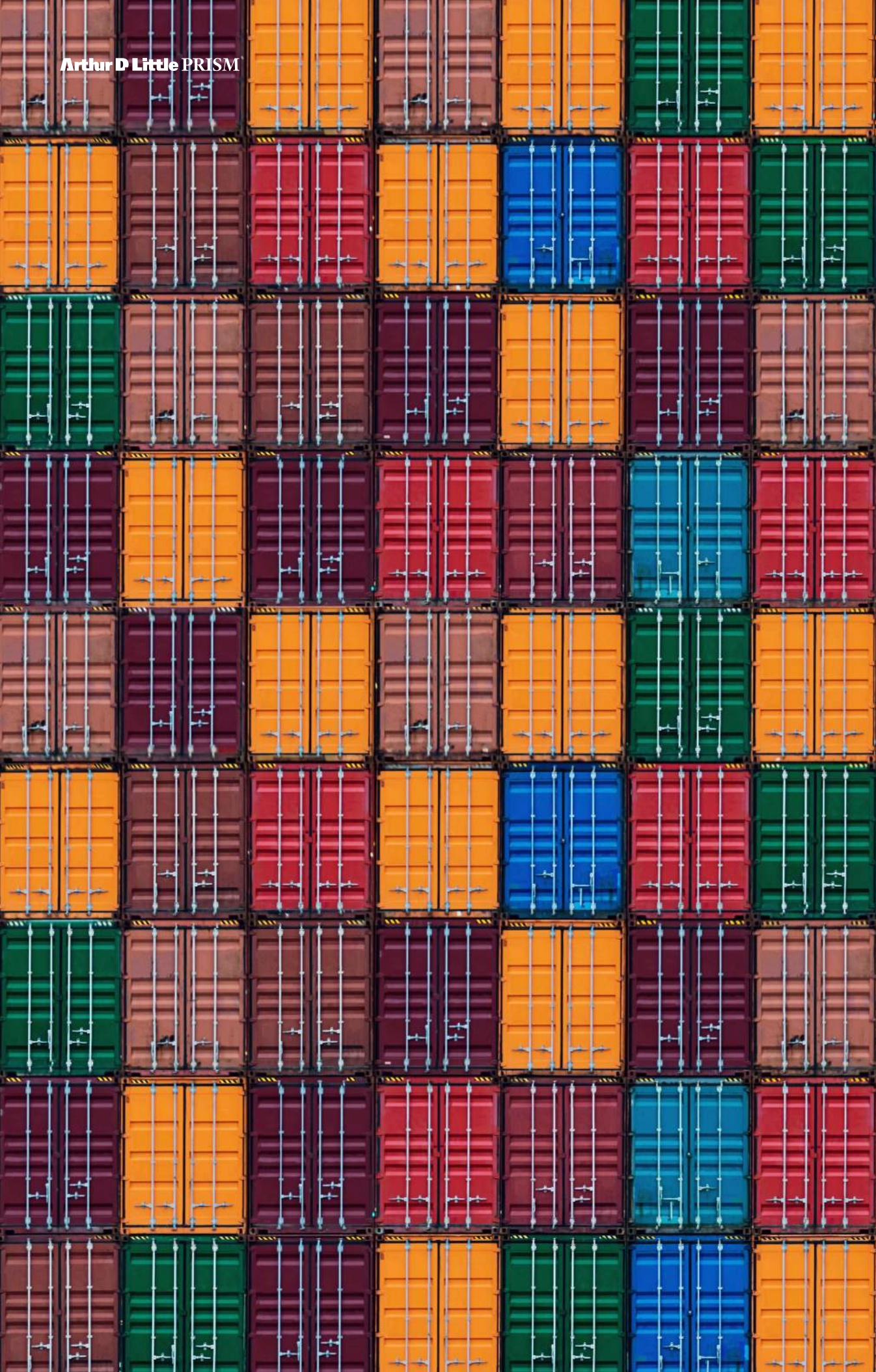
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# Blockchain in transport – Awaiting the breakthrough

## *Analyzing the impact of blockchain technology and identifying use cases within the transport industry*

Petter Kilefors, Dr. Fabian Döemer, Ingrid af Sandeberg, Tomislav Andric, Philipp Mudersbach, Gustaf Samuelsson, Simon Schmidtke

Since it came to prominence within financial services applications such as cryptocurrencies and digital asset exchanges, the race to find breakthrough applications for blockchain technology in other industries has been intense. However, despite major investments in knowledge, proofs of concept and pilots, the results and value generated from these efforts remain modest.

Blockchain seems the perfect solution for the complex, decentralized supply chains of the transport sector, but results to date have been disappointing. In this article, we analyze the latest global research with industry executives and use the findings to determine what needs to happen for the technology to reach its potential.



This has led to a change in attitude. Rather than asking when and where predicted disruptions will happen, many are now questioning “if” they will happen at all. As clear use cases have yet to emerge, it remains unclear whether the technology really is the silver bullet that companies have hoped for. This is particularly true in the transport industry, which was identified early on as a promising area for blockchain applications due to its large number

of independent but linked players, decentralized nature, and need to deal with issues such as verifying authenticity, improving traceability, and transparency, all while reducing transaction costs.

Through a global survey and review of use cases, as well as interviews and research, backed up with insight from ADL’s past and current blockchain projects, this article investigates blockchain adoption in the transport industry. It describes common challenges and provides practical recommendations for the future.

## About the survey

In October 2019, Arthur D. Little and BiTA (Blockchain in Transport Alliance) conducted an online survey of executives from more than 100 companies within the transport industry about current perceptions and adoption of blockchain technology. The survey aimed to evaluate the technology's potential, assess the current degree of adoption, and explore the factors that could be driving or preventing further acceptance.

## Blockchain today has failed to deliver benefits in the transport industry – Will this continue in the future?

After the introduction of Bitcoin in 2008, innovators and companies became interested in its underlying technology of distributed ledgers, specifically in blockchain. In a nutshell, a blockchain is a type of distributed, immutable ledger that allows for decentralized organization of data, with each computer node in a network holding an entire copy of the data set. This creates a self-governed, decentralized network that provides transparency, trust and traceability for all players in the network – a combination of characteristics unique to blockchain. With countless application possibilities mooted, significant hype around the technology followed. For example, Gartner<sup>1</sup> predicted that blockchain would create more than \$176 billion worth of business value by 2025 and over \$3,000 billion by 2030. The transport industry was seen as one of the most promising areas in which to tap into this value.

Despite its seemingly close fit with the needs of the transport sector, blockchain success seems to be absent. The path to successful implementation remains unclear and project results do not match the initial enthusiasm of their promoters. By 2023, it is expected that 90 percent of blockchain-based supply chain initiatives will suffer “blockchain fatigue”, due to lack of proven use cases<sup>2</sup>.

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1. Gartner (2019): <https://www.gartner.com/en/webinars/3878710/blockchain-potential-and-pitfalls>

2. Gartner (2019): <https://www.gartner.com/en/newsroom/press-releases/2019-05-07-gartner-predicts-90-of-blockchain-based-supply-chain>

However, even though the initial hype might seem to be over, the results of our recent online survey indicate that the transport industry still views blockchain as potentially disruptive. Over 70 percent of respondents believed blockchain could increase process efficiency, and nearly 60 percent said it had the potential to disrupt business models. Can the industry's optimism still be justified?

To find out, our analysis has looked at four questions, which we've answered in order within this article:

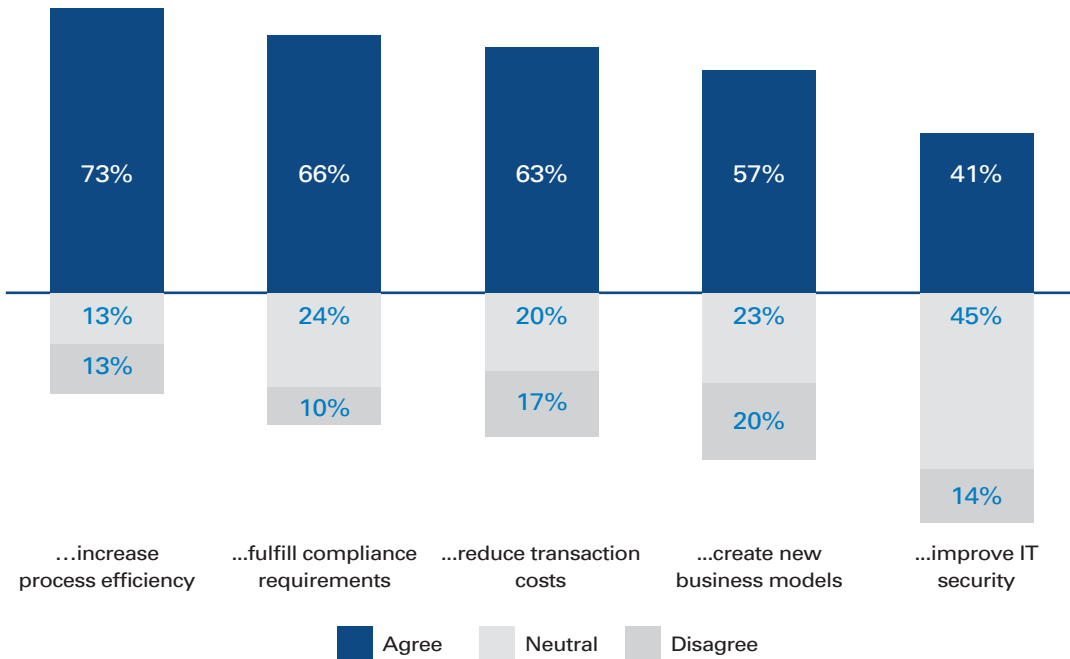
1. Is the transport industry still a promising application field for blockchain?
2. Which transport challenges are best overcome with blockchain?
3. What has prevented adoption of blockchain technology so far?
4. What foundations need to be put in place to deliver breakthroughs in the next three years?

## **1. The benefits of blockchain to the transport industry**

What is it that makes the combination of blockchain and transport interesting? Millions of people and hundreds of millions of tons of products and materials are transported around the world every day. Every supply chain is made up of a series of independent but connected players linking the source of a product to its ultimate destination, through a vast network of value-add processes, hand-overs and transactions. There is no central authority governing the entire supply chain, but rather, general practice, contracts and trust.

The global logistics market reached a value of \$4,730 billion in 2018 and has a projected CAGR of 4.9 percent, to reach \$6,300 billion by 2024<sup>3</sup>. Due to this considerable growth, the number of manufacturers, suppliers, and third-party intermediaries involved is increasing rapidly, making today’s global supply chains increasingly complicated to manage. At the same time, increasing digitalization and data utilization lead to security and transparency concerns across the industry. To solve these issues and overcome mistrust among the industry’s countless players, companies are turning to technology such as blockchain to achieve competitive advantage and, ultimately, unlock growth possibilities.

**2. The specific transport challenges that blockchain can overcome**



**Figure 1: Blockchain use cases with proven potential in the transport industry**

Source: Arthur D. Little and BiTA (Blockchain in Transport Alliance)

3. Research and Markets (2019): [https://www.researchandmarkets.com/reports/4775722/logistics-market-global-industry-trends-share?utm\\_source=GNDIY&utm\\_medium=PressRelease&utm\\_code=cj3hpz&utm\\_campaign=1277565+-+Global+Logistics+Markets%2c+2011-2018+%26+2019-2024&utm\\_exec=chdo54prd](https://www.researchandmarkets.com/reports/4775722/logistics-market-global-industry-trends-share?utm_source=GNDIY&utm_medium=PressRelease&utm_code=cj3hpz&utm_campaign=1277565+-+Global+Logistics+Markets%2c+2011-2018+%26+2019-2024&utm_exec=chdo54prd)



Our survey confirmed that users did see the potential of blockchain to tackle transport issues across the supply chain, as highlighted in Figure 1. In particular, users could see that it facilitated greater transparency and efficiency, resolving key challenges around inefficiency and information asymmetry among supply-chain players (Figure 2):

- **Transparency and trust:** Blockchain is well suited to providing end-to-end supply-chain transparency by creating a “single source of truth” to ensure **traceability** and **security**. In essence, it overcomes situations in which trust is lacking between parties that need to share information (such as financial data and intellectual property) without knowing one another. Through cryptography, blockchains enable all parties involved to add data, which is immutable and continuously updated in real time, providing complete transparency. Information about the origin, handling, and authenticity of goods and assets enables parties to improve quality assurance – thereby fighting counterfeits and building trust with consumers. One specific field is regulation and compliance. From pharmaceutical products to food and parcels, almost all goods change hands before final consumption – with organizations aiming to ensure that they are distributed compliantly. In our research, two out of three organizations that had already implemented blockchain solutions were using it to meet compliance requirements.
- **Process efficiency:** Our survey shows that 73 percent of executives feel blockchain has the potential to increase process efficiency within the transport industry through **automatization** and **speed**. In basic terms, smart contracts enable automated task execution and make manual checks for inaccuracies and fraud (often carried out by intermediaries) obsolete. Due to the speed and accuracy of self-executing contracts, organizations may save a significant amount of time and money, such as by removing the need to process manual paperwork or reconcile human errors before payments are released. A further blockchain-specific advantage is that every party in the value chain can access the same data around a product without needing to align on a common system.

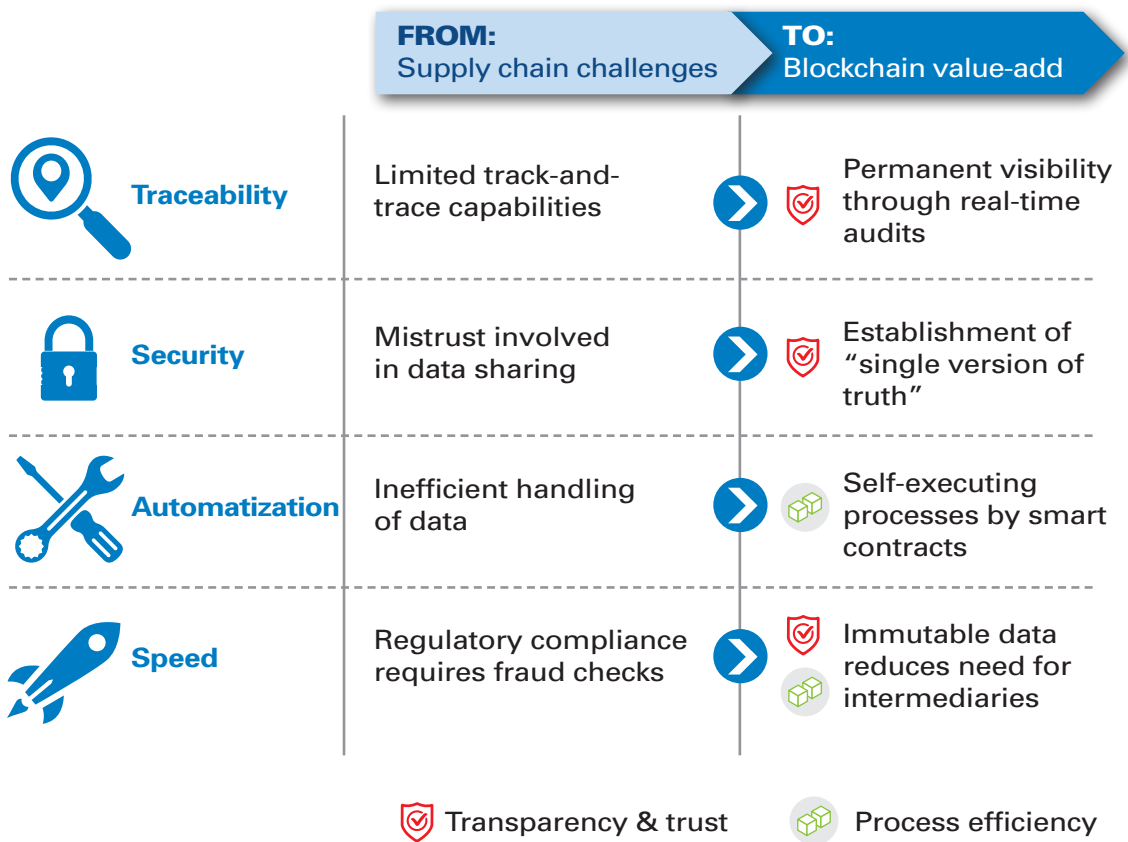


Figure 2: Value-add through blockchain application in the transport industry

There are already some pioneering use cases for these types of applications in the transport industry. For example, ADL worked with a large mobility provider to create immutable visibility of goods movement for all logistics partners involved in the supply chain. Once changes of ownership are recorded through barcode scanning at the different trans-shipment points, data is securely stored in the blockchain and payments are automatically triggered. These self-executing contracts reduce processing of manual paperwork and help to prevent time delays, as well as additional work resulting from inefficient handling of data.

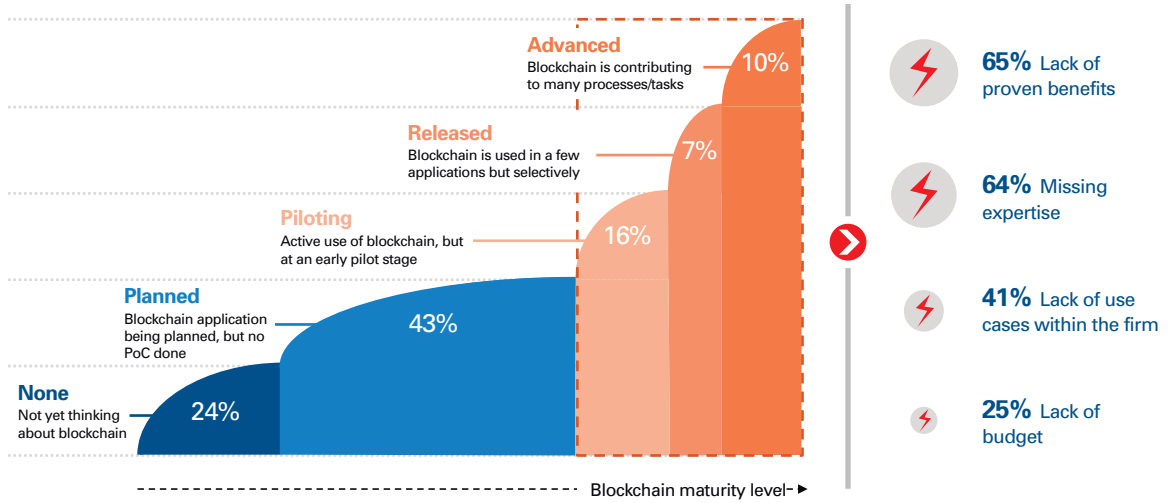
Another interesting example of a process enhancement via blockchain is Switzerland-based container specialist SkyCell. It developed a tailor-made transport solution for

biopharmaceuticals – offering certainty where trust reaches its limits. Biopharmaceuticals are medical drugs based on proteins, and therefore exceptionally temperature sensitive. To ensure quality, no temperature deviations are acceptable when shipped. SkyCell offers insulated containers equipped with temperature sensors that record the inside temperature during delivery. When such a container's barcode is scanned at a trans-shipment point, besides standard shipping information, temperature data is securely stored in the blockchain. This provides clients with reliable evidence about the cold chain, and they can therefore depend on the biopharmaceuticals' effectiveness.

A third example is Maersk's and IBM's TradeLens platform, which applies blockchain technology to global supply chains via its trade document module, ClearWay, enabling secure, cross-business information exchange. This helps to prevent delays that result from inaccurate documentation or slow information exchange. In addition, our experience has demonstrated that warranty-handling (such as automating insurance payouts) and demand-planning processes between manufacturers and suppliers can be significantly streamlined by drawing on secure information exchange and self-executing contracts.

### **3. Obstacles to blockchain adoption and success**

Apart from these and other pioneering use cases, blockchain implementations within the transport industry are still few and far between, despite the advantages. Our survey shows only a minority of organizations had launched blockchain projects to date. Two-thirds were still at the bottom two levels of maturity. Nearly one-quarter (24 percent) had not started projects, while an additional 43 percent were still in the planning stage. Figure 3 summarizes the barriers to blockchain technology progress in the transport industry.



**Figure 3: Level of blockchain project maturity and challenges in the transport industry**

Source: Arthur D. Little and BiTA (Blockchain in Transport Alliance)

Executives identified two major challenges that are holding back blockchain adoption in the industry:

**1. Lack of proven benefits (cited by 65 percent of respondents):** One of the biggest barriers is the lack of verifiable potential for blockchain applications. Most organizations are aware of use cases – but they do not know how to extract economic advantage from blockchain. This is demonstrated by the fact that just 41 percent of executives said scarcity of use cases was an issue. One reason players in the industry miss blockchain’s proven potential is that they still need to coordinate the complex ecosystems it entails – more precisely, their immaturity and lack of required industry standards to implement solutions across the overarching supply chain.

**2. Missing expertise (64 percent):** When it comes to implementing new technology, know-how is crucial. Nearly two-thirds of executives regarded missing expertise as one of the major factors preventing blockchain-related projects. As blockchain is still a nascent technology, specific knowledge, not only around coding, but also the complicated concepts of the underlying technology,

is scarce. Despite the growth in demand for blockchain experts, and the availability of numerous online training programs and educational services, the availability of talent is still lagging.

However, we believe there is one additional challenge that holds back organizations – we have seen it multiple times in our casework experience:

**3. Lack of technological foundations:** Real blockchain breakthroughs are based on new or improved business models. However, during our projects we see many organizations still lacking the necessary technology foundations, such as integrating tagging technologies for asset registration and being able to handle real-time data digitally. Essentially, blockchain implementations only add value if basic value-chain processes are digitalized end to end – and this is far from the case for many players.

Given these factors, does this mean industry executives believe blockchain is not going to deliver value to the transport sector? Far from it – the survey demonstrates that the significance of blockchain is expected to change drastically over time. Fifty-seven percent of respondents felt it would enable breakthroughs within the next three years. Bearing these challenges in mind, what is the best way for companies in the industry to move forward with blockchain?

#### **4. Cornerstones for blockchain implementation in coming years**

Our experience tells us that it is now time to move beyond the hype and get-rich-quick schemes towards a more rational, less euphoric approach. This recommendation holds especially true for existing players operating in transport, but is also applicable to organizations in many other industries. We recommend that executives follow four cornerstones, as illustrated in Figure 4.

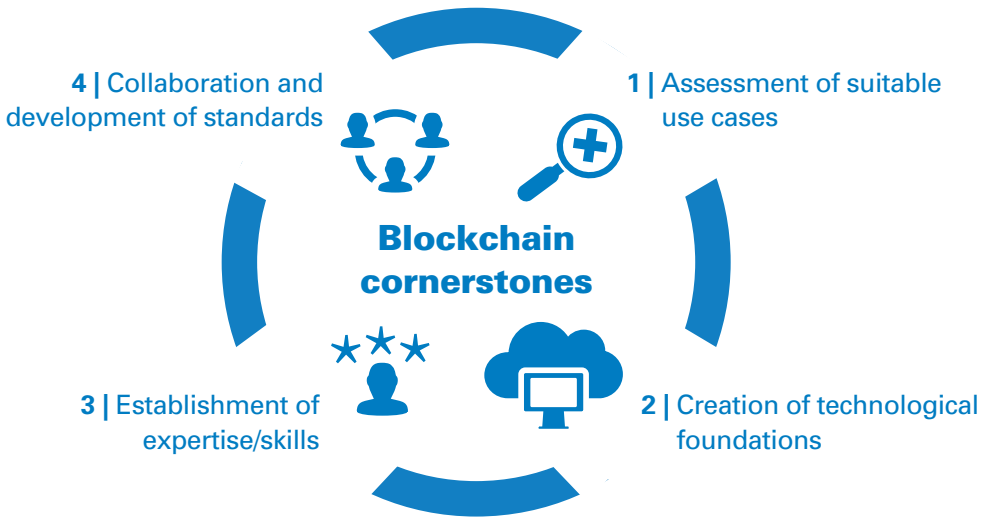


Figure 4: Cornerstones for successful blockchain implementation

**1. Assessment of suitable use cases:** We recommend that organizations in the transport industry first assess the potential impact of use cases instead of striving for first-mover advantages by rushing quickly into blockchain applications. Typically, only 10 percent of emerging use cases are likely to be implemented. Hence, investigation of the strategic fit with core competencies, addressed pain points, and feasibility are critical. In addition, development of practical proofs of concept within selected parts of the blockchain infrastructure is an effective method to avoid waves of repeated failure.

**2. Creation of technological foundations:** Within our case work, we often experience organizations rushing into piloting projects without establishing the requirements for successful application. We advise firms to first establish the necessary foundations for blockchain technology – be they end-to-end process digitization or more transport-specific options such as implementation of “tagging technologies”, for example, barcodes and RFID, to provide real-time and accurate data capture. Blockchain will not help if the underlying data is inaccurate or incomplete.

**3. Establishment of expertise/skills:** As stated before, blockchain expertise is not easy to find. Once promising use cases have been validated, organizations should strive to educate or hire tech-savvy and quick-to-learn individuals who can understand new applications in context – instead of only trying to recruit blockchain experts. In addition, organizations should seek collaboration with academic and specialist technical institutions in order to help shape the technology research and development agenda and gain access to key expertise. Finally, the organization itself needs to be suitably adapted to ensure the necessary blockchain expertise, whether internal or external, is connected and accessible to the key business functions.

**4. Collaboration and development of standards:** The major advantage of blockchain is its network effect – simply put, the benefits increase with the size of the network and ecosystem. A manufacturing company is not adding value with the technology if its business partners are not connected. Organizations need to make efforts to explain to their partners how the system works – for example, how to upload data to the blockchain application using an onboarding system. Also, collaboration in a blockchain network is the right first step, but on its own, it is not sufficient. Ultimately, organizations will only reap significant benefits when suitable standards and a policy framework are in place, covering, for example, privacy standards, data sharing and storage, taxonomies, and access rights. Organizations need to collaborate and support the industry in developing these standards and policies.

### Insight for the executive

With the hype around blockchain having subsided somewhat, we believe large-scale, near-term application is now more likely than ever before. This holds true for not only the transport industry, but also other sectors, provided that companies adopt the right approach, as set out in the

cornerstones described above. Still, investments in blockchain (and related projects) remain costly and returns on investment are often uncertain. First movers are exposed to the risk of ultimately ending up at a disadvantage.

We recommend that companies undertake robust assessments of market, commercial and technical factors, as well as their own capabilities with regard to blockchain, before jumping into implementations that may fail to deliver. Several factors, including value-chain fragmentation, supply-chain power, existing skills and company-specific use cases, have to be considered to create a bespoke blockchain strategy.

Based on our survey findings and consulting experience, we highlight three viable generic approaches that companies can take:

- 1. Monitor, but do not act yet:** Pay attention and observe evolving use cases and blockchain activities of business partners.
- 2. Take a defensive approach:** Focus on suitable, prioritized use cases and establish your technological/organizational foundation.
- 3. Move forward rapidly:** Invest in scaling of use cases, create standards, and support/enable business partners in using blockchain.

When choosing tactics, companies should be aware that the blockchain train has already left the station. Catching up may turn out to be expensive or, even worse, impossible. If you have not yet acquired the necessary capabilities, and you lack a promising market or commercial perspective, keep out of the blockchain game for now. On the contrary, if you have the necessary capabilities at hand and possess a strong commercial perspective, then push widely to scale up use cases and returns. If you are somewhere in between, make sure you invest enough in the blockchain cornerstones so you can achieve a position of early follower if and when blockchain finally achieves its breakthrough.



To assist, we have developed a short self-assessment questionnaire, called the Blockchain Readiness Assessment, <https://www.adlittle.com/en/blockchain-assessment> which helps you select the best blockchain approach for your company.



It is clear that blockchain offers significant benefits for organizations in the transport industry, but also poses major challenges. By enabling trust between the various players in the supply chain, organizations can finally use to unlock economic value from the increasing amounts of data generated and shared across the sector. For the transport industry, process optimization seems to be the most promising application field, with proven examples already in existence. In contrast, business-model diversification has shown to be far less prevalent as a use case. It will be interesting to see which organizations not only manage to identify suitable use cases for their businesses, but also encourage and enable their partners in the value chain to create value-adding blockchain applications.



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