

Point of View on Digital Construction

The business case of incorporating digital technologies into the construction industry

2019

Contents

1. Summary Digital Construction	03
2. Digital Construction as a solution	05
3. Learnings from new entrants	07
4. Call to action for construction incumbents	13
Authors and contacts	15



Summary Digital Construction: the business case of incorporating digital technologies into the construction industry.

The construction industry impacts all of our lives daily, whether we ever wield a hammer or take hold of a drill. Without it, there would be no roads, offices, hospitals, schools, and perhaps most importantly, homes. The industry represents the building blocks of our communities and, from a wider point of view, is a cornerstone of the economy. Ever-growing demand means the sector not only has the potential to create jobs and boost the economy, but to facilitate the growth of other industries, including energy and maritime, by laying the foundations for infrastructure, sites and offices, among other things.

Trends that shape the construction industry

In recent years, the construction industry has faced a number of challenges: Climate change, sustainability, lagging productivity and financial pressure. The construction incumbents are still formulating a response to these trends.

Digital technologies create opportunities

Digital construction could provide an answer. It is defined as utilizing digital technologies to construct more efficiently with higher quality. However, when looking at IT investments, the construction industry has historically underinvested in technology — only 1.2 percent of its revenue is allocated for IT, compared to a 3.5 percent average across industries. We believe that digitalization presents a significant opportunity to not only deal with these challenges, but to use them to thrive.

Learnings from new entrants

Digital construction is on the radar of ConTech start-ups and tech giants. They are currently trying to gain a foothold in the industry by applying new disruptive technologies that could upend the playing field. And they aim to do it in different ways. ConTechs are presenting focused solutions around a single technology, solving a specific but industry-wide problem, such as using augmented reality to enhance the productivity and safety of workers.

In contrast, tech giants are focusing on solving the world's big problems, including urbanization and



congestion, by rethinking the entire way of working and using a mix of technology solutions for one specific problem. They heavily invest to create industry-disrupting business models that stretch beyond 'simple' product development and sales. This is very different from most incumbents' strategies, which focus on cost saving and improved efficiency rather than value creation.

For construction incumbents wanting to seize the opportunity, there is much to learn from the new entrants' strategies. First, you need to be well-funded in your efforts to change the value chain, as new entrants are either VC-backed start-ups or capital-abundant tech giants. Simultaneously, be cautious in asset-centric thinking; disruptors bring "asset-light" strategies and think "digital first" in which they try to avoid only adding new tech to legacy products and processes. Another area of growth is identifying the critical data elements to own early on, which has proven vital to driving financial returns for most SaaS start-ups.

Finally, focus and speed matter: They are key to successfully developing winning value propositions. By focus, we mean concentrating efforts on as few technologies as possible, allowing you to continuously iterate and improve the proposition to facilitate a timely market launch ahead of the curve.

Call to action for construction incumbents

To successfully seize these learning opportunities, we advise construction incumbents to establish a digital foundry to accelerate their digital goals. They will need to think big, start small and act fast:

- Immerse yourself in technologies to explore the "art of the possible".
- Build your ecosystem and evolve your supply chain into "value webs" through collaboration.
- Set up a "black ops" team to enable disruption on the edge of the established organization.
- Prioritise your desired initiatives by picking just two or three to start with.
- Prove it works (quickly) by using an agile, iterative approach to move as fast as possible from strategy to prototype—"fail fast" and achieve rapid results.
- Champion your successes to gain traction and achieve enterprise-wide adoption.

We believe that by incorporating digital technologies into a more focused and value-creating mindset, construction incumbents can strengthen their position and respond to the disruption caused by the new players.



Digital Construction as a solution

The construction industry plays a crucial role in both developed and developing economies. The sector ensures job creation, drives economic growth and provides solutions to address social, climate and energy challenges. Digital technologies provide the construction industry with an opportunity to find innovative solutions to cope with a changing environment that could greatly impact the industry.

Trends that shape the industry's future

Climate change

The construction industry can play a crucial role in helping to alleviate the world's climate challenges, as 30 percent of global gas emissions are attributable to its buildings—both their construction and use. Demand for smart and zero-energy buildings is rising.

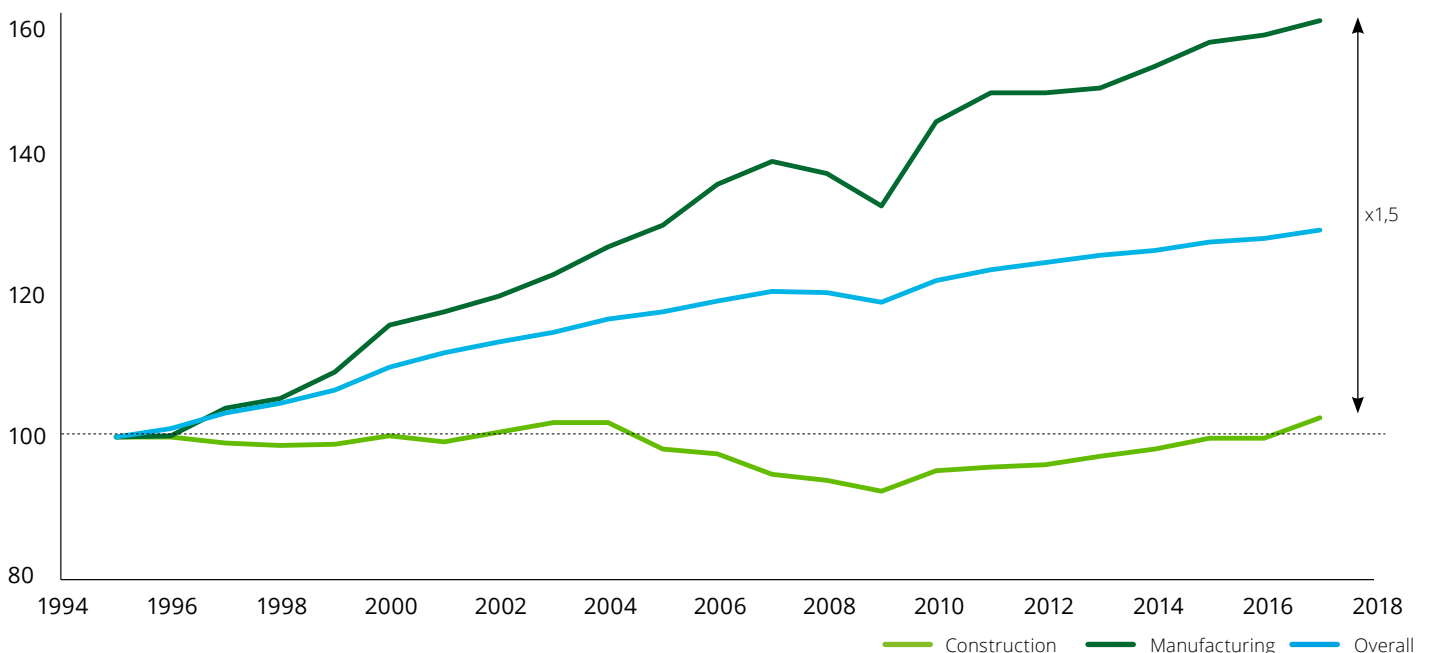
Resources and sustainability

Climate change has led to increasing efforts to lower the consumption of raw materials and the construction industry can play a huge role here as well. In recent years, circular building and waste management have gained popularity, with better waste management reducing the consumption of raw materials. The European construction industry, for example, accounts for 25-30 percent of all waste generated in the EU.

Productivity

While labour productivity across industries has increased by 25 percent in the past 20 years, in the construction industry, it has only grown by 5 percent. Interestingly, in the manufacturing industry, productivity has increased by nearly 60 percent (see below). This low labour productivity in the construction industry is one of its biggest showstoppers, effectively putting a brake on further innovation. It has become increasingly difficult for the industry to meet growing demand in the market. If productivity does not increase, more people will need to be hired and finding and retaining them remains a challenge. It also leads to higher prices, making it harder for construction incumbents to compete with new entrants.

Standardized labor productivity growth 1995 - 2018



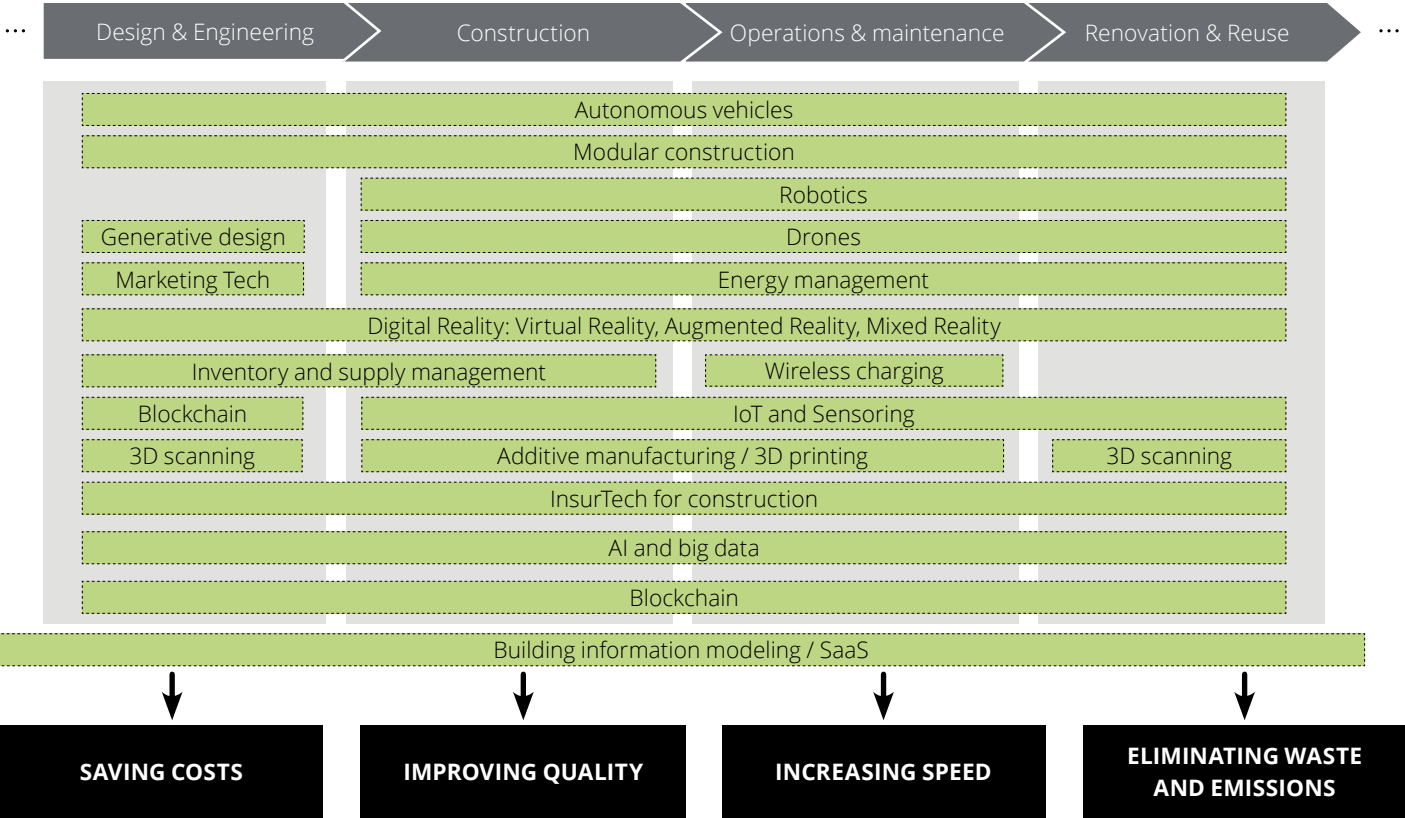
Innovations in IT are driving increased productivity in other industries. Many organizations, for instance, have shifted their ERP systems to a cloud environment and started working paperless in an effort to become more agile. One possible explanation for the low productivity in construction is that the industry is spending the least amount of money on IT compared to other industries. On average, IT spending is 3.5 percent of revenue and 4.6 percent of operating expenses. In construction, these percentages are respectively 1.2 and 1.3 percent. Tight margins in construction possibly contribute to low IT spending. The margins in the construction industry are under pressure. Companies are taking on projects at low prices, but most projects take longer to finish than scheduled, and some of them are up to 80 percent over budget. Migration and management of risk needs further attention in the industry.

Digital technologies create opportunities

During times of challenges, opportunities arise. Digital Construction is defined as utilizing digital technologies to construct more efficiently with higher quality. Many of the emerging technologies have already proven themselves and they offer numerous opportunities for the construction industry throughout the entire construction life cycle (see below).

A recent example of new technologies aiding the construction industry is the renovation of one of the world's major landmarks: Notre Dame. After the devastating fire, discussions regarding its renovation sparked inspiration from unexpected corners. Back in 2015, an Art History professor had 3D scanned the entire cathedral, generating over a billion data points and creating a high-resolution digital blueprint. His work will aid in mapping the building with great precision, allowing for detailed and careful decision-making.

Digital technologies throughout the construction lifecycle



Learnings from new entrants

Incumbents, start-ups and tech giants are the three players seizing today's opportunities. Each of them has a distinct approach to digital construction: Incumbents spray and pray their investments and develop them for internal use; construction technology start-ups ConTechs solve specific tech problems; and tech giants think big. This section sheds light on their different strategies.

European construction incumbents



































































































































We assessed the digitalization efforts of some of Europe's top construction companies. Except for the industry-wide adoption of Building Information Modeling (BIM), construction companies seem to spray and pray their investments in a wide array of digital






technologies, as is evident in the figure below.

The innovations mostly target company processes, leaving them lacking an industry-wide entrepreneurial view. Investments are relatively low — less than 1 percent of revenue on average.

Our research shows that construction companies have mostly invested in technologies that optimize their core businesses in order to reduce costs. Skanska, for example, invested significantly in IoT, smart sensing technologies, robust wireless networks and real-time location tracking systems (RTLS) to transform its construction sites into digital workspaces. The results? Real-time information flows, increased worker safety and enhanced jobsite visibility, which allows teams and owners to make informed decisions while reducing risk.

Digital technology adoption by European construction incumbents

Company	Revenue (€B)	BIM	Drones	VR	AR	Additive manuf.	AI & Big data	IoT & sensing	Robotics	Generative design
Acciona 	7.3									
ACS 	34.9									
Balfour 	7.9									
BAM 	6.6									
BESIX 	2.4									
Bouygues 	32.9									
Eiffage 	15.3									
FCC 	5.8									
Ferrovial 	12.2									
NCC 	5.3									
Skanska 	15.3									
Strabag 	13.5									
Vinci 	40.9									

 Daily business
  Multiple projects
  Single project / prototype
  Interest published / research started
  No investment yet

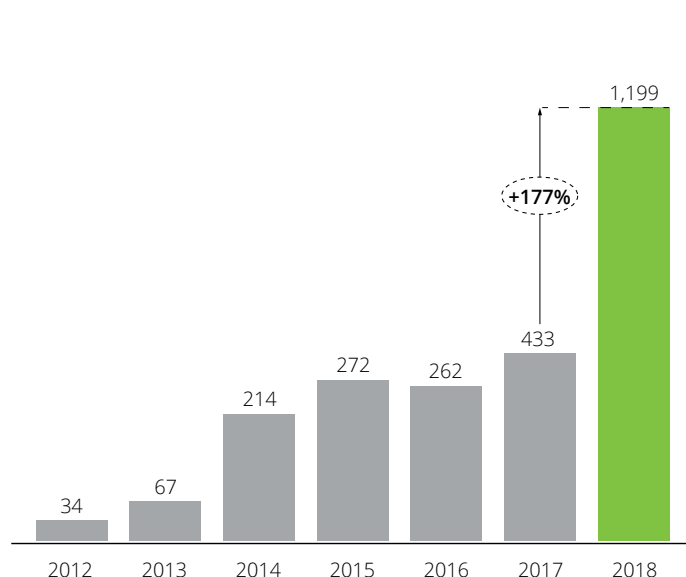
Source: company websites; press releases; annual reports

ConTech start-ups

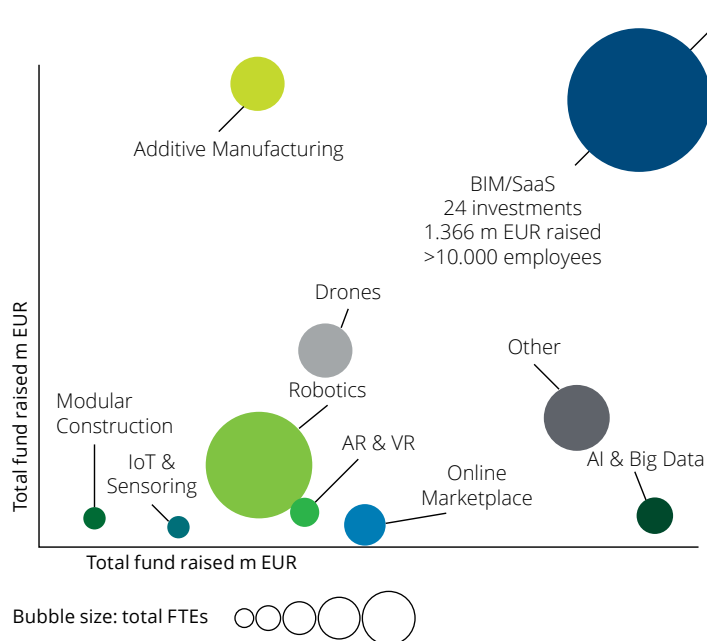
The size of the market and the fact that opportunities are literally around every corner makes construction an appealing industry for outsiders. The exponential upward trend in capital investments in construction start-ups is illustrative of investors' attitudes. These start-ups provide focused solutions around a single technology, solving specific but industry-wide problems, mainly around BIM, additive manufacturing and drones (see figure below).

M&A deals are not reflected in the Venture Capital funding graphs. Currently, North America remains the most appealing region for attracting venture capital funding for SaaS ConTechs.

Venture Capital funding in construction start-ups in m EUR



Top 70 start-ups by total fund raised between 2012-2018



Source: Pitchbook; Dealroom.co; Note: Buyout and M&A deals are not counted and technologies that are also applicable to other industries are not captured here (e.g. robotics for agriculture which also applicable for 3D scanning are not captured). Start-ups are categorized by their primary sector, most of technologies have AI & Big data flavour. AI & Big data here means start-ups using it as a core value proposition for their products.

The industry also continues to see M&A activity. Larger software companies are recognizing that it makes more sense to acquire relevant outside companies rather than trying to reinvent the wheel from within. For example, in the fourth quarter of 2018, 3D design software provider Autodesk announced plans to acquire two cloud-based software start-ups in the space: PlanGrid for \$875 million and BuildingConnected for \$275 million. Publicly traded software developer Trimble in July that same year acquired construction management software start-up.

One of the biggest ConTech deals

In January 2018, a construction start-up received \$865 million from an investor, making it one of ConTech's largest deals in recent history. The vision of this company is to manufacture buildings as efficiently as cars through end-to-end vertical value chain integration. As a technology company, it aims to apply to the design and construction sectors tested system approaches from other industries. The company's construction technology platform connects BIM tools and computational design directly to its ERP global supply chain infrastructure, easing material ordering, manufacturing, tracking and delivery. It enables construction companies to optimize every aspect of building development, design and construction.

The company's end-to-end construction process, which offers a fixed price per project for materials in advance, provides developers increased project certainty and competitiveness.

Its approach links standardization with customization, providing efficiency in the manufacturing of standard products without sacrificing design freedom. Often in standard construction projects, there are several middlemen involved. But with a global supply chain of curated, high-quality products, the intermediaries are eliminated and the savings are passed on to their customers. The final aspect of their approach is factory and jobsite integration, wherein factories act as extensions of job sites, providing greater precision, higher productivity and more quality control. In doing so, the company saves time and money on its projects.

Some other large venture capital ConTech deals in recent history



FINALCAD

Founded in 2007 in France
Deal size: 35.5m EUR series C
Total Funding: 57m EUR
Valuation: ~100m EUR

FINALCAD provides mobile construction software and predictive analytics that help construction stakeholders anticipate and fix issues found during a building's journey. Developed BIM solution for structures and finishes. FINALCAD is already active in 10,000 projects across 35 countries.



Atheer

Founded in 2011 in the US
Deal size: 12.3m USD series C
Total Funding: 29.5m USD
Valuation: ~90m USD

Atheer is an augmented interactive reality platform designed to enhance the productivity and safety of deskless professionals. It enables users to view critical work information in their field-of-view and interact with it using familiar gestures, voice commands and motion tracking.



3DR

Founded in 2012 in the US
Deal size: 53m USD series D
Total Funding: 164m USD
Valuation: ~110m USD

3DR is a provider of smart drones intended to offer site scanning and land mapping services. It collects accurate aerial data of jobsites, turns drone photos into maps, models and point clouds, and provides comprehensive onboarding and ongoing support.

The Boring Company

Founded in 2016

Valued at ~\$10bn - \$20bn



Elon Musk's Boring Company envisions building a network of tunnels many levels deep to alleviate congestion in cities, no matter how large they grow. Tunnels as a means of transportation have several benefits: They are weatherproof, there is no practical limit regarding how many layers can be built, their construction and operation are silent and invisible to those aboveground and tunnels do not divide communities with lanes and barriers.

Currently, the major challenge with tunnels is their price, with some projects costing as much as \$1 billion per mile. To make the tunnel network feasible, costs need to be reduced by a factor of more than 10. The company is doing that by achieving 14x fast boring speed, continuous tunnelling, going fully electric, automating operations and reducing the tunnel diameter by half. Also, in typical tunnelling projects, excavated dirt disposal is often costly, time-consuming and environmentally hazardous. The Boring Company intends to tackle these issues by recycling the earth into useful bricks that can then be used to build structures. These bricks can potentially be used in the tunnel lining itself, which is typically built from concrete. Since concrete production accounts for 4.5 percent of the world's greenhouse gas emissions, earth bricks would reduce both environmental impact and tunnelling costs. After developing an initial test tunnel in California as a place for R&D, the Boring Company proposed projects in Las Vegas, Los Angeles and Washington. But the company's crowning success so far has been its selection by the Chicago Infrastructure Trust (CIT) to enter in exclusive negotiations to design, build, finance, operate and maintain an O'Hare express service to provide fast and convenient transportation between the airport and downtown Chicago.

Tech giants

In recent decades, tech giants have disrupted several industries. Apple has changed the way we listen to music and use our phones, while Amazon has changed the way we read through its Kindle e-book reader. Airbnb has disrupted the hospitality industry, Uber the taxi industry and LinkedIn recruiting.

It was inevitable that tech giants would eventually turn their attention to the construction industry. And some of them have been very effective. Alphabet's (Google) Sidewalk Labs won a billion-dollar project to transform Toronto's waterfront area, and Elon Musk's The Boring Company won its first billion-dollar contract within 18 months of launching at Chicago's O'Hare International Airport.

There's also Amazon, which announced its investment in the modular prefabricated housing ConTech Plant Prefab, and Microsoft, which is spending heavily on its Azure Digital Twin concept, where users leverage real-time data to virtually replicate the physical world to enhance operations of buildings across the entire life cycle. It enables increased visibility, safety, and efficiency in and around a building during its design, construction and operation.

Learnings from new entrants for construction incumbents



1. Funds are needed for a breakthrough

The start-ups and tech giants that successfully entered the construction industry were backed by big investments.



2. Be cautious in asset-centric thinking (digital first)

New entrants bring “asset-light” strategies and think digital first, while incumbents often focus on adding new tech to legacy products and processes.



3. Identify the critical data elements to own

Owning the data has proven critical in driving early financial returns for most SaaS start-ups. Incumbents often still work with disparate and unstructured data.



4. Focus

Incumbents invest in various technologies to spread the risk, while Venture Capital portfolios focus on only one, or at most a few, value propositions.



5. Work fast

Speed matters. Exponential growth techniques are rapidly evolving, requiring constant iterations. New entrants never wait for a perfect product, starting instead with minimum viable products. Incumbents need agility in their organizations.



Call to action for construction incumbents

New entrants are disrupting the construction industry. If incumbents want to strengthen their position, they need to think big, start small and act fast.

The construction industry has historically underinvested in technology and seems to be resistant to change. In our view, the entire construction supply chain has traditionally been based on misaligned commercial objectives and incentives, with owners seemingly more interested in meeting proformas and deadlines and with contractors more interested in profits.

Leveraging technology in the planning, delivery and operation of construction projects presents a potentially significant business value opportunity. The development of digital capabilities should be considered when determining the key success criteria for any future construction project. There are significant benefits for those companies that invest wisely now.

Building a digital foundry

Investing wisely means investing in a digital foundry. Identify a visionary program leader and assemble a team to accelerate the realization of (digital) business goals. Determine a governance model and understand policies that might need to be adopted to execute successful change management and to ensure the solution is absorbed into the business fabric.

Establish a digital foundry

THINK BIG



Immerse yourself in technologies

Join an immersive experience (e.g., tour an IoT lab) to explore the “art of the possible”, incite ideas, and cultivate a culture of innovation



Build your ecosystem

Evolve your supply chain into “value webs” by collaborating with suppliers, engaging with digital technologies players, and sharing and/or offloading assets

START SMALL



Scaling the edges

Disconnect from the core business and set up a “black ops” team to enable disruption within an established organization



Pick two or three plays

Prioritize your desired tactics and pick just two to three to get started in order to establish proof of concept

ACT FAST



Prove it works quickly

Use an agile, iterative approach to move from strategy to prototyping as quickly as possible – “fail fast” and achieve rapid results



Market your own success

Champion your successes to gain traction and achieve enterprise-wide adoption

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Notes



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