OLIVER WYMAN

Volume 13

THE OLIVER WYMAN

PERSPECTIVES ON MANUFACTURING INDUSTRIES

MARSH GUY CARPENTER MERCER OLIVER WYMAN

MARSH & McLENNAN COMPANIES

INTRODUCTION

Dear Reader,

Manufacturing has undergone profound changes over the past decade, given the rapid spread of digital technologies, new organizational transformations, the rise of the digital organization, autonomous vehicles, and the sensor-driven Internet of Things.

But as far-reaching as those changes may have been, they represent but a tip of the iceberg as we head into the future. The 13th edition of *Perspectives on Manufacturing Industries* is our guide to the major trends reshaping industry across the world. In the Cover Story, we take a look at the Industrial Internet of Things (IIoT) platforms and discuss whether they are a source of new profit or inflated hype.

Further, the journal looks at many interesting ideas with regards to digitization and how it will transform the industry. You will encounter herein the strategies for getting the most out of artificial intelligence and how digital startups will have a greater impact on incumbent manufacturing firms. Further, you will get a glimpse not only of what the factory of the future will look like, but also what kind of talent will be needed in the workforce, both on the manufacturing floor and throughout the enterprise.

This digital journey, like all journeys, is likely to prove rough going at first, and manufacturers can expect choppy waters early on. But they should also keep in mind that the voyage is just beginning.

Yours sincerely,

THOMAS KAUTZSCH
Head of Oliver Wyman's
Global Automotive and Manufacturing Industries practice

PERSPECTIVES ON **MANUFACTURING INDUSTRIES**

Vol. 13

COVER STORY

04

BY FUNCTION: NEW SOURCES OF VALUE

40

12

MANUFACTURING IN A CHANGING WORLD

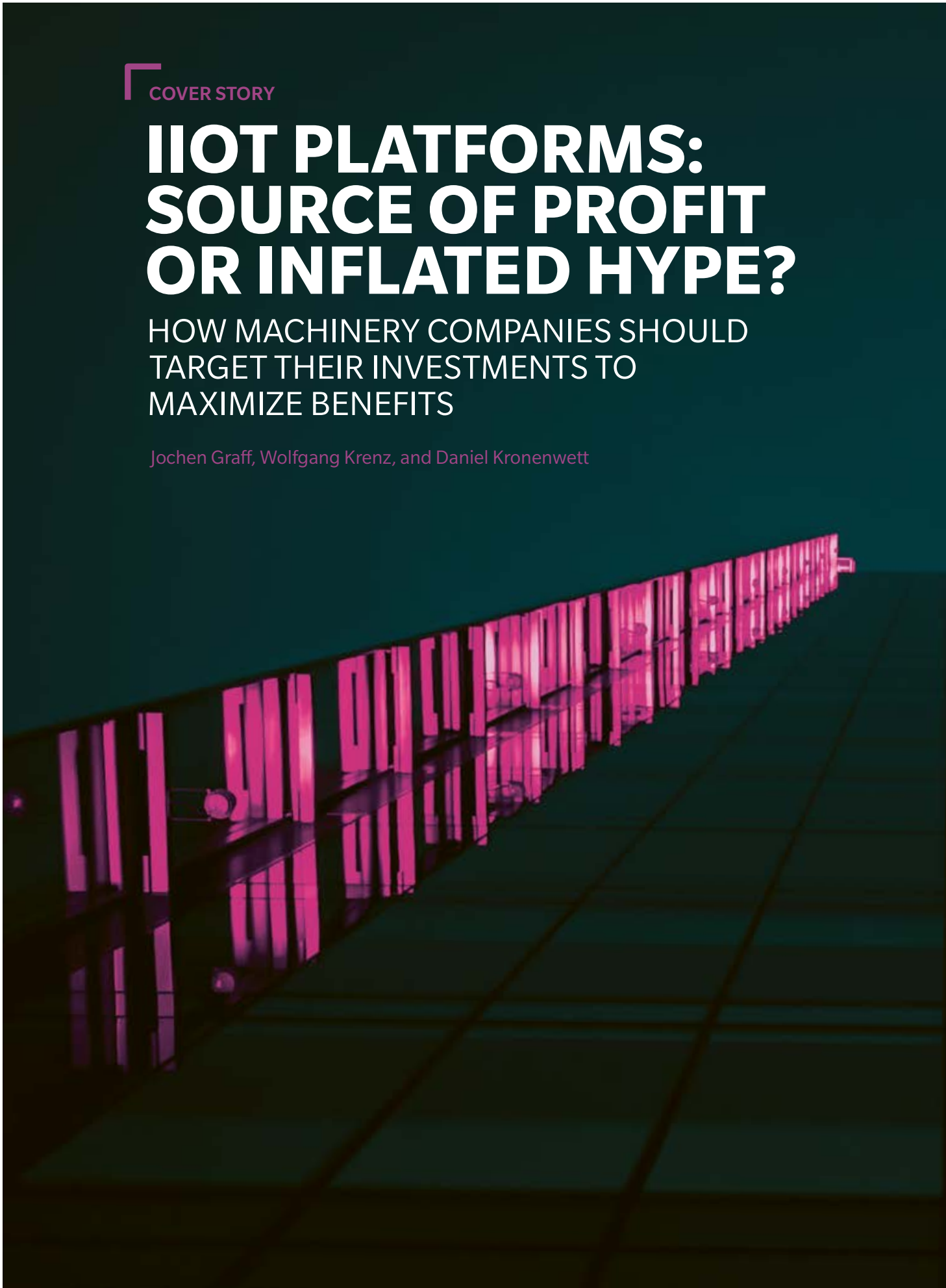
COVER STORY

COVER STORY

IIOT PLATFORMS: SOURCE OF PROFIT OR INFLATED HYPE?

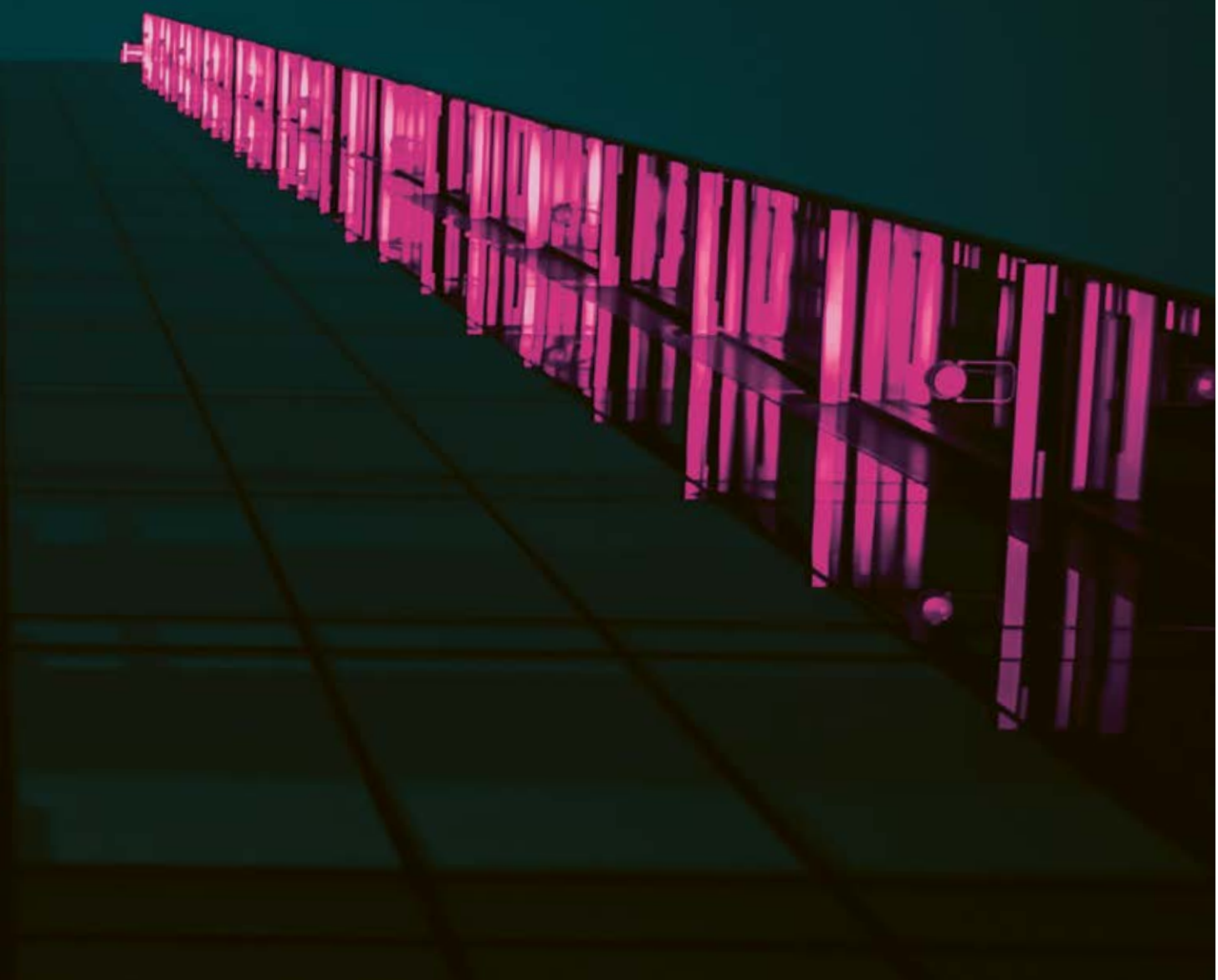
HOW MACHINERY COMPANIES SHOULD TARGET THEIR INVESTMENTS TO MAXIMIZE BENEFITS

Jochen Graff, Wolfgang Krenz, and Daniel Kronenwett



The Industrial Internet of Things (IIoT) platform landscape is seeing unprecedented change and growth, a transformation that promises enormous opportunities – and potentially expensive and damaging downsides. Only selected machinery firms will be able to define business models to tap into the additional value pools that will emerge from IIoT. The majority should view the development of an IIoT strategy as a way to secure and further develop their own core business, and not necessarily as a new source of profit.

Based on more than 50 discussions and interviews with senior leaders of machinery firms and software companies from the IIoT platform ecosystem, Oliver Wyman has analyzed the IIoT landscape and sees a value migration taking place, one in which the greatest value will come from



IIoT applications, rather than platforms and infrastructure. Platforms and their underlying infrastructure are simply the enablers for the IIoT ecosystem.

However, it will be the end customer, not the provider of the IIoT application, who will gain and enjoy the lion's share of this value. The majority of machinery firms should therefore focus on platform-agnostic applications that safeguard their core business and benefit customers. Moreover, they should leverage IIoT offerings to enable substantial internal value creation. Machinery firms should validate their IIoT strategies to avoid costly endeavors that have limited value. What is our answer as to whether platforms will be a source of profit or an inflated hype? In short, for most machinery firms platforms are likely to be hype, but IIoT is still key to secure future profits.

AN EXPANDING ECOSYSTEM

The number of IIoT platforms is expanding rapidly. Already, there are more than 150 platforms in place, and the ecosystem is growing, with expectations concerning its value contribution – and disruptive potential – running sky-high. Indeed, depending on which market study one reads, a future market in IIoT solutions reaching hundreds of billions in euros is treated as a given. According to the feverish projections of the studies' authors, who draw on analogies from the B2C world, the opportunities would appear to be limitless.

Machinery firms have been drawn to the new value pool's potential, too. They are leveraging IIoT platform solutions to increase process efficiency internally and to position themselves strategically, with select offerings aimed at customers. Thus far, the majority of solutions have been targeted at monitoring and optimizing customer equipment based on relatively basic algorithms and are not yet leveraging more advanced artificial intelligence-enabled solutions. Moreover, the IIoT offerings of most machinery companies are still in their infancy and have yet to add to company revenues or profits in any significant way.

Does the potential for a large IIoT platform value pool exist? And if so, what is the correct approach for machinery firms to tap into it? Should they try to adapt their IIoT strategy?

CURRENTLY, THERE ARE MORE THAN

150 IIoT platforms

ACROSS THE GLOBE

THE PLATFORM'S PROMISE

IIoT consists of using Internet of Things (IoT) technologies to enhance manufacturing and industrial processes. It incorporates machine learning and big data technologies to harness sensor data, machine-to-machine communications, and automation technologies that have existed in industrial settings for years. There are already multiple use cases that demonstrate the efficacy and benefits IIoT can bring. What the most successful use cases have in common is that they add value to customers by cutting costs in such areas as product development and maintenance and by increasing production output.

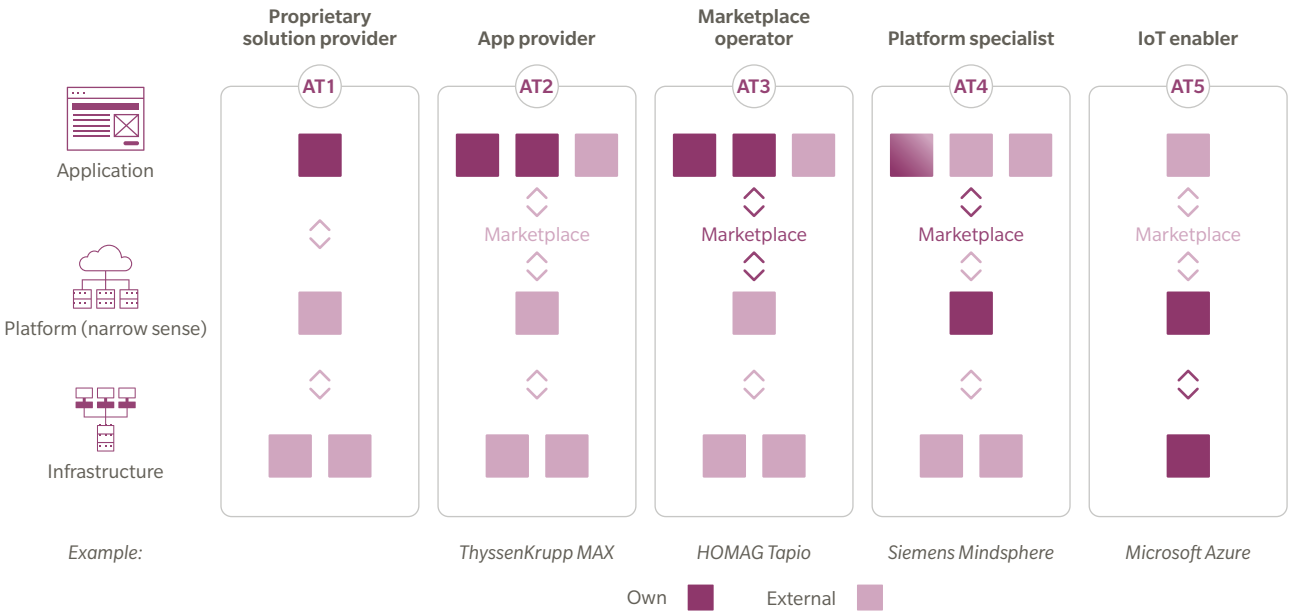
A key IIoT offering is predictive maintenance. By using real-time data generated from various sources, it is possible to predict defects in machinery before they occur, enabling companies to take corrective action before the part fails or machine breaks down. Another exciting area is centered on production process optimization, which involves using machine data and virtual test models to optimize production processes and quality. This creates savings on materials, setup, and personnel costs. IIoT also permits enhanced customer satisfaction: When products are connected to the IoT, the manufacturer can capture and analyze data about how customers use their products, helping them tailor future IoT devices, as well as to build and simulate customer-centric products.

FIVE IIOT PLATFORM ARCHETYPES

To deliver these solutions, leading IIoT players such as MindSphere, Predix, and Adamos are building IIoT platforms, as well as supporting ecosystems made up of technology and software partners, consulting and implementation partners, and startups. But "platform" is a term that serves to describe a range of activities. In discussing IIoT platforms, there are three distinct levels: the infrastructure, the platforms (in a narrow sense), and the applications.

Based on these three levels, there are five IIoT platform archetypes in the market. (See Exhibit 1.) The "proprietary solution provider" delivers an exclusive solution directly to each customer – or for its own internal production optimization. The "app provider" offers IIoT-based applications via existing IIoT platforms and marketplaces (similar to an app store), in order to reach a larger customer base. The "market

Exhibit 1: Five archetypes of IIoT platform offerings



Source: Oliver Wyman analysis

place operator" establishes a marketplace on an existing IIoT platform and offers its applications on it. The "IIoT platform specialist" creates its own IIoT platform and marketplace to market its own applications and others within an industrial context (such as MindSphere, Predix, and EcoStruxure) or in a B2X context (such as C3 IoT, and Watson). Finally, there is the "IoT enabler," such as Microsoft Azure, which focuses on leveraging its own infrastructure in combination with a platform offering. There are variations on these basic offerings, with IIoT platform providers leveraging existing white label platforms and placing their brand on or integrated providers supplying the infrastructure for other IIoT platforms.

THE FUTURE OF IIOT PLATFORMS

The IIoT ecosystem will most likely change dramatically in the coming five to 10 years. Based on our research and interviews with leading IIoT ecosystem players, these five theses will shape the future of IIoT platforms:

Typical B2C platform success factors will not apply: B2C platforms are characterized by a high number of customers, plug-and-play solutions, and a high number of transactions with unproblematic data traffic. None of these factors apply in the IIoT environment. The number of customers is significantly lower, with some companies having only a handful of customers. Plug-and-play IIoT solutions are often not possible, as the installed equipment is usually diverse, requiring a significant integration effort. The number of transactions is relatively low, driving companies to focus more on "best" data than on "big" data. In addition, a "data play" is hardly possible, given that B2B IIoT platforms typically do not own the data. Moreover, data security will remain a key hurdle, as it is more important in the B2B than in the B2C world due to the sensitive nature of the information.

Value will migrate dramatically: The IIoT market value is expected to grow significantly over the coming years. Currently, infrastructure players dominate the IIoT business. But over the next decade, value will migrate towards platforms and applications. (See Exhibit 2.) A similar dynamic between infrastructure and platform/application has taken place in the B2C world, where telecom-infrastructure providers (Deutsche Telekom, Telefonica O2, and AT&T) initially represented 70 percent of the combined market capitalization in 2008 and apps and content providers (Google, Facebook, and Netflix) made up the other 30 percent. Today, the ratio is reversed: Google, Facebook, and Netflix represent 80 percent of market capitalization. Coming back to the B2B world: It will be the customers, not the providers of the app, who will derive the lion's share of the value from IIoT solutions, which are designed to enable cost reduction and/or yield improvement.

Exhibit 2: Value migration in IIoT

Source: Oliver Wyman analysis

IIoT platform landscape will consolidate: The endgame will see three or four global, cross-industry IIoT platforms emerge as winners, along with roughly another 25 industry-specific or regional IIoT players. This is similar to what happened in the Enterprise Resource Planning (ERP) systems and industrial controls market. Moreover, in the endgame there will be at least one global Chinese player, so data from Western companies using that platform may be stored in China, thus raising subsequent potential data security issues.

Customers will enforce open standards: Customers are likely to use services from more than one IIoT platform and will need to combine the data to enable end-to-end value chain optimization. As a consequence, they will demand open data exchange as well as interoperability, which will drive the further emergence of open standards. A similar development can be seen in the B2C world where the previously proprietary connected home market is now becoming more interoperable via open standards developed by companies such as ZigBee.

Customers will only pay extra for IIoT services that demonstrate clear value-add: Just adding new product features will not create new value pools. All application categories, such as engineering optimization, production optimization and asset management, will have a set of basic solutions that the customer takes for granted. The client will only pay extra for more advanced solutions, that enable a clear and measurable value-add.

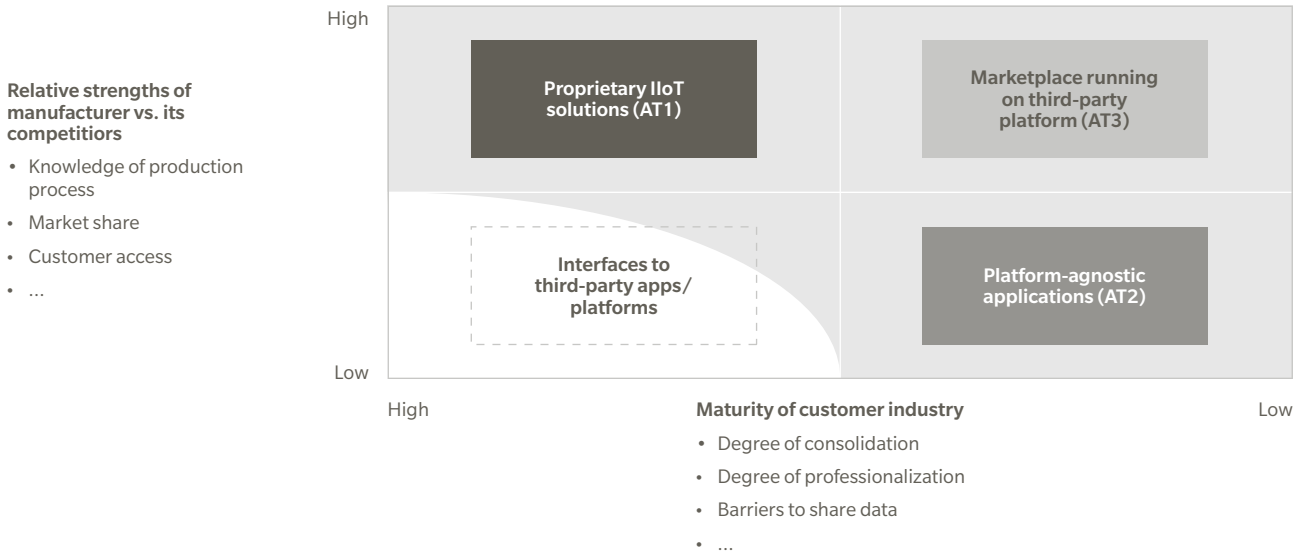
IIOT PLATFORM STRATEGIES FOR MACHINERY COMPANIES

What does this mean for machinery companies? How will they make money in the future IIoT platform ecosystem? To answer these questions, a framework matching the manufacturer's relative strength versus the competition provides guidance. (See Exhibit 3.) The suggested platform offering for a manufacturer is dependent on its relative positioning on the matrix. Of course, a more specific assessment will take into account a broader set of dimensions such as type of production flow and scalability when looking at an individual strategy for a manufacturer.

We analyzed the various platform strategies to assess where the best opportunities lie. The archetypes AT4 and AT5 from the previous section make limited sense for machinery companies and are not mapped in Exhibit 3. Given the dominance of Microsoft, Amazon Web Services, and Alibaba Cloud at the infrastructure level, competing as an "IoT enabler" (AT5) will be almost impossible; instead, machinery firms should build on the offerings of the three big infrastructure players. Similarly, developing one's own IIoT platform (AT4, "platform specialist") will have little chance of success. The motivation behind establishing one's own IIoT platform is to shield against dependency on software and automation players. But this will be hard to sustain since customers are likely to demand open, flexible systems.

Running a marketplace on a third-party platform (AT3) makes sense in case a manufacturer truly dominates the industry, as a large customer base can be reached with a moderate investment. Focusing on platform agnostic apps (AT2) may be the best way to participate in the IIoT platform business, especially when the manufacturer has limited access to the end customer and a limited view of the entire production process (such as non-critical component suppliers). Offering apps or customer-specific solutions

Exhibit 3: IIoT platform strategies for manufacturing firms



Source: Oliver Wyman analysis

directly to the client (AT1) makes the most sense where the industry is highly professionalized and consolidated and the company's competitive position is strong (such as a plant engineering company in the automotive industry).

Given the value migration towards the application layer, developing platform-agnostic apps seems to be the most promising approach among the potential strategies. The apps will need to maintain a high level of flexibility and address a larger customer base. More importantly, they must be able to demonstrate tangible value, allowing customers to increase process efficiency or reduce costs. Before introducing "pay per use" business models, a company needs to ascertain whether it generates customer value and whether the resulting shift in risk (such as becoming the owner of the machinery and assuming the business risk) can be correctly assessed, quantified, and priced.

Given that most of the value-add being generated by IIoT platform solutions will be captured by its end customers, machinery companies should make sure that they themselves too leverage IIoT solutions to optimize their internal processes and capture substantial value.

THREE STRATEGIC CONSIDERATIONS FOR MACHINERY COMPANIES

The majority of machinery companies should emphasize three areas in their strategic considerations. First, they should focus on applications, not on platforms. Second, they should leverage IIoT offerings not only for potential new business models but also for substantial internal value creation. Lastly, the question of how to safeguard and further develop the core business should take priority over high hopes for huge add-on revenue streams.

Machinery companies need to review and challenge their IIoT strategy and platform offering, based on where they view themselves as well as on the value-add potential of their offering. Currently, IIoT platforms for machinery companies are for the part hype. But in the future, IIoT will be essential to securing profits at manufacturing firms.

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MANUFACTURING IN A CHANGING WORLD

BUILDING THE WORKFORCE FOR THE FUTURE IN MANUFACTURING INDUSTRIES

DIGITIZATION WILL HAVE A SIGNIFICANT IMPACT ON PERSONNEL

Romed Kelp and Axel Miller

The manufacturing industry, like many other industries, faces massive changes due to digitization – both from a business model perspective and, just as critically, from a rise in productivity. While these transformations are well understood, two important questions remain: How will digitization affect the workforce and what do companies need to do to drive this change?

Even though the expected degree of digitization will differ between the various sub-sectors, business models, and functions, manufacturing companies face a wide array of digital trends and opportunities along the entire value chain. Too often, the discussion is focused on the automation of production processes. Innovations such as co-robots, where robots and employees work hand-in-hand, only represent the outward manifestations of change. Under the

surface lie innovations that will power the industry going forward: big data, advanced analytics, artificial intelligence (AI), and automated back-office processes have the power to change the way companies work in the future – to a much greater extent than the next evolutionary step in shop floor automation.

THE MANUFACTURING WORKFORCE WILL SHIFT IN SIZE, SHAPE, AND REQUIRED SKILLS

Over the past 20 years, manufacturing companies on average saw about a 25 percent improvement in productivity, due mainly to automation and standardization in production processes. Based on a multi-client study conducted by Oliver Wyman, digital levers could drive even greater gains in the coming decade. Based on current production volume figures, this change could result in a reduction in a manufacturer's workforce of up to 25 percent full-time equivalents (FTE), driven by artificial intelligence or back-office automation or by using technology to foster collaboration (and increase outsourcing in the area of R&D, for example). In addition, it will cause a significant recalibration in the type of tasks the workers perform. (See Exhibit 1.)

Along the value chain, various functions offer potential for digitization, chief among them indirect production functions, technical services and administration, which may yield high rates of workforce reduction.

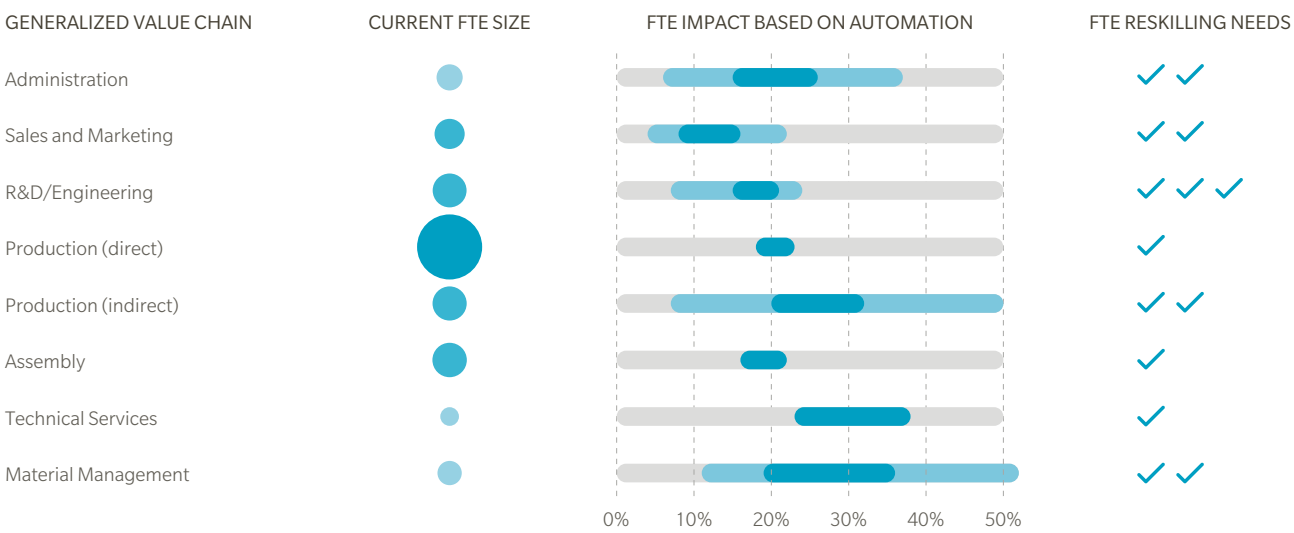
In indirect production functions, such as production planning and industrial engineering, for instance, will receive a productivity boost through big data analytics. Data collected by sensors in real time and artificial intelligence that analyzes and interprets the information will provide actionable insights to industrial engineers. To achieve this goal, however, new data scientists will be needed to develop and set up the systems while the existing workforce will need to be trained for the new tools.

In technical field services, productivity will benefit from digital assistance solutions. To address the issue of fast response in the case of clients' on-site problems, a plant-engineering company already makes use of video glasses that allow the field technician or client staff to be connected to a service engineer at headquarters, who is able to see what the on-site staff member sees and give advice. In near future, the service engineer back at headquarters will be able to send specific information such as drawings, videos, or procedures directly to the data glasses, so that the on-site technician can get the best possible support.

Digitization of administration and back-office activities will leverage artificial intelligence and robotic process automation. While the use of algorithms and AI will boost

Exhibit 1: Workforce reductions driven by automation

Activity-based analysis specific to the organization's distribution of employees across the value chain is required for specific projections



Source: Oliver Wyman analysis

data-analysis tasks (such as sales reporting and forecasting), automation will increase productivity of transactional tasks in areas such as accounting or Human Resources while delivering a better, and more seamless, user experience.

Digitization will reduce the share of routine transactional activities, enabling employees to focus on value-adding tasks. But to make use of this capability, the employees will need to develop new skills and become more digitally fluent. While training in process-automation tools is relatively easy, training in AI tools (such as supporting the development of commodity strategies in the purchasing department or laying the foundation for pricing decisions in sales) is more complex: Besides the learning on how to use AI tools, employees need to understand how the tools work to make full use of them. Additionally, employees will have to adjust to the new reality, one in which AI is more capable of analyzing complex, multifaceted problems than they are. Only if these requirements are met will staff be able to benefit from AI. While existing staff can be trained on the use of those digital tools to certain extent, there will be new job profiles for which no current employee has the competences or can be trained easily, such as data scientists.

Companies not only need to think about their internal workforce, but also of an external workforce strategy to find, attract, recruit, and motivate digital specialists, talent that typically is drawn to digital companies such as Google or nimbler startups. While manufacturers must increase their attractiveness and develop more flexible ways to engage with these talents, they may think about cooperating with universities, research institutes, and other companies to capture the digital talent.

Moreover, manufacturing companies need to define how to organize collaboration internally. Given that there are employees of different ages, digital savviness, background, and willingness to change, motivating and moving staff towards the "digital avenue", and the way how to combine the legacy corporate culture with new requirements for the digital age, needs an orchestrated, well thought out approach.

Manufacturers should rethink their workforce planning and recruitment processes to be more dynamic and agile. Instead of concentrating on existing career structures and recruiting channels, HR managers need to identify recruitment priorities for the future, finding the right people with the right skill sets, whether a job currently exists for them or not.

FOUR STEPS TO A DIGITALLY SAVVY ENTERPRISE

Manufacturers must begin preparing now for the digital talent ecosystem, following a four-phase workforce for the future framework. (See Exhibit 2.)

Exhibit 2: Four-phase workforce for the future framework
A dynamic framework for defining and delivering the workforce for the future

1. ALIGN
Set the vision and prepare change

What changes are impacting my workforce and what do they mean?

- Identify the trends impacting the workforce
- Assess the impacts across the value chain
- Align leadership around the future workforce vision

2. DEFINE
Map the current and forecast the future workforce

What will my future workforce look like?

- Size and shape the future workforce under different scenarios
- Identify future talent gaps
- Evaluate and select the options for addressing gaps

3. DESIGN
Determine and design workforce strategies

How do we drive the transformation forward?

- Establish transformation governance
- Roll out enabling technical platforms
- Manage the transformation

4. DRIVE
Deliver the transformation

How do we get there?

- Specify the strategies for delivering the future workforce
- Implement technology platforms to enable the automation of work and access to external talent pools

Source: Oliver Wyman analysis

DIGITAL DISRUPTIONS COULD DRIVE MANUFACTURING WORKFORCE PRODUCTIVITY INCREASE BY

25%

Set the vision and prepare for change. Manufacturers need to determine the changes affecting their workforces and what those changes mean. A solid starting point involves identifying the impact of different trends on the workforce – not just digital trends, but demographic, organizational, and environmental ones, too. Companies should evaluate several workforce scenarios via research on their peers and their industry's disruptors. They then must review the impact of identified trends, qualitatively and quantitatively assessing the changes across the value chain. The next steps involve building alignment within the leadership team regarding their future workforce and determining the organization's readiness.

Map the current workforce and forecast future needs. Company leaders must define the future workforce's profile. That involves mapping the size, shape, and skill sets of today's workforce, using a standardized approach with company specific adaptations, to gain a clear picture.

Determine and design workforce strategies. While great aspirations tend to move people to action, manufacturers need to understand and map out the road that lies ahead concretely. To start with, they must design strategies for optimizing relevant talent pools, identifying the best ways to engage talent while developing compelling "employee brand" and value propositions. Then, firms should use technology to access relevant talent pools, expanding the availability of critical skill sets and enabling a more flexible organization.

In a next step, manufacturer must build an integrated transformation plan to bring together new workforce strategies and organizational changes. Succeeding here will require strong stakeholder buy-in.

Deliver the transformation. Driving transformation is the goal, and this requires a company's personnel to get behind it. But that will only happen if company leaders themselves buy in to the change. A transformation management office can play an important role in implementing the roadmap. However, manufacturers will need good communication strategies that target affected employee groups and offer training on new technology platforms.

LEARNING THE DIGITAL ROPES

Manufacturers must get ready now if they want to gain a competitive edge. By starting today, they can get a jump on the competition in mastering – and benefiting – from the disruptive digital forces that lie ahead.

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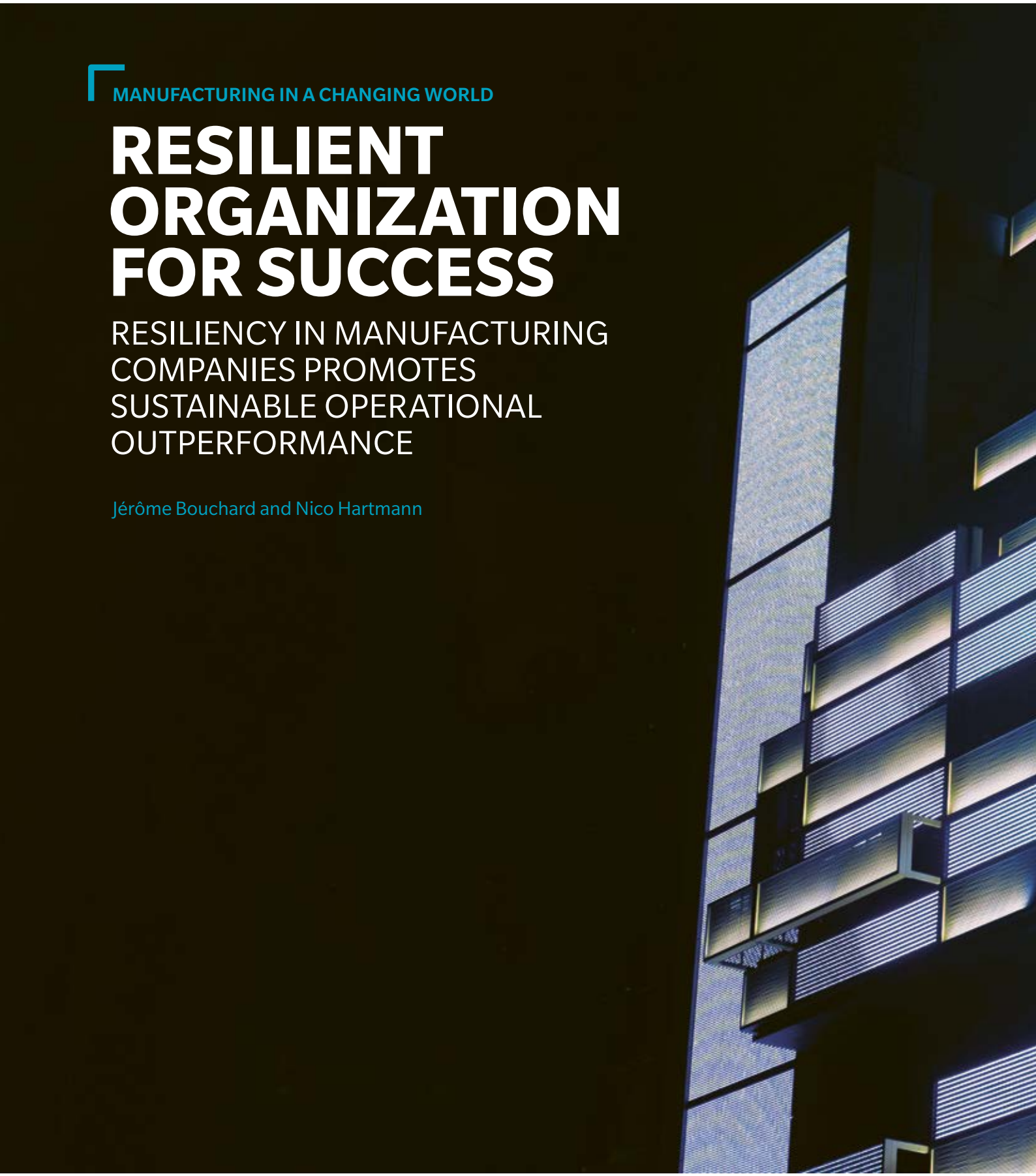
MANUFACTURING IN A CHANGING WORLD

RESILIENT ORGANIZATION FOR SUCCESS

RESILIENCY IN MANUFACTURING COMPANIES PROMOTES SUSTAINABLE OPERATIONAL OUTPERFORMANCE

Jérôme Bouchard and Nico Hartmann



The world today is changing faster than ever before – and in the future, the rate of change will be even greater than it is now. To survive in the long run, companies will have to continuously renew their competitive edge and build sufficiently resilient organizations to enable this capability.

Resiliency has become an imperative for manufacturing organizations, both in their supply chain and within the production lines. Elementary Performance Units (EPU) methodology is a way for designing resilient organizations that are customer centric, circular, innovation oriented, open – and successful!

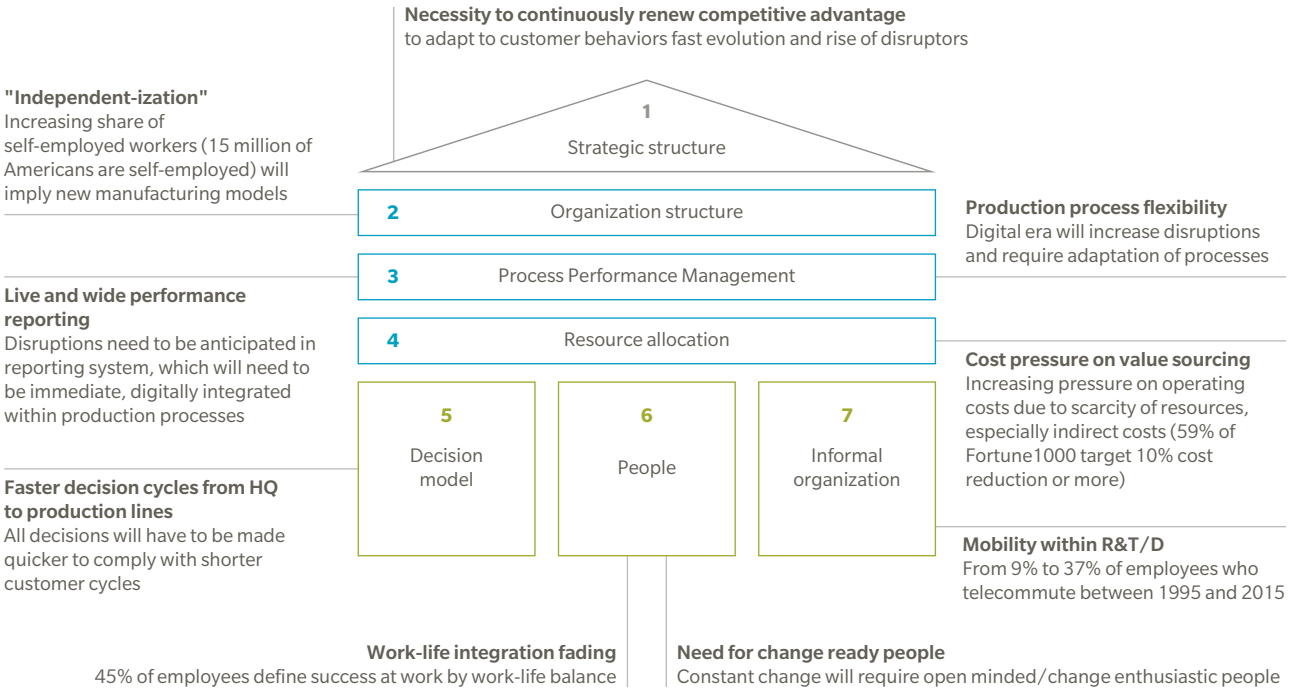
MANUFACTURERS MUST LEARN TO ADAPT AND PROFIT FROM INCREASINGLY UNCERTAIN ECOSYSTEMS

The megatrends transforming our society show that tomorrow's companies will evolve in increasingly uncertain ecosystems, where disruptions will be more frequent and resources less available. This will impact the way they organize – and this trend will be even more so the case in the manufacturing world. Indeed, most companies face the rise of digital disruptors, scarcity of natural resources, ecosystems at risk, natural disorder, and asymmetric conflicts in developing countries. But manufacturing companies are also disrupted by the acceleration of innovation, embodied by digital, smart devices and infrastructures, Industry 4.0, and autonomous vehicles. (See Exhibit 1.)

Manufacturing companies are more and more intertwined with their external ecosystems through open innovation, scientific marketing, social business, or immediate delivery. All dimensions of manufacturing companies are impacted: supply chain must recover from more frequent natural disorder and product development; innovation cannot go without intrapreneurship anymore; and manufacturing processes, often located in developing countries, are more and more automated, while value sourcing is now tantamount to using new materials and diversifying energy sources.

Most companies are now reacting. Mercer, a sister company of Oliver Wyman, reports in their *Talent Trends 2018* study that 96 percent of executives are planning structural changes this year, and they predict 20 percent of job roles to cease to exist within the next five years. The share of

Exhibit 1: Rising challenges for manufacturing organizations



Source: Oliver Wyman analysis

executives that declare that workplace flexibility is a core part of their stated value proposition has risen from 49 percent in 2017, to 80 percent in 2018, and flexibility is a necessary ingredient of resiliency.

ELEMENTARY PERFORMANCE UNITS: THE BUILDING BLOCKS FOR RESILIENCE

Consequently, organizations will have to withstand frequent change in their ecosystem and continuously renew their competitive advantage. Indeed, resilient organizations are the ones capable of sustainably thriving in an environment of uncertainty because they keep serving their purpose and values, and remain customer centric under any conditions. These manufacturing companies can anticipate, absorb, and accommodate any change or disturbance to recover their operational equilibrium, or move to a new one if needed. This is only possible thanks to an agile organization where each dimension and component are resilient in themselves.

We are convinced that using Elementary Performance Units – a concept of decentralized, self-governing organization bricks – is at the heart of resilient organization design. These EPUs are the lowest level elements within the organization, to which profit and loss responsibilities can be delegated, as for instance in project organizations. These are the smallest relevant bricks on which an organization can be redesigned. When all the EPUs of an organization connect to each other, they collectively form the core business of the company and connect to all other key company functions that have no P&L responsibility.

This "distributed autonomy" leads to a maximum of performance commitment by the EPU's individuals and fosters intrapreneurship, empowering employees towards a greater involvement and a positive culture. The concept has proven effective to realizing the economic benefits sustainably. As a matter of fact, resiliency requires customer centricity and awareness of any change of conditions and EPUs are the most appropriate level for this. Once a root cause is identified, EPU-based organizations can immediately ideate a local solution based on the best combination of organizational, accountabilities, and management model changes, as per the intuition of the top executives Mercer has surveyed.

SIX GOLDEN RULES FOR ACHIEVING RESILIENCY

To achieve resiliency, companies need to follow six agile principles: **1) Customer centricity** must be the central element of a circular design. Only then the organization will quickly detect shifts in end-consumer behavior and demands. **2) Short decision loops and governance paths** will enable rapid interpretation and reaction to any changes, from strategic marketing to production lines. **3) Bottom-up design** allows all levels of an organization to become a part of these decision-making processes, creating the urge to engage and commit to success. **4) A culture of innovation anywhere and everywhere** is key for teams to be further motivated, collaborate, and use digital technology with a view to accelerate time to market. **5) Orientation towards business results**, eased by a distributed autonomy, is required to trigger continuous improvement and positively impact business and operational performance. **6) Effective organization and process convergence** enables visibility and control of R&D, supply chain, manufacturing, and value sourcing.

Following these golden rules towards resiliency generates significant operational gains and contributes to sustain any manufacturing competitive edge. For instance, decision-making lead times are reduced anywhere from 10 percent to 20 percent in the wake of such organization transformation. As there is no doubt that the manufacturing environment is evolving faster and faster, manufacturing companies' surely need to shift to more resilient organization designs.

10-20%

TIME GAINS IN DECISION MAKING AFTER ORGANIZATION RE-DESIGN

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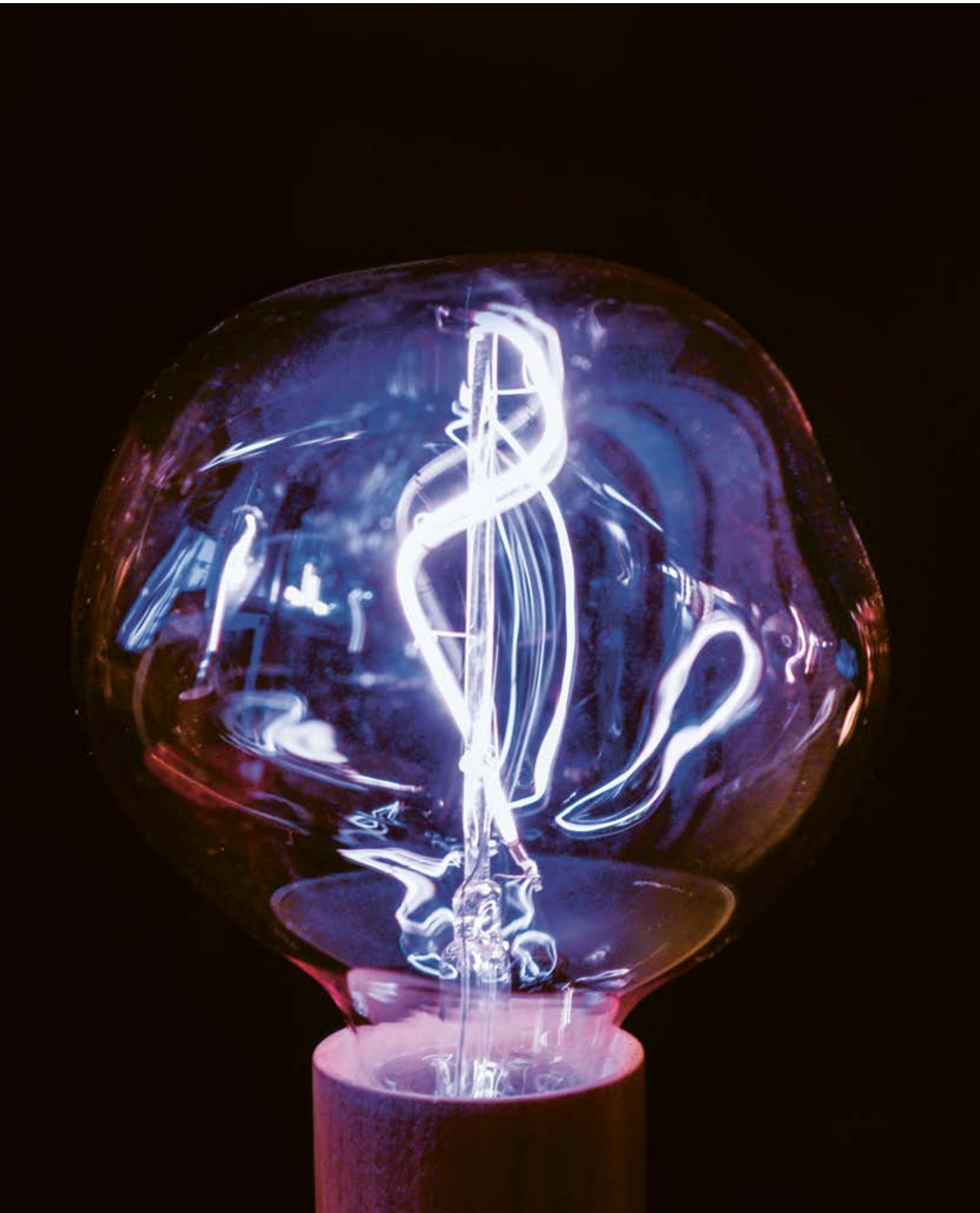


GETTING THE MOST OUT OF AI

MANUFACTURERS NEED TO ESTABLISH AN INTEGRATED AI STRATEGY

Juergen Reiner and Andreas Nienhaus

Artificial intelligence (AI) and machine learning innovations are beginning to transform a broad array of businesses functions, including manufacturing processes, with promising use cases ranging from research and development to sales. However, to truly leverage the abundance of production data and make use of AI, manufacturers first must connect stand-alone AI use cases and create an integrated AI strategy, taking production through edge computing to the next level.

Artificial intelligence and machine learning are the buzzwords of the moment, promising to enhance business processes, quality, performance, and profitability. Indeed, AI-based technologies and applications are expected to conquer many functional areas within companies and industries in the years to come, manufacturing industries included. But the road to success for AI has yet to be paved. A question remains: How are the improvements promised by AI to be measured and quantified?

A HOLISTIC AI STRATEGY: INTERLINKING THE DATA

Since the root of most AI-applications lies in using and interlinking different data sources, manufacturing companies (with their abundance of different data pools, ranging from R&D to real-time production data to sales figures) hope to see significant improvement in performance

40%

PRODUCTIVITY GAIN THROUGH AI-USE CASES UNTIL 2025

by making use of artificial intelligence. AI is expected to impact the industry with a significant revenue uplift and a simultaneous productivity gain of more than 40 percent. Equipment effectiveness can be expected to reach levels close to 85 percent when being AI-enhanced. (See Exhibit 1.) But, in order to realize the full potential of AI applications, it is important to develop a holistic and integrated AI strategy. Without an overriding strategy, the AI use cases will become stand-alone solutions, yielding an inferior patchwork.

But if separate departments develop individual solutions, use detached data lakes, or employ their own legacy data-processing infrastructure, then AI's full potential will never be realized. By developing an overarching approach to AI – an approach that recognizes that AI applications will sooner or later affect all areas of the value chain – and adapting a data-first state-of-mind, manufacturers can create a sustainable competitive advantage.

EDGE COMPUTING: BRINGING AI TO THE DATA AND NOT VICE VERSA

The promise of AI, however, depends on more than just highly interconnected devices. Even if multiple data sources can be connected to generate meaningful insights, AI manufacturing applications require real-time data processing and the ability to act instantly on the insights generated. Thus, processing the enormous amount of data provided by an ever-increasing number of sensors in the production process requires edge computing, putting analytics right at the data source instead of in the cloud. Currently, most manufacturing firms resort to cloud computing or are still using their own local data processing capacities. But to create real value from the interconnecting hardware and production facilities calls for AI to be used where the data originates.

For instance, a production robot equipped with multiple data-generating sensors will be able to use machine learning models to predict a defect or malfunction in real time and be authorized to shut down autonomously to prevent damage. In the case of traditional data processing, the production data collected by the robot's sensors would be sent to the cloud. The data analysis, as well as the order to shut down the robot, would have to be sent from the production facility to a server and back again. This would simply take too long, causing severe damage to the robot or the overall production process.

Thus, some AI use cases are only possible if deployed in real-time. Edge computing – computing that takes place directly at the edge of the data source, whether it be the robot or the production line – is a pivotal enabler for doing so.

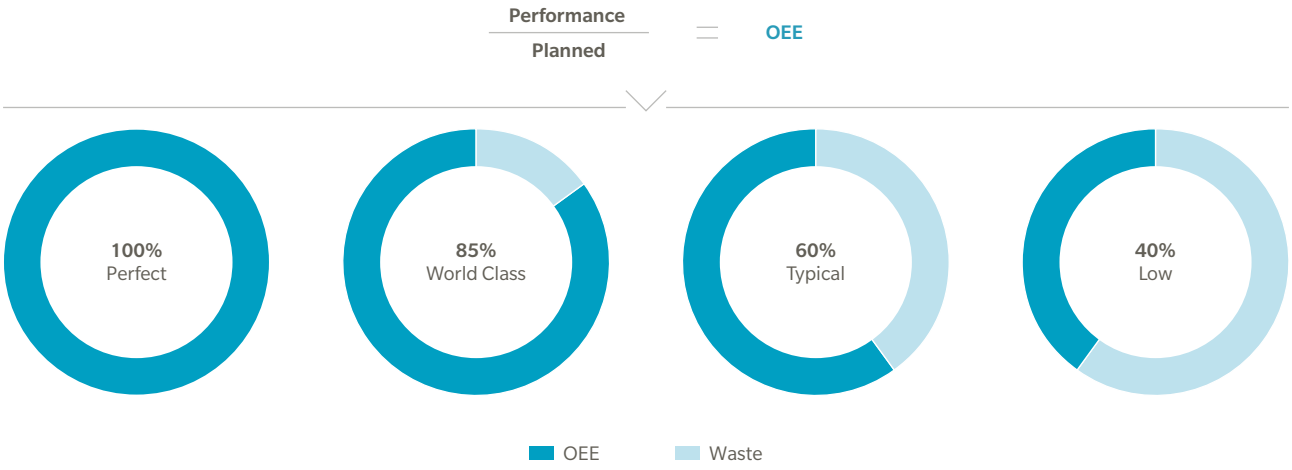
THREE KEY APPLICATION AREAS FOR AI IN THE FACTORY

If the two principles of a data-first, holistic AI strategy and of bringing AI to the data source are taken to heart, then the following AI uses will allow manufacturing firms to get the most out of artificial intelligence and gain a competitive advantage. It is important to keep in mind that this is not a comprehensive list. Instead, the three uses are easy to implement and can serve as stepping-stones towards an AI-driven manufacturing firm.

First, machine-learning prediction models can improve **planning and production scheduling** significantly, moving from experience and gut feeling to fact-based dynamic planning. By connecting real-time production data with planning and sales information, an AI-system could learn from previous conflicts in schedules, launch ramp-ups in production, and independently adjust production towards quality capacity planning. Through the integration of unstructured data across the entire supply chain, machine-learning models could continuously adjust conflicting system parameters to optimize output/wear-and-tear ratios or provide real-time process solutions to control the end-to-end manufacturing process. By doing so, the planning and production could be lifted to a level of accuracy that is unattainable via traditional methods.

Second, leveraging stochastic methods, machine learning, and AI to predict key sources of defects and manufacturing problems will bring **predictive maintenance** and in-line quality management to its full potential. Through edge computing, Internet of Things (IoT) components in a production process will be able to detect defects and irregularities in real-time and adjust manufacturing steps accordingly. Enabled by machine-learning analytics, IoT components will be able to untangle complex, hard-to-

Exhibit 1: Overall equipment effectiveness of typical manufacturing companies



Source: Oliver Wyman analysis

identify defects and quality issues and find sustainable solutions. Thus, manufacturers will be able to detect defects based on multidimensional attribute analysis and enable machines to not only detect and flag but to also solve the problem.

Third, an integrated AI strategy across the entire value chain will help manufacturing firms establish advanced supplier quality control and create an agile and adaptive supply chain. Being able to adjust supply not only allows manufacturers to adjust output to demand more easily, a modularized and IoT-network-based production process lets them satisfy the need for **variety and customization**. For instance, AI-steered production equipment allows producers to translate individual customer demand into 3D-printable output.

THE AI-TRANSFORMATION PROCESS

To transition towards an AI-driven company and realize the full potential of advanced analytics, manufacturers must: 1) integrate different data sources; 2) gain speed through edge computing; and 3) avoid creating a patchwork of AI use cases and instead develop an overarching AI strategy for the entire value chain.

Despite the hype surrounding AI, it is important to start realistically, even when having a rather disruptive target picture. For instance, the creation of AI lighthouses can promote AI applications within the organization and help to gain experience and trust. This is particularly important when accounting for the fact that a lot of AI tools like convolutional neural networks or other deep AI techniques are black boxes when it comes to the underlying data processing. At the end, this is what makes true AI powerful: It surpasses human data-processing capacity.

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MANUFACTURING IN A CHANGING WORLD

DIGITAL FAST-TRACK IMPLEMENTATION

USING AGILE PRINCIPLES AND PROCESSES TO IMPLEMENT DIGITAL USE CASES IN MANUFACTURING

Kai Bender, Florian Deter, and Sascha Coccorullo

Today, digital strategies need to demonstrate their impact and effectiveness quickly. This calls for agile development of minimum viable products (MVP): fast, implementable – yet powerful – digital solutions for testing strategic elements in a limited time frame. Even in B2B-dominated industries such as manufacturing, the time-to-market window for innovation and shrinking project timelines are key to differentiating and competing. B2B customers demand the same experience they are used to in the B2C world, such as flexible online modular product configurators, additive manufacturing methods, advanced digital remote services, and real-time big data analytics.

While most manufacturing companies have defined their digital strategy and identified promising use cases, only a few have managed to implement them thus far. The reason for this is that they often stick to classic waterfall approaches, which typically are not suited to quickly create results and demonstrate the impact of digital strategies.

Agile methods – applied correctly – could reduce the implementation time from an average of 18 months to only 12 weeks. That is because even in a first-step MVP, the result is a fully functional product (rather than simply a mock-up) that can then go live in a production environment, enabling end users to see and utilize it.

From Oliver Wyman's point of view, a proven best practice consists in a three-step process that we call "Digital Fast Track Implementation": the discovery phase for scoping and team setup, the agile implementation, and the scaling and further development of the MVP.

DISCOVERY PHASE

Typical digital use cases in manufacturing range widely. These can include the remote flow measurement in valves

for estimating needed service and replacement; it may also reach full Internet of Things (IoT) platforms, connecting smart sensor data from multiple production-line machines and using advanced machine learning techniques.

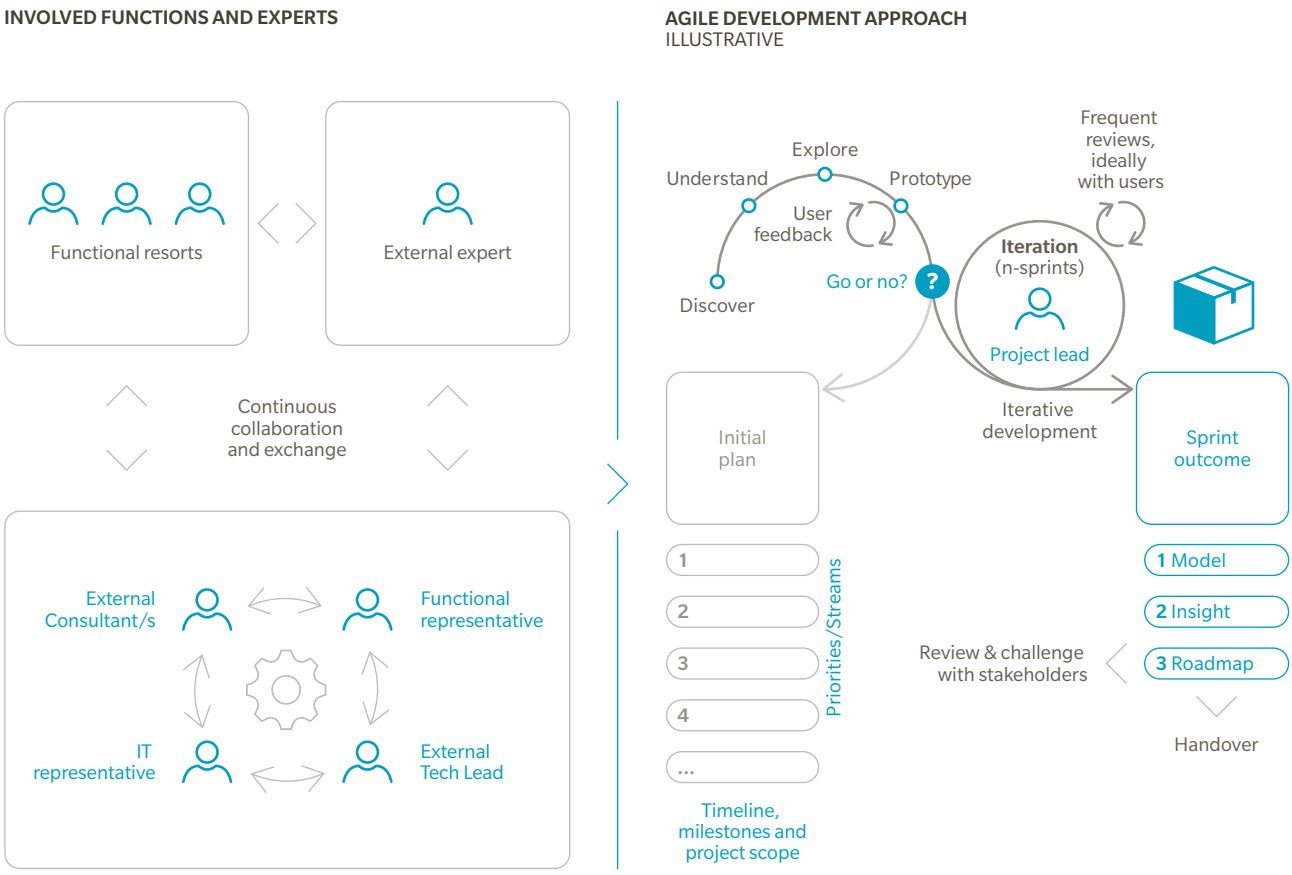
A thoroughly planned discovery phase helps to clearly define the scope of an MVP and should typically last between two and four weeks. (See Exibit 1.) Firstly, it is important to define the scope of the minimum viable product in an engaging format. This ideally entails a daylong offsite location with open innovation spaces to receive input and buy-in from involved stakeholders. Identifying candidates for a customer panel is critical, as well as engagement with them from Day 1.

Secondly, together with real clients (either internal or external ones), the user interface and experience need to be jointly developed to ensure the MVP delivers digital and enables strong adoption right from the start. Ideally, the user interface/user experience (UI/UX) can be tested with the customer panel in the form of quickly designed wireframes and clickable mock-ups. Successful ideation requires immediate prototyping – starting out "Low-Fi", but becoming "Hi-Fi" quickly.

Third, the minimum data requirements to achieve scope must be identified, and the availability and accessibility of the data need to be evaluated. This represents one of the biggest challenges: dependencies on available skills and resources,

Exhibit 1: Agile piloting – mode of operation

Ability to rapidly pilot the meta models by focusing on cross-functional insights and on an agile development method



The mode of operation makes sure that the meta models will be developed in a rapid and iterative fashion

Source: Oliver Wyman analysis

on external suppliers as well as legal restrictions, need to be scrutinized thoroughly.

The overall outcome of the discovery phase is the identification of input parameters and prerequisites for the first agile sprint.

AGILE PROTOTYPING

An agile, cross-functional approach allows for quick turnaround. For this purpose, it is indispensable to set up a multidisciplinary, agile team. In addition, clear roles with regards to business ownership, product ownership, data architecture, and technical architecture, as well as test users and scrum master, need to be clearly defined upfront.

Subsequently, in a matter of eight to 10 weekly sprints (with continuous user testing), the first MVP will be developed and deployed in a rapid, iterative fashion. User feedback and user behavior need to be continuously analyzed when planning the next sprint session. During the review and challenge sessions at the end of each sprint, different stakeholders (from top management) should be included to demonstrate progress and increase senior buy-in.

Early embedding of the MVP into the existing system and process landscape is key to ensure smooth implementation and to realize high adoption rates from the beginning. It is critical to set up a realistic testing environment and interact frequently with users of the MVP to define appropriate guidelines. These might include notes on the number of users, realistic context and time settings, a moderator to observe testers, and a suitably designed questionnaire to capture testers' feedback. In the above-mentioned example, the usability of a first maintenance and service report produced by the intelligent valves is verified with internal service departments and real customers (such as plant engineering/construction companies).

SCALING PROTOTYPES

Developing and rapidly implementing an MVP prototype is a powerful way to demonstrate digital impact, but a subsequent roadmap is needed to drive further development from "MVP" to "fully-fledged".

The focus needs to be on a continuous injection of new ideas through rapid deployment and testing. Each result needs to be scalable to a productive, client-facing solution.

In addition, technology architecture needs to evolve to support the platform. This may include the rationalization of legacy infrastructure and tool investments, cloud, test automation, DevOps, and IoT platform. Moreover, the existing workforce should be trained on new practices and – if required – supplemented with additional talent.

Organizational realignments will be required to draw business, support functions, and IT into permanently integrated teams and enable the long-lived application of MVP prototypes. In our example, this could mean adding functionality to display real-time information on handheld devices about the valves and their maintenance requirements, including automated scheduling with service teams for on-site replacements or repairs.

While the digital fast track process is a reliable method, early customer adoption and feedback cycles remain key to proving viable customer benefits for manufacturing companies.

12 weeks

ARE NEEDED TO DELIVER AN IMPACTFUL, FULLY FUNCTIONAL MINIMUM VIABLE PRODUCT, DEMONSTRATING EFFECTIVENESS OF THE UNDERLYING STRATEGY

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MANUFACTURING IN A CHANGING WORLD

TRUCK MANUFACTURERS: BUSINESS MODEL RISKS FROM ALTERNATIVE DRIVETRAINS

THE ROAD TOWARDS EMISSIONS REDUCTION

Joachim Deinlein and Romed Kelp

European initiatives to reduce emissions are pushing truckmakers to explore a range of alternative powertrains. The alternative technologies will erode manufacturers' extant competitive advantages and disrupt downstream revenues, with up to 10 percent of OEM revenues at stake. Consequently, OEMs need to be proactive in adapting their business models and rethinking technology investments, aftersales, and remarketing.

Commercial vehicles account for about 26 percent of all European greenhouse gas (GHG) emissions, with long-haul and regional distribution segments accounting for more than 90 percent of total freight-transport distance in Europe and significantly contributing to these emissions. While NOx and particulate-matter emissions have decreased drastically with

-30%

IS THE EU PROPOSAL FOR CO_2 REDUCTION FOR HEAVY-DUTY VEHICLES BY 2030 (COMPARED TO 2019)

EURO 6 implementation, there has been no explicit focus on decreasing fuel consumption and capping CO_2 emissions.

That, however, is about to change, with the European Commission's recent proposal for setting CO_2 standards for heavy-duty vehicles. Based on 2019 reference levels, the aim is to reduce the emissions by 15 percent by 2025 and 30 percent by 2030. Concurrently, regional and national governments are stepping up pressures on conventional vehicles with a slew of measures such as city bans and restrictions in the midterm and complete exit from fossil fuels eventually. Given such trends, it is time for truck OEMs to become proactive in the face of these pressures.

WHAT NOW? DIVERSE EMISSIONS-REDUCTION STRATEGIES

Because incremental innovations are capable of reducing emissions by just 20 percent even under the most optimistic scenarios, alternative propulsion technologies are being explored. Long-term zero emission freight would likely entail battery and fuel-cell electric trucks, and nearly all European OEMs have announced battery-electric eTruck model launches, focusing on regional distribution, despite battery cost and weight concerns. Fuel-cell trucks have longer ranges, but the current outlook on their total cost of ownership (TCO) is also dysfunctional. Dynamic charging is currently being tested in some pilot stretches. Other interim solutions include gas-powered (CNG/LNG) trucks and dynamic charging. CNG and LNG technologies are easier to implement but are limited by fuel infrastructure and the inability to comprehensively solve CO_2 concerns.

Each solution differs in technology maturity and requires infrastructure, though their emission reduction impact, scalability, and commercialization potential remain uncertain. However, it is clear that the solutions will be region-specific and case dependent. In Europe, it is reasonable to expect significant adoption of CNG and eTrucks for urban distribution and more LNG trucks in the long-haul segment in the next decade.

IMPACT: BUSINESS MODEL RISKS FOR EUROPEAN OEMS

With OEMs pushing eTrucks aggressively, it is important to explore their implications on extant business models. Conventional powertrains are a key source of competitive advantage and differentiation. Historically, they have been a key driver of TCO and in determining vehicle performance. A switch to eTrucks brings a significant risk of losing this advantage, since the performance is mainly driven by battery weight, cost, and reach. Batteries are the biggest cost drivers in electric vehicles. However, the battery manufacturing space is dominated by Asian companies. Over 90 percent of battery production capacity is located outside Europe, meaning European OEMs will have little control over this core differentiator. Individual OEMs must thus seek alternatives to mitigate further product commoditization and associated price pressures.

Additionally, conventional powertrains contribute significantly to aftersales. With powertrain-related spare parts becoming redundant, a major source of today's aftersales revenues and profits will disappear. Furthermore, with powertrain technology diversification, used-truck remarketing will also be disrupted. Currently, used trucks find a second and third life in Eastern Europe, the Middle East, and Africa. With fragmented markets for each alternative solution, remarketing will be limited to markets where technology, emission standards, and infrastructure are supportive, hindering used-vehicle sales abroad and limiting residual values. These exports have already seen a decline due to existing technology gaps; rapid adoption of eTrucks will further aggravate these pressures. Given the transportation sector's razor-thin margins, it is difficult to pass on additional investments to customer without more favorable TCO arguments. The more OEMs are forced to switch to alternative technologies by emission regulation in first-life markets, the greater the share of margins will be at risk.

APPROACH LEVERS FOR OEMS

European OEMs can proactively address these issues through four levers spanning the truck lifecycle.

Firstly, an agile approach and rigorous investment prioritization in the technology portfolio, with consideration for customer acceptance and differentiation criteria, will help OEMs manage R&D effectively. This entails strategic

Exhibit 1: 2030 forecast of alternative powertrain

25%

OF THE TRUCKS SOLD IN 2030 IN GERMANY WILL BE POWERED WITH ALTERNATIVE DRIVETRAIN SOLUTIONS

Source: Oliver Wyman analysis

decisions on whether to build innovation leadership, be a fast follower, or hedge investments. A key enabler is to build collaborative ecosystems and partnerships with diverse stakeholders.

Secondly, OEMs need new sources of downstream revenues. This means advanced connectivity features, with over-the-air updates, uptime offers, and freight mobility packages built around risk-based pricing and truck-as-a-service offers to balance the erosion in spare parts sales.

Thirdly, successful remarketing requires rethinking the vehicle architecture and processes around modular lifecycle concepts, including retrofitting and strategies for revitalizing batteries, electronics, and software. Remarketing chains must be adapted to the local technology opportunities.

Finally, to develop new sources of differentiation, OEMs must fundamentally overhaul their business models, recasting and reconfiguring themselves as providers of integrated transport solutions. This will require a shift in focus from truck sales and individual aspects of business to integrated service offers.

The shift to alternative powertrain technologies will not happen overnight. (See Exhibit 1.) However, OEMs must act now, not only to deal with the associated technical and commercial challenges, but also to proactively turn the disruption into opportunity and to reposition their business models transportation strategically to capture a fair share of future profit pools.

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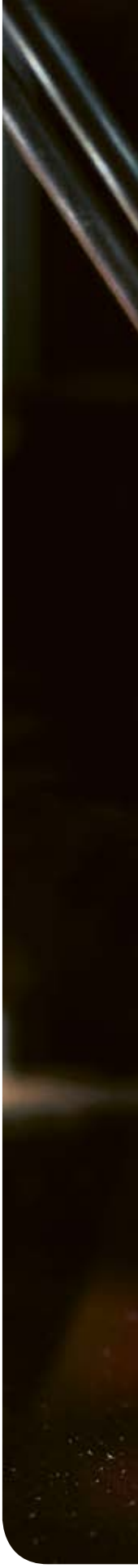
DIGITAL STARTUPS RESHAPE MANUFACTURING

"GOOD DEAL" POTENTIAL AVAILABLE IN DIGITAL EUROPEAN STARTUPS

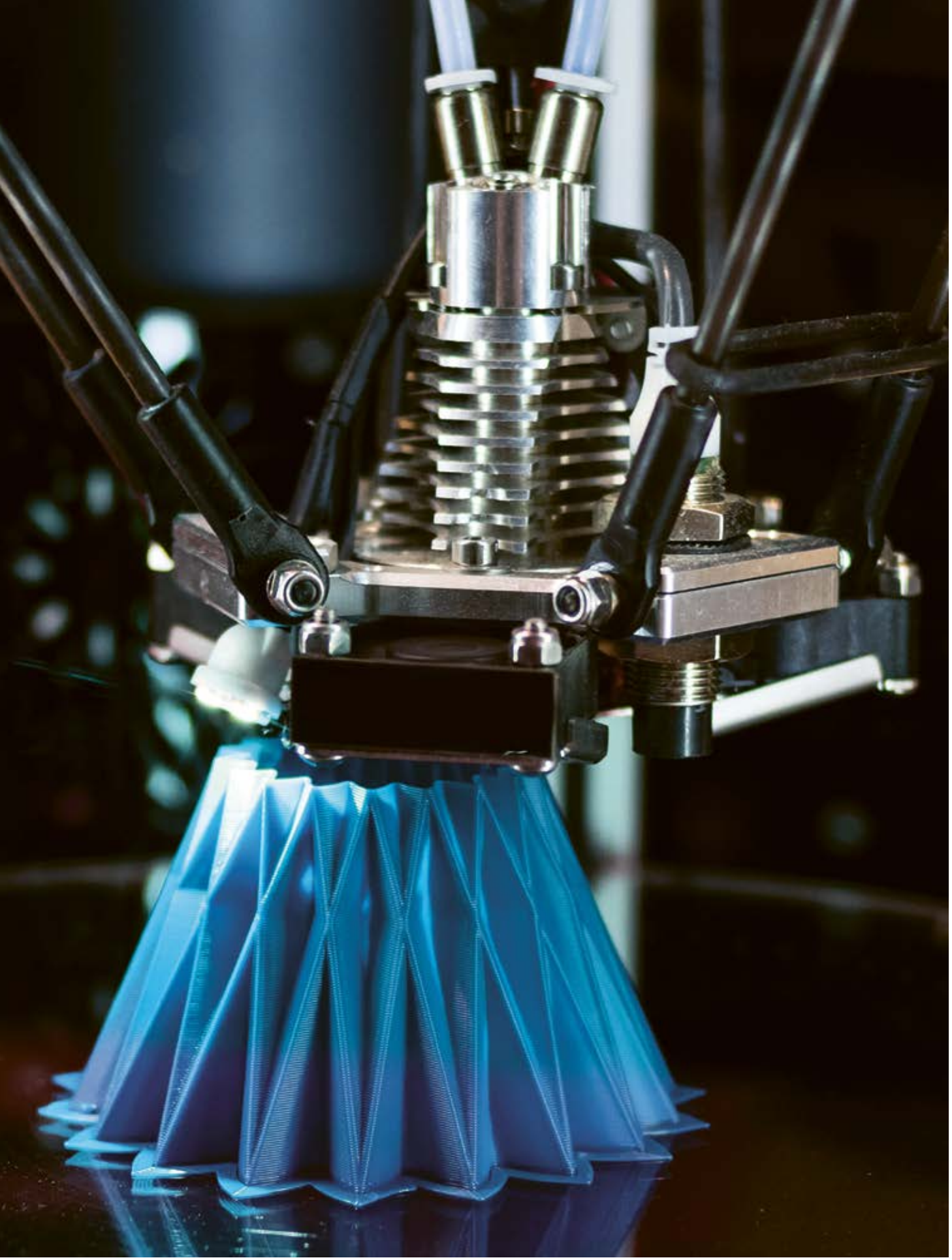
Nico Hartmann and Markus Mentz



Startups have the potential to change the rules of the game for manufacturers. By identifying the right partners early on and using their potential effectively, manufacturing incumbents can benefit from the innovations of these pioneers. Companies such as Xometry, Carbon, Konux, and Flyability provide concrete use cases in the industry, resulting in new offerings and improved efficiencies. Funding for manufacturing startups, which has amounted to around US$3 billion since 2013, is primarily tilted toward US firms. Consequently, European manufacturing players need to be on the lookout for good deals in their markets to keep up with the speed of innovation and improve their competitive position. (See Exhibit 1.)

A few examples illustrate the transformational potential of digital startups on manufacturing companies:

Xometry, a US startup, offers a platform for on-demand manufacturing, with more than 9,000 customers and 1,000 manufacturing companies offering their services, mostly in 3D printing. Instant quotes, based on 3D CAD, serves



ONE NEW DIGITAL STARTUP IN MANUFACTURING EVERY

10 days

to enhance transparency and decision-making speed for clients, and increases utilization of suppliers.

Adidas has recognized the benefits of additive manufacturing and expanded its collaboration with Carbon, the best-funded 3D printing startup. The "Futurecraft 4D" running shoe's midsole will be printed from liquids, making injection-molding technology obsolete.

Konux, a German startup, could win out over more established automation players in equipping the Deutsche Bahn with sensors that provide online data on train and track efficiency and status. Senseye, one of Konux' competitors, estimates maintenance and service cost savings in the range of 10 percent to 40 percent based on sensor-generated data, which may render approximately half of rail maintenance staff redundant.

Collision-safe drones, such as by Flyability, a Swiss-based startup, will allow for new applications such as physical maintenance in remote areas or inline maintenance without necessitating plant shutdown.

SIX STARTUP CLUSTERS TRANSFORM MANUFACTURING

The above-mentioned are only a few examples of startups, technologies, and their impact. Generally, digital startups in manufacturing can be divided into six clusters: 1) Industrial Internet of Things (IIoT), which connects machines and devices and provides an extensive set of data for further use; 2) robotics and drones, boosting manufacturing efficiency and automation; 3) machine learning and artificial intelligence (AI), which serve to increase machine performance and speed up transformation of industrial processes and automation; 4) maintenance and service technologies, enabling new business models and service-efficiency boosts; 5) additive manufacturing, which provides new manufacturing processes, challenging traditional manufacturing of components and consequently machine manufacturing's business models; and 6) cybersecurity, serving as an enabler to all of these digital developments.

Startups in these clusters provide specific advantages over manufacturing incumbents. In particular, their ability to take risk enhances their innovativeness, and opens up new sources of funding from venture capital and private equity. A greater affinity for risk, combined with relatively small size and flat hierarchies, enables fast decision making and agile implementation, shortening the time to market of new technologies and products. Independence is another competitive advantage: While incumbents typically innovate to solidify their own positions, startups open their technologies and platforms to the industry, generating network effects and establishing new industry standards.

DIFFERENCES IN FUNDING AND FOCUS

Since 2013, every 10 days a new startup has been born, each one raising millions of dollars in venture funding and holding the potential to transform manufacturing. In 2017 alone, investors pumped around US$1.4 billion into digital newcomers. Startups based in the US have raised 72 percent of this sum, with just three percent going to Germany, and all of Europe amounting to only nine percent. This results in potentially interesting investment opportunities in Europe – while the average startup in the US has already raised US$22 million in funding, the European average is only US$6 million.

The ability of startup clusters to attract funding differs greatly. The 33 startups in additive manufacturing have already raised more than US$1 billion since 2013, while the 20 companies active in machine learning and AI have raised only US$130 million. Investment also differs greatly by region: in the US, 50 percent of funds have gone towards additive manufacturing startups and only six percent towards IIoT; in Germany, the case is the reverse, with 44 percent going to IIoT and 16 percent to additive manufacturing.

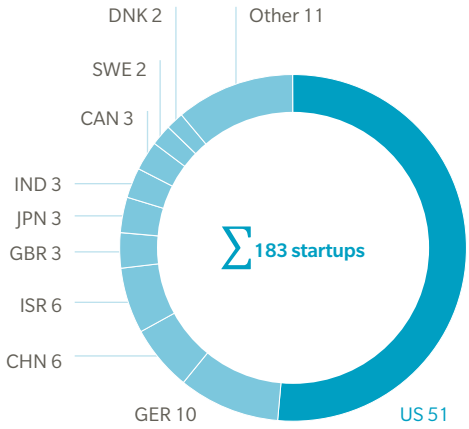
EUROPEAN STARTUPS SHOW "GOOD DEAL" POTENTIAL

Digital startups threaten old business models, yet also present opportunities for traditional manufacturing companies. In particular, if incumbents can combine the innovative potential of startups with their own strengths in traditional processes, financing, and market coverage, they can further improve their position in the global market. The differences in funding volume make it more likely that incumbents can strike good deals. The best-funded German startup, Relayr, has generated investments of US$60 million. Carbon in the

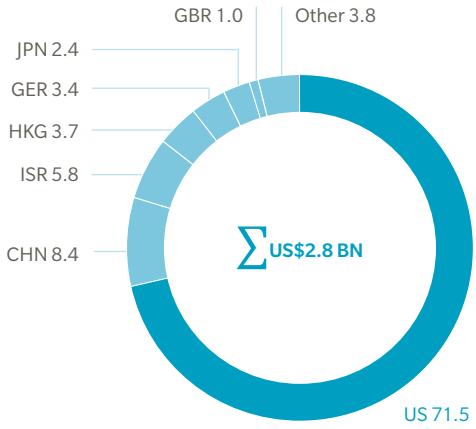
Exhibit 1: Geographical split of startups and funding

Around half of all startups are based in the US while more than three-fourths of funding volume goes to US startups

GEOGRAPHICAL SPLIT OF STARTUPS
IN PERCENTAGE, BY NUMBER OF STARTUPS



GEOGRAPHICAL SPLIT OF FUNDING
IN PERCENTAGE, BY SHARE OF TOTAL FUNDING VOLUME[1]



US market seems more prone to invest large volumes in startups

1. Funding information available for 161 of 183 startups
Source: Crunchbase, Oliver Wyman analysis

US, by comparison, has already generated more than seven times that. The key challenges are to identify the right target startups and integrate them carefully, making certain not to overload them with incumbent structures.

The opportunities outweigh the risks for manufacturers. It is critical that they keep up with the speed of innovation and improve their competitive position. As a first step, they should target young innovative firms that best complement their portfolio and hold the potential for breakthrough technologies (with a focus towards European startups, to be part of earlier investment rounds). Secondly, companies need to define their risk appetite and provide the necessary funding – or seek venture capital to co-finance investments. Finally, incumbents should consider building incubators to allow for the freedom and dexterity that is essential for startups and innovation.

The benefits digital startups offer to manufacturing companies are manifold, and many good deals remain on the market. But incumbents must act fast to realize them – and stay ahead of the competition.

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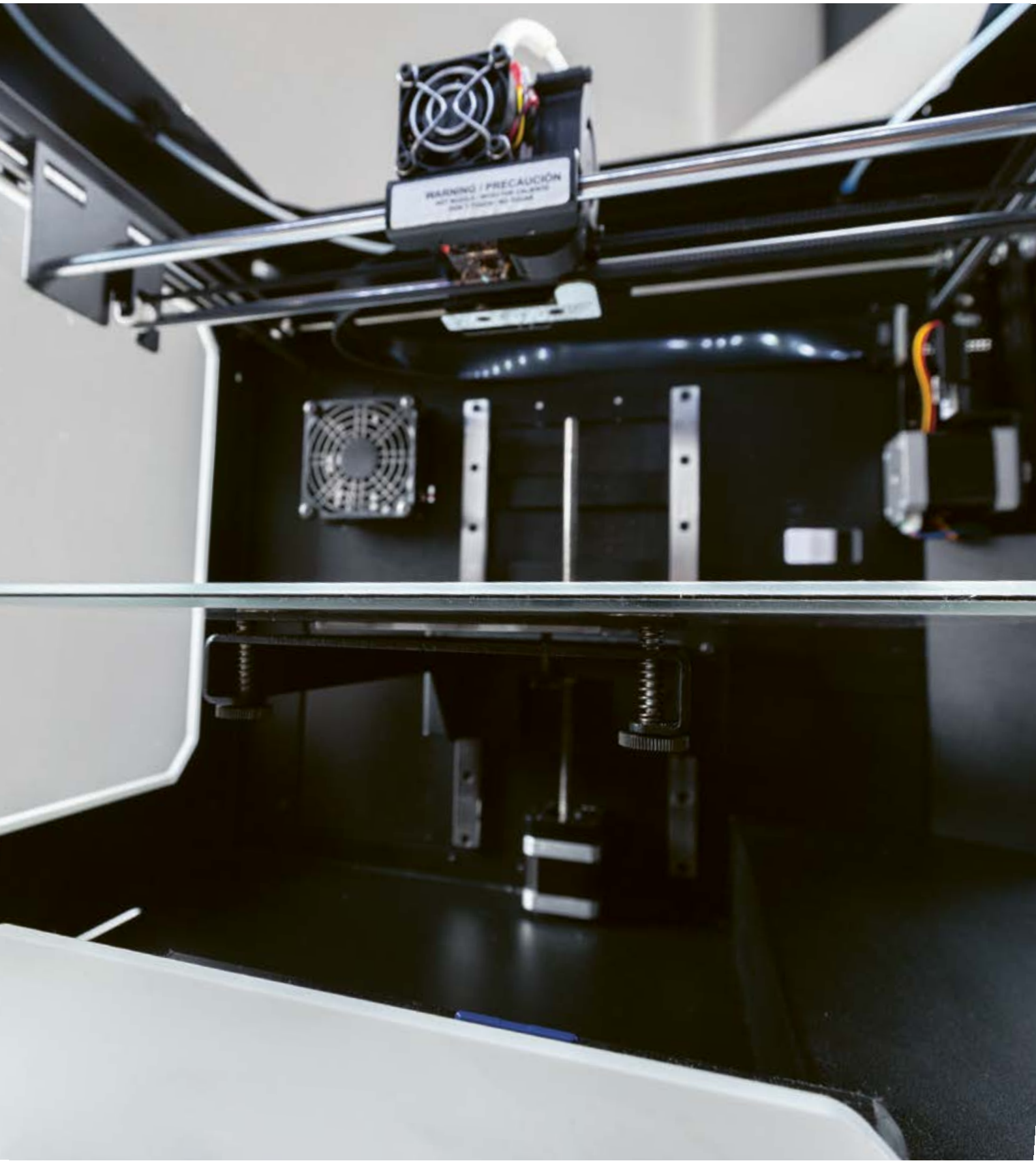
BY FUNCTION: NEW SOURCES OF VALUE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ADDITIVE MANUFACTURING: SHAPING UP FOR INDUSTRIALIZATION

THREE CATALYSTS ARE PUSHING 3D PRINTING IN A SCALING-UP PHASE

Eric Ciampi and Archag Touloumian

For decades, additive manufacturing (AM) was essentially used in rapid prototyping and tooling applications. The AM industry, however, has been evolving at an unprecedented pace recently. Three catalysts have driven its swift evolution: a sustainable cross-sectoral demand, the increasing maturity of technologies, and the consolidation of a competitive ecosystem. What is at stake for business leaders is competitiveness. Models based on large economies of scale and inflexible heavy capital supply chains are being threatened. As AM matures, it will not only offer new and more performant products, but also superior agility, new means of diversification, and potentially lower overall costs than conventional processes. The so-called 3D printing revolution is happening now.

No doubt, significant technological challenges remain before AM converges towards a state of the art. Yet, in today's swiftly transforming digital context, stakeholders of all sectors must understand how their business models and organizations need to evolve in order to scale and reap the true benefits of AM.

A SUSTAINABLE CROSS-SECTORAL DEMAND

According to expert reports, revenues of AM material, printers, and services have grown rapidly, undergoing more

BY 2022, THE MARKET FOR ADDITIVE MANUFACTURING MATERIAL, PRINTERS, AND SERVICES IS PREDICTED TO REACH

US$25 BN

than 28 percent compounded annual growth rate since 2010. At this pace, this market is projected to reach US$25 billion by 2022. Proofs of concept are being launched by ever-increasing numbers of companies, the most advanced of which will pursue scaling their production of metal-printed parts. Business cases crop up on a daily basis, with R&D costs and lead times constantly being factored down. The transportation industry is leading the way, with designs of light integrated products, functionality breakthroughs, and customized interiors being few differentiating factors. For most industrial companies, the reduction of inventories through spare parts on demand, combined with decentralized production labs, is expected to disrupt costly supply chains and associated aftermarket strategies. On the consumer products side, leaders will follow the path traced by the medical, dental, and jewellery sectors – in particular, by leveraging mass customization. Customer behavior is evolving towards a higher demand for individualized items, shorter purchasing cycles, or even on-the-spot production. Adidas, for instance, in collaboration with Carbon 3D, a major technology provider, is planning the use of AM to print millions of small batch-customized sneakers by 2019, targeting unbeatable times-to-market of less than a day.

THE INCREASING MATURITY OF TECHNOLOGIES

As noted above, there remain many technological barriers ahead, including weak repeatability of processes for metal printing, labor intensity of pre- and postprocessing, low printing speeds, and quality of surface finishes. However, technology providers are not only complementing each other to offset these challenges, but also responding to high demand. With their respective Jet Fusion and H1 Binder Jet printers, HP and GE for instance, intend to enable 10-times faster and cheaper printing options. Data-driven solutions are also emerging to monitor the quality of the melt pool in real time. By acting on micro molecules, AM offers great insights into materials, developing progressively graded multi-material solutions, as well as electronics-embedded technologies. Manufacturers are working towards agile and digitalized printing modules, thereby bringing new capabilities to further diversify product lines, test new markets at lower costs, or react faster to competition. The impact could be significant in terms of market share redistribution. If the cost advantage of AM versus conventional processes is not put in question on small series production, all these advances combined could eventually render AM competitive on large series, considering lower fixed costs and design breakthroughs together.

THE CONSOLIDATION OF A COMPETITIVE ECOSYSTEM

Lessons from the development of laser technologies show that the AM industry must adopt a global strategy, in order to properly manage the billions currently invested, risks, and mutualization of know-how. To this respect, numerous public-private partnerships have arisen across the globe, while alliances between printer manufacturers and key industrials are announced every day. The market is today dominated by a handful of vertically integrated actors – Stratasys, 3D Systems, and Envisiontech together own 60 percent market share – that have locked the use of their materials with their printers, hence generating high prices and market opacity for traditional material suppliers. However, recent market entries by conglomerates such as GE, HP, and Siemens are bringing greater competition to the market. As it further consolidates and enters a virtuous circle, the ecosystem will respond to the remaining challenges. The standardization of materials and processes, the reduction of costs to certify printed parts, or matching material supply and demand are all prerequisites to larger market adoption.

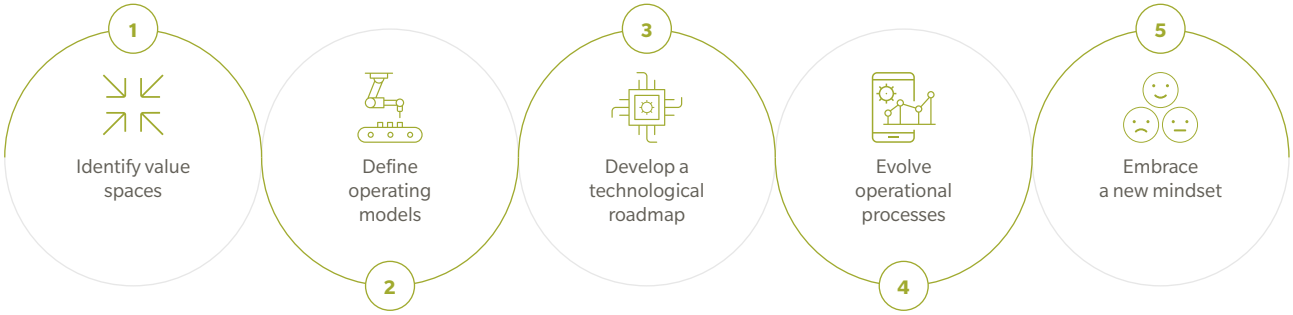
WHAT IT MEANS FOR BUSINESS LEADERS

To achieve the full potential of this revolution, business leaders will have to adress and focus on five key challenges: (See Exhibit 1.)

Identify value spaces of AM and associated business models. Understanding forthcoming disruptions will promote the right investments under an Industry 4.0 strategy.

Define the associated operating models. Such a transformation carries inherent uncertainties regarding the distribution of added value along the supply chain or risk-

Exhibit 1: Five key challenges need to be addressed to align the adoption of additive manufacturing with the long-term strategy



Source: Oliver Wyman analysis

sharing and IP ownership. Decentralized and mutualized production means, across industries, will reshape supply chains (including the emergence of large insourcing moves) back from low cost countries. Thus, Make or Buy, footprint strategies, and acquisition of capabilities will need to be carefully assessed.

Develop a technological roadmap, selecting appropriate partnerships with printer manufacturers, while factoring in current technological limitations.

Evolve operational processes. New engineering approaches will benefit from cheaper iterative testing, adopting more agile designs, through a "test and learn" mode. Eventually, all manufacturing processes will have to fully integrate into end to end digital chains, including cybersecurity options to secure the distribution of IP.

Embrace a new mindset. Organizations will need to adjust to these new processes. Beyond hiring new skill sets, a profound cultural change is required. Moving away from design to manufacturing dogmas into design to customer value will profoundly expand capital opportunities.

The AM industry is undergoing rapid change and evolution, driven by cross-sectoral demand, a maturing technology, and consolidation of the competitive ecosystem. Models based on economies of scale and inflexible capital supply chains are being threatened. As AM matures, it will not only offer new and better products, but also superior agility, new means of diversification, and potentially lower overall costs than conventional processes. The so-called 3D printing revolution is happening now. The endgame for manufacturing leaders is competitiveness – and survival.

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BY FUNCTION: NEW SOURCES OF VALUE

THE FACTORY OF THE FUTURE IS HAPPENING TODAY

COMPANIES MUST MEET CHALLENGES OF INDUSTRY 4.0 HEAD ON

Eric Ciampi, Charles de Pommerol, and Archag Touloumian

The adoption of Factory of the Future (FoF) technologies by companies is gaining momentum, as firms – having completed the first round of proof-of-concept (POC) phase – begin to embrace full-scale implementation of key disruptive innovations, such as cobots, additive manufacturing, machine-to-machine communication, big data, and analytics.

Digital transformation promises numerous gains comparable to those created by the introduction of business process re-engineering at the end of the past century. Given these trends, industrial directors at manufacturers must act now or risk lagging in maintaining cost competitiveness, delivering client services, and attracting talent.

Companies should not underestimate the urgency of getting the process started, as it could take a decade to make the full transition. The bigger manufacturers are already working on these innovations: having prioritized equipment modernization and human/machine interfaces, they are moving towards implementing big data, analytics, real-time visual management, and automating processes.

Meanwhile, smaller firms are falling behind. But to move forward in this transformation, industrial directors first must address three key challenges: a shortage in technologically skilled employees; a clear-cut business case for investing in new technologies; and a strategy for integrating the technologies into legacy equipment.

AWARENESS OF INDUSTRY 4.0 IS GROWING

Acceptance of the digital technologies underpinning the Factory of the Future is gathering speed. Having

conducted test-and-learn initiatives on a range of disruptive technologies, firms have a growing understanding of the key Industry 4.0 technologies.

The increased consciousness is reflected in a new survey by Oliver Wyman/L'Usine Nouvelle of industrial firms: 80 percent said they were familiar with key FoF concepts while 20 percent said they were familiar with all of the concepts. A survey conducted a year earlier found that 65 percent were familiar with the core concepts and just four percent knew about all of them.

DISPARITY BETWEEN BIG AND SMALL COMPANIES

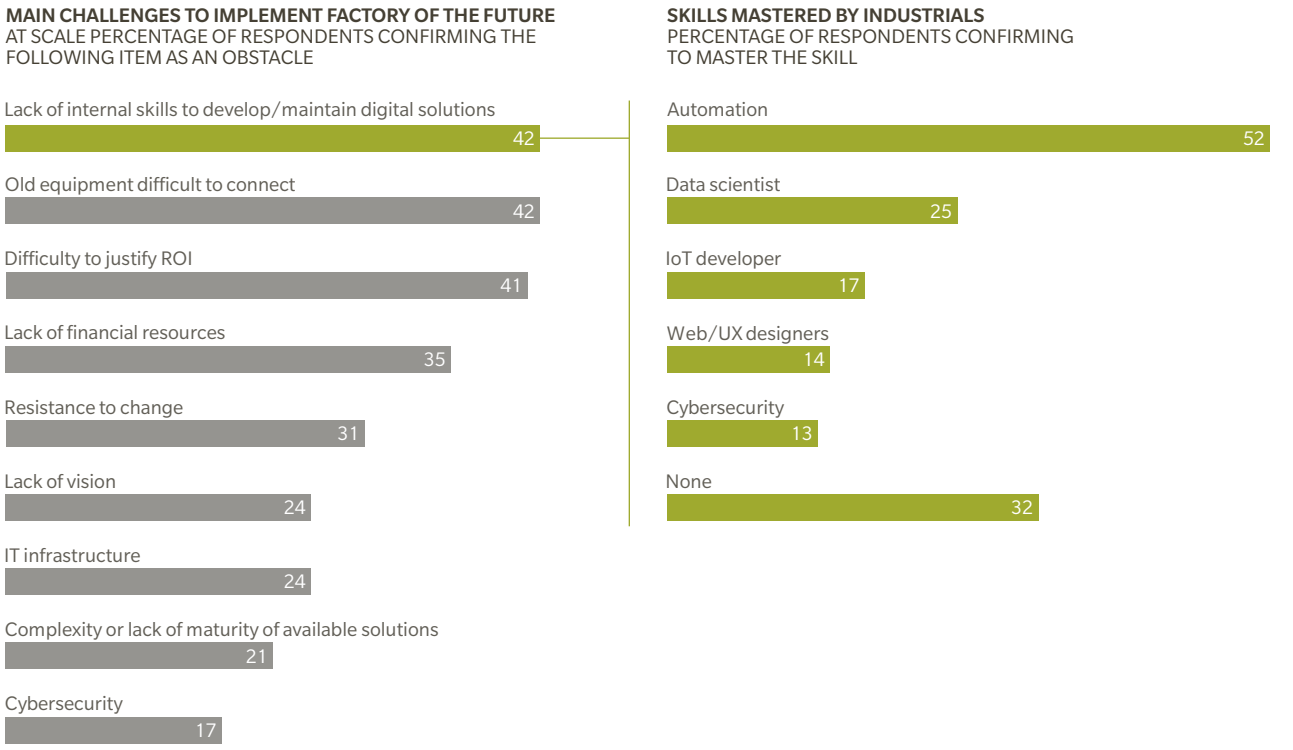
While operational teams are familiar with additive manufacturing, simulation tools, big data and analytics, and cobots, deployment is still in its nascent state and limited to a few production lines. But the growing share of capital-expenditure (capex) budgets aimed at digital underscores the pace of change: a quarter of the manufacturers surveyed said they are investing between 20 percent and 50 percent of capex into digitally transforming their production capabilities, a jump from 2016. Furthest along on the digital journey are the automotive, aeronautics, utilities, and transportation sectors.

The 2017 survey also highlights a growing disparity between the bigger and smaller companies in their approach to FoF. Large companies are working on more than half of the digital concepts, with equipment modernization (especially the human/machine interface) heading the list of priorities, followed by big data and analytics, real-time visual management, and automating tasks. More than 70 percent of respondents have implemented solutions for storing and using data, opening doors to more opportunities, such as predictive maintenance, planning and scheduling optimization, and process improvements. Meanwhile, smaller firms are falling behind, with only a third of them having studied the concepts.

TRANSFORMATIVE BENEFITS

Digital transformation will bring key disruptive benefits, including: cost efficiencies, improved client services, and better working conditions. Three-quarters of the respondents believe improvements in productivity and

Exhibit 1: Main challenges to implement Factory of the Future at scale



Source: Oliver Wyman analysis and L'Usine Nouvelle survey 2017

cost efficiencies will lead in key benefits of the Industry 4.0, noting that use cases have shown improvements in overall equipment effectiveness of 20-plus percentage points and cut lead time and improved production quality.

Besides internal benefits, client satisfaction and service improvements are top of mind for industrial directors. More than 65 percent expect digital technologies will let them be more responsive to clients and provide better services, versus 50 percent in 2016. Additionally, the technologies will lead to new services based on data, improving margins and generating new streams of revenue.

12%

OF RESPONDENT COMPANIES DECLARE HAVING A MATURE FACTORY OF THE FUTURE PLAN

BIGGEST CHALLENGES AHEAD

The greatest challenge facing manufacturers large and small concerns the issue of human capital, rather than hardware or smart-robot deployment. Nearly half the respondent companies point to a lack of both hard and soft internal skills to make the transformation happen fast. (See Exhibit 1.) Roughly a third say they lack competency in many key areas, including operation technologies, data, cybersecurity, systems integration, and change management. To tackle this hurdle, more than 70 percent said they are developing their operating model together with partners, including IT companies, startups, and academics.

Another key roadblock facing industrial directors is the need to make the return on investment (ROI) case for what is certain to be a costly investment, especially at companies with more than 1,000 employees. Getting an overarching view on ROI is a prerequisite for the transformation.

A HOLISTIC TRANSFORMATION

To overcome these challenges, industrial companies must put together a comprehensive roadmap, defining their strategic intent and operational solutions and guiding investment towards areas that will have the greatest impact.

Based on this roadmap, investment in technologies and equipment must be prioritized, to upgrade old equipment and digitize complete production lines. Target organization and governance must be redesigned to ensure monitoring and consistency of the transformation. HR must evolve to integrate skilled workers and support the legacy workforce. Finally, operational and purchasing teams must set up the ecosystem of partners and startups that will support fast development of skills and testing of key technologies.

ROADMAP TO THE FUTURE

The Factory of the Future has arrived, driven by fast-evolving digital technologies. Companies cannot afford to underestimate the urgency to get moving on this process, as it could take a decade or more to make the full transition. The changes brought about by the FoF will be all-encompassing, involving every aspect of business, from production and processes, to governance.

Industrial directors must develop a comprehensive roadmap for traversing the journey that lies ahead, streamlining and focusing on the ramping up of skills, technology and investment, organization and governance, IT and cyber, and building an innovation ecosystem. Building and deploying this multidimensional roadmap is critical to competing in cost, client satisfaction, and attracting talent.

The Oliver Wyman/L'Usine Nouvelle Survey

This article is based on the Oliver Wyman and L'Usine Nouvelle online survey conducted between August and September 2017, with industrial firms.

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DECIPHERING THE CODE

HOW TO GET DIGITAL SALES RIGHT IN MANUFACTURING INDUSTRIES

Wolfgang Krenz, Juergen Reiner, and Wolfgang Weger

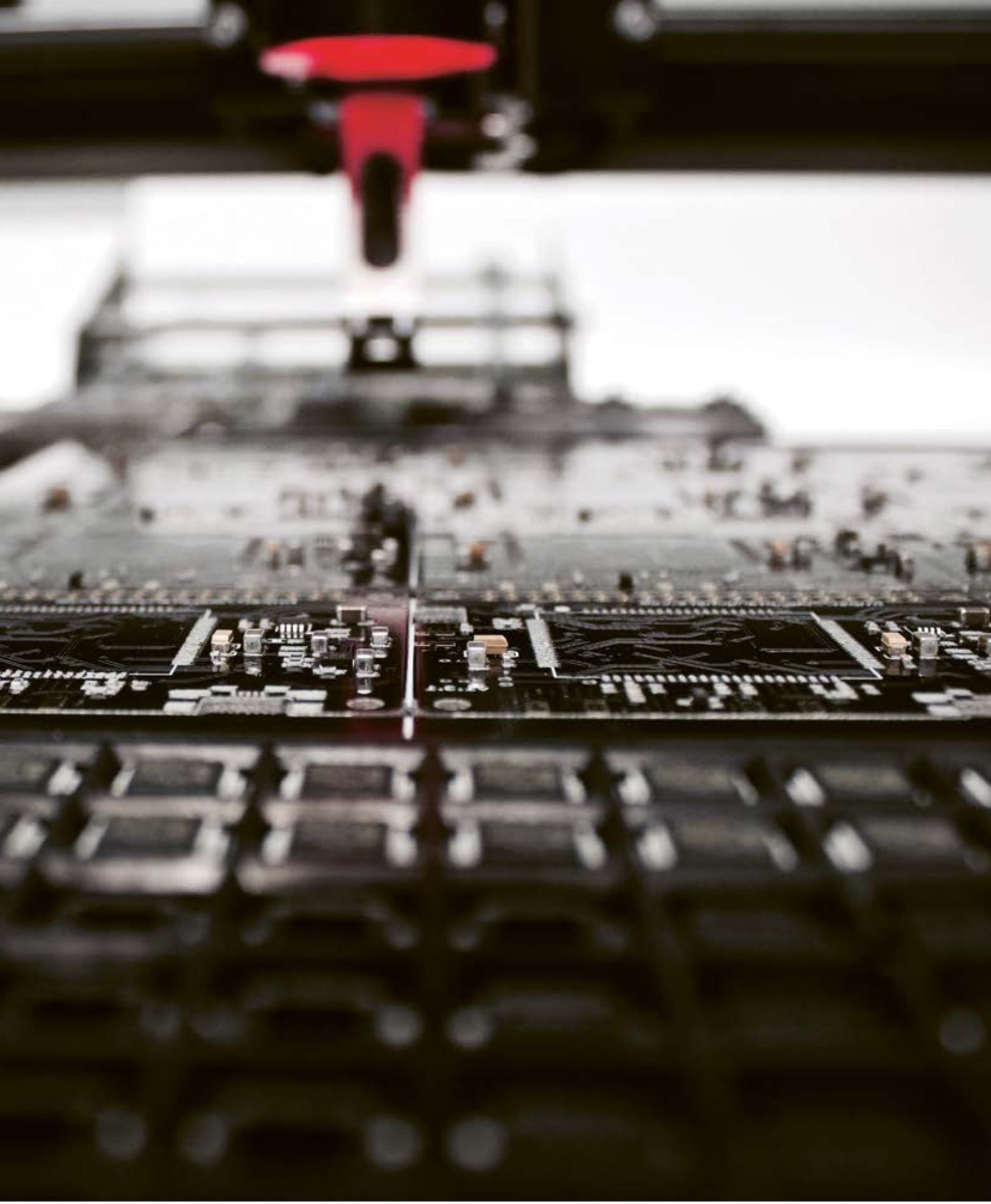
Manufacturers of industrial products have been slow to embrace the opportunities presented by the digitizing of their sales function. Misperceptions, as well as real challenges, are holding them back. But with the right focus and mindset, progress can be made quickly, and the benefits can be substantial. Here we lay out how.

Industries such as consumer devices, financial institutions, and even automotive have rapidly developed online offerings and digital sales channels. Products as diverse as laptops, insurance policies, and cars can today be configured to customers' needs and purchased online.

Manufacturers, however, have been hesitant to these changes, arguing that their complex products are simply not suitable to being "sold online." They are concerned with the risks, preferring to wet their toes slowly with minor digital projects. However, as we have witnessed in our work with pioneering manufacturers, many of the impediments to swift progress can be overcome. This makes speed even more crucial, as companies at the forefront will unlock significant value. Three principles should be kept in mind.

CUSTOMER EXPERIENCE AND CUSTOMER JOURNEY AT THE CENTER

From introducing the product portfolio to customizing the offer, seasoned sales staff are convinced that clients value and demand "face-to-face" communication throughout the purchasing process, especially when complex products and systems require customization and calculation. This impression is indeed confirmed by customers, who look for direction as to what products are best suited to their needs.



Facing limited alternatives, customers have little choice but to approach sales agents.

Recent studies, however, indicate that customers are changing: so too will their buying behavior. It is not necessarily the personal interaction that B2B customers seek, but rather the most effective form of communication. Thus, manufacturing companies need to rethink today's customer journey – the way a customer is guided through his online and offline interactions with a manufacturer. (See Exhibit 1.) Customer hassles ought to be addressed in a different, more efficient manner.

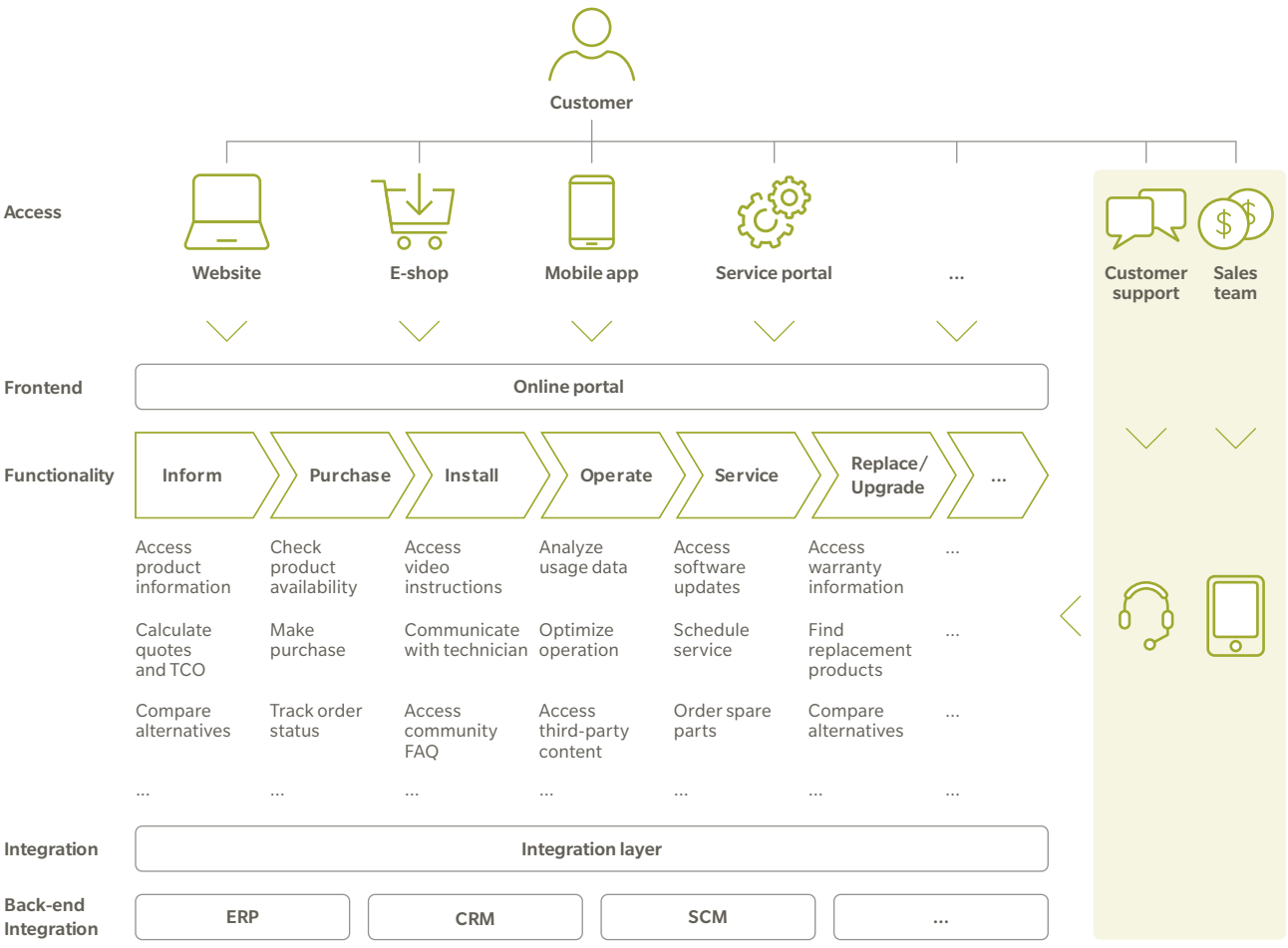
The aim is to offer the customer relevant choices and guidance at the right moments, fulfilling the desire for self-empowerment and speed while directing things ultimately towards purchase. Going further than B2C, the B2B customer journey must address the needs of multiple customer stakeholders: while the technical team may be interested in detailed specs, more commercially oriented members of the buying center will require easy access to a standardized set of relevant figures.

The future will be multichannel, combining the agility of personal interaction with the effectiveness of self-help online configuration and online tools. Customer enablement is key. We have seen this in many manufacturing industries already – from complex car configurations that are long-established to optoelectronics, specific custom semiconductor products, or embedded system controllers.

SALES FORCE SUPPORT, NOT REPLACEMENT

Many companies believe that only in the distant future will computers replace their human sales staff. But this should

Exhibit 1: Customer Journey – B2B customer enablement via sales portal



Source: Oliver Wyman analysis

not even be the intent. Instead, companies should focus on the digital enablement of the sales force: partial automation and additional intelligence can be a key to unlocking a more efficient, customer-centric sales process. The aim should be the co-existence of human labor and technology, the latter delivering key information to sales staff for better informed decisions.

Consider the example of a large chemical distributor. Facing accelerated commodity price fluctuation and near-term performance targets, the company needed to increase its sales effectiveness. Historically, the firm had used a disparate set of tools and generally did not have a systematic margin management process in place. The company embedded an integrated analytics-based system that identifies and details sales opportunities based on a range of parameters, including price elasticity, churn, rebates and campaigns, supplier prices, and shipping costs; the system is used to consistently evaluate the "quality" of business and thus enable effective prioritization. To make this intelligence accessible to sales representatives, a suite of intuitive tools was developed in an iterative, "for the field, by the field" approach. The tools are used via tablet computer and support the front-line staff in pinpointing actionable opportunities. The value of the new tool was reflected in the adoption rate among sales staff, which reached 80 percent six weeks into deployment, compared to just 30 percent previously for a standard CRM solution – a truly "magnetic" tool. The annualized impact on margins 18 months into deployment was a 10 percent increase over base.

What can a manufacturing company learn from this chemical distributor? The lesson to be drawn is that data – aggregated in a user-friendly way – can produce a tremendous commercial impact. Leading players in manufacturing already apply some of these elements to increase success rates and push cross- and up-selling.

PRAGMATISM BEATS PERFECTIONISM

To get digital right from the start, some companies have begun from the ground up with a focus on fixing or advancing legacy systems first. The conviction is that the house must be put in order before more advanced technology can be deployed.

Reworking legacy systems, however, oftentimes makes for a slow and cumbersome process where the reworked solution yields only marginal impact. In fact, off-the-shelf and standardized CRM systems frequently fail in the context of manufactured B2B goods, where a comparably small number of customers maintains highly specific requirements. By starting with the use case in mind, simple and pragmatic tools can provide significant and rapid improvement.

10%

PROFIT INCREASE 18 MONTHS INTO DEPLOYMENT OF A "MAGNETIC" TOOL

Even when it comes to digitally enhanced solutions, it is often preferable to set them up specifically tailored to the requirements at hand and separate from legacy systems. The new solution might build on existing data but bypass outdated interfaces. Alternatively, middleware can be deployed to connect the two, acting also as a filter and validation layer towards the legacy system. Interfaces built into existing systems should be pragmatic and developed only as required. In any case, the development of digital solutions should be driven by the eventual use case, not by an effort to "modernize" all systems currently in use.

The opportunity for manufacturing companies to use digital sales approaches to cater to evolving customer needs and increase efficiency and effectiveness in the sales process is real. Leading companies demonstrate that smart use of data applied in a pragmatic, use-case oriented mindset produces results fast. For manufacturers, the time to embrace the change is now.

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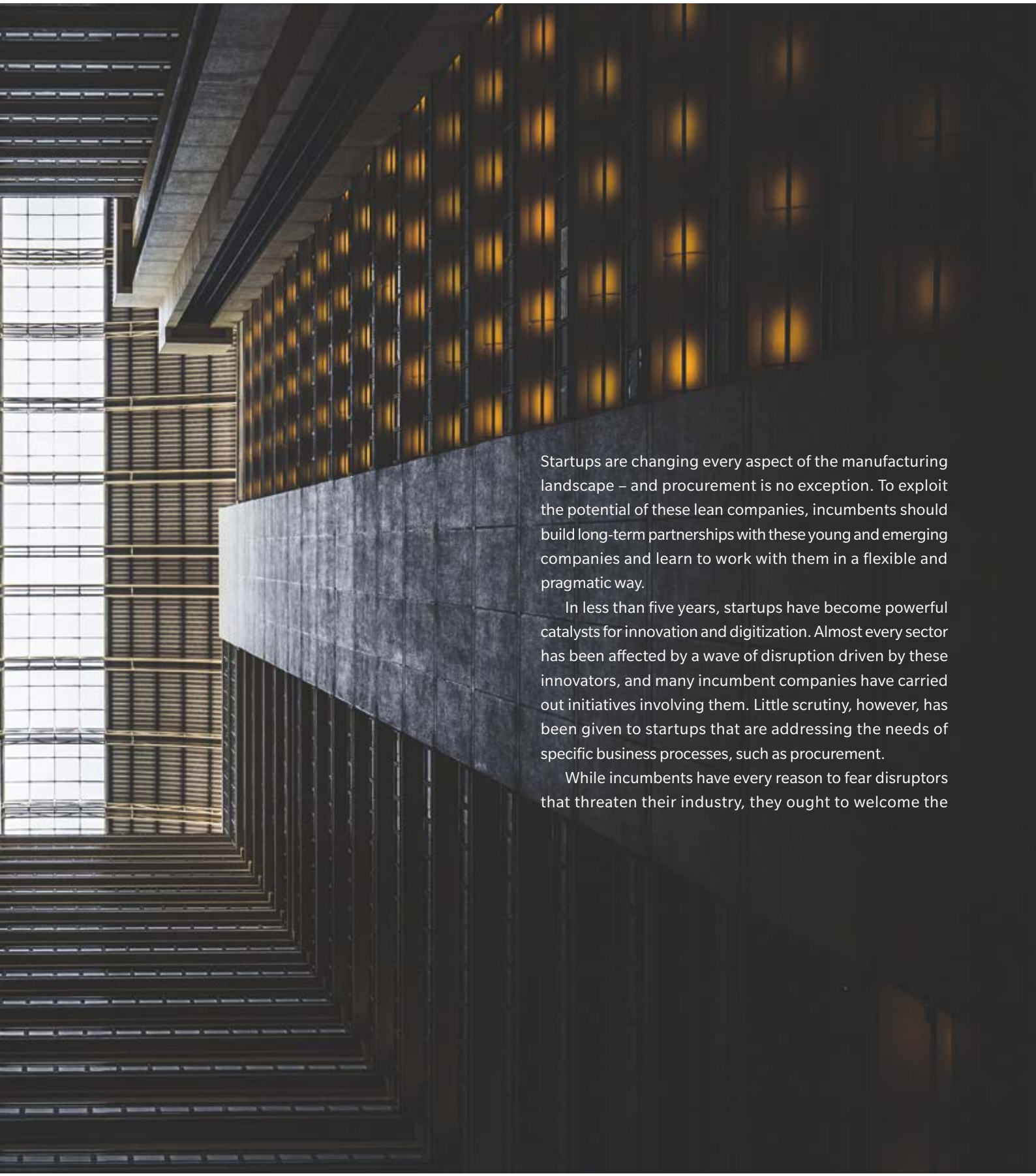
BY FUNCTION: NEW SOURCES OF VALUE

INNOVATIVE STARTUPS ARE SHAPING THE FUTURE OF PROCUREMENT

HOW MANUFACTURING INDUSTRIES CAN PROFIT FROM STARTUPS

Xavier Nougues and Stephane Rousselle



Startups are changing every aspect of the manufacturing landscape – and procurement is no exception. To exploit the potential of these lean companies, incumbents should build long-term partnerships with these young and emerging companies and learn to work with them in a flexible and pragmatic way.

In less than five years, startups have become powerful catalysts for innovation and digitization. Almost every sector has been affected by a wave of disruption driven by these innovators, and many incumbent companies have carried out initiatives involving them. Little scrutiny, however, has been given to startups that are addressing the needs of specific business processes, such as procurement.

While incumbents have every reason to fear disruptors that threaten their industry, they ought to welcome the

increase in the number of procurement startups as an opportunity for value creation. The primary responsibilities of procurement leaders within incumbent companies are to identify the most promising solutions to key operational challenges and improve the procurement function. In this way, they add value to the company beyond traditional cost savings, while reinforcing their role as business partners.

PROCUREMENT STARTUPS: A RECENT BOOM IN FUNDING

Most of the disruptors (amounting to 356 startups, or US$1.9 billion of funding) offer procurement solutions, ranging from firms dealing with the complete source-to-pay process, to those focusing only on specific steps of the procurement value chain, such as supplier scouting, tender management, or payment. (See Exhibit 1.) Consolidation within this cluster of procurement startups is already underway via incumbents such as SAP Ariba and Ivalua or through younger companies such as Coupa or Tradeshift. Meanwhile, innovators formed in the past few years have intensified competition by improving the user experience and enhancing the collaboration capabilities of their offerings. Other newly founded ventures have opted to focus on very specific customer groups, such as small and medium-size enterprises (SMEs) or particular industries.

Several of these new companies seek to solve procurement issues common among large industrial manufacturers. Some provide an integrated platform for strategic sourcing, facilitating RFx through intuitive and seamless experience. Innovative newcomers such as Haizol or Syncfab, in the B2B market place segment, provide on-demand manufacturing of industrials parts, while others in the advanced analytics cluster, such as Elementum or Celonis, provide manufacturers with real-time view and analysis of their supply chain processes.

ADVANCED PROCUREMENT ANALYTICS: THE NEW FRONTIER

The most recent companies offer innovative solutions involving machine learning, big data or blockchain technologies. A dozen new firms, located in Europe, the US, and Asia, are building artificial intelligence (AI) platforms that can automate the cleansing and classification of structured and unstructured procurement data from multiple sources and many formats. They provide clients with a comprehensive and consolidated view of their total procurement expenditure, together with its evolution in real time.

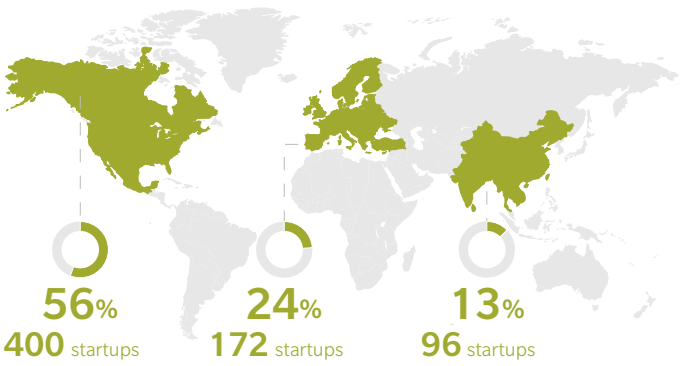
Apart from drastically reducing the time and burden involved in building the databases, these AI platforms offer procurement teams a clear view of both expenditure per category and supplier performance, with the level of granularity adapted to the needs of the particular procurement function. By applying advanced analytics and visualization techniques to such comprehensive data

Exhibit 1: Procurement startups landscape by cluster and region

FUNDING AND NUMBER OF STARTUPS
2001 TO 2017

Clusters	Total funding	Number
Procurement solutions	$1,868 MM	356
B2B marketplace	$692 MM	173
Digital procurement	$359 MM	61
Service providers	$44 MM	125
Σ	**$2,963 MM**	**715**

NUMBER OF STARTUPS FOUNDED BY REGION
2001 TO 2017



Source: Crunchbase, Capital IQ, Quid, Oliver Wyman analysis

sets, they allow procurement leaders to identify cost-saving opportunities through predictive models or to detect anomalies and risks in their supplier base.

When looking for innovative solutions, procurement leaders should not limit their search to new ventures with a primary focus on procurement. We have identified many outfits offering advanced analytics solutions with a scope broader than just procurement. In some cases, their founders did not have any procurement focus at all when they launched their business. As their companies developed, they discovered that their machine learning-based solutions would have a tremendous impact on the procurement function.

BUILDING WINNING PARTNERSHIPS

Given the multitude of new firms and the variety of solutions and technologies offered, procurement leaders can tap into a pool of opportunities for innovation and performance improvement. But to exploit the full potential of collaboration, chief procurement officers (CPOs) must ensure that they are building a successful long-term partnership. Identifying and selecting the startups to work with – based on their innovation potential and whether their solutions are both significant and robust – is just the first and probably the easiest part of the journey.

Successful collaboration depends on being able to work closely with selected companies in a flexible and pragmatic way. Startups and incumbents must cooperate together, focusing on one step after another: co-creation; fast prototyping or customization of the solution; test and learn with users to validate and adjust the end product and rapid scaling.

Leading procurement organizations have already acquired significant experience in implementing successful proof-of-concept initiatives, and have transformed these experiments into full-scale solutions. Some rely on dedicated units or procurement innovation labs, while others set specific objectives to ensure that they regularly test new ideas and solutions and incorporate innovations into business as usual.

It is important that CPOs also understand how startups differ from the more established companies they have grown accustomed to working with, and adapt processes to avoid administrative and structural barriers that diminish the potential for value creation. Given that the new companies are relatively small and have few resources, there are certain key success factors for those corporates wanting to engineer a successful collaboration: lean processes, a rapid decision-making procedure, direct access to decision makers, and sufficient corporate support to allow the scaling up of the solution.

STARTUPS HAVE BECOME POWERFUL CATALYSTS FOR INNOVATION AND DIGITIZATION IN LESS THAN

5 years

In the course of our study, one CPO of a worldwide technology company summarized the change that needs to take place. "Buyers must understand that they cannot work in the same way as they have in the past," he told us. "Leading corporations now focus their attention on digital leadership and prototyping as a way of instilling a startup culture within their organization. Procurement leaders must therefore constantly try out new ideas over a very short space of time, then accept any failures, and learn from them."

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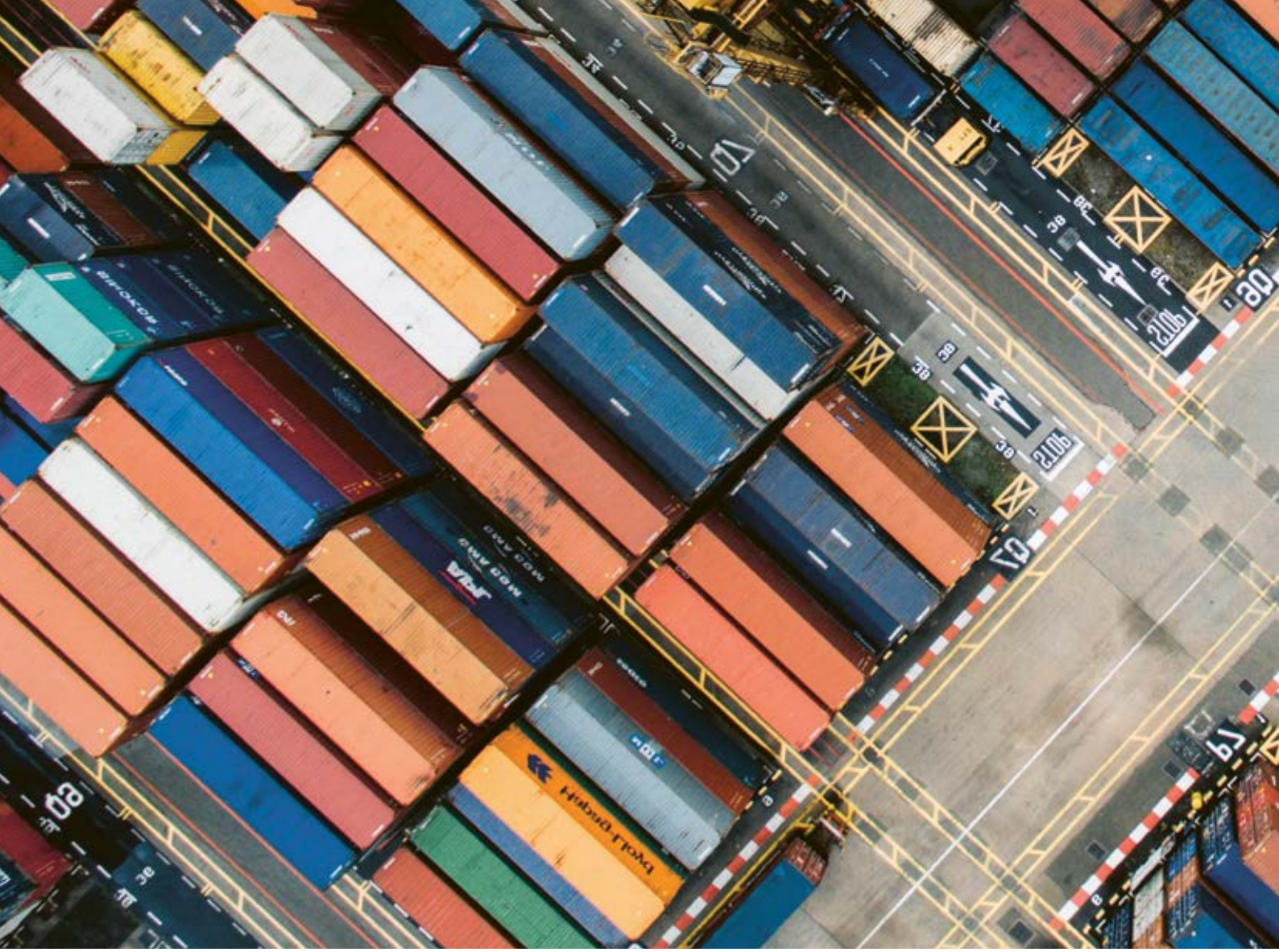


BY FUNCTION: NEW SOURCES OF VALUE

SUPPLY CHAIN TRANSFORMATION FOR INDUSTRIALS

LEVERAGING COST AND CAPABILITY ADVANTAGES OF CONTRACT MANUFACTURERS

Andrew Chien and Hendrik Becker

As contract manufacturers enter new areas of the industrial value chain as original design manufacturers (ODMs), established industrials fear that they will eventually be displaced by the ODMs. It is time for industrial leaders to look at the supply chain more holistically: they need to determine the core value proposition to their customers, select the right strategic ODM partner and business model, and overcome the internal resistance to change. This will allow them to convert a big threat into an even bigger opportunity.

Towards the end of the 20th century, most Western industrials were vertically integrated. As low-cost countries in Asia and Latin America opened their markets, and shipping costs dropped, companies started outsourcing parts of their manufacturing operations to overseas suppliers and contract manufacturers. But in recent years, industrials have largely exhausted this cost saving lever: Shifting production from one supplier or contract manufacturer to another may keep costs under control, but the savings yielded are only incremental.

On the other side, suppliers and contract manufacturers have continuously improved their cost structures through economies of scale and productivity gains. Contract manufacturers in particular have built more advanced capabilities and product know-how: Companies that started off as a "simple" manufacturing site in a low-cost country have now emerged as original design manufacturers, capturing larger parts of the value chain. They offer a range of services from product design, engineering services, and mass production, to end-customer shipping. By 2025, the

>US$700 BN

SIZE OF CONTRACT MANUFACTURING MARKET EXPECTED BY 2025

overall contract manufacturing market is expected to grow to more than US$700 billion.

Traditionally, ODMs have focused on consumer electronics such as computers and communication devices. But recent trends – such as the Internet of Things, big data, and artificial intelligence – have opened opportunities to partner with or even compete with traditional industrials in the automotive, aerospace, energy, and packaging sectors. Foxconn, the world's largest contract manufacturer and ODM, has significantly increased its R&D investment into these sectors, and created a new business division for industrial clients. Magna Steyr, an Austrian automotive contract manufacturer, is providing engineering services for systems and modules, but is also licensed to produce complete vehicles for BMW, Daimler, and Jaguar Land Rover.

Many industrial leaders perceive this development as an imminent threat and struggle to find the right response. To meet the challenge, they will need to transform their operations by determining the core value proposition to their customers, selecting the right blended model of existing contract manufacturing and more advanced ODMs, and finding the right strategic partner in parallel with the organizational change-management, activities to support the transformation.

KNOWING YOUR VALUE PROPOSITION

According to Gartner, 16 percent of global server sales to hyperscale data centers in 2018 will come from ODMs and will be directly supplied to end customers. Lower cost, an innovative and efficient design, along with options for product customization, are the main reasons for customers to choose the ODM over the original equipment manufacturer (OEM) product.

This example from the computer industry illustrates the threat to OEMs. It also showcases where OEMs need to increase their efforts: understanding their customers' true needs and requirements. For OEMs and industrials alike, recognizing the value proposition to customers, and closely preserving their relationships, is key. In many cases, they either overestimate the strength of their distribution relationships and brand equity, or underweight the attention that they should be dedicating to maintaining their advantage.

Another frequent concern of industrial leaders is the potential loss of intellectual property to the ODM. The fact is that the capabilities of ODMs have increased substantially over the past years: patents filed in China outnumber those filed in the United States and in Europe, according to the World Intellectual Property Organization. Foxconn filed 5,060 patent families from 2011-2014. In comparison, Google filed 5,333 patent families during the same timeframe.

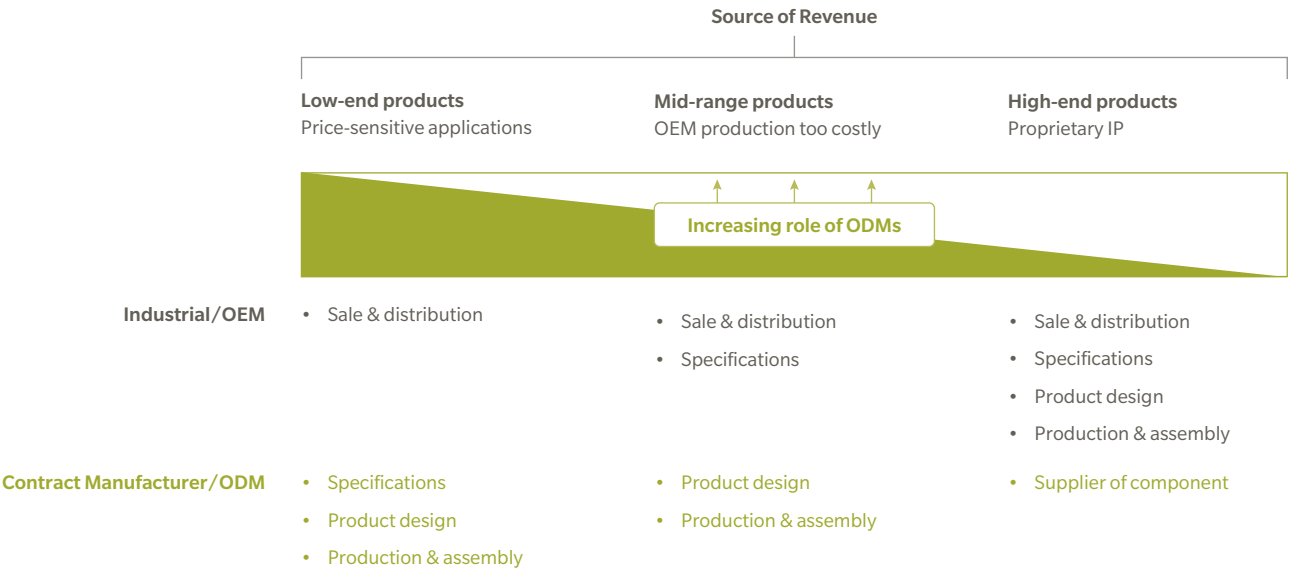
To create outstanding products, the OEM should focus on the customers' requirements, the key differentiating product elements to best meet these requirements, and the resulting service offering (including product distribution and end-customer service). The ODM should address the best designs for the non-differentiating elements and the most cost-effective manufacturing. Successful industrials increasingly use a blended operational model: ODMs design and manufacture product line extensions, particularly those midrange products needed to complete the product portfolio, while the OEM retains design for the heart of the high-end product line with contract manufacturers delivering components in their traditional role. (See Exhibit 1.) To get there, leaders will need to transform their supply chains and focus on choosing the right strategic partner.

FINDING THE RIGHT PARTNER

As industrials look for an ODM partner, it is essential to sell the supply chain transformation as a genuine opportunity and to offer scale by moving large chunks of spend. However, the latter can be very challenging, as it often means obtaining price quotes on thousands of complex components. Successful transformation projects have leveraged representative subsets of products and components that allowed for extrapolation to the whole business. This method helped in obtaining initial quotes, in order to shortlist two to three potential partners and to focus on enhancing their value proposition.

Additional selection criteria are important for a sound partnership: ODMs offer engineering services, continuous material cost reductions, distribution services, and more. ODMs are also oftentimes much larger than their industrial

Exhibit 1: Increasingly, industrials are seeing their revenue derived from not only traditional in-sourced operations but from contract manufacturing sources



Source: Oliver Wyman analysis

clients. This will mean treating them as a strategic partner, rather than the usual supplier. Industrial leaders need to ensure their organizations are ready for this.

OVERCOMING INTERNAL RESISTANCE TO CHANGE

Industrials are usually mature organizations that have grown over decades. Leaders face significant internal resistance when steering into the new direction, particularly when it involves a different operating model. Pushback stems from strong legacy relationships with suppliers developed over many years. A general fear of new ways of doing business is yet another concern to many employees.

In transforming the supply chain, it will be essential to select a "neutral" project management team that can entirely focus on the transformation and is not wedded to the status quo. A transparent process limits speculation and hearsay.

To gain organizational buy-in, risk management workshops have proven useful, as they provide a forum to identify and manage legitimate concerns. They also provide a structured method to allow stakeholders to express concerns and air frustrations. Systematically engaging stakeholders to be part of the solution and developing plans to logically address their concerns helps the project management team identify and address issues. And it allows stakeholders to vent their more emotional concerns before moving forward. The opportunity to simply be heard often diffuses some of the resistance to change.

At the end, if the process is done right, the industrial will be very well positioned to succeed in this new market environment. Rather than hiding from a threat that will happen one way or another, industrials need to act and move forward now. This will allow them to turn a threat into an opportunity.

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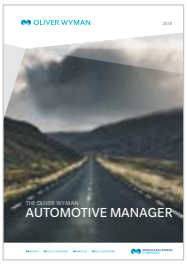

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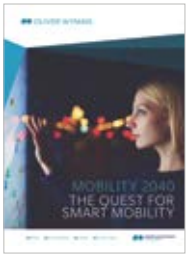

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Oliver Wyman surveyed 7,500 people worldwide to uncover how interested travelers are in smart mobility offerings, how these services might impact their travel choices, and who they trust to develop smart mobility options.

REPORTING CLIMATE RESILIENCE: THE CHALLENGES AHEAD

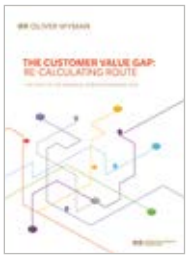
Developed by MMC Global Risk Center and CDP, the report aims to help organizations disclose information on climate-related risks and opportunities in a consistent, comparable and reliable way.

RESTRUCTURING STUDY 2018: IS EUROPE READY FOR THE NEXT CRISIS?

The current economic climate in Europe is very positive. However, some recent trends carry the potential to cause a downturn, and experience shows that major crises often come unexpectedly.

RETAIL'S REVOLUTION

We interviewed thousands of consumers and 50+ retail industry executives to make sense of the unprecedented change being experienced and present six new business models that will help organizations navigate the future.



STATE OF THE FINANCIAL SERVICES INDUSTRY 2018

Traditional financial firms will need to accelerate customer value creation or risk conceding an increasing share of customer attention and wallet to other firms, primarily to "big tech."

THE NEW CIO IMPERATIVE

Transform the organization – not just the technology.

THE OLIVER WYMAN ENERGY JOURNAL VOL.3

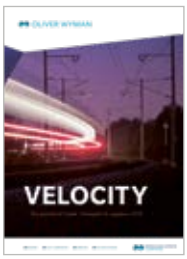
Oliver Wyman's latest thinking from across our global energy practice on the current and emerging opportunities and risks facing the industry.

THE OLIVER WYMAN RETAIL & CONSUMER JOURNAL VOL.6

Our latest perspectives on the retail and consumer goods industry.

THE OLIVER WYMAN RISK JOURNAL VOL.7

A collection of perspectives on the complex risks that are determining many companies' futures.



VELOCITY 2018

Our latest perspectives on emerging digital, technological, and business model innovations influencing travel, transport, and logistics.

WORKFORCE FOR THE FUTURE

Oliver Wyman and Mercer join forces to help organizations prepare their workforces for the digital era.

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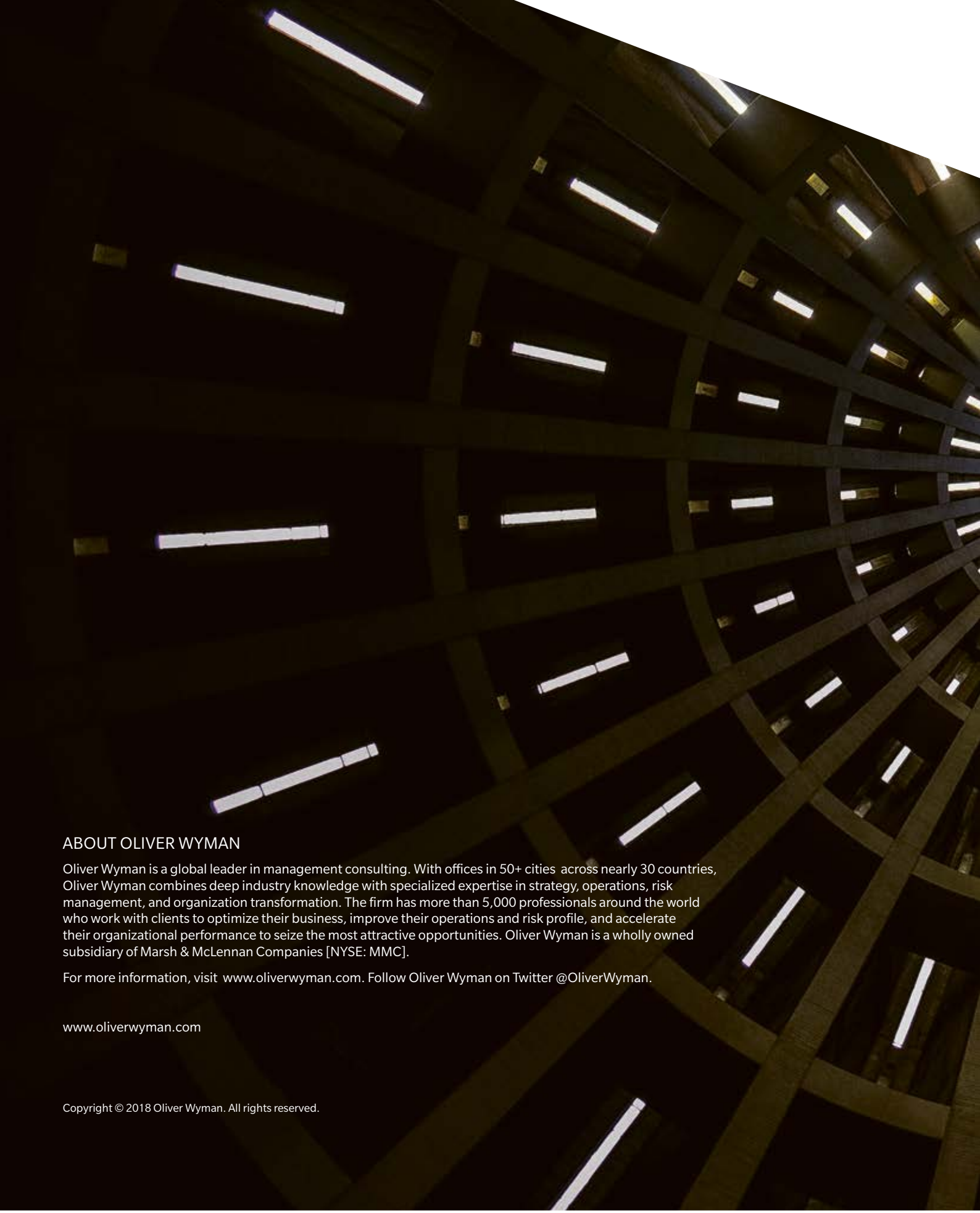

ABOUT OLIVER WYMAN

Oliver Wyman is a global leader in management consulting. With offices in 50+ cities across nearly 30 countries, Oliver Wyman combines deep industry knowledge with specialized expertise in strategy, operations, risk management, and organization transformation. The firm has more than 5,000 professionals around the world who work with clients to optimize their business, improve their operations and risk profile, and accelerate their organizational performance to seize the most attractive opportunities. Oliver Wyman is a wholly owned subsidiary of Marsh & McLennan Companies [NYSE: MMC].

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