

DIGITAL INDUSTRY

THE TRUE VALUE OF INDUSTRY 4.0



PREFACE

An overwhelming amount of words has been written about digitalization, the Internet of Things and Big Data. But most of it concerns the way digital technology will transform products and business models in the consumer space. This business-to-consumer (B2C) perspective is of little relevance to industrial firms and their senior executives. The applications of digital technology in “engineered products” industries will be quite unlike those in the consumer space, but no less transformative.

This Oliver Wyman report aims to give industrial clients a perspective on the true value of “Industry 4.0” in their industrial businesses – in large part by providing concrete examples of digital industry, both those that are emerging and those that are likely to arise. As we hope this report makes clear, digital transformation promises gains comparable to those created by the introduction of mass production at the beginning of the 20th century.

SECTION ONE

INTRODUCTION

The next generation of production technology is starting to be rolled out: Big Data analytics, virtual environments, simulation software, broad connectivity, collaborative robots, machine-to-machine communication and new manufacturing techniques such as 3D printing. These technological innovations will surely create substantial value for the companies supplying them, just as conveyor belts did during the second industrial revolution.

But the true value of digital industry will come from what this technology enables at original equipment manufacturers (OEMs) and operators of this equipment. By providing real-time information about customer demand, production capacity, operational performance and product quality, among other things, it will allow “clock speed”¹ algorithm-based decision making that will dramatically improve process efficiency in everything from pricing to production planning to supply-chain management to R&D. And it will provide OEMs with the foundations for entirely new value propositions to offer their business-to-business (B2B) customers.

This pattern is not new. In the three prior modern industrial revolutions, novel technology triggered a fundamental change in the way industrial companies operated (See Exhibit 1.), and this is where the real value was created. For example, the introduction of programmable logic controllers (PLCs) and ERP systems in the third industrial revolution of the 1970s boosted the growth of technology suppliers. But the major

economic value has been created through the resulting ability of OEMs and industrial goods operators to introduce LEAN and re-engineer their processes.

Understanding the value of the fourth industrial revolution requires more than identifying the technological step-changes. It requires that we be able to predict the way these technological changes will transform value creation, processes and business models. In this report, we restrict our attention to OEMs in automotive, rail, aerospace and machinery, the major categories of engineered products. We explain with concrete examples how digital technology can unlock value right along the value chain.

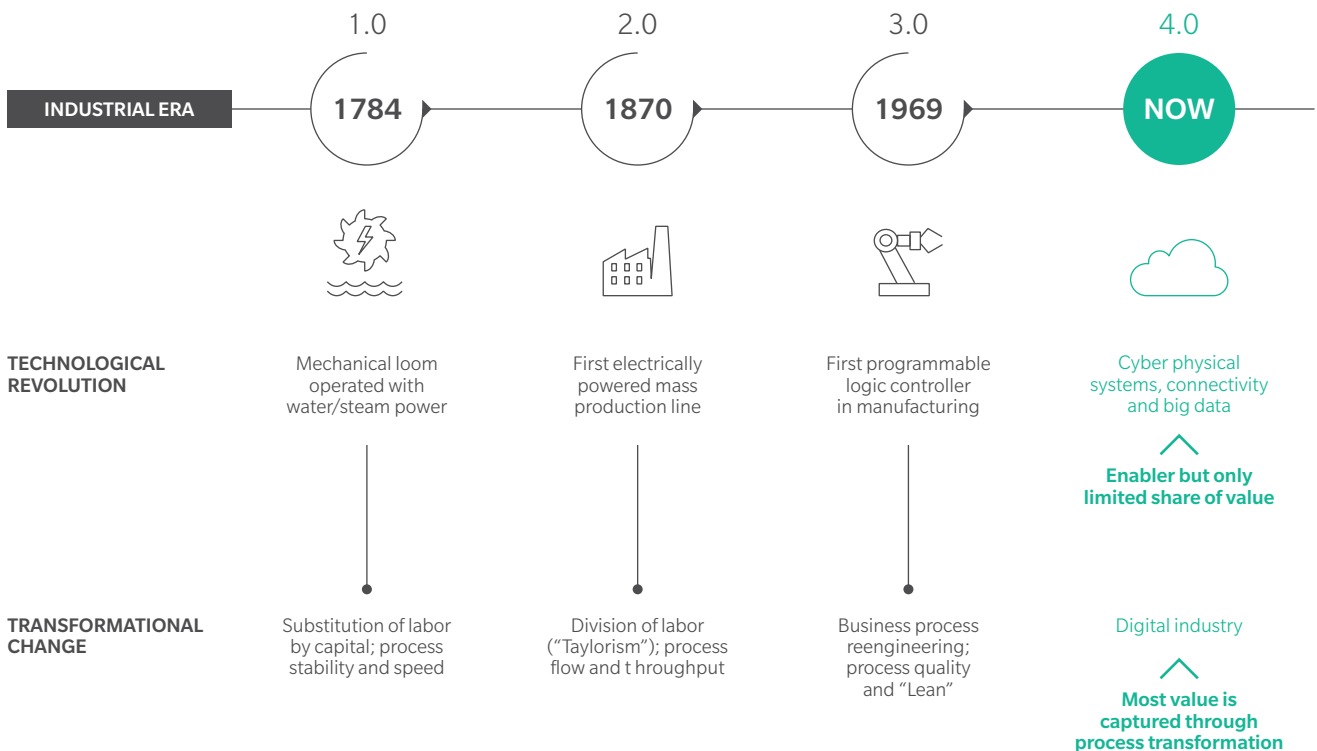
We begin by estimating the potential value creation from digital industry, broken out by its most important sources. Then, in Section 3, we examine the “internal levers” in greater detail, providing examples of ways in which digital technology is already being used to improve decision making and process efficiency, and

¹ See Oliver Wyman's 2015 report, *A New Paradigm for Competition: Clock Speed*. Digital technology can reduce decision-making from hours, days or weeks to seconds: hence “clock speed”.

ways in which it soon will. In Section 4, we look at ways engineered-products companies might participate in creating value for their customers through new business models or value propositions enabled by digital technology.

We end by identifying the organizational changes and improved capabilities in analytics, technology and innovation that will be required for the digital transformation of industrial firms.

Exhibit 1: Technological Change and Industry Transformation



Source: DFKI (German Research Centre for Artificial Intelligence), Oliver Wyman

SECTION TWO

THE VALUE OF DIGITAL INDUSTRY

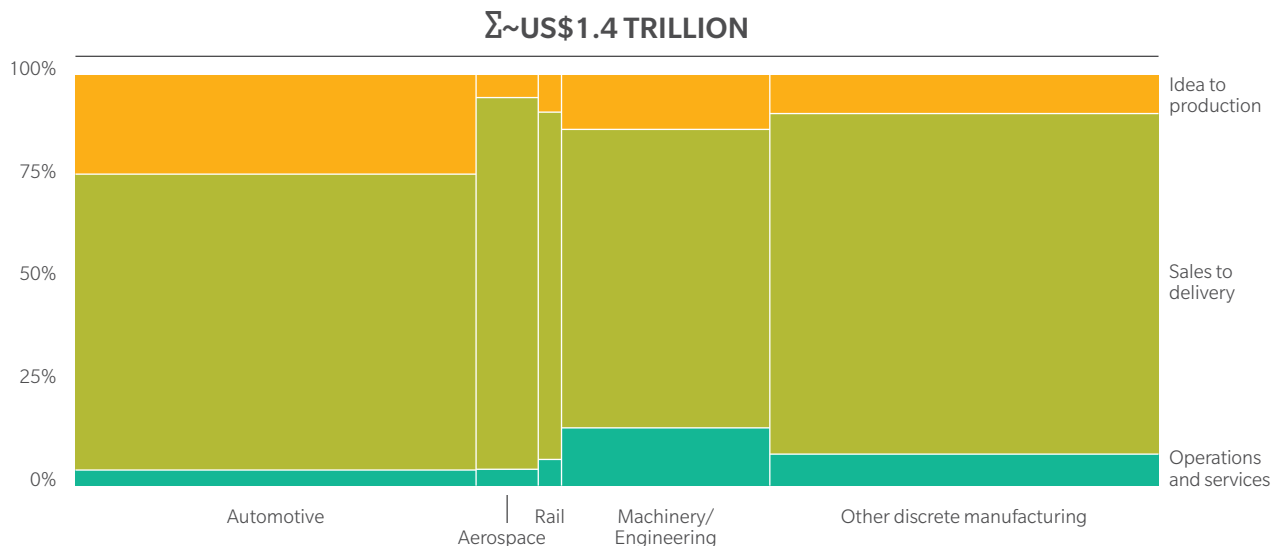
Oliver Wyman estimates that by 2030 digital industry will increase annual margin potential by more than US\$1.4 trillion. (See Exhibit 2.) The largest absolute gains will be in automotive, the largest sector, followed by machinery, aerospace and rail. However, at 5 percent, we expect the relative percentage gains to be smallest in the cost-mature automotive industry. Rail and aerospace are likely to see margins improve by between 10 percent and 15 percent.

Contrary to the common view, we expect most of the value of digital to be realized outside of production. It will be realized in processes such as R&D, product launch, pricing, planning, dispatching and purchasing. (See Exhibit 3.) As these “white collar” functions are increasingly

automated by algorithm-based decision making, many jobs now done by humans will become redundant. Speed, quality and consistency will improve while costs decline.

The expected gains listed in Exhibit 3 will not be evenly distributed across the various parts

Exhibit 2: Digital Industry Potential in 2030
Margin impact (distribution per industry)*



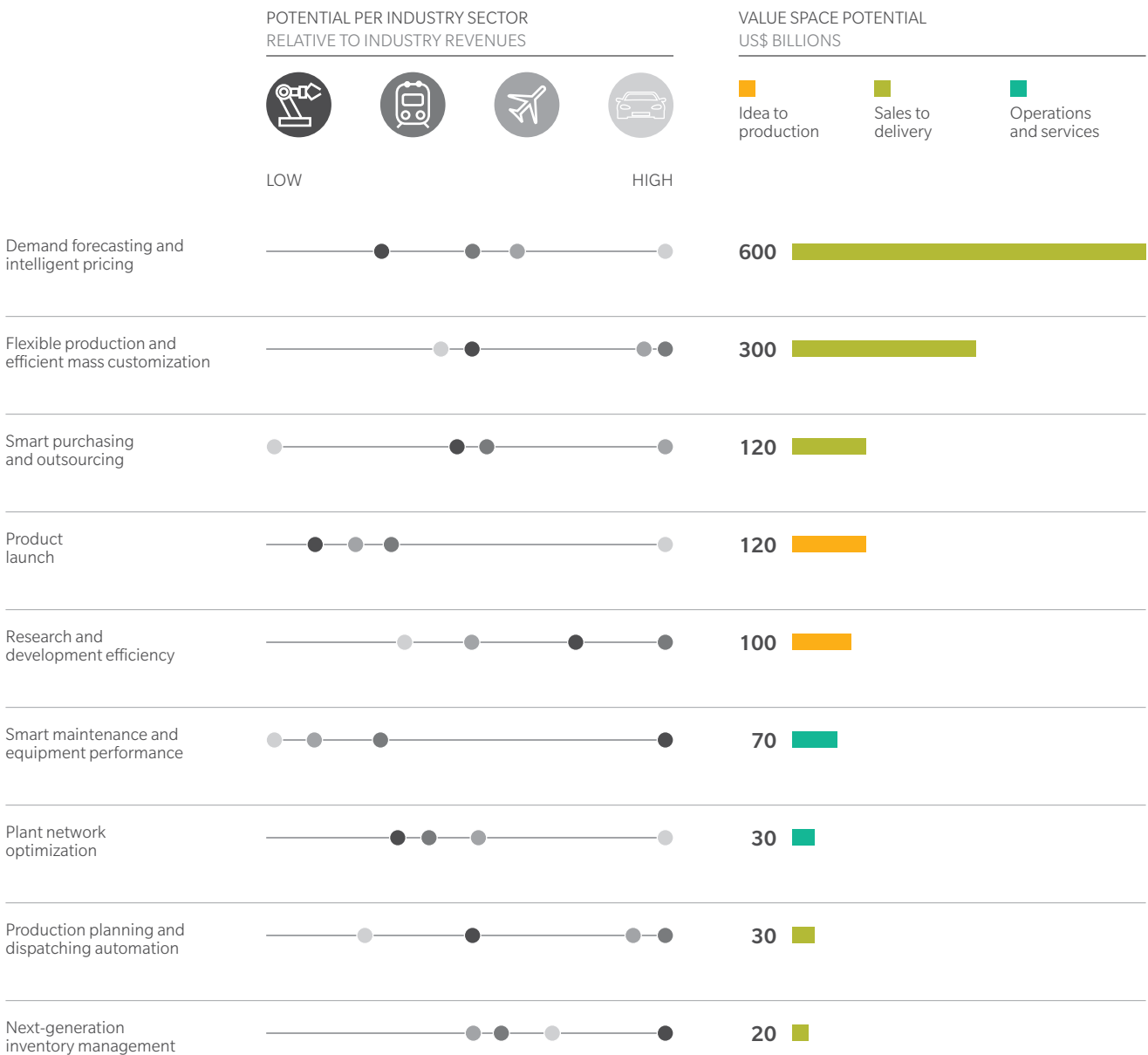
* Value spaces estimated on the basis of industry-specific cost structures and applied to approximated global value creation in 2030 (GDP growth assumed).
Sources: Oliver Wyman analysis, OECD, World Bank, United Nations

of the life-cycle value chain, such as suppliers, manufacturers and operators. Some will gain more than others and some will even end up worse off. Much of the benefit will ultimately accrue to final customers. But firms can maintain outsized profits so long as they keep ahead of the pack.

In the next section, we elaborate on the areas where firms will be competing to make the most

of digital industry (listed in Exhibit 3). More will be required of companies than simply improving internal processes. Successful firms will also help their clients to realize digital value, for example, by providing services that increase the efficiency of clients' production and maintenance activities. We describe such "external" sources of value developments in Section 4.

Exhibit 3: Gains from Digital Industry



Source: Oliver Wyman

SECTION THREE

INTERNAL SOURCES OF VALUE FROM DIGITAL INDUSTRY

DEMAND FORECASTING AND INTELLIGENT PRICING

Important business decisions – from sales planning to pricing to production planning – rely on demand forecasts. These have traditionally been derived primarily from estimates by sales managers, whose judgments are based on past sales volumes, market expectations and gut feeling. These estimates are imperfect and unresponsive to developments that are unobservable to sales managers.

Some companies have begun to improve on this approach by adding Big Data techniques. Drawing on data from a wide range of sources – such as dealers, sales agents and product “configurators” – centralized analytic algorithms predict future demand from various customer segments and geographies. We expect this approach to be extended, exploiting additional sources of data, some of which will be real-time information (or close to it). This data will feed algorithms that make better decisions about what products to make and when. And it will be used to alter prices rapidly in response to changes in demand and production capacity.

Real-time, algorithm-based demand forecasting will feed into many related processes, such as market research, sales planning, production planning and scheduling. Where these processes are local, as with sales planning, data is collected locally and analyzed centrally to provide guidance to local operations. Combined with improved revenues from better pricing, these savings make this the biggest source of value from digital industry: US\$600 billion by our

estimate. We expect efficiencies in production planning and dispatching automation to add another US\$30 billion of value potential.

(See Case Study 1.)

FLEXIBLE PRODUCTION AND MASS CUSTOMIZATION

The automation of production over recent decades has delivered great efficiency gains, especially in large series production settings like in the automotive industry. But it has probably reached a limit. Indeed, product complexity may even require some reduction in automation and a larger role for more flexible, well-educated and responsive humans. Digital technology will improve production efficiency not by automating it further but by providing data flows that facilitate a seamless collaboration between the humans and machines involved in the process.

More economically significant will be the flexible production and mass customization that digital technology allows, delivering some US\$300 billion of incremental value. These gains will come from the next level of data integration along CAD, Product Lifecycle Management (PLM) and Product Data Management (PDM) systems. In machine engineering, for example, small or individual lot sizes will be handled just like regular series production, based on 3D models, simulation, flexible systems and end-to-end data flows. The integrated reworking of non-quality parts within the regular production flow will be enabled by M2M-communication and embedded

Case Study 1: Demand Forecasting and Intelligent Pricing in the Automotive Industry

Seventy-five percent of global automotive production now follows a built-to-stock logic based on local dealers' judgment. The showcased cars rarely match the preferences of customers, who are reluctant to pay for options they do not require. As a consequence, built-to-stock cars have extended turnover times, dealers hesitate to order expensive options and cars have to be sold at discounts. Working capital, revenue and profit margins are eroded.

Now automotive OEMs have started systematically analyzing a variety of data to understand demand better. Dealer information, online configurations by customers,

current and past take rates and other customer interactions are used to determine the configurations built-to-stock cars should display. Although this approach is far from universal, average profit per vehicle may already have improved by several hundred dollars.

OEMs are likely to extend this approach, incorporating third-party research data, competitor information, dealer customer-relationship management (CRM) systems, discussions in online forums and social media. Automated analysis of this (often) real-time data will allow them to more accurately forecast which cars will be demanded through which

dealers. Options will be better tailored to consumers' preferences, and cars will be sold more quickly and with fewer discounts.

In parallel, OEMs will generate real-time insights into plant and production utilization. Greater allocation flexibility will allow "yield management" that optimizes utilization across plants. This data about plant utilization can also provide the "supply" data for a pricing model that accounts for short-term variation in demand and customers' price-sensitivity – estimated, for example, on the basis of social media-sourced data about customer's background, preferences and urgency.

Exhibit 4: Automated Demand Driven Ordering

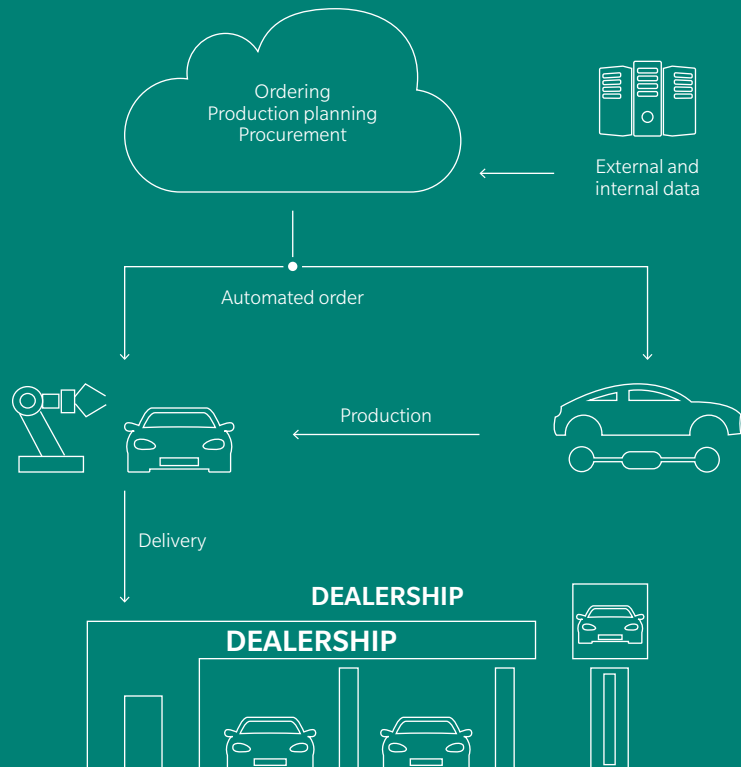
TO DATE

- Separate and manual orders
 - OEM retail network (incl. fleets)
 - Third party dealers
- Orders widely judgement-based
- No central validation/market intelligence check of individual orders
- Many departments and interfaces involved



DIGITAL INDUSTRY

- Automated ordering of the "right" car for the "right" dealer
- Fully centralized decision making based on internal and external data
- Less discounts (rev + ~3%), selling of more options (rev + ~3%), more efficient storage (cost - ~0.5%)
- Better and integrated ordering, production and supply chain planning
- Redundancy of manual planning and ordering steps and therefore of functions



product and machining information. Real-time simulation and feedback loops between the shop floor and engineering will help to avoid interruption in the production flow.

(See Case Study 2.)

SMART PURCHASING AND OUTSOURCING

Smart purchasing and outsourcing is the third largest source of value, adding US\$120 billion. Benefits will result from more transparent integration with suppliers, access to a wider range of suppliers and greater flexibility in make-or-buy decisions.

Standard sourcing arrangements today have several shortcomings. Materials and services are often sourced from local suppliers simply because relationships were established before alternatives were available. Product data, drawings, machining information and delivery schedules are often unavailable or are not consistently digitalized to inform a broad and competitive RFP process. And after a supply contract has been awarded,

standardized interfaces that enable a continuous exchange of data on product quality, milestone achievement, work in progress or effective delivery capacity are rarely established.

We expect the standardized exchange of fully digitalized product and production-related data with suppliers to overcome these shortcomings. It will reduce third-party risk, enable a wider initial competition and a more automated procurement. Based on frame contracts with third-party manufacturers, the make-or-buy decision will also become tactical rather than strategic. Real-time data exchange will allow capacity excesses and shortfalls to be traded between third-party manufacturers.

R&D EFFICIENCY AND PRODUCT LAUNCH

Improvements in R&D efficiency and product launch through digital technology will be US\$220 billion by 2030. Those gains will emerge from extensive simulation, data integration, big data pattern recognition and real-time feedback loops. In rail, for example, the development of product functionality is often “siloes” within its mechanical, electrical and software components. Paper-based drawings are still common, as is physical prototyping for new tools and products. Digital industry will make R&D more efficient, for example, through the structured analysis of train operating data and concurrent mechatronic engineering between manufacturers and suppliers using

More economically significant will be the flexible production and mass customization that digital technology allows, delivering some US\$300 billion of incremental value

Case Study 2: Flexible Production and Mass Customization in Machinery

A step change in mass customization and production efficiency can be observed in kitchen and furniture manufacturing. Production has traditionally been organized around standardized modules with customer specific elements added by hand. The process takes several weeks, is made expensive by the labor-intensity, and quality is notoriously poor, often failing to be right-first-time or delivered when promised. Digital industry solves these problems with a fully automated “lot size one” manufacturing process that uses a digital data model and integrated IT backend, a digital customer front (with 3D simulation) and integrated quality inspection and rework. The process time is cut from weeks to days, quality is greatly improved, the customer is provided with vast array of choices and cost is reduced significantly.

Case Study 3: Reduction of Launch Cost at Automotive OEMs through Integrated Quality Management

400 new cars are now launched each year, and the number is climbing. Yet the launch process remains largely an unautomated matter of craftsmanship. Complex products must be produced while facing the challenge of integrating hundreds of suppliers, new parts, new processes and new production methods within a short timeframe. Many last-minute changes and ad hoc decisions to fix quality issues, reorganize resources and de-bottleneck processes entail continuous firefighting. On average, each new premium car requires up to 20 hours of extra work related to quality, qualification and unplanned fixes. Digital industry could reduce these inefficiencies, saving up to US\$100 million per new car launch.

Digital industry can bridge the engineering-production interface with direct “online feedback loops,” preventing late changes and allowing for more planning certainty and less waste. For example, quality management and metrology can be integrated with the production process, fixing problems shortly after (or even before) they occur. This eliminates the need to take samples and limits delays between identifying and solving problems. A closer integration of engineering and production systems based on real-time data also speeds communication cycles in case of late changes. Showcasing the consequences of intended engineering modifications allows for better informed decision-making and more stable milestones (less “green light creep”).

Case Study 4: Performance Improvement through Digital Mock-ups in Plant Engineering

Malfunctioning software used to be a major cause of delays, on-site reworks and cost overruns at plant engineering companies. Software commissioning engineers had to be sent to the site to install, test and de-bug the software until the line was performing as expected. Today, a digital 3D mock-up of the plant or the line is developed upfront, including all internally and externally supplied modules. Software is then tested on the digital model, and commissioning is also simulated. Effective on-site commissioning can be completed faster, more reliably and at lower cost. Expensive software experts control commissioning remotely, while less qualified staff are deployed on site. The digital model of the commissioned plant also provides a basis for optimizing operations and maintenance through its lifecycle.

digital models. Less physical prototyping will be needed, replaced by digital modeling and virtual testing environments. (See [Case Study 3.](#))

IMPROVED PRODUCTION PERFORMANCE AND SMART MAINTENANCE

We expect improved production performance and smart maintenance to be worth about US\$70 billion. Production equipment and process performance can be optimized by fully digitalizing the offering and simulating production processes in real-time. When potential issues can be identified before they occur, uptime and output will increase, and scrap rates and reworks will be minimized. Real-time monitoring and improved analytics will allow machine operators to maintain equipment according to condition, avoid replacing parts too early or too late and manage stock levels according to actual needs. (See [Case Studies 4 and 5.](#))

PLANT NETWORK OPTIMIZATION

Individual plants typically have their own monitoring and control systems, and have different systems for each subsection or assembly line. Digital technology can now provide cross-sectional and cross-plant integration of control systems using the real-time exchange of performance

data. Decisions will be made from a cross-functional value chain perspective, optimizing the production network rather than individual machines, lines, functions or plants. This will include a more dynamic balancing of capacity and utilization in production networks. The efficiency gains from these developments will reduce costs by about US\$30 billion a year. (See [Case Study 6.](#))

NEXT-GENERATION INVENTORY AND QUALITY MANAGEMENT

Today, inventory and warehousing are often managed with incomplete data about the level and the timing of stocks along the supply chain. This means that to provide a buffer against unexpected shortages, stocks need to be kept at higher levels. In a digital world, firms will have real-time data about their inventory, more automated warehousing and better forecasting of bottlenecks. This will allow them to plan adjustments or place orders in a timely fashion. Costly short-term production rescheduling – for example, due to missing parts – will be minimized.

Stock management will also be improved by greater transparency regarding the hardware and software that have been built into products. Deviations between the “to be” bill of material (BoM) and the hardware and software that have actually been built into a product will be fully transparent (as they are today for safety-critical parts), allowing quality issues to be quickly traced and fixed. (See [Case Study 7.](#))

Case Study 5: Smart Maintenance through 3D Spare Parts Printing in Aerospace

Aircraft spare parts are prime candidates for 3D printing. Demand is hard to predict because the number of aircraft parts is enormous and spares are rarely needed. Yet when they are, they must be quickly available. This explains why 3.5 million spare parts are today on stock at locations around the world, and why several sites also have tooling and manufacturing capacities.

Because 3D printing can deliver parts “on demand” with very short lead times, it obviates the need to keep a stock of spare parts that are rarely needed, and expensive tooling equipment and labor can be replaced. Aircraft OEMs and component suppliers launched 3D printing for simple aircraft spare parts some years ago and are now expanding the range of parts covered, including even some complex engine components. New technologies, such as direct metal laser melting (DMLM), mean engine manufacturers have begun using 3D printing to mass produce parts, such as fuel nozzles.

Case Study 6: Plant Network Optimization

At a manufacturer of complex engine parts, the collection and flow of information about production and quality related data displayed the typical deficiencies: large delays between the occurrence of production issues and their identification by end-of-line testing. And the potential for a granular optimization of equipment uptime (OEE) was limited by fragmented data collection from work stations.

To address these problems, the firm added cyber-physical systems that feed real-time data into an advanced analytical model that creates a digital representation of the complex causal relationships within the manufacturing process. Using this model, early trigger points for quality and performance deviations can now be detected and controlled in near-time. The digital model also allowed OEE to be improved across the plant network of multiple manufacturing lines with only small changes to equipment and processes. The new model and associated analytical capabilities have become essential elements in the continuous improvement of manufacturing processes and product design, creating a data-driven interlock between the PLM/PDM, Quality Management System (QMS) and Manufacturing Execution System (MES) domain.

Case Study 7: Improved Quality Based on Machine-learning Algorithms

In components manufacturing today, quality inspection reveals much deviation from specified standards and, because it is done by humans, is slow and expensive. Different suppliers of similar parts often supply quality data that cannot be compared. Delays between quality inspections by the supplier and the provision of the information they produce disrupts component buyers’ production planning.

Digitalization allows quality inspection to be based on machine-learning algorithms that can identify early indicators of error, allowing them to predict rather than simply observe deviations from quality specifications. Standardized quality inspections across multiple suppliers of similar products allow the rapid optimization of production planning based on indicators early in the supply chain. Quality data can be integrated in the PDM system, trends being analyzed and engineering changes prompted. Human mistakes are eliminated; dependency on quality inspectors is reduced; tractability is enhanced; and a digital parts footprint becomes available along the entire value chain.

SECTION FOUR

NEW BUSINESS OPPORTUNITIES FROM DIGITAL SOLUTIONS

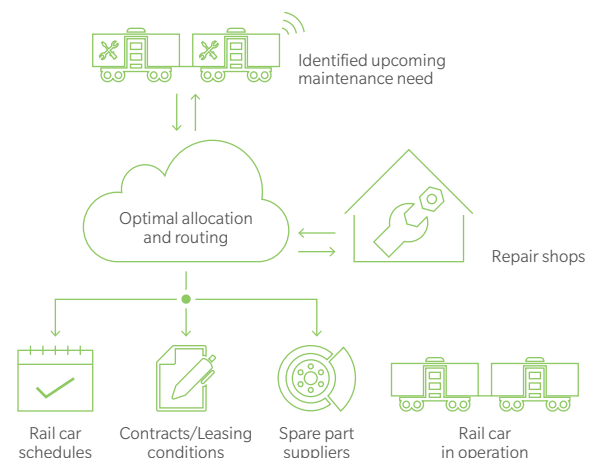
The applications of digital technology discussed above improve the efficiency of manufacturers' internal processes. But these are only part of the opportunity. OEMs can also boost growth by helping their B2B customers to reduce their costs (especially in production and maintenance) and improve their own customer offerings and value creation. The race to capture such opportunities has already started. In this section we describe some of these emerging digital OEM business models.

RAIL: ASSET LIFECYCLE OPTIMIZATION

A railcar and locomotive OEM is now offering a cloud-based software suite that improves asset management and operating efficiency for rail operators. It has four main components:

- A predictive maintenance tool based on sensors, data analytics and OEM domain knowledge that automates decisions on maintenance timing, integrating it into operations schedules and selecting repair shops and spare part suppliers
- Real-time information about train locations and speeds that optimizes network usage, especially in narrow corridors and yards
- Tools that help logistics providers automate operations, manage inventory and control transportation costs
- Optimized energy consumption based on a train's features and the route traveled, for example, by using automatic throttle control

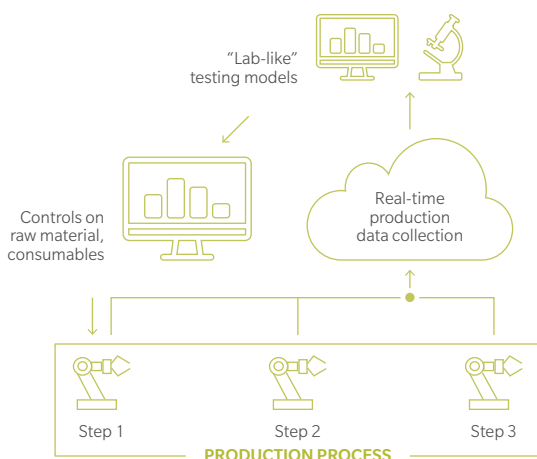
Customers benefit from reduced maintenance and energy costs as well as reduced track usage. By increasing the utilization of assets, rail operators can reduce their capital expenditure over the long run. The OEM receives an additional monthly revenue stream from selling the lifecycle optimization software. And it can increase downstream profits from service and spare parts by gaining increased customer lock-in.



PAPER INDUSTRY: PRODUCTION OPTIMIZATION

An OEM of paper manufacturing machinery offers software that optimizes input consumption and increases yield in paper production. The solution collects and analyses data, makes real-time estimates of optimization potentials and automatically adjusts process parameters. The quantity of input materials, machine setup and operational dispatching can be changed to improve the production process based on findings from the test model.

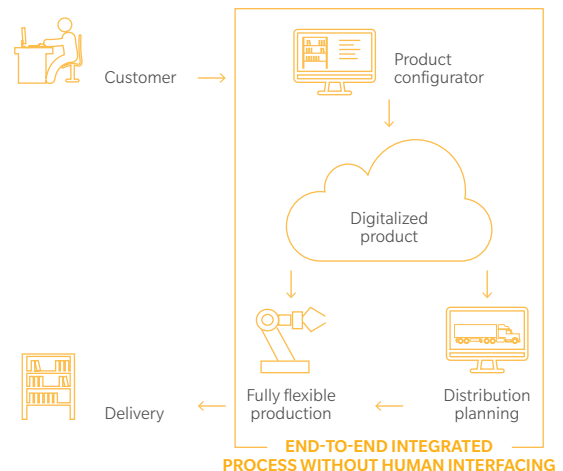
Customers save on input materials and from reduced scrap, amounting to 3 percent to 5 percent of total production costs. And the increased uptime of machines leads to a higher yield. The OEM charges a monthly fixed fee for installation and can receive success-based revenue streams if the customer achieves agreed-upon levels of savings on production costs. Additionally, the OEM can build a production consulting business using insights from the data and algorithms.



CUSTOM FURNITURE PRODUCTION: "DIGITAL PROCESS IN A BOX"

A machinery OEM now offers an end-to-end value proposition to its midsize customized furniture providers, including fully automated manufacturing, MES, ERP, digital modelling of products and a customer front-end. The digital model allows for mass customization and significantly reduces the cost of setting up new product lines.

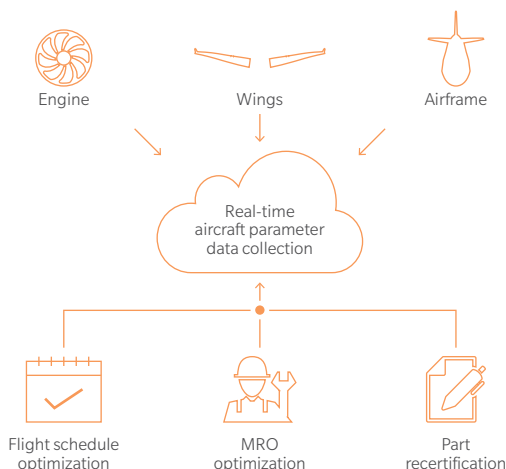
The new process creates a step change in the choice and process efficiency that kitchen and furniture manufacturers can provide for customers. The OEM receives a price premium for its differentiated offering and increased customer lock-in, which translates into greater profit from downstream servicing and software upgrades.



AEROSPACE: DATA-DRIVEN MRO

Aircraft component suppliers and OEMs can create new sources of recurring revenue by offering innovative data-driven maintenance, repair and overhaul (MRO) solutions to airline customers. Today, a large aircraft generates over 500 gigabytes of data from 600,000 parameters per flight. Advances in MRO will come from better analysis of this data for predictive maintenance activities. Aircraft health parameters can be tracked in real-time during operation and efficient MRO plans formed before critical operating thresholds are achieved.

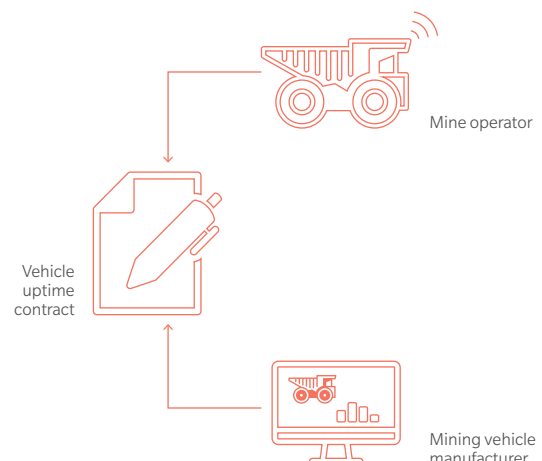
Such data-driven solutions cut MRO costs by reducing aircraft turnaround (grounding) times. The average cost of maintenance is now more than US\$1,200 per flight hour for a commercial aircraft. Even a 1 percent improvement in the efficiency of engine maintenance alone would save airlines US\$250 million. Improved maintenance will also increase the resale value of airplanes and their parts. The component manufacturer increases its long-term service contract penetration significantly, increasing profit streams from downstream services and original spare parts.



DIGITALLY-ENABLED PERFORMANCE GUARANTEES

The customers of OEMs often seek not the machinery supplied to them but what the machinery does. For example, an open-cast mining company wants to shift material from pits to rail trucks. They now buy the vehicles that do this from OEMs. But they could instead buy a promise of the desired outcome: that is, the movement of mined material. By using real-time condition monitoring and superior data analytics, the OEM can learn about the risk profile and manage and maintain the vehicles more efficiently than the customer, allowing both parties to profit from the guarantee. Similar substitutions of guarantees of performance for equipment could occur in many industries.

Customers would benefit from increased uptime and from transferring asset productivity risks to the OEM, shifting the assets off their balance sheets. Early moving OEMs can gain market share by offering something their competitors do not. And if the guarantees are properly priced and the technology properly used, OEMs will capture a portion of the value of the efficiency gains.



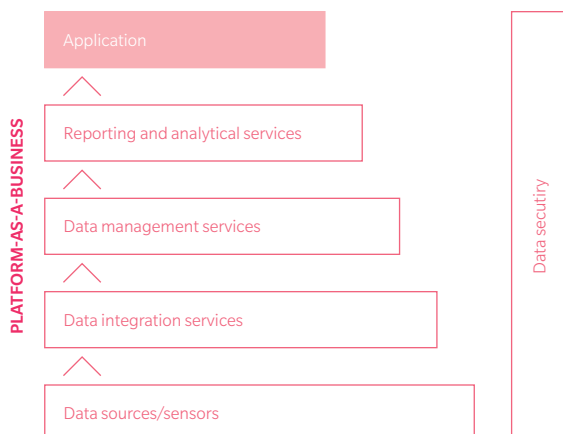
DIGITAL PLATFORM AS A PROPOSITION

Some companies are trying to leverage the digital platforms developed for their internal purposes by offering them to third-party users. Such platforms typically comprise hardware (for example, sensors, gateways), software (for example, data management, security, algorithms) and data storage (for example, cloud solutions).

Infrastructure alone typically creates no direct customer value. However, it can be a key enabler for valuable applications running on it. For the OEM, value is captured not only from add-on fees for the platform-as-a-business in current customer markets but also from selling the scaled platform into new markets. It is not yet clear, however, that such platform offerings have a strategic control point in the evolving competitive landscape (which includes traditional IT providers) nor which revenue model will be accepted by customers.

In summary, the investments OEMs make in digital technology to improve their own performance can also

provide the foundation for new business models or customer propositions, thereby increasing the yield on those initial investments. Being a “heavy user” of digital technology helps build credibility as a provider of digital solutions to customers.



SECTION FIVE

A NEW COMPETITIVE LANDSCAPE

Incumbent industrial firms and established software players in enterprise resource planning, product lifecycle management and automation are likely to be among the winners as digital industry develops. Industrial applications appear too small and fragmented to be a priority for the mass-market consumer-focused online giants. Just as Microsoft did not win in “open automation” in the 2000s, Amazon and Google are unlikely to conquer in the industries environment over the midterm.

Nevertheless, the distribution of market shares between industrial firms, automation players and software suppliers is likely to change. A variety of strategic moves can now be observed along the “value creation chain” and the “technology stack”. For example, hardware players are trying to use software to make their products smarter; PLM/PDM players are trying to extend their reach into ERP and MES; automation control players are trying to capture plant analytics. To favourably position itself in this multi-dimensional play, an industrial company must identify and capture strategic control points, deciding what technology it needs to own, what it can outsource and when it should enter partnerships.

At the same time, startup specialists are beginning to emerge, offering complex optimization algorithms, analytics and apps that increase process and data transparency for industrial customers. Successful specialist players, however, are likely to be bought out by the giants, given their lack of critical mass and limited access to the financing needed for R&D.

Intense competition could arise within the “tier structure” of an industry segment, as OEMs (for example, of vehicles) and tier-1 suppliers of components (such as gear boxes) both

try to offer digital solutions (such as efficient driving) to end customers (such as transport operators). This new source of competition arises from digital business models of the kind discussed in Section 4. But these models will take off only if answers can be found to difficult questions regarding the use and ownership of customer data.

In B2C, the issue is mainly one of privacy. In B2B, by contrast, the issue is competition. For example, an equipment supplier who gains access to its customer’s operational and sales data may be able to capture a greater share of the total supplier surplus generated along the end-to-end production chain. And if the OEM’s business model accidentally makes one of its suppliers’ data available to competitors, the OEM may find itself legally liable for any losses incurred by that supplier.

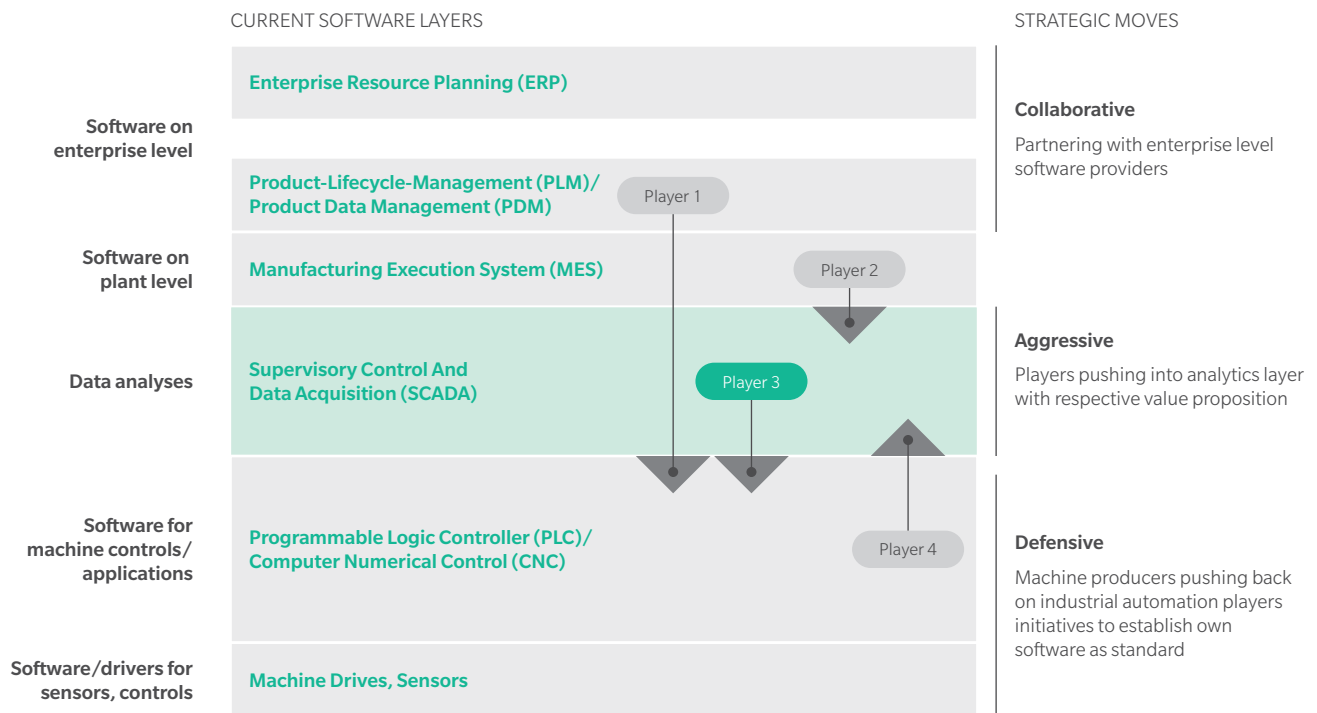
Uncertainty about the ownership of data, and who has access to it, thus creates an obstacle to the development of new digital business models. The customer will be reluctant to take the risk of providing the required data, especially before the superior value of the model is proven. Yet the value of the model cannot be demonstrated in practice until customers become willing to provide the data.

This is a familiar problem for new business models. A lack of precedent causes commercial and legal uncertainty. We expect the problem to diminish as the law surrounding data ownership advances with the burgeoning digital economy. In the short term, however, firms will need to find particular solutions to the particular risks presented by particular business models. Such

solutions may be provided by a “neutral” intermediary with no other stake in the value chain, by a non-compete or exclusivity contract or by a product development partnership. Where the potential gains and the risks are sufficiently large, we may even see some vertical integration – the classic solution to the problem of excessive transaction costs.

Exhibit 5: Connected Industry Competitive Dynamics

Example: Machinery



Note: Position of arrow indicates possible move of integration for player in the market
 Source: JP Morgan, CS equity research, CIM data, company homepage, expert interviews, Oliver Wyman

SECTION SIX

DIGITAL TRANSFORMATION

Industrial companies seeking to exploit their digital potential will not succeed by simply launching apps. They will need to transform many dimensions of their business and operating models and build a broad set of new capabilities. Even if this process unfolds over many years, with hindsight the corporate transformation will look revolutionary.

Companies should not underestimate the urgency of getting this process started because “it’s going to take a dozen years, anyway.” Customers’ expectations regarding digitization will rise at an increasing pace, and startups or fast-moving incumbents will grab the opportunities. In other words, “laggards will be losers.”²

But getting the process moving is difficult. When asked the greatest obstacle to realizing their digital potential, a group of CEOs from leading mechanical engineering firms surveyed by Oliver Wyman did not name the familiar

beyond today’s business and operating models” and to a “lack of competencies and capabilities”.

Becoming the kind of firm that can thrive in digital industry is a significant challenge. It will require incumbent industrials to develop skills in data analysis, to upgrade technology, to become more innovative and to make organizational changes that promote these advances. (See Exhibit 7.)

Customers’ expectations regarding digitization will rise at an increasing pace, and startups or fast-moving incumbents will grab the opportunities.

topics, such as a lack of technical standards or data security, as the main obstacles to realizing their company’s digital potential. (See Exhibit 6.) Rather, they pointed to a “lack of creativity to think

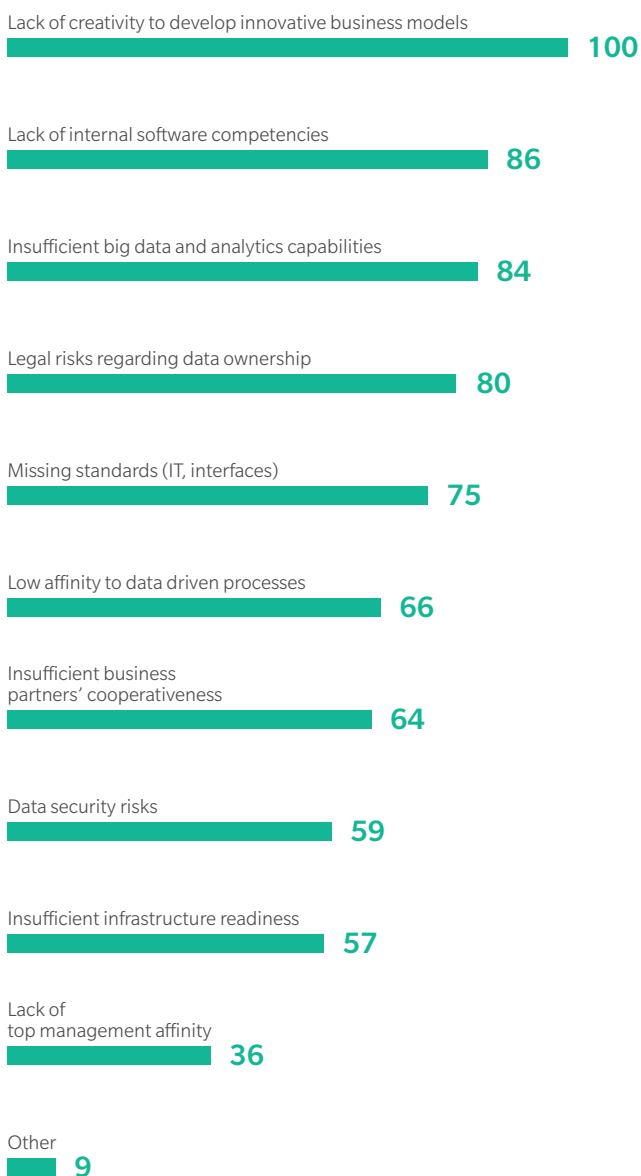
DATA ANALYSIS

Industrial companies, especially those in the B2B space, have traditionally made little use of advanced data analytics to drive business decisions, relying instead on experience and judgement (sometimes informed by basic quantitative analysis). The required skills are thus scarce in these firms. To become digital industries, they will need staff who can understand the content and value of existing data pools, handle large amounts of data (which often need to be extracted from the legacy systems), apply sophisticated analytical techniques and make full use of off-the-shelf analytics software. This will require

² See our 2015 Report, *Incumbents in a Digital World: Laggards Will Be Losers*.

Exhibit 6: Obstacles to Becoming a Digital Industry

As judged by CEOs, largest = 100



Source: Oliver Wyman survey of leading German manufacturing companies

companies to recruit new types of employees and, at least initially, to enter partnerships with specialized firms, startups or institutes. Over time, the proportion of staff with the relevant skills will need to grow significantly.

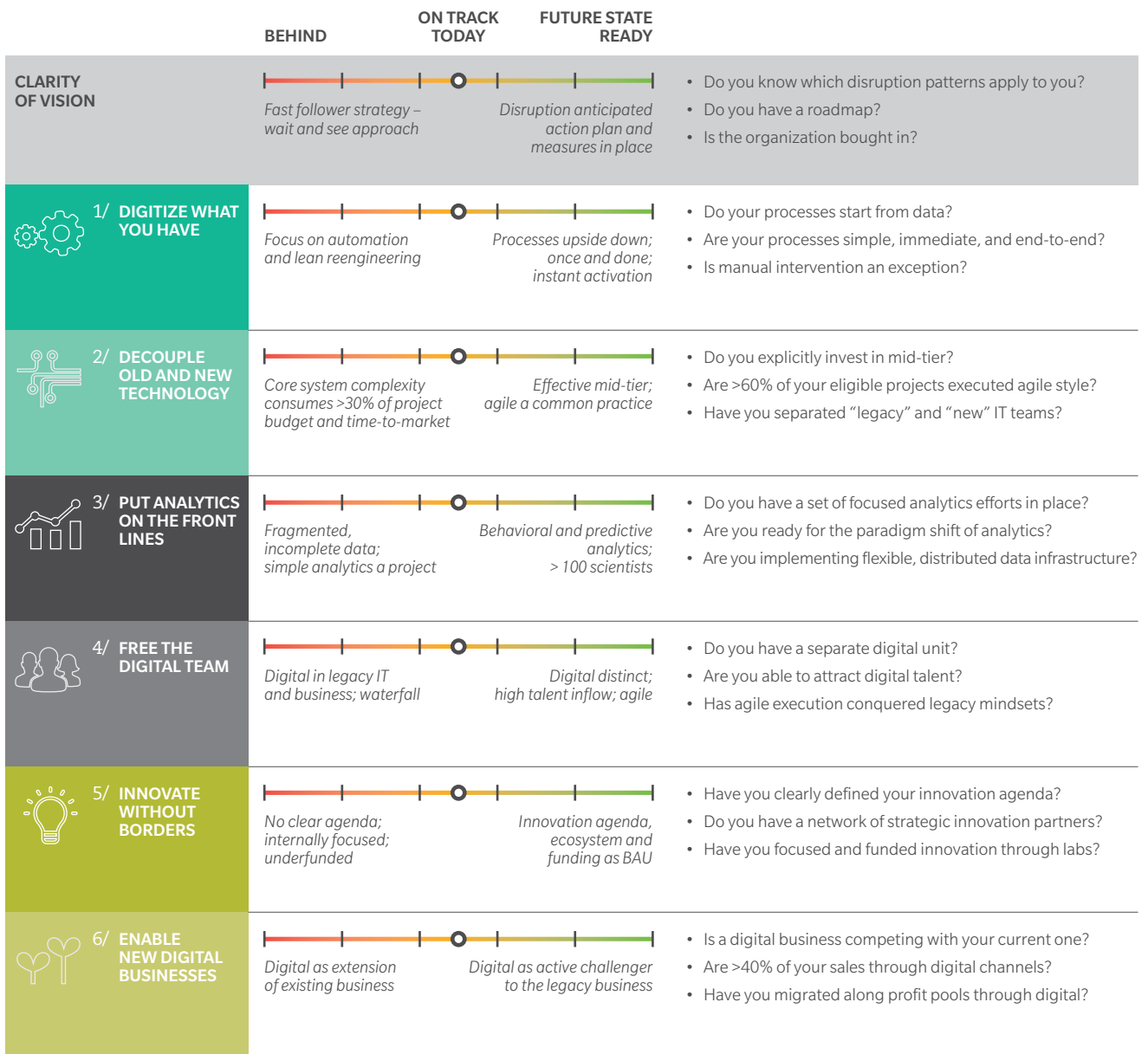
Besides acquiring staff who can produce analytic insights, management must develop the confidence to trust these insights and transparently act on them. Indeed, the transformation process needs to be driven by the business or commercial side of the firm, working with the analytics people to identify and prioritize the processes or decisions that will deliver the greatest upside from data-driven optimization, and following through with implementation.

TECHNOLOGY

Creating digital solutions requires an IT development process that differs in structure and pace from the now standard approach in industrial firms. Digital solutions require an agile and high-speed development process in which an initial solution is generated early on and then goes through numerous test-learn-rebuild cycles. Such a process is more likely to be run successfully by digital natives with a work style and spirit more akin to that of a startup. At least initially, the development of digital technology is likely to require organizational separation to thrive, giving rise to a “two-speed system” within the company.

Creating digital solutions requires novel decisions on the technology stack used to build the middleware and application layers on legacy IT systems. What was once a secondary asset may become primary, or

Exhibit 7: Digital Readiness



Source: Oliver Wyman Report, *Incumbents in a Digital World: Laggards Will Be Losers*

vice versa. Such shifts will require industrial firms to think harder than usual about the trade-offs between open or proprietary solutions and about make-or-buy decisions, including for the operating phase of the solution.

INNOVATION

The innovation culture of industrial firms typically reflects the perfectionist and risk-averse attitude associated with good engineering. To be successful in a digital world, industrial companies will need to “loosen up.” Pace is more important than perfection. An 80 percent solution is acceptable as a starting point, and failure is no catastrophe. Indeed, frequent – and, ideally, early and therefore cheap – failure is a key characteristic of a productive digital innovation process. Recruiting staff with not only the right skills but the right attitudes will help.

The greatest cultural obstacle to digital innovation can be a reluctance to undermine currently profitable business models. Even though loyalty effects will most typically enhance spare parts sales in the long run, introducing condition-based maintenance for customers may reduce spare part sales in the short run. The reason can be found directly in the parts: They will now be replaced only when necessary, rather than according to a regular maintenance cycle. Such reluctance will be costly. If incumbent companies are reluctant to disrupt themselves, others will do the job for them. And the loss will usually exceed the particular revenues concerned. Once a third party is inserted between the OEM and its customer, the OEM will lose opportunities to expand its share of wallet – in

the maintenance case, for example, the opportunity to sell higher value optimization services through this channel.

ORGANIZATION

As noted, going digital will require new kinds of staff and new ways of working within incumbent industrial firms. Because the overall culture of a large firm cannot be changed quickly, digital developments will initially need a “parallel organization,” creating a two-speed development process and, more generally, a two-speed workforce. The “second” organization is also needed to attract digital talent who would otherwise prefer to found or work for a startup.

New organizational roles will also be needed. These include “content authorities” – experienced managers who can quickly make judgement calls about the feasibility of new ideas – and “tweeners”: people who understand both the digital and the business side and who can act as mediators between these initially separate worlds.

Overall, we advocate a decentralized model in which digital “speed boats” get traction with a high degree of delegated decision authority. Consensus-oriented decision making in layered committee structures will not do the job. Indeed, digital technology means that the corporate and analytical centres can become virtual, with staff geographically dispersed. This will help to tap in to global talent pools and attract the kind of staff needed to make the digital transformation. Once the digital world has gained critical mass, it can be integrated with the legacy business – or absorb it.

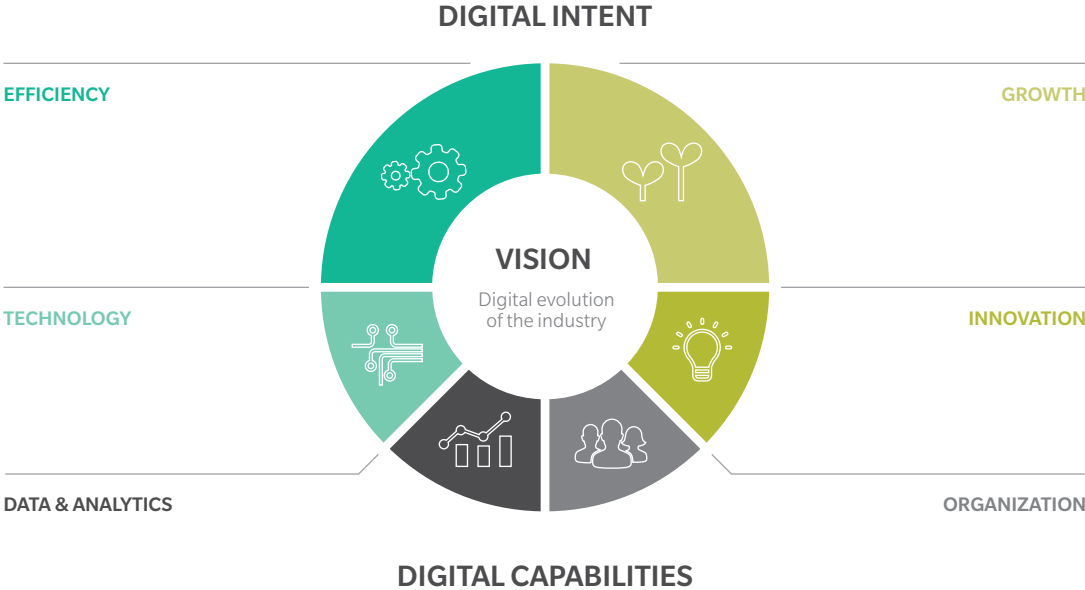
SECTION SEVEN SUMMARY

Digital technology will change industry profoundly, making it far more efficient and creating new business models. Unlike the previous industrial revolutions, this transformation will not replace human muscle with powerful machines; it will provide human decision making with support from intelligent machines. Digital firms will be quite unlike the typical firms of today: employing different kinds of people who perform different tasks within different organizational structures.

Industrial firms are often large and slow to change. They must overcome this natural inertia.

The first step is to articulate a digital vision. (See Exhibit 8.) This has two broad elements. First, industrial firms must decide on their digital intent: the kinds of efficiency improvements and growth they can achieve through the use of digital technology, as discussed in Sections 3 and 4. Then they need to identify the additional capabilities that will be required to achieve this digital intent, as discussed in Section 6. From here, they will need to develop action plans for transformation. Although the transformation will take many years, it cannot be delayed. As we have argued elsewhere, laggards will be losers.³

Exhibit 8: Building the Digital Vision and Action Plan



Source: Oliver Wyman Report, *Incumbents in a Digital World: Laggards Will Be Losers*

³ See our 2015 Report, *Incumbents in a Digital World: Laggards Will Be Losers*.

RECENT PUBLICATIONS FROM OLIVER WYMAN

For these publications and other inquiries, please email insights.mte@oliverwyman.com or visit www.oliverwyman.com.



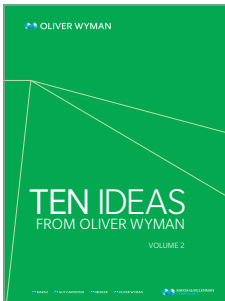
INCUMBENTS IN THE DIGITAL WORLD

How incumbent organizations can ultimately win in a marketplace transformed by digital disruptors.



PERSPECTIVES ON MANUFACTURING INDUSTRIES

A collection of viewpoints on industrial companies' challenges and trends, as well as their opportunities and potential courses of action.



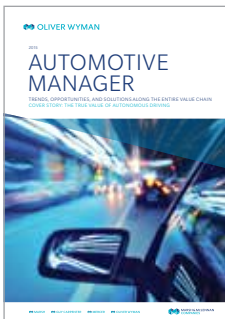
TEN IDEAS FROM OLIVER WYMAN, VOL. 2

In this collection of articles, we showcase ten ideas from across our firm for how business leaders can improve and grow their businesses.



THE OLIVER WYMAN RISK JOURNAL, VOL. 5

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



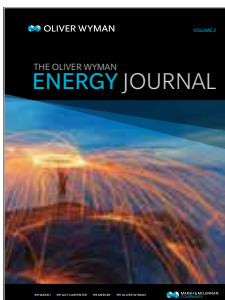
THE OLIVER WYMAN AUTOMOTIVE MANAGER

A magazine for automotive industry leaders that provides insights into trends, prospects, and solutions for manufacturers, suppliers, and dealers.



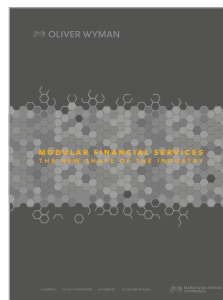
THE OLIVER WYMAN TRANSPORT & LOGISTICS JOURNAL

A publication that discusses issues facing global transportation and logistics industries.



THE OLIVER WYMAN ENERGY JOURNAL, VOL. 2

This issue of the Oliver Wyman Energy Journal reflects the latest thinking across Oliver Wyman's Energy practice on the resulting new risks and opportunities that will impact not just the energy sector, but also every company and person that depends on it.



MODULAR FINANCIAL SERVICES

The new shape of the industry.

ABOUT OLIVER WYMAN

Oliver Wyman is a global leader in management consulting. With offices in 50+ cities across 26 countries, Oliver Wyman combines deep industry knowledge with specialized expertise in strategy, operations, risk management, and organization transformation. The firm's 3,700 professionals help clients 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]. For more information, visit www.oliverwyman.com. Follow Oliver Wyman on Twitter @OliverWyman.

AUTHORS

THOMAS KAUTZSCH

Global Practice Leader, Automotive & Manufacturing Industries
thomas.kautzsch@oliverwyman.com
+49 89 939 49 460

WOLFGANG KRENZ

Partner, Automotive & Manufacturing Industries Practice
wolfgang.krenz@oliverwyman.com
+49 89 939 49 403

TOBIAS SITTE

Partner, Automotive & Manufacturing Industries Practice
tobias.sitte@oliverwyman.com
+49 89 939 49 541

www.oliverwyman.com

Copyright © 2016 Oliver Wyman. All rights reserved.

