



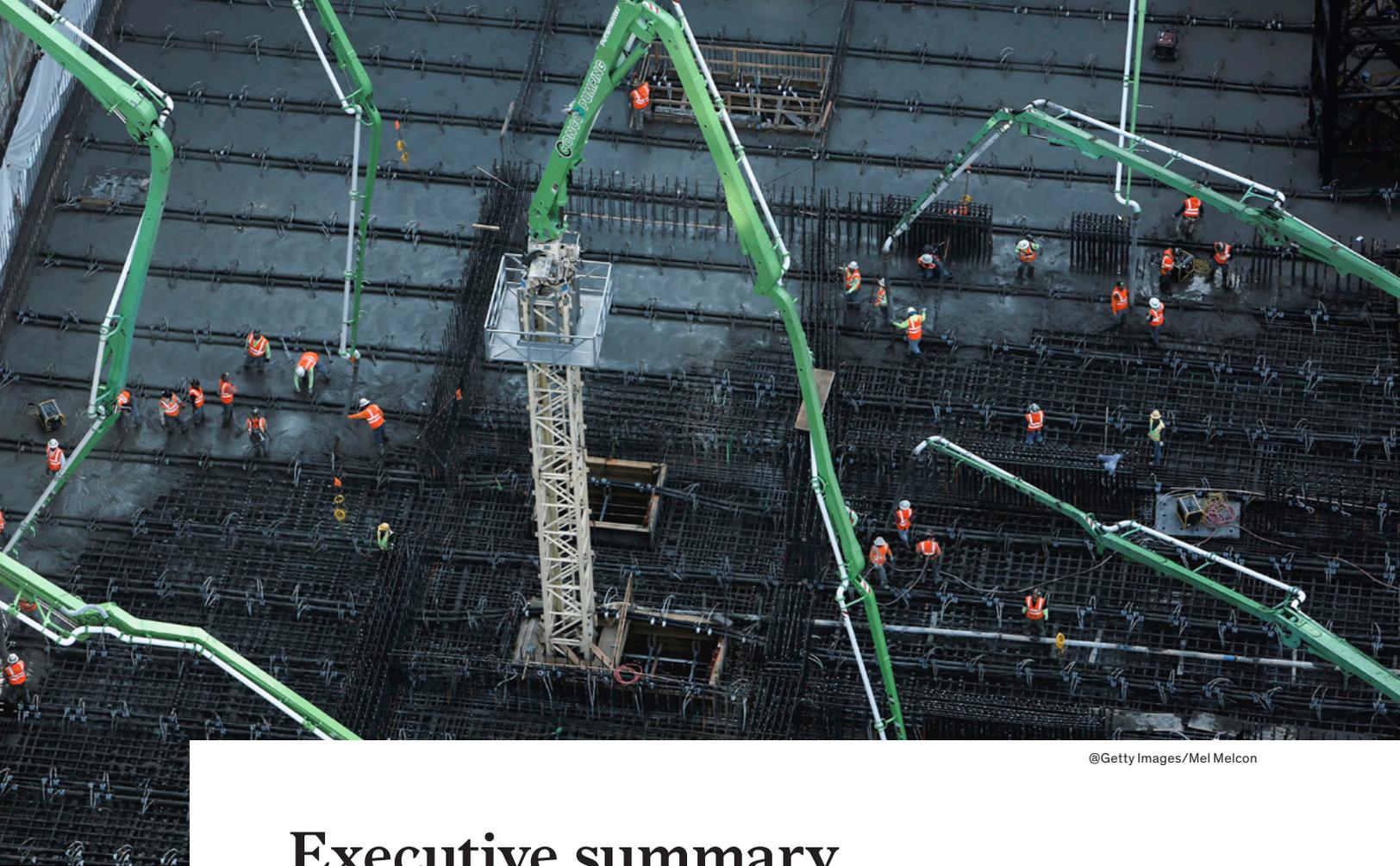
McKinsey
& Company

Executive summary

The next normal in construction

How disruption is reshaping the world's largest ecosystem

June 2020



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Executive summary

Construction, which encompasses real estate, infrastructure, and industrial structures, is the largest industry in the global economy, accounting for 13 percent of the world's GDP. A closer look at its underlying performance highlights the industry's challenges in good economic times, let alone in times of crisis. We expect a set of nine shifts to radically change the way construction is done. Companies that can adjust their business models stand to benefit handsomely, while others may struggle to survive.

Historically, the construction industry has underperformed

Construction is responsible for a wide range of impressive accomplishments, from stunning cityscapes and foundational infrastructure on a massive scale to sustained innovation. However, in the past couple of decades, it also has been plagued by dismal performance.

Annual productivity growth over the past 20 years was only a third of total economy averages. Risk aversion and fragmentation as well as difficulties in attracting digital talent slow down innovation. Digitalization is lower than in nearly any other industry. Profitability is low, at around 5 percent EBIT margin, despite high risks and many insolvencies. Customer satisfaction is hampered by regular time and budget overruns and lengthy claims procedures.

The industry will feel the economic impact of the COVID-19 strongly, as will the wider construction ecosystem—which includes construction companies' component and basic-materials suppliers, developers

and owners, distributors, and machinery and software providers. At the time of writing, high levels of economic uncertainty prevail worldwide, and the construction industry tends to be significantly more volatile than the overall economy. MGI scenarios suggest that if things go well, construction activity could be back to pre-crisis levels by early 2021. But longer-term lockdowns could mean that it takes until 2024 or even later. In the past, crises have had an accelerative effect on trends, and this crisis is also expected to trigger lasting change impacting use of the built environment, like online channel usage or remote-working practices.

The lagging performance of the construction industry is a direct result of the fundamental rules and characteristics of the construction market and the industry dynamics that occur in response to them. Cyclical demand leads to low capital investment, and bespoke requirements limit standardization. Construction projects are complex, and increasingly so, and logistics need to deal with heavy weight and many different parts. The share of manual labor is high, and the industry has a significant shortage of skilled workers in several markets. Low barriers to entry in segments with lower project complexity and a significant share of informal labor allow small and unproductive companies to compete. The construction industry is extensively regulated, subject to everything from permits and approvals to safety and work-site controls, and lowest-price rules in tenders make competition based on quality, reliability, or alternative design offerings more complicated.

In response to these market characteristics, today's construction industry must grapple with several dynamics that impede productivity and make change more difficult. Bespoke projects with unique features and varying topology have a limited degree of repeatability and standardization. Local market structures and ease of entry have resulted in a fragmented landscape (both vertically and horizontally) of mostly small companies with limited economies of scale. Moreover, every project involves many steps and companies in every project with scattered accountability, which complicates the coordination. Contractual structures and incentives are misaligned. Risks are often passed to other areas of the value chain instead of being addressed, and players make money from claims rather than from good delivery. High unpredictability and cyclicalities have led construction firms to rely on temporary staff and subcontractors, which hampers productivity, limits economies of scale, and reduces output quality and customer satisfaction.

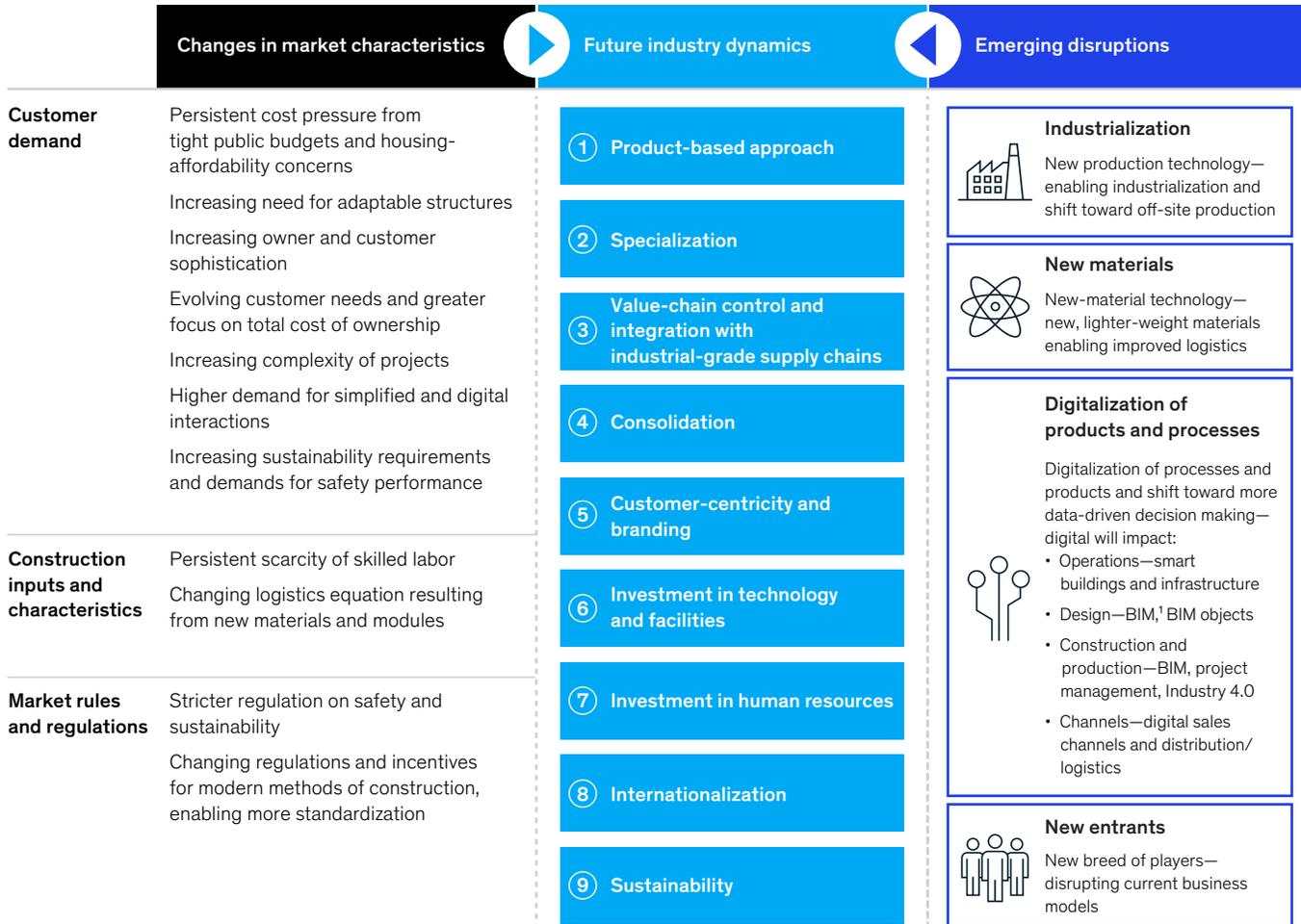
A changing market environment, technological progress, and disruptive new entrants will trigger industry overhaul

The construction industry was already starting to experience an unprecedented rate of disruption before the COVID-19 pandemic. In the coming years, fundamental change is likely to be catalyzed by changes in market characteristics, such as scarcity of skilled labor, persistent cost pressure from infrastructure and affordable housing, stricter regulations on work-site sustainability and safety, and evolving sophistication and needs of customers and owners. Emerging disruptions, including industrialization and new materials, the digitalization of products and processes, and new entrants, will shape future dynamics in the industry (Exhibit A).

Sources of disruption

Rising customer sophistication and total-cost-of-ownership (TCO) pressure. Customers and owners are increasingly sophisticated, and the industry has seen an influx of capital from more savvy customers. From 2014 to 2019, for example, private-equity firms raised more than \$388 billion to fund infrastructure projects, including \$100 billion in 2019 alone, a 24 percent increase from 2018. Client demands are also evolving regarding performance, TCO, and sustainability: smart buildings, energy and operational efficiency, and flexibility and adaptability of structures will become higher priorities. Expectations are also rising among customers, who want simple, digital interactions as well as more adaptable structures.

Changing characteristics and emerging disruptions will drive change in the industry and transform ways of working.



¹Building-information modeling.

The industry is facing persistent cost pressure because of tight public budgets and housing-affordability issues. McKinsey analysis found that \$69.4 trillion in global infrastructure investment would be needed through 2035 to support expected GDP growth and that every third global urban household cannot afford a decent place to live at market prices. The economic fallout of the COVID-19 crisis magnifies the cost and affordability issues.

Persistent scarcity of skilled labor and changing logistics equations. Skilled-labor shortages have become a major issue in several markets, and retirements will drain talent. For example, about 41 percent of the current US construction workforce is expected to retire by 2031. The impact the COVID-19 crisis will have on this dynamic in the long term is unclear at the time of writing.

Safety and sustainability regulations and possible standardization of building codes. Requirements for sustainability and work-site safety are increasing. In the wake of COVID-19, new health and safety procedures will be required. The global conversation about climate change puts increasing pressure on the industry to reduce carbon emissions.

At the same time, in some markets, governments are recognizing the need to standardize building codes or provide type certificates and approvals for factory-built products rather than reviews of each site. The process, however, is still slow.

Industrialization. Modularization, off-site production automation, and on-site assembly automation will enable industrialization and an off-site, product-based approach. The shift toward a more controlled environment will be even more valuable as the COVID-19 pandemic further unfolds. The next step in the transition to efficient off-site manufacturing involves integrating automated production systems—essentially making construction more like automotive manufacturing.

New materials. Innovations in traditional basic materials like cement enable a reduction of carbon footprints. Emerging lighter-weight materials, such as light-gauge steel frames and cross-laminated timber, can enable simpler factory production of modules. They will also change the logistics equation and allow longer-haul transport of materials and greater centralization.

Digitalization of products and processes. Digital technologies can enable better collaboration, greater control of the value chain, and a shift toward more data-driven decision making. These innovations will change the way companies approach operations, design, and construction as well as engage with partners. Smart buildings and infrastructure that integrate the Internet of Things (IoT) will increase data availability and enable more efficient operations as well as new business models, such as performance-based and collaborative contracting. Companies can improve efficiency and integrate the design phase with the rest of the value chain by using building-information modeling (BIM) to create a full three-dimensional model (a “digital twin”)—and add further layers like schedule and cost—early in the project rather than finishing design while construction is already underway. This will materially change risks and the sequence of decision making in construction projects and put traditional engineering, procurement, and construction (EPC) models into question. Automated parametric design and object libraries will transform engineering. Using digital tools can significantly improve on-site collaboration. And digital channels are spreading to construction, with the potential to transform interactions for buying and selling goods across the value chain. As in other industries, the COVID-19 pandemic is accelerating the integration of digital tools.

New entrants. Start-ups, incumbent players making new bets, and new funding from venture capital and private equity are accelerating disruption of current business models. As the COVID-19-propelled economic crisis unfolds, we also expect an increase in corporate restructuring and M&A activity.

The nine resulting industry shifts

In response, we expect nine shifts to fundamentally change the construction industry. According to our executive survey, more than 75 percent of respondents agree that these shifts are likely to occur, and more than 60 percent believe that they are likely to occur within the next five years. The economic fallout from the COVID-19 pandemic looks set to accelerate them.

Product-based approach. In the future, an increasing share of structures and surrounding services will be delivered and marketed as standardized “products.” This includes developers promoting branded offerings,

with standardized but customizable designs that can improve from one product generation to the next, and delivery using modularized elements and standardized components produced in off-site factories. The modules and elements will be shipped and assembled on site. Production will consist of assembly line–like processes in safe, nonhostile environments with a large degree of repeatability.

Specialization. To improve their margins and levels of differentiation, companies will start to specialize in target niches and segments (such as luxury single-family housing, multistory residential buildings, hospitals, or processing plants) in which they can build competitive advantages. And they will specialize in using different materials, subsegments, or methods of construction. The shift toward specialization will also require companies to develop and retain knowledge and capabilities to maintain their competitive advantages. Obviously, players will need to weigh carefully the effectiveness, efficiency, and brand positioning that greater specialization enables against the potential risk or cyclical benefits of a more diversified portfolio.

Value-chain control and integration with industrial-grade supply chains. Companies will move to own or control important activities along the value chain, such as design and engineering, select-component manufacturing, supply-chain management, and on-site assembly. Companies will be able to achieve this goal through vertical integration or strategic alliances and partnerships by using collaborative contracting and more closely aligned incentives. Digital technology will change the interaction model: BIM models will lead to more decision making early on in the process, distribution will move toward online platforms and advanced logistics management, and end-to-end software platforms will allow companies to better control and integrate value and supply chains. Value-chain control or integration will reduce interface frictions and make innovation more agile.

Consolidation. Growing needs for specialization and investments in innovation—including the use of new materials, digitalization, technology and facilities, and human resources—will require significantly larger scale than is common today. As product-based approaches, with higher standardization and repeatability, further increase the importance of gaining scale, the industry is likely to increasingly see a significant degree of consolidation, both within specific parts of the value chain and across the value chain.

Customer-centricity and branding. With productization—that is, turning development, engineering, or construction services into easy-to-market products or solutions—and specialization in the industry, having a compelling brand that represents an organization’s distinctive attributes and values will take on added importance. As in traditional consumer industries, a strong brand can tie customers more closely to the construction company’s or supplier’s products and help to build and maintain relationships and attract new customers. Similar to brands in other manufacturing industries, such construction brands will encompass, among other aspects, product and service quality, value, timing of delivery, reliability, service offerings, and warranties.

Investment in technology and facilities. Productization implies a need to build off-site factories, which requires investments in plants, manufacturing machinery and equipment (such as robotics to automate manufacturing), and technology. Where modular is not used, the construction site also will likely become more capital intensive, using advanced automation equipment and drones, among other technologies. R&D investment will become more important for specialized or more productized companies, so companies are likely to increase spending to develop new, innovative products and technologies.

Investment in human resources. Innovation, digitalization, value-chain control, technology use, and specialization in end-use segments all increase the importance of developing and retaining in-house

expertise, which will compel players to invest more in human resources. The importance of risk management and other current capabilities will decrease and be replaced by an emphasis on others, such as supply-chain management. To build the necessary capabilities, companies will need to further invest in their workforces. This becomes even more important in light of the transition to the future of work. Most incumbents struggle to attract the digital talent they need, and will need to raise excitement about their future business models.

Internationalization. Greater standardization will lower the barriers to operating across geographies. As scale becomes increasingly important to gaining competitive advantages, players will increase their global footprints—both for low-volume projects in high-value segments such as infrastructure, as well as for winning repeatable products that will be in demand across the world. The COVID-19 pandemic might slow down this development.

Sustainability. While sustainability is an important decision factor already, we are only at the very beginning of an increasingly rapid development. Beyond the carbon-abatement discussions, physical climate risks are already growing and require a response. Companies will need to consider the environmental impact when sourcing materials, manufacturing will become more sustainable (for example, using electric machinery), and supply chains will be optimized for sustainability as well as resilience. In addition, the working environments will need to radically change from hostile to nonhostile, making construction safer. Water consumption, dust, noise, and waste are also critical factors.

Today's project-based construction process looks set to shift radically to a product-based approach (Exhibit B). Instead of building uniquely designed structures on the jobsite, companies will conduct their production at off-site construction facilities. Standardized sub-elements and building blocks will likely be designed in house in R&D-like functions. The elements will be manufactured separately and then combined with customization options to meet bespoke requirements. To produce efficiently and learn through repetition, developers, manufacturers, and contractors will need to specialize in end-user segments. Data-driven business models will emerge. Overall, the process may resemble manufacturing in other industries such as shipbuilding or car manufacturing.

There is reason to believe that a winner-take-most dynamic will emerge, and companies that fail to adjust fast enough risk seeing market shares and margins erode until they eventually go out of business.

Construction is not the first industry to encounter lagging productivity and disruption across the value chain. Lessons can be learned from others that had similar traits and encountered the same challenges that construction faces now. We have analyzed shifts in four of them: shipbuilding, commercial aircraft manufacturing, agriculture, and car manufacturing. Clear patterns of the shifts are evident in all of them, and value shifted to those handling the change best. Innovation in production technology and new work methods kick-started all four of the industries' journeys. Today, across industries, winners continue to heavily invest in technology, many with focus on digitalization and data-driven products and services.

In commercial aircraft manufacturing, for example, the industry landscape was highly fragmented. Each airplane was built from scratch in a bespoke and project-based-manufacturing setup. Industrialization sparked a shift toward assembly-line manufacturing, which later became highly automated. As a result of the subsequent standardization, the industry entered a phase of consolidation that led to the rise of two major players: Airbus and Boeing. The transformation resulted in a significant shift of value to customers. This transformation journey took roughly 30 years to complete, as commercial aircraft manufacturing faced barriers to change similar to those now confronting construction.

The future construction ecosystem will be radically different.

Today's construction ecosystem

A highly complex, fragmented, and project-based construction process . . .



The construction process is highly **project based**—developed from unique customer specifications, using designs **planned from scratch**, and with limited degree of repetition

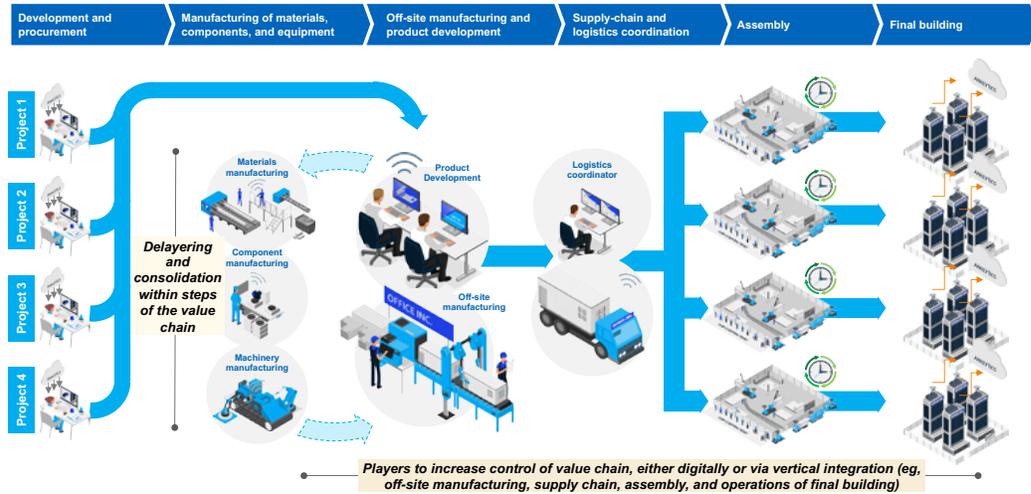
The value chain and player landscape are **local and highly fragmented vertically and horizontally**, resulting in a multitude of players involved at each step and major interface frictions

Construction is performed by generalists **on site in hostile environments**, with a large part of the workforce being **temporary and manual**

Limited use of **end-to-end digital tools and processes** as well as a capital-light delivery approach

The construction ecosystem of the future

. . . A more standardized, consolidated, and integrated construction process



The construction process is increasingly **product based**, meaning structures will be products and manufactured off site by branded product houses **specializing** in certain end-user segments

Developers choose **entire designs or specific components** from a **library** of options developed in house or offered externally on the market

Value chain is more consolidated, both vertically (delayering) and horizontally, with increased degree of **internationalization**

Disintermediation takes place through digital marketplaces and direct channels

Contractors focus on **lean, on-site execution and assembly of products**

Data and analytics on customer behavior generated after completion to optimize total cost of ownership and future designs

Almost half of incumbent value added is at stake

The transformation of the industry will create both large opportunities and sizable risks as value and profit pools shift in the next 15 years. Over the past years, approximately \$11 trillion in value added and \$1.5 trillion in profits have been unevenly distributed along the construction value chain and across all asset classes. Looking ahead, up to 45 percent of incumbent value may be at stake in those parts of the market most heavily affected by shifts, such as hotel construction (Exhibit C). Of this total, 20 to 30 percentage points will be kept and redistributed within the ecosystem to enable the shifts to take place. The remaining 15 to 20 percentage points will be value up for grabs as a result of the cost savings and productivity gains generated by the shifts, with the benefits accruing to players or customers (in the form of price reductions or quality increase). If that value is captured fully by players in the ecosystem, total profit pools could nearly double, to 10 percent, from the current 5 percent. Players that move fast and manage to radically outperform their competitors could grab the lion's share of the \$265 billion in new profit pools.

Some players will be more affected than others. For example, software providers are expected to significantly increase their value-added contribution, albeit from a small base of 1 to 2 percent of the value chain. Also, a large share of value is expected to move from construction jobsites to off-site prefabrication facilities. In contrast, general and specialized contractors could face a large decline unless they reposition themselves as companies that go beyond execution alone. Basic design and engineering and materials distribution and logistics may face substantial commoditization and automation risks.

The value at stake could benefit either the players in the ecosystem as profits increase, workers in the form of higher wages, or customers through lower prices and higher quality. Companies that move fast and manage to lower their cost base and increase productivity will have an advantage over the competition. These early movers could translate their productivity gains into profit. In the long term, as other players adjust and competition intensifies, the dynamics in other industries suggest that a large share of the gains will be passed on to customers.

Our baseline scenario estimates that 10 to 12 percent of construction activities will move along shifts outlined in this report by 2035, but change will vary significantly by asset class because of different starting points and abilities to transform. In real estate, for example, we expect that by 2035 an additional 15 percent of new building projects could be completed through a redesigned value chain. This higher-than-average number is partly the result of the potential for standardization in single- and multifamily residential, hotels, offices, and hospitals. For infrastructure, approximately 7 percent of additional new building volume could be delivered in a transformed way—with bridges, airports, and railways, for example, having particular potential. Industrial construction could see an additional penetration of about 5 percent, as several of its subsegments have already made significant progress in the past.

Transformation will take time, but the COVID-19 crisis will accelerate change

The full transformation of the construction industry could take decades, but the process has already begun. Our survey shows that industry leaders largely agree that the shifts outlined in this report are likely to occur at scale within the next five to ten years, and that the COVID-19 crisis will accelerate shifts.

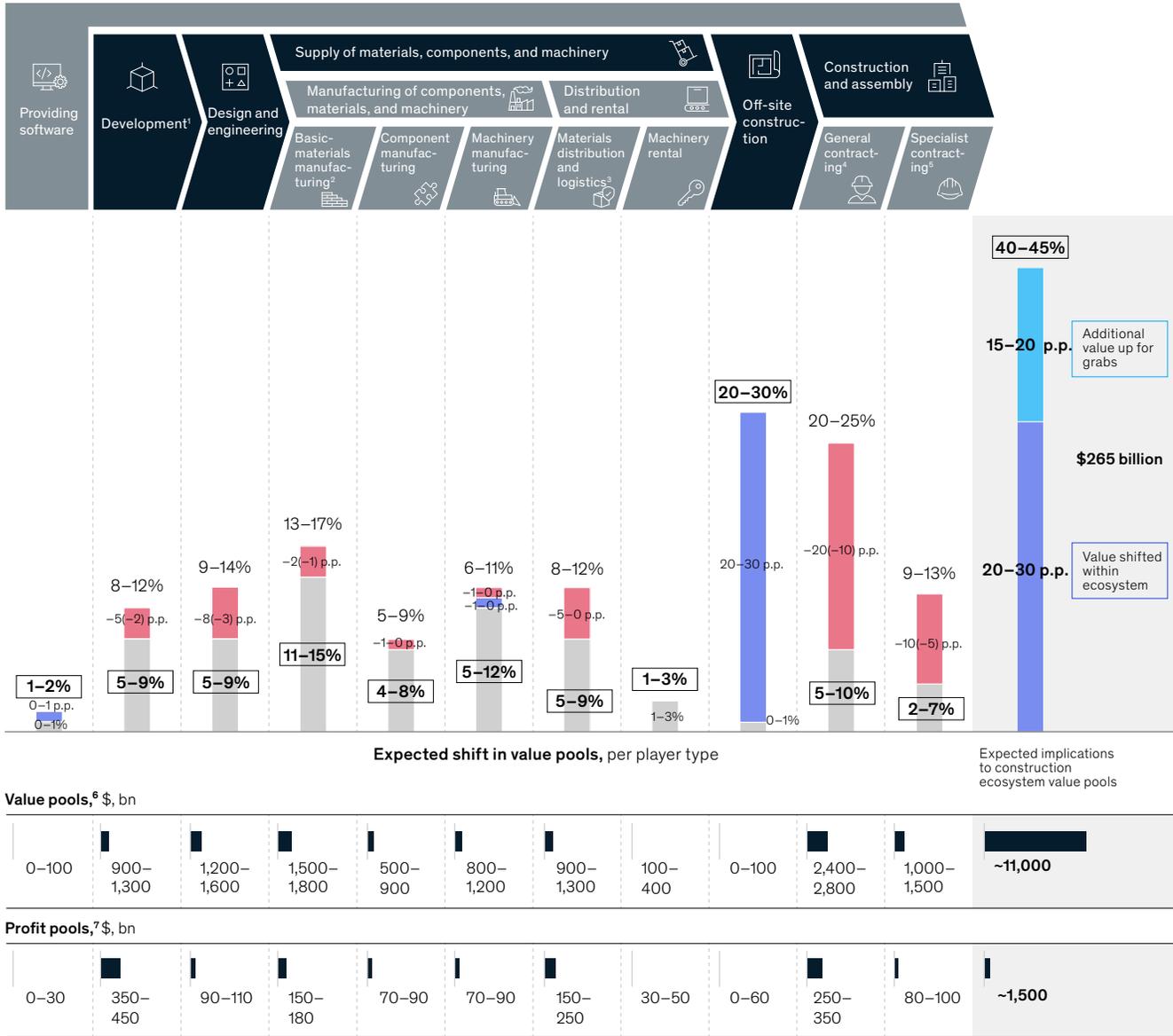
Our executive survey of 400 decision makers in November and December 2019 found that the attitudes of executives have evolved materially since three to five years ago (see sidebar “About the executive survey” in chapter 1 for more details on the survey). In all, 90 percent of the respondents strongly believe that the industry needs to change and that this sentiment has grown in the past ten years. Eighty percent also believe that the construction industry will look radically different 20 years from now.

Exhibit C

Forty to 45 percent of value pools are expected to shift and impact all players along the value chain.

Example of fully productized value chain (eg, real estate new build), current and future value pools, p.p.

Value at risk Remaining value added Value shifted Value captured



¹ Calculated by applying an assessed share of total value of development of output per asset class, allocated on top of total market output, since a limited number of stand-alone, pure-player developers have been identified.
² Looking at players processing raw materials but not the actual manufacturing of raw materials (eg, mining). If all steps of producing and refining raw materials were included, the value pool would be ~2.5x bigger.
³ Adjusted downward to reflect that some things materials distributors sell don't contribute to construction output (eg, clothes, white goods).
⁴ General builders (buildings and other heavy construction).
⁵ Specialized trade construction.
⁶ Defined as value added per player type.
⁷ EBIT pools.

Source: CapitalIQ; Euroconstruct; FMI; McKinsey analysis

Beyond our analysis and the overwhelming beliefs of the surveyed executives, we see signs today that the industry had already started to change before the COVID-19 crisis began. For instance, adoption of product-based approaches is increasing. In North America, the permanent modular-construction market share of new real-estate construction projects grew by approximately 51 percent from 2015 to 2018, and revenues for the segment grew (from a small base of \$2 billion) by a factor of 2.4 over the same period. Also, emerging players as well as incumbents are already seeking to control a larger part of the value chain; Katerra, for instance, used new technology to control the value chain, including design and engineering and off-site manufacturing. Indicators suggest the construction industry is increasing its emphasis on R&D, and companies that have invested in construction technology and facilities are gaining traction. Global R&D spending by the top 2,500 construction companies grew by 77 percent from 2013 to 2017.

The COVID-19 crisis looks set to accelerate change (Exhibit D). We conducted an additional survey in early May 2020 to understand the potential implications of the crisis on the disruptions and shifts outlined in the report. Respondents comprised 100 decision makers out of the same sample that responded to our first survey. Nearly two-thirds of respondents believe that the COVID-19 crisis will accelerate industry transformation, and half have already raised investment in line with the shifts. Investments in digitalization and supply-chain control are most pronounced, while respondents believe the crisis will slow down internationalization and the rise of new entrants—giving incumbents a rare opportunity to step in and drive change.

All players must prepare now for a fundamentally different next normal

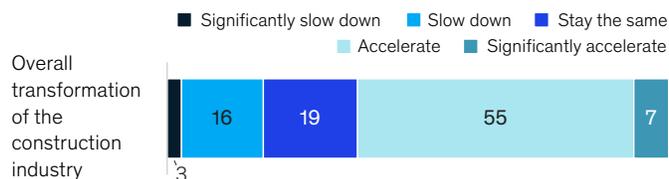
Our research shows that leaders leave laggards behind in times of crisis. Those that go beyond managing their survival to take fast, bold, strategic action tend to emerge as the winners. During past economic cycles, companies that managed to move quickly to improve their productivity (for example, reducing

Exhibit D

Two-thirds of survey respondents believe that the COVID-19 crisis will accelerate industry transformation.

As a result of COVID-19, do you believe that transformation of the construction industry will accelerate, stay the same, or slow down?

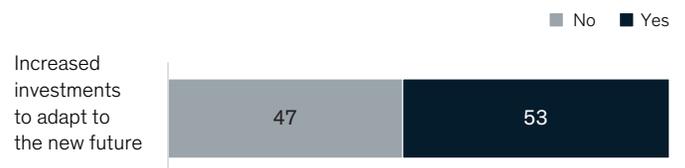
Share of respondents, %



Around two-thirds of respondents believe that the COVID-19 crisis will accelerate the overall transformation of the construction industry

As a result of COVID-19, has your company increased overall investments to adapt to the new future?

Share of respondents, %



More than 50% of respondents' companies have started to invest more to adjust to the new future

Source: Survey of 100 industry CxOs, May 2020

In the face of this transformation, companies all along the value chain need to review where they want to play.

their cost of goods sold through operational efficiency), divest earlier and are more acquisitive during the recovery. They cleaned up their balance sheets ahead of a downturn and outperformed competition in both revenues and earnings before interest, depreciation, taxes, and amortization (EBITDA).

Players in the ecosystem will need to develop strategies to deal with the disruption ahead. Our survey respondents identified four types of players set to face the largest long-term decline: design and engineering firms, materials distributors, general contractors, and specialist contractors. Furthermore, respondents believe that general contractors will be required to move first, as they could experience commoditization and a declining share of value.

In the face of this transformation, companies all along the value chain need to review where they want to play: which asset classes, segments, geographies, and value-chain steps. They will need to assess the impact of each of the disruptions and the nine shifts, decide how they want to act on them, and define new-business models and operating models in line with those decisions. This process is critical whether they aim to defend their core business and adjust to the new environment or fundamentally reinvent themselves and attack. For success, it will be critical for companies to invest in a set of enablers, such as agile organizations. Finally, companies can choose how to implement the new strategy and transformation, whether it's trying to evolve incumbent operations to work within the new setup, starting up new divisions or arm's-length operations, or applying targeted M&A.

In the materials-distribution and logistics segment, for instance, off-site manufacturing facilities will shift demand for shipments to factory hubs, the main logistics nodes, which will increase customer expectations for just-in-time delivery. The segment will be further reshaped by online and direct sales channels (including new competition from online-distribution behemoths), rising customer expectations, and increased use of technologies such as advanced analytics or automated warehouses. A shift in procurement activity, from small specialized trades firms to larger contractors, will affect companies' bargaining power, and internationalization will enable companies to source more from low-cost countries.

In response, companies could try to defend their core by, for instance, focusing on the refurbishment market, becoming leaner, and undertaking category reviews. They could adjust to the changing

environment by, for example, strengthening customer relationships, offering new business solutions to avoid disintermediation, consolidating to gain scale, and developing industrial-grade supply-chain capabilities. Reinvention would entail becoming the logistics hub of the future construction landscape. Strategies could include partnering closely with off-site manufacturers and materials suppliers to optimize logistics and inventory according to their needs, helping with international sourcing, or offering credit financing.

Companies that familiarize themselves with the next normal and move quickly will be best positioned to both create value and maintain their competitive edge.

Organizations that are adjacent to the construction ecosystem should look to facilitate—and benefit from—the coming changes. Investors are well advised to use foresight to anticipate the respective shifts and generate above-market returns. Insurance companies are already factoring use of modern methods of construction into their terms. Policy makers should help the industry become more productive and thereby attain better housing and infrastructure for citizens. And building owners stand to benefit from better structures at lower costs if they play their part in making the shifts happen.

Construction is already in the perfect storm. Industrialization, globalization, and digitalization have been key drivers of change in all industries. While this change happened in sequential waves—for example, in auto industrialization in the 1970s and 1980s, globalization in the 1990s and 2000s, and digitalization in the 2010s and ongoing—all of these drivers are hitting construction simultaneously. It is a daunting task and will require bold and agile moves to maneuver, but the size of the prize is enormous.