The trillion-dollar question for advanced industries: How to extract full value from technology

Venkat Atluri, Satya Rao, and Saloni Sahni

The digital revolution is far from over. As data, connectivity, and processing power expand, so do opportunities for industrial companies to extract value through innovative products, services, and business models.

With profitable growth in the industrial sector slowing over the past five years, companies have been striving to innovate faster, get much closer to customers, and achieve a step change in operational efficiency. Having exhausted the potential of traditional levers—capital-productivity programs, operational-cost reduction, footprint optimization, and the like—they urgently need to find new ways to grow their margins and their business. But how?

In our view, the explosion in data, connectivity, and cheap processing power and storage means that industrial companies should be looking to technology-enabled transformations for their next horizon of performance improvement and growth.

To take just one trend, the 10 billion connected devices in use today are expected to increase to 50 billion by 2025. As new data sources multiply and enable companies to generate and act on insights in real time, a whole range of innovative products, services, and business models is opening up.

A handful of leaders are already turning these trends to advantage and reaping early rewards. Yet across the sector as a whole, success stories are few and far between. After seeing promising results from early initiatives, many companies struggle to scale up and unlock value on a broader front. Indeed, when McKinsey surveyed executives developing IoT solutions in 2017, more than half had been running

customer pilots for one to two years, and more than a quarter for even longer. So what's going wrong?

In our view, a piecemeal approach to tech enablement lies at the root of the problem. Many companies are adopting artificial intelligence, machine learning, cloud services, and a host of other technologies on a case-by-case basis, instead of selecting technologies to serve their strategy or meet specific business goals. We believe success depends on a holistic approach to transformation. That means defining your aspirations, linking them to sources of business value, working out which technologies will help achieve them, and then doubling down to achieve impact across the enterprise.

Below, we analyze the value that could be unlocked across the industrial sector through successful tech enablement, look at where this value can be created in the business, identify the enablers needed to capture it, and consider the steps smart leaders take to make their transformation a success.

Sizing the prize
Our analysis shows that successful transformation across the whole industrial sector would be worth $0.8 trillion to $2 trillion in total return

to shareholders, an increase of 9 to 22 percent. This value comes from two sources: an estimated $0.3 trillion to $0.9 trillion in revenue growth (an improvement of 3 to 10 percent), and $0.3 trillion to $0.7 trillion in margin expansion from efficiency gains (an improvement of 4 to 9 percent).

In turn, revenue growth is generated by a range of factors: new business models with services and features that unlock value for end users; better knowledge of customers that helps companies tailor products, develop new services, and increase customer loyalty; the broadening of channels and access to new customers via e-commerce; and the optimization of pricing across products and services. Meanwhile, the cost savings that drive margin expansion come from the use of automation, analytics, and digital tools to enhance workforce productivity across the business, coupled with the application of advanced analytics and product-customization techniques to optimize nonlabor costs.

We analyzed these sources of growth and savings both within the enterprise and at industry-segment level to determine where the value lies.

9-22%
TRS
expansion

$0.8-2.0
trillion

3-10%
revenue
growth

$0.3-0.9
trillion

4-9%
margin
expansion[1]

$0.3-0.7
trillion

1 Cost reduction through productivity improvements and efficiency gains.

Where value can be captured

The value that could be captured from tech enablement across the advanced-industries sector is divided among five areas of value creation within the enterprise: innovating and developing products; making and delivering; selling; servicing; and running the corporation (Exhibit 1).

As part of our analysis, we identified how much additional value each of these five areas could contribute at an industry level. The results are illustrated in Exhibit 2.

Finally, we examined how value is distributed across the four core segments in advanced industries:

With the right approach, tech enablement can transform every part of the business

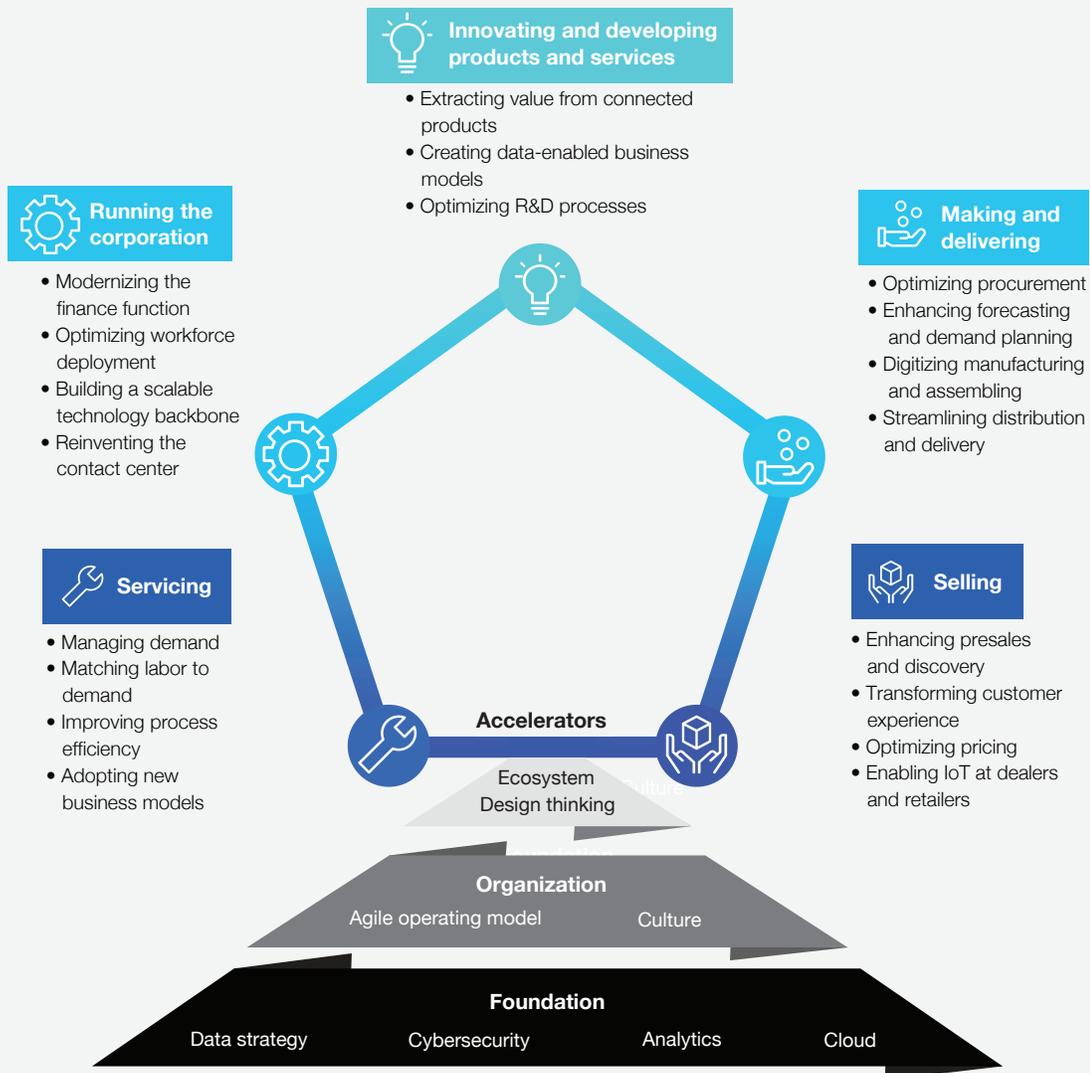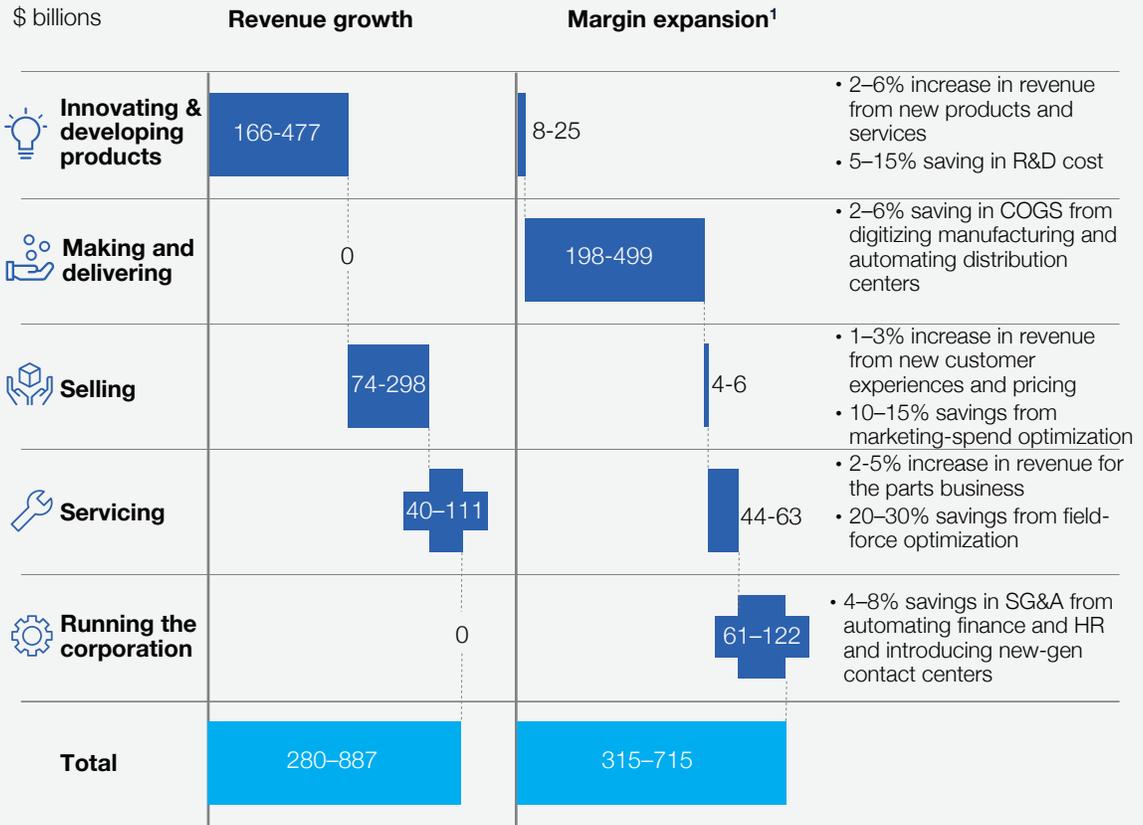**Innovating and developing products and services**
- Extracting value from connected products
- Creating data-enabled business models
- Optimizing R&D processes

Running the corporation
- Modernizing the finance function
- Optimizing workforce deployment
- Building a scalable technology backbone
- Reinventing the contact center

Making and delivering
- Optimizing procurement
- Enhancing forecasting and demand planning
- Digitizing manufacturing and assembling
- Streamlining distribution and delivery

Servicing
- Managing demand
- Matching labor to demand
- Improving process efficiency
- Adopting new business models

Selling
- Enhancing presales and discovery
- Transforming customer experience
- Optimizing pricing
- Enabling IoT at dealers and retailers

Accelerators
Ecosystem
Design thinking

Organization
Agile operating model   Culture

Foundation
Data strategy   Cybersecurity   Analytics   Cloud

EXHIBIT 2

Tech enablement could create enormous value across advanced industries

$ billions	Revenue growth	Margin expansion[1]	
Innovating & developing products	166-477	8-25	• 2–6% increase in revenue from new products and services • 5–15% saving in R&D cost
Making and delivering	0	198-499	• 2–6% saving in COGS from digitizing manufacturing and automating distribution centers
Selling	74-298	4-6	• 1–3% increase in revenue from new customer experiences and pricing • 10–15% savings from marketing-spend optimization
Servicing	40–111	44-63	• 2-5% increase in revenue for the parts business • 20–30% savings from field-force optimization
Running the corporation	0	61–122	• 4–8% savings in SG&A from automating finance and HR and introducing new-gen contact centers
Total	280–887	315–715	

[1] Cost reduction through productivity improvements and efficiency gains

automotive; commercial and other vehicles; aerospace and defense; and semiconductors and other industrial products, as shown in Exhibit 3.

Innovating and developing products and services

As connectivity spreads, data sources proliferate, and valuable insights can be generated in real time, companies have unprecedented opportunities to innovate across the board in products, services, and business models. Successful innovation relies not only on sound data and technology but on a deep understanding of how to use them to tap into new sources of value. For industrial companies, this

begins with an intimate knowledge of end users' needs and pain points. Depending on where you sit in the value chain, this could well mean getting to know not just your customer but your customer's customer. It's also likely to mean expanding into unfamiliar areas outside the boundaries of your traditional business.

Manufacturers of heating, ventilation, and air conditioning (HVAC) systems, for example, are venturing beyond their core of equipment sales. By using IoT technologies to analyze data from motion, temperature, and energy-use sensors, they can take over temperature monitoring and control

EXHIBIT 3

The value at stake varies by industry segment

	Revenue growth $ billions	Margin expansion[1] $ billions	TRS expansion $ trillions
Automotive[2]	107–367	116–259	0.2–0.4
Other mobility[3]	39–111	29–69	0.1–0.3
Aerospace/ Defense[4]	47–140	31–80	0.1–0.3
Broader industrials & semi-conductors[5]	86–269	139–307	0.4–1.0
Total	279–887	315–715	0.8–2.0
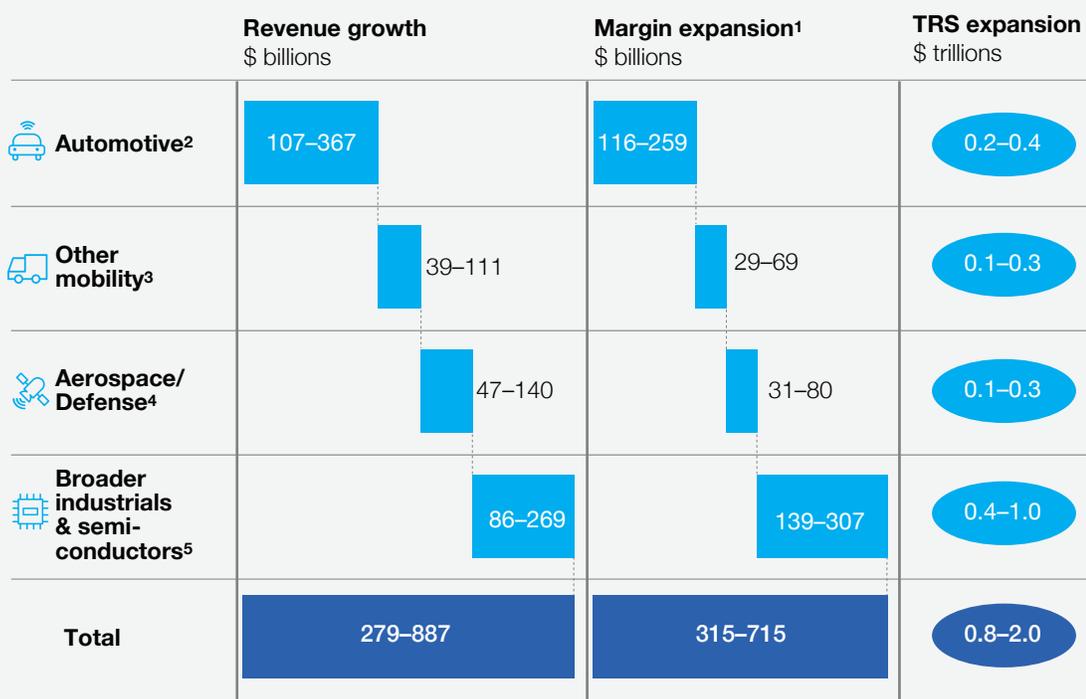
[1] Cost reduction through productivity improvements and efficiency gains
[2] Whole value chain including tier-one suppliers, automotive OEMs, and dealers
[3] Commercial vehicles and off-highway equipment (e.g., for construction and agricultural use) including tier-one suppliers, equipment manufacturers, and dealers and distributors
[4] Includes tier-one suppliers and equipment manufacturers
[5] Includes industrials, food processing and handling, motion and controls, industrial automation, and electrical, power, and test equipment across the value chain: component suppliers, equipment manufacturers, distributors, VARs, engineering and services providers, and product companies

in the office or factory from corporations, and help them manage their energy costs. In much the same way, original-equipment manufacturers (OEMs) and suppliers selling agricultural equipment have devised sophisticated controls that automatically adjust operating parameters and settings in real time to suit external conditions. The speed and direction of, say, a harvester can be fine-tuned to crop density, enhancing productivity and reducing equipment wear and tear. Manufacturers can deliver and charge for these and many other features on demand.

Making and delivering

Businesses can capitalize on advances in automation, machine learning, and robotics to make themselves more cost-efficient, flexible, and responsive to customer needs. The new era of automated production and data exchange opens up a broad range of use cases that can cut cost, increase yield, and support new manufacturing methods. Take the autonomous guided vehicles that move materials in plants and distribution centers, like the Kiva robots that Amazon uses to pick and pack goods

in its fulfillment hubs. Automation can cut storage, picking, and sorting costs by 10 to 30 percent—a hefty saving given that these activities typically account for up to 40 percent of costs in a distribution center.

In manufacturing, one of the many activities that lend themselves to automation is welding, a highly manual and error-prone process at most plants. Welding can account for 20 to 30 percent of the cost of manufacturing automotive equipment and large energy pipelines, for instance, and bad welds can be responsible for up to 5 percent of welding costs. Using robotic welding with intelligent controls, and monitoring quality during the process rather than afterwards, can reduce bad welds by up to 80 percent, adding up to 0.5 percent to manufacturers' margins.

Selling

Today's industrial companies sell their equipment through a complex set of channels that have evolved over decades. However, as younger and more digitally savvy people become industrial buyers and end users, they are increasingly doing their product research and order tracking online, often via tablets or smartphones. Meanwhile, traditional channels and sales models are being disrupted by innovators using technology to carve out new roles in the value chain.

To catch up, industrial companies should first gain a clear understanding of how their customers are buying and then work back along each customer decision journey to assess which digital tools and channels will add most value to the sales process and how to reinvent their selling platform. The options to consider range from e-commerce through an analytics engine that informs pricing and proposes the next product to buy, and from microsegmentation to digital customer-experience tools. When applied throughout the business, tools like these can improve productivity, margins, and customer stickiness, boosting profitability for first movers in a given sector.

Servicing

In aerospace, automotive, commercial vehicles, and other advanced sectors, aftermarket sales have grown more quickly than other areas of the business as capital investment in new equipment has slowed. Accordingly, aftermarket services—the provision of parts, repairs, maintenance, and digital services for the equipment a manufacturer sells—are the new focus of attention for leading industrial companies. These services provide more stable revenues than sales of new equipment and, often, higher margins as well. One McKinsey analysis across 30 industries showed that the average EBIT (earnings before interest and taxes) margin was 25 percent for aftermarket services, compared with 10 percent for new equipment.

The aftermarket service process is ripe for disruption. As innovative technologies such as predictive maintenance mature, manufacturers can use them to create stronger links with end customers, form a clearer view of how these customers use their products (and how the products perform), and capture increasing revenues from services. At the same time, tech enablement can be applied to field-force management, scheduling, and parts management to reduce costs and improve productivity.

Running the corporation

The many industrial companies that have pursued growth via acquisition end up running their business on multiple enterprise resource-planning (ERP) and legacy systems. Not surprisingly, median general and administrative costs for the sector—covering back-office operations in finance, human resources, legal, and marketing—are relatively high, at about 10 percent of revenues, with labor accounting for the largest share. Automating manual processes via robotic process automation (RPA) can significantly reduce these costs. Other measures to cut costs and improve cash flow include building data lakes to centralize data sets across ERPs, automating

financial reporting and invoice generation, and using advanced analytics to improve cash management.

Pulling it all together

To maximize value creation in a tech-enabled transformation, smart companies start by establishing a sound set of use cases across all five of these business elements. That's a critical step in setting aspirations, capturing value, and tracking value capture over time. Whether a company focuses on two or three of the business elements or looks to create value from all five through tech enablement, like the example in Exhibit 4, will depend on the nature of its business and its position in the value chain. But to avoid leaving value on the table, leaders would be well advised to examine all the elements in detail before deciding on the best approach.

The other imperative in starting out on a transformation journey is to check that your organization has all the supporting elements it needs, as described below.

EXHIBIT 4   What successful tech enablement could look like for an OEM

Running the corporation
Establish data lakes to pool data across multiple ERPs, and employ "build, operate, transfer" model to automate reporting and other manual tasks in finance and HR

SG&A down by 8%

Innovating and developing products and services
Deploy sensors and connectivity on products to better understand customer usage, and develop services to generate new revenue streams

Revenue up by 6%, R&D costs down by 15%

Making and delivering
Use advanced analytics to enhance forecasting, and deploy robotics, machine vision, and decision automation in factories and warehouses to reduce labor costs in picking, sorting, welding, and other workflows

COGS down by 6%

Servicing
Employ models to predict customers' servicing needs, and increase attach rate for service revenues

Parts revenue up by 4%, field-force cost down by 30%

Selling
Adopt digital tools to enhance salesforce productivity, scale e-commerce channels to address transactional sales, and deploy advanced analytics to optimize pricing

Revenue up by 3%, marketing cost down by 15%
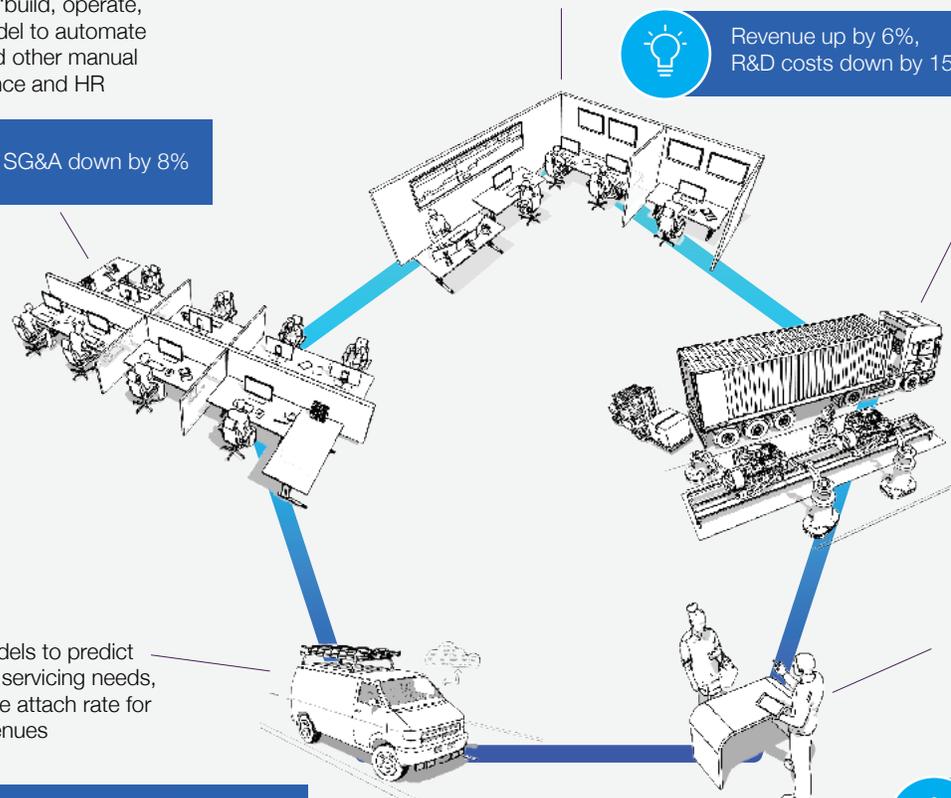
Ensuring the right enablers are in place

In considering the capabilities, structures, and practices that industrial companies need for a successful transformation, we find it helpful to define three sets of prerequisites that executives can use as a checklist in prioritizing initiatives and allocating resources.

Foundation: Data strategy, cybersecurity, cloud infrastructure, and analytics

A comprehensive **data strategy** involves identifying the data sets you need to drive insights across your priority use cases, understanding the sources of those data sets, and forming partnerships to access those that you need but don't own. For instance, a manufacturer seeking to reduce downtime for its mining equipment will need to combine its own data with a host of maintenance and usage data from the mining operators that use the equipment. Establishing which data sets you need and then building productive partnerships with OEMs and component manufacturers to access them will be critical in maximizing value capture.

As companies connect enormous numbers of devices and develop ever-more-complex data structures, **cybersecurity** becomes increasingly important. Once, cyberrisk was mainly confined to IT functions, but as businesses hook up their production systems to the Internet, operating technology comes under threat as well. Seventy-five percent of the experts who took part in a recent McKinsey survey said that IoT security was important or very important, yet only 16 percent felt their organization was well prepared. Building resilience will involve prioritizing assets and risks, improving controls and processes, and establishing effective governance.

Establishing the right **cloud infrastructure** involves creating flexible environments and sound application programming interfaces. Companies also need to think through which data should be in the cloud and which on the "edge"—on the devices themselves. Such decisions will largely depend on how much real-time processing is required. For instance, autonomous driving lends itself to an edge architecture, whereas analyzing consumption trends by aggregating data from connected appliances can be handled in the cloud at much lower cost.

Equipping your organization with **data analytics** capabilities to drive insights will be critical in capturing value. Whether you build the capabilities in house or outsource them will depend on your circumstances and needs. Often it makes sense to do both in the early stages, building capabilities over the long term while using outsourcing to accelerate short-term impact. Regardless of which route you take, data analytics and insight generation must be linked to actions that you can take to generate impact. For instance, if you are introducing analytics-driven dynamic deal scoring to improve margins, your reps will need a quoting tool that shows them the recommended prices, and leaders will need a performance-management system that tracks improvements across the whole sales team over time.

Organization: Agile operating model and culture

The ability to respond quickly to changes in the business environment relies on an **agile operating model** with small, flexible teams and clear processes that allow timely decision making on issues relating to governance, funding mechanisms, resource allocation, and so on. Old-style yearlong development cycles must give way to rapid iterations in which teams repeatedly test and refine concepts and products with customers.

Such an approach requires corresponding changes in an organization's **culture**. Successful companies take great care to foster a mind-set that embraces change, is comfortable taking risks, and views failure as a springboard for learning.

Accelerators: Design thinking and ecosystem

Using customer insights to rapidly innovate on products, services, and offers calls for new capabilities and tight linkages between a company's sales channel and its product organization. **Design thinking** uses closed-loop processes to generate customer insights, translate them into product features and services, rapidly deploy these elements with the customer, test the impact, and repeat as necessary until the desired impact is achieved.

Building an **ecosystem** is the final enabler and involves establishing a set of technology and go-to-market partnerships. The complexity of a tech-enabled transformation requires partners to share data, insights, and the value created in a mutually satisfactory and sustainable manner.

Getting started

- Though tech-enabled transformations in advanced industries are still in the early stages, companies have no time to lose. An early mover with the right strategy could not only reduce costs across the board, but also leapfrog over competitors and capture disproportionate value by gaining market share from peers or being the first to respond to radical shifts in customer behavior.

- Every company's approach to transformation will reflect its individual starting point and business priorities, but any leader would do well to follow a few basic steps:

  — *Understand where you are and build your transformation roadmap.* Too often, companies deploy solutions without first taking care to understand their current situation. Set a baseline and be realistic about your starting point and digital maturity—which will partly determine how much value you can expect to capture. Then, work out where the value lies, assess your capabilities, and build a roadmap that prioritizes and sequences the key elements in your transformation. Develop a clear view of the value-chain elements your business touches, your competitive environment, and the ways technology could disrupt it: for instance, through customer-service apps. Think in terms of three-to-five-year horizons to ensure you keep pace with the evolving technology and business landscapes.

  — *Analyze every aspect of the business.* When embarking on a tech-enabled transformation, the best way to start is by taking a step back and considering exactly what you want to achieve. Obvious though that might sound, it's not so easy to act on. Some companies are so overwhelmed by, say, the promise of the Internet of Things that they jump straight into working out how to introduce IoT applications into their products and operations. Instead, evaluate your whole business to see where technology could unlock the greatest value. If you are an industrial distributor, for instance, you may be able to improve your margins much faster by adopting analytics-based pricing or digitizing your selling process than by creating IoT-enabled services. Implementing and scaling basic technologies is a quick way to learn and capture value before venturing into more sophisticated territory such as remote diagnostics and maintenance.

  — *Reimagine your business model and aspirations.* Don't use technology to make your current model marginally more efficient. Set a bold aspiration to ensure the changes you make don't just reinforce the status quo. Define metrics and operational performance indicators to track improvement, and ensure you have leadership support. Treat your program as a transformation, not an incremental initiative.

— *Understand how new technologies affect working processes.* To succeed, new technologies need to operate in conjunction with legacy systems and existing workflows. Consider an OEM adopting IoT-enabled solutions to offer predictive maintenance. When a client's system detects an equipment problem, it automatically notifies the OEM to send a service rep to carry out unscheduled repairs. But for this to work, the OEM has to integrate these notifications into its service-dispatch processes so that reps are sent out promptly. Closing the loop on workflows in this way is a critical step in capturing value.

◆ ◆ ◆

Though advanced industries have been slower to digitize than many other sectors, advanced technologies now allow companies to reshape all their activities from product development to sales and servicing. Our experience indicates that taking a bold, strategy-led approach and identifying opportunities systematically across the entire business is the best route to a successful outcome. ◆

Venkat Atluri is a senior partner in the Chicago office, where **Satya Rao** is a partner and **Saloni Sahni** is a consultant.