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The new chief operating officer: Powering operations with artificial intelligence

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The coronavirus pandemic has underscored the importance of operational agility. Consider this future scenario: Before the next crisis or disruption strikes, your artificial intelligence (AI) system, analysing continuous streams of data from suppliers, customers and public sources, has already predicted it. Digital reflections (also known as digital twins) model the range of possible effects on your operations — on your suppliers, your distributors, your workforce and your market demand — to inform your response.

With a diversified, localised supply chain (seamlessly managed through the cloud and AI), you quickly scale up supplies from local producers and change product offerings. Your use of technologies such as robotics and 3D printing to automate complex operations makes the shift to new production, products and distribution seamless. Meanwhile, advanced analytics, supported by data from Internet of Things (IoT) sensors, have made your operations so efficient that the switch to new suppliers barely adds to your costs.

The technologies to support this scenario are available today or will be soon. But to realise their potential, companies must:

- Assess what they are currently capable of and what they want to be able to achieve
- Understand how to shape their operational priorities, aligned with their strategy and customer and end-market needs
- Consider how the implementation of these technologies and tools will strengthen their organisation's data fabric and enable effective and pervasive use of AI.

The goal is to give executives accurate data throughout the enterprise — including on sales, product launches, plant operations, suppliers, warranty claims, workforce and finances — coupled with the ability to use experience -based AI tools for both routine and critical decisions.

Even before COVID-19, forward-looking companies were making and profiting from operational investments in the 'Essential Eight' emerging technologies.[1] Consider supply chains, for example, in which many industrial manufacturers have been working to create autonomous and continuous supply chain ecosystems. A recent PwC study[2] (conducted before the pandemic) found that such investments paid for themselves in less than two years, on average. The ROI came not just from lower costs, but also from increased revenue, reduced inventory and more reliable delivery.

But the coronavirus crisis has made it clear that, as companies adapt to a new world,[3] they need what only truly modern operations can provide: broad and deep visibility into the operational value chain (supply, manufacturing, distribution and demand), accurate forecasts of what might impact those operations, resilience to potential disruptions, tools that help them quickly sense and predict changes in market demand, and the ability to swiftly adapt the value chain to deliver on its promises to customers. Some companies will need to rethink their operating model to better position themselves to handle challenges — COVID-19, in the near term, but also future crises — that disrupt the way people live and work. For example, if borders are shut down, transportation is constrained and emissions are more effectively monitored, how can organisations design their supply chains?

1 PwC, *The Essential Eight: Your guide to the emerging technologies revolutionizing business now,* 2019: https://www.pwc.com/gx/en/issues/technology/essential-eight-technologies.html.

2 PwC, *Connected and autonomous supply chain ecosystems 2025*, 2020: https://www.pwc.com/gx/en/industries/industrial-manufacturing/digital-supply-chain.html.

3 Blair Sheppard, Daria Zarubina and Alexis Jenkins, "Adapting to a new world," *strategy+business*, 13 May 2020: https://www.strategy-business.com/article/Adapting-to-a-new-world.

Rethink your operations

As you begin or accelerate efforts to modernise your operations, you will need a global vision to guide your decisions about what to prioritise. Start with an operations audit: assess how well your company performed during the COVID-19 disruption and identify what you wish you had done better, and start thinking about not just how best to prepare for future disruptions, but also how to create more agile and efficient everyday operations.

As part of this process, you'll need to ask a series of questions: How can you reconfigure supply chains and product management for lower costs, greater resilience and increased flexibility — while you also differentiate your business model? How can you sense and respond swiftly to changes in customer demand or distribution centres' capacity? What type of workforce will you need, both human and machine, and how can you synchronise that workforce to achieve maximum resilience while minimising costs? How can you make the workforce agile enough to adjust to potentially sharp changes in demand and supply?

As you go through this process, consider your onshore, nearshore and offshore operations. Imagine how humans, machines and AI should interoperate across this entire value chain to give you the insights and adaptability that you need, and give your customers the products and experiences they crave. Flexibility in operations may require you to think like a leader of a digital platform or media company: focus on being a business integrator and a guardian of quality, while including more local and autonomous producers.

You'll also need to question your previous priorities. In a pre–COVID-19 world, just-in-time production was a top supply chain priority. Today, resilience and adaptability may take precedence. Before, labour cost arbitrage guided many workforce decisions. Today, flexibility, safety and dependability may be even more important.

Consider the example of one global industrial manufacturer. It performed an operations audit of its ongoing COVID-19 response and discovered a glaring gap: the company lacked a global database of COVID-related workforce risks. Yet it had hundreds of facilities (including factories, R&D labs, warehouses and offices) in dozens of countries — its employees faced an extraordinary range of risks. To close the gap, the company built a risk and data platform, which expanded beyond health risks to include regulatory, political, and tax- and trade-related risks. An AI-enabled analytical engine provided regular insights and forecasts.

The company also developed a location-by-location database of manufacturing and logistics costs, along with AI-supported estimates for lead times, and capital costs for building, opening and shutting down different facilities. This platform is enabling the company to shift products and production to reduce costs and to quickly seize new market opportunities. And it is supporting (and is supported by) increased IoT capabilities, both in the company's own production and as a service to customers.

Flexibility in operations may require you to think like a leader of a digital platform or media company: focus on being a business integrator and guardian of quality.

Meet your top operational priorities

With your global vision to guide you, you can identify and integrate the technology and tools you need. These tools are converging in six ways[4] that can meet organisations' top operational priorities. In normal times, these suites of tools will boost productivity, agility and revenue. During disruptions, they will enable greater resiliency and cost flexibility. As companies reconfigure to ensure they are able to compete in an information- and platform-based economy, technology strategy and business model transformation will go hand in hand.

4 PwC, *The Essential Eight: Your guide to the emerging technologies revolutionizing business now*, 2019: https://www.pwc.com/gx/en/issues/technology/essential-eight-technologies.html.

In normal times, these tools will boost productivity, agility and revenue. During disruptions, they will enable greater resiliency and cost flexibility.

- **Detailed, real-time information for more effective management.** Hyperconnected networks, based on billions of IoT-connected endpoints, combined with the cloud, 5G[5] and mesh networking, can gather data from both tiny products and giant factories. These granular insights will enable better operational decisions with respect to cutting costs and increasing revenue, as well as supporting more predictive, adaptive and remote operations.
- **Accurate, continually refined operational insights and forecasts.** The IoT, combined with agent-based modelling and other advanced AI techniques, can create digital reflections[6] of how assets behave and interact with one another. You can then accurately map out your operations, better manage more complex supply chains, quickly adapt to boost resilience, meet changing market demands and cut costs.
- **Greater automation of industrial processes.** Robotics, drones and 3D printers, directed by AI, will automate even highly complex operations. This will reduce risks and costs, improve the employee experience, and increase resilience and revenue. It will also support more low-cost, localised production, further increasing your capacity to mitigate major disruptions.[7]
- **Tracing and verification of operations and transactions.** Blockchain, together with the IoT and AI, can automatically verify[8] data, identities and multiparty transactions. Automated trust reduces verification and compliance costs. It can provide reliable financial data quickly. It can also trace materials and products along the supply chain, increasing customer satisfaction and reducing risks of fraud and quality failures.

5 PwC, *5G in manufacturing: How the new wireless standard can accelerate automation*, 2020: https://www.pwc.com/gx/en/industries/tmt/5g-in-manufacturing.html.

6 Matthew Siegel and Chris Greenwood, "Organizational effectiveness goes digital," *strategy+business*, 29 May 2019: https://www.strategy-business.com/article/Organizational-effectiveness-goes-digital?gko=56fab.

7 PwC, *The fourth industrial revolution: A recovery plan for today's economic storm*, 2020: https://www.pwc.com/us/en/library/4ir-ready/fourth-industrial-revolution-economic-downturn.html.

8 Scott Likens and Kris Kersey, "Automating trust with new technologies," *strategy+business*, 1 May 2019: https://www.strategy-business.com/article/Automating-trust-with-new-technologies?gko=7e5a3.

- **Superior employee and customer experiences.** Immersive interfaces based on the IoT, AI, and virtual and augmented reality (VR/AR) can react to touch, motion and emotion, as well as language. This more natural human–machine collaboration can make the workplace safer and more efficient, enhance the customer experience, and enable companies to measure employee and customer experiences[9] to continually improve them.
- **More reliable, adaptive remote work.** Simulated environments, supported by the IoT, AI, VR, AR and MR (mixed reality) can enhance the learning[10] and execution of complex physical and cognitive tasks — even many industrial processes that traditionally take place onsite. This will then boost workplace safety and cut facilities costs, while increasing the ability to adjust and shift production without geographic restrictions.

To see the value of these tools in action, look to the experience of one major North American industrial manufacturer. After launching a state-of-the-art product with an accompanying services model that had huge market potential, the company set out to build a next-generation manufacturing facility, maintenance services platform and connected supply chain. The upgrade began with the COO and CIO instructing their teams to jointly define the core operations, IoT architecture and information flows to meet the business's operational and strategic priorities.

The teams created an integrated engineering–manufacturing–supply capability to ensure throughput and high quality, a cloud- and IoT-enabled product, a manufacturing and maintenance platform to minimise product and life-cycle costs, and a supporting cost management model. Sample tools include cameras enhanced with machine learning to inspect quality, real-time value stream analysis, machines and reports personalised (using AI) for individual workers, AR-enabled diagnostics, and AI-enabled reports delivered to mobile devices.

The overall feel is more like a technology company in terms of ways of working: software engineers are front and centre, working alongside the product and production engineers, and decision makers have access to verified, continually updated data to support their response. By taking a modular approach, based on the cloud and software, this production facility and supply network can be continually upgraded, so it will be modern not just today, but far into the future.

9 Matt Egol, Reid Carpenter and Sujya Saha, "ROX: How to get started with the new experience metric," *strategy+business*, 29 Mar. 2019: https://www.strategy-business.com/article/ROX-How-to-get-started-with-the-new-experience-metric?gko=d8837.

10 PwC, *The VR advantage: How virtual reality is redefining soft-skills training*, 2020: https://www.pwc.com/us/en/services/consulting/technology/emerging-technology/vr-study-2020.html.

Build an AI-powered organisation

With your vision and the right tools in place, the next step is to transform operations and decision making. AI can help companies move quickly from data to insights, decisions, actions and outcomes. This journey requires one to have both hindsight and foresight. AI gathers the oceans of data that the six operational priorities produce and then organises, analyses and presents it in a dashboard, providing a view of continuously updated insights into what happened and why.

AI also takes this data to make a 'cockpit': an application that projects what will happen in the future and why, answering what-if for different scenarios. By continually modelling and evaluating the full range of scenarios, this cockpit helps your employees make both short- and long-term decisions. Moreover, after each decision is made, your dashboard and cockpit continue to provide updated insights into the past and to model new scenarios for the future. These models are dynamic, accounting for the fact that policymakers' and consumers' responses to a changed scenario will alter future scenarios.[11]

11 Kay Firth-Butterfield and Anand Rao, "Lessons from COVID-19 modeling: The interplay of data, models and behaviour," World Economic Forum, 12 May 2020: https://www.weforum.org/agenda/2020/05/covid-19-coronavirus-models-data-behaviour-infection-death-rate-flatten-curve-policy/.

The dashboard and cockpits will not be isolated tools, limited to the COO's office: they will be embedded throughout operations, offering insights, permitting greater automation and enhancing decision making at every level. Your supply chains, for example, will have a 'control tower,' which is a dedicated team with access to data on all shipments and inventory, with AI-enhanced analytical tools to identify emerging issues and perform what-if scenario analyses.

Other examples include automatically inspecting product quality by video; determining preventive maintenance from audio, sensor or image data; sensing market demand using social media, sensors and economic data; modelling scenarios for long-term supply chain resilience; optimising workforce planning and scheduling; and automating an ever-greater number of physical and cognitive tasks. As AI advances further, it will offer the COO strategic recommendations and make more low-level decisions autonomously. It will continually improve its suggestions and decision making by learning from its own mistakes and successes.

This AI-powered future requires you to embed not just IoT sensors, but elements of AI throughout your value chain. You will have to embed AI into your overall IT stack, with a common services layer to allow any application to integrate with AI models. You will also need an AI-ready workforce,[12] in which product owners have the basic digital skills to collaborate with data scientists and data engineers, and develop new roles as needed.[13] For example, machine learning operations ('ML ops') engineers are increasingly needed to integrate AI models with downstream applications and maintain the health of these applications.

Of course, AI will bring with it new risks, which you will have to manage by making your AI responsible: bias-free, ethical, well-governed and featuring the right balance of transparency and performance. As your revamped operations create many additional cognitive assets — AI models that encapsulate your company's experience and expertise in a specific domain — you can reinvent your business model to monetise these new assets. You will then find that your company is no longer 'just' an industrial manufacturer, but an industrial digital organisation.[14]

Consider the following example (a composite of the experiences of executives at several consumer goods companies) as an illustration of how AI can provide a dashboard and cockpit to help leaders understand the present, model the future and enhance decision making at every level. It also points to possible changes in organisational roles and structures, as well as decision-making approaches.

After each decision is made, your dashboard and cockpit continue to provide updated insights into the past and to model new scenarios for the future.

12 Carol Stubbings, "The case for change: New world. New skills," *strategy+business*, 9 Jan. 2020: https://www.strategy-business.com/blog/The-case-for-change-New-world-new-skills?gko=1482a.

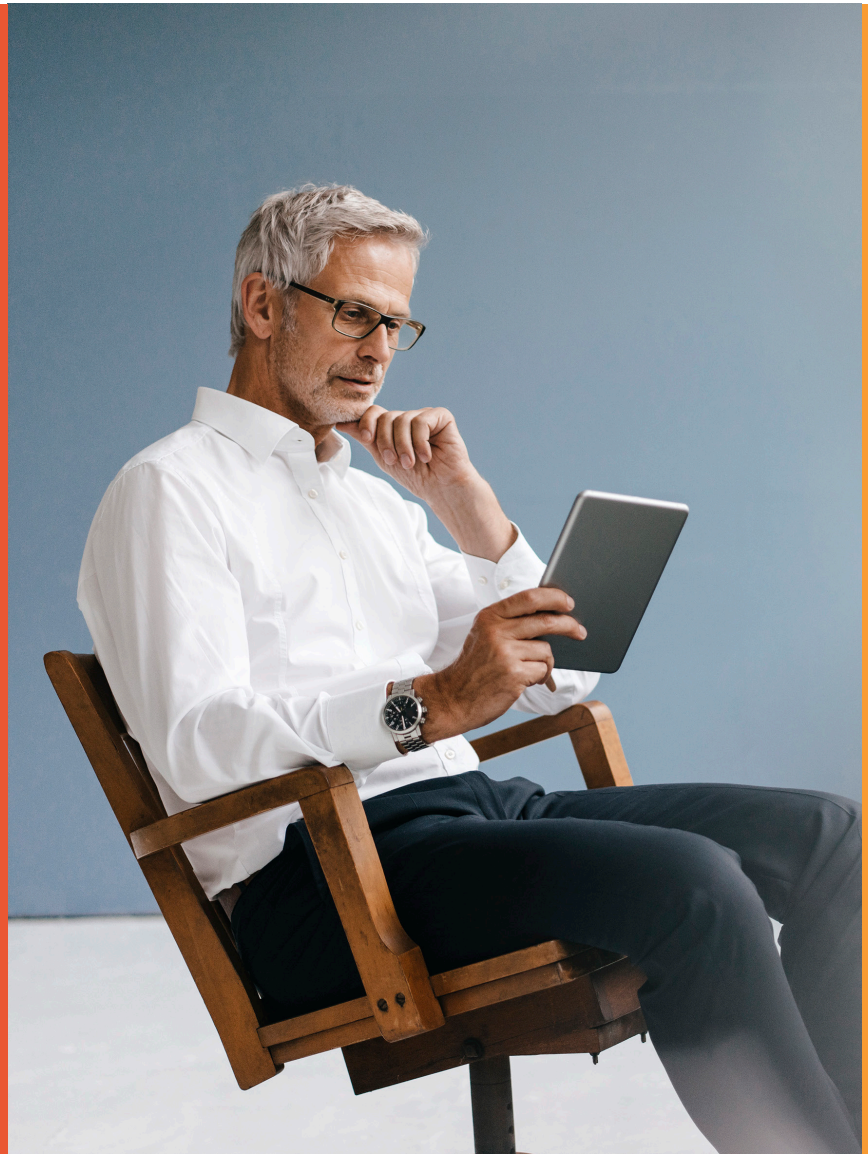
13 PwC, *2020 AI predictions: Operationalize AI — integrated and at scale*, 2019: https://www.pwc.com/us/en/services/consulting/library/artificial-intelligence-predictions-2020/operationalize-ai-integrated-and-at-scale.html.

14 PwC, *Defining the new DNA of industrial digital organisations: The CEO's agenda*, 2019: https://www.pwc.com/gx/en/industries/industrial-manufacturing/publications/defining-new-dna.html.

When the head of the company's supply chain control tower saw that store motion sensors reported a 20% increase in foot traffic in the Southwest US, his dashboard showed him store sales data and identified three products whose sales had grown more than 30% each, as well as the inventory for each of those products. Turning to his cockpit, this executive then viewed estimates for future sales, how fast inventory would be depleted, when shipments were scheduled to restore inventory and what risks to those shipments existed. When the cockpit identified the risk of a typhoon threatening a shipment from Asia — which would cause one of the three products to go out of stock during the prime shopping time around Thanksgiving — he called his COO.

The COO logged onto her cockpit using her tablet, which displayed the same scenarios that her supply chain tower head had identified. The AI-based supply chain resilience model embedded in the cockpit offered two alternatives to maintain inventory: a fast, costly air shipment from Canada and a slower, more economical shipment from South America. After the AI analysis indicated a low probability of disruptive events, such as poor weather, on the South American route, she chose that shipment option.

The COO next took the Southwest sales data to the executive team. Using an AI-powered customer insights platform that was part of his cockpit, the marketing manager identified 220 other counties in the US with demographics similar to those of the Southwest stores' customers. With a marketing campaign planned for these demographics, the COO used her cockpit to confirm the products' availability and the most cost-effective way of delivering them. An AI-enabled financial model integrated into the cockpit estimated the likely increase in sales — which enabled the CFO to adjust financial projections and enabled sales offices to set new targets.

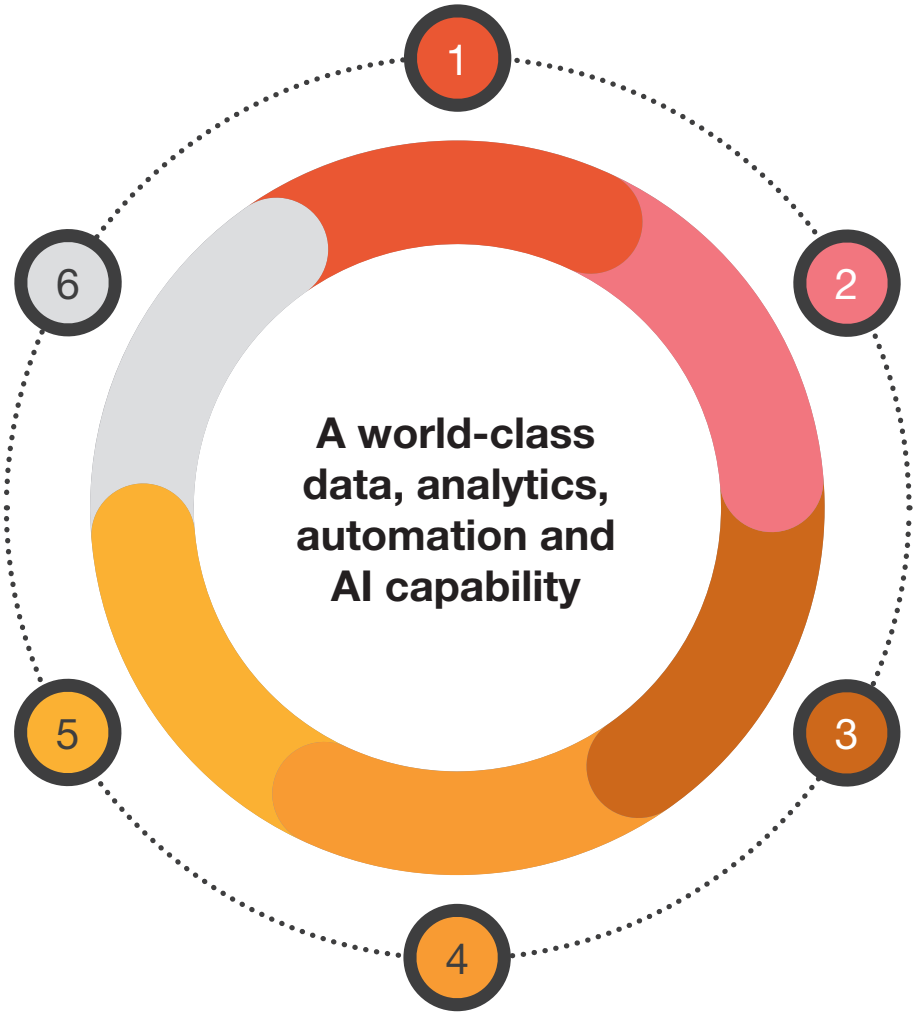


COOs can take five actions to get started

The imperative for companies to rethink their operations in preparation for crises of all magnitudes is clear.

- **Take stock of your crisis response.** Start with a deep understanding of how your operations — workforce, suppliers, distribution and demand sensing — performed during this pandemic. Then construct a long-term vision of how your operations can use technology to ensure it can quickly pivot to mitigate disruption or seize new opportunities. Consider how the data these technologies produce can support a wider organisational transformation.
- **Integrate technology into your culture.** Upskilling is one part of this story, but another part is culture change. The goal is to build an organisation in which humans and machines interact seamlessly and human decision making draws on machine-verified data and analysis. To achieve this, you'll need a culture that trusts machines as allies, rather than fears them as rivals.

Focus on six organisational elements to achieve information maturity



1. Business decisions and analytics
What key metrics do you want to address using data and analytics, automation and AI?

2. Data and information
What is the availability of and access to structured and unstructured, operational and sensor data?

3. Technology and infrastructure
How are you building or automating the systems to operationalise better decision making?

4. Organisation and governance
How are you combining emerging tech, traditional IT and operational teams?

5. Process and integration
How are you standardising, simplifying and automating your operational and decision-making processes?

6. Culture and talent
How will you build and encourage an operational culture driven by data, insights and outcomes?

Source: PwC

- **Develop a world-class data, automation, analytics and AI capability.** As your company begins to accumulate significant quantities of data, you'll need the organisation and governance to clean, distribute and analyse this data across aligned teams. As companies move along the information maturity scale, they'll need to focus on six organisational elements (see exhibit on page 13):
  - **Business decisions and analytics:** insights that fuel the business strategy
  - **Data and information:** flexible integration of multiple data types
  - **Technology and infrastructure:** tools that support the analytics ecosystem
  - **Organisation and governance:** operating model that enables and empowers users
  - **Process and integration:** agile integration of insights into decisions
  - **Culture and talent:** data-driven culture blending business knowledge and analytics insights.
- **Build trust among clients and other end users.** Take steps early to protect the data that will pass through operations, integrating both cybersecurity and privacy rights to foster consumer trust. You'll also need to prepare for ever-greater, more democratic use of AI[15] by ensuring that your AI will be responsible,[16] that is, secure, free from bias, ethical, explainable and well-governed.
- **Embrace agility as you roll out.** Start with business units and processes where operational enhancement will offer rapid ROI, then fail fast if needed, scale up winners and repeat. Continually reassess capabilities and needs, and determine how fast-evolving tech can fill them.

At its best, the process of using new technologies to enhance operations will be both iterative — with each step generating enough ROI to fund future ones — and guided by a broader vision. Companies will then find themselves on a path to operations that can pivot quickly and wisely, within an entire organisation powered by data and enhanced by AI.

15 Anand Rao, "Democratizing artificial intelligence is a double-edged sword," *strategy+business*, 15 June 2020: https://www.strategy-business.com/article/Democratizing-artificial-intelligence-is-a-double-edged-sword?gko=ffdcd.

16 Ilana Golbin, "Responsible AI is even more essential during a crisis," *strategy+business,* 16 June 2020: https://www.strategy-business.com/blog/Responsible-AI-is-even-more-essential-during-a-crisis?gko=775f4.

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