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Enhancing the tech backbone

By making the right investments in this foundational asset, industrial companies will be better positioned to take advantage of next-generation, data-driven tech solutions.

by Mark Huntington and Christoph Schrey

Most industrial companies struggle to quickly and effectively deploy technology solutions for their customers and internal business functions. All too often, new technology-enabled initiatives—such as aftermarket solutions to create new revenue streams, Internet of Things (IoT) platforms to improve the efficiency of manufacturing processes, or analytics use cases that could transform core operations—fall short of expectations. One key reason is that a company's tech backbone is outdated, inflexible, or insufficiently resilient to support the requirements of next-generation technologies.

Why is a tech backbone so critical to operations—to say nothing of a tech-enabled transformation? In short, the tech backbone manages the storage, aggregation, analysis, and provision of data across the organization. Companies with obsolete legacy systems face significant challenges in consolidating data from different sources, maintaining consistency and quality, and making the necessary updates within the required timelines. And because solutions based on analytics, AI, and the industrial IoT all rely on unfettered access to comprehensive, high-quality data to generate business insights, an inadequate tech backbone will severely limit the impact of these technologies.

Well-considered investments in upgrading the tech backbone can generate real value. Industrial companies that successfully modernize their tech backbones can improve efficiency of their end-to-end tech solutions by more than 20 percent. Further, optimized systems can be more than 20 percent cheaper to operate and maintain in addition to being more resilient and secure.

So how should industrial companies move forward? The path will be shaped by a company's strategy and its starting point—each organization has its own advantages and obstacles to overcome. We have identified three archetypes for enhancing the tech backbone, from a complete overhaul of foundational systems to a more surgical approach. By explicitly connecting tech-backbone upgrades to specific use cases and priority domains,

industrial companies can ensure these efforts translate into business value.

The elements of the tech backbone

As a first step, industrial companies must assess the current state of their tech backbones. Understanding what its elements are and how they work together to power technology solutions can help business leaders gain clarity on where they are falling short.

Core systems and integration architecture. To design, manufacture, and service a new product, multiple systems must work together effectively. With the right integration layers, critical data elements (for example, engineering data, manufacturing data, and bill of materials) can seamlessly move between the core systems of record—which include enterprise resource planning, product life-cycle management, and manufacturing execution systems—to create a "digital thread" from engineering to servicing. Furthermore, the divide between information technology and operational technology can be bridged to enable data exchanges across both areas. An effective integration architecture prevents manual rework, allows products to be brought to market faster, and supports data-driven decision making.

Data management and storage. To support operations and make better decisions, the way companies manage and store data must be improved. This effort applies to master both customer and product master data as well as transactional data that is often stored across many different systems. An effective tech backbone successfully manages data across the full ecosystem to provide relevant, quality data in an efficient way. Companies should define the "golden sources" of record for master data and set up a data warehouse, data lake, or other fit-for-purpose data-storage solution. Managing data correctly in the tech backbone significantly improves reporting quality, the performance of analytics, and overall business operations.

An API ecosystem. Application programmable interfaces (APIs) enable the IT function to conveniently build and implement new applications in the ecosystem. Having the right integration

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architecture and data-management capabilities is critical to effectively connecting the existing software solutions in the backbone. With the right API ecosystem, applications can be built and refined in days rather than months. APIs can seamlessly build on the data foundation and existing system functionality, which allows customer-facing domains (for example, aftermarket services) to respond flexibly to customer requests and new business needs.

Next-generation approach to hosting and infrastructure delivery. The software solutions and data need to be stored on the right infrastructure (such as servers and networks). In the past, many companies avoided their own data centers and hosting solutions. With next-generation cloud solutions, companies can design and implement infrastructure that features unprecedented cost efficiency and security. In the past, companies would sometimes need weeks to execute new servers. Now, however, the latest infrastructure offerings reduce provisioning time to mere minutes.

Agile execution model. The tech backbone is one critical building block for faster and more effective solution delivery. However, new hard- and software solutions alone are not enough; IT and business employees will need to work together using agile delivery methodologies to unlock their full improvement potential. If the infrastructure allows for multiple releases a day, for example, the joint business and IT teams must be able to coordinate their activities to capture the business improvements that come with this ability.

Secure environments. Organizations must ensure that the faster and more efficient delivery of software and analytics solutions doesn't result

in higher security and safety risks. The tech backbone needs to be designed and built to better protect intellectual property, sensitive data, and the overall stability of the systems. Companies that integrate information security effectively into the design and maintenance of the backbone can strengthen infrastructure security while retaining the necessary flexibility to support their operations. Furthermore, this can be done without increasing the cost of deployment and maintenance.

Challenges to improvement efforts

Once industrial companies have identified the gaps in their current tech backbone, as well as the necessary improvements to support business strategy, they must take on a more difficult task: overcoming the entrenched obstacles standing in the way of a renewed tech backbone. Several challenges can obscure a clear path forward.

First, changes in the backbone should always directly support business value. However, companies often struggle to determine which elements in the tech backbone are critical to support specific use cases or priority domains. The seemingly continuous procession of new solutions can also overwhelm organizations. Companies can get too fixated on technologies and software rather than asking how specific capabilities and features can help make a broader impact on the business.

In addition, companies can be discouraged by the scope of and commitment to renewing the tech backbone. It is usually a multiyear journey that requires significant investment, and a multitude of dependencies make it difficult to decide where to start. Specifically, if a company has limited funds, the key question is which changes should be made now rather than later. The complexity of

a backbone transformation is characterized by a multitude of interdependencies and tight timelines. As a result, companies often fail to develop an integrated architecture plan and comprehensive road map. Overly long cycles (such as a yearly cycle rather than quarterly or monthly) and weak program management further hinder progress and execution.

Last, companies frequently overlook the work required to gain consensus with stakeholders. Backbone transformations are costly and require support across the organization. If stakeholders don't understand the need and impact of the work, funding and support for these initiatives can falter when priorities change.

As a result of these challenges, we usually see two types of failures:

1. Companies make investments in technology without demonstrating value in digital or analytics use cases or clearly articulating a long-term vision. This approach usually means that an organization's large investments have little or no impact.

2. Organizations create digital or analytics solutions without investing in the backbone, meaning that promising solutions cannot be scaled across the enterprise. As a result, many companies have found themselves in "pilot purgatory," where multiple pilots run in parallel without enhancing each other and with no clear path to enterprise-wide application.

To avoid these types of failures, companies should ensure their backbone renewal efforts embody the following principles:

Link any improvements to business value.
Replacing any part of the tech backbone without understanding how upgrades will help generate value for the business (in the form of increased revenues, reduced costs, or better performance) will risk the success of the overall transformation.

Companies must recognize the importance of foundational elements. These elements may not appear to be directly linked to a business initiative, but they ultimately help accelerate the delivery of business solutions or otherwise improve a business- or customer-facing project. Understanding these motivators is important for the success of a backbone transformation.

Define the road map and vision for the backbone.
Without a compelling vision for why the tech backbone must evolve and the path to improvement, every transformation will fail. Companies must articulate the vision and road map and then use these pieces to gain buy-in from stakeholders. To focus these efforts, business leaders should identify the capabilities or solutions they want to support during the next two to five years. For example, if a company is interested in developing a digital experience for customers that is tied to its products, then the transformation should concentrate on enabling connected products.

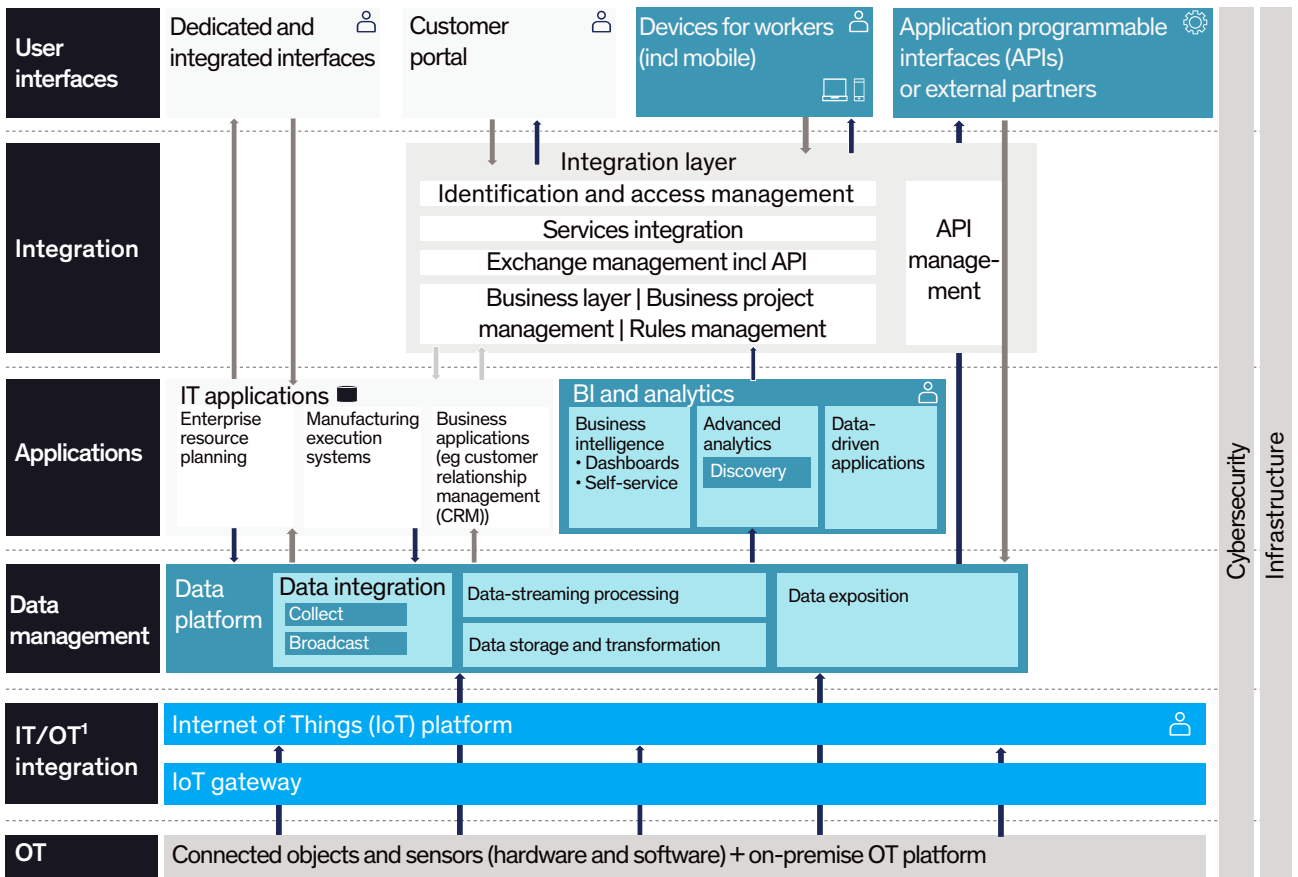*Establish a transformation office.*
A backbone transformation is a significant undertaking that touches many different IT and business functions and requires assistance from external parties: vendors that can help build and refine the backbone as well as the potential suppliers and partners that will connect to it. Therefore, a dedicated and well-resourced transformation office is critical to guide the transformation. This office should deploy an agile development approach to ensure that the road map is executed correctly and achieves the expected business value.[1]

Use a layered architecture. The tech backbone needs to remain flexible so that it can accommodate changing business needs and support growth (exhibit). The layers of successful architecture include core systems of record (data management), integration, and APIs. When assembled appropriately, these elements will enable greater flexibility.

[1] For more about the transformation office, see Matt Banholzer, Etienne Billette, Laurent Kinet, and David Pralong, "How transformation offices help tech-enabled transformations succeed," on p. 77 of this collection.

A reference architecture supporting industry 4.0 is data-centric and separates data from applications.

User interfaces	Dedicated and integrated interfaces 👤	Customer portal 👤	Devices for workers (incl mobile) 👤 💻📱	Application programmable interfaces (APIs) or external partners ⚙	

Integration layer
Identification and access management
Services integration
Exchange management incl API
Business layer | Business project management | Rules management

API management

Applications

IT applications ▪
- Enterprise resource planning
- Manufacturing execution systems
- Business applications (eg customer relationship management (CRM))

BI and analytics 👤
- Business intelligence
  - Dashboards
  - Self-service
- Advanced analytics
  - Discovery
- Data-driven applications

Data management

Data platform
Data integration
- Collect
- Broadcast

Data-streaming processing
Data storage and transformation

Data exposition

IT/OT[1] integration
Internet of Things (IoT) platform 👤
IoT gateway

OT
Connected objects and sensors (hardware and software) + on-premise OT platform

Cybersecurity · Infrastructure

[1] Information technology and operational technology integrations.

Renewing the tech backbone: Three strategies

There is no single recipe for success in transforming the tech backbone. Indeed, the starting point depends on several factors: the current state of an organization's backbone, the prioritized list of use cases, and internal capabilities (including talent). The trick is to balance immediate needs with long-term plans— all while ensuring the organization continues to operate with minimal disruption. Companies, both within industrials and across other industries, have followed three strategies successfully: the first

involves a more ambitious overhaul of foundational elements of the tech backbone, while the other two are ways to improve the performance of the existing backbone in the short term.

1. Replace core systems of record

Some companies start to transform the tech backbone by strategically replacing core systems of record first and planning their new backbone around the enhanced capabilities. These systems are costly and difficult to replace, so this strategy requires a significant and sustained commitment of resources to be successful.

One large OEM, for example, recognized its outdated core systems of record were an obstacle to improved productivity. Rather than building work-arounds, executives decided to systematically replace its legacy systems to achieve company-wide data consistency. It also did a greenfield build of an integration layer around those new applications. This road map sought to transition the company to the target state over a five-year period and included milestones. Done right, we have seen that these transformations can generate a return on investment (ROI) of more than 20 percent.

2. Abstract data and APIs

In the event that replacing the core systems of record is not feasible, companies can start by transforming the data and API ecosystem. This approach involves creating a new data and API layer on top of legacy systems. Companies can thus gain greater access to data and quickly develop and deploy new solutions. By investing in this work-around, industrial companies can make immediate progress.

One large pharma company with dozens of fragmented legacy systems decided to build a highly structured data lake that could collect critical data and make it available for digital applications through advanced APIs. With this strategy, the highly fragmented legacy system was effectively "shielded" from the new digital landscape. In addition, the company was able to achieve performance improvements without immediately replacing core systems of record (a step that would still need to happen at some point).

3. Adopt an agile delivery methodology

Some companies decide to first address the delivery methodology. These companies can include organizations with poor delivery processes as well as those that lack the funding to make larger technology changes. Once they have built the processes and capabilities to accelerate development cycles, organizations can start to address the underlying tech backbone to remove the respective bottlenecks.

A bank decided to implement an agile delivery methodology before replacing any of its systems. The plan was to ensure development teams were trained to be customer focused and build software solutions faster and more effectively. DevOps (development and operations) and other technology methodologies were introduced to further shorten delivery cycles. Through this approach alone, the bank achieved cost savings of more than 10 percent in software delivery as well as much shorter deployment cycles. This effort laid the methodological foundation to ensure the organization had the capabilities in place to start addressing its system challenges.

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In any transformation, choosing the right path is critical. Given the complexity of the tech backbone, a company can start by conducting an assessment of the status of its current backbone as well as the most critical business initiatives and corresponding tech requirements. This assessment can help the company develop a portfolio of initiatives, which can be used to build a business case for investments in backbone upgrades—an important element to gain stakeholder support. Companies should then move as quickly as possible on initial use cases by drawing on existing data (rather than waiting until the data is ready). This test-and-learn approach enables companies to make smarter investments, move faster, and develop better solutions.

Industrial companies that can successfully transform their tech backbones will have a crucial asset to not only power emerging solutions but also respond more rapidly to new opportunities.

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