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A guidebook for heavy industry's digital journey

Heavy industry has a lot to gain from the digital revolution. To capture the benefits, companies need the right kind of transformation plan.

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In an earlier article, we examined the potential impact of new digital technologies in heavy industrial manufacturing. Our analysis suggests that large-scale application of digital technologies and advanced analytics (DnA) could boost profit margins in the sector by three to five percentage points.

There is no one-size-fits-all approach to digitization, however. The best combination of technologies and approaches for an organization will depend on a multitude of factors, including the sectors in which it operates, its business goals, and the current maturity level of its operations.

In the early days of the Fourth Industrial Revolution, companies often took an unstructured approach to digitization. They identified promising technologies and experimented with them here and there across their operations. Even when the results of those experiments were successful, as they often were, organizations struggled to replicate and scale up their new approaches. Too many businesses found themselves trapped in "pilot purgatory", with plenty of technological promise, but no real impact.

In heavy industrial manufacturing, the digital landscape is complex and challenging. Instead of wandering at random, companies need to identify their desired destination and plan their journey with care. And like any trip into new territory, they must also be ready to adapt and reroute as they learn more about the terrain. In this article we describe a five-stage approach that several companies have used create a strategic road map for their own digital transformations. While each of these companies has tailored the approach to suit the specific needs of their organizations, their DnA journeys follow one of three basic archetypes (see sidebar, "Transformation archetypes").

Five steps to success

The fundamental steps of a DnA transformation in heavy industrial manufacturing will be familiar to any organization that has embarked on a large-scale change program (Exhibit 1). The journey begins by setting a vision for the transformation's end state. A diagnostic then assesses the

organization's current capabilities and performance, identifying the digital levers that will best close the gaps between current performance and the future vision. Next, the company prioritizes those levers into a road map that defines the overall sequence of actions required to achieve the vision—along with any necessary enablers, such as new infrastructure or capabilities. In the fourth step, the organization conducts one or more pilot projects to test its chosen actions. Finally, it scales up and rolls out the new approaches across the business.

Although the five steps can be arranged in a neat line as in Exhibit 1, in practice the process is iterative. While decisions made at each step determine the actions taken in the next, the outcomes of those actions are also used to refine and update preexisting plans. So, for example, the diagnostic may reveal that an organization's initial vision is overoptimistic, or overly cautious. Or pilot projects may reveal unexpected challenges or new opportunities that mean modifying the road map.

1. Defining the vision

An organization's vision for DnA defines almost every aspect of the subsequent transformation journey and its ultimate impact. Yet despite its central role, surprisingly few heavy-industry players invest significant effort in defining or communicating their digital-manufacturing vision. They should.

A vision can be highly focused on a single issue: "Resolve long-standing throughput challenges in our ore-processing facilities." Or it can address ambitions around a specific set of digital levers: "Use advanced analytics to drive performance improvement across our manufacturing operations." The visions of some organizations are very bold indeed: "Become the most advanced digital chemicals company in the world" or "Create a truly 21st century workplace for our people."

A clear vision allows the whole organization to align on priorities for the transformation, together with the changes required to embrace digitization. Neither can happen, however, unless everyone in the organization knows about the vision and understands its rationale. Successful companies

Exhibit 1

A digital transformation follows traditional transformation steps.

| **1** Vision | **2** Diagnostic | Assess identified portfolio of digital levers | **3** Roadmap | **4** Pilot | **5** Scale-up & transformation |

don't leave that to chance: they invest time and effort in communicating, discussing, and clarifying their vision with stakeholders across the business, from senior leadership to frontline associates.

2. Completing the diagnostic and business case
Guided by its vision, an organization's next step is usually a detailed investigation of DnA opportunities in its current operations. This diagnostic phase provides the bridge between digital potential and reality, helping companies identify where and how they can introduce new digital approaches in their manufacturing operations, and what the likely result of those changes will be.

The diagnostic involves detailed, forensic effort. It can be uncomfortable, too, requiring companies to be honest with themselves about the strengths and weaknesses of their current processes, capabilities, and data. The output of the diagnostic will be a detailed portfolio of digital levers, along with estimates of their likely effects and the complexity of their implementation.

Prioritizing and sequencing that list creates the basis for the transformation roadmap, so getting it right is important. Companies should look at potential DnA levers through three lenses. The first of these is the lever's potential impact, along with the associated risk. The second is ease of implementation, a combination of feasibility, payback period, and support available within the affected parts of the business. The final, and often underestimated, lens is the potential "signaling effect" of early projects. A company's first forays

into digital manufacturing will act as a showroom for the approaches it takes. To get the wider organization on board, these early projects need to be visible, compelling, and widely applicable.

Sometimes the diagnostic delivers unexpected insights. At one chemicals company, availability of a secondary raw material was limiting the yield of a major process. During the diagnostic, the company found that it could significantly reduce the quantity of the material it required by adapting the way it controlled its own manufacturing process. That change shifted the whole direction of its digitization effort, changing the focus from yield to throughput improvement, and almost doubling the expected results.

3. Building the roadmap
Based on the archetype that best fits its situation, an organization can now begin to develop the detailed implementation roadmap for its digital transformation. The roadmap serves three distinct purposes. Initially, it lays out the actions that the company will take to develop, test, and deploy digital solutions. Next, it defines the actions required to develop the necessary enablers, such as new capabilities, infrastructure, and data. Finally, it defines the pace and sequence of the scale-up and rollout of the transformation.

4. Running the pilot
Pilot projects serve multiple purposes in a transformation. They provide the first real-world proof of the benefits from adopting DnA solutions. They help the organization refine its approach

and develop its digital capabilities. And they act as digital "lighthouses," demonstrating what digitization can do for the wider organization. As a result, the choice of pilot is critical: companies must select a project with a high probability of success and the potential to deliver significant value, while being both visible and relevant to the whole enterprise.

In selecting the best pilot project, a company may have to trade short-term impact against long-term success for its digital transformation. At one specialty chemicals player, for example, a diagnostic suggested that selective process automation would deliver the fastest digital payback. But those changes would involve few employees and would be hard for outsiders to understand. Instead, the

Transformation archetypes

In our work with multiple heavy-industry players, we've seen that digital approaches diverge significantly after the diagnostic phase. In general, subsequent steps in will follow one of three basic archetypes (Exhibit A):
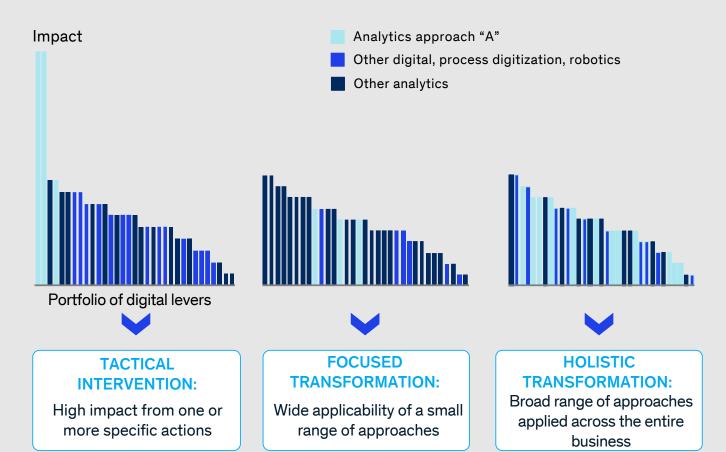
1. *Tactical intervention.* The diagnostic may reveal one or more specific actions that promise significant improvements and short lead time. One mining group, for example, found that a particular advanced-analytics approach could improve the performance and throughput of mineral-concentration equipment by 2 to 3 percentage points, and that the same technique could be replicated across multiple sites and material types. This situation calls for a digital project rather than a change program. Companies prioritize speed of implementation, often leaning heavily on external technology partners to develop and implement solutions.

2. *Focused transformation.* The diagnostic may identify a small number of tools and approaches with wide applicability across the business. In heavy industry, the most common current example is advanced

analytics, which have the potential to drive improvements in yield, quality and productivity across multiple sites and processes.

3. *Holistic transformation.* The most ambitious transformation archetype applies a broad range of digital approaches across an organization's entire manufacturing operation, such as through the simultaneous application of advanced analytics, process digitization, and robotics. This type of transformation, which is likely to involve the majority of the processes and personnel at affected sites, is typically undertaken by organizations that have already achieved a high level of digital maturity.

In practice, companies may adopt more than one of these archetypes at different times in their development. For example, a business may choose to undertake tactical interventions to capture quick wins, before embarking on a longer focused or holistic transformation. Alternatively, experience gained during the holistic transformation of one site may reveal that a few tools have disproportionate impact, encouraging the company to take a focused approach as it scales up across other units.

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In heavy industry, most digital transformations follow one of three archetypes.

Impact

Legend:
- Analytics approach "A"
- Other digital, process digitization, robotics
- Other analytics

Portfolio of digital levers

TACTICAL INTERVENTION:
High impact from one or more specific actions

FOCUSED TRANSFORMATION:
Wide applicability of a small range of approaches

HOLISTIC TRANSFORMATION:
Broad range of approaches applied across the entire business

company chose to begin with more visible projects, such as the redesign of human-machine interfaces on the production line. By making those changes first, the company sent a clear signal to its staff that they would share in the benefits of digitization.

The organization's transformation archetype also informs its choice of pilot project. A tactical intervention may have no pilot, with the new technology implemented in a one-hit effort.

Focused and holistic transformations both begin with a pilot on a part of a plant, but while the focused approach involves the application a single lever, a holistic pilot may involve the digitization of every part of the process.

Pilot projects can also lead to significant changes in the organization's digitization approach. At one company, additional process automation was originally given relatively low priority because its

payback time was expected to be long. When the approach was piloted on one line, however, the company found that the addition of new control technology significantly improved the precision and stability of its processes, providing rapid benefits with limited investment. That finding pushed automation to the top of the list during the rollout phase. At another company, the pilot revealed that there was insufficient data to support the planned analytical approach. While the company still installed new sensors and data-collection infrastructure, it held off on further changes until it had established a baseline dataset.

5. Scaling up

Once an organization has successfully piloted its digital manufacturing levers, it can begin to scale up. Planning for this phase should reflect lessons learned during the pilot, especially in terms of the technologies and approaches used and the requirements for investment in enablers, such as new data infrastructure or digital capabilities.

As with the choice of pilot, different transformation archetypes require different scale-up approaches. In a tactical intervention, the organization may adopt a simple cookie-cutter approach, repeating the original implementation across its operations. Focused transformations, by contrast, are rolled out in waves across the relevant domains. Since these efforts involve a subset of personnel from each affected site, there are often opportunities to share knowledge and experience by transferring personnel between sites, or by developing domain-specific communities. One particularly successful approach is known as "pull forward," where staff gain digital experience at sites that have begun their digital transformation, before returning to their home site to lead the transformation there.

Holistic transformations usually proceed site by site, with the sequence decided by geographic

proximity and similarity of sites. Organizations with large networks of sites may consider using a hub-and-spoke approach, where one site in each region transforms first, then acts as a template for others in the same area.

Essential enablers

Alongside the development, testing, and implementation of new DnA levers, companies also need the right enablers in place. These include robust, consistent, and accessible data, appropriate technology, the right talent, and an agile model for the delivery of new solutions—with the combination varying depending on its chosen transformation archetype.

In the case of a tactical intervention, the solution may be relatively self-contained, requiring few or no changes to wider processes or digital infrastructure. Capability building, if required, will be limited to training for the personnel who will interact directly with the new solution.

Focused or holistic transformations, on the other hand, often require substantial investments in enablers, including the development of a unified "data lake" and widespread capability-building initiatives. To support a focused transformation, for example, one steelmaker developed an internal "Advanced Analytics Academy," which now provides tailored training using real data and context-specific examples from the company's operations. To date, more than 200 people been through the academy. The unit is also being used help managers transition into the digital world, providing courses in the fundamentals of advanced analytics and in effective ways to direct digital projects.

We'll talk more about the challenges and best practices around DnA enablers in the next article in this series.

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