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INDUSTRY 4.0:

Bridging the Gap between Information Technology and Operational Technology

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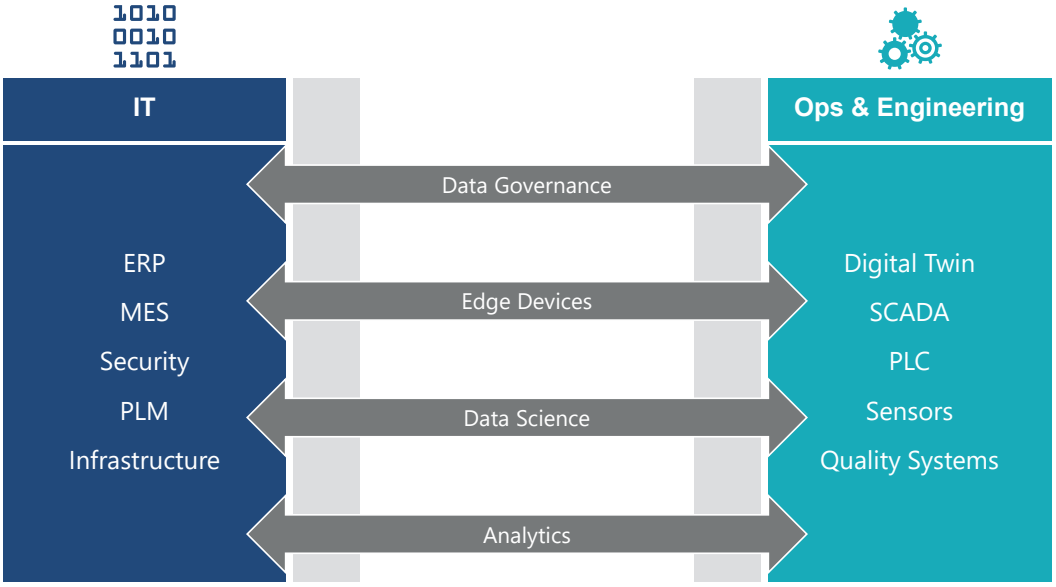
ISG WHITE PAPER

As the manufacturing industry continues to embrace the concept of the digital factory, companies are beginning to look at the lessons learned from Industry 4.0 – the term used to describe the current digital revolution in manufacturing – as a way to gain efficiencies, digitize operations and differentiate themselves. The challenge for most manufacturing companies on this journey is that their IT and operational capabilities are siloed and that deconstructing and rebuilding them in a more integrated way is difficult. Though Industry 4.0 was conceived with just this goal in mind, many Industry 4.0 initiatives fail because of the effort inherent in three essential activities: creating a top-down vision, building bottom-up use cases and scaling information technology/operational technology (IT/OT) solutions across the enterprise.

Traditional manufacturing enterprises suffer from a gap between IT and the operations/ engineering functions of their business.

These failures are not just a technology problem, but also a cultural and organizational change problem. Successfully making change requires breaking down old paradigms built up over the past several decades and creating an operating model that facilitates digital transformation. As shown in Figure 1 below, traditional manufacturing enterprises suffer from a gap between IT and the operations/engineering functions of their business. This gap in their operating model is bridged by thin lines in niche areas that are not structured to support the impending convergence of Industry 4.0.

Figure 1: Traditional Manufacturing Operating Model Gap



The Legacy Model

For enterprises that have not been through a transformation, the IT organization often is working in support of the business and, therefore, in support of functions within operations and engineering. So, while IT offers platforms and uptime, it is not integral to how operations and engineering teams get work done and, in most cases, IT operates in a silo organizationally disparate from these functions.

Historically, manufacturing companies have capitalized on the competitive potential of their operations, benchmarking one part of their operations against another, while allowing factories or other sub-segments of the business to determine what is best. This has created an environment in which IT is required to support a broader set of applications and technologies beyond the original site-level selection of a discrete software or element – and this is now a system-of-systems-level problem. To scale and realize the benefits of Industry 4.0, organizations need either one unified system to run and manage the digital-factory environment or a separate layer inserted in the technology stack to aggregate and translate data and feedback into the top-level solution.

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Whether organizations follow a bottom-up approach to system-and-process reconstruction or apply a solution layer on top of existing operations, issues around organizational change are likely to present themselves. In addressing organizational change, companies will face the following key questions:

- What are the components of a successful Industry 4.0 transformation?
- What organizational team should lead an Industry 4.0 initiative – or should a new team be created?
- What type of sustainable governance model will support the transformation and measure its outcomes?
- How do we scale what occurs at different sites across the enterprise, and how do we integrate proven ideas inside proofs of concept (POCs) at a site/plant level?
- How do we centrally automate change to sustain as it occurs across decentralized sites?
- What is the long-term plan for governing horizontal operational functions and specific domain knowledge?

The Three Archetypes of Industry 4.0 Transformation

Implementing Industry 4.0 is a complex undertaking. Success largely depends on determining which three Industry 4.0 archetypes describes your organization:

1. **Standalone:** Many organizations, particularly those carrying out an Industry 4.0 initiative of substantial size and scale, opt to create a specific organization focused solely on the initiative's goals. In larger, more complex enterprises, this may even be a requirement. A team will be made up of members from operations, engineering and IT, and will centralize itself under a chief data officer, chief operating officer or chief information officer. The centralized team will oversee personnel implementing elements of the initiative at each site. The structure of the implementation and expectations for how each site interfaces with the centralized organization will be key considerations.

2. **Centralized consultative:** In cases in which the organization is more limited in size and scale, the structure may require some centralization with the team of a limited number of subject matter experts (SMEs). These individuals build and create POCs that are "adoptable" at the site level. Then, they offer the POCs to sites and create a strategic team to drive localized implementations through site teams. This model leverages fewer resources but maintains centralization for scale. Though this approach may lead to a longer transition, it establishes greater control of the site implementation, which may be viewed as a benefit or a concern, based on organizational culture.

3. **Federated model:** In this model, no true organization is formed around the initiative, but change champions and SMEs are selected from across the enterprise to contribute to the strategy and implementation. Functional business areas design and develop solutions with input from a federated, cross-functional team. The Industry 4.0 initiative will sit in IT or operations, with the intent of encouraging diverse input. This model is the lowest-cost option with the shortest implementation time. When implemented successfully, it provides enterprises a solid understanding of the potential for Industry 4.0 and a quick way to gauge how it should work in their enterprise. However, over the long term, this model lends itself to a more IT-centric implementation, which may not translate to success at an operational level. It can create shallow data lakes or, on the other end of the spectrum, a number of POCs that, at the operations level, cannot scale.

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Issues with organizational structure and team dynamics are a core challenge of every Industry 4.0 initiative, so careful consideration is needed to ensure the enterprise is structured and aligned for transformation and success. It's critical to develop an integrated change strategy that includes organizational change management (OCM). Studies show more than 60 percent of a change project's success hinges on people, even when new technology, processes and knowledge assets are firmly in place. Therefore, strong OCM efforts that prepare and support your employees can help the workforce more quickly rebound and help your company more quickly realize the benefits of transformation. OCM work should include OCM strategy, stakeholder management, targeted communications, organizational alignment, and training and learning enablement that map out a learning journey for everyone who will be involved and/or affected by the change. This journey needs to support user adoption and long-term sustainability.

Selecting Who Should Lead an Industry 4.0 Initiative

Consider the following factors when designing an Industry 4.0 initiative and selecting its leaders:

- **Diverse skills:** Industry 4.0 is a cross-functional effort that involves the trifecta of engineering, operations and IT. The cross-pollination of personnel and skills is critical to achieving a sustainable plan.

- **Site integration:** In the end, all the work required to implement the change must roll out to individual manufacturing sites. Because most enterprises have a large footprint with multiple facilities that each have its own nuances, only careful consideration will ensure the sites are engaged and their perspectives are represented.
- **Focused capacity:** The success of the initiative is dependent on business operations and the people who support it. Therefore, it is important to clearly define roles and time commitments, allowing the team to focus and avoid being distracted by the next important initiative.
- **Culture:** Industry 4.0 is the next industrial revolution, and that cannot be understated. It is not just the next thing companies are trying; it is inevitable for survival. This key message should be deeply engrained in communication, so the team will recognize the significance of Industry 4.0 and become engaged and energized by its ideals. Having influential team members involved in this initiative can make all the difference in its effectiveness.

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Each enterprise must take all this into consideration and then think tactically about how to design its own Industry 4.0 initiatives to best suit its unique needs and culture.

Key Governance Considerations

To be successful, an enterprise must also structure its Industry 4.0 initiative to ensure the organization is making the right investments in the right areas, and then measuring the resulting successes. Strong governance and a common language for communication across the enterprise are critical. Important governance considerations include:

- **Business-case development:** The business case for Industry 4.0 and Internet of Things (IoT) initiatives can be elusive, with results sometimes difficult to predict prior to deploying the initiative and collecting data. While many benefits of a digital factory, such as reduced maintenance, improved uptime and automation, can be directly measured as a return on investment (ROI), other outcomes may not be as easy to track. Therefore, the business case for Industry 4.0 becomes a combination of direct measures and other weighted measures based on value to the end customer. Determine these metrics as early as possible and then keep tracking them, even well after the project's initial launch.
- **Data and device governance:** Individual manufacturing facilities often choose and leverage their own devices for programmable logic control and supervisory control and data acquisition (SCADA) systems, creating a disconnect between sites. In Industry 4.0 initiatives, individual sites may want to follow suit, but this hampers the ability to scale solutions. When data is defined differently at each site, this also presents another obstacle to downstream scalability. A strategy to manage these differences centrally should work to standardize devices, define the data, and create a data governance model that can span multiple sites.

- **Integrated blueprint management:** As businesses establish new governance models, business processes change, and the people who support them must learn to operate and collaborate in new ways. Enterprises that hope to improve organizational alignment, target operational inefficiencies and leverage enterprise synergies must take an integrated "blueprint management" approach anchored with an enterprise-wide program and a comprehensive change management strategy. This alignment will help ensure program, people and other changes happen more smoothly, in a more unified manner, setting a tone of standardization across the enterprise. **Leaders need to play a key role, helping to make the case for change across the organization**.

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As blueprinting begins, functional and subject-matter experts must maintain process standardization and message consistency. Process integration helps organizations build more holistic, enterprise-wide end-to-end processes. Without this collaborative development and management, organizations design and implement processes in silos, creating internal confusion that inevitably decreases operational efficiency and agility. When a company uses an integrated process approach in conjunction with an OCM team, the business effectively identifies and analyzes process changes and impacts, centralizes and standardizes change communications, and helps minimize organizational risks.

Creating a Framework for Scaling Up

A core element of successfully scaling a POC across the enterprise is ensuring it has a strong business case. However, not all sites and operations within sites may have the common approach required to scale effectively without additional change. A plan to scale a POC must take into consideration the specific cultural and operational nuances of individual sites. Often, team members don't realize they have a problem until the time has come for scaling, and the POC has already been rigidly defined in a way that makes it difficult to evolve.

Key considerations while developing a POC include:

1. **Commonality of sites:** How standardized are the sites, and what are the common elements? Many enterprises find it useful at the onset to go through an exercise to determine the commonality of approaches across sites, operations within sites, products and other elements to justify the business case. This rough measure of scalability can help immensely with prioritization of POCs.

2. **Process impact:** While Industry 4.0 should lead to more repeatable and automated manufacturing processes, it also may, in doing so, fundamentally change how a product is made or how aspects of quality are measured. While these are, in general, positive changes, they may complicate compliance procedures for existing standards. Quality measures or process quality controls put in place and agreed to by end-manufacturing buyers may not have considered the level of automation now available. Organizations must accommodate for these changes in process and quality control systems.

3. **Implementation repeatability:** Because many POCs are developed in an agile way, the process can be iterative, possibly leading to poor documentation for implementing the POC. This drives inconsistencies across sites when POCs are scaled and reduces the efficiency of POC implementation and uptime in plants.

Operationalizing and Sustaining Industry 4.0

Once an Industry 4.0 initiative is under way, companies must operationalize across every aspect of their organization, moving from experimentation mode to one of continuous execution. Figure 2 below illustrates the journey from an experimental lab-type of environment to a factory model of continuous adjustment.

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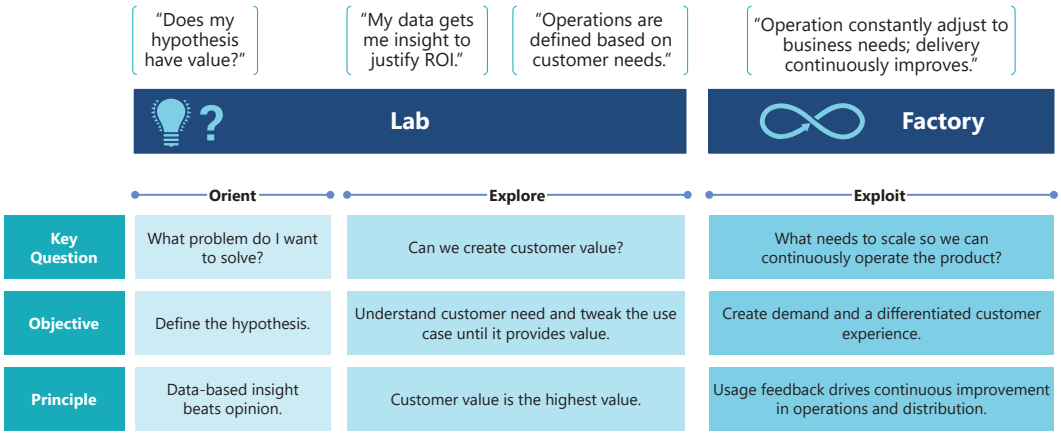
Figure 2: Target Operating Model for Industry 4.0



In the lab model, companies begin to experiment with different POCs and organize themselves for success, establishing governance and ensuring scalability according to the points above. Having accomplished these elements, organizations can move into the factory mode of implementation, in which POC development, implementation and scaling become a part of the DNA of the enterprise.

The linchpin of this final transition is how an organization trains the workforce and communicates about the initiative to the teams. Remember that most implementations fail due to people-related issues, not technology. A successful cultural shift depends on having an integrated OCM strategy that outlines a clear approach to organizational alignment, change communications, stakeholder management, training and enterprise sustainability. Companies must develop a detailed organizational-change-management plan, including all activities supporting the change strategy, and integrate it with their digital-factory initiative to gather requirements, analyze and interpret organizational data, monitor communication and learning effectiveness, evaluate user adoption and proactively mitigate organizational risk.

Weaving the Fabric of Industry 4.0 for the Long Term

Embarking on an Industry 4.0 initiative is not a simple matter of implementing automation. It is a comprehensive cultural-change program designed to establish connectivity and automation as driving forces for optimized operations at each manufacturing site. To that end, it's not an easy journey, with pitfalls that can be avoided with experience and domain expertise. As Figure 3 illustrates below, the initiative is a fabric woven of different elements to form a complete solution.

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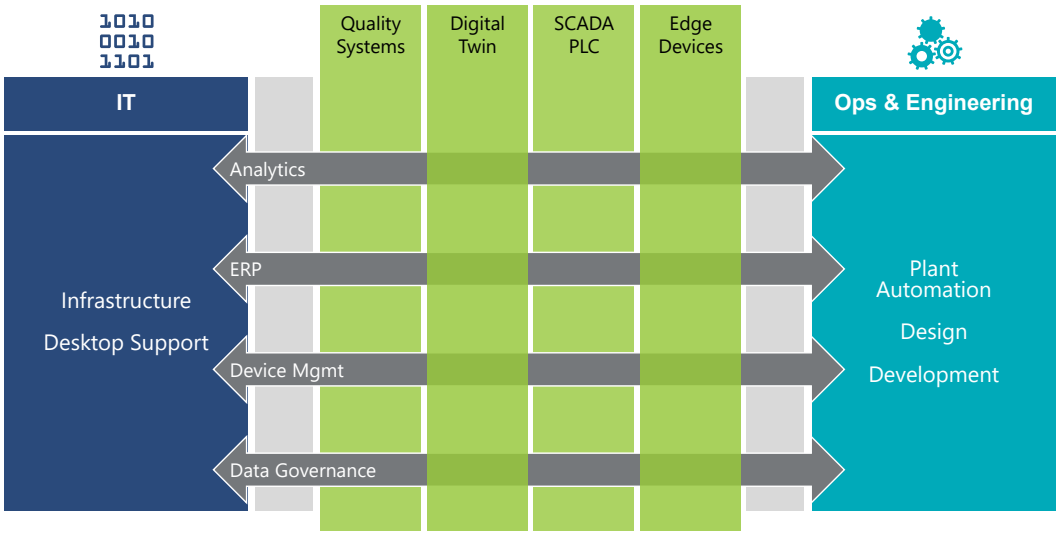
Figure 3: Fabric of Industry 4.0



Once organizations achieve these early stages of transformation and establish a model for continuous improvement, the structure of the enterprise will shift fundamentally, and the woven fabric will bridge the gap between IT and OT with horizontal technologies and services that enable manufacturing sites to take advantage of economies of scale operationalized by Industry 4.0.

Interconnectivity and the convergence of IT and OT are key trends in the manufacturing industry today and will continue to define the industry tomorrow. Successfully managing this convergence and using it as a lever to turn manufacturing operations into a go-to-market differentiator is a core element of survival in the competitive landscape of the future.

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