IDC TECHNOLOGY SPOTLIGHT

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Cloud IoT and Industry 4.0 transformations are complex, and the best implementations emerge from strong partnerships between customers, technology, and service providers.

Industry 4.0 Transformation: Leveraging Services Partnerships for Building a Smart Factory

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Introduction

Transformation is important today because organizations realize they cannot meet their growth goals or stay relevant and competitive in their markets by using only cost optimization strategies. This is true for manufacturers of all sizes and for other industries that are leveraging connectivity and other technology to transform operations. Why? Because Internet of Things (IoT) technologies are relatively inexpensive and cloud services allow for massive scale up/scale out, thus enabling business process changes that can be transformational. Moreover, while Industry 4.0 was originally conceived to help large-scale German manufacturers automate their processes, this type of process automation is now within reach of smaller manufacturers or any organization looking to instrument a process with IoT, even if it is not a traditional manufacturing process.

AT A GLANCE

KEY TAKEAWAY

IoT and cloud platforms are helping drive Industry 4.0 transformations. However, these transformations are very complex, and buyers can benefit from third-party assistance with implementation and the creation of an ecosystem of technology and services partners to overcome challenges related to talent, scale, and funding for new technology deployments.

Manufacturing customers struggle with legacy technology that is not connected and with justifying additional budget to modernize their plant operations. They also face hurdles related to sourcing, hiring, and retaining engineering talent experienced in recommending and deploying digital technologies. In addition, manufacturing customers face pressure from product teams to reduce time to market. In many situations, information technology (IT) and operational technology (OT) teams do not collaborate, which creates duplication in investments related to edge computing, cloud, security, and more. As a result, manufacturers are saddled with siloed infrastructure that does not take into account end-customer feedback for products and services. These disconnected assets also cannot provide a real-time view of factory systems.

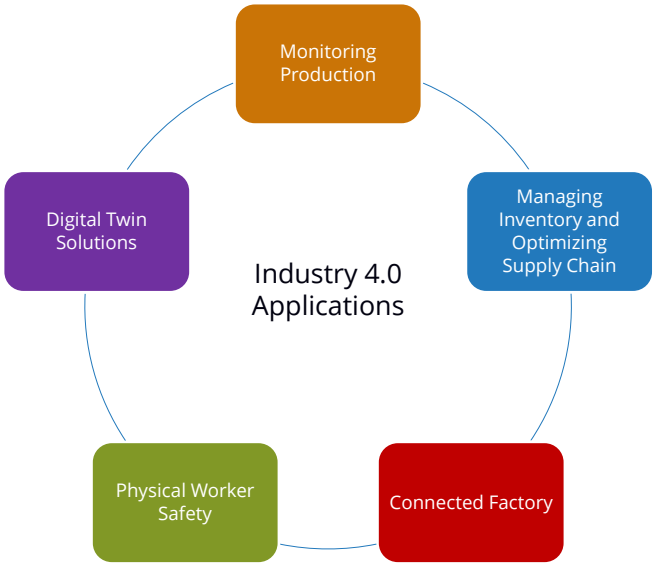
These inefficiencies resulting from legacy, nonconnected, and unintelligent infrastructure can be found in any manufacturing scenario and are not restricted to manufacturing operations in large global enterprises with multiple locations. The pandemic made every organization realize the weaknesses in its operations. Most manufacturers were blindsided as they saw their supply chains break down and production come to a grinding halt. The few companies that had invested in automating their factories by leveraging digital technologies including cloud were better able to bounce back relatively quickly compared with peers that had barely started envisioning digital or were in the early investment stages with the technology.

Industrial IoT and Industry 4.0

Industrial IoT (IIoT) or Industry 4.0 refers to technologies such as IoT, edge computing, digital twins, augmented reality and virtual reality (AR/VR), and other digital technology infrastructure on the manufacturing shop floor. Historically, PLC/SCADA sensors in the manufacturing industry collected data, but they were not connected to the IT network within the enterprise. With smart sensors and IT-OT convergence, plant assets are modernized or are being modernized by retrofitting sensors or systems that can talk to each other (i.e., machine to machine [M2M]). This capability brings a real-time consolidated view to the edge, enabling the creation of a command center–like operation. Analyzing ecosystem data from various sources — including sensors, PLCs, enterprise applications, maintenance modules, and workflow systems — by leveraging IoT platforms/IoT cloud platforms as well as machine learning/artificial intelligence (ML/AI) helps machines self-diagnose and self-analyze. This assists with monitoring asset performance and provides the ability to predict operational metrics such as impending degradation in performance of a part in a machine or the entire assembly line.

The benefits of deploying these modern technologies lie in making factories smart and always connected. They enable manufacturers to get their products to market faster, reduce operational expenses, improve asset and infrastructure uptime and performance, improve product quality and throughput, and increase productivity and workforce safety. Most engineering service providers offer consulting, design, engineering, integration, management, monitoring, reporting, maintenance, and managed cloud services functions. Figure 1 shows several applications of Industry 4.0.

FIGURE 1: ***Industry 4.0 Applications***



Source: IDC, 2021

- **Monitoring production.** IIoT sensors can monitor the production process until the final product is created. The approach enables insight into process, extra work, and any wastage that occurs, providing a way to improve operations performance and reduce costs.

- **Managing inventory and optimizing supply chain.** Leveraging sensors to track inventory and monitor global supply chains provides the insight required to schedule work, estimate production timelines, and take corrective action as needed. Manufacturers can collect and provide this data/insight to ERP and PLM business units. This process will provide a clear understanding of bottlenecks, help predict issues, and prescribe solutions that include inventory scaling and other strategies to prevent operations from being severely impacted.
- **Connected factory.** Machines equipped with IIoT sensors are able to communicate operational information to field engineers and OEMs. Based on the criticality of a situation, the equipment can be remotely managed, and automated alerts can be sent to engineers on the shop floor if readings from sensors that monitor temperature, pressure, and flow deviate from the predefined range. This capability will reduce downtime and improve overall plant efficiency.
- **Physical worker safety.** AR solutions and smart helmets worn by employees on the shop floor can improve working conditions and safety. Visual sensors can also monitor, detect, and avoid probable or actual accidents.
- **Digital twin solutions.** Once an entire operation is retrofitted with sensors, a digital twin deployment can identify an impending or existing failure in any part of the factory. This capability enables organizations to take proactive corrective action and avoid downtime and loss of raw material while saving energy and reducing costs.

IoT Platforms and Cloud IoT Platforms: Driving Transformation

There is no denying that PLC/SCADA/IoT sensors on the shop floor generate a lot of data. It is not easy for humans to adapt their processes, or thinking, to this tsunami of data. It is technically possible for data collected to be processed nearby (i.e., at the "edge" to minimize latency). However, organizations are now moving data to cloud-based IoT data services. This cloud-based approach makes it easier to analyze large historical data sets for trends or anomalies and to combine data from the edge with other data sets such as ERP or with third-party data sets. Transformation challenges organizations to determine what data should stay at the edge versus the center, so it makes sense to utilize third-party expertise to help with these decisions.

Partnerships and Ecosystems

Customers must deal with several distinct categories of IIoT ecosystem players. Each category has its own set of technology providers or implementation partners, many of which need to be integrated for a proposed IIoT solution that is part of a larger Industry 4.0 transformation. To understand which partners work best in what combination requires repeated exposure to different customer scenarios. These scenarios are less likely to be known by individual customers, which is why they rely on third-party integrators. Consider an Industry 4.0 transformation that involves connecting legacy SCADA system data with data from separate IIoT sensors. Having an integrator that understands the data security and access control protocols of both is key, and integrators that have captured or automated some of this expertise via software are even more valuable.

Challenges in Implementing a Robust Industry 4.0 Strategy

Many customers want to infuse resiliency into their operations. Those that have not embarked on an Industry 4.0 strategy or those that have run proof of concepts find it difficult mitigate or manage the following challenges:

If customers want to stay relevant in the market in which they operate and infuse resiliency into their operations, they should create an ecosystem of technology and services partners to augment challenges related to talent, scale, funding for new technology deployments, and internal silos.

- **Talent.** Smart factory initiatives require talent that understands both the manufacturing domain and digital technologies. There is a huge demand for this talent, and customers often struggle with hiring and retaining these workers and with the related acquisition costs.
- **Funding.** Without a clear road map and ROI strategy, customers find it difficult to convince internal stakeholders to provide the required investment. At times, limited funding results in siloed investments that are narrow in scope and benefits. This situation also complicates solution deployments at later stages.
- **IP and security concerns.** Physical and digital connectivity exposes the manufacturing infrastructure to increased vulnerability. When components or systems in the plant are connected to the network, a security flaw in one component can threaten the entire infrastructure. Unless they are aware of security best practices, leaders responsible for modernizing the infrastructure as well as other stakeholders are wary of Industry 4.0 initiatives. They need to be exposed to other successful Industry 4.0 technology implementations that have thwarted infrastructure attacks.
- **Siloed operations**. Modernizing any plant requires updating legacy infrastructure such as PLCs and SCADA systems and connecting them to the network. There are also investments in new digital technologies such as IIoT, AR/VR, edge, security, 5G, AI/ML, and cloud. Modernization is difficult to achieve if the plant stakeholders (OT) do not collaborate with IT. Many of the new technologies required to modernize a plant (cloud, security, networking) fall within the purview of IT. If the two sides fail to collaborate, these initiatives will be nonstarters or will not realize their true potential.
- **ML and scalability.** Introducing sensors to monitor every aspect of a plant's components or subsystems entails the use of IIoT sensors that generate significant amounts of data that must be combined with other legacy data formats. Deriving intelligence from these large data sets requires getting them into a single format so that new AI/ML algorithms can analyze the data and provide the relevant insight to anticipate and mitigate risks.
  A particularly important aspect of such initiatives is the ability to scale the operations. Some of the huge amount of data generated can be processed at the edge (on premises). The rest of it needs to be sent to the cloud for processing and timely analysis and retrieval.
- **Internal organizational change and program management considerations.** Customers embark on the Industry 4.0 journey without considering the people and process changes required. At times, some teams must be disbanded and another team with existing and new talent must be created. Leaders driving these initiatives must sync up with HR, marketing, and strategy to ensure adherence to the overall corporate strategy and goals.

Envisioning and Executing an Industry 4.0 Strategy

IDC recommends that organizations embarking on an Industry 4.0 journey consider the following factors:

- **Business problem and the goal.** Clearly understand, identify, and define the business problem. Do you want to improve operations efficiency due to supply chain constraints, or do you struggle with legacy infrastructure and resulting downtime that impacts production? Or is it something else? Identify what you need to build and how the business model will change.
- **Talent and infrastructure strategy.** Define the talent and infrastructure required to modernize plant operations. Identify the gaps and the investment and effort required to fill them. Based on budgets and the complexity of the hiring process, see which employees with deep manufacturing expertise can be retrained with digital; understand how much new talent is needed and the hiring costs; determine how much automation can be infused into the process; and leverage IT and engineering services partners for their global infrastructure, experience, expertise, technology partnerships, and talent to accelerate the transformation journey.
- **Required investment and resulting ROI.** Once the amount of investment required is understood, make an ROI-backed investment case to internal stakeholders. Make sure to clarify that any investment/partnership will result in benefits that include:
    - Building an "always aware" infrastructure that takes appropriate self-corrective action and provides a single version of the truth
    - Getting products to market faster
    - Reducing raw material wastage
    - Introducing the ability to remotely monitor and manage infrastructure
    - Using digital twin deployments that can simulate outcomes prior to investing in or experimenting with a technology
- **IP protection and security.** The probability of hacking increases as soon as sensors or systems start connecting wirelessly to the network. It is important to ensure that security becomes an integral part of the solution so that IP or infrastructure is not compromised.
- **Digital technology considerations.** Along with IIoT and edge, identify other digital technologies such as AI/ML, AR/VR, 3D printing, robotics, vision/video, and digital thread/digital twins that should be part of the solution. Each of these technologies has standalone or combined benefits and should be part of deployments based on the company's vision/strategy.
- **Services partnerships and ecosystem approach.** Identify prospective global technology and services partners with the required experience related to IIoT and cloud. Short-list two or three providers that meet the organization's needs. Clearly define a partnership role expectation and deployment/outcome road map for partners and for the company. Start small and scale rapidly.

Considering Larsen & Toubro Infotech

Larsen & Toubro Infotech (LTI) is a global technology consulting and digital solutions company partnering with more than 435 clients. With operations in 31 countries and more than 38,000 employees, the company assists organizations with digital transformation by enabling their mobile, social, analytics, IoT, and cloud journeys. LTI was founded in 1997 as a subsidiary of Larsen & Toubro Limited.

LTI's Industry 4.0 Solutions and Approach

LTI seeks to help manufacturing organizations modernize by combining advanced technologies and an Industry 4.0 approach to create a value chain of things, data, process, and people. It aims to deliver digital transformation that offers a comprehensive and interlinked approach to manufacturing by bridging the gap between the physical world and the digital world. The intent is to enable stronger collaboration and access across various business units within the organization. LTI offers smart manufacturing, connected product, and intelligent enterprise solutions.

Leveraging its expertise across the ISA 95 automation hierarchy, including PLC, SCADA, and MES/MOM, LTI is focusing on four broad service offerings around Industry 4.0:

- Consulting and advisory
- Implementation and integration
- Business scale up
- Solution as a service

LTI's IoT solutions stem from understanding the customer's business, formulating a framework, and then building and operating tailor-made modules. The company first engages with business and IT stakeholders to define their challenges. A dedicated LTI team of experienced domain and technology experts then integrates a digital enterprise portfolio of Industry 4.0 solutions in conjunction with the current technology landscape of the customer's manufacturing plant. This paves the way for IT-OT convergence facilitated by ready-to-deploy industry-grade IoT solutions that come with device and data management and preconfigured purpose-built industry use cases.

LTI Palette is a set of smart manufacturing solutions powered by the AWS IoT technology stack, which collects and stores machine data at any scale in a cost-effective manner. This includes not only data from on-premises historians and SCADA systems but also enterprise data such as ERP systems and third-party data. Once all data is collected in an industrial data lake on AWS, it is democratized, and post analytics is transformed into actionable insights. LTI Palette solutions include quality inspection, worker safety, opera water, digital twin, digital command center @Edge, and smart energy.

The solution provides an integrated view at the plant level by connecting functional areas such as the quality control lab, plant energy monitoring, and inbound and outbound logistics. LTI has implemented Industry 4.0 solutions around overall equipment effectiveness, digital work instructions, predictive maintenance, track and trace of parts/products on the shop floor, and AR-based training. The company reports it has delivered a 10-15% improvement in OEE, a 15% reduction in manual efforts at workstations, and an up to 12% reduction in unscheduled repairs with predictive maintenance for customers.

Leveraging an ecosystem of partners and its internal pool of talent, LTI has developed a turnkey approach to help customers accelerate their digital journeys and improve business outcomes. This approach includes a comprehensive repository of solution accelerators, frameworks, and technology bundles that enables successful, efficient, and streamlined building and implementation. LTI promotes co-innovation along with its customers to understand business challenges and drives business outcomes with preconfigured solutions to bring in early ROI. Additionally, the company implements processes and frameworks to help customers adopt organizational change.

Challenges

Industry 4.0 implementation partnerships enable manufacturing operations transformation, and the benefits can be seen in the form of reduced downtime, reduced business risk, and improved supply chain visibility, among others.

However, any new business model or transformation is not without its challenges. Issues organizations must keep in mind as they embark upon an Industry 4.0 initiative include the following:

- **Vision and strategy.** Organizations need to investigate where challenges lie, define outcomes, and envision a new organization and the related processes to achieve the end state.
- **Budgets.** Without leadership buy-in, securing funding may be difficult. Organizations should plan well and work closely with a services partner that can assist with inputs related to defining and estimating ROI.
- **Internal collaboration.** IT and OT teams must collaborate to realize the true potential of the Industry 4.0 exercise. This should happen during the process of envisioning and planning the strategic road map. All relevant stakeholders must have a seat at the table during this process.
- **Change management.** Industry 4.0 implementations will require new modernized internal and external processes and tools. Buy-in from the teams executing the vision and strategy is needed. At times, this become a challenge because these teams may resist change and avoid additional tasks/new roles that they are assigned. It is therefore important to involve them in the process from the initial phase and explain how they will benefit from this operational transformation.
- **Proof-of-concept trap.** Organizations need to identify the right business use cases and conduct pilots before scaling them. They should not extend the pilot beyond its time frame, and they should scale quickly if the outcome is satisfactory.
- **Culture.** An engineering services partner can assist with these challenges and others. Organizations should select a partner closely aligned with the company's culture. This will go a long way in accelerating transformation initiatives.

Implementation partners such as LTI should ideally embark on Industry 4.0 initiatives in collaboration with their customers and after analyzing their customers' business problems. The easiest thing to do is to adopt a tactical approach and provide talent without looking at the big picture. In addition, LTI should ensure that:

- Infrastructure is ready to meet the required technology and scalability requirements for any specific Industry 4.0 transformation program.
- Knowledge is managed to reduce the impact of talent attrition.
- Processes and technology are in place to keep the infrastructure and data secure.

Conclusion

If organizations want to stay relevant in their markets and infuse resiliency into their operations, they should create an ecosystem of technology and services partners to augment challenges related to talent, scale, funding for new technology deployments, and internal silos. IDC believes the professional IT and engineering services market for IoT and Industry 4.0 implementations will continue to grow, especially with the advent of more smart manufacturing solutions and cloud IoT platforms. To the extent that LTI can address the challenges described in this paper, the company has good opportunities for success.

About the Analysts

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Mukesh Dialani is a Program Director for IDC's Worldwide Product Engineering and Operational Technology Services research. He is responsible for executing field research and custom research projects across the entire life cycle of hardware and software products. Based on this background that included working with end customers in the engineering services domain, his core focus also includes operational technology and emerging technology areas related to industrial IoT, computer vision, robotics, AR/VR, and digital transformation pertaining to engineering services.

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