



Manufacturing Operational Intelligence

Using Data and Analytics to Achieve Operational Improvements



Imagine recovering up to 20% of production capacity, reducing finished goods inventories by 30%, while validating supplier quality to reduce operational variability, risk, and rework.

Now more than ever, manufacturing leaders are challenged to balance a multitude of competing priorities. Materials and energy costs are rising; customers increasingly demand just-in-time order fulfillment; and technology savvy competitors are entering the market with lean, build-to-order production capabilities.

Although many manufacturers have invested significantly in automation solutions – HMI/SCADA control networks, MES/MOM and ERP/MRP applications, database historians – most manufacturing information systems exist as disparate data silos. Production managers must frequently employ a piecemeal combination of spreadsheets and paper reports to derive basic manufacturing performance metrics.

Hand-crafted systems integrations are extremely brittle (e.g., simple process changes cause critical data flows to fail), and their manually-intensive nature severely limits business agility and scale.

The goal of this paper is to discuss Manufacturing Operational Intelligence (MOI) as an enabling solution for modern manufacturing companies. The sections below identify outcome-driven MOI benefits and identify key requirements of an effective MOI implementation.

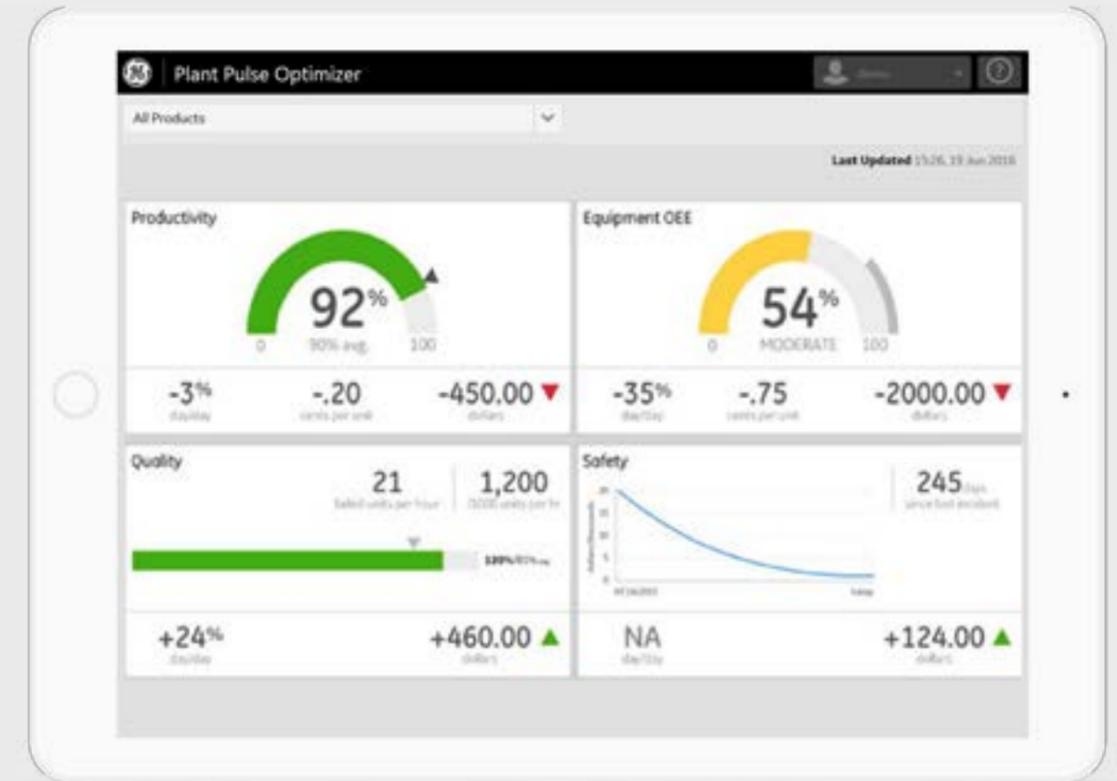


Enabling Operational Excellence

Imagine all of your machines and processes working together, with vast amounts of performance data easily feeding into a single integrated dashboard.

Imagine key performance metrics visible throughout your operations, delivering actionable insights to your plant managers and production supervisors. Insights they can use to tune equipment and production lines. Insights that can help balance material inventory against real demand and capacity without over or under stocking.

Imagine outcomes such as 20% recovered production capacity and 30% reduced finished goods inventories.



LNS Research, a leading industrial analyst firm, recently found that 21% of companies LNS surveyed are currently using MOI software solutions, and an additional 26% are planning to do so in the next year¹. Thus, MOI adoption is accelerating as companies look to utilize real-time information as a strategic tool to improve business.

“If your company isn’t on the path towards using manufacturing performance dashboards, 61% of your competitors will be using them to drive continuous improvements in performance more accurately and rapidly.”

LNS Research



Key MOI Business Outcomes

Although priorities vary among manufacturing leaders, most agree that MOI can have a profound impact on production operations by improving visibility, streamlining decisions, and replacing guesswork with fact-based decisions. Important business outcomes are highlighted below.

Reduce Downtime Costs

MOI enables equipment maintenance to be performed predictively, in many cases dramatically reducing repair costs. Maintenance departments can order the replacement parts in advance to get better pricing, and managers can allocate repair personnel at the most cost-effective times – when production demand is lower or when inventory and raw materials are exhausted.

Increase Labor Efficiencies

To optimize workforce productivity, MOI dashboards often visualize operator productivity and downtime metrics. Armed with these critical insights, management can optimize resource allocations based on personnel productivity, and identify additional capacity within the existing workforce instead of hiring new labor or allocating overtime.

Reduce Defects and Related Costs

By tracking context-rich quality data, MOI allows Production Managers to identify defect root causes and eliminate costs associated with rework and scrap. Improving the focus on quality at every stage of production also reduces warranty costs.

Achieve Automation Efficiencies

MOI enables the shop floor to go paperless. Typically, plant managers and line supervisors spend an enormous amount of time collecting, analyzing, and reporting downtime information. MOI eliminates human-intensive data collection by capturing and reporting downtime sources automatically – allowing skilled workers to focus on high-value activities.

Increased Yield

The net effect of reduced machine downtime, higher productivity of operators, and reduced defects is the achievement of higher production yields with the same resources.

GE Healthcare Deploys Plant Pulse Optimizer to Achieve MOI

GE Healthcare, in a continuation of its Brilliant Factory initiatives, has deployed the Plant Pulse Optimizer software solution at five manufacturing sites, including three in Asia that cover all modalities, including Life Care Solutions and Ultrasound. The latest site in Wuxi, China represents one of the largest GE Healthcare ultrasound manufacturing sites worldwide.

“Plant Pulse Optimizer will support manufacturing leaders with clear visibility to KPIs in a high paced environment. Our focus is increased efficiency and productivity, reduced scrap and increased product quality. Plant Pulse optimizer automatically pulls KPI data in near real-time to visualize via production dashboards.”

Zishan Siddiqui, Brilliant Factory IT Leader
GE Healthcare

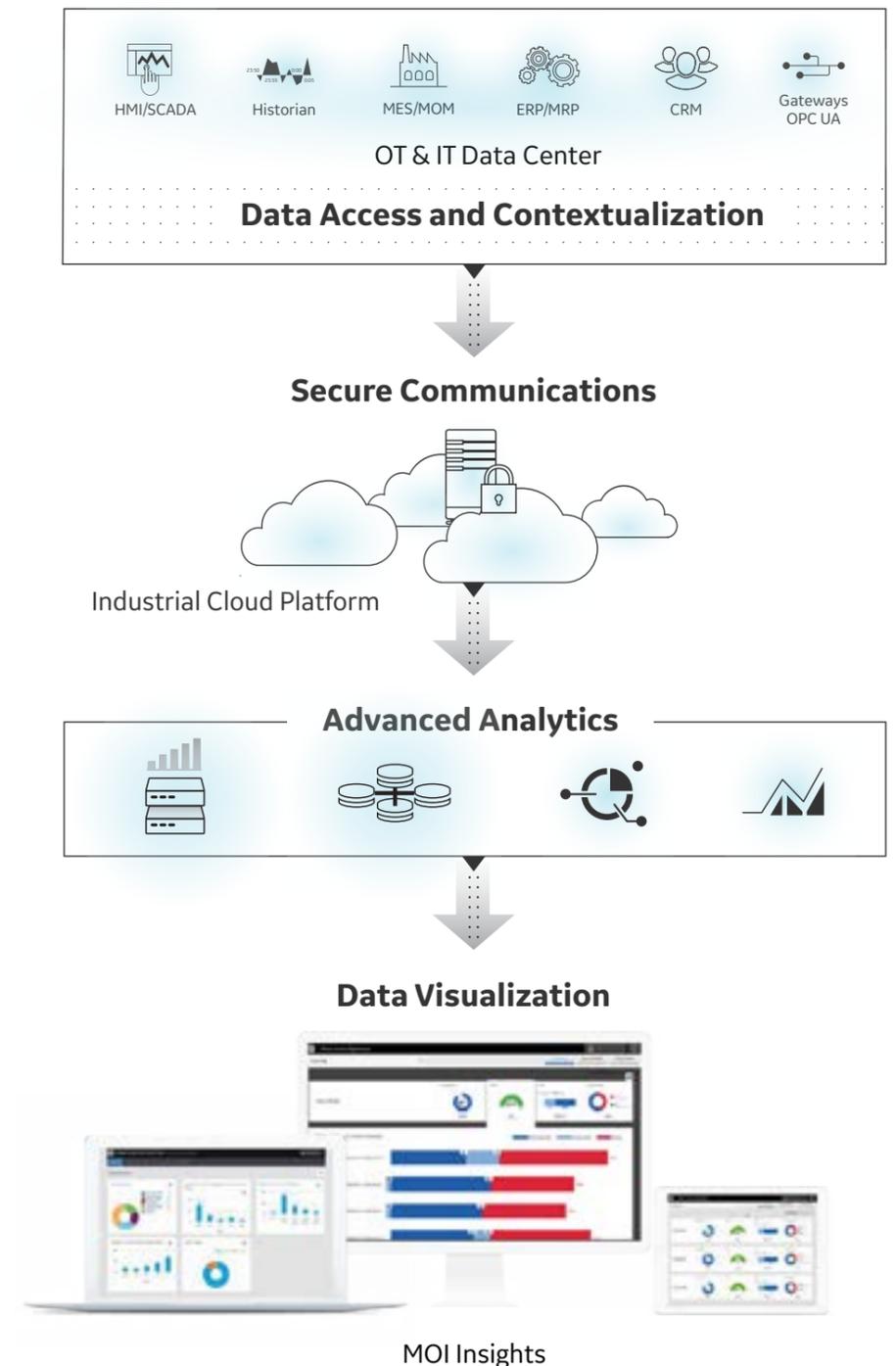


MOI Technology Foundation

Although information architectures vary, most manufacturers have systems in place for real-time process control (HMI/SCADA), manufacturing management (MES/MOM), resource planning (ERP/MRP), and customer relationship management (CRM). Many organizations are also implementing historians to hold time-based machine and process data histories. Combined, these systems form the information backbone needed to drive MOI analytics and insights.

Core capabilities of effective MOI infrastructures include:

- **Data access and contextualization.** The MOI data access tier must be capable of retrieving and integrating data across critical back-end systems in OT and IT data centers, using whatever APIs and semantics those systems expose (ODBC, OPC UA, REST, etc.)
- **Secure communications.** Regardless of whether an MOI solution is deployed entirely on prMOIse or on an industrial cloud, such as GE Digital's [Predix*](#) industrial cloud, security is paramount. Data must be protected while at rest and in flight, and MOI communications must not expose critical control systems to attack from malicious intruders.
- **Advanced analytics.** Some manufacturing insights can be achieved by simply providing visibility into machine, inventory and process states. Other insights – e.g., for machine and equipment health – require predictive models and advanced analytics. An effective MOI provides ready access to a continuum of analytic horsepower needed to drive meaningful operating improvements.
- **Data visualization.** Leading MOIs use advanced visualization patterns to bring manufacturing data to life. Users gain immediate visibility and insight into key operating performance metrics, and dashboards are easily customized to accommodate new analytic requirements.

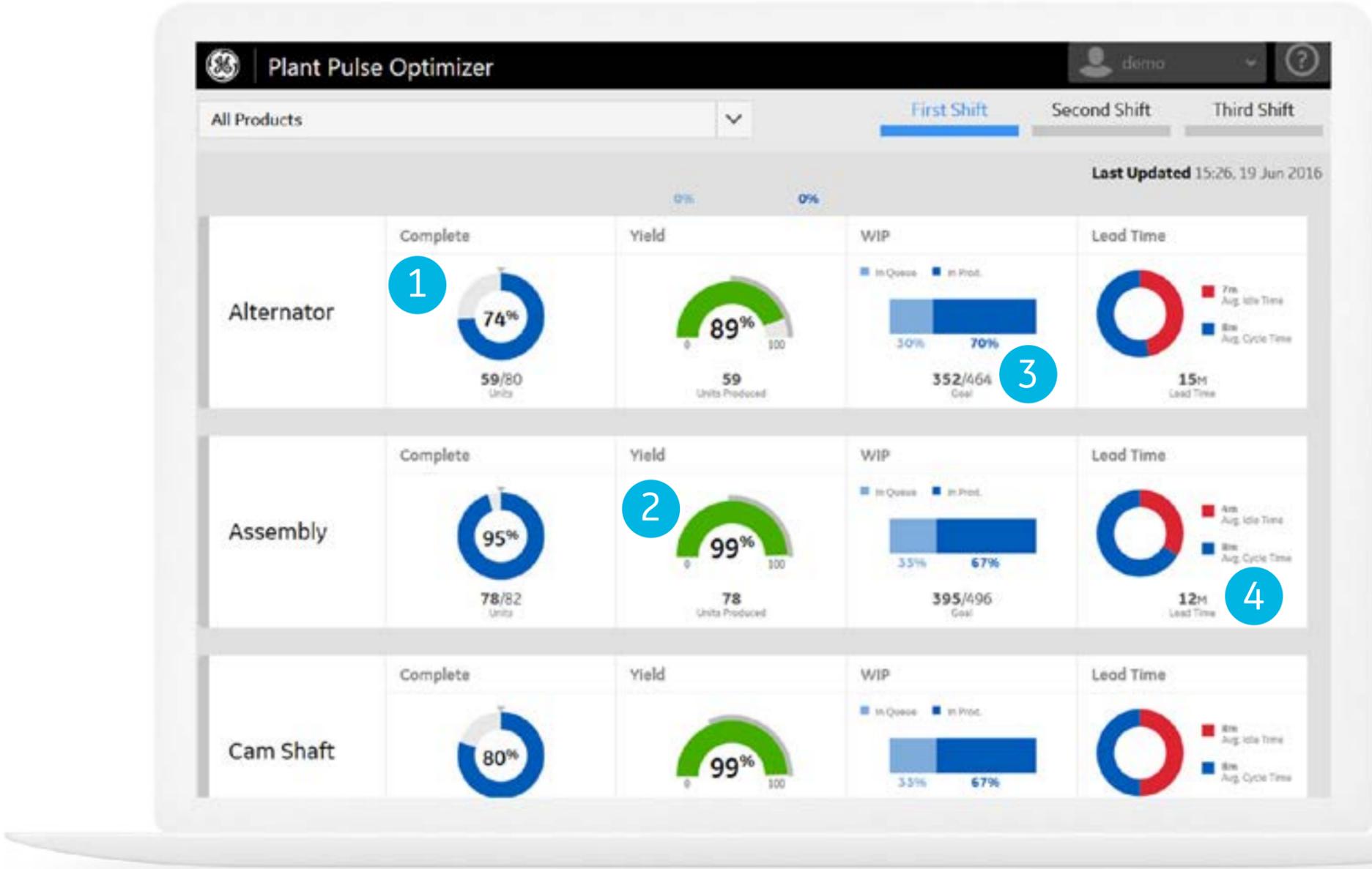


MOI Insights Example

This simple dashboard illustrates useful manufacturing insights in an automotive parts plant.

Data to drive the dashboard is collected from multiple back-end datastores and applications. It is enriched with relevant analytics and rendered using visualizations that can be understood at a glance.

MOI gives all team members instant access to defined plant KPIs – by shift – eliminating data clutter, exposing key insights, and improving operational agility.



1 Actual units completed as a percentage of the planned number of units for the selected time range.

2 Successful product units produced as a percentage of total units. The value represents a "classic" yield because successful units include reworked units.

3 Percentage of units for a discrete manufacturing process in the queue awaiting work, in relation to those in production. The "goal" shows actual work in process in relation to planned work in process to make production.

4 Defined Average Idle Time and Average Cycle Time for a site. Idle Time is Lead Time minus Total Cycle Time.

Key MOI Capabilities: Tools vs. Applications

One of the first decisions an MOI implementation team must make is whether to acquire point-level technology tools and build from scratch or install/configure a unified application. Although a build-from-scratch strategy offers flexibility, it also assumes the implementation team has all of the requisite knowledge and skill to build an MOI application correctly - the first time.

Commercial MOI applications offer significantly shorter times-to-implementation – and reduced project risks because they are designed to deliver advanced MOI capabilities out-of-the-box. Further, leading MOI applications offer the flexibility to begin with on-premise implementations and expand to secure cloud deployments over time.

Key capabilities of a world-class MOI solution – whether built from scratch or deployed as a commercial application – are summarized below..

- **Aggregation.** Making available data from many sources, mostly shop floor systems, including custom databases, MESs, LIMs, Quality systems, and increasingly combined with financial and business data from ERP systems.
- **Contextualization.** Providing a structure – or model – for the data that will help users find what they need. Usually a folder tree utilizing a hierarchy such as the [ISA-95](#) standard.
- **Analysis.** Enabling users to analyze data across sources and especially across production sites. This often includes the ability for true ad hoc reporting.
- **Visualization.** Providing tools to create visual summaries (often ad hoc) of the data to alert decision makers and call attention to the most important information of the moment. The most common visualization tool is the dashboard.
- **Propagation.** Automating the transfer of data and transactions from the plant-floor up to enterprise-level systems or vice versa.

MOI Transaction Propagation Scenario

A heavy equipment manufacturer implemented a commercial MOI application with the goal of reducing line downtime and improving dealer service levels. Under production load, a key piece of equipment begins to report vibration in its main bearing assembly. Analytics predict the bearing will fail within 72 hours.

In addition to alerting operators about the possible problem condition, the MOI alerts the maintenance team by automatically triggering an urgent inspection work order based on upper and lower control limits on vibration settings for the asset. The MOI enables the supervisor to adjust anticipated production throughput in the MES system, and issue a fulfillment delay notification in the supply chain application. The manufacturer's CRM system is also notified to keep the Sales team updated on product availability status.



A Checklist for Getting Started on the Path to MOI

Although some organizations are staffed to roll their own MOI infrastructures, the discussion above reveals that implementations require a diversity of technical skills - including data integration, security, analytics, and advanced visualization. LNS Research suggests a 5-step roadmap for implementing an MOI pilot and expanding to a larger vision once the pilot has been successfully completed¹.

01 Don't go it alone

Start by building a small, easily manageable cross-functional team that includes members from the impacted areas of manufacturing/production operations and IT.

02 Clearly define the objectives of an MOI pilot solution

The initial expectations should be set that the first proof of concept will collect, aggregate, and contextualize a certain set of data into new information that can “bring to life” some new or faster performance insights. These new insights need to be associated with one or more current challenges that exist within the manufacturing/production operations.

03 1-3 months Scope the MOI pilot solution to be small

The pilot project will need to address issues like where and how will automated data collection occur. Will the MOI solution collect data from data historians, through API calls to enterprise applications, through OPC UA gateways? Involve end users (and customers) in the pilot design phase to determine what metrics are most meaningful to provide, and what actions can be taken based on the new information insights.

04 Once successful, expand the MOI pilot to other areas

As the pilot implementation team gains experience and confidence, and the larger organization becomes convinced that MOI can act as a performance visualizer and accelerator, companies are ready to define a long-term vision (1-5 years). This vision should be transformative in the way in which your organization can work and collaborate in the future.

05 Accelerate the MOI journey by choosing the right partners

A chosen software vendor should have a technology tool set that can address both the quick project cycles in the short-term pilot, as well as possess the capabilities to scale to the sophistication of a long-term vision.

1. *Getting Started with Manufacturing Operational Intelligence* – LNS Research, 2014



Summary

Manufacturing leaders are increasingly challenged to balance a multitude of competing priorities – improved customer service levels, reduced costs and cycle times, and build-to-order production capabilities.

Although many companies have invested in manufacturing automation systems, most manufacturing data remains locked in disparate data silos.

MOI solutions provide the software infrastructure needed to access and aggregate critical industrial data, thereby providing context for advanced analytics and visualization. Adopters have reported significant gains in productivity and efficiency in comparison to outdated spreadsheet models and paper reports. Importantly, MOI also provides a path for business optimization, as newly automated processes can drive further automation in all adjacent systems.

Organizations can choose to implement hand-crafted MOI solutions by selecting from a variety of available tools and building from scratch. Although a "tools-centric" strategy offers flexibility, it is accompanied by significant costs, risks, and time-to-implementation factors that may not be acceptable.

Many manufacturers are choosing instead to acquire and install a commercial MOI application such as GE Digital's [Plant Pulse Optimizer \(PPO\)*](#). Commercial applications offer a compelling alternative when time-to-implementation and risk management are driving criteria.

GE Digital: Solutions and Services for Brilliant Factories

GE Digital is a leading provider of technology solutions for manufacturing organizations worldwide. Our [Brilliant Manufacturing*](#) suite is the synthesis of two decades of working with the world's most recognized brands in manufacturing, including our own GE plants.

In addition to providing world-class manufacturing solutions, GE Digital offers the flexibility to deploy our software on premise, on the [Predix*](#) industrial cloud, and in hybrid configurations. We also provide a wide range of professional services – including design and mentoring workshops, implementation Starter Kits, and remote management – to put your digital industrial initiatives on the fast track. Contact us today to learn how we can help you get started on your MOI journey.





About GE

GE (NYSE: GE) is the world's Digital Industrial Company, transforming industry with software-defined machines and solutions that are connected, responsive and predictive. GE is organized around a global exchange of knowledge, the "GE Store," through which each business shares and accesses the same technology, markets, structure and intellect. Each invention further fuels innovation and application across our industrial sectors. With people, services, technology and scale, GE delivers better outcomes for customers by speaking the language of industry.

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