



# The Rise of Multimodal Manufacturing

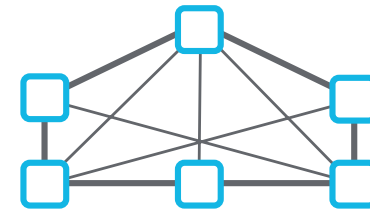


# Manufacturing market drivers

The manufacturing industry is always driving for more efficiency. According to a study by IDC, there is an opportunity of \$4.5 trillion in economic value-add across the manufacturing value chain—\$1.1 trillion in the factory itself. To capitalize on this, manufacturers seek to address indicators of such inefficiency, including time-to-market being affected by just-in-time needs and pressure for reducing parts inventory, cost overruns, and machine downtime. Additional problems might include delays or bottlenecks in the rest of the organization because they can't keep up with factory improvements in cycle time and deficiency gaps in the standard languages for modeling production and manufacturing processes.

In today's manufacturing world, complexity is a significant challenge, because it is not uncommon for enterprise organizations to be in more than one business. For example, GE is one of the largest and most diverse manufacturers on the planet, producing everything from airplane engines to wind turbines to CT scanners. Manufacturers need to find the capacity to produce what the market wants, when it wants it, and at increasingly higher quality—even when it means quickly changing lines and entire facilities over to new products.

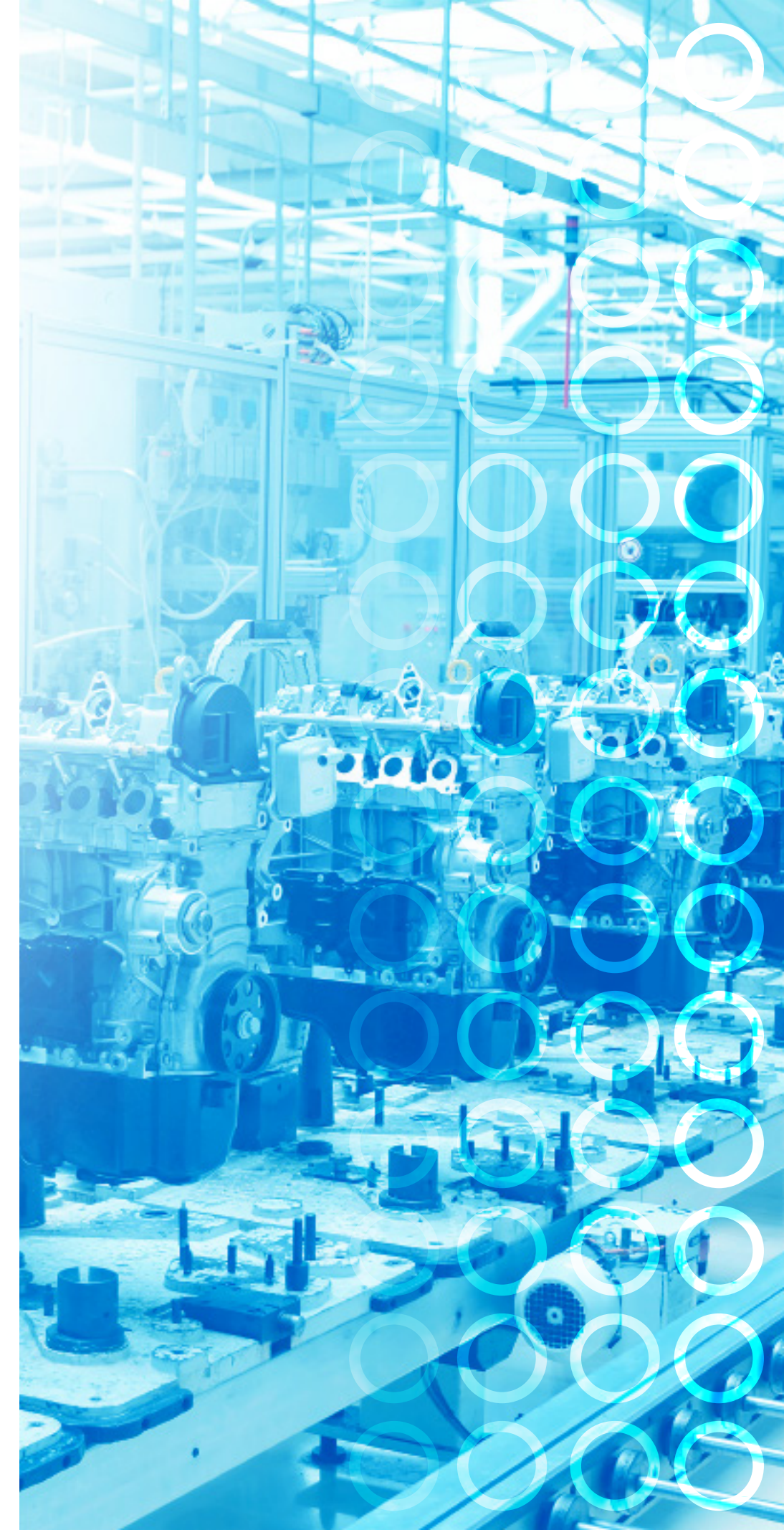
Today, products can be conceived, developed, and sold over the Internet in a matter of weeks or days, meaning today's manufacturers are already competing on their ability to manufacture to order.



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*As a result, there is a movement underway in manufacturing that is profoundly changing the way products are manufactured. Multimodal manufacturing is on the rise, with plants undertaking several types of manufacturing processes in one facility.*

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# What is multimodal manufacturing?

As defined, multimodal manufacturing refers to plants that are undertaking several types of complex manufacturing processes within the same four walls. For example, food and beverage manufacturers are doing everything from mixing batches, cooking their recipes, and packaging it all under one roof.

While multimodal manufacturing has been more common in process manufacturing, it's not uncommon to see these practices extending to discrete processes as well. GE is leading the way in multimodal manufacturing with its facility at Chakan in Pune that combines manufacturing for six different businesses from power to aviation, and a second in Canada. Both facilities are leveraging GE Digital's portfolio of industrial applications to optimize operational processes and gain equipment efficiency.

A multimodal factory has the capability to produce multiple, diverse products for varied businesses. Pune's factory connects digitally across three major areas of the value chain—product engineering, manufacturing, and supply chain operations—to integrate machine data and reduce downtime. The advanced manufacturing plant, which is located near Mumbai in western India, spans 67 acres and includes a 250,000 sq. ft. shop floor that manufactures a variety of products, and can switch to building other products for other industries. This means that GE can adjust its production in line with demand, using the same infrastructure and people in the facility. This helps cut costs, maintain economies of scale, and improve efficiencies.



# Implications of multimodal factories

Performing different processes in one facility has implications on technology requirements. It is more streamlined to have one technology for all machines and processes so that the staff only needs to learn one technology and only has to look in one place for process and performance data across the entire shop floor.

No matter what is being manufactured. Due to the varied production processes in a multimodal factory, the technology should be able to handle both discrete and hybrid processes. In the Pune facility mentioned earlier, operators weren't supported with a system to fully notate reasons for machine downtime and had no unified system to access technical information, record production, or view quality data. This was addressed in its transformation to a multimodal facility.

Keeping the production line in one facility means that the health of each machine is vitally important to the overall plant production of multiple different products. This drives the need to connect the machines into one visualization and employ more sophisticated approaches, like predictive maintenance to prevent downtime. Predictive maintenance gives maintenance teams the analytics tools to predict possible machine tool failures before they occur.

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*And a multimodal factory benefits from a holistic view into its production that allows engineers real-time visibility into machine data and manufacturing performance to allow them to optimize labor and machine run time.*

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Today, about 23% of manufacturing plants globally operate as smart factories, according to IDC's recent Manufacturing Insights Information Technology and Operational Technology Integration Survey. But IDC anticipates a drastic shift. 40% of manufacturers have already completed work to integrate information technology and operational technology, and 52% of manufacturers have an ongoing initiative to do so. Within five years, IDC says that more than half of manufacturers will have truly integrated their infrastructure in order to function as a smart factory. These are important building blocks to multimodal factories.

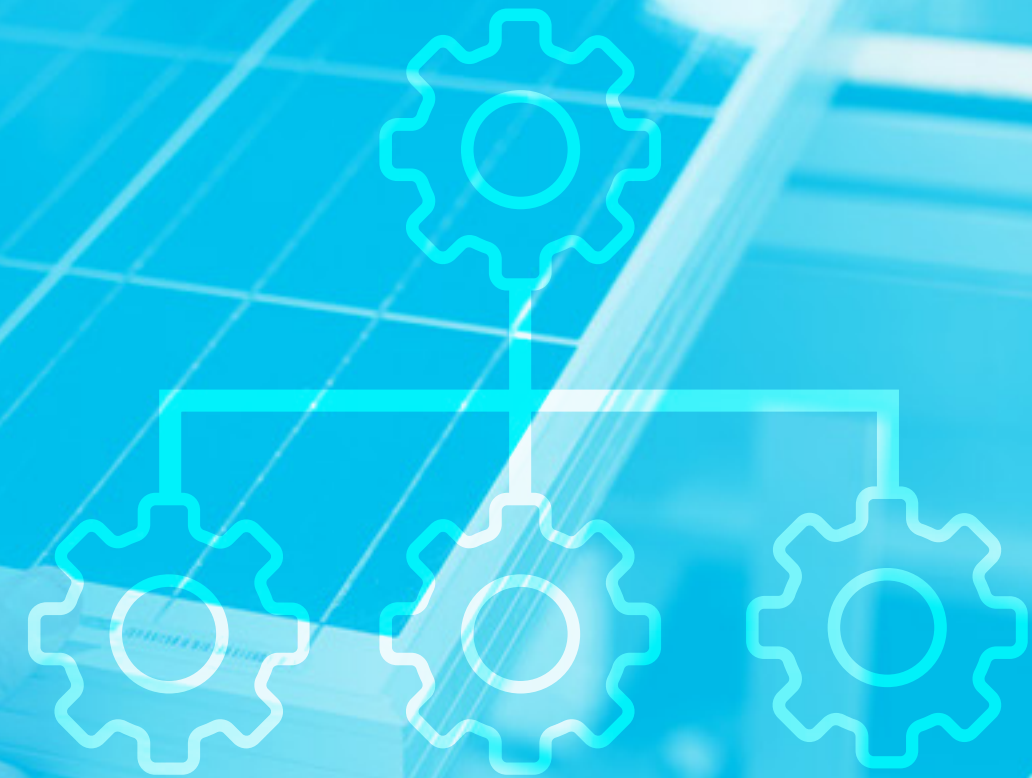


# How GE Digital accelerated Pune's digital transformation

After its transformation to a multimodal factory, Pune is now a manufacturing facility that serves six different GE businesses—Power, Aviation, Thermal, Oil and Gas, Renewables and Transportation—and products for these businesses can all be built under its roof. Due to the implementation of GE Digital solutions, the machines and computers within the Pune facility communicate in real-time.

The transformation involved getting connected to Predix Platform and Predix Manufacturing Execution Systems (Predix MES), including Plant Applications and CIMPLICITY. Engineers connected sensors from 20 computer numeric control (CNC) machines to integrate the machine data and enable visualization of performance across machines on a single screen. This real-time visibility of machine performance enables a lean operation and the reduction of waste. A cross-functional team leverages technology to analyze data and create a plan to reduce machine downtime, enable operators to notate downtime, and allow operators to view 3D work instructions along with facility or record production and quality data.

Predix Asset Performance Management (Predix APM) is leveraged to monitor how Pune's assets are operating in real-time. This helps operators diagnose the current health conditions of all critical subsystems of a machine and enables a framework of condition-based maintenance when that machine's tag data, in combination with the machines' maintenance history, is modeled using analytics. This allows them to diagnose health conditions, provide predictive maintenance recommendations and identify equipment issues before they occur.



# Brilliant results

As a result of getting connected, the Pune facility now has a single visualization of their integrated machine data as well as a machine downtime notation system for operators, and established a unified user interface to provide technical, production and quality data. This has driven significant gains in effectiveness for the Pune facility.

Pune has experienced \$4 million in cost avoidance for three of their CNCs and a 45% to over 70% increase in overall equipment effectiveness (OEE) across their connected machines. Operating costs per hour are down significantly.

With over 20 machines connected across multiple critical processes and over 150 sensors being tracked real-time, the Pune facility expects a return on investment within 1.2 years of implementation. In addition, they expect a cost savings of \$170,000 in year one from improvements in both mean time between failures (MTBF) improvements and quality rejections due to breakdowns.

**Today, the Pune facility is ready to undertake the next phase of its evolution. As part of this phase, the facility will integrate their ERP, PLM, and MES systems to pull in quality, labor, and supply chain data to provide visibility for labor hours, task time, and work in progress. These aspects of this phase will decrease maintenance costs with predictive analytics and leverage Predix Platform for advanced analytics.**

# MULTIMODAL PUNE INDIA

▲  
**18%** Equipment effectiveness

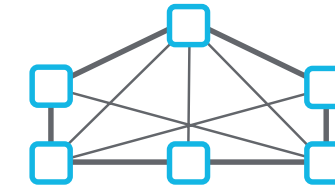
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**76%** → **45%**  
Operating cost per hour  
**+3** inventory turns

# Is multimodal manufacturing right for you?

Consider these five questions when evaluating a multimodal process.

- Are you incurring expense related to transporting parts from one facility to another for assembly?
- Does your plant suffer from downtime due to waiting on supplies to transport from one facility to another?
- Do you suffer a high error rate on components supplied from other facilities?
- Does seasonality or consumer demand create spikes and lulls in production?
- Do you have specialized equipment or labor that is underutilized because of the limited products being manufactured at some facilities?



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*To learn more about how Predix MES can help you manage multimodal production complexity and improve manufacturing efficiencies, visit our [Predix Manufacturing Execution Systems page](#).*

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FIND OUT MORE

