

# Accelerate Digital Transformation in Manufacturing

**How IoT Plus Data Analytics Equals Smart Manufacturing**



## EXECUTIVE SUMMARY

The manufacturing sector is no stranger to change. Over the course of three industrial revolutions, companies have relied on everything from water and steam to electricity and information technology to power their operations, provide services and make products. But the evolution taking place with Industry 4.0, [which McKinsey & Company defines](#) as “a new wave of technological changes that will trigger a paradigm shift in manufacturing,” may be the most significant change of all.

The catalyst for this shift, in which “smart factories” can respond in real time to quality issues, equipment outages and other production challenges, is the combination of several interrelated technologies that are maturing at the same time: the internet of things (IoT), advanced data analytics, artificial intelligence (AI), machine-to-machine learning (M2M) and cloud computing.

*IoT applications in factory settings have the potential to create as much as \$3.7 trillion in value per year in 2025*

Today’s manufacturers must operate at breakneck speed to keep pace with ever-changing customer demands, market trends and global competitors in a rapidly evolving marketplace. Yet many traditional challenges, such as increasing costs, unplanned downtime, quality control (QC), evolving business requirements and aging infrastructure, continue to hamper progress.



**Improve Production.** Unplanned downtime from equipment breakdowns, unforeseen bottlenecks, supply chain disruptions, labor shortages or changing customer orders can idle assets, resulting in loss of production time and revenue.



**Tame Complexity.** As the manufacturing sector moves from mass production to mass customization, QC is becoming increasingly complex. Even the most minor variations in production can negatively affect quality, leading to widespread recalls, costly lawsuits, consumer mistrust or exorbitant warranty expenses. And production line irregularities can produce enormous waste.



**Find Flexibility.** Legacy systems based on proprietary or outdated technologies can’t be integrated with new applications without costly customizations, thereby limiting their extended functionalities. In addition, legacy systems can be expensive to maintain and can divert resources from more-innovative initiatives.

In response, manufacturers are turning to IoT technologies that combine manufacturing assets with embedded sensors, advanced analytics, AI and cognitive computing. The goal is to generate digital intelligence across the entire value stream and, as McKinsey notes, create “processes that govern themselves, where smart products can take corrective action to avoid damages and where individual parts are automatically replenished.”

By harnessing IoT and advanced analytics technologies, manufacturers can:

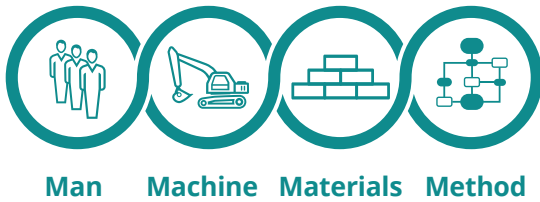
- ✓ Increase productivity and uptime.
- ✓ Improve process efficiencies.
- ✓ Accelerate innovation.
- ✓ Reduce asset downtime.
- ✓ Enhance operational efficiency.
- ✓ Create end-to-end operational visibility.
- ✓ Improve product quality.
- ✓ Reduce operating costs.
- ✓ Optimize production scheduling.
- ✓ Improve overall equipment effectiveness (OEE).

[IoT applications](#) in factory settings have the potential to create as much as \$3.7 trillion in value per year in 2025, according to a report from the McKinsey Global Institute.

# Advanced Analytics at the Core

At the core of IoT and its potential to create value is advanced analytics. Research firm Gartner defines advanced analytics as the “autonomous or semi-autonomous examination of data or content using sophisticated techniques and tools, typically beyond those of traditional [business intelligence](#) (BI), to discover deeper insights, make predictions or generate recommendations.” According to Gartner, advanced analytic techniques include machine learning pattern matching, cluster analysis, multivariate statistics and a variety of other methods.

## THE 4 M's OF MANUFACTURING



## Lumada and Pentaho: the Perfect Tandem for IoT Program Success

Hitachi's Lumada IoT platform uses artificial intelligence, advanced analytics and asset virtualization – called asset avatars – to illuminate your data and drive better outcomes. With its Pentaho platform, Hitachi Vantara enables users to ingest, blend, cleanse and prepare data from any source. With visual tools to eliminate coding and complexity, Pentaho puts the best quality data at the fingertips of IT and the business.

[Click here](#) to learn more about Hitachi's [Lumada](#) and [Pentaho](#) platforms.

Using advanced analytics capabilities, manufacturers can aggregate, sort and analyze the vast volumes of information generated by the four Ms of manufacturing, blend structured and unstructured data and convert this data into actionable insights. These are some of the benefits:

### IMPROVING QUALITY

Inconsistent product or component quality can reduce yields, create costly waste and cripple production capacity. Consider, for example, a manufacturer whose polymer mixing process continues to produce output of inconsistent quality. The need to scrap poor batches results in huge costs and compromised production capacity. Worse yet, if left undetected, this material issue creates inferior product quality down the line and can lead to millions of dollars in lost revenue.

An advanced analytics platform that integrates a wide range of production and sensor data could visualize, analyze and diagnose the mixing process. As a result, the production engineering team can understand the correlations and cause and effect of inconsistent or poor-quality output from a wide range of variables.

This type of advanced analytics eliminates poor-quality output. It helps manufacturers boost average yields and reduce operating costs as the focus shifts from scrapping poor batches to optimizing manufacturing processes. By adding machine learning capabilities, the system can also adapt to changing conditions, such as new product designs, increased product variations and new or changing ingredients.



## CASE STUDY: SULLAIR

### Real-Time Monitoring of Critical Assets for Fast Response

They're the manufacturing industry's unsung heroes: portable air compressors that power some of the world's largest production facilities in areas such as construction, mining and oil.

Sullair would know. A top provider of stationary and portable air compressors, Sullair recently bundled its air compressors with a remote monitoring system powered by Hitachi's Lumada IoT platform. The system works by recording the parameters of an air compressor in real time and observing machine performance. Take lubricant level, vibration and temperature — They're all variables remotely monitored by compressors to identify meaningful events, such as overheating or the need for a filter replacement.

Workers can view the details on a user-friendly dashboard for mobile devices or desktop computers. And in pressing circumstances, Sullair air compressors proactively alert administrators to all breakdowns and unscheduled stops.

By relying on sensors to remotely monitor the machine's operational status and efficiency performance, Sullair air compressors deliver many benefits, including:

- Increased factory power savings.
- Improved system reliability and greater uptime.
- Better protection of investment dollars in high-priced air compressors.
- Reduced risk of unplanned downtime.
- Minimization of maintenance tasks by automating service and fault alerts.
- Fewer operational delays.
- Improved efficiencies for competitive advantage.
- Better planning for component replacement.
- Improved field management and workflow of service staff.
- More-timely servicing of equipment with built-in service alarms.

In addition to these business benefits, Sullair air compressors provide customers with extensive data and a thorough understanding of how their compressor package is performing, for fast remedial action.

### MAXIMIZE PERFORMANCE OF CRITICAL ASSETS

Equipment failures can cost manufacturers millions of dollars in downtime and productivity loss. [One survey of auto industry manufacturing executives](#) by Thomasnet.com showed that every minute of stopped production costs an average of \$22,000. Advanced analytics and machine learning can help avoid production shutdowns by monitoring sensor, event and historical data to detect trouble spots. Using these types of prescriptive analytics, manufacturers can proactively identify machinery requiring attention and conduct necessary repairs under controlled conditions before it stops working.

Consider air compressors, an essential part of most manufacturing and production processes: They are used to power equipment in 90% of all industrial companies. By deploying a condition-monitoring system that uses advanced analytics, a manufacturer can track the machine's performance in real time. The system will send alerts about conditions, such as excessive pressure or rising temperatures, that could lead to breakdowns and unscheduled production halts. Rather than simply reacting to production halts, maintenance becomes a proactive, integrated part of production.

Detecting inaccuracies in the early stages of a production cycle can also offer a critical advantage. By preemptively detecting production line problems, such as nonconforming parts or improper calibration, manufacturers can decrease the likelihood of producing defective products, thereby improving throughput yield without having to commit time, money and resources to rectifying defects.

Improving asset uptime can also significantly boost plant productivity. An IoT approach can result in a [20% to 25% increase in production volume](#) and a 45% reduction in downtime. By eliminating unknown problems, such as equipment failure, manufacturers can optimize production schedules and shorten lead times, for improved quantity and quality of finished goods.

#### ANTICIPATED WORLDWIDE IoT SPENDING

**\$737 billion**      **\$1.29 trillion**  
2016                      2020

#### IoT MANUFACTURING OPERATIONS INVESTMENT

**\$102.5 billion**

Source: IDC

A detailed understanding of equipment performance through analytics offers several benefits. Using analytics to monitor production line quality can help identify quality problems quickly and improve yield. Additionally, analyzing historical equipment performance data and real-time data can reduce maintenance costs and increase equipment availability.

Manufacturers can also more easily adhere to factory safety and regulatory compliance standards by taking the time to convert IoT-generated data into actionable insights, such as how to prevent system vulnerabilities.

## The Wisdom of a Co-Creation Approach

In today's highly competitive digital business world, manufacturers must act fast and pivot quickly to meet fluctuating market trends and consumer demands. IoT, combined with advanced analytics as part of a broader digital transformation strategy, can help manufacturers create new business models, improve operational efficiencies and drive innovation in products and services.

Yet, nearly **70%** of all digital transformation initiatives are considered unsuccessful, according to data from McKinsey. Many manufacturers lack the multidomain experience and expertise required to create innovative solutions that will lead to successful digital transformation. Although they have in-depth manufacturing industry knowledge, it's rarely accompanied by a deep understanding of IoT, computing and communication technologies, predictive analytics or AI.

However, by partnering with a vendor that has both information technology (IT) and operational technology (OT) expertise in data analytics, a manufacturer can co-create solutions that cater to unique needs and business requirements. This innovative co-creation approach to IoT and advanced analytics includes four critical steps:

### **Step 1: Engage**

The vendor and manufacturer work together to create a shared vision, understand pain points and goals, conduct discovery in reviews and workshops, and analyze data. They discuss options and distill abstract concepts into a prioritized list of use cases to address.

### **Step 2: Build a Model**

A team of data scientists sifts through various data sets. Then they cleanse data, standardize and enrich it, and choose the right analytics techniques and algorithms to build an analytical model to fit a manufacturer's use case.



### Step 3: Create the Solution

Solution developers deploy an analytics platform and tools. Then, they build the solution model code and algorithms, user-experience wire frames, user-interface design models and templates. Lastly, they integrate these with IT tools for analysis. The concepts of the solution are exposed to pipelines of real data and proven to deliver the expected results. Co-creative spaces help ensure effective workshop processes, and simulation tools produce positive results.

### Step 4: Test and Validate

Delivery engineers integrate the solution with a customer's operational technology (OT) and IT systems in an operating environment. Next they integrate live data, deploy analytical pipelines, test robustness and scalability, and validate business outcomes and key performance indicator (KPI) results to ensure optimum value.

By drawing stakeholders directly into the innovation process and supporting them with an ecosystem of partners and expertise, a co-creation approach fosters a deep understanding of a manufacturer's pain points. And it solves issues with a customized solution rather than an off-the-shelf tool. As a result, co-creation delivers the following benefits:

- Offers a low-cost methodology for developing new products and services.
- Sparks innovation and advances complex projects.
- Reduces risks associated with implementing new digital initiatives.
- Helps speed up desired outcomes.

Together, these benefits provide a solid foundation for business transformation.

#### CASE STUDY: DAICEL

### Maintain a Data-Driven Bird's-Eye View of Production Line Performance

No industry is immune to product recalls. Drug companies, technology titans, electronics manufacturers: They've all pulled defective goods from retail store shelves and global marketplaces. The repercussions can be disastrous: millions of dollars in lost revenue, government sanctions, lawsuits and consumer mistrust.

There is a way for manufacturers to minimize the risk of product recalls, however. Daicel Corporation, a global manufacturer of chemical products and a major manufacturer of airbags, joined forces with Hitachi Vantara to co-create an image analysis system that can detect signs of operational failure in production line facilities and identify deviations in worker activities on their manufacturing lines.

The system works by analyzing video data on the front lines of manufacturing, using Hitachi Vantara's image analytics technologies. Depth cameras extract 3-D forms to measure worker activities and obtain positional information on human joints, such as hands, elbows and shoulders.

Next, the system compares these worker movements with standard behavior models to quickly identify deviations and detect abnormalities in worker activities. The system can also detect abnormalities due to welding defects by combining voltage and current data from existing facilities with light-emitting element color analysis using high-speed cameras. Taking a four-M's approach, other units of monitoring include detecting abnormalities in materials and facilities.

Manufacturers are already gathering a wide range of work-related performance data — including manufacturing,

performance and inspection data — to identify the root causes of product defects. But Daicel's image analysis system drills down quickly into problem areas by extracting only information related to improvements in quality and productivity from vast volumes of video data. The system then analyzes this data to improve work efficiency, enhance product quality and quickly discover defects. The result is a shift from after-the-fact measures to monitoring real-time trends so that Daicel can prevent defects in any final product.

By using IoT technologies to accumulate and manage performance and inspection data, Daicel's image analysis system also improves product traceability. The system links image data with final products, based on individual serial numbers, enabling Daicel to pinpoint which production processes are causing defects and rectify problems immediately.

## Three Types of Advanced Analytics

Three distinct types of advanced analytics can aid manufacturers:

- 1 **Descriptive analytics**, which mines historical information, such as production data, to provide insights into equipment performance and maintenance activities.
- 2 **Predictive analytics**, which examines real-time data and identifies patterns for forecasting equipment failures.
- 3 **Prescriptive analytics**, which examines historical and real-time data and, based on identifiable patterns, recommends best actions to take next.



### ➤ **Manufacturing and the Industrial Internet of Things (IIoT)**

Innovate with sensor data, AI and advanced analytics to gain end-to-end operational visibility and predictive quality and optimize production efficiency.

## Conclusion

Today's manufacturers are under unprecedented pressure to produce high-quality products at record speed and with unmatched precision. To keep pace with fluctuating market trends and satisfy rising customer expectations, manufacturers must embrace IoT technologies and leverage advanced analytics to bring insights into asset health, output quality and operational processes.

However, just as no two companies are the same, no two IoT solutions are the same. For this reason, it's critical for manufacturing firms to work with a partner that has both OT and IT expertise in data analytics to co-create solutions that address those unique requirements and specific needs. This type of partnership can help realize the promise of IoT and enable companies to enhance product quality, cut operational costs and optimize manufacturing operations for long-term rewards.

Learn how Hitachi Vantara can leverage 100+ years of OT experience and nearly 60 years of IT expertise to help you co-create IoT solutions and analyze your data for improved strategic decision-making.

- [Pentaho Big Data Integration and Analytics](#)  
Easily prepare and blend machine and sensor data with other data assets to deliver better business outcomes.
- [Lumada IoT Platform](#)  
Drive IoT solutions faster with our expertise to unify the physical and digital worlds.

### **Hitachi Vantara at a Glance**

Your data is the key to new revenue, better customer experiences and lower costs. With technology and expertise, Hitachi Vantara drives data to meaningful outcomes.

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