Making Manufacturing Analytics and AI Matter

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It's Time to Invest in Analytics and AI

Analytics and AI Deliver Value to Manufacturing

Analytics and artificial intelligence (AI) are hot topics in manufacturing operations today. This research explored what companies are doing, why, and how. The data from 423 responses from companies that manufacture or produce worldwide is conclusive. Those companies investing in analytics and AI are gaining substantial benefits. The benefits matter, as they are in the areas that match the most common objectives: cost, efficiency / productivity, quality, and error-proofing.

100% of these respondents are facing significant challenges, and 99% are investing in manufacturing operations, analytics, and AI to address them. Those using analytics and AI longer tend to see benefits in more areas.

Top Performers doing better on operations metrics are also outperforming Others on business metrics. What are they doing differently? More of them are using dashboards, analytics, and AI. They also prioritize use cases based on business value.

" AI is moving fast and can help with many tasks today. We must start the process of learning and using it, or we'll be behind quickly."

Nasser Ahmad
Director,
Digitalization
Höganäs

DRIVERS OF PLANNED INVESTMENTS IN MANUFACTURING OPERATIONS AND ANALYTICS FOR 2025 AND 2026

Driver	Percentage
Cost Reduction	74%
Supply Chain Resiliency	47%
Sustainability Goals and Requirements	46%
Overcome Workforce Skills Gap	42%
Greater Revenue Opportunity	41%
Regulatory Compliance	26%
Streamlining IT	22%

❝ ML/AI reduces compliance impacts and defects in production. From a raw material saving point of view, it helped when raw material prices rose during COVID.❞

Peter Thompson
Director of Manufacturing IT
Uponor

Why Invest in Manufacturing Operations and Analytics?

Manufacturing is Central

Manufacturing is the center of a company's profitability: costs and revenue opportunities depend heavily on production's operating prowess. 99% of respondents are investing in operations and analytics.

Investment Drivers

- **Reducing operating costs** is a nearly universal driver.
- **Supply chain resiliency** means being an agile, reliable partner.
- **Sustainability** is a new goal that many seek to improve.
- **Overcoming workforce challenges** is an ongoing need.
- **Improving revenue opportunities** is the other side of the profit equation.

Skills & Knowledge

For over a decade, manufacturers have struggled to hire skilled workers. Analytics and AI can address this workforce skills gap, whether troubleshooting, explaining, predicting, guiding, or providing support.

Range of Uses

Most manufacturers plan to use analytics to predict what might happen and when (66% and 61%). Over 40% plan to troubleshoot, support workers, achieve autonomous operations, and explain what happened.

Complete View

Yet, getting a complete digital view of the plant requires both operations technology (OT) and information technology (IT) data. So, the operation often needs investment to put data in context.

Challenge	%
Supply uncertainty	60%
Difficulty retaining skilled personnel	53%
Changing regulations	51%
Supplier quality variability	50%
Cybersecurity and IP threats	36%
Rapidly changing competition	32%
Unpredictable costs	29%
Frequent changes in customer requirements	23%
Product or variant proliferation	19%
Customer expectations for customization	17%
Product lifecycles too short	12%

Business Challenges

Insights to Overcome Challenges

While 99% of respondents are investing, 100% face business challenges with significant impact. Overcoming these business challenges requires fast, reliable insights.

- Supply and regulatory changes require agility, and fact-based insights can point to appropriate adjustments.
- A lack of skilled people with the expertise to identify issues and impacts of changes means companies are seeking technology support.
- Supplier quality variability impacts product quality and efficiency, demanding another dimension of information to guide the operation.

Lacking Decision Data

All roles need reliable access to complete data to make timely decisions, from executives through all levels to operators. When asked typically what roles **do not have reliable access** to a complete data set to make timely decisions:

- 50% report maintenance
- 45% report operators / associates / supervisors
- 44% report schedulers
- Office-based employees, including automation engineers, quality managers, and inventory or materials managers, are more likely to have the data access they need.

Specific Data Challenges

Insights come from information that is based on data. However, manufacturing data poses challenges. Top issues with decision-ready data: data quality is poor (60%), it is inconsistent and lacks data governance (41%), and it is not in context (38%). 37% also report inability to access needed data quickly enough for real-time decisions and action, and poor data visualization.

" It all goes back to data quality. Creating a data model is like sculpting. You must start with unmolded clay when making a sculpture. Once the data model is refined, you are then well positioned to automate data collection, which will be less prone to manual error."

Will Spears
Senior Product Owner, Smart Manufacturing
Sonoco

Smart Manufacturing Journey

Why Embark on the Journey?

Smart Manufacturing, which may also go by the name of Industry 4.0 or 5.0 or Digital Transformation, is intended to help meet business challenges and changes with digital means. It is typically a journey that includes many projects. Smart Manufacturing is generally intended to improve issues such as

- Efficiencies such as yield, uptime, capacity utilization, and quality
- Agility
- Decision-making data access
- Knowledge retention
- Support less-skilled workers
- Enable new business models

Multi-Faceted

As the MESA Smart Manufacturing model[1] illustrates, there are many aspects to consider. As always, technologies enable and support new processes and the people in the company. MESA's model includes lifecycles, cross-lifecycle threads, and enabling technologies. Every discipline in the company and every process may be affected. So, it is a journey for the entire manufacturing enterprise.

THE MESA SMART MANUFACTURING MODEL

> " We are a balance of old-school cabinetmakers and technologies. We have grown up with ERP on the shop floor. Now, we are seeking two-way information sharing with engineering because we can save time and minimize the risk of typing incorrectly into one of those pieces of software."

Jason Bassett
IT Manager
Madsen's Custom Cabinets

> " We have refocused to serve larger European OEMs in the past five years. We moved to a newer ERP and then deployed MES. This was a multi-year journey. Surface mount technology is more standard and easier. Implementing MES in other areas of the factory was more difficult."

David Batet
CTO
DigiProces

Smart Manufacturing Progress

Smart Manufacturing Progress

Many companies are still early in this journey, but most are at least getting started with several projects in this survey response base. A quarter have many initiatives underway, and 6% report significant progress and results already. Note that starting with one project and creating a plan or strategy are good practice starting points. Just don't get stuck on the first project. Every manufacturer will need to improve on several fronts.
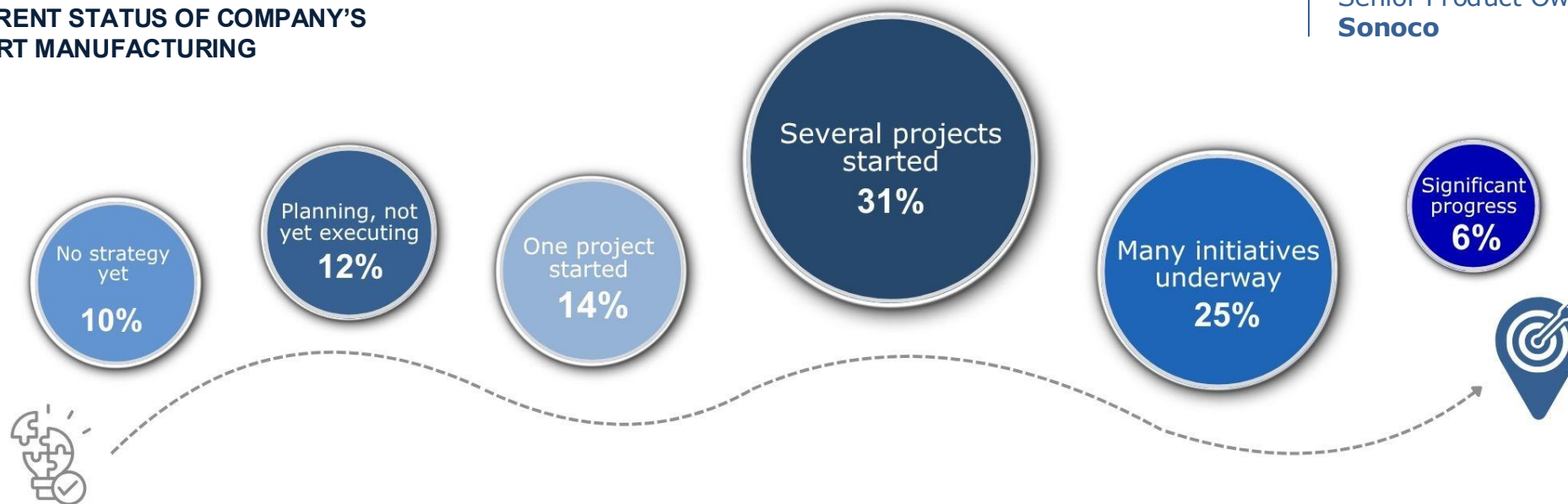
Model Support for Projects

Throughout this report, we talk about projects, initiatives, and use cases. Each of these can be structured using the MESA model. Consider the business objective in terms of the main lifecycle first. As the issue is defined, it may become apparent which cross-industry threads play a role: analytics and what else? Finally, consider which technologies apply.

" We're fostering an environment where all stakeholders need to understand the cost and value of new initiatives. Our process involves developing a business case that includes cost of ownership when a new technology is requested. If leadership approves, we proceed with a proof of concept (PoC). When the technology shows potential as an enterprise solution, we will provide funding for scaling that technology."

Will Spears
Senior Product Owner, Smart Manufacturing
Sonoco

CURRENT STATUS OF COMPANY'S SMART MANUFACTURING

No strategy yet
10%

Planning, not yet executing
12%

One project started
14%

Several projects started
31%

Many initiatives underway
25%

Significant progress
6%

Investment Outcomes

Priorities Vary

Companies are investing to make progress in Smart Manufacturing. As we saw above, many manufacturers' drivers are around cost, supply chain resilience, sustainability, workforce skills, and revenue opportunities. At least 13% of respondents are working on each of the 10 items we listed.

Data Access for Plant Employees

Nearly half of respondents prioritize improving data access for plant employees. This is essential for making good decisions, retaining employees, and attaining high quality and throughput. Data is the foundation for AI or analytics to deliver insights that lead to effective action.

Integrating Systems

Following closely with over 40% of respondents is the integration of automation, plant, and enterprise systems. Getting data flowing from the "shop floor to the top floor" has been both a goal and a hurdle for decades. The good news is this is getting easier with data fabric and integration frameworks.

Advanced Analytics and AI

38% want an outcome of advanced analytics or AI aimed at operating performance improvement. Companies will need education to achieve this. Fortunately, they only need one data set for a specific use case to get started.
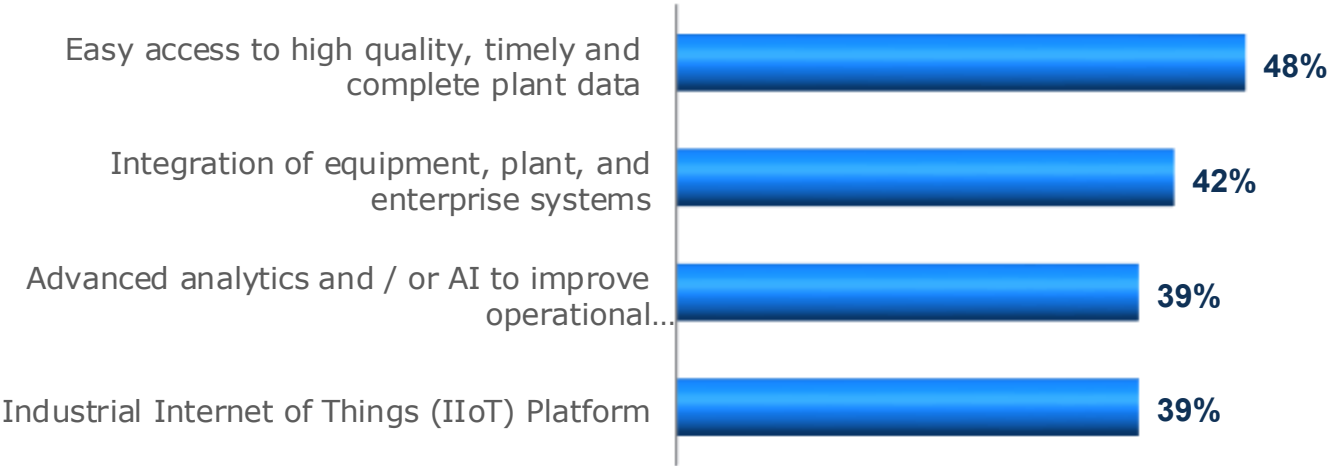
IIoT Connectivity

Nearly 40% aim to gain an Industrial Internet of Things (IIoT) platform. This capability is increasingly incorporated in leading software or has deep applications available to run on it. IIoT platforms will be key to bridging the IT/OT divide and creating industrial DataOps, which are crucial for analytics and AI success.

> " The backbone of the applications is the real capability, having a goal of all relevant data in one central location, preferably in a single database. If you have data sets in multiple SQL databases across multiple locations, then the whole process will be inefficient and complicated. Also, when someone new joins the team, the onboarding time increases."

Peter Thompson
Director of Manufacturing IT
Uponor

TOP THREE PRIORITY OUTCOMES FOR INVESTMENTS IN MANUFACTURING OPERATIONS AND ANALYTICS IN 2025

Easy access to high quality, timely and complete plant data	**48%**
Integration of equipment, plant, and enterprise systems	**42%**
Advanced analytics and / or AI to improve operational…	**39%**
Industrial Internet of Things (IIoT) Platform	**39%**

Analytics May Pay Off Faster Than Other Software

Quick Positive Impact

Investments are always made to yield a return or positive impact. Just as the previous time MESA partnered to conduct this research[2], advanced analytics was the top application for rapidly delivering ROI. Nearly a third of the respondents gained the value of analytics and AI relatively rapidly.

Changes Over Time

We suspect many of the changes between 2022 and 2025 are due to the different sets of respondents. Other possible reasons for the

significant changes: The big new drive to AI in the past couple of years is likely a factor in its more prominent showing. Maintenance and asset management have been a focus of predictive analytics. In contrast, sustainability has moved into the realm of legal and regulatory requirements, which may be slowing the benefits.

Critical Data

Each use case will require a specific set of data. New technologies make it easier to identify and extract essential data from existing sources.
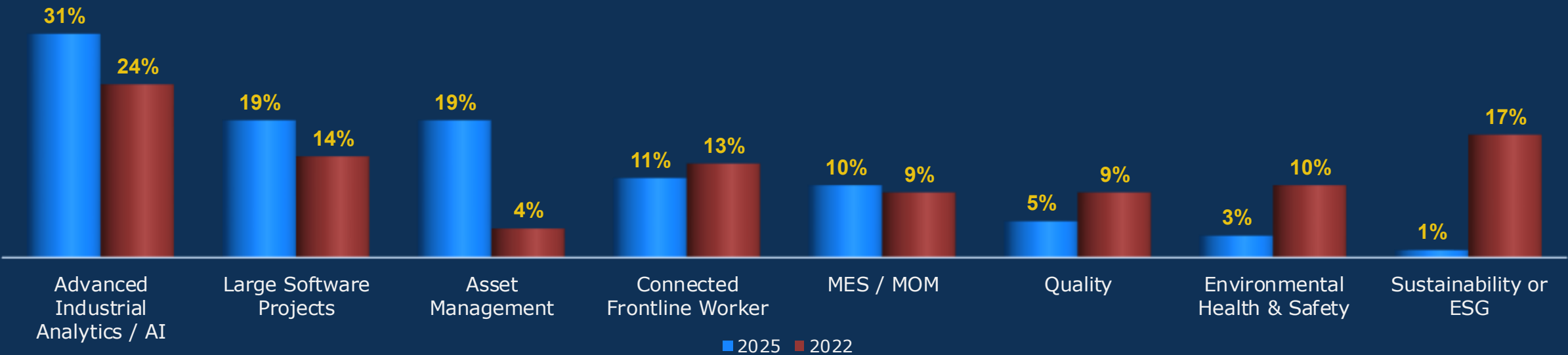
Data Foundation

Most of these projects require modeling and data-cleansing efforts to deliver benefits. Companies gaining rapid benefits from analytics and AI will likely already have a good data foundation.

Paving the Path to Value

Companies may get a solid data foundation by implementing some of the other systems on this list, such as ERP, Asset Management, and Manufacturing Execution Systems (MES) or Manufacturing Operations Management (MOM).

SOFTWARE PROJECTS WITH QUICKEST POSITIVE IMPACT

Category	2025	2022
Advanced Industrial Analytics / AI	31%	24%
Large Software Projects	19%	14%
Asset Management	19%	4%
Connected Frontline Worker	11%	13%
MES / MOM	10%	9%
Quality	5%	9%
Environmental Health & Safety	3%	10%
Sustainability or ESG	1%	17%

Analytics and AI Deliver Benefits That Matter

100% Gaining Benefits

Analytics projects are delivering significant benefits that support top drivers and help meet challenges. Every one of these respondents (100%) reports gaining benefits from analytics programs, which is excellent news for our industries.

Cost

Cost reduction is the #1 driver (p. 4) and actual benefit. Most companies know they could lower costs, but analytics and AI can help to pinpoint where to focus efforts. Predictive and preventive analytics can avoid an array of unnecessary expenses due to waste.

Efficiency & Quality

Efficiency contributes to cost and indicates people are effective, even in the face of a skilled workforce shortage. Error-proofing is necessary for less skilled staff, and even

more experienced staff can benefit from error-proofing when change is rapid, the product mix through the plant is high, or specifications change frequently.

What Customers Need

On-time perfect orders make the company a reliable supplier, leading to revenue opportunities and being viewed as trustworthy in these uncertain times. Customers also seek quality; internally that lowers costs, increases revenue opportunity, improves supply chain resilience, and enhances sustainability.
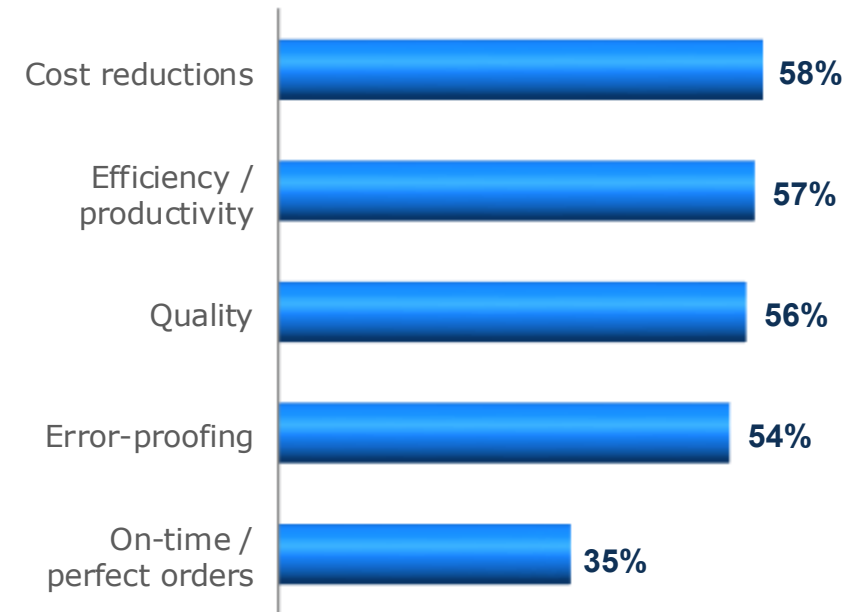
And More

Other areas where respondents report significant benefits from analytics programs include:

- Office visibility into performance (22%), which is crucial to executives and other disciplines since

manufacturing is at the center of the company.

- Planning and scheduling at 21% is heavily dependent on insights and is inherently an analytical process.
- Customer satisfaction and collaboration (20%) based on analyzed data and sharing insights can drive revenue.
- Some get benefits in waste/scrap/energy, asset performance and uptime, comparability among lines or sites, employee satisfaction, supplier issues, and returns or warranty costs.

TOP AREAS THAT BENEFIT SIGNIFICANTLY FROM ANALYTICS

Area	Percent
Cost reductions	58%
Efficiency / productivity	57%
Quality	56%
Error-proofing	54%
On-time / perfect orders	35%

" The most unexpected benefit was discovering random events that happen in the machines during production. The ML algorithm wasn't able to define exactly where in the machines the event was happening due to a lack of sensors in that area, but it was able to point directly to the machine that caused it. This specific scenario has happened quite regularly."

Peter Thompson
Director of Manufacturing IT
Uponor

Top Performers Are Role Models

PERCENTAGE RATING THEIR ANNUAL PERFORMANCE CHANGE OVER THE PAST 3 YEARS AS 'BETTER' OR 'SIGNIFICANTLY BETTER'

METRIC	TOP PERFORMER	OTHERS
Change in perfect orders	76%	29%
Change in operating margin	75%	29%
Change in cost of quality	69%	29%

Who are Top Performers?

While everyone benefited significantly from analytics in some areas, some companies outperformed their peers. Top Performers were selected based on their ability to improve on four common manufacturing metrics compared to their competitors: OEE, first-pass yield, throughput, and capacity utilization. We used a mathematical formula to identify these **21% of respondents as Top Performers**. The other 79% we call Others.

Learning from the Best

With this breakdown, we determined what they do differently. Based on those areas of difference, we make recommendations. Do you want to be like these companies? You certainly want to achieve their results, so consider whether you are doing those things they do differently, highlighted later.

Excellent Business Metrics

Not surprisingly, these Top Performers were also much more likely to report better outcomes on business metrics than their peers. These business metrics matter to the overall success of a manufacturing enterprise.

- Outperforming on perfect orders boosts supplier ratings and customer satisfaction.

- Operating margin is crucial to profitability.

- Cost of quality is a hallmark of companies that do things right the first time.

Top Performers are more than three times as likely to have hit their manufacturing cost targets for the past year at least 96% (25% vs. 8%).

Smarter Manufacturing

Progress on the Journey

Top Performers are more likely to be further along in their Smart Manufacturing or Industry 4.0 initiatives than Others. Among Top Performers, 46% have made significant progress or have many initiatives underway, compared to 26% of Others. Another 43% of Top Performers are getting started with several projects, compared to 29% of Others.

Bridging IT and OT

Ensuring IT and OT collaborate is crucial to success with Smart Manufacturing and having complete data sets to analyze. Top Performers' IT and OT organizations are more likely to be tightly integrated (58%) than Others (34%). In both groups, only 4% are the same organization.
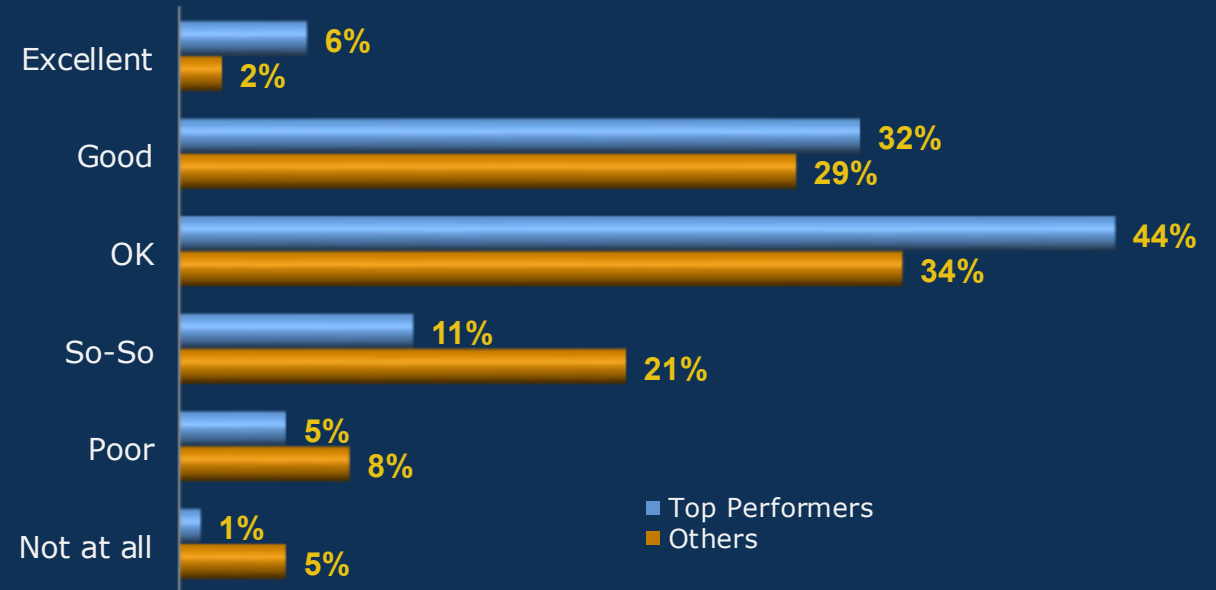
Seamless Digital Flows

Top Performers are more likely to be able to move data seamlessly from collection to context to analysis than Others. Yet, there is room for improvement, with only a few percent reporting they are excellent at this. Coherent data flows continue to be a top challenge in manufacturing, one that can dictate whether decisions can be made in time to prevent scrap and waste or safety hazards and hazardous emissions.

Using AI/ML to Detect

Typically, monitoring and detecting capabilities are in place before models come into play to predict, prevent, or guide operations. Top Performers are more likely (75%) than Others (56%) to use AI/ML to monitor and detect. Naturally, most companies also use manufacturing intelligence or dashboards for this.

ABILITY TO MOVE OPERATIONS DATA SEAMLESSLY FROM COLLECTION TO CONTEXT TO ANALYSIS

Category	Top Performers	Others
Excellent	6%	2%
Good	32%	29%
OK	44%	34%
So-So	11%	21%
Poor	5%	8%
Not at all	1%	5%

■ Top Performers
■ Others

" We thought digitalization would be without any extra effort, that the software would do it. Now, we need a team of three engineers for digitalization, including one on the shop floor. It's worth the investment because the results are there, even if you don't see them up front."

David Batet
Chief Technology Officer
DigiProces

Descriptive Analytics

How Are We Doing?

Smart Manufacturing involves understanding the production process well and being able to characterize it at all times. Descriptive analytics clearly show the past and current state of some aspect of the operation. The first iterations of this research, starting in 2006, were about performance metrics, which is one facet of describing manufacturing. Metrics and other descriptive analytics are typically a foundation for continuous improvement (CI).

Modern Analytics Tools

Top Performers are more likely to use modern technologies for descriptive analytics. 85% of Top Performers use interactive dashboards vs. 69% of Others. Dashboards are a great way to indicate visually what's happening at any time. They are typically tailored to a specific plant or line and role.

68% of Top Performers use advanced industrial analytics, including AI and ML, compared to 46% of Others. Adopting the latest approaches to analytics is another hallmark of Top Performers. A few respondents are using GenAI now, but we expect that might change once the use cases and appropriate tools are identified.
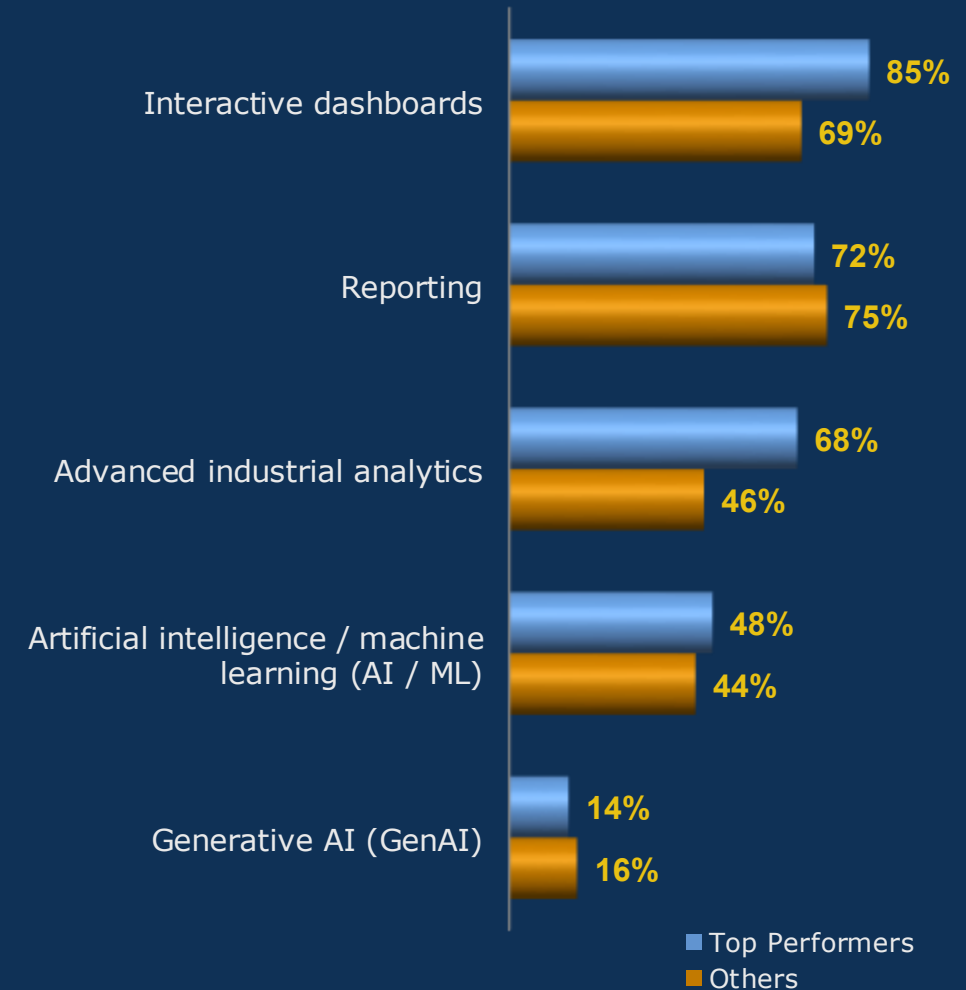
KPIs for All Always

It is not easy to always provide operations with relevant key performance indicators (KPIs). This involves data availability, descriptive analysis, and agreement on metrics and calculations for KPIs.

- 26% of Top Performers usually or always show KPIs vs. 17% of Others.
- 66% of Top Performers say KPIs are sometimes available vs. 55% of Others.
- So nearly all Top Performers' employees can see how they are doing (92%).

" We are creating safety and auditing tools. The more you can automate, the more you can control errors. The fewer keystrokes someone has to do, the better. So, we think beforehand about what could go wrong and how to avoid that to minimize the impact."

Jason Bassett
IT Manager
Madsen's Custom Cabinets

TECHNOLOGIES USED TO DESCRIBE AND SUMMARIZE

Interactive dashboards: 85% (Top Performers), 69% (Others)
Reporting: 72% (Top Performers), 75% (Others)
Advanced industrial analytics: 68% (Top Performers), 46% (Others)
Artificial intelligence / machine learning (AI / ML): 48% (Top Performers), 44% (Others)
Generative AI (GenAI): 14% (Top Performers), 16% (Others)

■ Top Performers
■ Others

Predictive Analytics

TIMEFRAME OF USING PREDICTIVE AI TOOLS IN MANUFACTURING OPERATIONS

- > 5 years: Top Performers 6%, Others 1%
- 3 to 5 years: Top Performers 43%, Others 18%
- 1 to < 3 years: Top Performers 40%, Others 46%
- < 1 year: Top Performers 6%, Others 16%
- Not using yet: Top Performers 6%, Others 18%

■ Top Performers
■ Others
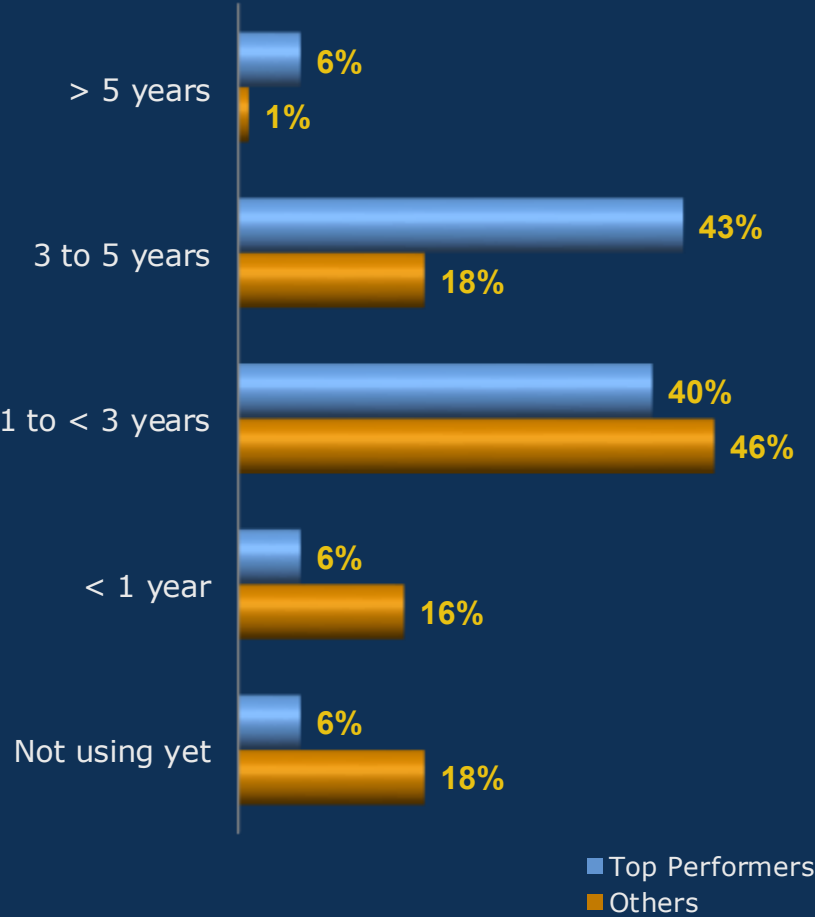
Seeing the Future

Understanding performance is crucial, but increasingly, manufacturers want to use analytics to predict what issues are likely to occur and when. Predictive analytics is typically based on mathematical models or machine learning (ML). Remember, over 60% of the respondents hope to predict what might happen and when.

Already in Use

Top Performers are more likely to have AI in pilot or production to predict manufacturing issues. Nearly one in five Top Performers have been using AI to predict issues for over three years (9% vs. 19% of Others). An additional 40% of Top Performers have been using predictive AI for 1-3 years. So, nearly all of them have experience with predictive analytics.

Digital Twin for Prediction

Beyond using AI and ML, Top Performers are more likely to use a Digital Twin of the Plant to predict issues (76% vs. 62% of Others). A virtual representation of the plant enables safe offline what-if analysis and ongoing prediction of likely problems.

Simulation is another technology used by most respondents (>70%) to predict issues.

Quality and Business Focus

Top Performers are more likely to focus predictive analytics processes on quality issues such as product quality and process drift. These often are upstream of on-time delivery and customer satisfaction issues. So, concentrating on quality makes sense to lower costs, expand revenue opportunities, and improve efficiency. Top Performers are also more likely to prioritize AI use cases based on business value aligned to strategy.

" Post-COVID, there has been a slowdown, so we are trying to rebound and make ourselves stronger and more resilient to the possibilities of a downturn. We hope asking our ERP questions will save us time and allow our people to do more."
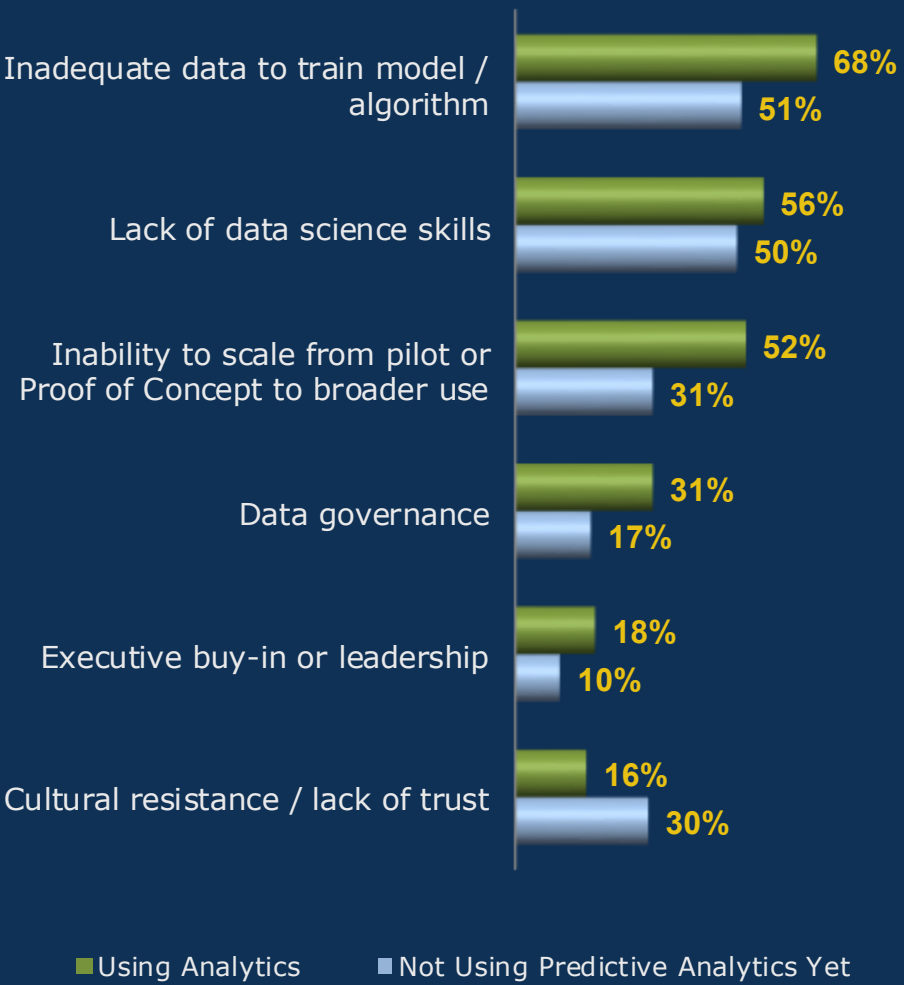
Jason Bassett
IT Manager
Madsen's Custom Cabinets

Predictive Analytics Hurdles

Inadequate data to train model / algorithm — 68% / 51%
Lack of data science skills — 56% / 50%
Inability to scale from pilot or Proof of Concept to broader use — 52% / 31%
Data governance — 31% / 17%
Executive buy-in or leadership — 18% / 10%
Cultural resistance / lack of trust — 16% / 30%

■ Using Analytics   ■ Not Using Predictive Analytics Yet

Facing Headwinds

All digitalization projects tend to face some headwinds; analytics and AI are not exempt. Adoption challenges for predictive analytics are somewhat known. However, our data indicates that experience paints a stronger picture of where obstacles may lie.

Adequate Data is Top Challenge

Nearly 70% of companies face the challenge of having adequate data to train an analytical model or algorithm. Those further along in making data flow across their business are likely to have an easier time with this, which typically requires both IT and OT data. Focusing on a specific target issue helps limit the data set needed for a successful starting project.

Skills

Most of these programs also need data science skills to succeed. We believe that needs may diminish as solution providers incorporate more predictive analytics for the specific issues their software addresses. Also, AI education is popping up everywhere, so employees have more avenues to learn.

Scaling

Another common hurdle is the inability to scale beyond a pilot or proof of concept (PoC). This again points to special-purpose models trained on very specific data. Not all issues can be predicted using the exact same model and data. Yet some companies are finding that early projects can least accelerate broader projects if they are designed for that.

Culture Less Challenging than Expected

The one issue that looms larger for more of those not yet using predictive AI is cultural resistance or lack of trust. That expectation causes some companies not to invest. Yet success with descriptive analytics and KPIs may alleviate that lack of confidence. Successful predictive analytics applications typically appeal to users and show value to the funders.

Overcoming Challenges

Data cleansing, governance, and management are foundational to maximize the value of predictive analytics. Educating and training employees and learning about AI is essential. It's moving so fast this may be ongoing. Fortunately, GenAI may help address some of these top hurdles for predictive analytics.

Overcoming the Challenges

" Initially, we relied heavily on third party partners for AI expertise. However, we are now positioning ourselves to 'learn to fish.' In the future, we aim to have in-house talent capable of performing business analytics, thereby reducing our dependence on external data scientists. Our goal is to become more self-sufficient."

Will Spears
Senior Product Owner, Smart Manufacturing
Sonoco

" Machine Learning is easier to digest and more tangible overall than the term AI. It's a natural step from SPC and Six Sigma. So, it is easier for people in production to buy into because we've already convinced them from actual successful SPC and Six Sigma deployments."

Peter Thompson
Director of Manufacturing IT
Uponor

" Start with an application that can be replicated easily. Keep it small and just solve the issues you face. In our case, bridging the separate batch and time-series data, real-time data acquisition, and analytics. Start small and prove that it works."

Nasser Ahmad
Director, Digitalization
Höganäs

" When we started, we did not know how difficult it was to walk this way. Mainly because of the change in the culture. When people see the benefit, it's exponential. It creates a singularity that makes things go very fast. But it takes time to get to that point."

David Batet
CIO
DigiProces

" We are using a low-code and AI-based process automation platform to produce safety and auditing tools. The more you can automate, the more you can control errors. The fewer keystrokes someone has to do, the better. We try to think beforehand about what could go wrong, how to minimize the impact, and create systems to avoid that."

Jason Bassett
IT Manager
Madsen's Custom Cabinets

Predictive Analytics Benefits

Benefits for All

Overcoming those challenges is worth it to reap the significant benefits predictive analytics can deliver. Among many other things, predictive analytics can capture and encode knowledge, helping fill the skills gap. Our respondents gained every benefit we listed from investing in predictive analytics.

Faster, Better, Cheaper

Over half of those using predictive analytics have gained efficiency/productivity and error-proofing. Over half of those using predictive analytics for over 3 years have also benefited from cost reductions and quality. Over a quarter gained asset performance and planning / scheduling benefits. These are two common areas where accurate predictions pay off easily.

Pinpointing Predictions

Predictive analytics, AI, and ML projects tend to focus on a critical pain point. Thus, some respondents gained benefits in compliance / risk management, materials management, customer satisfaction / collaboration, employee satisfaction, waste / scrap / energy, returns / warranty cost, supplier issues, on-time / perfect orders, and performance visibility. Pinpointing where predictions can improve overall performance and drive success with company strategy is a great way to select projects.
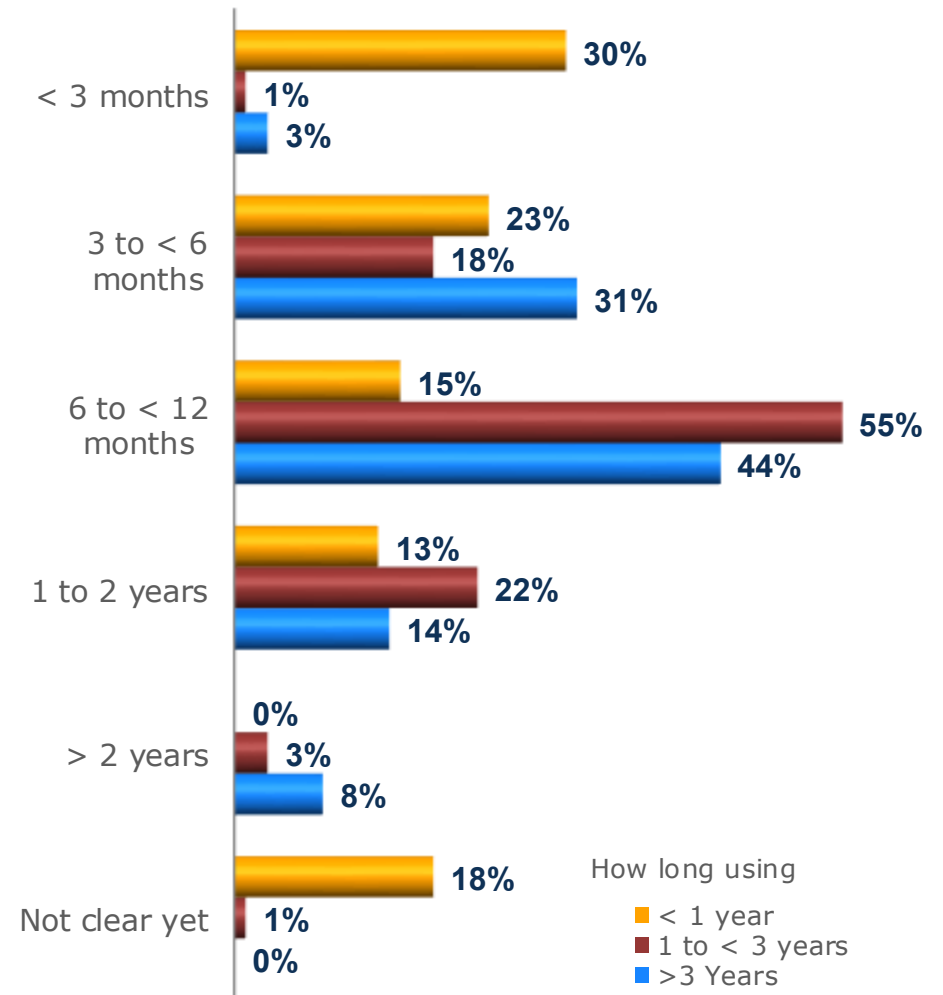
Accelerating Payback

Most predictive analytics projects achieved a payoff in a year or less. Recent projects are more likely to pay off in under three months. (30% using it under a year vs. 3% of those using it over three years got payback in a quarter). We suspect using newer technology and building on best practices for predictive analytics has accelerated their success. This makes for a great return on investment (ROI) calculation.[3]

Different Focus

Earlier investors seemed more focused on quality, cost, and efficiency while later investors focused more on supply chain and customer satisfaction issues. Quality and plant issues may be more challenging with IT/OT data issues, lower-skilled operations staff, and many interdependencies. Yet they are upstream causes of other issues.

TIMEFRAME TO ACHIEVE THE EXPECTED BENEFITS OR ROI OF PREDICTIVE ANALYTICS BY LENGTH OF TIME IN USE

Timeframe	< 1 year	1 to < 3 years	>3 Years
< 3 months	30%	1%	3%
3 to < 6 months	23%	18%	31%
6 to < 12 months	15%	55%	44%
1 to 2 years	13%	22%	14%
> 2 years	0%	3%	8%
Not clear yet	18%	1%	0%

How long using
- < 1 year
- 1 to < 3 years
- >3 Years

Generative AI and Analytics to Support and Guide

To Support People

Filling the workforce skills gap is the #1 reason respondents have adopted GenAI. These systems help less experienced or lower-skilled people do the work well. Over half also cited cost reduction or doing the same work with fewer people and less waste, plus streamlining IT.

Language-Based

Semantic models, neural networks, and generative AI (GenAI) are various flavors of analytics based on language processing, so they are easy to use, even with voice. Anyone who tries GenAI discovers that you can start quickly and refine the request.

The Recent GenAI Boom

The arrival of ChatGPT a few years ago seems like the dawn of a new era. However, as ChatGPT itself points out, GenAI goes back more than a decade. (Think of this technology as embedded in search engines, chatbots, and similar.) Top Performers are more likely to have been using GenAI to support operations for years.
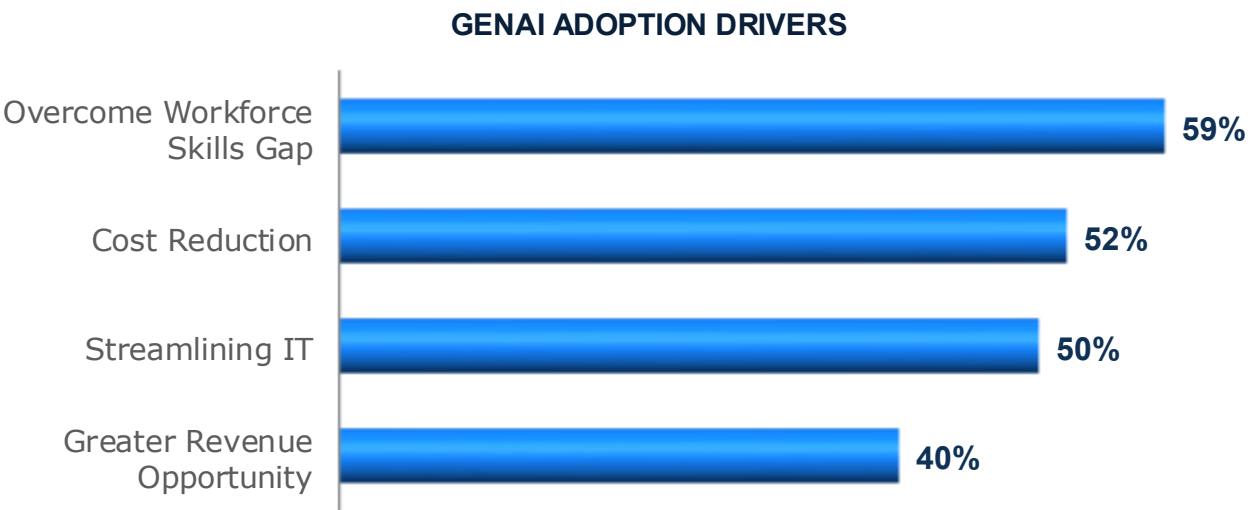
Selecting Use Cases

Knowing where to apply GenAI may not be so obvious. Top Performers have a business-value-based approach to selecting use cases. Do you have a clear process for selecting use cases? Many can't say they do. While 24% of Others don't have a process, 10% of Top Performers don't.
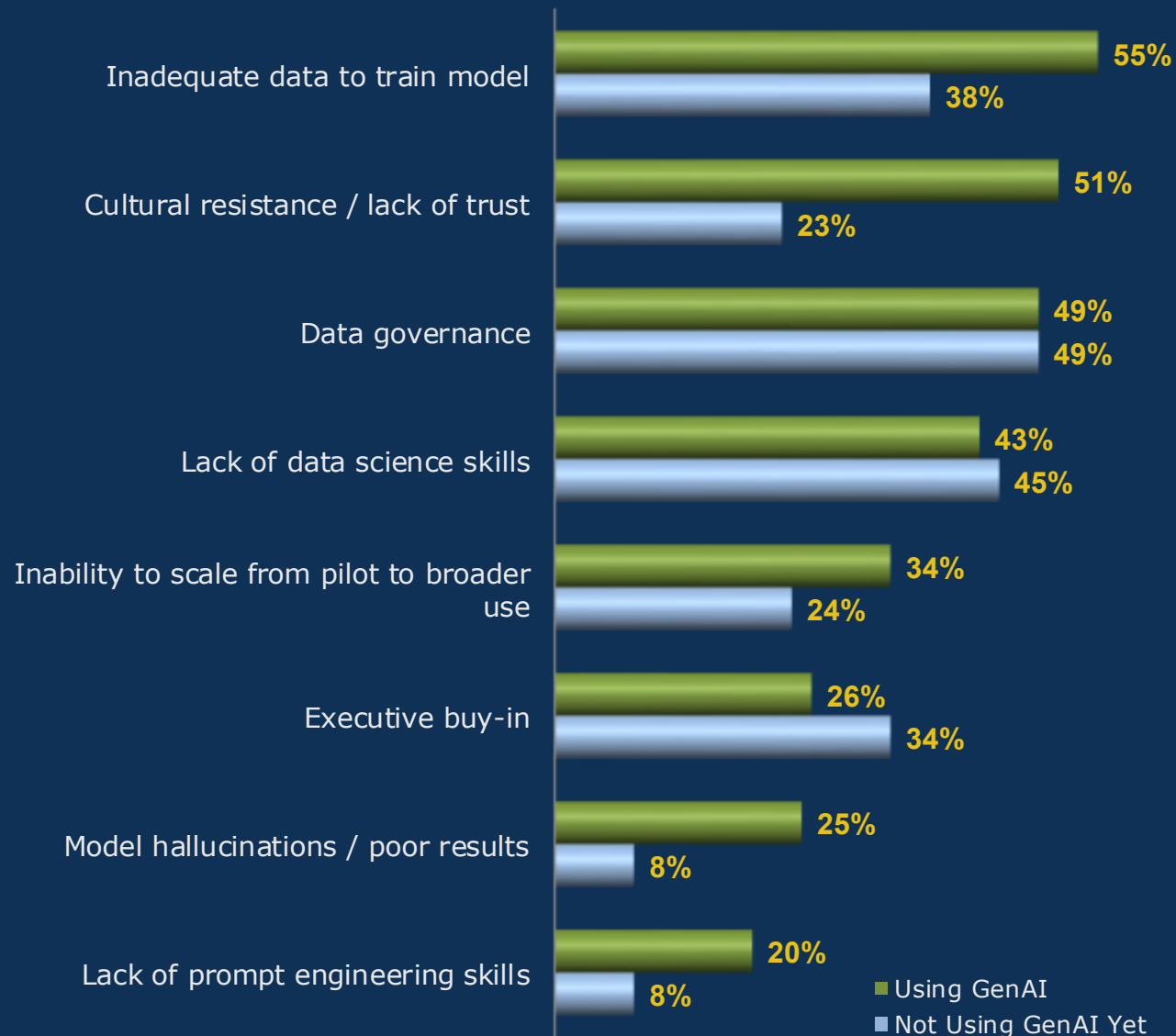
Safety, Quality, Instructions

Guiding employees could be effective in any discipline across the company. Top Performers are more likely to focus on quality and safety use cases. These fit language models well; they are often instructions, SOPs, forms, and checklists.

> "We got early access to Epicor's Knowledge Assistant which allows us to ask ERP questions such as the best way to complete a task. It answers from the knowledge base and support tickets. We're really excited about the new AI in our ERP that looks at our data. Now we can ask it questions like "What's my total revenue looking like this month?" or "How many open POs do I have?" Instead of me building something custom, users can ask the questions of the ERP. This saves them time and saves me time."
>
> **Jason Bassett**
> IT Manager
> **Madsen's Custom Cabinets**

GENAI ADOPTION DRIVERS

Driver	Percentage
Overcome Workforce Skills Gap	59%
Cost Reduction	52%
Streamlining IT	50%
Greater Revenue Opportunity	40%

GENAI ADOPTION CHALLENGES – ACTUAL AND PREDICTED

- Inadequate data to train model: 55% (Using GenAI), 38% (Not Using GenAI Yet)
- Cultural resistance / lack of trust: 51% (Using GenAI), 23% (Not Using GenAI Yet)
- Data governance: 49% (Using GenAI), 49% (Not Using GenAI Yet)
- Lack of data science skills: 43% (Using GenAI), 45% (Not Using GenAI Yet)
- Inability to scale from pilot to broader use: 34% (Using GenAI), 24% (Not Using GenAI Yet)
- Executive buy-in: 26% (Using GenAI), 34% (Not Using GenAI Yet)
- Model hallucinations / poor results: 25% (Using GenAI), 8% (Not Using GenAI Yet)
- Lack of prompt engineering skills: 20% (Using GenAI), 8% (Not Using GenAI Yet)

■ Using GenAI
■ Not Using GenAI Yet

GenAI Hurdles

Data Again #1 Issue

Again, adoption challenges for supportive and guiding analytics become more apparent once the effort is underway. Once again, the number one challenge is having adequate data to train an analytical model or algorithm.

Gaining Buy-In

Cultural resistance and a lack of trust score high for those using GenAI. More experienced workers often don't trust new tools to support them. They may have reason: among respondents using GenAI, one in four has seen poor results. This may be related to the lack of clean, robust data. However, AI is typically a way to boost employee effectiveness, not replace them.

Getting Good Results

One in five respondents find their employees are not skilled prompt engineers. This is no surprise, as most of us have only known that was a skill in the past year or two. Designing a good prompt is crucial to getting good results. Fortunately, more GenAI training is available every month. Also, more applications are building in GenAI and providing the prompts for the user behind the scenes.

Data and More

The complex nature of manufacturing data (structured, unstructured, time-series, internal, and external) means that data governance is an ongoing process. For maximum value from GenAI and supporting analytics, a manufacturer will focus on data, education, model tuning, and how to scale from a pilot. Tackling data governance one use case at a time can help make it feasible.

GenAI Benefits

Benefits Based on Focus

As with any software, the benefits of supportive analytics and Generative AI accrue in various areas based on the system's application area or use case. Given how broad this set of manufacturers is, the benefits are also scattered.

Common Benefits

Half or more of those using GenAI for over a year gained benefits in cost, error-proofing, and efficiency. 30% or more got benefits in quality, compliance and risk, returns and warranty, asset performance and uptime, on-time/perfect orders, and customer satisfaction. The message is that GenAI is likely to provide the support where you need it.
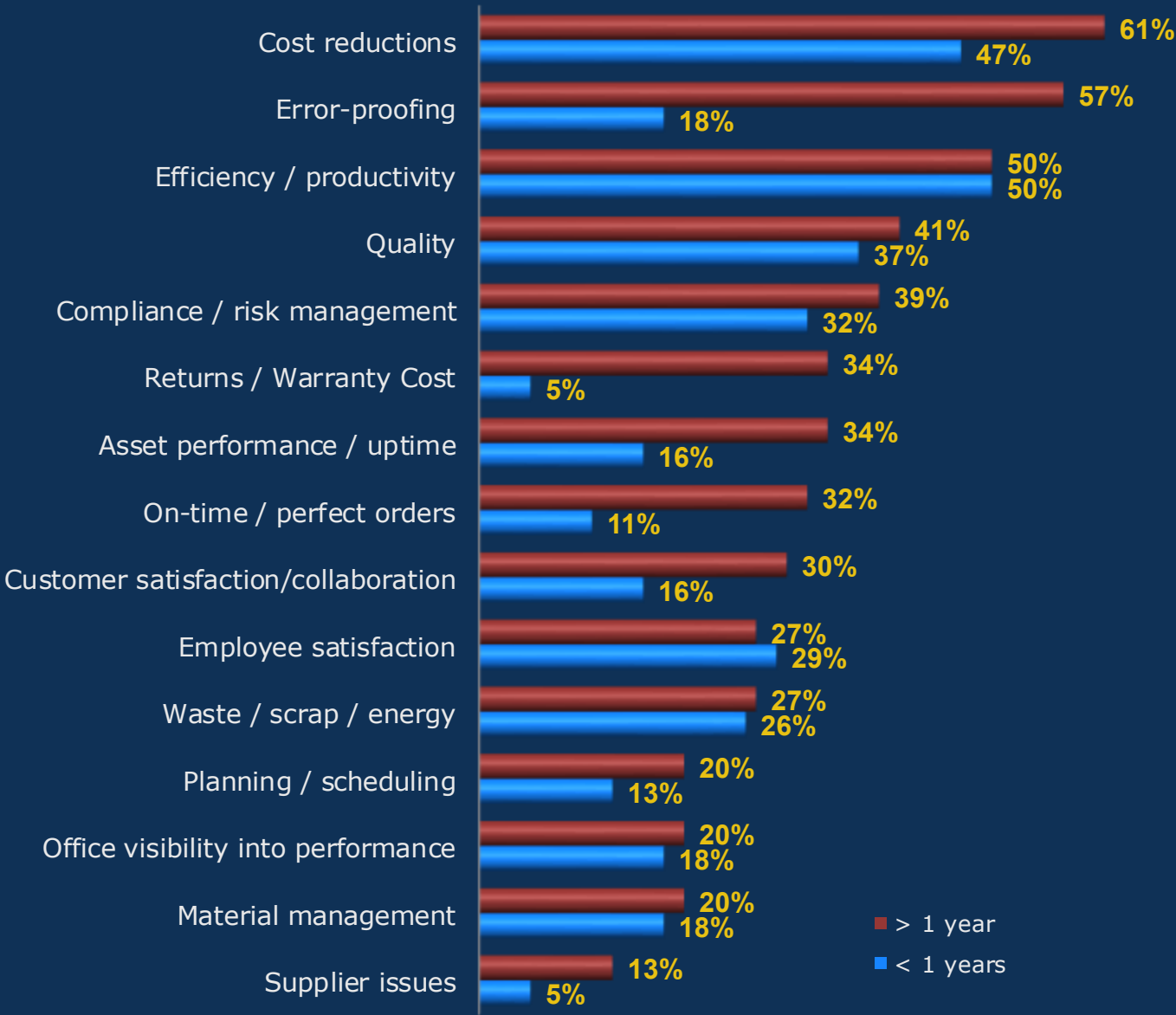
Growing with Time

The benefits appear to increase over time. Those using GenAI for over a year are more likely to report 13 of the 15 benefits in our list.

Error-Proofing with Longer Use

The most significant difference is in error-proofing, with those using GenAI for over a year more than two and a half times as likely as those using it for less than a year. As a 'virtual assistant', GenAI can help bridge knowledge gaps that lead to errors. This is an upstream factor that many companies may not fully value. Gaining error-proofing may lead to lower returns and warranty costs, easier on-time perfect orders, greater customer satisfaction, and lower waste.

GENAI ADOPTION BENEFITS BY LENGTH OF TIME USING GENAI

Benefit	> 1 year	< 1 years
Cost reductions	61%	47%
Error-proofing	57%	18%
Efficiency / productivity	50%	50%
Quality	41%	37%
Compliance / risk management	39%	32%
Returns / Warranty Cost	34%	5%
Asset performance / uptime	34%	16%
On-time / perfect orders	32%	11%
Customer satisfaction/collaboration	30%	16%
Employee satisfaction	27%	29%
Waste / scrap / energy	27%	26%
Planning / scheduling	20%	13%
Office visibility into performance	20%	18%
Material management	20%	18%
Supplier issues	13%	5%

■ > 1 year
■ < 1 years

Rapid Benefits from GenAI

Fast Time to Benefit

The benefits of GenAI come relatively quickly. The message is that investing in GenAI pays off, typically in a year or less. Nearly half (48%) of Top Performers saw benefits in under six months, and 36% of Others. An additional 25% of Top Performers saw results in 6-12 months and 30% of Others.

> " It was a step-by-step approach. We kept the scope small to get from investment to results in a time that matched the top management concentration levels. We have been an early adopter in our specific industry, but not from the applications we use."
>
> **Peter Thompson**
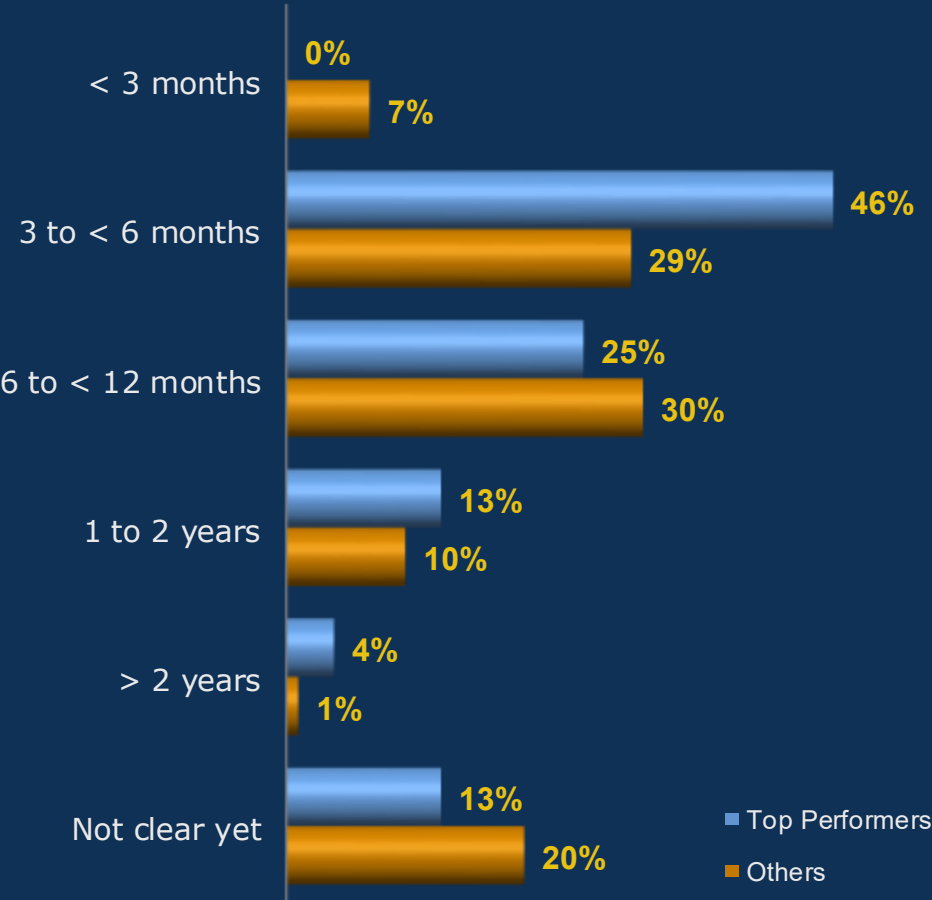> Director of Manufacturing IT
> **Uponor**

As Fast as a Quarter

11% of those who invested in supportive or GenAI in the last year reaped the benefits in three months or less. Most companies can easily justify an investment that pays off in one calendar quarter, or even two. Fast returns typically come from focused projects to solve specific pain points. Working with solution partners who have deep experience may also accelerate gains.

AI Supporting AI Projects

GenAI can also help with other analytics and AI projects. Typically, these language-based models can help reduce the amount of data needed to train an ML or other analytical model. Their ability to summarize existing data is one we all see daily, and it's valuable in a production setting. Another factor in GenAI's favor is that it doesn't require a data science background to structure.

TIME TO ACHIEVE EXPECTED BENEFITS OF GENAI

Time	Top Performers	Others
< 3 months	0%	7%
3 to < 6 months	46%	29%
6 to < 12 months	25%	30%
1 to 2 years	13%	10%
> 2 years	4%	1%
Not clear yet	13%	20%

Manufacturing DataOps Needs Improvement

Missing: Reliable Data

Reliable, consistent data is the foundation for analytics and AI. However, most companies don't have it in manufacturing. Only 29% of Top Performers and 18% of Others report that their data is reliable and consistent. Most say 'Usually,' but usually, or even Six Sigma, is inadequate for trustworthy analytics, AI, or smart manufacturing.

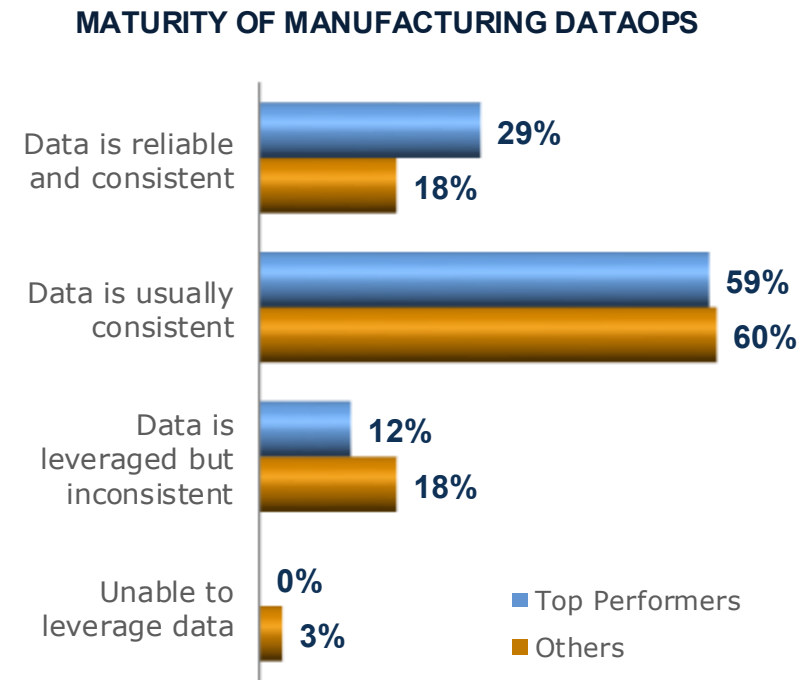## Standard Data Model Insufficient

Respondents mostly report having a standard data model to leverage data from many systems (86% of Top Performers and 75% of Others). Yet, apparently, it does not currently provide full coverage across data sources or perhaps lacks adequate governance to ensure they can use data effectively, reliably, and consistently. Note that a standard data model might be a goal but is not a prerequisite for analytics and AI.

Start with Needed Data

Starting with a data model for a specific problem is a good way to get value from analytics and AI. So, while eventually you may want all data in a standard ontology, it's OK if that's not true while you work through your first projects. Each project's data set must be available, consistent, and trusted. These sets of data can build out over time. As stated, new approaches such as data fabric and agentic AI may help alleviate the need to structure all data in a common model.

Breaks in Operations Data Flow

Most manufacturers are not good at moving operations data seamlessly with no manual handoffs. 38% of Top Performers rated themselves as excellent or good, compared to 31% of Others. 17% of Top Performers report this ability to move operations data as So-So, Poor, or Not at all, compared to 34% of Others.

MATURITY OF MANUFACTURING DATAOPS

Data is reliable and consistent — Top Performers 29%, Others 18%
Data is usually consistent — Top Performers 59%, Others 60%
Data is leveraged but inconsistent — Top Performers 12%, Others 18%
Unable to leverage data — Top Performers 0%, Others 3%

■ Top Performers
■ Others

> "Our data architects analyze the flow of data during integrations to determine the necessary data exchanges. We maintain uniformity by utilizing consistent integration and data collection tools, including a standard API for our ERP system."
>
> **Will Spears**
> Senior Product Owner, Smart Manufacturing
> **Sonoco**

> "It's difficult, but when you reach the point when the culture and processes start to change, you see a new paradigm. That's the nice thing. Once we have all this data, we could implement new things to collect it and do more magic. We now see it because we have the other layers fulfilled."
>
> **David Batet**
> CTO
> **DigiProces**

Industry-Specific AI

Manufacturing-Specific

Manufacturing has some unusual needs. Most want either industry- or application-specific AI software, or they want it embedded in software they already use. Top Performers seem more dedicated to this.

Analytics from Familiar Vendors

The good news is that software providers are including analytics and AI in their applications. Most respondents say their primary software systems include at least descriptive analytics, and many also provide predictive analytics, with a few having GenAI.
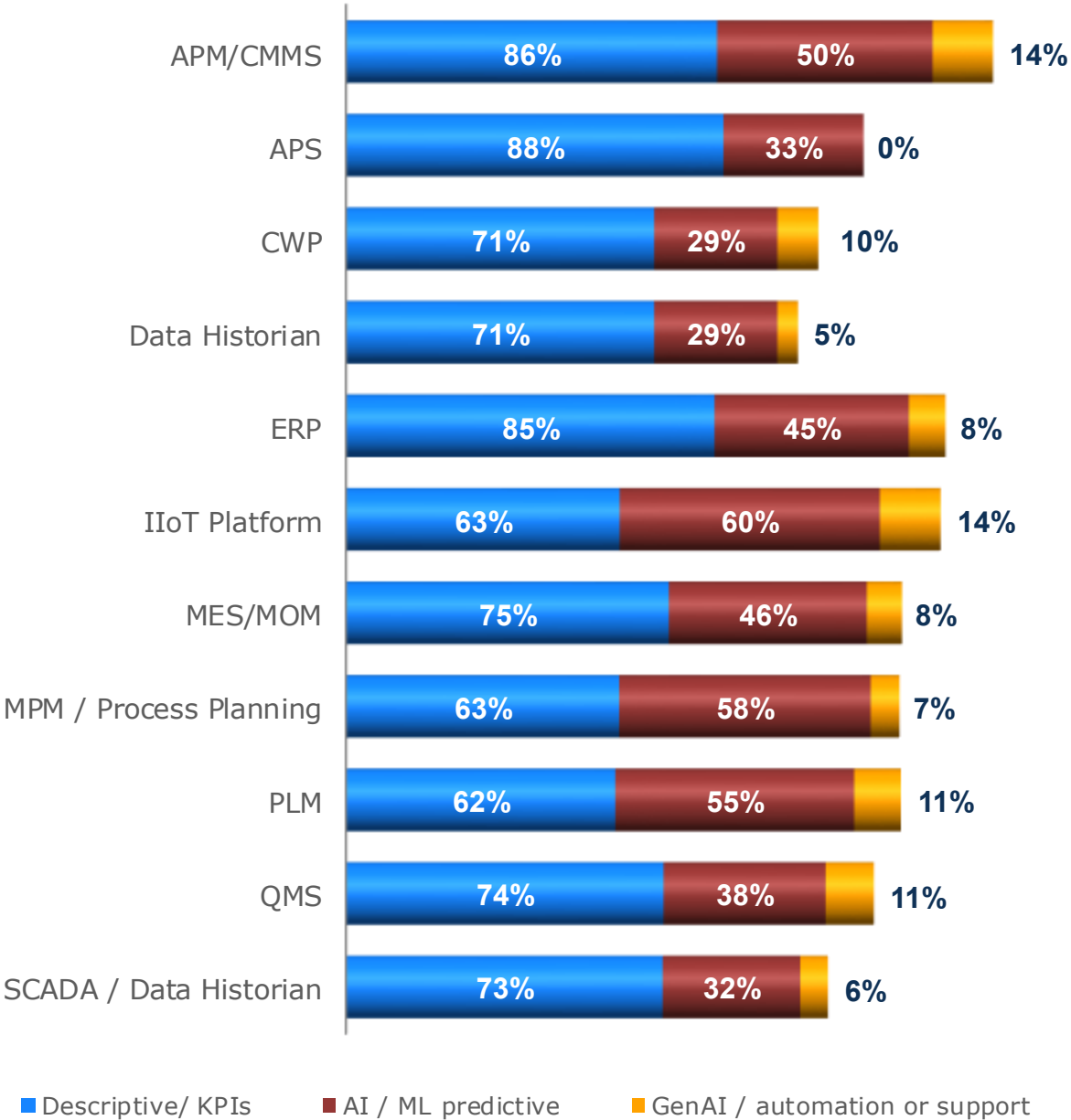
Ready or Not

Some manufacturers are willing to use new applications or general-purpose AI. Four of five Top Performers are willing to experiment without a proven use case. This indicates an open-minded, learn-as-you-go attitude.

❝ We are piloting a system that's robotics combined with AI doing basic tasks in a test station with four positions and a packaging station. It is aware of the people and speeds up when they are not present. It is always looking to improve and proposes new procedures to the process engineers. Our supply chain software and MES also use AI."

David Batet
CTO
DigiProces

TYPES OF ANALYTICS IN PRIMARY SOLUTIONS USED IN MANUFACTURING

Solution	Descriptive/ KPIs	AI / ML predictive	GenAI / automation or support
APM/CMMS	86%	50%	14%
APS	88%	33%	0%
CWP	71%	29%	10%
Data Historian	71%	29%	5%
ERP	85%	45%	8%
IIoT Platform	63%	60%	14%
MES/MOM	75%	46%	8%
MPM / Process Planning	63%	58%	7%
PLM	62%	55%	11%
QMS	74%	38%	11%
SCADA / Data Historian	73%	32%	6%

■ Descriptive/ KPIs   ■ AI / ML predictive   ■ GenAI / automation or support

" The difficulty arises when someone tries to add new data sets into the discussion without realizing that sometimes that can be a very lengthy project in itself. It's crucial to first actually understand if said data set will have any statistical impact at all. For example, someone says "I wonder if ambient temperatures would have an impact? I believe it does. We must find out." It's a waste of time to later statistically prove it has almost 0% impact on the project. Indirect data often doesn't reap the rewards people think."

Peter Thompson
Director of Manufacturing IT
Uponor

" Our predictive analytics solution pulls together data from various sources into a comprehensive dataset. We collaborate closely with data scientists to develop the appropriate models and algorithms, ensuring the business has high confidence in the results. We constantly refine these models to predict the desired outcomes accurately."

Will Spears
Senior Product Owner, Smart Manufacturing
Sonoco

Key Takeaways

- **Progress:** Manufacturers are moving along the Smart Manufacturing path. Many have multiple projects underway or are already seeing results.

- **Seeking Data Outcomes:** Manufacturers are seeking some fundamental data management outcomes from their investments, such as easy access to high-quality, timely, complete plant data for plant employees and integration of equipment, plant, and enterprise data.

- **Interested in New Technologies:** Many are also focused on advanced analytics and IIoT.

- **Varied Drivers:** What matters most to manufacturers right now varies, but cost reduction, supply chain resilience, sustainability, workforce skills, and revenue opportunity top the list.

- **AI Delivering Benefits:** Fortunately, AI in all its forms is delivering benefits in desired areas. Benefits come relatively quickly, with expected payback often in less than a year.

- **Supporting Operations:** AI can help fill the knowledge gap in today's workforce, driving efficiency and guiding people.

- **Key Differences:** Top Performers are more likely to have organizational structures, capabilities, and technologies to support their success.

- **Room for Improvement:** Nearly all manufacturers we surveyed could improve their data management, governance, accessibility, and operations. We are growing as an industry in this area.

Recommendations

Invest now in Smart Manufacturing and analytics

- Whether you need descriptive, predictive, or supportive AI, they all pay off.
- Expect to gain more benefits over time.
- Invest in open, modern, and analytics-ready or AI-infused software.

Build your manufacturing data management foundation

- Driving toward data management is a worthy goal.
- Get started on focused AI and analytics projects with just the needed data.
- This is a multi-faceted investment for most companies, including people, processes, and technology.
- Ensure you have organizations like IT and OT ready to work together closely.
- Create processes to improve data handling and governance.
- Use common data models and integration frameworks to ensure your data is reliable, available, and in context.

Give your frontline workers all they need

- Provide access to job-relevant KPIs.
- Deliver timely views into all data they need for tasks, or better yet, have analytics and AI deliver them actionable insights based on data.
- Capture knowledge before your best employees retire. Use it to guide and boost workers' performance and improve on those KPIs.
- Educate them to counteract concerns and enable them to use analytics to their fullest benefit.

Prepare for AI

- Hurdles for both predictive analytics or AI and supportive or GenAI tend to pop out once you are in the implementation journey.
- Start evaluating your data now for completeness, quality, and context to identify what you must do to succeed with analytics models and algorithms.
- Educate your employees and your executives to minimize the risk of cultural resistance or lack of trust.
- Recognize that choosing a pilot use case may require considering the future rollout and prioritizing the most prevalent issues.

Follow the Top Performers' path as they show the way on this journey

- Invest in Smart Manufacturing, Analytics, and AI.
- Focus on getting data to operations personnel for decisions.
- Ensure use cases are based on business value.
- Seek vendor-delivered analytics that are specific to your industry or need.
- Be willing to experiment with analytics and AI.

About the Research

Data Gathering
Tech-Clarity and MESA gathered and analyzed over 420 responses to a web-based survey. Survey responses were collected by direct e-mail, social media, and online postings by Tech-Clarity.

Industries
The respondents represent companies that serve a broad cross-section of industries. 13% were from Industrial Equipment, 11% Automotive / Transportation, 9% Pharmaceutical / Biotech / Cell Therapy, 9% Aerospace / Defense, 8% Medical Devices, 6% Electronics, 6% Consumer Packaged Goods, and others including Oil / Gas and Semiconductor.*

Company Size
The respondents represent a mix of company sizes, including 25% from less than $100 million, 15% between $100 million and $250 million, 19% between $251 million and $1 billion, 21% between $1.1 billion to $5 billion, and 20% greater than $5 billion. Company sizes were reported in US dollar equivalent.

Geographies
Responding companies report doing business in North America (54%), Western Europe (53%), Asia (58%), Eastern Europe (11%), Australia (11%), Latin America (11%), New Zealand (11%), Africa (8%), Middle East (6%), and Africa (6%).*
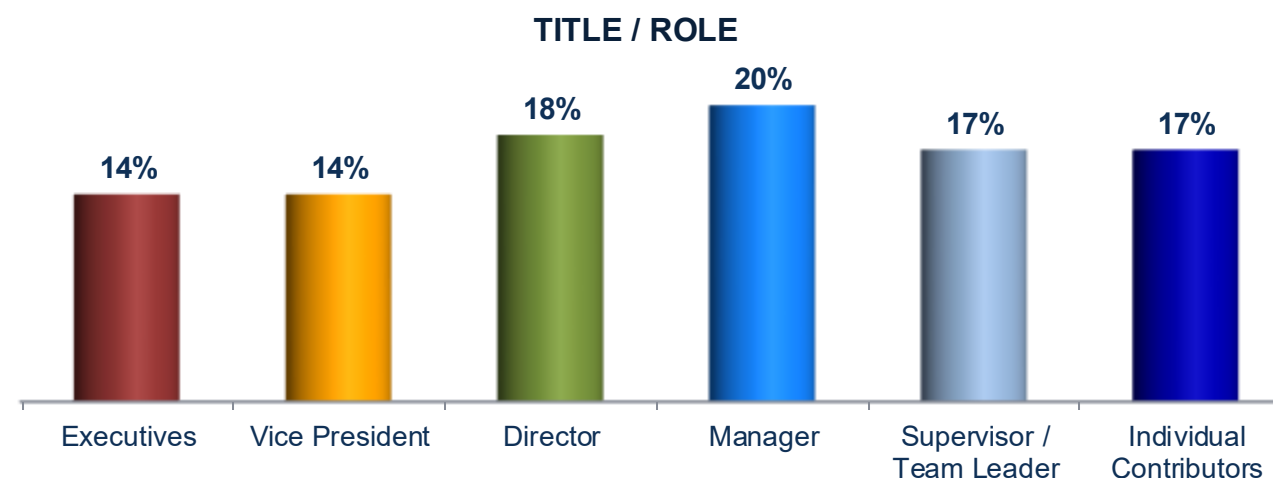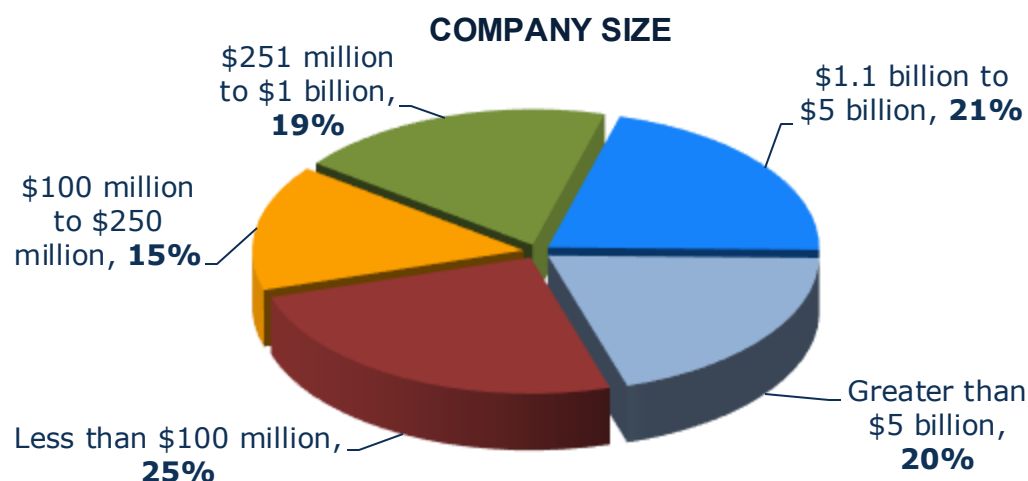
Title
The respondents comprised of 14% Executives, 14% VP level, 18% Directors, 37% Manager level, and 17% individual contributors.

Organizational Function
Of the respondents, 19% were in Manufacturing or Production roles, 10% Industrial / Manufacturing Engineering, 9% Manufacturing IT, 7% Company Leadership, 6% Automation / Operations Technology, 6% Plant or Facilities Engineering and the remainder were from a variety of other roles including Product Engineering, Supply Chain and more.

* Note that the values may total greater than 100% because companies reported doing business in multiple industries and geographies.

COMPANY SIZE

- $251 million to $1 billion, **19%**
- $1.1 billion to $5 billion, **21%**
- $100 million to $250 million, **15%**
- Greater than $5 billion, **20%**
- Less than $100 million, **25%**

TITLE / ROLE

Executives	Vice President	Director	Manager	Supervisor / Team Leader	Individual Contributors
14%	14%	18%	20%	17%	17%

Acknowledgments

About the Author

Julie Fraser joined Tech-Clarity in 2020 and has over 35 years of experience in the manufacturing software industry. She is an enthusiastic researcher, author, and speaker. She has a passion for manufacturing progress and performance gains through Industry 4.0 strategies and supporting software technology.

Julie is actively researching the impact of digital transformation and technology convergence in the manufacturing industries, with a focus on supply chain and plant floor and how to use manufacturing data in conjunction with data from offices, labs, and the ecosystem. She is a lifetime member of MESA International.

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Tech-Clarity is an independent research firm dedicated to making the business value of technology clear. We analyze how companies improve innovation, product development, design, engineering, manufacturing, and service performance through the use of digital transformation, best practices, software technology, industrial automation, and IT services.

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Note From The Sponsor

At GE Vernova, we believe that data is the foundation for smarter, safer, and more sustainable manufacturing. When OT and IT teams have access to high-quality, contextualized data, they're empowered to make better decisions—faster.

*This research reinforces what we've seen across our customer base: success with analytics and AI depends on selecting business-driven use cases, building a strong data infrastructure, and enabling scalable insights. At Höganäs, for example, teams used our **Proficy Historian** to connect batch and time-series data and **Proficy CSense** to analyze that data and identify a potential 1–2% yield improvement with positive impacts on cost, carbon footprint, and safety—demonstrating how targeted analytics can drive real operational impact.*

*Our broader **Proficy Software portfolio**, including tools like our upcoming **Proficy Data Hub**, helps manufacturers overcome data silos and scale insights across their enterprise. We're proud to support this research and the conversation around building practical, high-value Analytics and AI strategies in manufacturing.*

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Action