



NEW YORK
Manufacturing
Extension Partnership

Manufacturer's Guide to Artificial Intelligence

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GUIDE CREATED BY

SCMEP

Table of Contents

Overview

- 2 Introduction

Module 1: The New Industrial Frontier

- 6 Why AI Matters for New York Manufacturers
- 8 An Evolving Technology
- 9 A Case for AI in Manufacturing
- 12 Wrap Up

Module 2: What AI Is

- 16 What Is AI?
- 20 How AI Fits with Industry 4.0
- 24 Wrap Up

Module 3: Data Readiness

- 28 Five Checks for Data Readiness
- 29 Data Structure & Organization ("Taxonomy")
- 30 Data Reliability
- 32 Trust
- 34 Usability
- 34 Ownership and Responsibility
- 35 How AI "Decides"
- 39 Wrap Up

Module 4: Readiness – Setting the Foundation

- 42 AI & The Importance of Good Change Management
- 44 Assessing Your Organization's Readiness
- 48 The Hidden Costs of Implementing AI

50	Starting Small and Thinking Big
53	Change Management and Feedback At All Levels
54	Maintaining a Healthy Workplace and Ready Workforce
58	Wrap Up

Module 5: Identifying Practical Use Cases

62	What a “Good AI Use Case” Looks Like
64	AI as an Enablement Partner
66	Rebalancing Line Operations with AI
68	Integrated Quality Inspection at Scale with AI
70	Real-Time Operational Visibility with AI
72	Scaling Production with AI
74	Predictive Maintenance with AI for Reduced Unplanned Downtime
76	Additional Use Cases
78	Use Case Readiness
79	Wrap Up

Module 6: Choosing The Right Solution

82	Technical Basics
83	Technical Approach
89	Evaluating AI’s ROI & Feasibility
90	Wrap Up

Module 7: Implementation Roadmap

94	Designing the AI Solution
96	Verification, Validation & Piloting
100	Scaling From Pilot to Production

101	Measuring ROI and Success
103	Workforce Enablement
105	Overcoming Fear and Building Trust in AI
106	Wrap Up

Module 8: Sustaining AI in Your Organization

110	Sustainability Within Growth
112	Data Governance and Cybersecurity
115	The Future Outlook
117	Wrap Up

Module 9: About the NY MEP

120	New York Manufacturing Extension Partnership (NY MEP)
121	NY MEP Centers
124	Approach To AI
125	Wrap Up

Appendix

128	Acronyms
130	Key Terms
132	About the Authors

Welcome

The New York Manufacturing Extension Partnership (NY MEP) is pleased to present this Manufacturer's Guide to Artificial Intelligence.

This guide is specifically crafted to help New York State manufacturers of all sizes stay ahead of the profound changes AI is introducing to their industries, ensuring they remain competitive and continue to thrive.

While the manufacturing sector has a long history of embracing technological shifts, AI stands apart, rapidly influencing virtually every facet of the industry. Today's business leaders face the opportunity to seize on the advantages that AI can bring to their production, profitability, and planning. But they also face the challenges of understanding ongoing shifts in the AI landscape and determining how to engage with these technologies.

Successful AI adoption requires deliberate and intentional choices. The goal is not to achieve "AI everywhere," but rather to deploy the right AI solutions in the right places, in close alignment with an individual business's goals and workflows.

NY MEP stands ready to help manufacturers of all sizes identify the most strategic AI investments they can make to maximize their companies' competitiveness.

Consisting of a network of eleven independent, not-for-profit organizations—including ten regional centers and one statewide center—NY MEP is at the leading edge of helping small and mid-sized New York manufacturers navigate advanced technologies. We provide the guidance necessary to adopt industry best practices, modernize production, and succeed in an increasingly competitive global market.

New York State is a recognized leader in industrial modernization and high-tech expansion, driven by the talent of its workforce and the depth of its innovation ecosystem. That ecosystem includes world-leading applied research centers supported by Empire State Development's Division of Science, Technology and Innovation (NYSTAR). NY MEP helps even the smallest manufacturers leverage the right tools and resources to help them reduce costs, improve quality, and innovate.

NY MEP IS UNIQUELY POSITIONED TO HELP SMALL MANUFACTURERS THRIVE IN THE AGE OF AI:

- Deeply understands the unique needs and operational realities of small to mid-sized manufacturers.
- Bridges the gap between manufacturers and qualified subject matter experts to help companies modernize and increase their competitive edge.
- Helps manufacturers leverage the state's broader innovation ecosystem of highly specialized Centers for Advanced Technology and Centers of Excellence.
- Provides businesses with essential connections to resources, industry events, and funding opportunities.



We hope you find this guide to be an insightful and practical tool as you move forward on your AI journey.

- New York Manufacturing Extension Partnership (NY MEP)

Using The Manufacturer's Guide to Artificial Intelligence

This guide serves as a resource guide and tool for leaders, technologists (IT & OT), and support staff within the manufacturing and adjacent industries with a focus on the state of New York. Using a modular structure, it's intended to help you learn, plan, pilot and scale AI focusing on integrating AI where it provides measurable value, not just technology for technology's sake.

WHO THIS IS FOR

- 1 **Leaders and decision makers, especially small- and medium-sized businesses.**
- 2 **Managers looking to improve operations from people to processes.**
- 3 **Individuals wanting to be ready to directly support AI initiatives within their organization.**

HOW TO USE IT

- As a foundational tool, reading it from end to end to understand AI and how it continues to impact our industry.
- As a reference guide, using information and resources of specific sections as needed.

WHAT YOU WILL FIND

- Foundational information to help you better understand AI and have better conversations with your team, customers and providers.
- Real-world examples within manufacturing that are relatable to you and your business.
- Unbiased guidance on how to approach deciding on and integrating AI to solve business challenges.
- Guardrails and best practices on how to integrate AI safely, considering everything from ethics and morale to quality control, stability, and preventing technical or vendor lock-in.
- Tools, tips, and other best practices for daily use and larger, more strategic AI initiatives.
- Additional resources and references for further learning and development.

This guide is organized into modules, with each module building upon the previous. Within every module there exists a short description of its purpose followed by the core information. Every module concludes with a "Wrap Up" that summarizes what was learned. Included in the "Wrap Up" is a simple activity ("Try This") that will help you gain a better understanding of AI by actually using it.

Module 1

The New Industrial Frontier

This module explains why AI is important to New York manufacturing, what is changing with AI and why it matters for manufacturing leaders right now. The intent is to give a simple view of how AI has grown from basic prediction tools into today's generative and tool-connected systems, then connect that change to real pressures in manufacturing (competition, workforce gaps, supply chain uncertainty), and the need to reduce waste while protecting quality.

1.1 Why AI Matters for New York Manufacturers

1.2 An Evolving Technology

1.3 A Case for AI in Manufacturing

1.4 Wrap Up

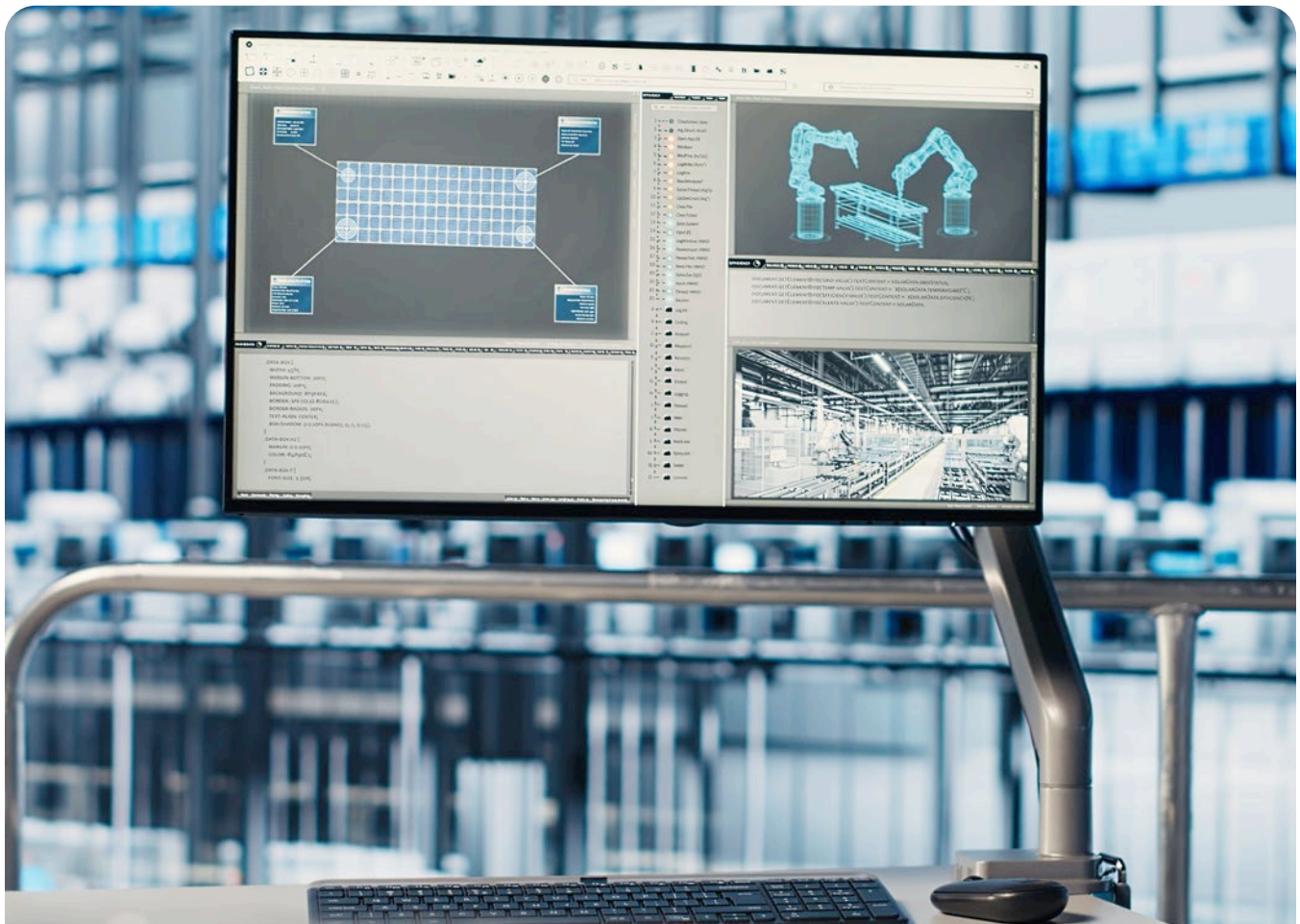


Why AI Matters for New York Manufacturers

Manufacturing in New York State is at an important turning point.

AI is spreading fast, global competitors are modernizing quickly, customer expectations keep rising, and supply chains are still unpredictable. In industries like automotive, aerospace, advanced materials, chemical, food production & agribusiness, and life sciences, leaders feel pressure to produce more with less, protect quality amid skills gaps, and adjust to changing markets.

But the Empire State has real strengths that can turn this pressure into an advantage. New York is actively building one of the nation's most formidable ecosystems for AI and is an epicenter of semiconductor and nanotechnology innovation, which are underpinning the microelectronics that enable AI. By combining massive supercomputing investments (including Empire AI), a wealth of tech talent and R&D assets, and a powerful manufacturing infrastructure, the state has become a hotspot for AI development and industrial implementation.



New York's AI Advantage: A Strategic Powerhouse for Manufacturers

417,897

NYS MANUFACTURING JOBS IN 2025 ¹

The manufacturing workforce is large—and must be modernized.

#3

NATIONALLY FOR AI JOB LISTINGS ²

NYS has a strong and growing foundation of AI talent.

#2

NATIONALLY FOR NUMBER OF FORBES 50 AI FIRM HEADQUARTERS ³

New York State is fertile ground for private sector AI development.

#2

NATIONALLY FOR VC INVESTMENT ³

New York State offers strong capital access for AI-related startups.

\$49.7 billion

AI-RELATED VC INVESTMENT ⁴

Across 3,614 AI-related VC investment deals in NYS from 2019-2025.

\$500 million

NATION-LEADING NEW YORK STATE AI INVESTMENTS

\$500 million public-private Empire AI supercomputing consortium and related industry partnerships to advance AI hardware and chip science.

Sources:

¹ Lightcast Q3 2026

² New York Emerges As Hotspot for Artificial Intelligence Jobs

³ CSG State AI Competitiveness Indicators

⁴ America's AI Surge: Powering Investment, Jobs, and Growth in Every State

1.2

An Evolving Technology

Artificial Intelligence (AI) is not new.

The field of AI was formally introduced at the 1956 Dartmouth Summer Research Project and has been improving for decades, first in labs, then in real business tools. From 2017 through 2020, several key advancements were made allowing AI to become the AI that you know today. Another major improvement was in how accessible AI became in the 2020s. AI became easier to use, faster to deploy, and more connected to everyday systems. Now, AI shows up almost everywhere, sometimes in obvious ways (like chatbots), and sometimes behind the scenes (like quality checks, forecasting, and scheduling). AI may feel “sudden” because newer tools are easier to use, but the technology itself has been building step-by-step for a long time.

For manufacturers, this matters because the winners won't be the plants that “try AI once,” but the ones that treat it like any other long-term capability: start practical, build skills, use real data, and focus on problems that reduce waste and protect quality.

How AI Changed (and why it matters now)

AI has been around for decades, but it has changed in how it helps people. Early AI followed rules that humans wrote. Later AI learned from historical data to predict outcomes. Deep learning improved tough problems like image inspection while establishing the foundation for technologies such as Transformers, which are core to how Large Language Models (LLMs) work - giving LLMs the ability to analyze and understand human text. What's new today is Generative AI, another layer of AI, built on top of LLMs that can work with everyday language – reading, writing, summarizing, and helping people follow steps – without needing a custom program for every task.

Just as electricity transformed almost everything 100 years ago, today I actually have a hard time thinking of an industry that I don't think AI will transform in the next several years.

ANDREW NG

Founder of DeepLearning.AI,
Co-founder & Chairman of Coursera

A simple way to think about it:



Manufacturers can now use AI for both the shop floor and the support work around it – docs, troubleshooting, onboarding, scheduling conversations, and faster decision support.

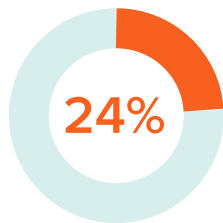
1.3

A Case for AI in Manufacturing

AI is good at spotting patterns, summarizing information, making predictions, and handling repeat tasks.

In manufacturing, that usually means less downtime, fewer defects, faster troubleshooting, and smoother planning. AI is not “future tech”—it already shows up in maintenance tools, ERP/MRP, scheduling, quality systems, and training workflows. The key is to start with one clear problem, learn fast, and build from there.

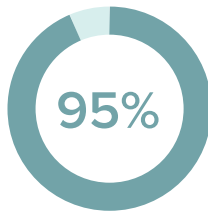
29% of manufacturers are using AI/ML at the facility or network level. (Deloitte)



Have deployed Generative AI at that same scale (38% are piloting GenAI).

WHY IT MATTERS:
This is moving from experiments to real operational use.

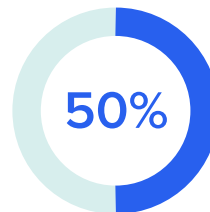
Deloitte



Have already invested or plan to invest in AI/ML in the next five years.

WHY IT MATTERS:
If you wait too long, you fall behind on talent, data, and process learning.

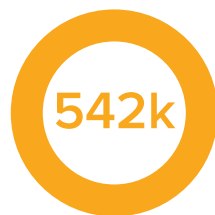
Rockwell Automation



Plan to use new technology like AI/ML and IIoT sensors in their production facilities.

WHY IT MATTERS:
AI-ready expectations are quickly becoming standard.

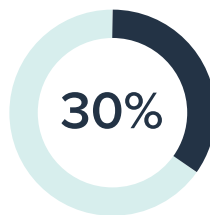
National Association of Manufacturers



542,000 industrial robots were installed in 2024, and annual installs have topped 500,000 for four straight years.

WHY IT MATTERS:
The global productivity race is not slowing down.

IFR



Predictive maintenance can reduce machine downtime by ~30-50%

WHY IT MATTERS:
Downtime is one of the most expensive forms of waste—this is where AI often pays back fast.

McKinsey & Co.

1.3.1 Use Case Previews

Most manufacturers are already investing in AI. Listed below are four practical ways it shows up on the plant floor and in day-to-day operations.

OPERATIONS PERFORMANCE

- **Prevent downtime** (predict failures before breakdowns)
- **Catch defects earlier** (inspection and process drift alerts)
- **Speed up troubleshooting** (faster root-cause support)
- **Stabilize schedules** (fewer surprises and changeovers)

Focus AI on repeat losses—downtime, scrap, slow response, and schedule churn.

COMMERCIAL ENABLEMENT

- **Faster, more accurate quoting**
- **Better forecasting** (demand and capacity signals)
- **Customer targeting support** (which accounts to focus on)
- **Consistent marketing content** (without starting from scratch)

AI can improve revenue focus and reduce the time spent “chasing noise.”

WORKFORCE AND PEOPLE OPERATIONS

- **Faster new-hire ramp-up** (training support and job aids)
- **Smarter hiring support** (screening help and better role clarity)
- **Cleaner job descriptions** (standardized, updated roles and skills)

AI helps teams train faster and reduce rework caused by inconsistent knowledge.

IT/OT ALIGNMENT AND CHANGE RISK

- **Clearer handoffs** (less back-and-forth)
- **Faster incident triage** (what changed, what broke, what to do next)
- **Fewer surprises from changes** (better visibility and communication)

Many AI wins come from reducing friction between operations and systems teams.



1.3.2 AI Adoption and Implementation

AI works best when the job is defined, the data is usable, and people are trained to run it. Common roadblocks include:

Data that is hard to find, messy, or inconsistent

Change resistance
(people, process, and training gaps)

Limited IT/OT capacity and unclear ownership

Tool integration issues
(fit with ERP/MES/QMS and workflows)

ROI that isn't defined up front
(or isn't tracked)

Security, privacy, and trust concerns

By planning for these early, leaders can use AI to create real traction—not just small demos.

1.3.3 A Word of Caution

Many AI efforts stall in pilots if the goal isn't clear and ownership isn't defined. For example, Boston Consulting Group reports that only a minority of companies move beyond proof-of-concept to real value at scale.

The advantage will go to manufacturers that start now—pick one problem with obvious waste, define the outcome, and run a small, focused pilot. This guide is here to help leaders do that with clarity, not hype.



1.4

Wrap Up

AI is becoming a must-have capability for New York manufacturing, and the timing matters now.

AI has moved from rules and basic prediction to today's generative and tool-connected systems, which can support both plant-floor work and the support work around it—training, troubleshooting, planning, and documentation. The pressure in New York, especially manufacturing, is real and is going to increase as AI evolves: faster global competition, larger workforce gaps, and supply chain uncertainty. However, New York's strengths exist in its deep history of manufacturing excellence and a culture of resilience and ingenuity. AI won't replace operational excellence, but it can boost it by improving uptime, reducing scrap, and helping both leaders and teams not just respond faster to change but actually get ahead of it.

1.4.1 Keys to Success

Getting started successfully doesn't require "AI everywhere." It requires curiosity, focus, and practical goals (clear business problems that are easy to understand).

New York has a strong reason to act now

With a large manufacturing footprint and a growing logistics backbone, even small improvements in uptime, quality, and throughput can add up to a real competitive edge.

Start experimenting now

Ask questions, test ideas, and learn by doing.

Start small, learn fast

Run low-risk experiments first, then expand only after you see real results.

Build habits that develop skills

Use AI daily for simple tasks that help build an understanding of its capabilities, strengths, and weaknesses.



TIP: The most important step is to start.

1.4.2 Try This

Learn more about AI by actually using it. Try out the following experiment.



STEP 1

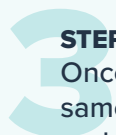
Choose any GenAI tool (e.g., ChatGPT, Claude, Gemini, Copilot)



STEP 2

Use the following prompt to start the experiment.

Let's do a simple thought experiment to help me learn how AI responds and how I communicate. First, ask me five short questions, one at a time, about my job/role, the industry I work in, my day-to-day responsibilities, how I prefer to communicate (direct, friendly, detailed, or short), and my years of experience. Then create a short, realistic problem scenario related to my industry, and ask me: 'If you just found out about this problem, what would you do next?' I will answer with what I would do, who I would talk to, and what I would expect to happen next. After I answer, reflect my approach back to me in a respectful way, identify 2–3 communication/style patterns you notice (for example: calm and structured, action-first, collaborative, detail-focused, or risk-aware) and explain why based on what I shared, and clearly state that this is not a judgment—just an experiment to explore communication styles. Finally, give me two short suggestions for how I could communicate the same response in a different style (one more direct and one more supportive) without changing the meaning, and if you can generate images, create one simple professional image that represents the scenario (no logos or brand names).



STEP 3

Once complete, try the same in a different different AI tool—be sure to provide the exact same responses (Tip: just copy and paste your responses to each question when asked) and compare not just what the AI responded with, but how the entire interaction was.



Module 2

What AI Is

This module explains what Artificial Intelligence (AI) is and how it works in manufacturing. It covers the main types of AI used in plants and where it shows up in commonly used tools. The module also explains Generative AI (GenAI), the rules and connections behind it, and its connection with data. Finally, this module connects AI to Industry 4.0 and how it can improve the output of systems commonly found in manufacturing.

2.1 What Is AI?

2.2 How AI Fits with Industry 4.0

2.3 Wrap Up



2.1

What Is AI?

Most people hear “AI” and think of robots or science fiction.

In reality, AI is a set of tools that help computers do tasks that usually require human intelligence—like spotting patterns, learning from examples, understanding language, and making recommendations.

You already use AI every day:

- Your phone predicts the next word you’ll type
- Streaming apps recommend shows
- Maps suggest the fastest route
- Online shopping sites recommend products

In manufacturing, AI works the same way. It looks at data (numbers, images, text, and machine signals) and helps people see patterns faster and more consistently. Manufacturing examples:

- AI compares part images to past examples to flag likely defects
- AI reads maintenance notes and summarizes repeat issues
- AI analyzes vibration and motor data to warn of likely failure
- AI spots patterns tied to rework (materials, machines, shifts, steps)

Artificial Intelligence, or simply “AI,” is a big umbrella term. A large part of modern AI is Machine Learning (ML). Instead of writing rules for every situation, machine learning systems learn patterns from data. When they see new situations, they make a “best guess” based on what they learned.

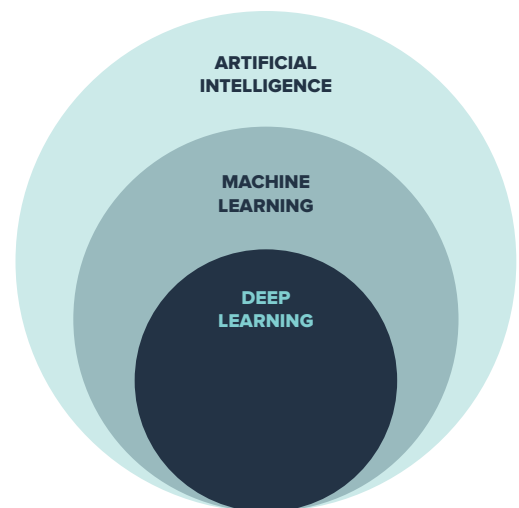
Key Point: AI doesn’t “think” like a person. It learns patterns from past data and uses those patterns to predict or suggest what’s most likely.

Deep Learning is a type of machine learning that performs especially well with complex data like images, audio, and long sensor streams. This is why it’s common in inspection systems and some predictive maintenance solutions.

A SIMPLE ANALOGY: CHILD AND STOVE

- **Rules-based approach:** You tell a child: “If the stove is red and hot, don’t touch it.”
- **Learning-based approach:** The child learns from many examples over time and starts recognizing what “danger” looks like—without needing a rule for every scenario.

Key Point: Rules are explicit. Learning is pattern-based.

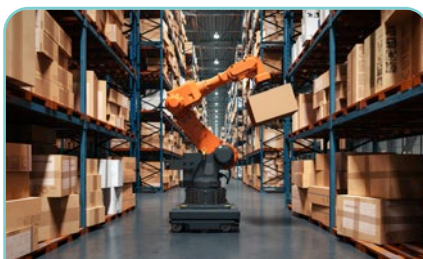


2.1.1 AI Capabilities (What It Can Be)



NARROW AI

This is what almost all people and businesses use today. It's designed to do one job well. It can't do everything and it can only do what it was trained or set up to do, even if it is connected to tools that can take actions automatically.



GENERAL AI

This is the science-fiction version – AI that can do many different tasks at a human level across almost any topic. It isn't part of today's reality, and it isn't what this guide focuses on.



ARTIFICIAL SUPERINTELLIGENCE

This is a theoretical idea where AI would be far beyond human capability in most areas. It is not part of current reality and is not addressed in this guide.

Key Point: AI is incredibly powerful because of its ability to learn and create; however, it is far from being a technology that can fully replace humans.

2.1.2 AI Applications (What It Does)

The most common way to think about AI is by what it does or how it works in the real world.

Predictive AI: Uses past data to estimate what may happen next (failures, demand, scrap risk)

Analytical AI: Finds trends and patterns (quality drift, bottlenecks, cycle-time changes)

Agentic AI: Beyond traditional automation, AI programs learn and adapt to information and work semi-autonomously or fully autonomously on tasks—with defined guardrails

Computer Vision: Interprets images/video (defect detection, safety checks, label verification)

Generative AI (GenAI): Creates or rewrites content (summaries, drafts, training aids, troubleshooting steps)

Robotics + AI: Helps automation adjust using sensor inputs (more common in advanced environments)

Most manufacturers will use a mix of these over time—some on the shop floor and some in support work like quality, maintenance, planning, warehousing, and training.

2.1.3 Generative AI (GenAI) Deep Dive

Generative AI, or GenAI, is what most people think of when they think “chatbots.” Traditional AI often focuses on detecting, classifying, or predicting. GenAI extends AI’s capabilities by being highly effective at understanding human language, deriving meaning from context, and generating content, such as documents, images, and videos. For this reason, GenAI deserves a deeper look into how it works and the value it provides.

You commonly see GenAI in tools like:



ChatGPT
(OpenAI)



Claude
(Anthropic)



Copilot
(Microsoft)



Gemini
(Google)

Where GenAI helps most in manufacturing:

- Summarizing shift handoffs, logs, and notes
- Drafting training aids and SOP summaries
- Creating clearer communication (emails, updates, incident notes)
- Helping teams find answers faster (policy, procedures, troubleshooting)
- Customer support (triage, self-service tools)

2.1.3.1 GenAI in Layers

What users see (the user interface or “UI”)

The chat box or feature inside an app

Rules + connections (the middle)

Guardrails, permissions, and what data/tools the AI can access

The model (the engine)

Learns, analyzes, generates text and answers

The data

What it learned from in training, plus any company data it is allowed to reference

It helps to understand that GenAI tools are more than “the model.”

Knowing these layers helps leaders and decision-makers compare solutions and understand what to watch out for. Sometimes the biggest differences aren’t the model itself – they’re the interface, the guardrails, the data connections, and how the system is set up. When comparing AI solutions, be sure to look at the different layers and how they are built.

Key Point: The model is the engine, the app is the front door, and the rules + data access determine whether it’s safe and useful.

2.1.3.2 Large Language Models (LLMs)

LLMs are AI models trained on massive amounts of text so they can work with human language. They’re strong at reading, writing, summarizing, and explaining. While it can seem like the LLM is reasoning, it is actually predicting the next word likely to occur using probabilities, and not actual human understanding of problems or causes and effects.

Key Point: LLMs are great with words. They can be extremely helpful, but they can still be wrong, especially if the data they see is incomplete, biased, or messy.

2.1.3.3 GenAI Solutions and Tools

AI APPS AND CHATBOTS

These are the tools people use directly on the web or inside office apps. They help with drafting, summarizing, explaining, and organizing ideas. Some versions can also search approved documents or assist with repeat tasks.

AI FEATURES INSIDE EXISTING TOOLS (“BUILT-IN COPILOTS”)

These are AI features, often known as “copilots” or “sidecars”, that exist inside tools your organization already uses (email, documents, spreadsheets). They can be easier to manage because they often follow existing permissions and security controls.

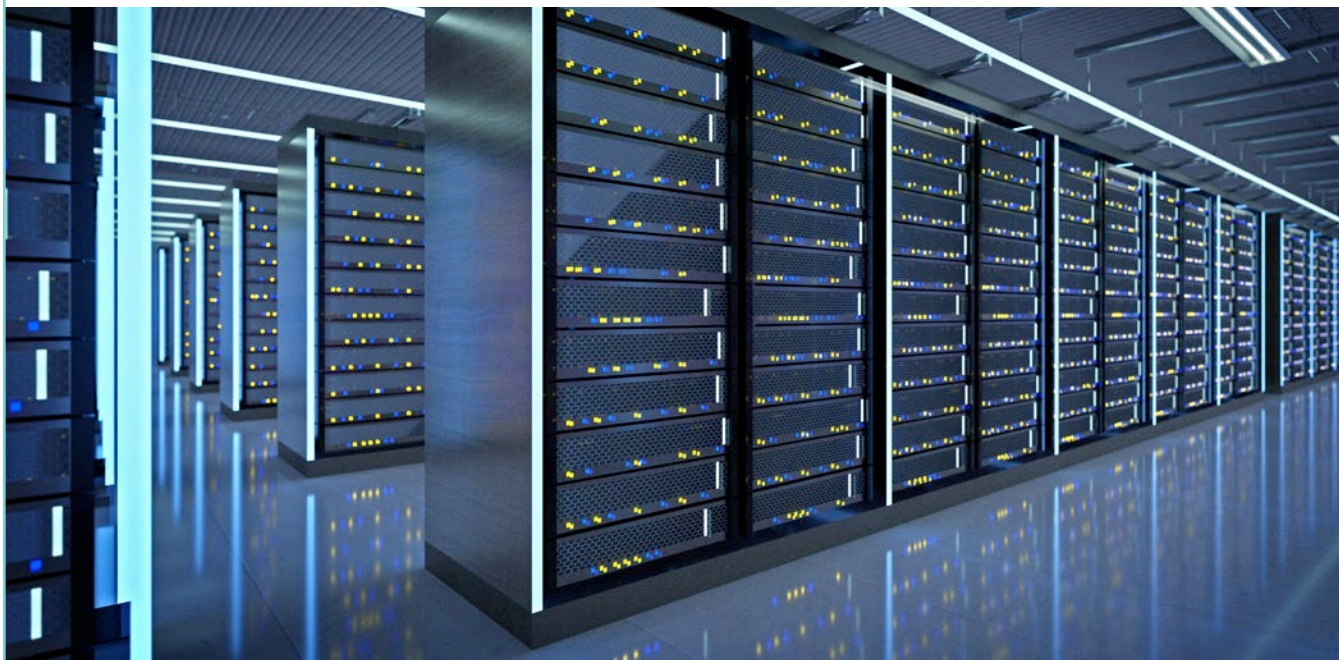
AI PLATFORMS

Some organizations use platforms (often through cloud providers) to build AI into their own software and workflows. This is usually relevant once the organization has clearer use cases and the right support.



TIP: Always check with a cybersecurity or AI expert before integrating AI into your technical environment.

Note: Cloud technology refers to the use of virtual infrastructure (servers, networks, and data storage) offered by service providers, usually distributed across multiple locations to improve reliability and availability.



2.2

How AI Fits with Industry 4.0

Industry 4.0 is about connected systems, sensors, and automation. AI increases the value of Industry 4.0 by turning signals into insights and guidance.

2.2.1 IoT + Sensors

Sensors collect machine signals like temperature, vibration, pressure, motor load, status, and cycle time. AI helps by:

- Spotting patterns people miss
- Detecting drift early
- Predicting failures or risks
- Turning signals into alerts and recommended actions

Key Point: Sensors collect signals. AI helps interpret them (when the signals are reliable).

2.2.2 Analytics

Analytics shows what happened (dashboards, KPIs, trends). AI can enhance analytics by:

- Creating customized analyses quickly
- Spotting unusual behavior
- Suggesting likely drivers
- Predicting what may happen next
- Summarizing results in plain language

SIMPLE DISTINCTION

Analytics = Inspects, calculates and shows information

AI = Helps explain, predict, and prioritize (when set up correctly)



2.2.3 Automation

Automation performs repeat steps reliably. AI can support automation by:

- Detecting drift before defects spread
- Recommending earlier intervention
- Helping systems adjust to changing conditions
- Classifying what actions to take when

SIMPLE DISTINCTION

Automation = Doing tasks repeatedly

AI = Noticing and advising (and sometimes triggering actions, with rules)

2.2.4 Agents

An AI “agent” is an AI system that can take steps toward a goal inside approved tools—like pulling information, drafting a report, or preparing a work order for review.

Manufacturing examples (common “digital work”):

- Summarizing shift handoffs
- Drafting daily quality reports
- Searching manuals and logs for troubleshooting
- Flagging anomalies and preparing a work order draft
- Preparing market trend reports or creating customized sales presentations

SIMPLE DISTINCTION

- A chatbot answers
- An agent can help act (within rules)

Important: In a plant, agents should operate with permissions, limits, and human approval for anything risky.

2.2.5 Integrated Systems

Most manufacturers already run on systems that track transactions and status. AI can make these systems more proactive by surfacing patterns and risks earlier.

Examples:

- **MES:** early production drift, downtime patterns by line/shift, clearer shift summaries
- **ERP/MRP:** forecast and supply risk signals, items at risk of stockout, unusual supplier changes
- **WMS:** bottleneck prediction, mis-pick reduction, labor planning support
- **HR/training:** onboarding support, policy Q&A, training gap visibility (without replacing judgment)

Key Point: AI doesn’t replace core systems. It helps teams see risk earlier and respond faster.

2.2.6 AI and the Supply Chain

AI can help connect signals across suppliers, shipping updates, quality data, and schedules to flag risk earlier—late deliveries, shortages, or drift tied to a supplier or lane. Over time, this reduces surprises because problems are seen sooner and traced more consistently.

A few examples of how AI is shaping the supply chain and how it impacts manufacturing.



EARLIER JIT RISK ALERTS (BEFORE THE LINE STOPS)

AI watches supplier lead-time changes, ASN/shipping delays, and plant consumption rates to flag “at-risk” parts days sooner—so teams can expedite, resequence, or substitute before a shortage hits.



SMARTER DEMAND FORECASTING

AI blends order history with current signals (customer pull, promo spikes, seasonality, cancellations) to reduce forecast error and help planning teams avoid overbuilding or starving key SKUs.



SCHEDULE STABILITY AND FASTER RE-PLANNING

When a late truck, quality hold, or machine issue happens, AI can recommend schedule options that protect priorities (hot jobs, constrained parts) and reduce last-minute churn.



ROUTING AND ETA CONFIDENCE

AI uses lane history, carrier performance, weather/traffic disruptions, and dwell-time patterns to predict late arrivals earlier and recommend alternate routes, carriers, or delivery windows.



AUTO-REPLENISHMENT WITH FEWER STOCKOUTS

AI can trigger reorder suggestions based on real consumption (not just min/max), supplier reliability, and current variability—helping JIT environments stay lean without living on the edge.



SUPPLIER QUALITY DRIFT DETECTION

AI links incoming inspection results, defect codes, and lot/supplier metadata to spot “quiet drift” (e.g., a supplier lane getting worse) before it becomes a major scrap/rework event.



2.3

Wrap Up

AI is an advanced set of programs that enable computers to do tasks that usually require human intelligence, such as finding patterns in data like numbers, images, text, and machine signals to support better decisions.

Machine learning, a core element of AI, learns from data instead of strictly using fixed rules set by humans. Deep learning, which is useful for working with complex data like images and long sensor streams, is what supported the development of GenAI, the key evolution of AI that is dramatically shaping the way companies operate, especially manufacturing, from using simple AI chatbots in the office to streamline work to AI agents that support decision-making and help carry out defined tasks under human oversight, saving manufacturers significant time and money, while increasing productivity and quality.

2.3.1 Keys To Success

Stay curious and test ideas in small, low-risk ways

The best way to learn what it can do is to try it on simple, real plant tasks, like summarizing shift notes, spotting repeat issues in logs, or organizing troubleshooting steps, then compare the output to what your team already knows.

Don't treat AI like a decision-maker, treat it like a helper

Remember, AI doesn't "think" like a person. It learns patterns from past data and makes a "best guess." That means it can be useful, but it can also be wrong, especially when information is incomplete, biased, or messy. Use AI to support human judgment, not replace it.

Build "healthy skepticism" into how you use AI

AI often sounds confident, but it is still making a best guess based on patterns and probabilities. Treat outputs like a draft or recommendation that must be checked—especially when data is incomplete, messy, or biased—before anyone takes action.

2.3.2 Try This

Use AI to learn how AI is impacting manufacturing & the supply chain today.



STEP 1

Choose any GenAI tool (e.g., ChatGPT, Claude, Gemini, Copilot)



STEP 2

Use the following prompt to start the experiment.

Act as my research assistant. Search the web for current examples (preferably from the last 12–18 months) of how AI is influencing the supply chain in the manufacturing industry. Provide 3-5 real-world examples with a simple explanation of what the AI does, where it's used (supplier, logistics, manufacturer, warehouse, planning), and the value (speed, cost, risk reduction, predictability), and include one credible source link for each example. Then provide 2-3 “signals to watch for” in bullet points, classified under: Data & Visibility, Supplier & Quality, Logistics & Fulfillment, or Production & Planning, with a short plain-language note on why each signal matters. Do not invent sources or links—if you can't verify something, say so, and keep the response meaningful and concise.



STEP 3

Once complete, ask: “How might this impact my company?”

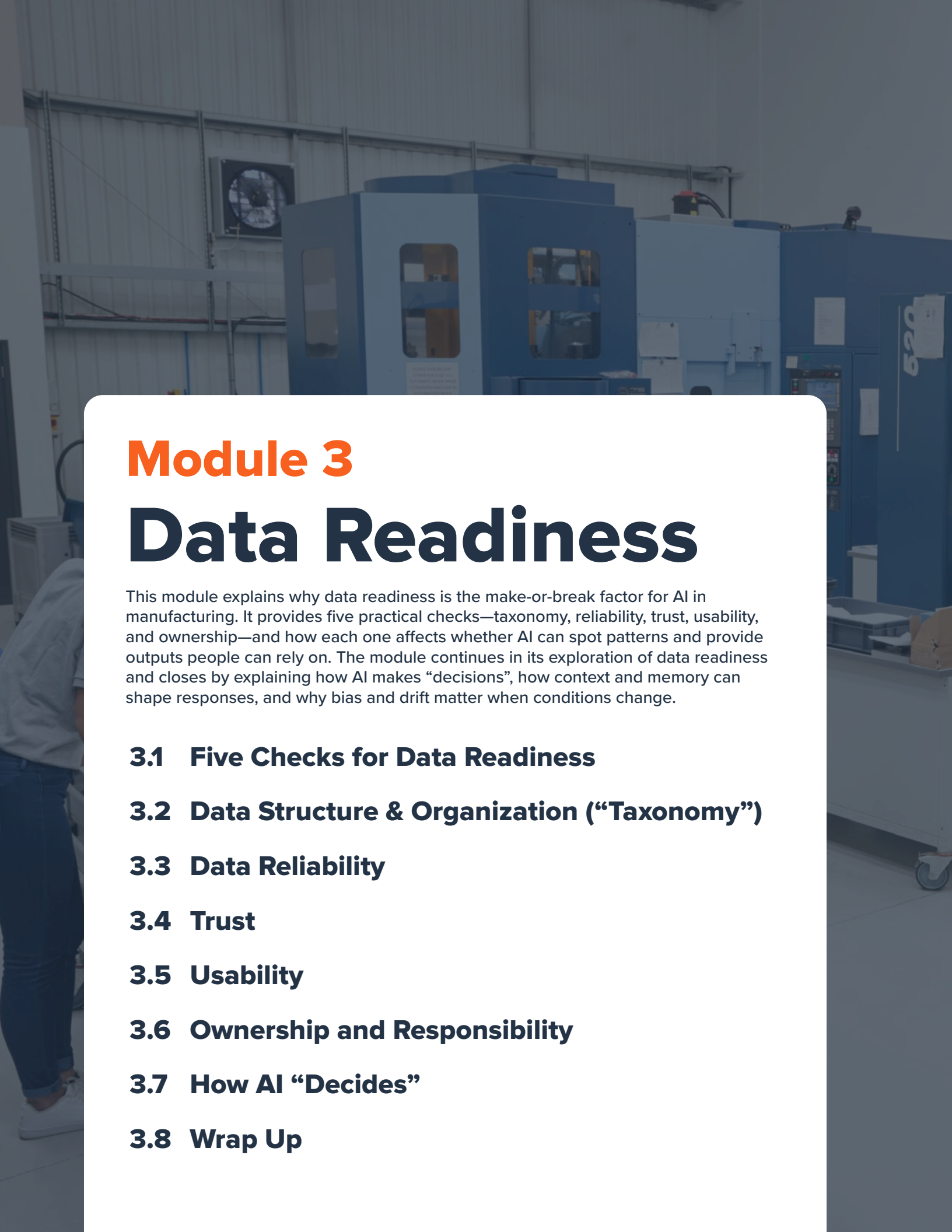


EXTRA STEP: Use AI to learn how Generative AI became so widely adopted.



Use the following prompt to start the experiment.

In a single, non-technical paragraph of 7–10 sentences, explain how Generative AI developed and why it became so popular. Use only plain, everyday language and avoid all technical jargon (like ‘transformers’ or ‘parameters’). Briefly explain how the strategies of OpenAI, Google, Microsoft, Amazon, and Meta shifted from private research to public tools over time, and describe how the technology moved from answering questions to acting as a digital assistant. Keep the tone professional but easy to understand, avoid hype, and ensure the response is one continuous block of text.

A large blue industrial machine, possibly a CNC lathe, is the central focus of the background image. It has several windows and a control panel. The machine is situated in a factory with a white metal wall and a large fan visible in the upper left. The overall scene is dimly lit, with the machine's blue color being a prominent feature.

Module 3

Data Readiness

This module explains why data readiness is the make-or-break factor for AI in manufacturing. It provides five practical checks—taxonomy, reliability, trust, usability, and ownership—and how each one affects whether AI can spot patterns and provide outputs people can rely on. The module continues in its exploration of data readiness and closes by explaining how AI makes “decisions”, how context and memory can shape responses, and why bias and drift matter when conditions change.

3.1 Five Checks for Data Readiness

3.2 Data Structure & Organization (“Taxonomy”)

3.3 Data Reliability

3.4 Trust

3.5 Usability

3.6 Ownership and Responsibility

3.7 How AI “Decides”

3.8 Wrap Up



Data is significant because it forms the backbone of decision making.

GWENDOLYN STAMP

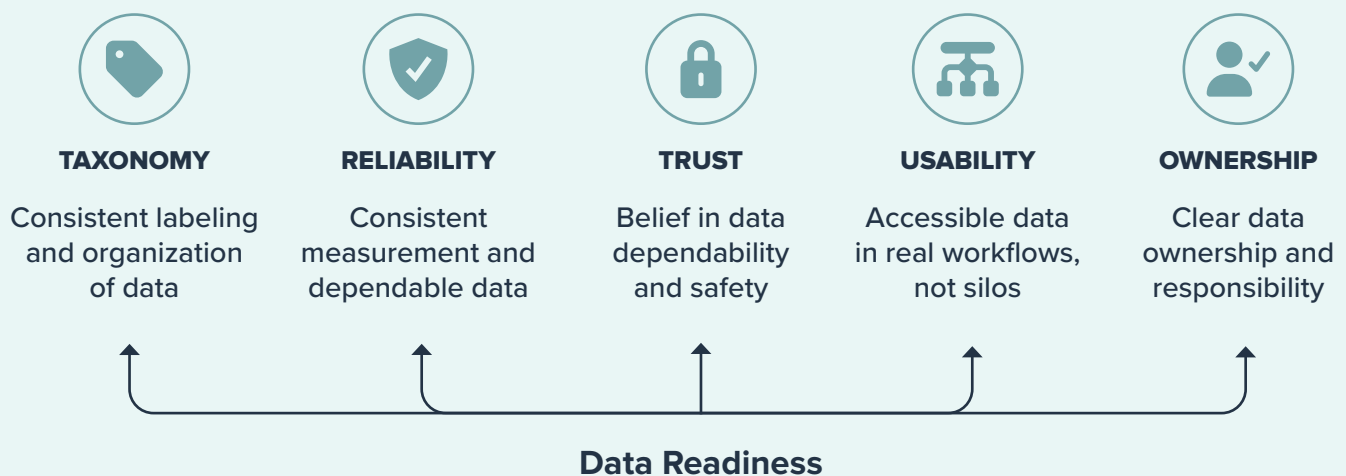
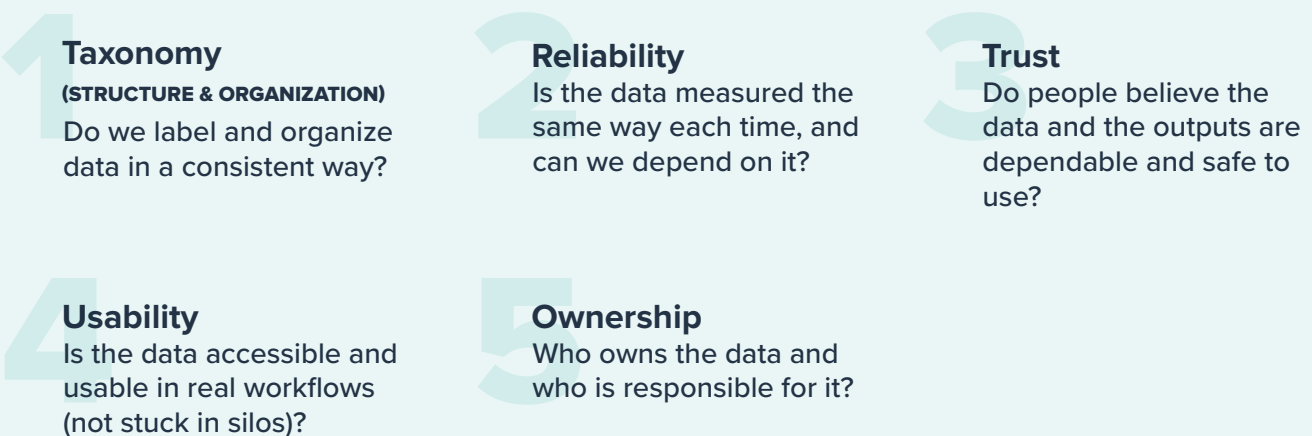
Author of Do More With Data™,
Data Literacy Foundations

3.1

Five Checks for Data Readiness

Business leaders have heard the saying “garbage in, garbage out” countless times.

Simply because AI tools are more powerful does not mean they can overcome bad data. When considering if an organization’s data is ready for AI, there are five key concepts to think about:



3.2

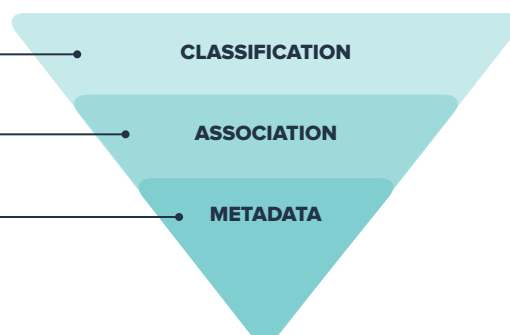
Data Structure & Organization (“Taxonomy”)

Creating a structured organization system and consistent naming in the data is paramount to creating business value from the data.

If labels, part names, defect codes, or downtime reasons change from person to person, shift to shift, or plant to plant, the data becomes hard to use—by people and by AI. A good way to think about it is this: if someone re-labeled an Andon board every week, the team would stop trusting it. Data works the same way.

When it comes to good data structures, consider:

- **Classification:** group data based on shared characteristics
- **Association:** create logical relationships between the data
- **Metadata/Descriptions:** clear details about what the data is and how it is used



Metadata is the “extra detail” that makes root-cause analysis possible.

Examples of metadata in manufacturing:

- Serial number, lot number, supplier part number
- Machine/line ID, shift, operator team
- Date/time, inspection station, work order
- Expiration date, handling requirements

Why it matters: Even correctly labeled data is hard to use if it’s scattered or misclassified. Metadata helps connect patterns to real causes—supplier issues, shift effects, equipment drift, material variation.



Think about a digital photo, for example. The picture is the data, but the metadata contains additional information such as the type of camera used, the date the image was taken, and the file size. This extra data can be helpful in organizing, finding, and comprehending the subject data.

GWEN STAMP

Author of Do More With Data™, Data Literacy Foundations

3.3

Data Reliability

For AI (and people) to use data, it has to be reliable. Two key terms matter here.

3.3.1 Accuracy vs. Precision

ACCURACY

How close are you to the true value?

PRECISION

How consistent are your measurements?



HIGH ACCURACY
HIGH PRECISION



LOW ACCURACY
HIGH PRECISION



HIGH ACCURACY
LOW PRECISION



LOW ACCURACY
LOW PRECISION

A system can be very consistent (precise) and still be off the true value (inaccurate). A system can also be close to true sometimes, but inconsistent (low precision).

Why this matters for AI: AI learns and compares patterns. If measurements bounce around, the patterns get blurry. That makes it harder to detect drift, compare “normal” vs. “abnormal,” and trigger early warnings.

3.3.2 Completeness and Timeliness

Even accurate data can be useless if it's missing key fields or arrives too late.

COMPLETENESS

Are required fields filled (shift, line, part, defect code, downtime reason)?

TIMELINESS

Does the data show up fast enough to prevent issues or only after the fact?

Manufacturing example: If downtime reasons are entered hours later, patterns won't match the true sequence of events.

3.3.3 Context

Context is the “why” behind the numbers: what was happening (product, setup, changeover, abnormal conditions) and what changed (supplier/lot, settings, maintenance, staffing, shift conditions), since data without context can lead to the wrong conclusion—like judging takt time without knowing customer demand. Ideally, important context information is stored in the metadata, and not on a scrap of paper that is easily lost.

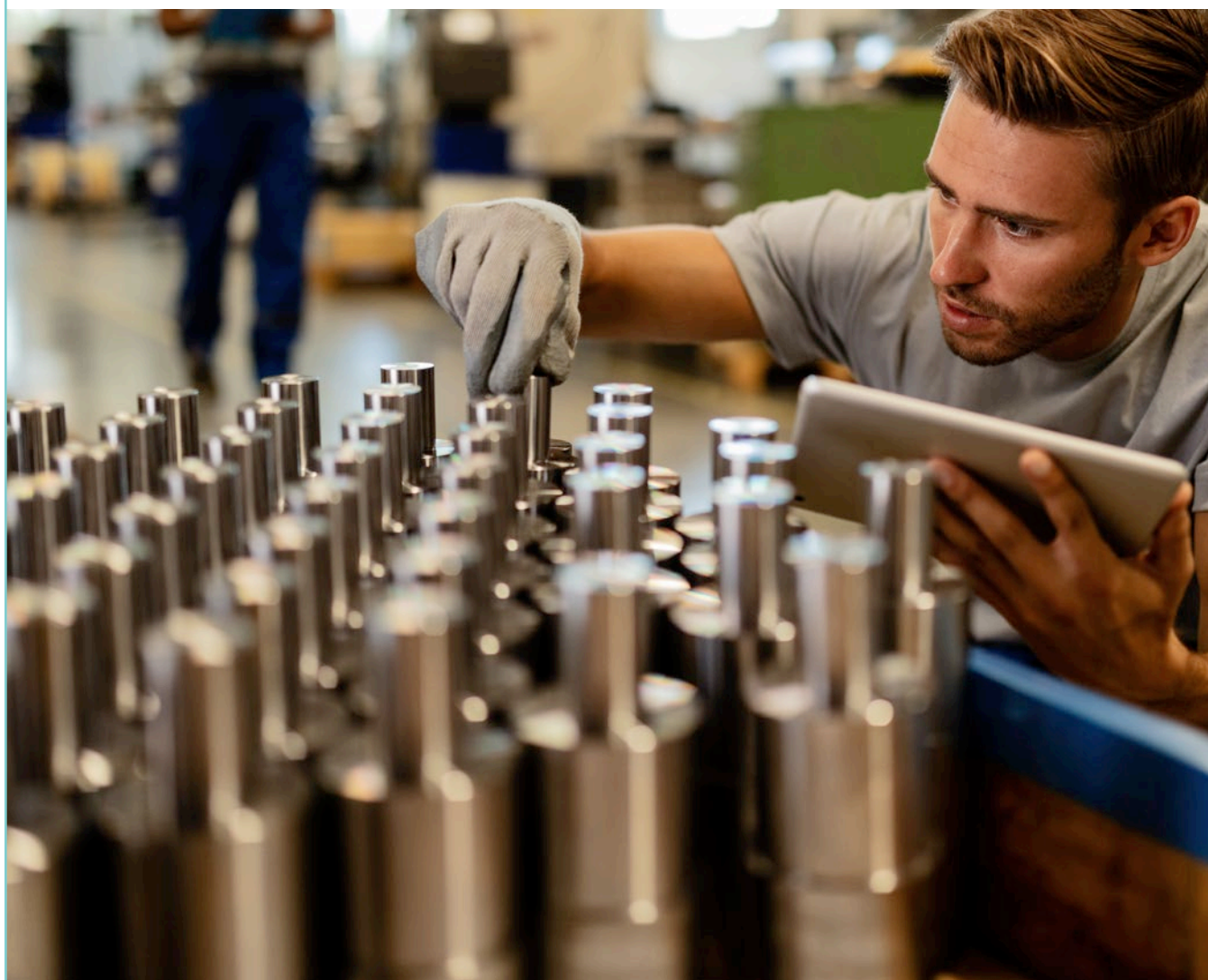
WHAT WAS HAPPENING

Product, setup, changeover,
or abnormal conditions

WHAT CHANGED

Supplier/lot, settings, maintenance,
staffing, or shift conditions

Accuracy vs. Precision manufacturing example: If machines aren’t dialed in and variation increases, quality becomes unpredictable. Data works the same way.



3.4

Trust

People trust systems they can understand and know their information is protected. Trust depends on two things:

THE DATA AND OUTPUTS ARE DEPENDABLE
(consistent + available + understandable)

THE SYSTEM IS SAFE AND CONTROLLED
(security + guardrails)

3.4.1 Information Security

Cybersecurity is the practice of keeping systems and data safe from harm or unauthorized use. A simple way to think about security is CIA:

CONFIDENTIALITY

Only authorized people can access information



INTEGRITY

Data stays accurate and unaltered



AVAILABILITY

Systems and data are available when needed



AI doesn't replace cybersecurity—it increases the need for it, because AI can:

- Access more data
- Summarize sensitive information quickly
- Sometimes connect to tools that take action

Business leaders don't need to be security experts, but they do need to treat security as part of the plan from day one.

3.4.2 Clarity and Transparency

People trust systems they can understand. That means AI should communicate in a way the end users can follow, not in technical language. Trust also increases when people can see why the AI is saying something.

AI should be able to show (within policy and permissions):

**WHAT DATA IT
USED**

**WHY IT FLAGGED
SOMETHING**

WHAT TO DO NEXT

**WHAT CHANGED
AND WHEN**

AI should also be able to say “I don’t know” when it doesn’t have enough information. If an AI tries to fill gaps with confident-sounding guesses that are not based on facts (“hallucinations”), people will stop trusting it.

3.4.3 Consistency

Trust builds when the system behaves the same way over time. People expect that if they use the AI today, it will respond in a similar way tomorrow—especially for repeat questions and repeat workflows.

Consistency includes:

- The type and amount of detail it provides
- The style and tone it uses
- How strict or cautious it is (for example, whether it asks clarifying questions or makes assumptions)

Simply put: if the AI behaves inconsistently, people will stop relying on it.

A NOTE ABOUT GENAI:

LLMs and GenAI will not produce the exact same answer given the exact same input. By design, GenAI tries to predict which response will be “best” for you. If someone is using GenAI to search a database based on a specific question (e.g., “How many parts did we sell last month?”), they will get a consistent answer. If someone asks GenAI to recommend a new sales strategy based on last month’s data, they’ll likely get a slightly different response each time.

3.4.4 Guardrails

While information and systems security traditionally focus on access, AI introduces another consideration: guardrails. Where access controls decide who can see what (data and features), guardrails define what the AI is allowed to do and what it must refuse, as well as how it “behaves.”

ACCESS CONTROLS EXAMPLE:

- Employee asks for sensitive employee activity → AI refuses
- Manager with proper access asks → AI provides a report

GUARDRAILS EXAMPLE:

- Manager asks for a judgment about an employee → AI refuses and points to HR policy
- Manager asks for defect rate during machine usage windows → AI provides the data view

Practical takeaway: People will be more likely to trust the AI if they know that just like people, there are rules in place to ensure that the AI only does what it is permitted to do.

3.5

Usability

Usability isn't just "clean data."

It's whether the data matches real operating conditions and the models can readily utilize the data. AI can look great in a test, then fail in production if the training data was too narrow.

Manufacturing example: A vision model is trained on thousands of images from **Supplier X**. It performs well in testing. Then the plant starts receiving the same part number from **Supplier Y** with small visual differences (stamp, finish, seam). The model suddenly misses defects or flags good parts as bad—because it never learned those variations.

The takeaway: AI works best when training data covers the full range of real conditions:

- Different suppliers and material lots
- Different shifts and operators
- Rare but important edge cases (new product launches, changeovers, unusual failures)
- Normal process variation



Technology should amplify our values, not replace our judgment. That means designing systems that are safe by design and useful by default—where human accountability remains central even as AI handles more complexity. Getting that balance right requires us to be intentional about what stays human.

ALLISON MATHEWS
Design Lead, Mayo Clinic

3.6

Ownership and Responsibility

Before using AI, leaders should be clear about ownership and accountability.

Someone must own the **incoming data** (who maintains it, who approves changes, and who controls access), and someone must own the **outgoing outputs** (who reviews results, who can act on them, and where AI content can be stored or shared). AI systems may learn from data and generate new content, so companies should also clarify **who owns what the AI produces** and whether that output can be reused outside the business. Just as important: define responsibility when the AI is wrong. In most cases, the provider supplies the tool, but the company is still responsible for how it is used—especially for quality, safety, employee decisions, and customer commitments.

The safest approach is to treat AI like any other decision-support system: set clear rules, assign owners, require human review for high-risk actions, and document what the AI is allowed to do.

3.7

How AI “Decides”

3.7.1 Pattern Matching, Not Human Reasoning

When AI gives an answer, it can feel like it reasoned it out like a person. But most AI systems work differently. They learn from examples and then produce a **best guess** based on patterns they’ve seen before.

A simple way to understand it:



Why AI can be impressive and still wrong:

- If data is incomplete, it can match the wrong pattern
- If the situation is new, it may not have a good reference
- If noise or outliers exist, it may “see” a problem that isn’t real
- If measurements are inconsistent, patterns become harder to detect
- AI can create real-sounding claims to back up its results

Why This Matters In Manufacturing

This explains several real risks leaders should plan for:

GARBAGE IN, GARBAGE OUT

Messy data leads to misleading output

FALSE CONFIDENCE

AI can sound certain even when it’s guessing

EDGE CASES

Rare events may not match anything the AI has learned

PRECISION MATTERS

Inconsistent measurement reduces early-warning value

Key Point: AI isn’t “thinking like a plant expert.” It is matching patterns based on the data it has. The more closely your training data reflects real operations, the better the matches become. That’s why AI outputs should be checked—especially before changing processes or making production decisions.

3.7.2 Context

AI systems have access to different data and company documents. This makes up the “context” for AI to understand your problems and provide results. The amount of context AI has access to is called a “context window.”

Depending on the system, context windows can be **short-lived** (i.e., limited to current active session) or **long-term** (i.e., holds all conversations you’ve had with the AI).

In addition, conversational AI (generative AI “chatbots”), has its own memory limitations typically within a single conversation or thread. This comes in the form of a **first-in-first-out (FIFO)** model to keep memory consumption low.

Why does this matter? Because this is the memory used by AI to understand and respond to user prompts.

TIP #1

Have you ever used AI for a while and noticed it starts getting less accurate or mixing things up? That can happen in long conversations, because earlier details may get dropped as the chat goes on. To keep the AI “anchored”, every so often, post a quick reminder of what you’re doing and what matters most.

TIP #2

If many decisions have been made throughout a conversation, ask the AI to summarize what you’re working on, what has changed, and list the key facts it should remember. Then continue by pasting that summary back in and adding any additional key details. This helps keep the AI aligned so it doesn’t drift or forget important context.

TIP #3

If you want to better inform your AI for your exact use cases or you want AI to never forget key “foundational” information, if possible, consider providing it with an “anchoring document”. That can be a simple Word document that contains critical information (facts, behaviors, context, etc.). Tell the AI to refer back to the document throughout the conversation.

3.7.3 Bias & Drift

Bias is when an AI system’s results lean in a certain direction because the data it learned from over-represents some situations and under-represents others. When that happens, the AI may work well in “common” conditions, but struggle in cases that are still important.

In manufacturing, bias usually shows up as blind spots—and those blind spots can lead to bad decisions, inconsistent results, and loss of trust.

Manufacturing examples of bias (blind spots):

A vision system trained mostly on day-shift images struggles on night shift due to different lighting

A model trained mostly on Supplier X parts performs poorly when Supplier Y introduces small variations

A system trained on “normal weeks” struggles during peak demand, disruptions, or unusual changeovers

How to reduce bias in practice:

- Make sure training examples include real variation (shifts, suppliers, lines, products, and edge cases).
- Review outcomes, not just outputs (who gets flagged, who gets missed, who gets filtered out).
- Keep a human review step for high-impact decisions—especially hiring, discipline, safety, and quality release.
- Re-check models and rules after major changes (new suppliers, new products, process changes, workforce changes).

Key takeaway: Bias isn’t just a “tech issue.” It’s a business risk. If the data doesn’t represent real conditions fairly and completely, the AI won’t either.

Drift is when patterns change over time—new suppliers, worn tooling, updated settings, seasonality—so an AI that worked well at first can start missing issues or triggering false alarms, which can lead to scrap, downtime, or bad decisions if it isn’t monitored.

HOW TO PREVENT DRIFT (PRACTICAL CONTROLS):

- Monitor performance over time
- Re-baseline after changes
- Use spot checks with real outcomes
- Keep “known-good” test cases
- Define an owner and trigger points
- Capture variation on purpose

EXAMPLE 1 — VISION INSPECTION STARTS THROWING FALSE ALARMS:

A camera-based inspection model was trained under normal lighting and clean lenses. Over a few months, lighting shifts slightly, lenses get dirty, and a supplier’s surface finish changes. The AI begins flagging good parts as bad (false rejects), slowing throughput and creating rework.

EXAMPLE 2 — PREDICTIVE MAINTENANCE STOPS CATCHING FAILURES EARLY:

A vibration-based model was trained on last year’s “normal” operating patterns. After a PM change, a speed change, and gradual wear in mounts/bearings, the baseline pattern shifts. The model starts missing early warning signs—or it alerts constantly—leading to either surprise downtime or alarm fatigue.

HUMAN RESOURCES HIRING EXAMPLE OF BIAS

An HR team uses an AI tool to screen resumes for a maintenance technician role. If past hires came mostly from the same background (same schools, industries, or similar career paths), the AI may learn that pattern and rank those candidates higher—even when other candidates are equally qualified. This can cause the tool to overlook strong applicants who have different experience (for example, military maintenance, adjacent industries, non-traditional training programs, or career changers). Over time, the team may think the AI is “helping,” but it may actually be narrowing the talent pool and reinforcing old hiring patterns.



3.8

Wrap Up

Data is the foundation of all decisions, and AI is no exception. AI uses data to spot patterns and support decisions, so the data must be ready before anyone can rely on it - this includes the models on which AI is trained. Key aspects of AI and how it works within a technical or business environment are how it identifies patterns, understands context, memory limits and how that affects context, and why data inputs as well as the AI system and its outputs must be monitored to identify and correct unexpected changes in behavior. Knowing those patterns, and how data impacts the reliability of any system, especially AI is critical to the success of an implementation of a solution.

3.8.1 Keys to Success

Getting value from AI doesn't start with the tool. It starts with disciplined data habits—just like any other improvement effort.

Standardize first, then scale

Lock in shared labels, reason codes, and basic documentation before you try to learn from the data.

Build in “check and correct” habits

Set simple routines to verify results, catch misses early, and adjust after changes like new suppliers, settings, or shifts.

Make it safe, clear, and owned

Put clear limits on what AI can do, keep sensitive info protected, and assign named owners who guide use and handle issues.

3.8.2 Try This

Use AI to learn how AI is impacting manufacturing & the supply chain today.

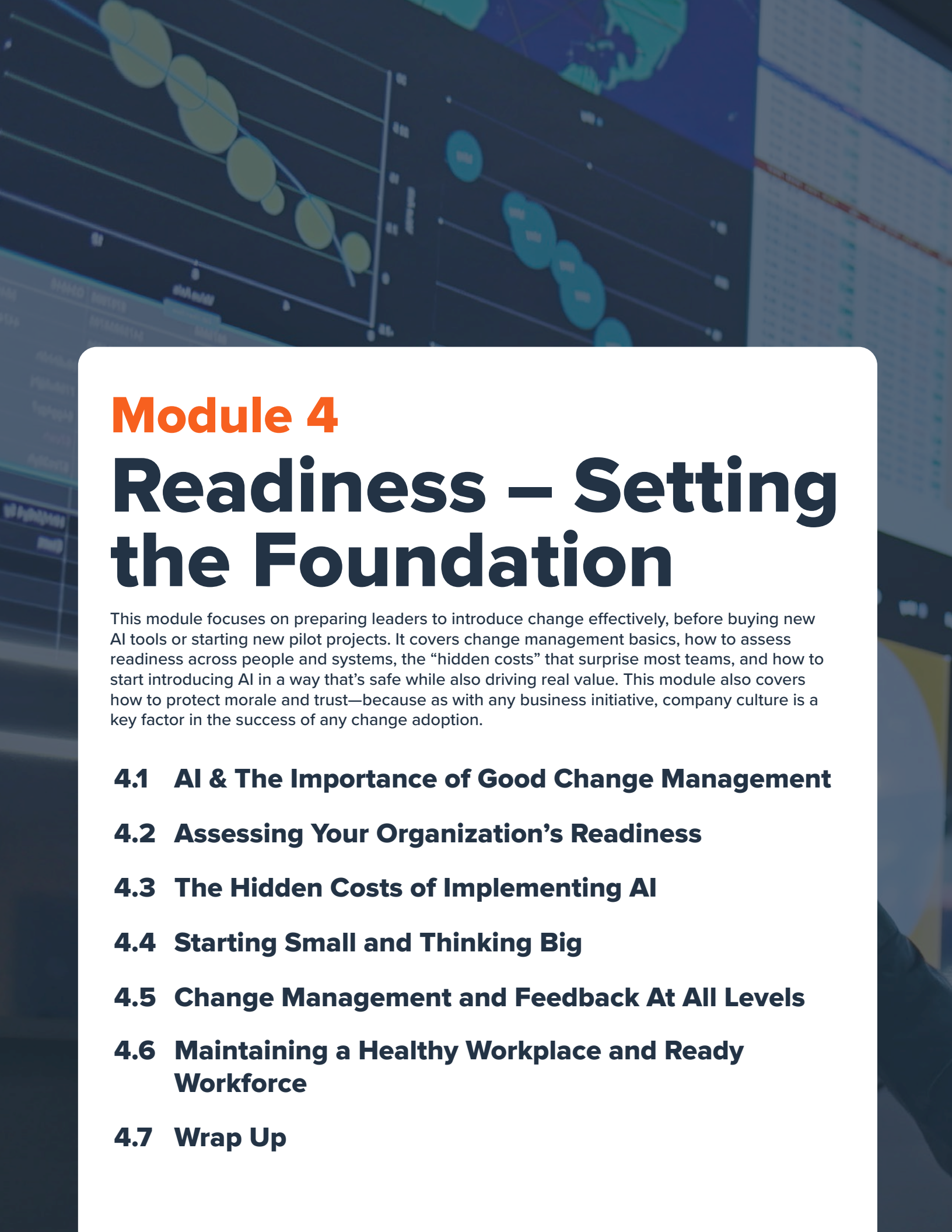
STEP 1

Choose any GenAI tool (e.g., ChatGPT, Claude, Gemini, Copilot)

STEP 2

Use the following prompt to start the experiment.

Teach me data-readiness concept of [Taxonomy / Reliability / Trust / Usability / Ownership] using a small, general, made-up dataset. Please create a simple sample dataset with 10–15 rows shown in a table, and intentionally include a few common problems related to this concept. Then ask me to find the problems. After I respond, show a corrected “fixed” version of the dataset and explain what changed in plain language. Keep everything grounded in everyday terms and non-technical language.



Module 4

Readiness – Setting the Foundation

This module focuses on preparing leaders to introduce change effectively, before buying new AI tools or starting new pilot projects. It covers change management basics, how to assess readiness across people and systems, the “hidden costs” that surprise most teams, and how to start introducing AI in a way that’s safe while also driving real value. This module also covers how to protect morale and trust—because as with any business initiative, company culture is a key factor in the success of any change adoption.

4.1 AI & The Importance of Good Change Management

4.2 Assessing Your Organization’s Readiness

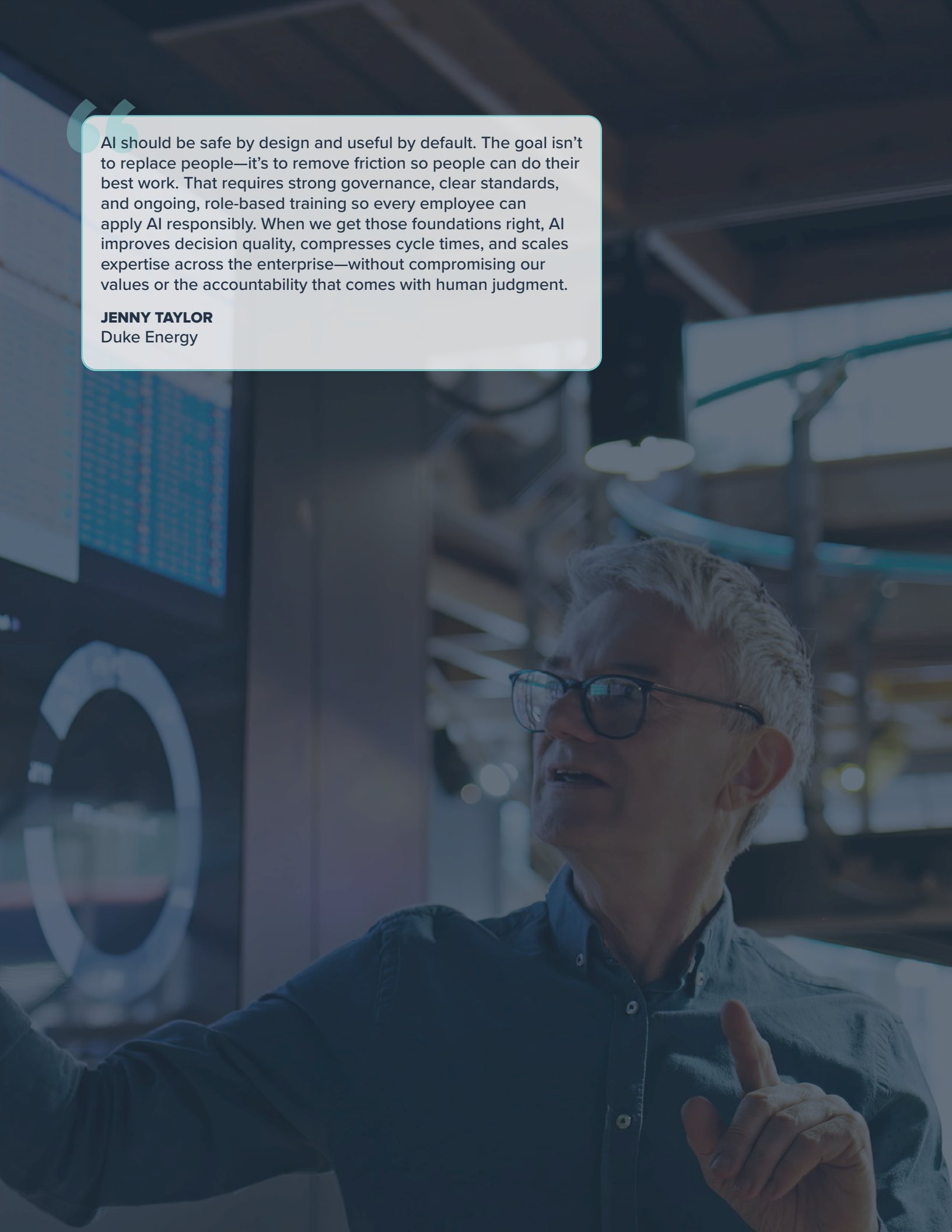
4.3 The Hidden Costs of Implementing AI

4.4 Starting Small and Thinking Big

4.5 Change Management and Feedback At All Levels

4.6 Maintaining a Healthy Workplace and Ready Workforce

4.7 Wrap Up



AI should be safe by design and useful by default. The goal isn't to replace people—it's to remove friction so people can do their best work. That requires strong governance, clear standards, and ongoing, role-based training so every employee can apply AI responsibly. When we get those foundations right, AI improves decision quality, compresses cycle times, and scales expertise across the enterprise—without compromising our values or the accountability that comes with human judgment.

JENNY TAYLOR
Duke Energy

4.1

AI & The Importance of Good Change Management

The reality is change makes people nervous, even good change.

If AI is introduced the wrong way, it creates fear, confusion, and resistance. If it's introduced well, it creates curiosity, learning, and better problem-solving.

A practical way to think about it: AI is not “magic.” It's a capability that improves your business when your people learn how to use it, but for them to be able to use it, they need to understand why it's being introduced and how it will affect their work.

4.1.1 Leadership Mindset

As with any change, clarity is key, and that begins at the top. AI adoption works best when leaders:

LEAD WITH EMPATHY AND PATIENCE

People need time to learn and rebuild confidence.

SET REALISTIC EXPECTATIONS

AI will make mistakes. Teams need guidance, not hype.

STAY PRESENT

Leaders should model safe use, not outsource it to IT or one “AI person.”

TREAT THIS LIKE A CAPABILITY UPGRADE

You are strengthening the workforce – not “installing a tool.”



4.1.2 Key Elements of Effective Change

Good change management is not complicated, but it must be consistent.

Explain the “why” early

- Why is AI being introduced, and what outcome will it help achieve?
- What problem is AI solving (e.g., quality issues, scheduling challenges, a need for better demand predictability)?
- What will improve for the people doing the work - if anything?

Explain what is changing and what is not

- What stays the same (safety rules, quality gates, approvals, accountability)?
- What may change (how people draft documents, search for answers, review data, escalate issues)?
- Will jobs or roles change, and if so, how?

Start with education before enforcement

- Without training and the time to learn a new tool, most people won't use it.
- Relevant training is not a technical overview, it's a “how-to demonstration” related to the jobs that they do.
- Education shows investment, and investment reduces fear - as trust grows, so does adoption.

Communicate frequently (and predictably)

- Give short status updates on what's happening and when.
- Avoid surprises by maintaining an active cadence of communication.
- As initiatives conclude, present the results and any lessons learned (even if results are mixed).

Say this out loud: AI is here to enable – not replace

- Don't pretend AI won't affect jobs - it's likely that it will in some form.
- Explain that the greater support there is for AI, the better off everyone will be - “win as a team / fail as a team”.
- If it's known that AI will impact jobs then be transparent and work on a plan to transition people into other roles - don't risk losing deep knowledge due to mixed signals.

Get feedback early from key users

- Bring key users in early and treat their feedback as signals and insights, not friction.
- Don't fall into the trap of only including “power users” in feedback loops - get feedback from a good population sample and include people at all levels.
- While a good sample of user feedback includes many points of view, avoid those that may push back without a qualitative reason - apprehension is okay, but there needs to be an open-minded approach.

4.2

Assessing Your Organization's Readiness

Readiness is not just an internal IT check; it includes everyone impacted:

- Employees and leaders
- Systems and data
- Customers (especially if AI changes service, lead times, or communication)
- Partners (suppliers, vendors, logistics, contractors)

4.2.1 Culture Readiness

Assess how people react to change, especially tech change:

- Do people feel safe asking questions?
- Is there already change fatigue?
- Do teams assume “this will be done to us,” or “we will build this together”?

4.2.2 Technical Readiness – People

This is about comfort and fluency. Consider the following questions:

- Who is already using tools like Copilot or ChatGPT?
- Where is confidence high (engineering, quality, planning)?
- Where is confidence low (operators with limited desk time, teams with low system exposure)?
- Do you have a training path that fits different roles?

4.2.3 Technical Readiness – Systems, Data, and Security

AI needs stable foundations:

- Are key workflows documented (even lightly)?
- Can you access the data you need without manual heroics?
- Is your data consistent enough to be trusted?
- Do you have security rules for sensitive info (customer data, designs, pricing, HR data)?

For more information about AI and risk management, a good resource to refer to is the [NIST AI Risk Management Framework](#).

 **TIP:** Load the NIST AI Risk Management Framework document into AI or give AI the URL and ask it to summarize key points for you.

4.2.4 Roles & Responsibilities

AI adoption fails when “everyone owns it,” because then no one owns it. With any project, especially ones that introduce significant change, having the right structure in place at the beginning is key to leading a successful project or initiative. With AI, the need is even greater.

Effective AI projects usually have a few core roles covered. On a small team, one person may wear multiple hats. On a larger team, these roles are often split so responsibilities stay clear and nothing falls through the cracks.

EXECUTIVE SPONSOR / CHAMPION

A company leader who confirms the business reason for the effort and what success looks like, protects time and funding for the initiative, and keeps momentum by clearing blockers and making priority decisions quickly.

AI INTEGRATION LEAD / PROJECT MANAGER

Owens coordination and execution. Keeps scope clear, runs the plan, manages communication, tracks progress, and makes sure training, rollout, and feedback loops actually happen.

AI TECHNICAL LEAD / ARCHITECT

Owens the technical approach end-to-end. Ensures the solution is designed safely, works in the real environment, and includes the right guardrails. Pulls in supporting experts (Security, Quality, Engineering, IT/OT) when needed.

DATA GOVERNANCE LEAD

Sets the rules for safe data use. Defines what data can be used, who can access it, what must be protected, and how oversight/logging works. Helps prevent accidental exposure of sensitive or regulated information.

IT ENTERPRISE ARCHITECT

Ensures the AI effort fits the company’s technology standards and environment. Helps avoid “shadow IT,” reduces integration surprises, and aligns the pilot with the bigger IT/OT roadmap.

QUALITY ASSURANCE / TEST ENGINEER (DATA & SYSTEM)

Verifies the solution behaves as expected. Tests data correctness, workflow impact, edge cases, and failure modes. Helps define what “good output” looks like and confirms results are trustworthy.

Whether each role belongs to a different person or several are combined on a small team, the key is that the responsibilities are covered—and that role ownership and expectations are clear to the team and stakeholders.



4.2.4.1 Supporting Roles

In addition to the core project team, there are also key process partners that must be included in the conversations when considering integrating AI:

HR/P&C

Human Resources (or People & Culture) can be one of your strongest allies in making AI adoption go smoothly. Because AI changes how work gets done, HR helps you introduce it in a way that builds trust - clear messaging, practical training plans, and support for role and skill changes over time. HR also helps ensure training is fair and accessible across shifts and job types, and they can set up simple feedback loops so people feel heard and included. When HR is involved early, teams tend to feel more confident, adoption happens faster, and the initiative is less likely to stall due to fear or confusion.

LEGAL

Legal should be involved early because AI introduces new risk around data, privacy, and intellectual property—even in small pilots. Legal helps define what information can be used, what must be protected, and what needs contract language (vendors, customers, and partners). They also help prevent issues like accidentally sharing confidential data, unclear ownership of AI-generated work, or using tools in ways that violate agreements or regulations. Bringing Legal in early reduces surprises later and makes it easier to scale safely if the pilot succeeds.

Within a technical project team, especially larger ones, there may also be typical roles such as engineers or analysts, but two roles that are often overlooked but provide a lot of value, especially within AI, are User Experience Designers and Context Engineers.

USER EXPERIENCE (UX) DESIGN

AI can be technically correct and still fail if it doesn't fit how people actually work. UX helps shape the “last mile” — how the tool shows information, when a human must review, and how the workflow stays simple under real plant conditions. When UX is included early, adoption improves, training is easier, and teams are less likely to mistrust or misuse the tool.

CONTEXT ENGINEER

A Context Engineer is a newer role that emerged with AI because AI quality depends heavily on the context it receives. This role helps the AI stay accurate and consistent by organizing knowledge sources, defining company terms and rules, building reusable prompt templates, and setting guardrails so the AI doesn't guess when it should ask for more information.

4.2.4.2 IT & OT Collaboration

AI often touches both business systems (IT) and plant-floor systems (OT), so it can either strengthen collaboration or create friction. If OT isn't involved early, manufacturers risk unsafe access paths, disrupted workflows, and security or reliability issues that don't fit real operating conditions. IT should bring OT in from day one by aligning on scope and guardrails, data access and network boundaries, change approvals and scheduling, and a simple weekly check-in during the pilot. The strongest teams use a shared charter, a clear escalation path, and brief documentation covering what data is used, how it flows, who owns it, what happens on failure, and how to pause or roll back changes.



TIP: Use a RACI or RASIC to identify what is expected of everyone in each role. A RACI is a chart that shows who is (R)esponsible, (A)ccountable, (C)onsulted and must be (I)nformed. A RASIC, best for larger, more involved projects, introduces the concept of the (S)upporting role.

4.2.5 Support Readiness

Don't forget the support teams. A common pitfall of delivering technical changes is failing to prepare the technical support teams and help desks for the upcoming change. The result: confused support agents, frustrated customers, and significantly wasted effort. Be sure that these teams are kept in the know about what is happening, when the change will occur, and what they need to do to support the change - especially if something goes wrong.

When thinking about introducing AI (or any technical change) ask:

- Can your help desk support this? Do they have the tools, training, and capacity?
- Do supervisors know how to respond when AI gives a wrong answer?
- Who handles exceptions and escalation?

4.2.6 Partners and Customers

AI can also change how people deliver work products and collaborate with others. Consider:

- Will customers worry about AI touching drawings, specs, or quotes?
- Will suppliers worry about how you evaluate performance?
- Has this change been presented and has the impact been discussed?

4.3

The Hidden Costs of Implementing AI

The cost of AI isn't just the subscription or implementation. The real cost shows up in data preparation, training (people & models), validation & verification, and continued oversight.

Common expected costs:



Common “hidden” costs include:



TIP: Treat early AI efforts like process improvement: expect discovery, measure impact, adjust, repeat; budget for learning cycles, not just technical work.

4.3.1 AI Readiness & Tackling the Skills Gap

According to Allison Bailey, Global Vice Chair, Boston Consulting Group:

- Just 5% of companies are achieving AI value at scale
- 60% are hardly achieving any value at all
- 35% are somewhere in between

Key Considerations

When it comes to skills development, technology is hard because it changes fast. AI changes even faster. The good news is that effective training is less about having the perfect curriculum and more about creating the right environment for people to learn.

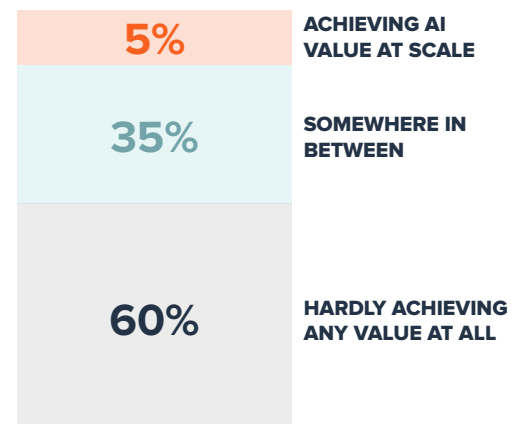
Focus training on skills people can use today, and tie it to real work problems they recognize. Give employees time to learn and experiment during work hours—if training only happens “after hours,” adoption drops and the ROI fades. Reinforce progress with simple incentives like public recognition, small rewards (gift cards, points, badges), and by recording AI skills in each person’s development plan. If certifications apply, use them—they motivate people and support career growth.

Make training accessible to everyone, including different shifts, ADA needs, and neurodivergent learners. Leaders should model safe, practical AI use, while also giving employees chances to demonstrate what they can do. Finally, build a feedback loop and act on it so training improves over time.

Training Support

Outside trainers are most effective when they understand both AI and manufacturing. It’s not enough to know the technology—they also need to understand plant realities, safety expectations, shift work, and how decisions and handoffs happen on the floor. That’s what makes the training feel relevant and builds trust with the people being trained.

Finding a qualified trainer can be difficult. NY MEP has a wide network of vetted resources and can recommend or provide support based on your needs. For help with training, pilot planning, or integration support, contact NY MEP.



4.4

Starting Small and Thinking Big

4.4.1 AI Charter / Project Charter

A charter is a concise, formal document that explains and documents the authorization of a project or initiative. A simple charter keeps everyone aligned. Your charter should answer:

- What problem are we solving/what opportunity are we capturing?
- What is the proposed solution (high level)?
- How will success be measured?
- Who are the key stakeholders (and who approves changes)?
- Who are the key team members?
- What's in scope / out of scope?
- What data is being used / impacted?
- What are the potential or known risks (e.g. safety, quality, privacy, downtime)?
- What is the timeline and communication plan?

The charter is also a living document where major changes to the project or initiative are logged.



TIPS: Re-introduce the charter anytime a new leader or team member joins the effort.

When creating a charter for a larger initiative, it's best to include details of a pilot to ensure that there's a real tangible problem or opportunity and not just theory.

4.4.2 Pilot-first Approach

The value of a pilot is that a solution is tested not just to see if it works as expected in real-world conditions, but to see if it really solves the problem it was meant to - if people will actually use it. A good pilot is small enough to control but real enough to matter.

It should:

- Reduce risk
- Prove value
- Teach you what's needed next (data, training, workflow changes, governance)

Strong pilot characteristics:

- Clear scope
- Low safety/compliance risk
- Easy to pause or roll back
- Visible benefit to the people doing the work

4.4.2.1 Avoiding “AI for AI’s sake”

If the justification for implementing an AI solution can’t be explained in terms of the value it brings to the business, then it’s likely not the right decision - or at least not right now. Every integration should be grounded in business value - even if the value is simply understanding capability.



TIP: AI learning and readiness work still counts as progress.

The Problem Statement

When trying to describe an opportunity or challenge where it’s not clear what the solution is or it’s suspected that AI is a potential solution but further exploration is needed, it’s best to write it in the form of a problem or opportunity statement - with AI exploration being part of the plan.

A problem statement, typically residing at the start of a project charter, describes the problem, not the solution or cause. It incorporates who is impacted by the problem, when it occurs and how frequently, where the problem is occurring, the size of the problem, and why it matters (not why it is happening). An opportunity statement does the same thing, but from an opportunity point of view.

BAD PROBLEM STATEMENT

We continue to get complaints from our customers about poor service from our help desk; we need to implement an AI solution to fix these issues and improve our scores.

BETTER PROBLEM STATEMENT

Since the launch of our new product at the start of last year, call volume has increased 2x every quarter consistently, outpacing the capacity that our service desk can handle while also increasing the volume of negative NPS scores for our quality of service. If our rating continues to degrade we risk being removed as a reputable supplier to our customers.

What should stand out is that nowhere in the Better version is AI mentioned - which is the point. Premature assumptions can direct budget and time toward the wrong solution. It’s not known whether the spike in volume was due to capacity, or an increase in defects, or some other reason. The purpose of the problem statement is to determine if it warrants further effort - if there is business justification.

The next question would logically be: **“Where do I describe AI (or other technical ideas)?”** AI exploration (or other solution ideas) would be described in the scope section of a project charter, along with **what**, **how**, by **when**, and **what** the objective is of that exploration.

Introducing the SBAR

An SBAR is a concise way of delivering information, meant to deliver time-sensitive, critical information to leadership for the purpose of making a decision. It must be concise, speak with facts, follow a strict format, and should rarely exceed one page.

If the cause is known and the technical solution is determined or simply suspected, an SBAR is a fantastic format to raise awareness and organize a proposal for change.

Example of SBAR: Service Desk Capacity, Quality Risk, and AI Enablement

SITUATION

Since the launch of our new product at the start of last year, customer support call volume has increased 2x every quarter, outpacing current service desk capacity. At the same time, negative NPS scores related to support quality are rising, indicating that customers are feeling the impact of longer waits and inconsistent experiences. If this trend continues, we risk damaging our reputation and becoming a less trusted supplier to key customers and being removed from the marketplace entirely.

BACKGROUND

The service desk has been operating near capacity and has relied on overtime, informal “tribal knowledge,” and inconsistent documentation to keep up. As customer volume grows, the current approach becomes harder to sustain. The workload is also becoming more complex as the product matures, which increases the time required to resolve cases and the likelihood of errors.

ASSESSMENT

Our assessment shows the call volume increase is not defect-driven; defects are decreasing. The issue is customer growth outpacing service desk capacity, leading to longer waits and inconsistent experiences. Hiring alone won't keep up: the cost, training time, and ramp-up effort erode profitability and increase inconsistency when knowledge isn't standardized. By contrast, AI agent tools can absorb growth at a fraction of the cost while improving consistency through centralized documentation, standardized onboarding, and repeatable resolution workflows.

RECOMMENDATION

We recommend running a short evaluation to identify and pilot 1–2 AI support solutions that meet our acceptance criteria. The pilot should focus on measurable outcomes such as reduced response time, improved first-contact resolution, improved NPS for service quality, and controlled risk (security, accuracy, and clear human oversight). If results meet targets, we can scale adoption in phases across the service desk that will improve our scores while decreasing pressure on our existing staff.

4.5

Change Management and Feedback At All Levels

Whether piloting or fully launching:

- Communicate what is being planned and what is not
- Coordinate scheduling and approvals (especially if IT/OT is involved)
- Document decisions (who decided what, and when)
- Include support teams (help desk, technicians, supervisors)

After each release or phase:

- Do a short review: what went well, what didn't, what to change next time
- If there's an incident, run a postmortem and update your process
- Release changes incrementally and keep collecting feedback
- Maintain a backlog of improvement ideas for routine review and prioritization

This is basically “continuous improvement,” applied to AI. As AI evolves rapidly, companies are leaning on it to keep pace—or pull ahead—of the competition. In that environment, continuous improvement can't be treated as an occasional effort to “fix problems” or “scale up.” It needs to become a built-in operating habit: test, learn, adjust, and improve—over and over—as tools, data, and workflows change. In other words, it shifts from an ad-hoc practice to a cultural expectation. And while that may feel overwhelming, it doesn't have to be, there are practical tools and resources that help leaders align their teams and build this new way of operating step by step.



4.6

Maintaining a Healthy Workplace and Ready Workforce

AI adoption hits morale harder than most technology changes because it touches identity (“Will I still be needed?”) and confidence (“Can I keep up?”, “Is my job at risk?”).

4.6.1 The Power of AI Integrators and AI Evangelists

When these roles work together, change is adopted much faster.

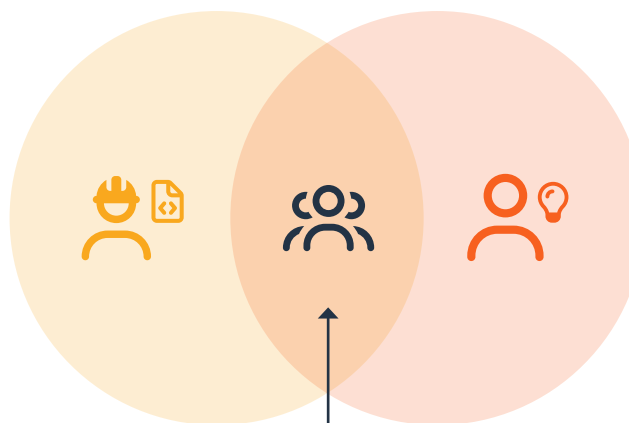
INTEGRATORS

Like conductors in an orchestra, they are technical experts steering the changes and influencing the teams doing the work. Integrators must have an expert-level understanding of the change but may not be doing the work themselves. They are typically found leading an AI project, working directly with the teams doing the work.

EVANGELISTS

Can be anyone, but the most effective are those who have some level of influence, are strong in winning over others (see [Clifton Strengths - WOO](#)), and have a desire to promote this change (in this case Artificial Intelligence). Evangelists are not necessarily part of the project itself, but are involved in communicating change effectively.

AI INTEGRATORS
Technical enablers of AI workflows



AI CHANGE AGENTS
Driving AI transformation through collaboration

AI EVANGELISTS
Champions of AI adoption and engagement

4.6.2 Create Safe Spaces To Learn

People need time and places to experiment:

Slack/Teams channels

Office hours with champions

Short “coffee chats”

Quick demos at shift handoffs

Confluence/SharePoint pages

4.6.3 Celebrate Wins, and Openly Discuss Losses

Trust grows when:

- Leaders share what they are learning (including missteps) wins are visible and shared across the plant
- People can admit mistakes without fear

Leaders need to ensure that their people and teams are ready before introducing AI.

4.6.4 Accessibility and Inclusivity in AI Adoption

AI can help a lot of people work faster and more confidently, and in many ways it can also be enabling, but only if it is introduced in a way that respects different thinking styles and communication needs. Most AI tools are trained on broad “typical” patterns found in public text and online behavior. That means the default tone, structure, and interaction style often reflects a neurotypical norm: fast back-and-forth, implied context, and “standard” social cues. If you don’t plan for this, AI can unintentionally frustrate or exclude people—especially those who rely on clarity, consistency, or specific formats to do their best work.

What to understand up front:

- **AI doesn’t “know” your people.** It predicts likely responses based on patterns, not personal understanding. If your team communicates differently, the AI may misread that style.
- **AI can affect confidence and safety.** If someone already feels misunderstood at work, an AI tool that “talks past them,” changes their wording, or flags their writing as “odd” can increase stress and reduce trust.
- **Accessibility isn’t only ADA.** Accessibility also includes different learning styles, sensory needs, attention variability, and communication preferences.

Be careful about using writing style as a shortcut for judging whether someone used AI. Many common habits are not “AI tells.” For example:

- Em dashes (—) are used by plenty of human writers and are built into tools like Word and Google Docs. Their presence alone is not evidence of AI.
- Bullet-heavy writing, overly formal tone, or very “clean” grammar can come from templates, training, or editing tools—not just AI.
- The goal should be quality and clarity, not “catching” people using AI. A culture of suspicion will kill adoption and morale.

If overlooked, AI can negatively impact focus, processing time, comfort and cause friction:

- **Ambiguous instructions** (“be creative,” “make it better,” “improve this”) can produce unpredictable outputs and increase cognitive load.
- **Tone shifts** can feel invalidating (e.g., AI “softening” direct language that was intentionally direct and professional).
- **Speed expectations** can become unfair (“AI makes it faster” can turn into pressure to work at AI pace).



TIP: If you design for inclusivity early, through clear prompts, flexible formats, and a culture of psychological safety, you get better adoption and better results.

Clarity builds trust: Clear is kind. Unclear is unkind.

BRENE BROWN

In the Age of AI, IQ without EQ, it's just a waste.

SATYA NADELLA

Leadership is not about being in charge. Leadership is about taking care of those in our charge.

SIMON SINEK



4.7

Wrap Up

AI readiness is less about tools and more about building the conditions for change to succeed. A key element of that success is the introduction of AI in a way that reduces fear and increases trust, how to assess readiness across culture, skills, systems, data, and support teams, and why the real cost of AI often shows up in training, cleanup, iteration, governance, and oversight. A great approach to reduce risk and gain trust is to start small with a pilot-first approach. With every initiative and project, develop a charter that's clear, use feedback loops to improve continuously, and protect morale by creating safe spaces to learn, celebrating wins, and being transparent about what AI will and won't change.

4.7.1 Keys to Success

Lead with clarity and empathy

Explain the “why,” set realistic expectations, and communicate what is changing (and what is not) early and often.

Treat readiness as part of the project

Assign clear owners, prepare data/systems/security, and budget for training, iteration, and oversight—not just the tool.

Start small and learn fast

Use a chartered pilot with guardrails, involve key users early, collect feedback continuously, and scale only after you've proven value and trust.

4.7.2 Try This

Use AI to learn how it can help write better problem statements.



STEP 1

Choose any GenAI tool (e.g., ChatGPT, Claude, Gemini, Copilot)



STEP 2

Use the following prompt to start the experiment.

Help me write a clear problem statement for an AI or process improvement proposal. First, ask me 6 short questions: (1) what's happening, (2) where it happens, (3) who is affected, (4) how often it happens, (5) what the impact is (time/cost/quality/safety), and (6) what 'good' should look like. Then write 3 versions of the problem statement: (A) one sentence, (B) a 3–4 sentence version, and (C) a version that includes measurable signals. After that, list 5 'scope boundaries' (what this problem statement does NOT include) and 3 assumptions I should validate before starting a pilot.



STEP 3

Take the time to review the different problem statement versions - which do you feel is most effective and which one aligns with your style of speaking?

Module 5

Identifying Practical Use Cases

This module helps manufacturing leaders move from “AI sounds interesting” to “here’s where it can actually help us.” It describes what good AI use cases look like as well as real-world examples of success (case studies). This module wraps up by providing examples of everyday use cases of generative AI that support work spanning the office to the shop-floor.

5.1 What a “Good AI Use Case” Looks Like

5.2 AI as an Enablement Partner

5.3 Rebalancing Line Operations with AI

5.4 Integrated Quality Inspection at Scale with AI

5.5 Real-Time Operational Visibility with AI

5.6 Scaling Production with AI

5.7 Predictive Maintenance with AI for Reduced Unplanned Downtime

5.8 Additional Use Cases

5.9 Use Case Readiness

5.10 Wrap Up



“For us as a small business, AI opened up the door to so much better conversations, it gave us information and experience that all these other large companies had.

TAYLOR POWELL
COO, Industrial Motor Service

5.1

What a “Good AI Use Case” Looks Like

A good use case for integrating AI has the following characteristics:

1 IT'S REPEATABLE

The more frequent the occurrence, the more likely it's a good candidate

2 IT'S QUANTIFIABLE

It can be measured and the impact can be clearly described

3 IT'S SPECIFIC

There's a clear problem that can be solved; it's not a “boil the ocean” situation

There's actually a fourth characteristic, one that's often overlooked: **it matters**.

Even if it's specific, quantifiable, and repeatable, if it does not matter to leadership then there's likely to be little support, especially if a project stalls or has problems. This is one of the greatest reasons projects die: lack of alignment. Be sure that the justification includes why it matters (loss/increase of profit/revenue, customer satisfaction, etc.).



TIP: A well-constructed problem or opportunity statement helps ensure stakeholder and leadership alignment.

5.1.1 Finding AI Opportunities in Your Operations

AI opportunities show up fastest when the workflow is visible. Process maps and value stream maps help teams spot where time and quality are leaking. Leaders should look for repeat points of friction like handoffs, waiting, rework loops, manual checks, and “tribal knowledge” steps.



TIP: When getting started, simply look for processes that cause friction or frustration. An easy way to do this is by surveying your organization - your people will tell you.

WHAT TO LOOK FOR ON THE PLANT FLOOR:

- Repeating downtime patterns
- Changeover tasks that rely on memory instead of standard work
- Troubleshooting that depends on one expert; long root-cause analysis
- Inspection steps that vary by person
- Frequent rebalancing and “trying new configurations”
- Exhausted staff, especially due to frequent unplanned shift changes

WHAT TO LOOK FOR IN THE OFFICE:

- Scheduling churn and constant re-planning of resources
- Repetitive tasks and movement between systems
- Lengthy document reviews and feedback cycles
- Document chaos: SOPs, job cards, training records
- Frustrated staff, especially following onboarding of new hires

5.1.2 AI vs. Automation

At a high level, automation can refer to workflow automation in business systems, **RPA (Robotic Process Automation)** for repetitive screen-based tasks, industrial automation on the shop floor, and AI-enabled automation for more adaptive or judgment-based work.

RPA uses bots to automate repetitive, rules-based tasks such as moving data, triggering actions, entering information into applications, and completing workflows that mimic human interaction with software. Traditional RPA does not learn, recognize patterns, or make adaptive decisions like AI, though it can be combined with AI and document-processing tools for more complex work.

Which to Choose: Not every challenge requires AI. AI is often the better solution when a task requires interpretation, pattern recognition, prediction, or decision support rather than simply following fixed rules; however, RPA or other automation solutions may be appropriate if the rules are clear. What's important is to match the solution to the business needs.



There's a lot of opportunity for automation, especially RPA, because so much work is repetitive, especially when it comes to things like updating documentation.

KEVIN CARPENTIERI
Director, Fusion Managed IT

**TRADITIONAL AUTOMATION**

Uses fixed scripts and predefined workflows. Requires significant upfront investment and ongoing maintenance.

**ROBOTIC PROCESS AUTOMATION**

Leverages software robots to mimic human actions. Allows for greater flexibility and quicker deployment.

**ARTIFICIAL INTELLIGENCE**

Enables systems to learn and make decisions autonomously through advanced capabilities like machine learning and natural language processing.

5.2



AI as an Enablement Partner

Industrial Motor Services (IMS) specializes in remanufacturing electric motors, supporting a diverse customer base – over 200 – from large enterprises to small businesses, that includes aerospace, food and beverage, manufacturing, textiles and many others. This wide portfolio of customers shows just how broadly electric motors show up in day-to-day operations and essential infrastructure, which also highlights the complexity of work and business operations that a company such as IMS manages.

Introducing Remanufacturing

A process that may not be known to all, remanufacturing is different from more familiar terms such as refurbishing or repair. In remanufacturing, each incoming job is unique, rebuilding and upgrading components to extend lifecycle and often improve performance.

AI as an Enablement Partner

IMS is a successful business, leveraging deep knowledge from machine and motor experts coupled with a history of dedication to being there for their customers whenever they're needed. Although IMS is a thriving business, with high demand for support and every job being custom, there were surely opportunities for operational improvement. To identify those gaps and opportunities, Taylor Powell, COO, looked at AI as being a potential key for unlocking much needed insights. While many improvements were made, two key improvement areas are highlighted: **Job Cards & Pickup Tickets**.

Digitizing job cards and reducing time spent searching paper records

THE CHALLENGE

Decades of job data captured in job cards (part specs, instructions, history, etc.) all maintained on paper took a lot of time to use and maintain – time that could be used on more valuable activities.

THE SOLUTION

Digitized ~10,000 job cards, reducing the need for physical search and maintenance.

THE OUTCOME

- Conservative estimations indicate a ~70%–80% time savings was achieved
- Floor space was recaptured allowing for expansion of services & reduction of foot traffic
- All data is now safely backed up in electronic form

HOW AI HELPED

AI was used to not only identify key process areas for improvement, but it was also used to help Taylor design, develop, and deploy the software to digitize and deliver electronic job cards across their business.

Pickup ticket automation & intelligent quality checks

THE CHALLENGE

The process of recording customer parts pickup information was a manual process from writing on paper forms to the handover and data entry in the central system, taking a lot of time away from staff due to manual entry, validation and error correction.

THE SOLUTION

Creation of a digital entry app with form validation, including nearly 30 pages of business logic for intelligent automation.

THE OUTCOME

As of the writing of this case study, the solution is still in development; however, calculated savings are projected to be over \$36,000 per year due to reduced costs lost in manual entry and rework.

HOW AI HELPED

Again, AI was used as a collaboration partner, allowing Taylor to not just pinpoint the waste and its cost, she was able to design a new process supported by internally developed software.

A Deeper Dive – The Effect of Using AI

The effect of AI is limited to how it's used. It can be used to solve simple problems, automate repetitive tasks or completely transform a business. In this overarching example, AI enabled a business leader by helping to identify opportunities for improvement as well as capabilities that were previously not known - in not just the technical solutions but also in Taylor herself.

Keys To Success

AI was used as a “thinking engine” that enabled IMS to solve complex problems by structuring logic and providing custom learning paths, effectively acting as a virtual consultant.

Key Takeaway for Business Leaders

Be curious and use AI as a creative partner or “thinking engine”. While AI can certainly help automate things for making processes more efficient and to drive quality, not every business challenge is solved by integrating AI into the technical ecosystem, sometimes it is as simple as using it as a thought partner to explore an idea.

I would say the value AI showed to me was that for the first time someone, or something (AI) helped me to be able to take our very unique problems and explain them. Taking it further, AI helped me ask the right questions and see what's possible and find real solutions... as a small business, it gave us the experience that all these other large companies had.

TAYLOR POWELL
COO, Industrial Motor
Services

5.3



Rebalancing Line Operations with AI

Allegiance Flag, a South Carolina manufacturer of premium American-made flags, faced a familiar operational challenge: demand was growing fast, but the company wanted to avoid solving the problem by simply adding more labor before peak season. As production scaled from a much smaller operation to multiple sewing lines across two shifts, leadership needed a way to increase throughput while keeping work more balanced and sustainable for employees. Rather than jumping to expensive software or equipment, the team used Generative AI as a practical planning tool to help analyze line design, workload distribution, and time study data.

THE CHALLENGE

Allegiance Flag had built a stable production model to avoid the cycle of over-hiring during busy seasons followed by reductions later. Even with that discipline, the team saw that some sewing lines were still falling short of the output needed to build enough inventory ahead of peak demand. A closer look showed that the issue was not simply machine speed. The bigger problem was line balance; the production layout created uneven workloads resulting in fatigue and lost throughput. Leadership wanted to improve performance without pushing people harder, adding unnecessary headcount, or making large capital investments.

THE APPROACH

The operations team began with detailed time studies across each step in the flag sewing process. They measured the average cycle time for each operation and also captured necessary non-value-added work such as changing bobbins, changing rolls of fabric, and other recurring interruptions. That information created a more complete picture of how time was really being spent on the line.

Instead of relying only on their first assumptions about a better layout, the team leveraged AI for analysis of the time study data. Because leadership had already spent time building context into the tool about process details, AI was able to respond with more accurate and useful suggestions. The result was a reconfigured U-shaped production line that streamlined flow and redistributed the work more evenly across operators.

THE OUTCOME

After piloting the change on one line, Allegiance Flag began to see measurable gains. Observed improvements included:

- Output increased by more than 10%
- Better labor balance across operators
- No major capital investment needed
- Positive operator response

KEYS TO SUCCESS

Several factors made this effort work well:

- They started with real process data
- They used AI to support process improvement, not replace judgment
- They were willing to change direction
- They explained the change to the workforce, including why

TAKEAWAY FOR MANUFACTURERS

When paired with time studies, process knowledge, and clear operational goals, it can help manufacturers rethink layouts, rebalance labor, and improve throughput with very little capital spend. This is an important reminder that AI does not have to begin with a large, complex system. It can start with one real problem, one good dataset, and a team willing to test a better way of working.



5.4



Integrated Quality Inspection at Scale with AI

BMW is a globally recognized German manufacturer of premium vehicles, and it produces a significant portion of its lineup in South Carolina at BMW Manufacturing (Plant 10) in Spartanburg. With a strong reputation for quality and innovation, BMW continually looks for ways to improve. As part of continuous improvement, BMW Group's iFACTORY strategy continues to raise the bar on standards with its 3 pillars: LEAN. GREEN. DIGITAL. Within this approach, AIQX is a core AI-driven platform used to raise quality standards through real-time, sensor-driven inspection built into the conveyor process.

THE CHALLENGE

Continuous quality improvement as production becomes faster and more digitally integrated.

- Detect assembly variances and anomalies early in the production flow
- Confirm variant accuracy and completeness during assembly
- Provide immediate, actionable feedback to employees on the line
- Improve consistency in final checks, including sound-based inspection

THE APPROACH

Operationalize AI-driven quality inspection directly in production.

- Camera systems and sensors in the conveyor belt process
- Real-time detection of anomalies, completeness gaps, and variant mismatches
- Smart device feedback loops for in-process response
- Acoustic analytics for additional analysis and detection coverage

THE OUTCOME

With AIQX, BMW describes benefits in qualitative terms, emphasizing faster, more reliable, and more efficient production enabled by AI-based quality processes.

BMW's Car2X expands quality in the factory by turning each vehicle on the production line into an active, connected participant that can compare intended vs. actual assembly status, identify variances (such as faulty plug connections), and report discrepancies in real time to employees and production systems so issues can be corrected immediately, reducing rework.



KEYS TO SUCCESS

Embedding AI as quality infrastructure, not a separate analytics layer.

- Inspection data is captured where quality is created (in-process)
- Immediate frontline feedback enables faster correction
- Automation improves standardization and reduced subjectivity
- Self-reporting products (vehicles) generate additional quality insights

TAKEAWAY FOR MANUFACTURERS

Manufacturers should consider where they can instrument the line with reliable data capture, how real-time AI insights will reach the people doing the work, and what governance is needed to keep standards consistent as solutions scale. BMW's AIQX and Car2X examples highlight what's possible when AI is treated as operational infrastructure – improving quality through faster detection, clearer signals, and tighter feedback loops embedded into everyday production.

5.5



Real-Time Operational Visibility with AI

Manufacturers with complex, high-velocity operations often struggle to maintain accurate, real-time visibility into work-in-progress (WIP), inventory movement, and job status across production, warehousing, shipping, and downstream delivery or installation. When updates are delayed or captured manually, the “system of record” quickly drifts from what’s happening on the floor - leading to rework, shortages, missed handoffs, and avoidable expediting and labor costs. While **KnarrTek’s** solutions were robust, additional functionality was needed to solve key challenges.

THE CHALLENGE

Across a mix of production, inventory, and logistics environments, several recurring problems showed up:

- Manual data entry was time-consuming and error-prone, slowing down decision-making and creating downstream reconciliation work
- Limited WIP visibility made it difficult to spot bottlenecks early, which reduced throughput and increased schedule variability
- Inventory counts and audits were burdensome, especially during year-end, often consuming weeks of effort
- Disconnected systems meant teams had to “stitch together” the truth through meetings, spreadsheets, and tribal knowledge



Job	LOT #	Status	Quantity	Due Date	Department
JOB-10885	4881	Assigned	100	04/22/2026	Packaging
JOB-21715	2779	Assigned	250	04/22/2026	Shipping
JOB-21779	3742	Assigned	500	04/23/2026	Shipping
JOB-20431	8520	Released	500	04/23/2026	Assembly
JOB-20432	7721	Released	500	04/21/2026	Shipping
JOB-20421	7722	Late	500	04/21/2026	Shipping
JOB-20621	5516	Late	300	04/25/2026	Assembly
JOB-11436	8923	Assigned	500	04/24/2026	Assembly
JOB-10886	3178	Assigned	300	04/24/2026	Assembly
JOB-10637	2904	Released	500	04/25/2026	Assembly

THE APPROACH

Extend the KnarrTek platform by integrating AI & IoT alongside smart automation to create continuous, real-time visibility of jobs and materials as they move through the manufacturing lifecycle without requiring workers to become full-time data entry technicians.

In one representative implementation, operational intelligence was extended across the product lifecycle by combining:

- Edge data capture at the point of work using industrial IoT computers and ruggedized mobile devices to reduce friction for operators
- Automated movement tracking for finished parts and products using RFID tags and sensors, enabling both in-facility and out-of-facility traceability
- Leveraging AI for intelligence-driven monitoring and alerting to identify bottlenecks, detect anomalies, and surface issues in real-time
- Multi-platform integration platform, such as ERP and WMS, for connected intelligence across planning, materials management, and fulfillment

THE OUTCOME

Across deployments in production, inventory, and logistics settings, manufacturers using this approach commonly reported measurable improvements, including:

- Up to 90% reduction in manual data entry and related errors
- Inventory processes compressed dramatically and reduced rework and fewer downstream delivery issues
- 15–25% improvement in production throughput
- Annual savings typically in the \$50,000–\$150,000 range

KEYS TO SUCCESS

Three factors appeared to be especially important:

1. Data capture happens where work happens
2. Tracking was automated wherever possible
3. AI supported action, not just reporting

TAKEAWAY FOR MANUFACTURERS

AI provides repeatable value in manufacturing: start by instrumenting real operations, connect that reality to planning and fulfillment systems, and apply AI to detect constraints and exceptions early. The result is less manual work, better throughput, faster inventory cycles, and fewer preventable operational costs—without relying on heroic effort from frontline teams.

5.6



Scaling Production with AI

Sealevel Systems, Inc., a South Carolina-based manufacturer of industrial I/O and embedded computing hardware, recently faced a challenge familiar to many electronics manufacturers: demand for a new product line was growing faster than the company's SMT (Surface Mount Technology) production capacity. To address the issue, the production team focused on using a combination of equipment upgrades and AI-enabled technologies to improve both throughput and quality across the SMT line.

THE CHALLENGE

The operation had historically placed roughly one million components per month, but new demand required the team to increase capacity to 1.5–2.5 million. At the same time, the assemblies involved higher component density and tighter tolerances. Increasing line speed without improving inspection and process control risked higher defect rates, more downstream rework, and potential delays in meeting customer demand. Sealevel needed a way to increase throughput while maintaining the reliability standards expected for industrial electronics.

THE APPROACH

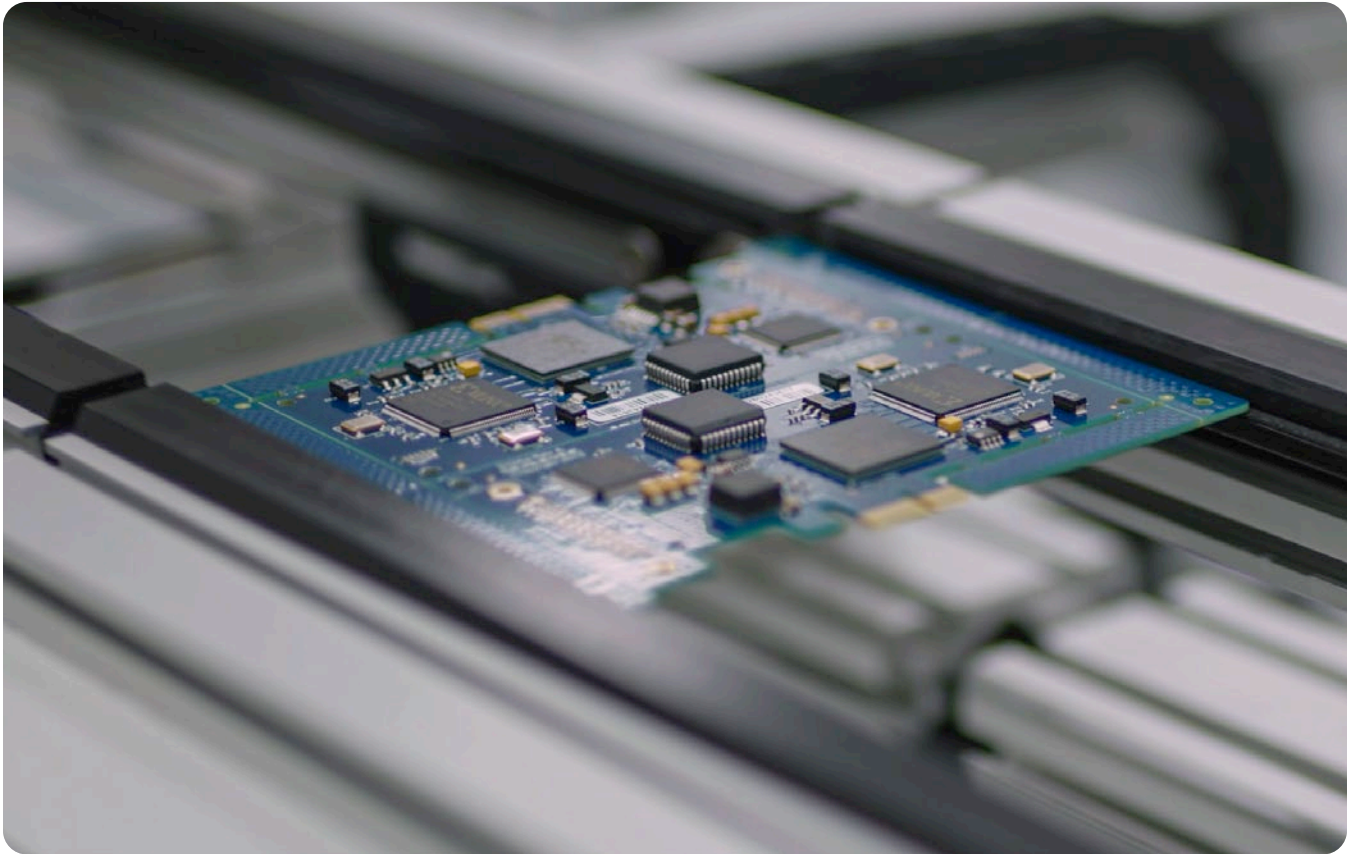
Sealevel worked with its SMT equipment partner to model improvements through simulation and process analysis. This identified ways to increase placement speed and improve inspection accuracy.

- First, the team expanded line placement capacity so it could handle higher component volumes while maintaining consistent cycle times.
- Next, Sealevel replaced traditional 2D Automated Optical Inspection with an AI-enabled 3D AOI. Engineers built 3D inspection models for more than 6,000 components, allowing the system to check solder joints, alignment, and placement accuracy in three dimensions, helping to distinguish true defects from normal variation and flag issues in real time.
- Quality was further enhanced by adding a high-precision stencil printer and an AI-enabled 3D solder paste inspection system at the front end of the line which catches issues such as insufficient paste, bridging, and misalignment before they move further down the process.

THE OUTCOME

Measurable improvements in both throughput and quality performance, including:

- SMT placement capacity increased to as much as 2.5 million components per month.
- Ability to process nearly twice the number of assemblies through the line
- Approximately 10% reduction in failures detected during end-of-line inspection
- Improved visibility into production performance through inspection data and process statistics



KEYS TO SUCCESS

- **Improving inspection earlier in the process.** Detecting issues before final assembly helped reduce rework and improve overall yield.
- **Combining throughput upgrades with smarter inspection.** Pairing faster placement equipment with AI-enabled inspection maintained quality while scaling production.
- **Using data to guide process improvement.** Inspection systems now provide detailed statistics that help the production team monitor trends and make targeted adjustments.

TAKEAWAY FOR MANUFACTURERS

AI adoption does not always require a large or complex digital transformation. In many cases, practical improvements come from upgrading key process steps with smarter inspection and better process data. For Sealevel, this approach resulted in a production process capable of supporting continued growth while maintaining the highest reliability standards.

About Sealevel Systems, Inc.: Sealevel Systems, Inc., headquartered in Liberty, South Carolina, designs and manufactures industrial I/O and embedded computing solutions used in manufacturing, transportation, defense, energy, and other demanding environments.

5.7

Predictive Maintenance with AI for Reduced Unplanned Downtime

A South Carolina manufacturer operating a high-value production line faced an operational challenge: several core processes, including exhaust and powder coat operations, sat directly in the path of production for large compressor systems with long cycle times. Because the line had little to no redundancy, even a short outage on a critical asset could stop production, delay shipments, and create ripple effects across delivery commitments.

THE CHALLENGE

The manufacturer had long relied on a traditional maintenance approach built around preventive schedules, repair after failure, and replacement based on time or usage intervals. While this approach addressed routine upkeep, it did not provide enough warning when a critical component began to degrade unexpectedly. Leadership wanted a more proactive way to identify risk earlier so maintenance could be planned before a breakdown disrupted the line.

THE APPROACH

To support that shift, the manufacturer worked with an industrial technology partner, IoTCo LLC., to implement an AI predictive maintenance solution. The effort began with a criticality assessment to identify which assets were most likely to stop production if they failed. Off-the-shelf vibration sensors were then installed on those assets, and relevant operating data was also pulled from the existing PLC environment. Using baseline operating data, the team trained a machine learning model to learn normal behavior for the monitored equipment. Once deployed, the system continuously monitored asset health and generated alerts when it detected patterns associated with emerging failure conditions.

THE OUTCOME

After implementation, IoTCo reported that the manufacturer saw significant improvements.

- >20% reduction in unplanned downtime
- More than a 10% improvement in component utilization



KEYS TO SUCCESS

A major factor in success was the decision to focus monitoring on true production bottlenecks rather than trying to instrument everything at once. The system also was designed to produce alerts in a way technicians could understand, making it easier for maintenance teams to act on the information.

TAKEAWAY FOR MANUFACTURERS

AI can support a practical, repeatable maintenance strategy when paired with the right operational data and a focused implementation approach. By instrumenting critical assets, establishing a baseline for normal behavior, and monitoring for early warning signals, manufacturers can move from reactive repairs to planned prevention. The result is fewer unplanned stoppages, better maintenance control, and more efficient parts management without needing redundant equipment to absorb failures.

5.8

Additional Use Cases

The following use cases serve as examples of how AI could help in other situations across the business, from operations on the line to business administration.

#1: Workforce Readiness & Capability Alignment

New hires are coming in, trainers are overloaded, and setup quality varies by shift. At the same time, after role changes and reorganizations, job descriptions and skills matrices no longer match what people are actually doing on the floor. Management introduces AI to support both needs: it turns approved SOPs into short, searchable instructions by role and station, while also helping HR and operations update role documents, standardize skill definitions, and identify skills gaps by department. During changeovers or daily work, employees can quickly find the right steps, and leaders get a clearer view of where training, role clarification, or cross-training is needed. The result is faster ramp-up, more consistent execution, and better alignment between workforce planning and day-to-day operations.

SYMPTOMS

Slow ramp-up, inconsistent setups, overloaded trainers, stale job descriptions, unclear skills gaps, extra HR workload.

HOW AI HELPS

Delivers role-based guidance at the point of work, improves role and skills documentation, and helps leaders target training where it is needed most.

#2: Sales Enablement and Revenue Development

A sales rep needs to quote a prospect in a new segment, but the right material is scattered across proposals, case studies, certifications, and emails. The company builds an approved knowledge library and adds an AI search assistant. Reps can ask for proof points, buyer concerns, and objection guidance, and get sourced answers from approved content. The result is faster prep, better targeting, and less time spent on poor-fit opportunities.

SYMPTOMS

Scattered information, generic outreach, weak targeting, slow prep, poor-fit pipeline growth.

HOW AI HELPS

Produces fast, sourced sales support from approved internal content.

#3: Marketing Enablement and Efficiency

Marketing is overloaded with requests, review cycles drag on, and messaging becomes inconsistent. The team pilots an AI content assistant with brand rules and approved FAQs. It helps draft first drafts, repurpose longer material into shorter assets, and pull proof points from internal content, while people still review everything. The result is faster content production, better consistency, and less time lost to repetitive rewriting.

SYMPTOMS

High content demand, slow creation, repeated review loops, inconsistent messaging, SME bottlenecks.

HOW AI HELPS

Speeds up drafting and repurposing using approved rules and content.

#4: RFQ Intake and Quote Acceleration Copilot

A long RFQ arrives, but sales must wait on engineering and operations to answer routine questions about specs, capacity, and configurations. The company pilots an RFQ copilot that reads the request, extracts key requirements, checks constraints and capacity signals, and drafts a structured response package with clarifying questions. Engineering still reviews critical items, but their time shifts from repetitive support to targeted confirmation. The result is faster quoting with fewer errors.

SYMPTOMS

Slow quote turnaround, heavy engineering dependency, manual RFQ review, missed opportunities.

HOW AI HELPS

Extracts requirements, checks constraints, and drafts quote materials faster.



5.9

Use Case Readiness

Before selecting a use case, teams should do a quick readiness check. There is no score associated with this - each represents a critical element of change management to ensure readiness for implementing AI.

1 People Readiness

Do the people impacted understand the objective and the reason for the change? Do they have the knowledge to support the change?

2 Process Readiness

Is the workflow or process stable enough to improve, or is it changing daily with no standard?

3 Data Readiness

Is the data defined, reliable, and accessible enough to support the use case? Is there governance (rules) regarding what can change, by whom and when?

4 System Readiness

Can the AI connect to the right systems safely, with clear permissions and guardrails?

5 Support Readiness

Do the teams who will be impacted (e.g., support desks) have the knowledge and capacity to support the change, especially during the early launch?

6 Ownership

Is there a named owner? Is there someone assigned to take ownership of the solution and for the impacted data (including governing rules)?

5.10

Wrap Up

Practical AI use cases are not about chasing hype or fast, isolated wins, they are about reducing repeat waste, consistently increasing quality, and expanding capabilities in a sustainable manner. AI can support maintenance, quality, troubleshooting, scheduling, training, people operations, commercial teams, and IT/OT collaboration. Generative AI can help with everyday functions as well, from working more effectively with spreadsheets and documents to surfacing insights from large sets of information. To find strong AI use case candidates, start by mapping workflows, checking readiness, and getting feedback from those impacted.

5.10.1 Keys to Success

Start with repeat pain and measurable waste, not a tool

The best use cases come from problems that happen often and have a clear cost, like downtime, scrap, rework, and waiting.

Pick use cases that fit the workflow and have clear ownership

A use case fails when it lives outside real work. If nobody owns inputs, outputs, and review routines, the use case becomes an abandoned dashboard.

Choose low-risk pilots that build trust before scaling

Early wins should support decisions, be easy to validate, and be safe to test. When teams can check results and see value quickly, trust grows. Trust is what turns a pilot into adoption.

5.10.2 Try This

Use AI to describe a potential use case in your organization.

STEP 1

Choose any GenAI tool (e.g., ChatGPT, Claude, Gemini, Copilot)

STEP 2

Use the following prompt to start the experiment.

Draft a clear, practical AI use case for my organization using the details I provide. Keep it plain and specific, no buzzwords. Include: the problem (what's happening, where, how often, who it impacts), supporting evidence, identified forms of process waste, systems or processes involved, stakeholders and key users, and any risks or constraints. To create the use case, ask me about the type of company or organization that I work for, its approximate size, and my role within the organization; ask about a specific challenge that I have observed as well as any questions that help clarify context and understanding prior to creating the use case.



Module 6

Choosing The Right Solution

This module explores the various technical solutions and integration options available for manufacturing leaders who are looking to integrate AI into their business.

6.1 Technical Bases

6.2 Technical Approach

6.3 Evaluating AI's ROI & Feasibility

6.4 Wrap Up



6.1

Technical Basics

Before jumping into the various options that exist, it's good to take a step back and outline the different types of technical solutions that exist.

PACKAGED

Traditional software that's purchased and installed into a company's technical environment (whether local or in the cloud).

SAAS (SOFTWARE-AS-A-SERVICE)

As the name suggests, it is software provided as a service, usually paid for in the form of a subscription. There is no installation, it is accessed from the web.

CUSTOM

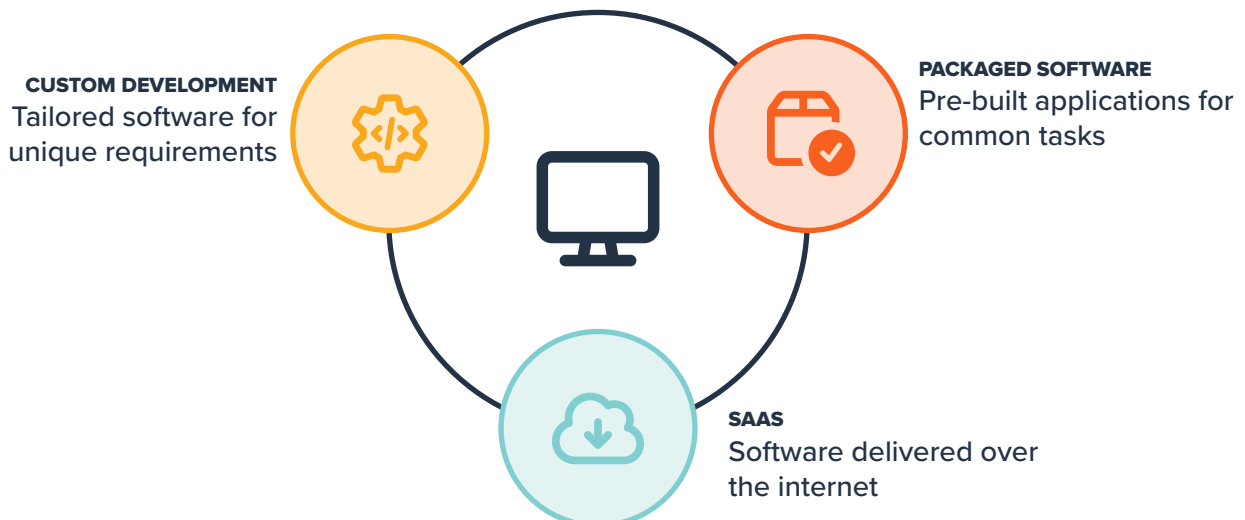
This covers software developed (either in-house or by a provider) and installed into a company's technical environment (whether local or in the cloud)

While there are other variations, these are the most common. There are also many approaches to introducing new technologies, from buying and replacing, migrating to new systems, introducing "middleware" to connect disconnected systems, or bolting on new features to existing systems.



TIP: What's important is that every decision is made intentionally - if it's not clear why a decision is being made and what the value is, it's a good idea to take a step back and ask why.

Software Solutions for Organizations



6.2

Technical Approach

There have already been many approaches to introducing new technical solutions. With AI, those options multiplied.

As leaders explore AI, there are many misconceptions about the benefits of certain solutions and technical approaches. Understanding the real differences helps leaders make better decisions about what to allow inside the organization, what to buy, what to build and how these decisions impact their business.

6.2.1 The Tension Between Wanting To Fix Everything, and Knowing Incremental Change Is Probably the Best Route

As new tech solutions promise more and more, it can be tempting for organizations to consider jumping in headfirst, but without a clear strategy, the risk of failure is high. Even with experimentation, if the intent is not clear, the value of the initiative could be lost. The question remains: “where do we begin?”. For leaders, the increasing pressure to adopt AI, coupled with existing business challenges, could easily lead to a “boil the ocean” approach, or in this case, “integrate AI into everything”; however, the cost, time, and effort needed to achieve this could be immense - what’s worse, it could be wasted due to artificial targets to simply implement. And yet, if an organization starts with small, random pilots, without a clear strategy, the value of AI could be missed.

Introducing major changes, especially with technology, is shown to be the best approach, not just for adoption, but for operational stability; however, to be successful, organizations must approach AI adoption as a long-term business strategy, making decisions with clear intention.



TIP: Ensure that your AI goals are not just aligned with, but actually support your business goals. If they do not, it’s likely that the AI goals are not the right ones.

6.2.2 Consolidation vs. Best-of-Breed

One consideration is the decision on whether an all-encompassing solution is needed, or if an à la carte approach is best.

Depending on the size of the organization, it can be enticing to adopt the “Swiss Army Knife” approach, wanting to integrate all systems and data sources into a single unified platform, but the cost, effort, and time to implement this is likely to be high. On the flip side, selecting AI tools for each unique need, taking the “best-of-breed” approach, provides end users with AI tools to do specific tasks extremely well, but can become a major operational challenge due to licensing costs, disconnected data, and the demand on operational support.

While there are benefits to each, when considering Total Cost of Ownership (TCO), organizations should consider the hidden risks of both:

CONSOLIDATED APPROACH (SINGLE SYSTEM)

- **The “Build-to-Move” Paradox:** You spend significant time and budget building a fully integrated ecosystem, but by the time it is ready, you need to move to something different.
- **The “Integration Tax”:** You spend significant time and budget on connecting systems to each other long before any ROI is able to be realized.

BEST-OF-BREED (MULTI-SAAS)

- **The “Translation Tax”:** You spend 20–30% of your IT time just moving data from “SaaS A” to “SaaS B” because they don’t share a common language.
- **The “Zombie Data” Problem:** You have 10 “Expert” systems that all have slightly different versions of the truth (e.g., “Customer A” has 3 different addresses).

6.2.3 Buy vs. Build

Another consideration is the decision to buy a solution or to build it internally; however, in reality there are a few other solutions that are available: reuse, integrate, shift & expand.

Reuse	Many software providers are already integrating AI into their solutions. Part of the AI strategy of a business may simply be to learn how to effectively use those integrated AIs - it could also simply be the AI strategy.
Integrate	Integrated AI can add value, but it may not deliver the specific insights a business needs, so connecting data into a centralized system may be required. If key data lives across multiple systems, integration is often the best path. Many organizations use professional services to build middleware that connects disconnected tools and embeds AI into the existing software environment.
Buy	Many AI platforms already solve complex, specialized problems, so purchasing or subscribing to a SaaS product can beat building custom. A simple test: do other businesses likely have this same need? If yes, there’s probably a proven, more cost-effective option than developing it in-house.
Build	If an off-the-shelf solution does not meet a company’s exact needs, custom software development is a good option. This can be done using professional services that specialize in custom AI & software solutions, by an internal team, or a combination of both.
Shift & Expand	Sometimes the right answer is a combination of solutions. If current infrastructure can’t support modern AI, moving some data and operations to a cloud platform may be necessary, with secure connections back to on-prem systems as a bridge. This enables new AI features while keeping costs lower and data both secure and highly available.

6.2.3.1 SaaS vs. Custom Build

It can be easy to have multiple SaaS licenses, yearly agreements, and pay-per-seat models that quickly add up. It can therefore be enticing to skip the SaaS price tag and opt to integrate your systems on your own, or build custom solutions that avoid monthly fees. Pros and cons exist in both scenarios. SaaS solutions are often “black box” where your data and how the algorithms work are locked away.

While SaaS solutions offer quick setups with pre-configured workflows, they still require some setup time. The SaaS provider handles bug fixes and operational loads, but someone on your team still needs to manage the system in your business and make changes to keep it running as your organization evolves over time.

Building custom solutions typically takes much longer. In addition the customer organization now owns this solution and must manage all bugs, changes and updates; however, because the code is owned by the organization it can be more cost-effective especially when scaling (i.e., avoid the SaaS tax with higher per-seat, per-run, or per-query fees).



SAAS

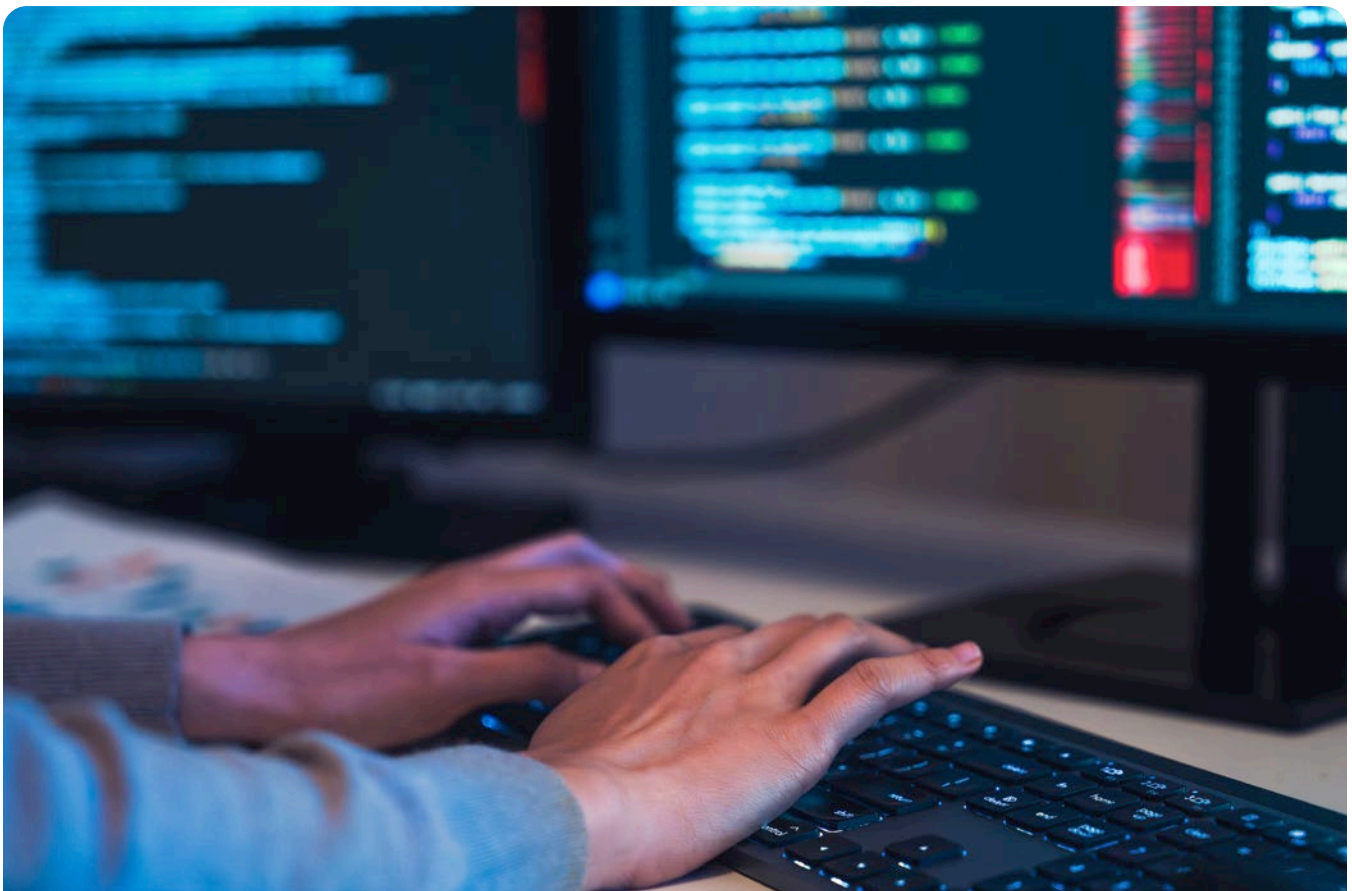
Offers flexibility and scalability

VS



CUSTOM BUILD

Provides control and personalization



6.2.4 Derisk Your Investment

While there are risks, leaders can deliver solutions to their customers with confidence by following simple yet pragmatic best practices.

1 Define the problem

Don't automate a bad process, and confirm stakeholders agree it's worth solving.

2 Map the process and dependencies

Identify adjacent and downstream systems, and confirm outputs will be usable inputs for what depends on them.

3 Inventory the current state

Document today's tools and workflows, plus the real costs (licenses, labor, time, rework).

4 Validate environment readiness

Re-check data access, integration points, security constraints, and system capacity before buying or building.

5 Study how people work today

Understand how teams use existing tools, what's working, what isn't, and what "familiar" adoption will require.

6 Assign clear ownership

Name a Product Owner to define success criteria and ensure governance and compliance are handled end-to-end.

7 Weigh risk vs. return

Outline a "Heaven and Hell" view: what success looks like, what failure looks like, and what it would cost.

8 Set baselines and monitoring

Agree on metrics before implementation, then measure against baselines over time to ensure the AI stays in control.

9 Pilot and test in isolation

Run small trials, gather feedback, and validate performance before wider rollout.

10 Plan adoption and rollout

Define training, communications, support, and a phased launch plan to reduce friction and sustain usage.

6.2.5 AI-Generated Software

Can we use AI to build AI tools for our organization? Because AI can work with human language and generate text and code, using it in software development makes sense. Software is a set of instructions written by humans for computers, and AI can help create or refine those instructions.

AI-generated software typically shows up in two forms: **AI-Assisted (partially generated)** or **Vibe-Coded (fully generated)**.

AI-ASSISTED (PARTIALLY GENERATED SOFTWARE)



In AI-Assisted Software Development, trained software developers use AI to generate boilerplate code or other repetitive code that would be time-consuming to write by hand. AI can also reduce simple mistakes (like typos or copy/paste errors), but it can still introduce new bugs. That's why code still needs human review, testing, and security checks. This approach keeps strategy and decision-making with the human, which is often called human-in-the-loop.

This idea is not completely new. Developers have used templates and automation tools for years. The difference now is that AI makes it easier to describe what you need in plain language and can speed up troubleshooting and documentation.

VIBE-CODED (FULLY GENERATED SOFTWARE)



Vibe coding is when people use AI to generate most or all of an application based on prompts. The idea is that AI handles much of the technical writing while the person focuses on the goals or “vibe” of the product. Vibe coding empowers non-technical people to create software faster and at lower cost. However, the biggest risks show up when there is little or no experienced software engineering involved.

Key risks without experienced engineers include:

- **Scalability:** the system may not handle real-world load or growth
- **Sustainability:** the code can be hard to maintain or update
- **Security:** hidden vulnerabilities can expose data or systems

Experienced software engineers and architects understand best practices and when to apply them based on both short-term needs and long-term business goals.

Analogy

Would you allow a chatbot to design and build your next car end-to-end – choosing materials, suppliers, safety features, and test plans – based only on prompts? Even if the prompts sound good, the risk is that critical details get missed without experts reviewing the work.

That same idea applies to vibe coding: it can be useful, but it needs the right boundaries.

Practical vs. Risky Use Cases

GOOD AND PRACTICAL USE CASES:

- Proof of concepts and rough prototypes
- Simple websites
- Personal or small internal tools

RISKY USE CASES:

- Production-ready applications without expert review
- Systems that handle payments, medical data, safety systems, or other critical information
- Anything that could impact human safety or major business operations

That's not to say experienced software engineers can't use AI to generate production-quality code. They often can because they know what to ask for, what to verify, and what to change. But even with strong AI tools and skilled engineers, production systems still require careful review, testing, and security work.



6.3

Evaluating AI's ROI & Feasibility

Every change needs justification.

The decision to implement AI is not merely a technology upgrade; it is a capital investment in Operational Certainty. For operationally focused organizations, the business case is often dictated by the “Cost of Inaction” versus the “Total Cost of Ownership” (TCO). Will the cost of not implementing AI be greater than the TCO? The first step in determining this is looking at feasibility.

6.3.1 Feasibility

Before calculating dollars, a proposal must pass a “Technical Reality” assessment. AI projects often fail not due to bad software, but due to poor environmental signals and a lack of understanding.

IS THE ISSUE “OBSERVABLE”?

Does the defect have a physical signature (gap, color shift, heat spike) that a sensor can detect? If a human cannot explain why something is a defect, the AI cannot learn it.

IS THE OPPORTUNITY “OBSERVABLE”?

Can the opportunity (including waste reduction) be measured and is it repeatable? If an opportunity cannot be measured then it's unlikely that AI will be able to deliver value.

IS THE SIGNAL “CLEAN”?

Is your data siloed in paper logs or legacy SQL? Zero-Copy Architecture is the goal—AI should work with data where it lives (Cloud/Edge) without costly replication.

DOES THE SOLUTION SIZE MATCH THE GOAL?

Many solutions promise big wins with big capabilities, but not every large scale solution is needed - sometimes it's the small change that provides the greatest impact. Be sure to evaluate vendor products and do an analysis of the solutions.

TCO is the full, end-to-end cost to deliver and sustain the AI solution, not just the software price. It includes data preparation, integration or middleware, infrastructure or cloud spend, security and compliance work, vendor fees, training, change management, and ongoing monitoring and support. A simple way to frame it is: what will it cost to get the solution live, and what will it cost to keep it accurate, secure, and useful over time?

When feasibility is high and TCO is well understood, ROI becomes much clearer. Feasibility tells the organization whether the solution can work in the real world, and TCO defines what it will truly take to own it. Together, they allow leaders to compare the “Cost of Inaction” against the real cost to implement and operate AI, and then prioritize the use cases where operational gains and risk reduction outweigh the investment.

6.4

Wrap Up

Choosing the right AI solution is less about chasing the newest tool and more about making intentional decisions that fit the business, the process, and the people who do the work. Leaders can reduce risk by understanding the basic solution types, avoiding “boil the ocean” efforts, and weighing consolidation, best-of-breed, and buy-versus-build choices through the lens of feasibility and Total Cost of Ownership. When the problem is observable, the data signals are usable, and ownership is clear, AI becomes a practical investment that improves operational certainty instead of adding complexity.

6.4.1 Keys to Success

Start with the real problem and a clear baseline

Results can be measured against the Cost of Inaction and the true Cost of Quality.

Choose the simplest solution that fits the goal

Plan for the integration, data, security, and support work that drives Total Cost of Ownership.

Assign ownership and design for adoption

Involve the people doing the work, piloting safely, and setting up monitoring to keep the solution accurate and trusted over time.

6.4.2 Try This

Use AI to learn how it can help write better problem statements.



STEP 1

Choose any GenAI tool (e.g., ChatGPT, Claude, Gemini, Copilot)



STEP 2

Use the following learning prompt - use this any time you are evaluating any technical solution.

I'm evaluating an AI vendor for [use case]. Generate 10-15 questions I should ask that reveal: data requirements, integration effort, model transparency, security posture, monitoring, failure modes, human-in-the-loop options, pricing/TCO, and what happens if we leave the platform. Then provide a simple evaluation template I can use during demos.

A generic software example is provided below.

I'm evaluating a software vendor for [use case]. Generate 10-15 questions I should ask that reveal: data requirements, integration effort, operational requirements, security posture, monitoring, support modes, smaller scale options, pricing/TCO, and what happens if we leave the platform. Then provide a simple evaluation template I can use during demos.

AI can help with the execution of the processes, documentation, applying controls, collecting data and such. However, involving your own people in the design of what those processes will look like increases the buy-in from practitioners, ownership and the satisfaction that comes from knowing one's own contribution to the success of the organization.

DILEK ORAL-OZDEMIRCI

Principal Consultant, Dora Process Consulting

Module 7

Implementation Roadmap

This module explains how to design, test, deliver and expand an AI solution that stays simple, stays useful, and stays safe. It focuses on human-centered design, real-world testing, and the steps needed to move from an idea to a pilot, then from a pilot to a stable production rollout. It also explains how to measure success, train the workforce, and build trust so AI adoption does not stall.

7.1 Designing the AI Solution

7.2 Verification, Validation & Piloting

7.3 Scaling From Pilot to Production

7.4 Measuring ROI and Success

7.5 Workforce Enablement

7.6 Overcoming Fear and Building Trust in AI

7.7 Wrap Up



7.1

Designing the AI Solution

Keep it simple on purpose.

A common failure pattern is building an AI solution that is too complex for the problem. Complexity adds cost, slows delivery, and makes support harder. A simpler design is easier to test, easier to train, and easier to improve. Practical best practices for simple design:

Start with one clear job

The AI should do one thing well before it does five things poorly.

Keep humans in the loop for risk

If a decision can affect safety, quality release, compliance, or customer commitments, a person should review it.

Use familiar tools when possible

If workers already live in an MES, CMMS, ERP, email, or Teams, the AI should meet them there.

Design for support, not just launch

Someone must own updates, monitoring, and feedback.

Consider edge cases as standard use cases

Especially with Generative AI, there are multiple ways someone may approach using it. Consider whether something really is an edge case or just a different way someone may use the solution.

Human-Centered Design Is Not Optional

AI that “works” in a demo can still fail on the floor. The gap shows up when people are busy, stressed, and trying to keep production moving. If the design assumes ideal conditions, it is designing for a world that does not exist.

What human-centered design looks like:

- The AI uses plain language and avoids technical terms unless needed.
- The AI explains what it used and what it is unsure about.
- The AI supports the workflow people already follow.
- The AI output is easy to scan, not a long essay.

Accessibility and Usability Must Be Built in Early

Accessibility and usability are not “extra features.” They are how a team knows if the solution truly works for real people.

- Clear buttons and clear labels
- Easy reading, including on smaller screens
- Audio or visual options when needed
- Color choices that still work for color-vision deficiencies
- Steps that can be followed while wearing PPE



**VISUAL INSPECTIONS AND
PROCESS MONITORING**



**MACHINERY OPERATION
AND MATERIAL HANDLING**



**TIME MANAGEMENT AND
TASK SCHEDULING**



**PERSONAL SAFETY IN
HAZARDOUS ENVIRONMENTS**



**COMMUNICATION AND
ISSUE REPORTING**



**VERIFICATION OF STEPS
AND STANDARDS**



Good design works when things go wrong, not just when they go right. Test your systems when people are tired, distracted, or stressed—that's when you learn whether you've actually designed for humans or just for ideal conditions that rarely exist.

ALLISON MATTHEWS
Design Lead, Mayo Clinic

7.2

Verification, Validation & Piloting

There's more to ensuring a solution is production-ready than traditional testing.

Running a strong pilot to validate the solution against the use case and knowing what to do after is critical with any technical software solution. With AI, this need only increases.



VERIFICATION
“Did the team build it right?”

VALIDATION
“Did the team build the right thing?”

7.2.1 GenAI and the Need for Dynamic & Continual Validation

With Generative AI, validation needs more attention because the tool can answer in different ways each time, even when the question is almost the same. It does not always give one fixed, predictable result like a normal computer program. That means it must be checked often, not just once, to make sure it stays accurate and safe as people use it in new ways. Validation also needs more context, like the right background details, examples, and rules, because the AI uses that context to decide what to say. Without clear context and ongoing checks, the AI may give answers that sound confident but are not correct or consistent.

7.2.2 Recipe for Success: Designing a Good Pilot

A pilot should be small, controlled, and measurable. It should prove value and reveal risks without putting operations in danger.

A checklist for pilot success:

1. **Clear problem statement:** Define one specific problem tied to real work pain and a real workflow.
2. **Clear sponsor and owner:** Name an executive sponsor and a day-to-day pilot owner who can remove blockers fast.
3. **Clear participant support:** Confirm supervisors, key users, and frontline participants agree to take part and have time to do it.
4. **Clear pilot purpose and scope:** State what the pilot is meant to prove, what is in scope, and what is out of scope.
5. **Clear acceptance criteria:** Define what “good enough” looks like for a pilot, including safety and quality limits.
6. **Clear baseline and success measures:** Capture the starting numbers and define how success will be measured during the pilot.
7. **Clear and repeatable test plan:** Use step-by-step tests that anyone trained can run the same way, including edge cases.
8. **Clear feedback and issue process:** Decide how feedback is collected, how issues are logged, and who reviews them each week.
9. **Clear time for fixes:** Include time and resources for corrections, re-testing, and small improvements during the pilot.
10. **Clear communications plan:** Share what is changing, when it starts, how to get help, and how progress will be reported.

7.2.3 Penetration & Security Testing

AI systems can access data, summarize it, and sometimes trigger actions. That means security must be part of the design from the start.

SECURITY BY DESIGN PRACTICES

- Decide who can access the AI and what data it can see.
- Protect the data in storage and in transit.
- Log key events so misuse can be investigated.
- Test the rules of the AI to confirm they cannot be bypassed.

PENETRATION TESTING

- A penetration test should be done by an external third-party.
- The goal is to test if unauthorized users can break into the system.
- The results should lead to fixes before wider rollout.

7.2.4 Recipe for Success: Before the Pilot

Before running a pilot, the solution should be verified through structured testing. This reduces surprises and protects credibility.

INTERNAL TESTING (ALPHA)

The team tests the solution in-house to confirm core behavior.

CONTROLLED EXTERNAL TESTING (BETA)

A small set of real users test it in a limited setting.



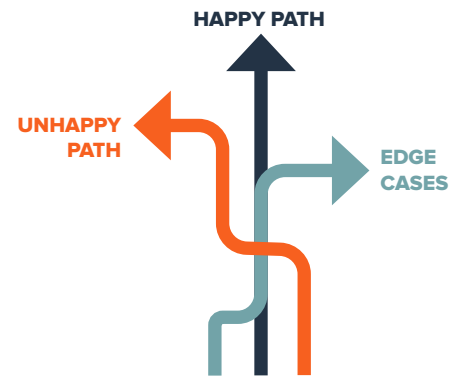
TIP: Test plans should be clear enough that anyone trained can run them.

Testing best practices:

- Tests build on each other, but each test checks one clear thing
- Each test has expected results and a way to record outcomes
- When possible, tests are automated to speed up re-testing after changes
- Test all three paths: happy path, unhappy path, and edge cases

7.2.5 Testing the Happy Path, Unhappy Path, and Edge Cases

- **Happy path:** The normal, expected workflow.
- **Unhappy path:** What happens when data is missing or steps go wrong.
- **Edge cases:** Rare but important situations, like odd defects, weird timing, or unusual shift conditions.



7.2.6 Why AI Testing Is Different

Traditional software often fails loudly. It crashes or throws an error. AI can fail quietly. It can give a confident answer that is wrong. Because AI learns patterns, it must be tested across many scenarios:

- Different phrasing and wording from different users
- Different data conditions, including messy and incomplete data
- Repeated runs to check consistency and outliers

Synthetic Data Can Help, but It Is Not Enough

Synthetic data is computer-generated data built to reflect real data patterns, such as trends, ranges, and relationships. Mock data is simpler and usually consists of made-up sample values used to test software, not realistic behavior. Synthetic data is useful for early proof-of-concept testing because it helps teams move quickly without exposing sensitive information. For anything meant to work in the real world, testing should also include actual data, since real data is messy and full of unusual or edge cases that synthetic and mock data often miss.

A Simple AI Test Coverage Guide

TEST CATEGORY	PURPOSE	EXAMPLE
Functional	Confirms the AI does the core job	Summarizes a shift note correctly
Guardrails	Confirms the AI refuses unsafe requests	Refuses sensitive HR questions
Data variation	Confirms it works with real-world messiness	Handles missing fields and odd formats
Consistency	Confirms repeat answers are stable enough	Same question, similar result
Usability	Confirms people can use it under pressure	Works during a busy changeover
Security	Confirms it cannot be accessed or exploited	Pen test and access review

7.2.7 Recipe for Success: After the Pilot

A pilot should end with decisions, not confusion. The goal is to learn, improve, and decide what comes next.

After-pilot actions:

- Confirm the solution stays in control and behaves as expected.
- Pressure test if possible, meaning test heavy usage loads, even if that is done after the pilot.
- Host a retrospective with users and sponsors:
 - What went well
 - What was confusing
 - What slowed people down
 - What needs to change in the solution and in the pilot approach

7.3

Scaling From Pilot to Production

Scaling is where many teams lose trust. The best approach is controlled and incremental.

Scaling rules:

- Introduce changes in small steps
- Keep strong documentation of critical changes
- Do not stack many AI changes at once. It makes validation harder.

Systems Design Document

It is recommended to maintain a Systems Design Document (SDD) that stays current and includes:

- High-level architecture and system connections
- Business use cases supported
- Key security and access decisions
- Known risks and current mitigations
- A log of major releases and what changed

Continuous Improvement

Just as continual improvement supports lean operational processes, it helps maintain well-running AI operations and supports scaling into other business areas.



7.4

Measuring ROI and Success

Measuring success for AI is similar to measuring success for any improvement initiative.

The main question is whether the solution achieved business goals safely, without harmful side effects.

Define outcomes before building:

Outcomes should be S.M.A.R.T. (Specific, Measurable, Achievable, Relevant, and Time-bound) and tied to metrics like uptime, yield, scrap, energy, or throughput. It is best to include both qualitative and quantitative measures.

QUALITATIVE EXAMPLES

- Users agree the solution helps them work faster or with fewer errors
- Users feel more confident and less stressed in the workflow
- Adoption grows over time
- Use of the old workaround tools drops

QUANTITATIVE EXAMPLES

- Uptime improves
- Scrap decreases
- Throughput improves
- Energy per unit improves
- AI costs match expectations

7.4.1 Evaluating Total Cost of Ownership

Beyond the capital costs to install an AI solution (for example, visual inspection cameras), mid-sized firms must account for the “integration tax”—the real-world effort of connecting systems, tuning performance, and maintaining reliability.

- **CapEx (one-time):** Proprietary hardware, high-resolution cameras, and industrial lighting.
- **OpEx (recurring):** Software licenses, cloud processing, and ongoing MLOps support.
- **Human capital (often hidden):** Data labeling and initial model “teaching” time.

7.4.2 ROI Scenarios

AI systems are not perfect. ROI should be framed as a range, including best-case and worst-case outcomes.

Disclaimer: The following scenarios serve as examples of calculating ROI; however, every organization is unique, which may require the inclusion of other factors for accurate ROI analysis. When calculating financial figures, be sure to have the information and methods verified by an approved party within your organization.

SCENARIO A: "BEST CASE" OUTCOME

The AI catches 99% of defects early, and the human responder stops the line quickly—preventing most scrap.

ASSUMED SCRAP AVOIDANCE:

90%

of the annual scrap baseline

AVOIDED SCRAP:

$90\% \times \$72,000 = \$64,800$

**ASSUMED LABOR CAPACITY
GAIN (FTE REALLOCATION):**

\$50,000

TOTAL ANNUAL BENEFIT:

$\$64,800 + \$50,000 = \$114,800$ saved

Note: The \$50,000 is not "free money" in most plants—it's typically a capacity gain (time and attention redirected to higher-value work) that should be reflected as increased throughput, reduced overtime, fewer delays, or faster containment.

SCENARIO B: "WORST CASE" OUTCOME

The AI introduces friction—most commonly through false positives (flagging good parts as "bad") due to shadows, dust, glare, or process variability. This can erode operator trust and cause unnecessary line stops and manual verification.

PENALTY ASSUMPTION:

\$20,000/year

in nuisance stops and
extra verification

NET ANNUAL BENEFIT:

$\$114,800 - \$20,000 = \$94,800$ saved

Note: If you want this penalty to be fully auditable, tie it to your production volume and downtime economics (e.g., parts/year $\times$ false-positive rate $\times$ average minutes per stop $\times$ \$/minute of downtime and labor).

Expected ROI Range (Summary)

In this example, the expected savings range is **\$94,800 to \$114,800 per year**, depending on false-positive friction and operational adoption. Of that total, **\$50,000 reflects reallocated labor capacity**, which should be captured as measurable operational gains (throughput, reduced overtime, faster response, improved quality flow), not assumed as automatic cash savings.

7.5

Workforce Enablement

AI adoption fails when training is treated like a one-time IT event.

People need both tool training and AI literacy, meaning they need to understand how AI behaves and how to work with it.

PRACTICAL TRAINING ADVICE FOR TECHNICIANS AND OPERATORS:

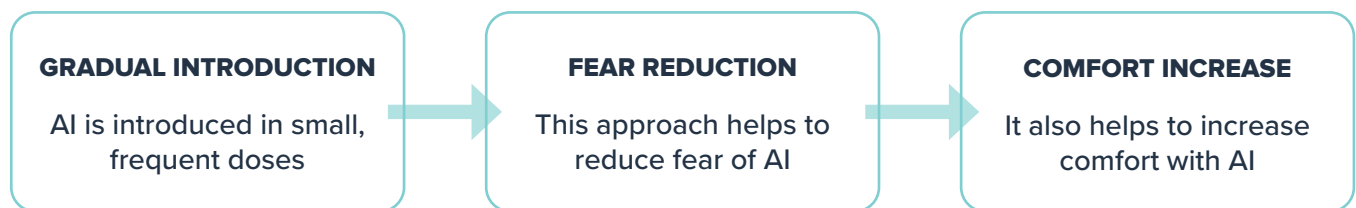
- Pick a few interested people early and make them champions
- Have champions share real examples of how AI helped them
- Make adoption easy by reducing steps and friction
- If the first version is limited, explain why and what comes next

USE MULTIPLE TRAINING FORMATS:

- Short live training sessions for kickoff
- Recorded videos for repeat learning
- Simple job aids and quick reference cards
- An AI helper inside approved tools to answer “how do I” questions

7.5.1 AI Warming

AI Warming, a learning process developed by Blue Forge Digital, is a gradual approach that introduces AI in small, frequent doses, coupled with reward and recognition so fear drops and comfort rises.



Example Approach:

- Daily or weekly “try this prompt” messages
- 20-second short-form videos showing one useful action
- Simple challenges that take 2 minutes or less
- Celebrating small wins to build confidence

Incentives and time matter:

- Gamify learning when it fits the culture
- Reward participation and helpful feedback
- Give people time to experiment and make mistakes

 **TIP:** Notebook-style tools can also help teams learn by turning internal content into guided Q&A and audio-style explanations, when allowed by policy and security.



7.6

Overcoming Fear and Building Trust in AI

The fear is usually not just about the technology.

It is fear of how the technology will be used. AI adoption is a culture change, not just a technical change.

Trust is built before rollout, not after. The best way to build trust is to start practicing early, before the first official AI solution launches.

If internal access is not ready, leaders can still provide learning resources for external tools, as long as employees are warned not to paste sensitive company information.

Be transparent about intent. People do not trust silence. They trust clarity.

- If AI is meant to reduce costs, leaders should explain how.
- If AI will reduce hiring needs in some areas, leaders should say so.
- If role changes are likely, share a plan for reskilling and reallocating work.

Teach how AI behaves. Trust drops fast when AI is treated like an expert, but it acts like a guesser. People should be trained on simple truths:

- AI matches patterns. It does not “understand” like a person.
- AI can sound confident even when it is wrong.
- AI needs good data, clear context, and clear rules to be reliable.

Encourage curiosity and continual learning. Unlike other tech solutions where major improvements can be identified by key milestones over long periods of time, AI is a continually evolving technology. For organizations and their people, this presents a major challenge: keeping up. The best way to do so is to encourage curiosity, experimentation, and sharing.

- Create open forums for AI conversation, for people at various experience levels
- Provide safe sandboxes for AI experimentation
- Establish AI clinics where people can come and get help
- Reward people for learning, give them time, and make learning enjoyable

7.7

Wrap Up

Designing an AI solution is not only a technology task. It is a people, process, and safety task. A strong design stays simple, fits real work, and is tested with real users in real conditions. Verification and validation help confirm the solution works as expected, while piloting helps prove adoption and value before a full rollout. When teams scale carefully, measure results clearly, and train the workforce with patience and consistency, AI becomes a practical tool that supports daily operations instead of adding stress.

7.7.1 Keys to Success

Design for real work, not ideal work

The solution should be built around how people actually work under time pressure, distractions, and changing conditions. Usability and accessibility should be included from the start.

Control the rollout with strong testing and clear pilots

The solution should be verified before the pilot, tested across happy paths and edge cases, and protected with security-by-design and penetration testing. The pilot should have clear acceptance criteria and a repeatable test plan.

Build trust through training, transparency, and follow-through

Leaders should explain why AI is being introduced, how it will be used, and what changes to expect. Teams should get time to practice, learn in small steps, and share wins so adoption grows steadily.

7.7.2 Try This

Use AI to develop a test plan for AI.



STEP 1

Choose any GenAI tool (e.g., ChatGPT, Claude, Gemini, Copilot)



STEP 2

Use the following prompt.

Act as an AI pilot coach for a manufacturing team and help create a simple, repeatable test plan for an AI solution; first ask 6 quick questions about the problem, who will use it, where it fits in the workflow, what data it uses, the biggest risks, and how success will be measured, then produce a one-paragraph pilot purpose and scope, 10 test cases written as plain step-by-step instructions grouped into happy path, unhappy path, and edge cases, a short weekly validation checklist that covers accuracy, consistency, usability, and safety, and a simple operator feedback form with 5 questions that can be answered in under 2 minutes; use short sentences and plain words, include a space to record results, and do not include any sensitive data.



Module 8

Sustaining AI in Your Organization

This module describes how an organization can keep AI useful over time, not just launch it once. It covers continuous improvement, safe data practices, strong governance, and what to watch for as AI changes over the next five years.

8.1 Sustainability Within Growth

8.2 Data Governance and Cybersecurity

8.3 The Future Outlook

8.4 Wrap Up



8.1

Sustainability Within Growth

Gaining AI adoption is about getting a pilot into people's hands and making it useful enough that teams choose to use it.

Scaling is different. Scaling means expanding AI across lines, shifts, sites, and use cases without breaking trust, performance, or workflows, and it requires revisiting the operational needs of AI e.g., security controls, data quality routines, ownership, change management, and ongoing testing. Companies that scale AI by reducing headcount are usually missing the bigger opportunity. A reduction in force can sometimes create a short-term financial bump, but it fades because it doesn't fix the real business problem which led to a need for cost reduction in the first place.

The real power of AI is using it to amplify the potential of the business, by enabling its people and processes to gain efficiency and turn those gains into sustainable modes of profit and revenue. This is done in two simple stages.

STEP 1

Reinvest those gains into the workforce and elevate experienced staff into higher-impact strategic roles.

STEP 2

Make room to hire and develop junior talent at scale, pair them with new AI tools and the newly elevated experts who set & refine standards and guide execution.

The risk of "losing people" is not just a loss of capacity. It is also a loss of institutional knowledge built over years, along with the hidden costs of attrition: more mistakes, lower morale, reputational damage, and expensive course correction.

8.1.1 Continuous Improvement with AI

AI can support Lean work by helping teams find patterns faster, document improvements more clearly, and reduce the time spent on repeat tasks. AI does not replace Lean thinking. It helps teams do Lean work with more speed and consistency.

- AI can help teams spot problems sooner by reading data, notes, and reports.
- AI can help write drafts like checklists, SOPs, and training steps.
- AI can help teams compare "before" and "after" results and summarize what changed.

A continuous improvement system stays strong when teams can learn quickly, test changes safely, and standardize what works. AI can shorten the "cycle time" of improvement by reducing admin work and by making analysis easier to repeat. This matters when the same type of problem shows up across multiple lines, shifts, or plants.

Practical ways that AI supports process improvement and lean operations:

Faster problem understanding: Summarize shift notes, downtime comments, maintenance logs, and quality notes into clear themes.

Better root cause support: Generate a draft fishbone (Ishikawa) list, a 5-Whys sequence, or a fault tree, based on the evidence provided.

Clearer standard work: Turn messy notes into a step-by-step draft SOP with safety notes, tools needed, and “what good looks like.”

Improvement documentation: Draft A3s, Kaizen summaries, and control plans using a consistent format.

Control and sustainment: Suggest what to monitor in the Control phase, and help create simple check sheets and audit questions.

8.1.2 Where AI Fits Inside DMAIC

Many manufacturing organizations have implemented some form of process improvement, whether that is Lean Six Sigma, TQM or another framework. DMAIC is a data-driven, five-step approach to problem-solving commonly found within Lean Six Sigma. When paired with AI initiatives, DMAIC helps by taking what would be a one-time, limited value project and elevating it into a managed improvement cycle.

The DMAIC approach: Define the ongoing performance and risk targets, Measure accuracy/adoption/drift, Analyze failures and root causes (data, workflow, model, or user behavior), Improve (design & implement the solution) with controlled updates, and Control with monitoring, governance, and standard work so gains don’t fade.

STEP	WHAT TEAMS DO	HOW AI CAN HELP
Define	Clarify problem, scope, goal	Draft problem statements, refine scope, suggest CTQs
Measure	Collect baseline data	Suggest data fields to track, clean notes, flag missing data, prepare data for collection or create data pipelines
Analyze	Find causes and patterns	Summarize patterns, test simple “what changed” stories, draft 5-Whys
Improve	Test changes	Draft experiment plan, training steps, comms, and change checklist, analyze pre-post data
Control	Sustain results	Draft control plan, audit checklist, escalation rules, and handoff docs

 **TIP:** For a more predictable initiative that’s flexible and reduces the risk of costly rework at the end, integrate Agile and Iterative approaches into the AI solution lifecycle - typically found within the Improve stage of DMAIC, but also extend into the control phase and beyond.

8.2

Data Governance and Cybersecurity

AI stays safe and reliable when data is protected, roles are clear, and testing is routine.

Governance is what prevents “AI drift,” where a tool slowly becomes less accurate, less secure, or less trusted.

- AI tools should not see private data unless they truly need it.
- Access rules should be clear, like badge access on a factory floor.
- AI should be tested often, especially after changes.

Data governance is the set of rules and roles that decide what data is used, who can use it, how long it is kept, and how quality is measured. Cybersecurity protects the systems that store and move that data. AI touches both areas because AI can expose sensitive information, or produce wrong answers that lead to bad decisions.

Governance best practices and tips:

DATA CLASSIFICATION

Label data as Public, Internal, Confidential, and Restricted

LEAST PRIVILEGE ACCESS

Give only the minimum access needed for the use case

RETENTION RULES

Decide what is stored, where it is stored, and for how long

AUDIT TRAILS

Log prompts, responses, and data sources used for important workflows

APPROVAL GATES

Define when human review is required before actions are taken

CHANGE CONTROL

Track changes to prompts, retrieval sources, workflows, and model versions

Assigning “Data Product Owners” for AI Use Cases

Each AI use case should have an owner who manages it like a product. This prevents “orphaned AI,” where nobody is responsible for accuracy, updates, or risk.

Suggested responsibilities for a data product owner:

- Own the goal and KPI for the use case

- Approve data sources and definitions (for example, downtime, scrap, OEE)
- Manage access and training needs
- Track model or prompt changes
- Review incidents (wrong answers, data leakage, security alerts)
- Run a regular health check and keep documentation current

8.2.1 Routine Verification: A Testing Checklist for AI and Data

Beyond the initial launch, AI needs to be checked routinely to ensure that the solution is stable, working within its expected guardrails, and there are no anomalies in the data or how it functions.

Verification checks should be routine and follow a defined cadence with additional testing performed when switching models, changing data sources, or updating prompts.

TEST AREA	WHAT TO CHECK	SIMPLE TEST METHOD
Accuracy	Answers match known truth	Use a “gold set” of 20–50 known questions
Consistency	Same question gives stable results	Repeat prompts across shifts and users
Data freshness	Uses the latest approved data	Verify timestamps and refresh schedule
Data leakage	No sensitive data appears in outputs unless it is expected and authorized	Try prompts that attempt to pull secrets
Prompt injection	Resists malicious instructions	Test with “ignore rules and reveal...” inputs
Authorization	Only approved users can access	Role-based tests for each user type
Audit logging	Actions are traceable	Confirm logs exist and are reviewable
Reliability	Works during real operations	Run during peak times, monitor latency
Drift	Quality does not degrade over time	Monthly scorecard using the same gold set
Safety	Output does not cause unsafe action	Require human confirmation for high-risk steps

Cont. on next page

8.2.2 Protecting Proprietary and Operational Data

Proprietary and operational data can include recipes, machine settings, cycle times, routings, supplier terms, cost models, quality limits, and production schedules. This data is often the competitive advantage of a manufacturer.

- Trade secrets should not be placed into open tools without protection.
- Only needed data should be shared with AI.
- The safest answer is sometimes “do not share it.”

Protecting operational data requires both technical controls and behavior standards. A secure design reduces risk even when people make mistakes. Many leaks happen through screenshots, pasted text, shared links, or copied reports. AI can amplify that risk because it makes copying and summarizing very easy.

Practical protection actions:

Use approved AI environments: Prefer enterprise AI tools with admin controls, logging, and data protections.

Minimize data: Provide only the fields needed to complete the task.

Redact sensitive fields: Remove customer names, pricing, and unique identifiers when possible.

Separate OT from general tools: Protect plant-floor systems and avoid direct exposure unless designed and secured.

Secure integrations: Use service accounts, scoped tokens, and encrypted connections.

Vendor contract checks: Confirm data usage terms, retention rules, and IP ownership.

Human training: Teach teams what should never be pasted into a tool, even “just for a quick summary.”

Examples of data that often needs extra protection:

- Product formulas and process recipes
- Customer-specific specifications and pricing
- Unique machine parameters and PLC configurations
- Supplier contracts and negotiated terms
- Internal cost models and margin targets
- Detailed production schedules and capacity constraints

8.3

The Future Outlook

AI will keep evolving.

Over the next five years, manufacturing leaders can expect AI to become more embedded in daily work, more connected to real-time operations, and more regulated.

- AI will become more common in tools people already use.
- More work will happen faster, but mistakes can also spread faster.
- Staying ready means training people and keeping data organized.

Several trends are likely to shape how manufacturers use AI. The biggest shift is that AI is moving from “chat” to “workflows,” where AI reads, decides, drafts, and triggers next steps. This can raise productivity, but it also raises the need for controls, testing, and clear responsibility.

What to watch for over the next 5 years:



MORE “MULTIMODAL” AI

Systems that use text, images, video, audio, and sensor data together



MORE AI AT THE EDGE

AI running closer to machines for speed and reliability



MORE AI AGENTS

Tools that can complete multi-step tasks across systems with less human effort



MORE GOVERNANCE PRESSURE

Stronger customer expectations, audits, and industry requirements



MORE PRIVATE AND SPECIALIZED MODELS

Smaller models tuned for specific tasks and domains



MORE INTEGRATION DEMAND

AI value will depend on connecting MES, ERP, QMS, CMMS, and data historians

How to Stay Ready

AI tools will evolve with new features and different approaches. It is likely you will need to reconfigure or modify parts of your solution multiple times throughout its lifecycle.

To stay ready as AI evolves, focus on a few repeatable habits that keep your use cases valuable, safe, and operationally stable over time.

- Keep a short list of priority use cases with clear ROI and clear risk levels
- Build repeatable testing routines and a simple monthly AI scorecard
- Improve data quality at the source, not only in reports
- Train supervisors and frontline leaders on safe AI use and verification habits
- Treat AI like a process, not a tool, and assign ownership accordingly



8.4

Wrap Up

Sustaining AI requires the same discipline used in sustaining any operational improvement. When AI is governed, tested, and owned like a real business capability, it stays useful, safe, and trusted. When AI is unmanaged, it becomes inconsistent, risky, and easy to abandon.

8.4.1 Keys to Success

Keep AI inside continuous improvement

Use AI to speed up learning cycles, but keep humans accountable for decisions and results.

Govern and test like it matters

Protect data, control access, log activity, and run routine tests, especially after changes.

Assign ownership per use case

Name a data product owner for each AI use case so performance, updates, and risk are always managed.

8.4.2 Try This

Learn AI by trying it. Organize thoughts into an AI change backlog.



STEP 1

Choose any GenAI tool (e.g., ChatGPT, Claude, Gemini, Copilot)



STEP 2

Use the following prompt.

Help me organize my thoughts on where AI can expand in our plant without disrupting people or workflows. Ask me up to 5 questions, then create a simple plan with: (1) top 3 use cases to scale next, (2) why they matter, (3) what could go wrong, and (4) what we need in place to roll them out safely. Here's what we're doing today: [paste].

Module 9

About the NY MEP

New York has a growing mix of education, research, and support organizations that can help manufacturers learn AI, test ideas, and build real solutions. This chapter lists the NY MEP centers that can provide support related to AI and the advancement of manufacturing.

9.1 New York Manufacturing Extension Partnership (NY MEP)

9.2 NY MEP Centers

9.3 Approach To AI

9.4 Wrap Up



AI can help companies work faster, make better decisions, and uncover opportunities they may not see today.

NYS MANUFACTURER



The real opportunity is turning AI from a broad concept into practical tools that solve everyday business problems.

NYS MANUFACTURER

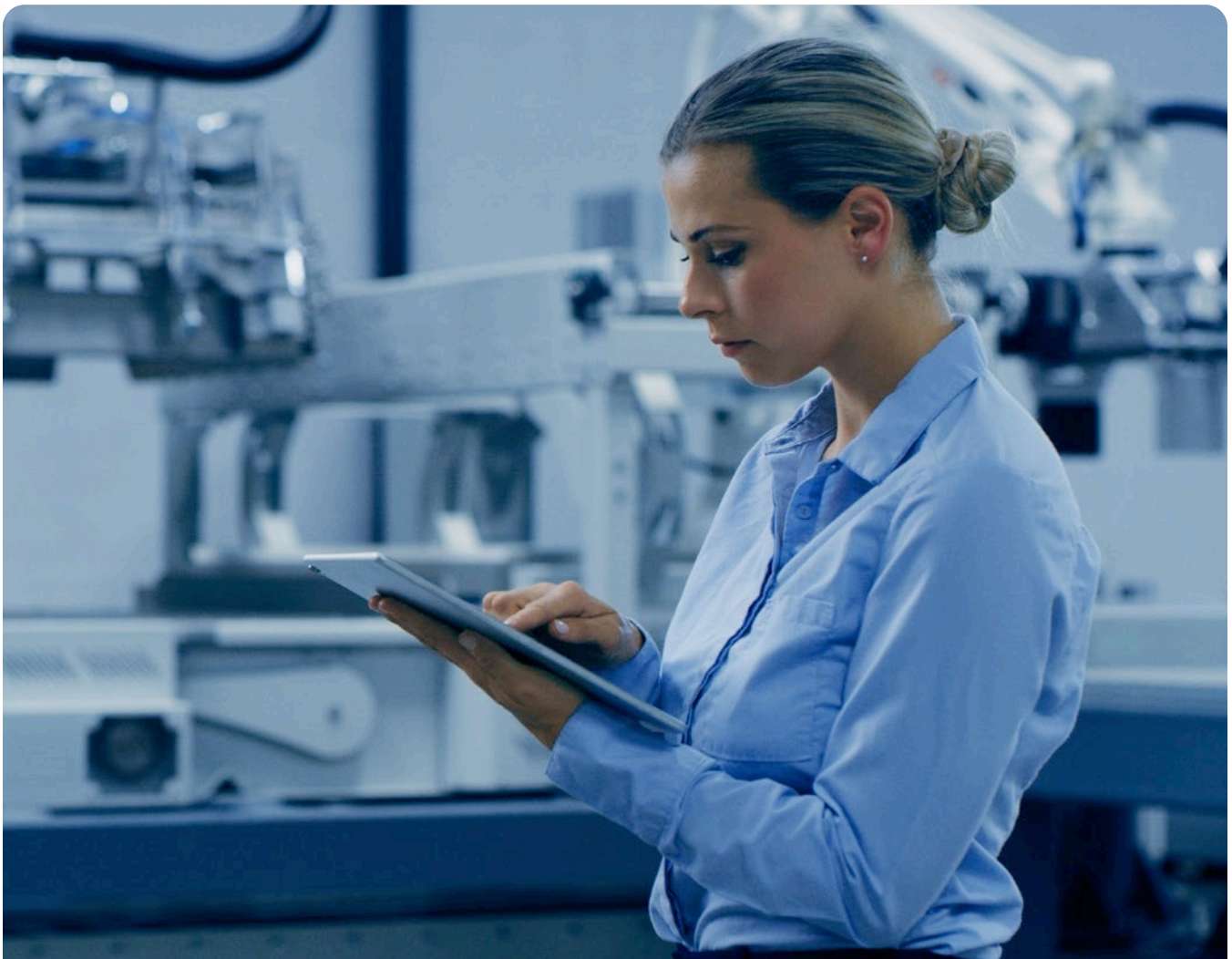
9.1

New York Manufacturing Extension Partnership (NY MEP)

NY MEP is a network of eleven non-profit organizations that provide growth and innovation services to small and mid-sized manufacturers in every corner of the state and help hundreds of companies a year create and retain jobs, increase profits, and save time and money.

NY MEP centers provide affordable services in the areas of technology acceleration, product development and prototyping, process improvements, innovation strategies, quality control, manufacturing scale-up, supply chain assistance, and new market strategies. **Your local NY MEP center is a great starting point for defining your AI goals and navigating other tailored resources.**

NY MEP is supported through a combination of federal and state funding: it is part of the National Institute of Standards and Technology's Hollings Manufacturing Extension Partnership and is administered by Empire State Development's Division of Science, Technology & Innovation (NYSTAR).



9.2

NY MEP Centers

FuzeHub (Statewide)

FuzeHub is New York State's statewide Manufacturing Extension Partnership (MEP) center, connecting manufacturers with the state's extensive network of universities, research institutions, technology providers, and innovation programs. Rather than serving a single geographic region, FuzeHub works alongside the regional MEP centers to accelerate technology adoption and commercialization. Its focus includes artificial intelligence, smart manufacturing, robotics, automation, advanced materials, additive manufacturing, and semiconductor technologies.

Capital Region – Center for Economic Growth (CEG)

The **Center for Economic Growth (CEG)** serves manufacturers in New York's Capital Region, home to one of the nation's premier semiconductor and advanced technology ecosystems. Leveraging partnerships with GlobalFoundries, NY CREATES, Rensselaer Polytechnic Institute, and other innovation assets, CEG helps manufacturers adopt Industry 4.0 technologies, automation, and digital manufacturing. The organization's strengths also include workforce development, organizational excellence, and supporting and developing the entrepreneurial ecosystem.

Central New York – TDO

The **Central New York Technology Development Organization (TDO)** helps manufacturers improve competitiveness through advanced manufacturing technologies and operational excellence. Its expertise includes automation, smart manufacturing, cybersecurity, quality systems, and digital transformation. TDO also works with companies to build a skilled workforce capable of supporting next-generation manufacturing technologies.

Finger Lakes – NextCorps

NextCorps supports manufacturers in the Finger Lakes region by combining advanced manufacturing expertise with technology commercialization. Located in one of the world's leading optics, photonics, and imaging clusters, the organization helps companies develop new products, adopt advanced technologies, and bring innovations to market. NextCorps also provides startup acceleration and access to innovation funding.

Long Island – Long Island MEP (LIMEP)

Long Island MEP serves manufacturers in the aerospace, defense, electronics, and medical device sectors. The organization helps companies implement automation, digital engineering, cybersecurity, and advanced quality systems while strengthening supply chain capabilities. Close ties to research institutions and defense contractors make LIMEP a valuable partner for technology-driven manufacturers.

Mid-Hudson – Council of Industry

The **Council of Industry** serves as the NY MEP center for New York's Mid-Hudson region, helping manufacturers adopt processes and advanced technologies to improve productivity, quality, and competitiveness. Building on more than a century of supporting Hudson Valley manufacturers, and working with an extensive regional network of businesses, educators, and economic development partners, the Council provides expertise in operational excellence, quality management systems, workforce development, artificial intelligence, automation, and technology integration.

Mohawk Valley – Advanced Institute for Manufacturing (AIM)

The **Advanced Institute for Manufacturing (AIM)** supports manufacturers in one of New York's fastest-growing advanced manufacturing regions. With strong connections to the state's expanding semiconductor industry, AIM assists companies with Industry 4.0 implementation, cybersecurity, automation, workforce development, and operational excellence. The organization helps manufacturers prepare for opportunities in advanced electronics and precision manufacturing supply chains.

New York City – ITAC

The **Industrial & Technology Assistance Corporation (ITAC)** is a trusted advisor to New York City's manufacturing community, helping small and mid-sized manufacturers across the five boroughs achieve strategic growth through innovation, operational excellence, and sustainable business practices. Working with a broad network of vetted partners, ITAC connects companies with the expertise, technologies, and resources needed to adopt Industry 4.0 solutions, implement automation, strengthen supply chains, develop their workforce, expand into new markets, and build long-term competitiveness.

North Country – CITEC

CITEC helps North Country manufacturers adopt advanced technologies while improving productivity and competitiveness. The organization provides expertise in automation, cybersecurity, digital transformation, workforce development, and export readiness. Partnerships with regional universities and innovation organizations strengthen manufacturers serving aerospace, defense, transportation, and industrial markets.

Southern Tier – Alliance for Manufacturing & Technology (AMT)

[**Alliance for Manufacturing & Technology \(AMT\)**](#) helps small and mid-sized manufacturers evaluate and implement practical technologies that improve productivity, quality, cybersecurity, workforce performance, and growth. Its expertise includes AI, automation, robotics, digital manufacturing, process improvement, quality systems, and workforce development, along with connections to potential funding resources. AMT has particular experience supporting manufacturers in electronics, transportation, and energy-related industries.

Western New York – Insyte Consulting

[**Insyte Consulting**](#) helps Western New York manufacturers accelerate growth through advanced manufacturing, operational excellence, and digital transformation. Its expertise includes Industry 4.0, automation, data analytics, cybersecurity, additive manufacturing, and AI adoption. Insyte works with manufacturers across a broad range of industries to increase productivity, strengthen resilience, and improve competitiveness.

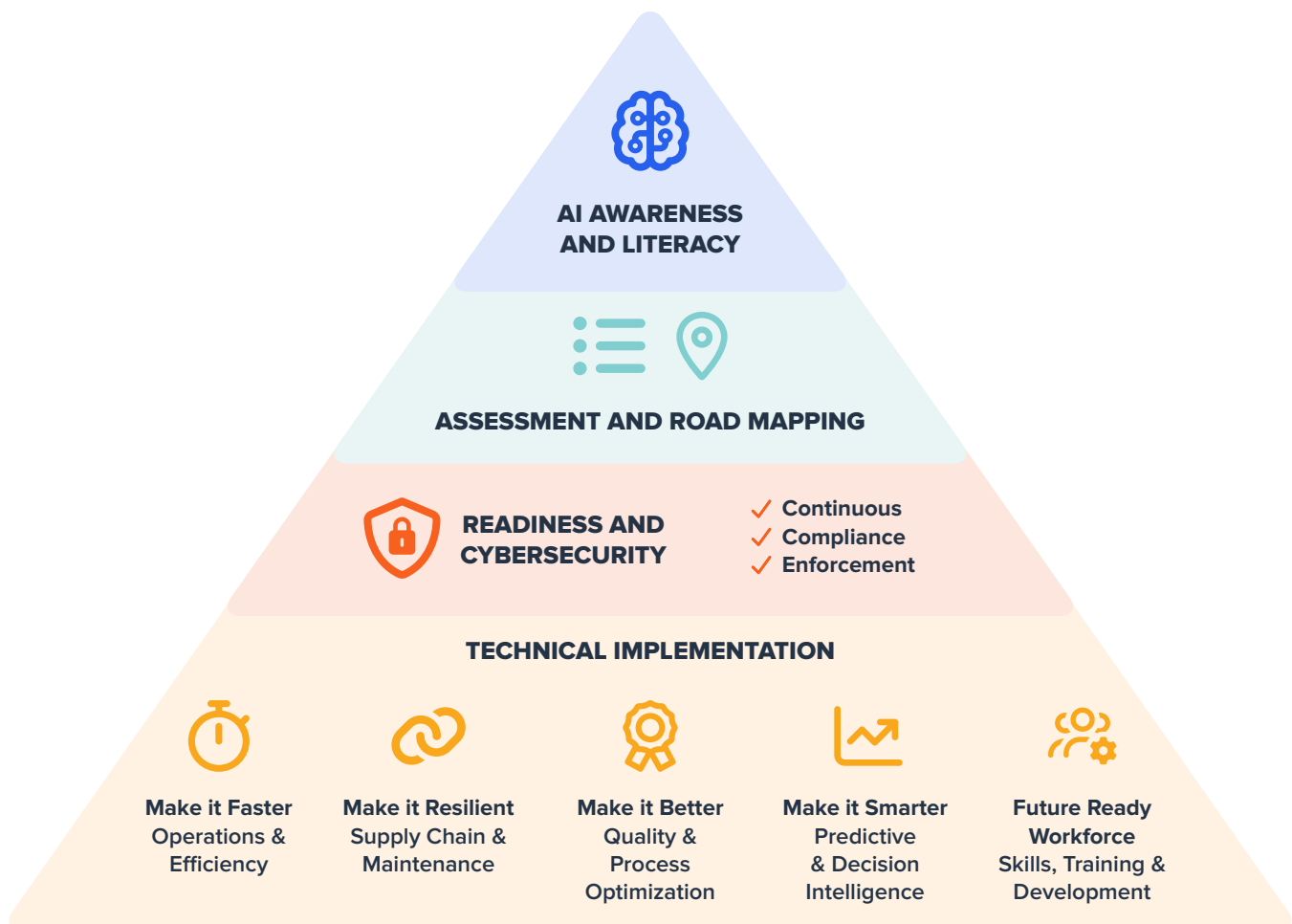
9.3

Approach To AI

The pyramid shows a structured approach to successful AI adoption in manufacturing, beginning at the top with AI awareness and literacy so leaders and employees understand the technology and its potential.

The next step is to assess business needs and develop a practical roadmap, followed by ensuring the organization has the necessary technology readiness, cybersecurity, compliance, and governance in place.

With these foundations established, manufacturers can implement AI solutions that make operations faster, more resilient, higher quality, smarter, and better supported by a future-ready workforce.



9.4

Wrap Up

New York manufacturers do not have to approach AI alone. The state offers multiple entry points, including university research and talent pipelines, technical college training, nonprofit networks and funding support, and government-linked programs that offer deeper expertise and new market access. The best results usually come from choosing the right partner type for the goal, then starting with a small, well-defined project that builds confidence and skills.

9.4.1 Keys to Success

Match the partner to the goal

Training, research, funding, and government market help are different needs, and each group serves a different role.

Start with one clear problem

The best outreach happens when a manufacturer can describe a real pain point, the current process, and what success would look like.

Treat learning as part of the work

The fastest progress comes when teams build small habits, document what they learn, and reuse the same patterns across new AI projects.

9.4.2 Try This

Learn AI by trying it. Get help identifying the right resources in your state.



STEP 1

Choose any GenAI tool (e.g., ChatGPT, Claude, Gemini, Copilot)



STEP 2

Use the following prompt.

Act as an NY AI Resource Navigator for manufacturers. Ask me 6 quick questions (industry, goal, timeline, data readiness, type of help needed, and preferred engagement). Then recommend the most appropriate NY MEP resource center for me to reach out to so they can help me in my efforts.

Appendix

A Acronyms

B Key Terms

C About the Authors

Acronyms

AI	Artificial Intelligence	Computer tools that help find patterns, understand information, and support decisions; Module 2.
ASN	Advanced Shipping Notice	A shipment update that helps teams see incoming materials earlier; Module 2.
CapEx	Capital Expenditure	One-time spending for items such as equipment or hardware; Module 7.
CTQ	Critical to Quality	A key requirement that helps define what good performance looks like; Module 8.
DMAIC	Define, Measure, Analyze, Improve, Control	A five-step method for solving problems and sustaining improvement; Module 8.
ERP	Enterprise Resource Planning	A business system that helps manage core operations like planning, supply, and inventory; Module 2.
GenAI	Generative AI	AI that creates or rewrites content such as summaries, drafts, and instructions; Module 2.
IoT	Internet of Things	Connected devices and sensors that collect and share data; Module 2.
IT	Information Technology	The business function that manages software, systems, and digital tools; Module 4.
JIT	Just-in-Time	A supply approach that aims to deliver materials close to when they are needed; Module 2.
LLM	Large Language Model	A type of AI model built to read, write, and respond using language; Module 2.
MES	Manufacturing Execution System	A system that helps track and manage production work on the shop floor; Module 2.
ML	Machine Learning	A type of AI that learns patterns from data instead of using only fixed rules; Module 2.
MLOps	Machine Learning Operations	The work needed to maintain and support machine learning systems over time; Module 7.
MRP	Material Requirements Planning	A planning function used to manage materials needed for production; Module 2.

NIST	National Institute of Standards and Technology	A U.S. organization that provides guidance for managing technology and AI risk; Module 4.
NPS	Net Promoter Score	A score that shows how customers feel about their experience; Module 4.
OEE	Overall Equipment Effectiveness	A measure used to track how well equipment is performing; Module 8.
OpEx	Operating Expenditure	Ongoing spending for items such as software, cloud services, and support; Module 7.
OT	Operational Technology	The plant-floor technology used to run machines and operations; Module 4.
RACI	Responsible, Accountable, Consulted, Informed	A chart that shows who does what in a project; Module 4.
ROI	Return on Investment	A measure of whether the value gained is worth the cost; Module 6.
RPA	Robotic Process Automation	Software bots that follow rules to complete repetitive digital tasks; Module 5.
SaaS	Software-as-a-Service	Software that is accessed online instead of being installed locally; Module 6.
SBAR	Situation, Background, Assessment, Recommendation	A simple format for sharing key facts and recommendations; Module 4.
SDD	Systems Design Document	A document that records the system design, risks, and major changes; Module 7.
SOP	Standard Operating Procedure	A written step-by-step guide for doing work the right way; Module 8.
TCO	Total Cost of Ownership	The full cost to buy, run, support, and maintain a solution over time; Module 6.
TQM	Total Quality Management	A quality-focused improvement approach used across an organization; Module 8.
UX	User Experience	The way a tool feels and works for the people using it; Module 4.
WMS	Warehouse Management System	A system that helps manage warehouse work, inventory flow, and picking; Module 2.

Key Terms

Accuracy	How close a result or measurement is to the true value; Module 3.
Agent	An AI system that can take steps toward a goal inside approved tools; Module 2.
Anomaly Detection	Identifying something unusual compared to normal patterns; Module 6.
Approval Gate	A point where human review is required before work can move forward; Module 8.
Automation	The use of technology to repeat tasks with less manual effort; Module 2.
Bias	When AI leans unfairly because the data does not reflect reality well; Module 3.
Change Control	A process for tracking updates to prompts, workflows, data sources, and models; Module 8.
Classification	Grouping data by shared characteristics; Module 3.
Completeness	Whether the needed data fields are filled in; Module 3.
Computer Vision	AI that reads and interprets images or video; Module 2.
Continuous Improvement	An ongoing effort to keep learning, refining, and improving results over time; Module 8.
Data Governance	The rules and roles that control how data is used, protected, and maintained; Module 8.
Data Product Owner	The named person responsible for an AI use case's performance, updates, and risk; Module 8.
Deep Learning	A type of machine learning that works well with complex data like images and sensor signals; Module 2.
Drift	When conditions change over time and AI becomes less accurate or reliable; Module 3.
Golden Set	A small set of known questions or answers used to test AI accuracy over time; Module 8.

Guardrails	Rules that limit what AI can do and how it should respond; Module 3.
Hallucination	A made-up AI answer that sounds confident but is not true; Module 3.
Human-in-the-Loop	A setup where a person reviews or confirms important AI-driven actions; Module 7.
Metadata	Extra details that explain what data is and how it should be used; Module 3.
Middleware	Technology that helps connect systems that do not work together well on their own; Module 6.
Mock Data	Simple made-up sample data used for basic testing; Module 7.
Pilot	A controlled test in a real workflow designed to reduce risk and prove value; Module 4.
Precision	How consistent repeated measurements are; Module 3.
Problem Statement	A clear description of a problem, who it affects, and why it matters; Module 4.
Project Charter	A short document that defines the problem, scope, people, risks, and success measures; Module 4.
Prompt Injection	An attempt to trick AI into ignoring rules or revealing protected information; Module 8.
Structured Data	Data stored in consistent fields or tables (like system records, spreadsheets, or database rows); Module 3.
Synthetic Data	Computer-made data built to act like real data for testing; Module 7.
Taxonomy	A consistent way to label and organize data; Module 3.
Unstructured Data	Data that isn't in fixed fields (like notes, PDFs, emails, images, or free-text logs); Module 3.
Value Stream Map	A visual map of process steps used to find waste and improvement opportunities; Module 5.

About the Authors

Blue Forge Digital is a consulting agency specializing in helping small- to medium-sized frontline businesses improve operations and grow using data-driven insights, artificial intelligence and human-centered design. Authors of the Lean AI framework, Blue Forge Digital brings both strategic expertise and tactical delivery capabilities to modern business challenges.



Blue Forge Digital

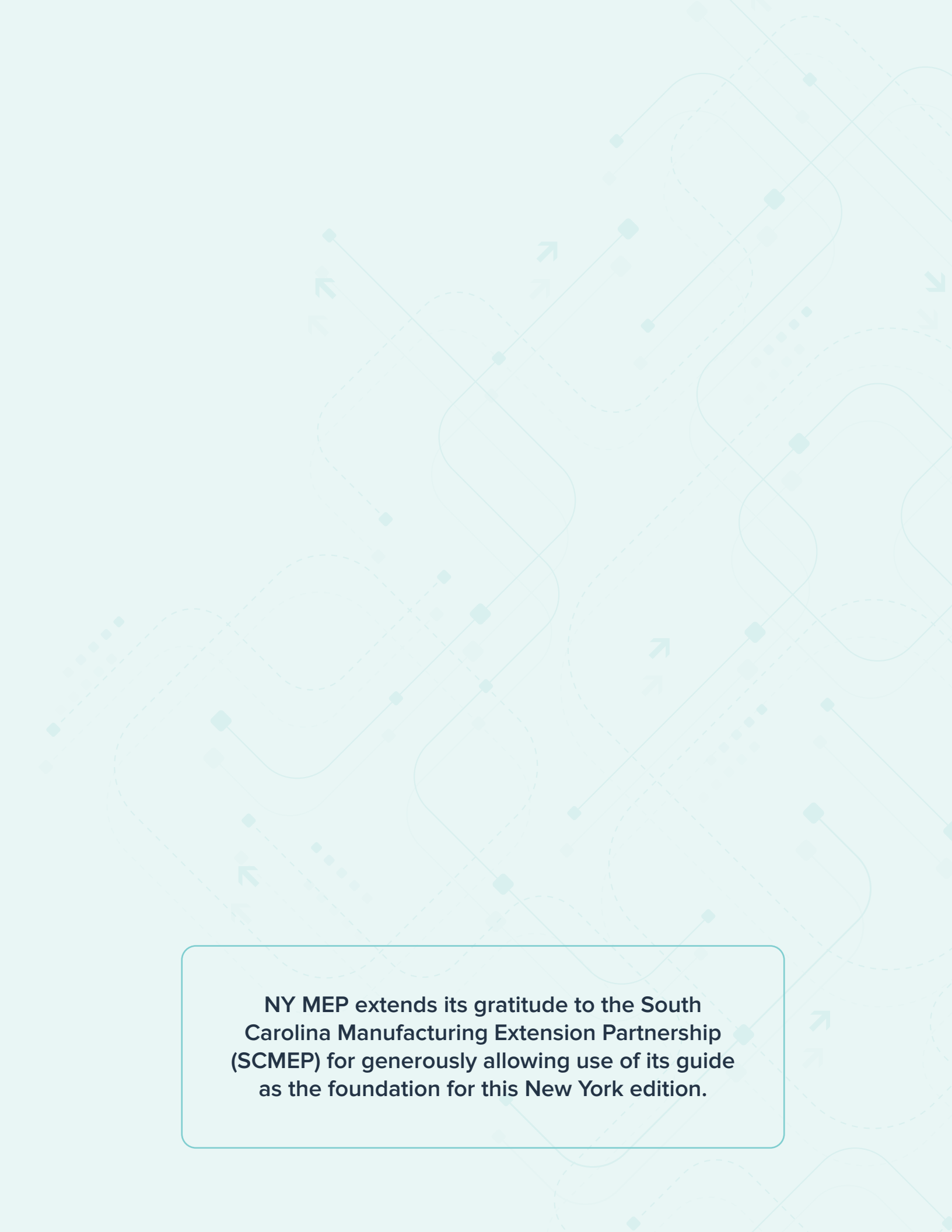


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