

# AI in Operations & Supply Chain Management

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## Part 2: Types of AI, Use Cases & Industry Applications

*Beyond GenAI — Understanding the Full AI Landscape*

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## Not All AI Is Generative AI

When most people say “AI” in 2026, they mean ChatGPT, Claude, or Gemini. But generative AI is just one branch of a much bigger tree. Understanding what’s *not* GenAI is just as important as understanding what is — because it shapes how you use these tools and what you expect from them.

### The AI Family Tree

Let’s map out the major types of AI you’ll encounter. Think of Artificial Intelligence as the big umbrella, with several specialized branches underneath.

| Type of AI                         | What It Does  | How It Learns   |
|------------------------------------|---|---|
| <b>Machine Learning (ML)</b>       | Finds patterns in data to make predictions. Thinks in numbers, not words.                                     | Learns from labeled examples. Show it 10,000 loan applications and outcomes, and it learns to predict defaults. |
| <b>Deep Learning</b>               | A powerful subset of ML using neural networks with many layers. Excels at complex pattern recognition.        | Learns from massive datasets with minimal human guidance. Powers image recognition, speech-to-text, and more.   |
| <b>Reinforcement Learning (RL)</b> | Learns by trial and error through a reward system. The AI tries actions, gets feedback, and improves.         | Like training a dog: reward good behavior, discourage bad. No labeled data needed — just a clear goal.          |
| <b>Generative AI (GenAI)</b>       | Creates new content — text, images, code, audio, video — based on patterns learned from training data.        | Trained on massive text/image datasets. Predicts the most likely next token to generate coherent output.        |
| <b>World Models</b>                | Builds internal simulations of how the physical world works. Can predict what happens next in an environment. | Learns physics, cause-and-effect, and spatial reasoning from video and interaction data.                        |

#### Key Takeaway

GenAI is great at language and content creation. But when you need a system that predicts equipment failure, optimizes delivery routes, or plays chess — you're often looking at ML, deep learning, or RL. Different tools for different jobs.

## Case Study: AlphaGo & AlphaFold — AI, But Not GenAI

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These are two of the most famous AI achievements in history. But students often assume they're the same kind of AI as ChatGPT. They're not. Let's clear that up.

### AlphaGo (2016): Mastering the “Impossible” Game

Go is a 2,500-year-old board game with more possible positions than atoms in the universe. For decades, experts said AI could never beat a top human player. In 2016, Google DeepMind's AlphaGo did exactly that, defeating world champion Lee Sedol 4–1.

#### How It Works

AlphaGo uses **reinforcement learning + deep learning**. It played millions of games against itself, learning which moves lead to wins. It doesn't generate text. It doesn't create content. It makes *decisions* — calculating the optimal next move from billions of possibilities.

#### Why It's Not GenAI

- It doesn't create anything new — it selects the best action from a possibility space
- It uses reinforcement learning (reward-based), not language modeling (next-token prediction)
- Its “output” is a single move on a board, not text, images, or content

### AlphaFold (2020): Solving Biology's 50-Year Grand Challenge

Proteins are the building blocks of life, but knowing their 3D shape from their genetic code was one of biology's hardest problems. Scientists had been working on it for 50 years. AlphaFold essentially solved it — predicting protein structures with accuracy that matched experimental methods, but in minutes instead of months.

#### How It Works

AlphaFold uses **deep learning** trained on known protein structures. Given a sequence of amino acids, it predicts how the protein will fold in 3D space. It's a prediction system, not a generation system.

## Why It's Not GenAI

- It predicts a specific, verifiable physical structure — not creative content
- There's one correct answer (the actual protein shape), not infinite possible outputs
- It uses specialized neural networks designed for spatial reasoning, not language

| Feature                | AlphaGo / AlphaFold                                   | GenAI (Claude, GPT, Gemini)                  |
|------------------------|---|--|
| Primary technique      | Reinforcement learning / Deep learning                | Transformer-based language modeling          |
| Output type            | A decision or prediction (one right answer)           | Generated content (many valid outputs)       |
| Training approach      | Self-play (AlphaGo) or labeled structures (AlphaFold) | Massive text/image datasets + human feedback |
| Creativity             | No — optimizes for a specific goal                    | Yes — creates novel text, code, images       |
| Can it write an email? | No  | Yes  |
| Can it beat you at Go? | Absolutely  | Probably not — it's not designed for that    |

### Why This Matters for Operations

In operations and supply chain, you'll encounter both types of AI. Demand forecasting, route optimization, and predictive maintenance typically use ML and deep learning (like AlphaFold's approach — prediction from patterns). Report writing, supplier communication, and analysis summaries use GenAI. Knowing which tool fits which problem is a career-defining skill.

## Multimodal Models & World Models

AI started with text. Then it learned to see. Now it's learning to understand the physical world. This progression — from text-only to multimodal to world models — is reshaping what's possible.

### Multimodal AI: Beyond Text

A **multimodal model** can process and generate multiple types of content: text, images, audio, video, and code — all within the same system. Instead of needing separate AI for each media type, one model handles it all.

| Capability     | What It Means                              | Real Example  |
|----------------|--|---|
| Text + Image   | Upload a photo and ask questions about it  | Photograph a warehouse layout, ask AI to identify bottleneck points                             |
| Text + Audio   | Process spoken language or generate speech | AI listens to a supplier call and summarizes key commitments                                    |
| Text + Video   | Analyze or generate video content          | Upload production line footage, AI identifies quality issues                                    |
| Text + Code    | Generate, explain, and debug code          | Describe a data transformation in English, AI writes the Python script                          |
| All modalities | Combine inputs freely                      | Show AI a product photo + spec sheet + audio of customer complaint, ask for root cause analysis |

**Current multimodal leaders:** GPT-4o (OpenAI) handles text, image, and audio natively. Gemini 2.0 (Google) processes text, images, video, and audio. Claude (Anthropic) handles text, images, and documents with deep analysis capabilities. Each model has different strengths depending on the modality.

## World Models: AI That Understands Physics

This is the frontier. A **world model** is an AI system that builds an internal simulation of how the physical world works. It doesn't just recognize objects in a photo — it understands that if you push a ball off a table, it falls. It grasps cause and effect, spatial relationships, and physical dynamics.

### Why World Models Matter

Think about what this enables for operations and supply chain:

- **Robotics:** A warehouse robot that can figure out how to pick up an oddly shaped package it's never seen before, because it understands how objects behave physically.
- **Digital twins:** AI that can simulate an entire factory floor and predict what happens when you change a machine layout, add a shift, or reroute material flow.

- **Autonomous vehicles:** Self-driving delivery trucks that can predict how other vehicles and pedestrians will behave, not just recognize them.

## Notable World Models

| System  | Developer       | What It Does  |
|---------|-----------------|---|
| Genie 2 | Google DeepMind | Generates playable 3D environments from a single image. Understands object interactions, physics, and character movement. |
| Cosmos  | NVIDIA          | Generates physics-aware virtual worlds for training robots and autonomous vehicles. Simulates realistic object behavior.  |
| Sora    | OpenAI          | Video generation model that demonstrates understanding of how objects move and interact in 3D space over time.            |

### The Progression to Remember

Text-only AI → Multimodal AI → World Models. Each step represents a deeper level of understanding. Text-only AI understands language. Multimodal AI understands language + vision + sound. World models understand how reality works. For operations, this progression moves from “AI helps me write reports” to “AI simulates my entire supply chain before I make changes.”

## AI Use Case Patterns: A Framework

Rather than memorizing specific tools, focus on **patterns** of how AI gets used in business. Every AI use case falls into one of these categories.

### Pattern 1: AI as Coding Assistant (Automation Engine)

This is arguably the **highest-value, most underappreciated** use case right now. Here’s the insight most people miss: you don’t need an LLM running 24/7 to automate a task. You just need the LLM *once* — to help you write the code that automates it.

#### How This Works in Practice

**The scenario:** Every Monday, you download a sales report, reformat it, calculate week-over-week changes, and email a summary to your team. Takes 45 minutes.

**The AI-assisted solution:** Ask Claude or Cursor to write a Python script that does this automatically. The script is deterministic code — it runs the same way every time, costs nothing per execution, and doesn't need an API key.

**The key insight:** The AI helped you BUILD the automation. But the automation itself is plain old code. Reliable, free, and fast.

**When to use this pattern:** Any repetitive task with clear rules. Data formatting, report generation, file management, email routing, inventory calculations, schedule creation. If you can describe the steps, AI can help you write code to automate them.

**Why this matters:** Most business automation doesn't require AI to run. It just requires AI to build. This means the cost is a one-time investment of your time, not an ongoing API fee. And the result is more reliable than asking an LLM every time, because deterministic code doesn't hallucinate.

## Pattern 2: AI as Knowledge Worker

This is what most people think of when they think of GenAI — using LLMs to draft content, analyze documents, brainstorm strategies, and answer questions.

- **Drafting:** Emails, reports, proposals, meeting agendas, project briefs
- **Analysis:** Summarizing long documents, extracting key insights, comparing options
- **Research:** Exploring topics, synthesizing multiple sources, generating frameworks
- **Communication:** Translating technical concepts for non-technical audiences, adjusting tone for different stakeholders

## Pattern 3: AI as Decision Support

Using ML and deep learning (not GenAI) to make predictions and optimize decisions.

- **Demand forecasting:** Predicting how much product you'll need next quarter based on historical patterns
- **Predictive maintenance:** Flagging equipment that's likely to fail before it actually breaks down
- **Route optimization:** Finding the most efficient delivery paths across thousands of stops
- **Quality detection:** Computer vision systems that spot defects on a production line faster than human inspectors

## Pattern 4: AI as Autonomous Agent

The newest pattern. AI systems that can plan, act, and iterate on their own to accomplish complex goals.

- **Supply chain monitoring:** An agent that tracks shipments, detects delays, alerts stakeholders, and suggests rerouting — automatically
- **Customer service:** AI that handles multi-step support tickets by accessing order history, processing returns, and escalating edge cases
- **Procurement:** An agent that monitors inventory levels, identifies best-price suppliers, drafts POs, and routes them for approval

### ⚡ The Smart Framework

Before choosing an AI approach, ask: Is this task **repetitive and rule-based**? Use Pattern 1 (coding assistant). **Creative or analytical**? Pattern 2 (knowledge worker). **Predictive**? Pattern 3 (decision support). **Complex and multi-step**? Pattern 4 (agent). The best solutions often combine multiple patterns.

## AI Use Cases by Industry & Business Function

Now let's get specific. This section maps real AI use cases to the industries and roles you might enter after graduation. Notice how the *same AI capabilities* show up differently depending on context.

### Healthcare

| Role / Function                    | How AI Is Used  | Key Insight   |
|------------------------------------|---|---|
| <b>Back Office / Revenue Cycle</b> | Automated coding and billing, claims processing, prior authorization, scheduling optimization                       | AI handles repetitive admin tasks that account for ~30% of healthcare costs. Mostly Pattern 1 (code automation) and Pattern 3 (prediction). |
| <b>Doctors / Physicians</b>        | Clinical decision support, diagnostic imaging analysis, treatment plan comparison, medical literature summarization | AI doesn't replace clinical judgment — it augments it. A radiologist uses AI as a "second set of eyes" to catch things they might miss.     |

|                                   |   |   |
|-----------------------------------|---|---|
| <b>Nurses / Clinical Staff</b>    | Patient monitoring alerts, medication interaction checks, care documentation, shift scheduling optimization | Nursing staff spend ~25% of time on documentation. AI voice-to-text and auto-charting gives that time back to patient care.   |
| <b>Supply Chain / Procurement</b> | Medical supply demand forecasting, expiration tracking, vendor management, cost benchmarking                | Hospital supply chains are uniquely complex — items are perishable, demand is unpredictable (you can't forecast a pandemic), and stockouts can be life-threatening. |

### Retail & E-Commerce

| <b>Role / Function</b>          | <b>How AI Is Used</b>  | <b>Key Insight</b>   |
|---------------------------------|--|--|
| <b>Back Office / Operations</b> | Inventory optimization, demand forecasting, automated reordering, loss prevention analytics, workforce scheduling    | Retail runs on thin margins. AI-driven inventory optimization (Pattern 3) can mean the difference between profit and loss.       |
| <b>Marketing</b>                | Personalized recommendations, dynamic pricing, campaign copy generation, customer segmentation, A/B testing at scale | Amazon's recommendation engine drives ~35% of revenue. GenAI now creates personalized product descriptions for millions of SKUs. |
| <b>Store Operations</b>         | Shelf-stocking optimization, computer vision for out-of-stock detection, checkout automation, foot traffic analysis  | Computer vision (deep learning, not GenAI) identifies empty shelves in real-time and triggers restocking alerts.                 |
| <b>Supply Chain / Logistics</b> | Last-mile delivery optimization, warehouse robotics, supplier risk scoring, returns processing                       | The real competitive battleground. Companies like Walmart and Amazon invest billions in AI-powered supply chain systems.         |

### Financial Services

| Role / Function             | How AI Is Used  | Key Insight   |
|-----------------------------|---|---|
| <b>Banking Operations</b>   | Fraud detection, anti-money laundering (AML) screening, loan underwriting, document processing, compliance monitoring | Fraud detection is classic ML (Pattern 3) — real-time pattern recognition across millions of transactions. Not GenAI.                             |
| <b>Financial Advisors</b>   | Portfolio analysis summaries, market research synthesis, client communication drafting, regulatory filing assistance  | Advisors use GenAI (Pattern 2) to draft client communications and synthesize research, but regulations require human sign-off on all advice.      |
| <b>Investment / Trading</b> | Quantitative analysis, sentiment analysis from news/social media, risk modeling, algorithmic trading                  | Wall Street has used ML for decades. GenAI adds the ability to process unstructured data like earnings call transcripts and news articles.        |
| <b>Insurance</b>            | Claims processing automation, risk assessment, policy document generation, customer service chatbots                  | Insurance is document-heavy. AI processes claims forms (Pattern 1 automation), predicts risk (Pattern 3), and drafts policy language (Pattern 2). |

## Manufacturing

| Role / Function                | How AI Is Used  | Key Insight  |
|--------------------------------|---|--|
| <b>Production / Shop Floor</b> | Predictive maintenance, quality inspection (computer vision), process optimization, digital twin simulation           | Predictive maintenance alone saves manufacturers an estimated 10–40% in maintenance costs. This is deep learning and sensor analytics.               |
| <b>Engineering / Design</b>    | Generative design (AI creates optimized part geometries), simulation acceleration, tolerance analysis, BOM management | Generative design in manufacturing is different from GenAI — it optimizes physical structures using physics-based simulation, not language modeling. |

|                                   |  |   |
|-----------------------------------|--|---|
| <b>Supply Chain / Procurement</b> | Supplier performance scoring, lead time prediction, demand sensing, inventory positioning across multiple facilities | This is where your Practice Operations simulation connects. The same decisions you make in the sim are being augmented by AI in real factories. |
| <b>Safety &amp; Compliance</b>    | Incident prediction, compliance document generation, safety protocol monitoring via computer vision                  | Computer vision monitors PPE compliance on the floor. GenAI helps generate and update safety documentation.                                     |

### Consulting & Professional Services

| <b>Role / Function</b>     | <b>How AI Is Used</b>   | <b>Key Insight</b>  |
|----------------------------|---|---|
| <b>Strategy Consulting</b> | Market analysis, competitive intelligence synthesis, presentation drafting, financial modeling assistance | Consultants are power users of GenAI (Pattern 2). The firms investing in AI-augmented consultants can serve more clients with the same headcount.                 |
| <b>Accounting / Audit</b>  | Transaction classification, anomaly detection, tax preparation, audit sampling, workpaper generation      | Accounting combines Patterns 1 and 3 heavily. Automation for repetitive tasks, ML for anomaly detection.  |
| <b>Legal</b>               | Contract review, legal research, document drafting, due diligence, e-discovery                            | AI can review thousands of contracts in hours instead of weeks. But hallucination risk means every AI-generated legal analysis needs human verification.          |
| <b>Human Resources</b>     | Resume screening, employee sentiment analysis, policy document creation, onboarding workflow automation   | HR is a mix of all four patterns. Screening is ML, policy docs are GenAI, onboarding workflows are code automation, and retention prediction is decision support. |

### Technology & Software

| Role / Function             | How AI Is Used  | Key Insight   |
|-----------------------------|---|---|
| <b>Software Development</b> | Code generation, bug detection, code review, documentation writing, test case generation                  | AI coding assistants (Cursor, Windsurf, GitHub Copilot) are the most mature enterprise AI use case. Developers report 30–55% productivity gains.      |
| <b>Product Management</b>   | User feedback analysis, feature prioritization, competitive analysis, PRD drafting, roadmap communication | PMs use GenAI as a thinking partner — stress-testing product decisions, synthesizing user feedback, and drafting stakeholder communications.          |
| <b>Data / Analytics</b>     | Automated EDA, SQL generation from natural language, dashboard creation, anomaly alerting                 | Pattern 1 is huge here. AI helps write the SQL queries and Python scripts that automate data pipelines. The code runs without AI afterward.           |
| <b>IT Operations</b>        | Incident response automation, log analysis, infrastructure optimization, security threat detection        | AI agents (Pattern 4) are increasingly handling first-response for IT incidents — diagnosing issues and applying known fixes before humans get paged. |

### The Cross-Industry Pattern

Notice what's consistent across every industry: back-office automation (Pattern 1) is the most immediate ROI, decision support (Pattern 3) is the most established, knowledge work augmentation (Pattern 2) is the fastest-growing, and autonomous agents (Pattern 4) are the emerging frontier. Your career advantage comes from understanding all four — not just the trendy one.

## Connecting This to Your Major

No matter what business major you're pursuing, AI changes your field. Here's your personalized cheat sheet.

| Your Major        | Your Highest-Value AI Skills   | Interview-Ready Talking Point  |
|-------------------|--|--|
| <b>Accounting</b> | Automation of reconciliations and audit sampling; understanding ML-driven anomaly detection; using GenAI for workpaper documentation   | “I understand how AI automates routine accounting tasks, which lets me focus on the judgment-intensive work like evaluating unusual transactions and advising clients.”                        |
| <b>Finance</b>    | Using GenAI for research synthesis; understanding ML-driven risk models; building automated financial models with AI coding assistance | “I can use AI to rapidly synthesize market data and build financial models, but I know that investment decisions still require human judgment about risk tolerance and client goals.”          |
| <b>Marketing</b>  | AI-powered personalization and segmentation; GenAI for content creation at scale; understanding recommendation algorithms              | “I know how to use AI to create personalized content and analyze customer behavior, while ensuring our messaging stays authentic and on-brand.”  |
| <b>Management</b> | Orchestrating AI tools across teams; understanding which AI pattern fits which business problem; change management for AI adoption     | “I can evaluate where AI creates real value versus where it’s just hype, and I know how to lead teams through the transition of adopting AI tools responsibly.”                                |
| <b>MIS</b>        | AI system architecture; API integration; building AI-powered workflows; evaluating build vs. buy for AI solutions                      | “I bridge the gap between business needs and technical AI capabilities. I can evaluate which AI solutions to build in-house versus purchase, and design the integrations that make them work.” |

*The AI landscape will keep changing.  
The thinking frameworks in these notes won't.*  
**Learn the patterns, not just the products.**