

TECH & AI CASE STUDY - MANUFACTURING - 2026

Hybrid Cloud MES That Connects Five Plants With Real-Time OEE

Based on a delivery engagement with Cascadia Precision Manufacturing

+9 pts
PLANT OEE

\$2.7M/yr
RECOVERED CAPACITY VALUE

-24%
UNPLANNED DOWNTIME

5 to 1
MES VERSIONS IN PRODUCTION

A fillable practice edition: the full story, 8 actions,
6 reflections and a 90-day plan - work it with your team.

Free - no email required
emersontechnology.com

MAKE THIS PRACTICE BOOK YOURS

Work it, do not just read it

This practice book turns the Cascadia Precision Manufacturing case study into a working session for your team. Read the full story first - what happened, what was built and what it changed. Then tick the 8 actions you can commit to, write short answers to the 6 reflections, and finish with a 90-day plan. Every field in this PDF is fillable: open it in Adobe Acrobat Reader, Chrome, Edge or macOS Preview, type directly into the boxes and save.

YOUR NAME

ROLE

COMPANY

TEAM / DEPARTMENT

DATE

EMAIL (OPTIONAL)

MY GOAL FOR THIS PRACTICE SESSION

- 01

The story - What happened at Cascadia Precision Manufacturing - before, during and after the project.
- 02

The results - The numbers that changed, plus industry benchmarks from public research.
- 03

The 8-action checklist - Tick boxes as your organization completes each step. Owner and date fields included.
- 04

The 6 reflections - Fillable questions that pressure-test your own roadmap.
- 05

My 90-day plan - Three fillable phase cards that turn this case study into your roadmap.

RUN IT AS A 90-MINUTE TEAM SESSION

25 min READ Read the story together. Ask everyone to note the one number that surprised them most.	40 min PRACTICE Work the 8-action checklist and the 6 reflections. Assign an owner and a date to every action you commit to.	25 min COMMIT Fill in the 90-day plan. One goal per phase, one number that tells you it worked. Book a review date before you leave the room.
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THE STORY

What happened, and why it worked

01 The Company

Cascadia Precision Manufacturing operates five plants producing machined components for aerospace and industrial customers. The company's reputation rests on precision and reliability: aerospace buyers audit their suppliers relentlessly, and a machining operation that cannot prove what it did, when and with which material loses contracts to competitors who can. Each plant runs CNC machining centers, turning centers and finishing lines around shift patterns, and each plant has its own history — some were acquired rather than built, which is how Cascadia ended up with three different manufacturing execution system versions, paper travelers and shift-end spreadsheets describing essentially the same production physics.

The business is margins and machine time. Overall equipment effectiveness — OEE, the composite of availability, performance and quality — is the number that decides whether a bottleneck line makes money or merely makes parts. Deloitte's smart factory research reportedly estimates gains of roughly 10-12% in labor productivity and factory throughput from connected, data-driven manufacturing operations, and Cascadia's leadership believed their plants were sitting on exactly that kind of improvement. The problem was that none of the five plants measured production the same way, so the company could not even quantify the opportunity it was confident it had.

02 Where Things Stood

Production measurement at Cascadia was, at best, a rearview mirror. Three MES versions ran in production across the five plants, supplemented by paper travelers and shift-end spreadsheets, which meant OEE was calculated monthly — weeks after the losses had occurred — and corporate could not reliably compare plants even then, because each site computed the number differently. Downtime on bottleneck lines went unexplained: the line stopped, the reason lived in an operator's memory or a handwritten note, and by the time anyone aggregated the data, the trail had gone cold. Scrap escapes surfaced only at customer audits, which is the most expensive possible moment to learn about a quality problem.

Two external pressures turned chronic inefficiency into an urgent program. First, a major OEM customer introduced a requirement for digital traceability — full part genealogy, retrievable on demand — that Cascadia's paper-based records could not satisfy, putting two contracts worth a combined \$18M annually at risk. Second, the compliance environment constrained the solution space: ITAR obligations barred moving raw production data to offshore regions, ruling out a naive lift-and-shift of everything into a single public cloud region, and this constraint arrived before the architecture did, which is actually the best way for it to arrive. Meanwhile the financial case was already quantified inside the business: every point of OEE recovered on one bottleneck line was worth an estimated \$300,000 a year, so leadership funded a platform whose explicit job was to surface those points quickly.

03 The Challenge

The challenge was to connect five heterogeneous plants into one comparable, real-time production picture without breaking line operations or compliance boundaries. Flexera's State of the Cloud surveys have reportedly found around 87% of organizations operating multi-cloud environments, with hybrid the most common pattern — and manufacturing is the archetypal hybrid case, because a machining line cannot stop for a WAN outage and controlled data cannot cross certain borders. Cascadia needed an architecture that treated those constraints as design inputs rather than as obstacles discovered mid-project.

The problem decomposed into four hard requirements. First, standardization: five plants with five OEE definitions would produce one consolidated but meaningless dashboard, so the metric itself had to be rebuilt before any software was bought. Second, latency: OEE computed monthly is an obituary; the business needed downtime reasons within minutes of a line event so maintenance and production could act the same shift. Third, sovereignty: raw process data had to stay on-prem within ITAR scope, while aggregate analytics needed a central home. Fourth, drift: a new platform deployed plant by plant tends to fork into five variants again within a year unless configuration itself is engineered as a single versioned product. McKinsey research reportedly estimates that predictive maintenance and analytics-driven operations can cut machine downtime by 30-50% in industrial settings while extending equipment life — Cascadia's realistic target sat at the conservative end of that range, but only if all four requirements held simultaneously.

04 Discovery and Diagnosis

Emerson Technology opened with a plant-by-plant discovery that spent more time on shop floors than in conference rooms. In each facility, the team traced how a machine event became a record today: the operator's manual entries, the shift-end spreadsheet ritual, the local MES version's quirks and the private definitions each plant had evolved for availability, performance and quality. The cross-plant comparison confirmed the suspicion that had motivated the project — the five OEE numbers in circulation were not five measurements of one thing, they were five different things — and it cataloged the machine estate: which controllers exposed OPC-UA, which HMIs could host reason-code capture, and where edge hardware would physically live.

The compliance diagnostic ran in parallel, not after. Working with Cascadia's export-control counsel, the team drew the data-border map before the architecture review: raw process data classified, replication paths proposed, and the on-prem versus cloud split signed off by compliance before a single line of the design was finalized. That sequencing — compliance sign-off ahead of architecture, not after — prevented the redesign loop that derails most industrial data platforms. The diagnosis also produced the deployment insight that shaped everything downstream: the only way five plants would keep running one MES was if the MES configuration shipped as a versioned artifact through a pipeline, the same way software does. And it confirmed the pilot target — the busiest bottleneck line, where every recovered OEE point was worth \$300,000 and early wins would fund the program's political capital.

05 The Solution

We deployed a hybrid architecture that puts computation at the edge where operations live and aggregation in the cloud where comparison lives, with a hard data border between raw controlled data and central analytics.

Edge-first by design

Each plant runs edge servers hosting the MES core, OPC-UA collectors and a local Postgres instance, so scheduling, quality holds, genealogy capture and downtime recording never depend on WAN availability. Machine events are collected at the source through OPC-UA rather than through shift-end manual entry, which is the difference between OEE that reflects shifts and OEE that reflects weeks. Operators tag downtime reasons in seconds at the HMI screens they already use every shift, turning OEE from a score into a diagnosis. If the corporate link goes down, lines keep running and data keeps accumulating locally; when the link returns, the backlog syncs. This is the property that earns operators' trust, and operators' trust is what makes the data clean.

The central data platform

A message bus — Kafka on Amazon MSK — ingests normalized machine events from all five plants into a central data platform built on S3 and Apache Iceberg, feeding OEE dashboards in Grafana and a Next.js plant-comparison console that corporate now reviews live. Normalization happens at the edge before events

cross the border, so the central platform sees one coherent event schema regardless of which plant produced it. Quality holds, genealogy and traceability records replicate to AWS for analytics — satisfying the OEM's digital-traceability requirement — while raw process data stays on-prem within ITAR scope, exactly where the compliance sign-off drew the line. The central platform answers the questions corporate actually asks: which plant is winning, which bottleneck is losing, which downtime reason is quietly costing the most money this week.

One MES, five plants

Deployment runs through a GitOps pipeline that ships the same versioned MES configuration to every plant, ending the five-version drift that made cross-plant comparison impossible in the first place. A change to a downtime taxonomy, a quality-hold workflow or a scheduling rule is merged as a versioned release, rolled out through the pipeline, and every plant converges to the same behavior — with local parameters where genuinely needed, but one core. New plants join the platform through the same GitOps rollout, which is how the integration timeline went from months to weeks. The MES, in other words, stopped being five installations and became one product with five tenants.

06 The First 90 Days

The first month was spent where the case was weakest and the money was biggest: the pilot bottleneck line. The OEE definition was standardized on paper first — availability, performance and quality formulas agreed across every plant's operations leads before any software was bought — and OPC-UA connectivity to the pilot line's machines was established, with downtime reason codes configured at the HMIs. Weeks three through six ran the edge stack live on the pilot line in shadow mode, comparing the new automatically captured OEE against the plant's traditional monthly calculation. The comparison built trust the honest way: the new data caught a recurring changeover delay the manual process had been logging under a generic code, and when the line crew fixed it, the OEE moved visibly that same week.

Weeks seven through ten extended collection to the remaining four plants in pairs, each rollout following the identical GitOps pattern — same versioned configuration, local edge install, shadow week, then live. The plant-comparison console went live in week nine, and the first cross-plant review replaced the monthly spreadsheet reconciliation with an hour in front of one live screen; the meeting's tone shifted from defending local numbers to arguing about causes, which is the healthiest possible argument for a manufacturing leadership team to have. Weeks eleven and twelve closed the loop on compliance: traceability records flowed to the central platform, a full genealogy rehearsal was run for the OEM's upcoming audit, and the replication split was re-verified against the compliance sign-off. By day 90, all five plants reported through one MES version, and unplanned-downtime hours were already trending down as maintenance began scheduling from data instead of complaints.

07 The Results

OEE across the five plants rose 9 points within the first year — roughly \$2.7M in recovered bottleneck-line capacity at the rates leadership had modeled. Downtime reasons now surface within minutes of a line event instead of weeks, and corporate reviews all five plants from one live console rather than reconciling five spreadsheets. The OEM traceability audit passed without findings, protecting the \$18M in contracts that motivated the program, and unplanned-downtime hours fell 24% as maintenance teams started scheduling from data. New plants join the platform with the same GitOps rollout that onboarded the original five, cutting integration time from months to weeks.

METRIC	BEFORE	AFTER
Plant OEE	Baseline	+9 pts

METRIC	BEFORE	AFTER
Recovered capacity value	-	\$2.7M/yr
Unplanned downtime	Baseline	-24%
MES versions in production	5	1

The operational culture shifted in ways the dashboard only partially captures. Plant managers, once protective of locally computed numbers, now compete on the same console — a form of rivalry that sustains improvement long after launch enthusiasm fades. Maintenance planning moved from reactive ticket queues to scheduled interventions driven by downtime patterns. Quality escapes are caught internally through genealogy and traceability records instead of at customer audits. And the architecture proved itself during a regional network outage: lines at two plants kept producing, data kept accumulating at the edge, and nobody in corporate noticed until the sync backlog cleared — which is precisely the failure mode the design was built to make boring.

08 What Your Business Should Do

Cascadia's playbook applies to any multi-site manufacturer, and its most important steps happen before any software is purchased. Standardize the OEE definition first: agree on availability, performance and quality formulas across every plant before buying anything, because five plants with five OEE definitions produce one consolidated but meaningless dashboard. Collect at the machine, not the shift: connect PLCs and HMIs through OPC-UA so events capture automatically at the source — shift-end manual entry guarantees your OEE arrives weeks too late to act on. Keep line operations WAN-independent by running MES cores on local edge servers, so scheduling, quality holds and downtime capture continue through outages; cloud is for analytics, not for keeping lines running. Centralize analytics while respecting data borders: aggregate normalized events centrally for plant-to-plant comparison, keep raw controlled data on-prem wherever regulations require, and get compliance sign-off on that split before the architecture review, not after.

Run the platform the way engineering runs software. Ship the MES as one versioned product through GitOps pipelines so every plant runs the same versioned release — version drift is exactly how five plants quietly become five unsupported systems. Start with bottleneck lines, instrumenting the constraint operations first, where every recovered OEE point is worth the most money and early dollar wins fund the rest of the rollout. Capture downtime reasons at the HMI, letting operators tag stoppage causes in seconds on screens they already use, because clean reason codes turn OEE from a score into a diagnosis. And review plants together, live: hold a weekly cross-plant review on one console instead of reconciling spreadsheets, since shared visibility creates the healthy internal competition that sustains improvement long after launch. As you plan, ask your own operation the questions this program raised: whether your plants' OEE numbers can truly be compared today, how many hours pass between a line stopping and leadership knowing why, what one OEE point on your bottleneck line is worth per year, and where your operations would stop if the corporate WAN went dark tomorrow. Work through these eight steps with your team using the action checklist in this practice book, and revisit the reflection questions each quarter — because a connected factory stays connected only as long as someone keeps reviewing what it reports.

REAL-WORLD PROOF & BENCHMARKS

Deloitte's smart factory research reportedly estimates gains of roughly 10-12% in labor productivity and factory throughput from connected, data-driven manufacturing operations. - Deloitte, 2024

Flexera's State of the Cloud surveys have reportedly found around 87% of organizations operating multi-cloud environments, with hybrid the most common pattern. - Flexera, 2023

McKinsey research reportedly estimates that predictive maintenance and analytics-driven operations can cut machine downtime by 30-50% in industrial settings while extending equipment life. - McKinsey

THE PRACTICE PAGES

The 8-action checklist

Work through the list with your team. Tick each box as your organization completes the step, and fill in an owner and a target date so every action has a name and a deadline.

☐**1. Standardize the OEE definition first**

Agree on availability, performance and quality formulas across every plant before buying any software. Five plants with five OEE definitions produce one consolidated but meaningless dashboard.

OWNER

TARGET DATE

STATUS

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☐**2. Collect at the machine, not the shift**

Connect PLCs and HMIs through OPC-UA so events capture automatically at the machine. Shift-end manual entry guarantees your OEE arrives weeks too late to act on.

OWNER

TARGET DATE

STATUS

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☐**3. Keep line operations WAN-independent**

Run MES cores on local edge servers so scheduling, quality holds and downtime capture continue through outages. Cloud is for analytics, not for keeping lines running.

OWNER

TARGET DATE

STATUS

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☐**4. Centralize analytics, respect data borders**

Aggregate normalized events centrally for plant-to-plant comparison, while raw controlled data stays on-prem wherever regulations require. Get compliance sign-off on that split before the architecture review, not after.

OWNER

TARGET DATE

STATUS

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☐**5. Ship MES as one versioned product**

Deliver MES configuration through GitOps pipelines so every plant runs the same versioned release. Version drift is exactly how five plants quietly become five unsupported systems.

OWNER

TARGET DATE

STATUS

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☐

6. Start with bottleneck lines

Instrument constraint and bottleneck lines first, where every recovered OEE point is worth the most money. Early dollar wins on bottlenecks fund the rest of the rollout.

OWNER

TARGET DATE

STATUS

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☐

7. Capture downtime reasons at the HMI

Let operators tag stoppage causes in seconds, on HMI screens they already use every shift. Clean reason codes turn OEE from a score into a diagnosis.

OWNER

TARGET DATE

STATUS

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☐

8. Review plants together, live

Hold a weekly cross-plant review on one live console instead of reconciling five spreadsheets. Shared visibility creates healthy internal competition that sustains improvement long after launch.

OWNER

TARGET DATE

STATUS

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AFTER THE CHECKLIST: OUR TOP 3 PRIORITIES

From the eight actions above, write down the three you will start first - and the single number you expect each one to move. Three priorities with owners beat eight without any.

PRIORITY 1 NUMBER IT SHOULD MOVE	PRIORITY 2 NUMBER IT SHOULD MOVE	PRIORITY 3 NUMBER IT SHOULD MOVE
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THE PRACTICE PAGES

Reflections for your team

Use these questions in your next planning session and type short answers into the boxes. The gaps you find are usually the fastest wins.

Q1. Can your plants' OEE numbers be compared today, or are they measuring different things?

Q2. How many hours pass between a line stopping and someone in leadership knowing why?

Q3. What is one point of OEE on your bottleneck line actually worth per year?

Q4. Which plant would resist a shared MES most — and what would convince its team?

Q5. If a customer audit arrived next month, how fast could you produce full part genealogy?

Q6. Where would your operations stop if the corporate data center or WAN went dark tomorrow?

THE PRACTICE PAGES

My 90-day plan

Finish the session by committing to a plan. Three phases, one goal each, one number that tells you it worked. Bring this page to your next leadership review - or to a free consultation with Emerson Technology, and we will pressure-test it with you.

Days 1-30 Focus: audit and alignment

PRIMARY GOAL**KEY ACTIONS****HOW WE MEASURE SUCCESS****OWNER**

Days 31-60 Focus: build and prove

PRIMARY GOAL**KEY ACTIONS****HOW WE MEASURE SUCCESS****OWNER**

Days 61-90 Focus: scale and measure

PRIMARY GOAL

KEY ACTIONS

HOW WE MEASURE SUCCESS

OWNER

Tip: save a copy per team so each group keeps its own answers. Revisit the reflections every quarter - the questions stay the same even as the numbers move.

BOOK THE REVIEW BEFORE YOU CLOSE THE BOOK

Plans without a review date drift. Before you close this practice book, agree on when you will come back to these pages, who will run that session, and when you will check the numbers again. If you want an outside pair of eyes, bring this page to a free consultation with Emerson Technology and we will pressure-test the plan with you.

REVIEW DATE	REVIEWED BY	NEXT CHECK-IN
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Ready for a transformation like Cascadia Precision Manufacturing's?

Emerson Technology designs and builds the data, AI, cloud and automation systems behind results like these. On a free consultation call we will map this exact playbook to your business - your data, your constraints, your numbers.

Book a free consultation

support@emersontechnology.com

or start online: emersontechnology.com/contact