

From Pilot to Platform: Scaling Smart Manufacturing Across a Global Enterprise

A case-based framework drawn from Kimberly-Clark's enterprise-wide digital manufacturing transformation, validated against the CESMII Smart Manufacturing Roadmap Framework.

Whitepaper

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Abstract

Only **28% of manufacturers** are successfully scaling smart factory initiatives across their enterprise, according to the 2026 Manufacturing Leadership Council (MLC) Smart Factories Survey. The majority remain in “pilot purgatory” — a phenomenon documented by [McKinsey](#) and the [WEF Global Lighthouse Network](#), which found **at least 70% of manufacturers** unable to scale digital innovations across their manufacturing networks.

This paper presents a practitioner-authored case study of Kimberly-Clark's (K-C) Digital Manufacturing Foundations Program, documenting a multi-year journey from a fragmented, legacy-dominated Manufacturing Execution System (MES) landscape to a globally scaled template deployed across 70+ manufacturing sites. The program has achieved hundreds of go-lives, connected a substantial portion of the global manufacturing network, engaged thousands of users across the enterprise, and enabled significant measurable financial value — while setting internal records for deployment speeds.

From this journey, we derive a **Three-Pillar Scaling Framework** — People, Process, and Data Foundations — validated against the [Smart Manufacturing Acceleration Roadmap framework](#) developed by the Collaborative Ecosystems for Smart Manufacturing Innovation Institute (CESMII). The framework identifies the organizational, process, and data-architecture decisions that determine whether a smart manufacturing program scales or stalls and offers a replicable four-step methodology for practitioners seeking enterprise-wide impact.

1. Introduction

The promise of smart manufacturing — real-time visibility, data-driven decision-making, enterprise-wide operational excellence — has been widely documented and broadly pursued. The global smart manufacturing market was valued at **\$394 billion in 2025** and is projected to reach \$1.34 trillion by 2034 at a CAGR of 14.7% ^[1]. The MES segment alone was valued at **\$15 billion in 2024**, expected to reach \$39 billion by 2034 ^[2].



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Yet scaling remains the critical unsolved problem. McKinsey's collaboration with the World Economic Forum's Global Lighthouse Network found that **at least 70% of manufacturers are stuck in pilot purgatory**, with no clear approach for scaling digital innovations across their manufacturing networks ^[3]. More recent 2026 MLC survey data confirms the problem persists: only 28% of manufacturers are successfully scaling smart factory initiatives enterprise-wide ^[4]. The gap between pilot success and enterprise scale is not primarily a technology problem — it is an organizational, process, and data architecture problem.

This paper addresses that gap through an in-depth practitioner case study of Kimberly-Clark's Smart Manufacturing Operations Management (SMOM) program. K-C is a \$20+ billion global consumer goods company operating 70+ manufacturing sites across five major product categories — representing over **\$240 billion in total global market opportunity** ^[5]. The scale and complexity of K-C's manufacturing network makes it a representative and instructive case for any organization undertaking enterprise digital transformation. The paper proceeds as follows:

- **Section 2:** Reviews the literature on smart manufacturing scaling and MES deployment
- **Section 3:** Describes the K-C case in detail
- **Section 4:** Presents the Three-Pillar Framework
- **Section 5:** Describes the CESMII Smart Manufacturing Acceleration Roadmap framework in detail
- **Section 6:** Maps the K-C journey to that framework
- **Section 7:** Offers a four-step practitioner methodology
- **Section 8:** Concludes

2. Literature Review

2.1 The Scaling Problem in Smart Manufacturing

The phenomenon of “pilot purgatory” was formally identified by McKinsey in their 2018 Digital Manufacturing Global Expert Survey, which found that while two-thirds of industrial companies worldwide named digital manufacturing as a top priority, meaningful bottom-line benefits from enterprise-wide deployment remained elusive ^[3]. McKinsey's 2020 update reinforced that **70% of manufacturers** remain unable to scale digital innovations beyond isolated pilots, identifying culture as the most significant challenge alongside the absence of strategic direction, governance infrastructure, and required organizational capabilities ^[6].

The academic literature on MES implementation echoes these findings. Tabim et al. (2024) identify information asymmetries between MES buyers and providers as a key implementation barrier, noting that technology providers often fail to communicate integration complexity while buyers overestimate the scope of automated solutions — a dynamic that systematically undermines deployment at scale ^[7]. Jaskó et al. (2020) identify the need for standardized, semantically enriched information models as fundamental to the next generation of MES, arguing that global networking of production resources “crucially requires the adoption of unified standards” ^[8].

McKinsey further identifies the “last IT/OT mile” — integration complexity arising from heterogeneous equipment purchased over decades from different suppliers — as one of the highest barriers to scaling Industry 4.0 ^[9]. IoT Analytics (2025) quantifies ground-level reality starkly: **54% of plants globally** still manage manufacturing operations primarily through paper and spreadsheets, and only **8% use a commercial MES** ^[10].



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2.2 The Data Foundation as Prerequisite

A consistent theme across literature is the centrality of data architecture. Deloitte's 2025 Smart Manufacturing and Operations Survey of 600 manufacturing executives identified data readiness as a foundational constraint alongside talent ^[11]. MLC research confirms this: **65% of manufacturers lack useful, AI-ready data**, making advanced analytics effectively inaccessible regardless of the technology tools deployed ^[4].

BCG's 10-20-70 principle frames this usefully: AI and digital success is 10% algorithms, 20% data and technology, and **70% people, processes, and cultural transformation** ^[12]. Gartner finds that 85% of all AI projects fail due to poor data quality, and predicts that 60% of AI projects will be abandoned without clean data foundations ^[12]. The implications for investment sequencing are direct: the data layer must precede the analytics layer.

2.3 Maturity Frameworks and Roadmap Approaches

CESMII — the U.S. Department of Energy-funded Smart Manufacturing Institute established in 2016 — developed the Smart Manufacturing Acceleration Roadmap Framework as a practitioner-oriented, vendor-neutral methodology ^[14]. Unlike many academic maturity models that focus on technology adoption across 16–20 dimensions, the CESMII framework assesses **six business practice dimensions** (Strategy, Culture, Processes, Systems, Workforce, Supply Chain) and is specifically designed to be revisited every two years ^[14]. McKinsey's synthesis of Global Lighthouse Network findings identified six success factors common to at-scale manufacturers, including focusing on bottom-line value, driving transformation from the top through P&L owners, and building a focused ecosystem of technology partners ^[3].

3. The Kimberly-Clark Case

3.1 The Legacy Landscape

Prior to SMOM, K-C's manufacturing environment exemplified the fragmentation documented in the broader literature. Four distinct MES landscapes operated in parallel:

- **PIPE (Personal Care):** Homegrown system, 1997 vintage, deployed across ~35 sites. Not meaningfully enhanced in a decade.
- **PIMS (Family Care):** Built on GE Plant Apps / OSI PI (1999 vintage), deployed across ~20 sites. Lacked standardization.
- **Other MES:** ~10 sites running APMS, DAA, AGIL, MIS, PRODUC, and other homegrown tools with no enterprise coherence.
- **No MES:** 10+ sites on manual data collection and paper-based processes. Real-time data logging — a standard in heavy industry since the 1990s — was absent.

The quality management landscape was equally fragmented: EWMA quality software was reaching end of life, with unplanned shutdowns due to diminishing vendor support. Regional IT teams had independently selected point solutions that made local sense but created enterprise overhead and prevented cross-site analytics.



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3.2 Program Architecture: SMOM

The SMOM¹ program was designed around three integrated digital projects forming a unified manufacturing data backbone:

- **PI (Data Historian):** The operational nervous system — collecting, contextualizing, and transmitting real-time machine data and translating sensor/controller information into structured inputs for MES and enterprise systems.
- **PASS (Product Acceptance Software System):** Modern replacement for legacy EWMA quality software, with a rebuilt UX designed to drive adoption across a global, multi-lingual workforce.
- **MES:** The operational core — a 35+ capability suite spanning production data collection, OEE measurement, raw material validation, centerlining, genealogy tracking, and automated ERP/WMS integration. Built as a global template rather than site-specific deployments, a design decision that proved foundational to the program's scaling velocity.

Four guiding principles shaped program design: **Connect** (end-to-end integration across production, quality, and enterprise systems), **Improve** (building on enterprise best practices), **Partner** (leveraging strategic technology partners), and **Standardize** (creating a digital foundation that enables enterprise scaling rather than site-by-site variation).

3.2.1 What 'Global Template' Means in Practice

- **Standardized core functionality:** Identical workflow logic, OEE definitions, and event classifications across all sites, ensuring every plant measures performance against the same standard and enabling meaningful cross-site benchmarking.
- **Standardized data model and integration interfaces:** A single schema and a centrally maintained ERP/WMS integration layer, not bespoke site-by-site connections. This creates the unified data foundation that makes enterprise analytics and AI possible.
- **A common release and versioning discipline:** One software product with a central release cycle; North America, Asia Pacific and Europe all run the same version, meaning every improvement benefits the entire global network simultaneously.
- **Bounded site configuration, not customization:** Sites can configure parameters (language, shift patterns, equipment names) but cannot change core logic or the data model preventing fragmentation over time.

3.3 The Digital Manufacturing Strategy House

K-C organized its digital investment around a layered Strategy House framework — a pyramid with Digital Manufacturing Foundation and Change Management at the base, ascending through capability leverage, digital network strengthening, and advanced analytics and automation, to Best in Class Manufacturer at the apex. Every SMOM capability decision was evaluated against its contribution to ascending this pyramid. Critically, **Change Management was embedded at the foundation level**, recognizing that technology alone does not transform organizations.



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3.4 Program Trajectory: Non-Linear but Committed

- **Pre-2020:** Multiple aging, siloed platforms. No global standard or shared data model across 70+ sites.
- **2020–2021:** Initial out-of-the-box MES evolved into a highly customized, templated platform. Requirements gathering significantly expanded the capability suite.
- **2022–2023:** Broader testing revealed new gaps. Dedicated development teams resolved thousands of bugs and user stories across multiple capability domains, driving structural improvements and solution stabilization.
- **2024–Present:** Template stabilized, deployment accelerated globally. New internal benchmarks for site deployment speed were set, demonstrating the compounding value of standardization.

3.5 Program Results

Metric	Result
Deployment Velocity	300+ asset go-lives completed; internal deployment speed benchmarks significantly improved year-over-year
Global Users	5,000+ users across the enterprise, with many more leveraging the resulting data
Continuous Improvement	Thousands of product improvements resolved through a dedicated Agile development model, demonstrating ongoing product investment
Value Enabled	Significant annualized financial value enabled, spanning operational savings (OEE, Waste, Energy) currently in process and advanced capability unlocks (AI, automation) on the future roadmap

Table 1: Illustrative SMOM program results as of early 2026.

4. The Three-Pillar Scaling Framework

Drawing from both the K-C journey and the author's prior digital transformation leadership at Kohler Company, validated against the CESMII Smart Manufacturing Roadmap, three interconnected pillars emerge as determinative of whether a smart manufacturing program scales or stalls. They must advance together.

Core thesis: Scaling smart manufacturing is not a technology problem. It is a people, process, and data foundations problem — and each pillar is a prerequisite for the others.



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4.1 Pillar 1: People — The Human Operating System

Every scaling failure observed traces back, at least in part, to a people or governance gap. Four sub-dimensions proved critical:

- **Leadership alignment and sponsorship:** Without visible, sustained C-suite and plant-level sponsorship, digital programs are systematically deprioritized when operational pressure mounts. BCG research confirms that active executive sponsors make organizations 1.8x more likely to scale digital initiatives effectively ^[12].
- **Organizational structure and governance:** K-C's "Powerhouse Connected Team" model uses a COE and SteerCo for strategic guidance with strong IT/OT collaboration at the execution layer. Governance prevents organizations from re-debating the same design decisions at every new site.
- **Site engagement and change management:** Workers must be empowered as innovators, not merely handed new systems. Site champions, structured onboarding, and visible early wins are the human infrastructure that determines whether deployed tools are actually used. K-C hired dedicated site-level Digital Manufacturing leaders to anchor this.
- **Deployment partners and sustain adoption:** External expertise accelerates deployment velocity. Adoption requires ongoing investment well past the go-live date — the tools must be used consistently for months and years after the deployment team has moved on.

4.2 Pillar 2: Process — Turning Strategy Into Scalable Action

- **Strategic roadmap sequencing:** The CESMII Assess > Focus > Roadmap sequence enforces the right investment order. K-C's initial assessment, which revealed the full severity of legacy fragmentation, was the evidentiary foundation that justified the scale of the SMOM investment.
- **Global KPI and process standards:** If every plant defines OEE differently, cross-site benchmarking is meaningless. MLC research confirms that 35% of manufacturers cite data interoperability as a primary scaling roadblock ^[4] — a problem rooted in non-standardized process and data definitions.
- **Project-to-product mindset:** MES is a long-lived enterprise capability requiring continuous investment and iteration. K-C's continuous Agile development cadence is direct evidence of product thinking. Organizations that treat digital as their product — with roadmaps, product owners, and release cycles — are the ones that scale.
- **Capital funding model:** Project-by-project ROI models are structurally incompatible with long-horizon enterprise digital investment. Infrastructure-based funding — the same logic applied to ERP deployments in the 1990s — is required.



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4.3 Pillar 3: Data Foundations — The Groundwork That Makes Everything Else Possible

- **Standard technology stack:** A global digital foundation standardizing systems and data from the sensor layer to enterprise analytics is the technical prerequisite for enterprise intelligence. K-C's move from 70+ disparate regional systems to a single global SMOM release enabled faster rollouts and eliminated costly rebuilds.
- **The MES as global template:** Every improvement at one site becomes available at every site on the next release cycle, creating compounding returns on standardization investment that per-site deployments cannot achieve.
- **Data as AI prerequisite:** K-C's roadmap explicitly sequences the data foundation before AI/analytics capabilities. Operational savings programs run now; advanced AI and automation capabilities unlock only once the data layer is in place. MLC survey data confirms the imperative: 65% of manufacturers lack useful AI-ready data ^[4]. There is no shortcut.

Framework summary: The Three Pillars are not independent dimensions. Leadership without process governance produces unsustainable pilots. Process discipline without a standard data foundation produces ungeneralizable insights. A clean data foundation without organizational adoption produces unused dashboards.

5. The CESMII Smart Manufacturing Acceleration Roadmap Framework

CESMII is the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy (EERE)-funded Smart Manufacturing Institute, established in 2016 and headquartered at UCLA. Its mandate is to accelerate smart manufacturing adoption across U.S. industry by integrating advanced sensors, data contextualization, analytics platforms, and controls into manufacturing operations. One of its most significant practitioner contributions is the **Smart Manufacturing Acceleration Roadmap Framework** — a structured, vendor-neutral methodology that helps manufacturers move from informal, technology-driven experimentation to a coherent, business-objectives-driven transformation plan ^[14, 15].

The framework was built by practitioners who have engaged in successful smart manufacturing adoption in their own companies. It is specifically designed to address the three core struggles manufacturers consistently report:

- Difficulty envisioning what smart manufacturing means for their specific business.
- Lack of a clear strategy for justifying and prioritizing investments.
- The absence of a structured, repeatable process for moving from current-state assessment to a funded roadmap ^[14].

Approximately 100 certified CESMII Smart Manufacturing Roadmap Professionals are currently active in the U.S., providing organizations access to a structured coaching engagement rather than a prescriptive vendor playbook.



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5.1 The Four Phases of the CESMII Roadmap

The CESMII framework structures the journey from maturity assessment to funded action plan across four sequential phases, comprising 14 discrete steps. The phases are designed to flow sequentially — critically, the Assess phase must be completed honestly before Focus can begin, and Focus must produce alignment on priorities before Roadmap investments can be credibly defended to leadership.

Phase	Purpose	Key Steps
Pre-Assess	Orient the engagement. Establish consulting approach and ensure the manufacturer understands the framework and expected outcomes before assessment begins.	1. Consulting approach 2. Framework overview delivered to client leadership
Assess	Establish an honest, data-driven baseline. Surveys, interviews, and diagnostic analysis across the six business practice dimensions determine the organization's current maturity state. This phase is iterative by design.	3. Execute assessment 4. Develop themes and insights 5. Review opportunities and gaps
Focus	Translate assessment findings into prioritized opportunities. Deep-dive interviews and analysis identify which improvements will deliver the most business value, defining the future-state targets across each dimension.	6. Deep-dive questions 7. Conduct interviews 8. Analyze insights 9. Develop opportunities and value 10. Define future state
Roadmap	Build the actionable, funded plan. Business objectives, initiative scoping, prioritization, and a finalized communications deck provide the leadership-ready output needed to secure organizational commitment.	11. Business objectives 12. Initiatives and scope 13. Prioritize programs 14. Finalize and communications deck

Table 2: The CESMII Smart Manufacturing Acceleration Roadmap — four phases and 14 steps. Source: CESMII ^[14].

5.2 The Six Assessment Dimensions

Unlike most Industry 4.0 maturity models, which assess 16–20 dimensions with a heavy focus on technology adoption, the CESMII framework assesses six business practice dimensions — keeping the engagement focused, affordable, and actionable. The six dimensions are:

1. **Strategy:** Clarity of digital manufacturing vision, alignment of technology investment with business objectives, and the organization's horizon for smart manufacturing ambition.
2. **Culture:** Organizational readiness for change, manufacturing excellence culture, leadership behavior modeling, tolerance for experimentation, and the depth of cross-functional collaboration.
3. **Processes:** Maturity and standardization of manufacturing processes, including quality management, production execution, and continuous improvement practices.
4. **Systems:** The current state of technology infrastructure — MES, ERP, data historian, connectivity — and the degree to which systems share data and enable visibility.



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5. **Workforce:** Digital skills and capabilities across the organization, training and upskilling programs, and the degree to which workers are empowered to leverage digital tools.
6. **Supply Chain:** Connectivity and data exchange with suppliers and customers, and the organization's ability to use digital manufacturing data to drive supply chain performance.

This six-dimension structure is a critical differentiator. It ensures that technology is discussed only where it enables the business strategy — not as an end in itself. A manufacturer can score highly on Systems (technology infrastructure) while scoring poorly on Culture or Workforce, and the framework surfaces this imbalance explicitly, preventing organizations from over-investing in tools before the organizational readiness exists to use them effectively ^[14].

5.3 The State Transition Matrix

The CESMII framework uses a State Transition Matrix to locate an organization's current maturity and define its target state across five levels: Reactive, Aware, Collaborative, Proactive, and Adaptive. Each level represents a qualitatively different mode of operating:

- **Reactive:** Operations are managed by exception. Data is collected inconsistently and used retrospectively. Digital tools, if present, are siloed and not integrated into decision workflows.
- **Aware:** The organization has begun to identify digital opportunities and is running pilots or early deployments. Data collection is improving but analysis remains largely manual and site-specific.
- **Collaborative:** Cross-functional teams are working toward shared digital goals. Some integration exists between shop-floor systems and enterprise systems. Early standardization efforts are underway.
- **Proactive:** Standardized processes and connected systems enable predictive insights and proactive actions rather than reactive operations. Analytics inform decisions at multiple organizational levels. Knowledge transfers across sites.
- **Adaptive:** The organization operates as a self-improving system. AI and advanced analytics continuously optimize processes. New capabilities deploy rapidly across the global network. Best practices propagate automatically.

Most manufacturers have been entering CESMII engagements sitting between the Aware and Collaborative levels. The matrix is not simply a diagnostic — it is a strategic planning tool. By coaching the team to articulate both the current state and the target state across each of the six dimensions, organizations can make explicit trade-offs about where to invest first and what “good enough” looks like at each stage of the journey.

5.4 What Differentiates the CESMII Framework

Several characteristics distinguish the CESMII framework from commercially-developed maturity assessments and large-consulting-firm engagements:

- **Vendor-neutral and solution-agnostic:** The framework produces a roadmap tied to business objectives, not a technology selection. No vendor is privileged in the process, and technology options are evaluated only where they serve the strategy.



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- **Business-first, technology-second:** Technology is one of six assessed dimensions. The framework explicitly prevents organizations from jumping to technology procurement before establishing strategic clarity, cultural readiness, and process discipline.
- **Designed to be revisited:** The framework recommends reassessment every two years to check progress, measure impact, and realign the roadmap with evolving business goals. This built-in cadence operationalizes the product mindset required for sustained digital transformation.
- **Crowd-sourcing methodology:** Assessment draws on input from across the organization — not just IT or operations leadership — creating internal alignment on the need for selected improvement initiatives before work begins. This dramatically improves change management outcomes.
- **Affordable and scalable:** A typical CESMII roadmap engagement is targeted at \$8–15K in consulting fees, significantly below the cost of large-firm engagements, making it accessible to mid-size manufacturers as well as global enterprises.

The CESMII framework is not a checklist — it is a structured facilitation process. The goal is to help manufacturers “learn to fish”: to become equipped to sustain and evolve their own smart manufacturing plan, rather than remaining dependent on consultants to operate it.

6. Mapping the K-C Journey to the CESMII Smart Manufacturing Roadmap

The CESMII Smart Manufacturing Acceleration Roadmap Framework is the most rigorously practitioner-developed, vendor-neutral framework available for assessing manufacturing maturity ^[14, 15]. Its four phases and six assessment dimensions map directly onto the K-C journey:

CESMII Phase	K-C Manifestation	Key Learning
Assess	Legacy Landscape Discovery — PIPE, PIMS, 10+ sites with no MES	The severity of the problem, honestly assessed, justified the scale of the solution. Without this, the investment case would have been speculative.
Focus	Digital Mfg Strategy House — layered framework connecting foundational capabilities to best-in-class manufacturing	The Strategy House enforced the right investment sequence: foundation before analytics, standardization before AI.
Roadmap	Two-Stage Deployment Plan — Stage 1 (baseline) and Stage 2 (advanced differentiating capabilities)	Staging prevented premature investment in advanced capabilities before the data foundation could support them.
Sustain	Continuous improvement model — thousands of product improvements through an ongoing Agile development cadence; template continuously updated and deployed globally	Treating MES as a product meant the roadmap had no end state — only ongoing iteration. This operationalizes CESMII’s guidance to revisit every two years.

Table 3: Mapping the K-C SMOM journey to CESMII Smart Manufacturing Acceleration Roadmap phases.



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7. A Four-Step Practitioner Methodology

Step 1: Assess — Know Where You Stand Before You Invest

Run a structured manufacturing maturity assessment — ideally using the CESMII Smart Manufacturing Readiness Assessment — at your highest-priority sites, covering Strategy, Culture, Processes, Systems, Workforce, and Supply Chain. The assessment must be **honest about severity**: the K-C assessment revealed a landscape far more fragmented than informal estimates suggested, and that severity was essential to building the investment case for SMOM's scale. Notably, 20% of manufacturers cite lack of a roadmap as their primary scaling roadblock^[4] — the assessment is the prerequisite for the roadmap.

Step 2: Align — Build Governance Before You Write Code

Establish organizational structure and governance before committing to vendor contracts or deployment timelines: define COE mandate and composition; establish SteerCo and escalation paths; clarify enterprise vs. site-level ownership; and secure visible, named executive sponsorship. McKinsey's analysis of Global Lighthouse Network manufacturers identifies top-driven, coordinated governance — specifically not treating transformation as an IT implementation — as one of six key success factors^[3]. BCG confirms active executive sponsors make organizations **1.8x more likely to scale** effectively^[12].

Step 3: Standardize — Resist Customization, Build the Template

Commit to a global template and resist site-specific customization. Every site will have genuine reasons why it is “different.” Uncontrolled customization is the mechanism through which enterprise scaling fails — it creates the fragmentation that SMOM was built to replace. The economic case is powerful: IoT Analytics (2025) estimates MES total addressable market at over \$50 billion, with the primary barrier being per-site integration cost^[10]. K-C's global template design eliminated this complexity: every improvement at one site becomes available at every site on the next release cycle, creating compounding returns that per-site deployments structurally cannot achieve.

Step 4: Scale — Deploy in Stages, Build Capability, Demonstrate Value

Deploy in defined, sequenced stages. Stage 1 establishes the baseline digital foundation: data infrastructure, MES template, quality and Manufacturing KPI tracking capabilities. Stage 2 deploys advanced differentiating capabilities — AI, advanced analytics, cost modeling, automation — accessible only with a clean data foundation. Use each go-live to improve the template and demonstrate value. The compounding effect of a well-designed global template means later deployments are faster, cheaper, and better than earlier ones. K-C's significantly improved site deployment velocity is a direct product of this compounding dynamic.



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8. Conclusion

The problem of pilot purgatory in smart manufacturing is not new, but its persistence — 70% of manufacturers unable to scale per McKinsey / WEF Global Lighthouse Network, only 28% successfully scaling per 2026 MLC data — demands practitioner-grounded models for enterprise scaling.

This paper has documented one of the most extensive global MES deployments in consumer goods manufacturing, derived a Three-Pillar Scaling Framework from that experience, and demonstrated its alignment with the CESMII Smart Manufacturing Roadmap framework. The core finding is straightforward: scaling smart manufacturing requires simultaneous, coordinated progress across **People** (governance, leadership, change management), **Process** (roadmap sequencing, global KPI standards, product mindset, capital funding), and **Technology & Data** (standard stack, global template, data foundation as AI prerequisite). Deficiency in any pillar limits progress in the others.

“Pilots prove what’s possible. Platforms decide what’s sustainable.”

The 28% who are successfully scaling share a common trait: they stopped treating digital manufacturing as a project and started treating it as a capability. The path to joining them begins with one honest assessment.



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