

Generative AI in MEP Engineering: The Transformation Ahead

A Strategic Overview for European
MEP Decision Makers

Paper 1 of 4: Strategic Overview



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Introduction to the Series

This four-part whitepaper series examines how generative AI is transforming MEP engineering, with specific focus on European regulatory requirements and practical implementation challenges. Rather than offering generic AI guidance, the series addresses the distinct needs of MEP decision-makers across strategic, organizational, technical, and business dimensions.

Paper 1: Strategic Overview establishes why this transformation differs from previous technology waves, what competitive advantages MEP firms possess, and which strategic options are emerging.

Paper 2: Human-AI Collaboration addresses workforce transformation, role evolution, talent development strategies, and organizational change management.

Paper 3: Technology and Implementation provides technical depth on AI capabilities, maturity assessment, data infrastructure architecture, and integration patterns.

Paper 4: Business Strategy and Execution details positioning scenarios, investment frameworks, implementation roadmaps, and risk management approaches.

Each paper can be read independently, though the series is designed to provide comprehensive understanding when read sequentially. This first whitepaper provides a strategic overview and is intended to build understanding of the main drivers behind AI transformation in the MEP sector. Practical examples, risk discussions, change management, and implementation guidance will be addressed in greater detail in the upcoming parts of this series

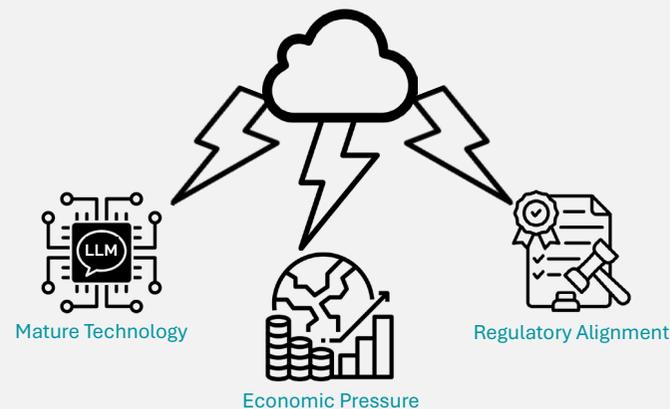
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Executive Summary

The Convergence: Why This Moment Matters

Three forces are converging to make AI adoption mandatory, not optional, for MEP engineering firms. Large language models have matured from impressive demos to practical tools capable of processing HVAC calculations while understanding broader system control strategies. Economic pressure mounts as construction productivity lags other industries, with AI offering direct pathways to improved planning, coordination, and cost reduction. Most critically, EU regulations create an unavoidable mandate: the 2030 Digital Product Passport, CSRD supply chain reporting requirements (phased 2025-2027), and carbon footprint mandates in building permits demand automated data flows that traditional methods cannot deliver. Without systematic data infrastructure, firms will drown in manual compliance. AI isn't optional innovation-it's mandatory infrastructure for regulatory survival.



MEP's Unique Strategic Position

MEP firms possess what tech giants cannot easily replicate: decades of semi-structured domain knowledge in Revit models, IFC files, and calculation sheets. Your advantage isn't building better AI-it's creating the translation infrastructure that makes AI practically useful for MEP work. While global tech firms can build superior models, they lack the accumulated domain knowledge, regional code interpretations, supplier ecosystems, and engineering conventions that make AI practically deployable. Your MEP competitors have this knowledge in their engineers' heads but haven't invested years systematizing it into machine-readable formats. Domain-specific infrastructure compounds with each project, separating scalable AI services from both commodity software and consulting sold by the hour.

Executive Summary

Three Strategic Imperatives

First, data infrastructure is the foundation. Firms that systematically structure project data will build compounding advantages, enabling automation and compliance at scale while competitors remain trapped in manual processes. Second, partnership ecosystems outperform individual tools. Success depends on orchestrating multiple AI capabilities-combining proprietary strengths with strategic partnerships rather than betting on single solutions. Third, human expertise becomes more valuable as AI automates routine tasks. The premium shifts to judgment, creativity, and client understanding. (Papers 2-4 in this series explore these imperatives in depth: human-AI collaboration, technology implementation, and business strategy respectively.)

The Choice

Two viable paths exist: first-movers gaining years structuring data and encoding regional practices, or fast-followers learning from proven patterns but acting decisively. Manufacturing's Global Lighthouse Network shows fast followers achieved 2-3x higher ROI by moving 25-50% faster than early adopters, applying validated approaches rather than chasing experimental technology. What doesn't work is passive observation. The regulatory mandate is clear, the technology is mature, and success depends on how quickly you build the data infrastructure and talent capabilities that will define competitive advantage for the next decade.

If you are looking for concrete examples, guidance on change management, or a deeper discussion of risks and challenges, we recommend continuing with the next papers in this series.

The Convergence: Three Forces Creating Urgency

The coming transformation rests on three simultaneous developments, each independently significant but together creating an unavoidable imperative for action.

Technological Maturity

Large language models have crossed the threshold from research curiosity to practical engineering tools. Zhang and Chen demonstrated that modern LLMs can process specific HVAC calculations while simultaneously understanding broader system control strategies - a dual capability essential for real engineering work. The AI systems available today grasp both heat transfer equations and their role in building operations, enabling practical deployment rather than just impressive demos.

Economic Pressure

Construction productivity chronically lags other industries, with low levels of informatization hindering improvement. AI and machine learning technologies directly address this challenge through improved planning and coordination, decreased project delays, and reduced costs via better resource management and real-time monitoring. The economic case for AI adoption strengthens as traditional approaches to productivity improvement show diminishing returns.

Regulatory Mandate

The EU's 2030 climate targets require the building sector to reduce greenhouse gas emissions by 60%, but the real transformation comes from coordinated regulatory architecture. The Corporate Sustainability Reporting Directive (CSRD), phased from 2025-2027, mandates environmental data from entire supply chains. Finland's new Building Law (2026) requires carbon footprint data in building permits. The EU's Digital Product Passport (2030) will mandate standardized product data. These aren't isolated requirements-they're a systematic transformation of the built environment's information architecture. Traditional design methods cannot optimize the complex interplay of systems and supply chain transparency these regulations demand. Without automated data flows from design through construction to operations, firms will drown in manual reporting. The firms that build data systems now gain compounding advantages that competitors with mature infrastructure will be able to leverage for services requiring years of foundational work to replicate.

Learning from Adjacent Industries: The Fast-Follower Advantage

While the urgency is clear, lessons from manufacturing's digital transformation reveal that success comes not from chasing experimental technology, but from strategically applying mature capabilities to domain-specific problems.

The World Economic Forum's Global Lighthouse Network tracked 189 pioneering manufacturing sites and discovered a counterintuitive pattern: fast followers who learned from proven approaches achieved ROI 2-3x higher over three years by moving 25-50% faster than early adopters. These winners didn't pursue innovation for its own sake. They identified validated technical capabilities, then executed decisively on targeted implementations delivering conversion cost reductions exceeding 50%. The lesson for MEP is direct: don't be first to the technology, be first to solve your domain's specific problems with it. Organizations using mature hybrid approaches to bridge legacy systems achieved 70% faster document retrieval and 80% reductions in processing delays, while 95% of implementations without clean data integration failed entirely.

For MEP firms sitting on decades of valuable project data, this reveals the strategic imperative: invest in data infrastructure and targeted deployment before model complexity. Success requires neither pioneering experimental AI nor waiting passively. It demands starting narrow with mature technology applied to high-value problems, investing in data quality before algorithmic sophistication, and focusing on solving engineering challenges faster and better rather than pursuing technical novelty.



The MEP Advantage: Semi-Structured Domain Knowledge as Competitive Moat

Every Revit model, IFC file, and calculation sheet represents domain knowledge that tech companies cannot easily replicate. But MEP faces a specific challenge: data that's perfectly structured for human engineers becomes wildly inconsistent for machines. Every mechanical engineer might structure an equipment schedule differently-same information, different Excel layouts, column names, abbreviations. "CHW" means chilled water to experienced engineers, but that contextual knowledge isn't encoded in the data itself.

The solution creates lasting competitive advantage. Firms that build translation infrastructure-systematically converting engineer-specific conventions into machine-readable formats-establish barriers competitors need years to overcome. This infrastructure leverages standardized BIM content, product identification systems, and domain ontologies that teach machines how to interpret MEP-specific terminology and relationships. Unlike creative industries with subjective quality measures, MEP operates within clearly defined parameters: code compliance, energy efficiency, thermal comfort. This objective framework means once you've built the translation infrastructure, AI can systematically optimize against measurable criteria.

This infrastructure creates a defensive moat against two types of competition simultaneously. Global tech firms can build better AI models but lack the accumulated domain knowledge, regional code interpretations, supplier ecosystems, and engineering conventions that make AI practically useful. Traditional MEP competitors have that domain knowledge in their engineers' heads but haven't invested in systematizing it. The result: firms with robust translation infrastructure offer automated compliance and carbon analysis while tech giants sell generic tools and traditional competitors are still reformatting spreadsheets. Domain-specific infrastructure compounds with each project - a competitive advantage that strengthens over time rather than eroding. (Paper 3 in this series details the technical architecture for building this infrastructure.)

Technology Readiness: Beyond the Hype

The AI transformation in MEP will be largely invisible, embedded in existing workflows rather than requiring radical software replacement. Current capabilities span the entire MEP lifecycle: digital twins combining design intent with performance data, specialized models trained on technical standards and calculation methods, context-aware systems that retrieve equipment specifications and building codes during design, and autonomous agents that orchestrate multi-step engineering workflows.

What matters for strategic planning isn't the technical sophistication of these systems, but their maturity and deployability. The technologies enabling practical MEP applications—from automated BIM coordination to code compliance checking to equipment selection—are available today, not aspirational futures. The competitive question becomes not which technologies to develop, but how to deploy proven capabilities ahead of competitors. (Paper 3 in this series provides detailed technical analysis of these capabilities, their maturity levels, and MEP-specific implementation patterns.)



The Human Dimension: Judgment Becomes the Premium

AI creates a fundamental paradox: it makes engineering easier to do but harder to do well. When AI can generate functional HVAC layouts in seconds, what separates exceptional engineers from adequate ones? The answer emerging from early adopters is clear: judgment, creativity, and client understanding. AI excels at optimization within constraints; humans excel at questioning whether those are the right constraints.

Smart AI deployment follows a clear principle: eliminate mechanical overhead (syntax checking, unit conversions, report formatting), help manage complexity (breaking down unfamiliar systems into digestible components), but protect the productive thinking-the creative problem-solving, judgment calls, and engineering insights that clients actually value. Engineers who combine domain expertise with AI capabilities represent rare and valuable talent. Organizations that systematically develop these hybrid capabilities-engineers who understand both traditional engineering fundamentals and emerging AI tools-will dominate their markets. (Paper 2 in this series explores the organizational transformation required: role evolution, talent development strategies, and change management approaches for building AI-augmented engineering teams.)

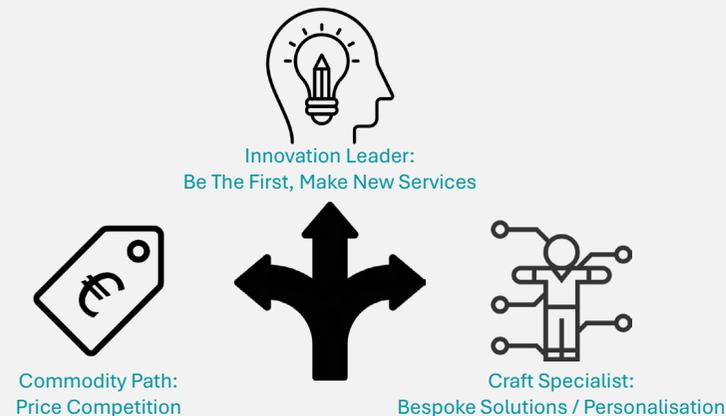
Type of Cognitive Load	Extraneous Load	Intrinsic Load	Germane Load
MEP Engineering Examples	 Code Checking, Formatting, Unit Conversion ...	 Complex Engineering Challenges	 Creative Problem Solving, New Challenges
Use of AI?	 Give to AI!	 Work Together with AI	 Preserve this for Engineers

Strategic Positioning: Multiple Paths to Success

The classic build-versus-buy debate oversimplifies today's strategic landscape. The real question is where your organization needs proprietary advantage versus where standardized capabilities suffice. Build where unique expertise creates lasting value: custom models trained on your project data, workflows tailored to specific market niches, integration layers connecting your internal tools. Buy where industry-wide standardization delivers efficiency: foundational AI infrastructure, common calculations, automated compliance checking. Partner for everything else: collaborate with startups for agility, engage established vendors for stability, work with consultants to bridge capability gaps.

Research shows hybrid “combination” strategies-balancing in-house capabilities with strategic partnerships-double deployment success rates compared to purely internal builds. Organizations succeed by maintaining composable architectures with standardized foundations and modular extensions, preserving both flexibility and scalability.

Three distinct positioning strategies are emerging: firms adopting standard solutions competing primarily on cost in increasingly commoditized markets; innovation leaders pioneering new service categories that literally didn't exist before, creating new revenue streams through outcome-based contracts; and craft specialists maintaining premium positioning through exceptional service quality on complex, high-value projects where standard approaches cannot deliver. Each represents a viable strategy depending on market position, capabilities, and organizational culture. (Paper 4 in this series analyzes these positioning strategies in depth, including implementation roadmaps, investment frameworks, and risk management approaches.)



The Path Forward: Timing, Focus, and Action

Market positioning during this transformation will shape competitive advantage for years to come. Two timing strategies offer viable paths. First-movers starting their AI journey now gain advantages beyond refined workflows and AI-literate teams. The deeper value comes from years spent solving the translation problem-converting project documentation optimized for human engineers into formats machines can learn from. Every firm has decades of valuable project data scattered across inconsistent formats and engineer-specific conventions. Early movers who systematically structure this knowledge while encoding regional practices and local expertise build competitive moats that compound over time.

The alternative fast-follower strategy, validated by manufacturing's experience, offers lower risk by waiting for patterns to emerge before moving decisively. The key is intentional positioning-neither rushing into immature solutions nor delaying so long that the accumulated data structuring advantage becomes insurmountable. What doesn't work is passive observation without commitment to either strategy.

Leading organizations invest approximately four times as much on process and people enablers as they do on technology itself. Start by identifying engineers who understand both your domain conventions and emerging AI tools-these become your bridge builders. The firms that will thrive are those developing deliberate approaches that build data translation capabilities alongside workforce development, recognizing this as a fundamental transformation in how engineering knowledge is captured, structured, and applied.



Conclusion: The Infrastructure You Build Now Determines Tomorrow's Position

The coming years will separate MEP firms into distinct categories-not based on who adopts AI first, but on who builds the foundational capabilities that make AI adoption meaningful. The convergence of regulatory mandates, technological maturity, and economic pressure creates a rare window where strategic investments in data infrastructure and workforce development compound into lasting advantages.

Firms that systematically translate decades of engineering knowledge into machine-readable formats while cultivating engineers who bridge domain expertise with digital capabilities will find themselves offering services competitors need years to replicate. This isn't about choosing between human judgment and algorithmic efficiency-it's about architecting organizations where AI eliminates mechanical overhead while amplifying the creative problem-solving, client understanding, and engineering excellence that define professional value.

The question isn't whether AI will transform MEP engineering; it already is. The question is whether your firm will shape that transformation or be shaped by it. The infrastructure you build now-in data systems, partnership ecosystems, and human capabilities-determines which side of that divide you'll occupy. Start narrow, move deliberately, and remember: the winners won't be those with the most sophisticated AI, but those who solve the most valuable engineering problems with it.

This introduction is intended to frame the strategic issues. For a complete picture of how AI can be implemented in practice, what risks exist, and how organizations can best manage change, please refer to the following parts of this series.



Looking Ahead: The Complete Series

This overview establishes the strategic context for AI transformation in MEP engineering.

Three subsequent papers explore the critical dimensions in depth:

Paper 2:

Human-AI Collaboration - Role transformation, cognitive design principles, talent development strategies, and organizational change management.

Paper 3:

Technology and Implementation - Detailed technical analysis of AI capabilities, maturity assessment, data infrastructure architecture, and integration patterns.

Paper 4:

Business Strategy and Execution - Build / buy / partner frameworks, positioning scenarios, investment analysis, implementation roadmaps, and risk management.



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