

Catalyzing Scale: 7 Barriers to Closing the Pilot-to-Scale Gap

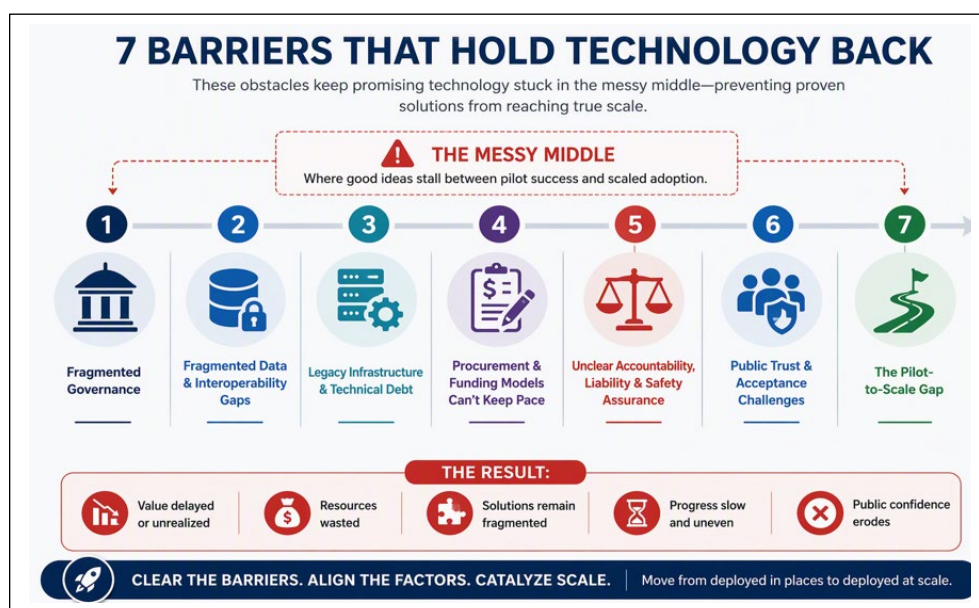
Why promising transportation technologies stall and what it takes to move them forward.

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If the 10 factors presented in Executive Brief 2 describe what can accelerate connected, AI-enabled and autonomous transportation technologies toward scale, these seven barriers explain why that transition remains difficult.



Barrier 1: Fragmented Governance

Federal agencies, state DOTs, cities, counties, MPOs, toll authorities, transit agencies, ports and public safety organizations all shape transportation outcomes, each with its own policies, funding structures, procurement rules, operating practices and risk tolerance. A connected or automated mobility service moving across regions can encounter different data standards, signal systems, regulatory requirements and communication networks at nearly every boundary. The result is an uneven deployment environment where solutions that work in one jurisdiction may not transfer easily to another, limiting their value for agencies and the communities they serve.

STRATEGIC IMPLICATION: Without greater alignment across jurisdictions, deployment stays uneven and scaling stalls. Progress depends on connective governance, including shared standards, coordinated priorities and interoperable rules that let a solution proven in one place travel to many without losing benefit or value.

Barrier 2: Fragmented Data and Interoperability Gaps

Data fragmentation is both a technical and an institutional barrier. Transportation agencies operate multiple systems developed independently, purchased from different vendors or built for specific programs, leaving data trapped in proprietary formats, inconsistent across jurisdictions or inaccessible in real time. This limits mobility AI effectiveness, connected vehicle and AV deployment, regional situational awareness and cross-agency cooperation, producing a familiar pattern: a tool works in one environment but cannot scale across networks, geography or jurisdictional boundaries (see Barrier 1).

STRATEGIC IMPLICATION: Without shared, interoperable data ecosystems, even successful ITS technologies, systems and tools stay boxed inside the corridor that built them. Breaking down data, functional and operational silos is a precondition for turning isolated wins into network-scale capability for next-generation mobility technologies.

Barrier 3: Legacy Infrastructure and Technical Debt

Aging signal systems, limited communications networks, disconnected traffic management platforms, legacy databases and manual, sometimes paper-based, processes remain common

in transportation and many other industries. These systems predate the connected and automated mobility era and cannot natively support it.

The hidden cost is technical debt. Agencies often must modernize foundational systems before advanced mobility AI or AV applications can be deployed, much less scaled. When the necessary investment and upgrades are not immediately possible, new technology is layered onto brittle systems that cannot reliably support it. Technical debt also reflects future rework and maintenance costs that result from short-term decisions made to prioritize speed or cost over long-term quality. Small technical debts can be managed, but at scale, unpaid technical debt accumulates interest, making future work more costly and complex.

STRATEGIC IMPLICATION: Modernization is not a distraction from innovation; it is the precondition for it. Transportation agencies that pay down technical debt build the table foundation on which scalable, AI-enabled transportation operations can reliably stand.

Barrier 4: Procurement and Funding Models That Cannot Keep Pace

Traditional processes assume fixed requirements, long implementation cycles and infrequent upgrades. That model was built for assets that are bought or built once and used for decades with a regular, commonly understood maintenance cadence. AI demands the opposite: iterative development, continuous performance monitoring and full lifecycle management. When acquisition moves more slowly than innovation, agencies cannot capture emerging opportunities. When funding covers the initial purchase but not sustained operation, promising tools cannot be maintained long enough to scale.

STRATEGIC IMPLICATION: Static funding and procurement will keep mobility innovation trapped in pilots, regardless of how effective the technology is. Transportation agencies that modernize both and move toward agile, lifecycle-oriented procurement and funding models remove one of the most decisive barriers to mobility technology scaling.

Barrier 5: Unclear Accountability, Liability and Safety Assurance

An agency's deployment of mobility AI and AVs makes responsibility more complex. Who is liable when an AI-generated recommendation contributes to a poor decision? How should algorithmic performance be audited? Who certifies that an AI-enabled system or AV is safe? What level of human oversight is required, and how should cybersecurity risks be managed?

These questions, and others like them, remain unresolved in next generation ITS deployment environments. AI risk can be framed as operational risk arising from the integration, deployment and operation of AI-enabled systems in the transportation ecosystem. Mobility AI risk reinforces the need for safety-assurance and governance models that account for real-world system interactions and operational realities, especially edge cases.

STRATEGIC IMPLICATION: Uncertainty is itself a barrier to mobility AI and AV deployment at scale. Establishing clear accountability, liability and safety-assurance frameworks gives agencies the confidence to say “yes” and replaces hesitation with the clarity needed to scale safely and responsibly.

Barrier 6: Public Trust and Acceptance Challenges

Public trust is fragile. Highly visible mobility AI or AV safety and operational failures, cybersecurity incidents, privacy concerns, opaque decision-making or perceived data or operational biases can quickly erode public support for mobility AI and automated systems. Persistent concerns, including fears about losing human control of systems people depend on every day, cannot be addressed through messaging alone. Agencies must pair innovation with transparency, community engagement, ongoing performance measurement and independent evaluation, along with clear communication of public benefit and value.

STRATEGIC IMPLICATION: Trust is not built through messaging alone. Trust is earned through demonstrated public value, credible oversight and consistent transparency. Transportation agencies that treat trust as something to be continuously earned will strengthen the public confidence that technology scaling ultimately depends on.

Barrier 7: The Pilot-to-Scale Momentum Gap

The pattern is familiar: pilot, demonstration, evaluation, conference presentation and limited institutional adoption. The technology works, the results are presented and then momentum fades before anything reaches scale. Bridging that gap requires more than a successful trial. It takes executive sponsorship, sustainable long-term funding, workforce integration, procurement modernization, governance structures and performance management. In other words, catalyzing scale demands the organizational scaffolding that turns a one-time success into standard practice.

STRATEGIC IMPLICATION: Mobility AI and AV technologies do not scale themselves; organizations scale technology. Closing the pilot-to-scale momentum gap is one of transportation's most important challenges. The payoff is a system that moves proven technologies from demonstrated success to deployed capability.

Conclusion: Clearing the Path Out of the Messy Middle

The future of intelligent, connected, AI-enabled and autonomous mobility will not be decided by whether the technology works. It will be decided by whether the transportation community can align the conditions that let proven innovation reach the scale needed to deliver national impact.

Throughout this *Scaling Technology* series, a single theme recurs: the hardest distance in transportation technology is not the leap from idea to invention but the long, uncertain crossing from *demonstrated* to *deployed at scale*.

There are forces that can carry technology across that divide: digital infrastructure treated as a core asset, connected and AI-augmented operations, mature data ecosystems, ready institutions and workforces, agile governance, earned public trust, modern funding and procurement, defensible business cases and orchestrated public-private ecosystems.

There are also many forces that hold it back: fragmented governance and data, legacy technology debt, misaligned funding, unresolved accountability, fragile public trust and the persistent gap between pilot and program.

Taken together, they reveal that scaling is not a technical event but an ecosystem achievement, one that no single agency, vendor or jurisdiction can accomplish alone.

This can be a defining insight for leaders navigating the decade ahead. Scale in next-generation transportation technology often needs an assist; it can ignite when enabling conditions converge and barriers fall away at roughly the same time. The role of a catalyst, then, is not to build one more successful pilot but to help align the whole: to mature the standards, prove the interoperability, de-risk the business case, strengthen institutions and workforces and earn the public trust that can tip a promising technology into self-sustaining

and widespread adoption. The organizations that master this orchestration will not merely deploy next-generation transportation technology. They will shape the operating model of 21st-century mobility.

For agencies and their federal partners, that combination is the catalyst the moment increasingly demands: the discipline to turn isolated successes into national momentum and the credibility to carry connected, AI-enabled and autonomous mobility from *deployed in places* to *deployed at scale*. The technology is advancing quickly. The path to scale requires right conditions, trusted evidence and coordinated action.

Battelle can make this transition possible. We help organizations move from promising pilots to responsible, scalable deployment by bringing independent evaluation, safety assurance and systems integration. By delivering integrated applied research together, engineering, deployment and decision support, Battelle is committed to reduce risk, strengthen public trust and turn proven transportation technologies working closely with agencies and the federal government to catalyze localized deployment successes into operational capability.

Contact us to learn how Battelle helps decision-makers bridge the pilot-to-scale gap with evidence-based solutions that move transportation technology from proven to deployed at scale.