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Legacy modernization: Turning complexity into advantage

Deloitte Ascend Mainframe Modernization powers legacy system modernization for growth and resilience

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Key takeaways

- Legacy modernization is a strategic imperative as aging systems constrain agility, resilience, innovation and competitiveness.
- Modernization efforts often stall because of duration, complexity, dual-system costs, obsolete skills, and institutional knowledge gaps.
- Traditional approaches remain useful, but application modernization services should match each system's business criticality and technical complexity.
- Generative AI (GenAI) and agentic frameworks preserve business logic while reducing modernization effort, time to market, and cognitive load.
- Deloitte Ascend™ Mainframe Modernization applies autonomous agents to code transformation, database migration, and automated code analysis across enterprise applications.

Legacy modernization is no longer optional

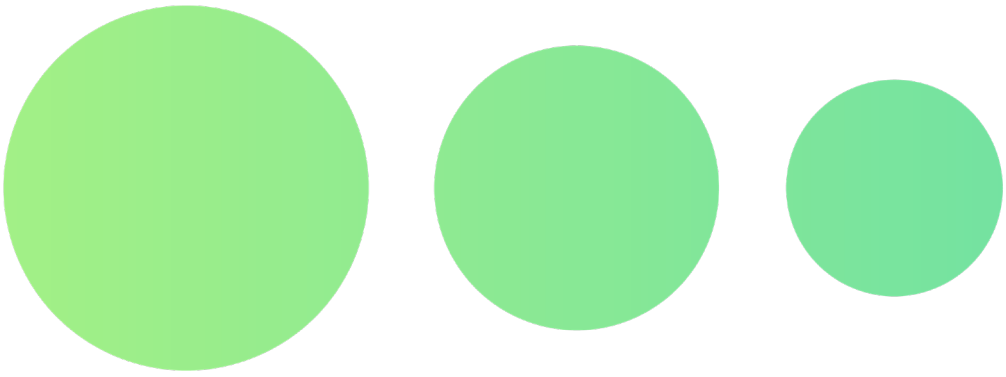
Legacy modernization is an imperative due to decades-old systems that anchor enterprise IT and support business continuity but now create a growing, tangible competitive risk. As customer expectations evolve, regulatory requirements shift and technology accelerates, organizations need to modernize while preserving the primacy of human judgment and embedded contextual knowledge.

As AI-driven innovation accelerates and the digital ecosystem evolves, maintaining legacy environments in isolation is no longer viable for many organizations. Relying on legacy systems may offer stability, but that reliance exposes organizations to strategic vulnerabilities. Legacy system modernization is vital, not simply as a technical upgrade but as a foundational step toward embracing agility, scale and resilience in a rapidly changing landscape.

Why legacy modernization initiatives stall

Complexity issues are frequently the culprit when legacy modernization initiatives stall. Legacy systems are woven into the fiber of the business, and they often rely on decades-old code bases and can be more difficult and costly to maintain. They're also difficult to staff with skilled resources, especially those with institutional knowledge.

Years of software development modifications often result in a significant and wide-reaching asset base of legacy source code with tangled dependencies and interactions. This legacy architecture can limit developers' access to modern tools. Further, security concerns can prohibit access to vibrant open-source ecosystems and increase custom development cost and effort. These costs can considerably impact organizations' abilities to innovate for growth.



One reason it can be difficult to modernize legacy systems

Cost, both in hard dollars and human effort, is one significant reason many organizations find it daunting to undertake legacy system modernization. During interim states, enterprises manage the cost of maintaining current systems as well as costs of the modernization effort until the cutover to the modernized systems. Unfortunately, modernization initiatives often fail midstream because of this significant cost issue.

Adding to the complexity is the ubiquity of aging codebases. For example the Open Mainframe project—COBOL Working Group estimates that approximately 250 billion lines of COBOL are still in use worldwide.1 However, despite the risks involved (obsolescence, complex dependencies), as well as compounding factors like a shrinking institutional knowledge base, many enterprises decide to defer the problem due to cost and effort concerns.

The availability of cloud-based compute-on-demand and cloud-native technology on-premises can substantially mitigate modernization costs and effort; the real question enterprises should answer is, “Why have we not modernized yet?”

However, as with many complex problems, time doesn’t provide easier answers, but that’s changing. Modern advances in GenAI and agentic frameworks can help reduce a significant amount of effort in modernizing legacy systems.

Current modernization approaches

Despite the barriers we've discussed, many organizations are experimenting with modernization strategies. They are:

1. Reverse-engineering existing legacy applications into requirements and specifications to enable the construction of new, modern systems and applications.
2. Converting legacy code into a more modern language.
3. Implementing code emulation to run existing code on modern systems, either through cross-compilation or run-time emulators.
4. Replacing existing legacy systems using commercial off-the-shelf (COTS) solutions.

Each of these "traditional" modernization paths has a time and place, but none provides a universal solution. The "right choice" for a particular application will depend on factors including business criticality, technical complexity, performance requirements, and maintainability. Issues with each of these approaches include the cost of reimplementing a current system only to replicate current functionality, difficulty in understanding the current code base, and performance issues that arise from running older architectures on modern infrastructures.

A new approach: *Generative AI and agentic frameworks*

Emerging architectures that use GenAI and agentic frameworks can provide new opportunities to bend the cost/risk curve of modernization. This approach can provide solutions to help address many of the issues with more traditional approaches. It can potentially lower modernization costs, time to market, and the cognitive load of modernizing systems and represents a balancing of preserving business logic while modernizing and improving applications and systems.

The transformative impact of GenAI is amplified by the emergence of increasingly autonomous agents. These agents can extend the capabilities of generative models beyond simple automation—enabling intelligent, context-aware decision-making and collaboration. By harnessing a growing ecosystem of specialized agents, organizations can orchestrate complex modernization workflows that bridge the gaps between legacy systems and future-ready architectures with significantly more efficiency than more traditional modernization approaches.

However, achieving these benefits requires explicitly established human decision rights at defined control points. These decision rights enable business specialists and engineers to analyze high-impact transformation decisions, address exceptions, and adapt agent behavior as needed.

In this emerging agentic paradigm, where autonomous agents operate with contextual awareness and tool interoperability, the Model Context Protocol (MCP) plays a pivotal role. With MCP as their connective tissue, agents are empowered to seamlessly invoke specialized tools, coordinate tasks, and execute real transformation work, which can turn modernization plans into concrete outcomes. In addition to the MCP, newer approaches like vectorless retrieval augmented generation (RAG) are better suited to linked call chains versus textual parsing of queries and data sources using natural language processing (NLP).

In emerging agentic frameworks, agents are no longer siloed executors but collaborative entities. They can delegate tasks, share results in real time, and coordinate complex workflows across domains. This multiagent orchestration can unlock substantial benefits such as detailed insights from other domains, parallel processing, and emergent problem-solving capabilities.



Deloitte Ascend Mainframe Modernization: A new solution to GenAI and agentic modernization

These opportunities become tangible when applied through Deloitte's application modernization services and platform suite, Ascend Mainframe Modernization, which embeds agentic principles into practical solutions for legacy mainframe modernization. Deloitte has built Ascend Mainframe Modernization to operate seamlessly within agentic environments, leveraging the MCP to facilitate intelligent orchestration and collaboration between autonomous modernization agents.

This integration enables agents to autonomously initiate, coordinate and validate modernization tasks, transforming legacy systems into agile, future-ready architectures with minimal manual intervention needed. However, it's humans who establish guardrails, review and resolve exceptions, and validate and approve changes pre-deployment to ensure that outcomes preserve intended business functionality.

Equipped with a broad suite of capabilities, Ascend Mainframe Modernization helps organizations transform legacy code bases, such as COBOL, into modern languages like Java, and migrate legacy databases to contemporary platforms. Its agents can initiate language and data transformation tasks, scaling from individual modules to entire enterprise applications while preserving business context and transformation fidelity.

That capability requires a deep understanding of legacy architectures, semantics and idiomatic coding patterns. Ascend Mainframe Modernization agents can recognize why multiple jobs invoke the same programs; why one logical input is split across multiple files; and how to identify interfaces across screens, message queues, reports and files, including VSAM, GDG, PDS and flat files. They can also interpret packed decimal fields and determine how to expand date and numeric fields to meet the data representation requirements of modern platforms.

Multiple agents work together to identify functionally cohesive code blocks, analyze code structure, create transformation logic, and validate output against business rules, with the goal of gaining deep insight into the legacy code base for modernization, service decomposition, or even full reimagination of the legacy application.

The upshot? Leveraging agentic AI helps organizations reimagine legacy system modernization as a dynamic, intelligent and continuous process. Agents contained within Deloitte Ascend Mainframe Modernization platform suite of capabilities can autonomously modernize legacy systems, adapt to evolving architectures, and align with enterprise goals to create a future where modernization is not a one-time project but a self-sustaining, agent-driven evolution.

Charting a path forward

Together, these capabilities not only demonstrate the art of the possible but also chart a path for organizations to transform legacy systems into strategic advantage. Legacy modernization is no longer a distant aspiration—it's a strategic necessity for organizations seeking to thrive amid relentless digital transformation. The convergence of GenAI, agentic frameworks, and advanced platforms such as Deloitte Ascend Mainframe Modernization is fundamentally reshaping what's possible.

By leveraging autonomous agents that understand legacy architectures, orchestrate complex transformations and collaborate seamlessly, all while remaining guided by human judgment, enterprises can overcome the long-standing barriers of cost, complexity and risk. This new paradigm enables more than technical upgrades. It provides the ability for organizations to reinvent business agility and resilience. Organizations that embrace these innovations may be better positioned to unlock value from their legacy assets, adapt rapidly to change, and lead confidently into the future.



Endnote

1. Open Mainframe Project, COBOL Working Group, “COBOL in Active Production Use,” estimate of approximately 250 billion lines of COBOL code worldwide, accessed September 11, 2026.

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