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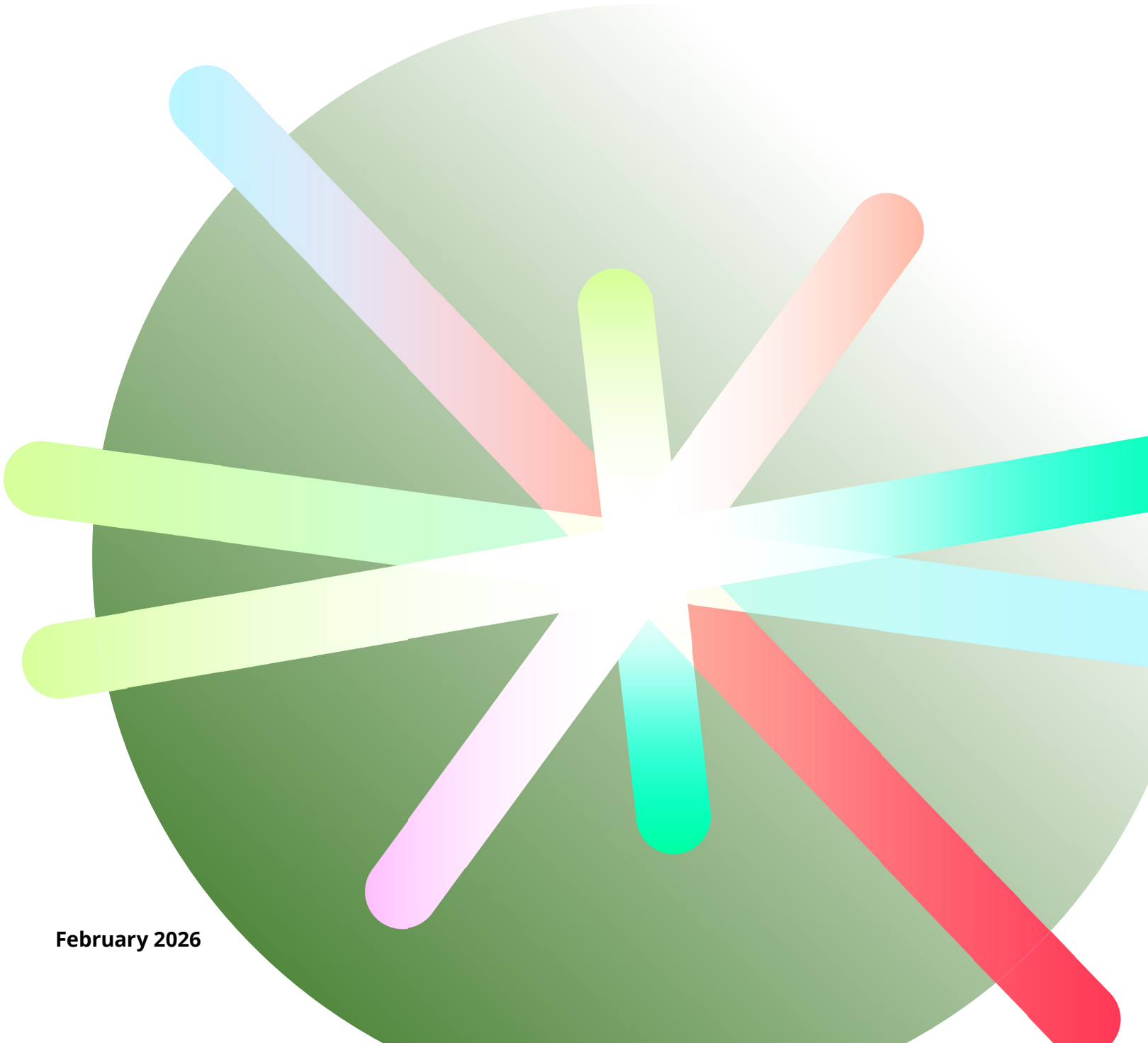
REALIZING THE PROMISE OF AI AND EMERGING TECHNOLOGIES
IN THE TRANSPORTATION INDUSTRY



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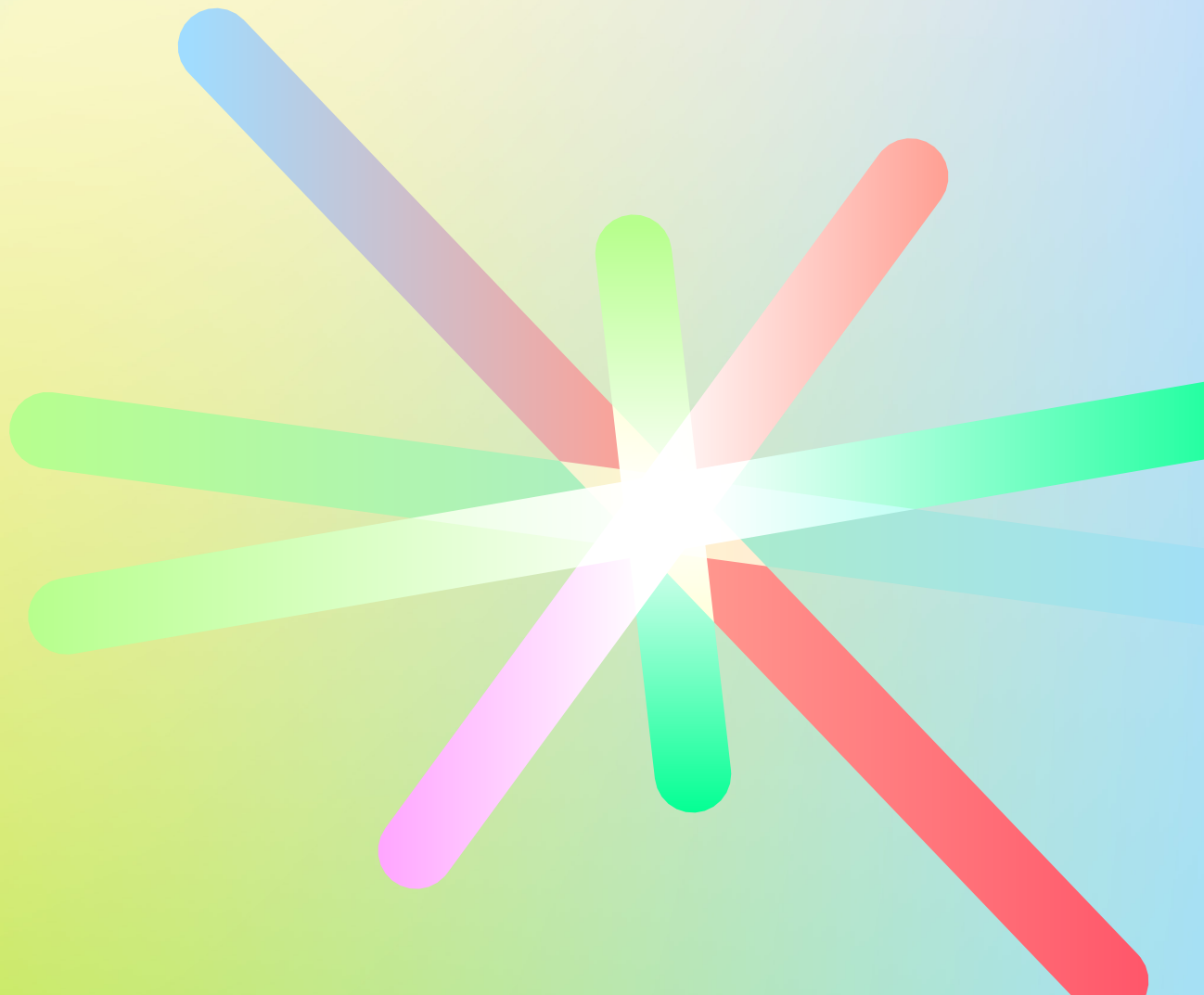
KEY TAKEAWAYS

The transportation industry operates with varying degrees of technological sophistication—from legacy systems to cutting-edge cloud computing, but companies in the industry face one constant: rising expectations from shippers and consumers that will drive transformation over the coming years.

- Expectations are rising, with demands for real-time visibility, intuitive interfaces, and seamless integration extending from consumer applications into business-to-business transportation operations.
- Legacy systems hinder adoption of innovations such as real-time data processing, AI integration, and cloud-based collaboration, limiting operational improvements, financial and talent constraints, and the need for operational continuity make technology adoption challenging for established companies.
- New entrants are disrupting the industry, particularly in freight brokerage and fleet management, by applying artificial intelligence (AI), Internet of Things (IoT), and data analytics for greater efficiency and improved customer service



INTRODUCTION

To better understand the challenges and opportunities associated with Generative AI (GenAI) and emerging technologies in the transportation sector, Deloitte launched a study in November 2024. The study surveyed 210 transportation executives at the C-suite and director levels, with 82% of respondents representing companies with annual revenues exceeding $1 billion—underscoring the scale at which these technologies are being explored.[1]

The findings revealed that while 75% of transportation companies have initiated pilots or implemented at least one GenAI solution, widespread adoption remains limited; only 34% of identified use cases have been adopted broadly across organizations.[2]

To further explore the factors influencing varying levels of adoption, Deloitte conducted extensive primary and secondary research, including interviews with C-suite and EVP level executives across five transportation modes: rail, freight, car rental, third-party logistics (3PL), and parcel delivery. Deloitte's analysis of this research identified pressures toward realizing the promise of emerging technology and strategies to navigate the complexities of modern technology adoption while managing persistent concerns, such as operational continuity, talent shortages, and margin pressure.

1 GenAI in Transforming Transportation: Lessons from the Frontier of an Emerging Technology, Deloitte, November 21, 2024

2 GenAI in Transforming Transportation: Lessons from the Frontier of an Emerging Technology, Deloitte, November 21, 2024

THE TRANSPORTATION TECHNOLOGY LANDSCAPE

The transportation industry encompasses a broad spectrum of business models. Ride-share and rental car companies transport people, executing millions of monthly transactions for both business and leisure customers, all while operating with relatively few physical assets. In contrast, parcel, rail, trucking, and ocean freight companies maintain networks of costly infrastructure such as tracks, roadways, and waterways.

Technology at these companies varies widely, too. At one end, some companies operate with decades-old systems, managing complex networks through manual processes and outdated software. At the other, newer entrants deploy modern technologies—such as IoT sensors, AI, and robotics—using cloud-based applications that enable real-time data analytics and automate decision-making.

This technological gap creates both significant challenges and unprecedented opportunities for transportation companies. Those relying on legacy systems face substantial hurdles in modernizing to meet customer expectations, while those embracing contemporary technologies often drive innovation in the industry, offering improved customer experiences and competitive differentiation.

Legacy-dependent companies should look to develop processes for adopting new technology that can transform their performance and meet rising customer needs without compromising the reliability and trust they have in their existing systems.

CHALLENGES OF A BROAD TECHNOLOGY SPECTRUM

To understand the varying levels of technological maturity among companies, we created a framework for viewing each sector and the hurdles they face. These companies can be differentiated based on their technological infrastructure and approach to innovation and experimentation, each of which can be divided into three categories (See Figure 1):

Figure 1

Redefining Industry Practices in an Industry Segment or Mode			**C. Rideshare Companies (including local delivery services), Freight Brokerage**
Innovating and Partnering in Ways to Support Competitive Advantages		**B. Third-Party Logistics, Trucking companies**	
Experimenting and Implementing Small Scale Use Cases	**A. Class I Railroads, Freight**		
	Operate with Legacy Systems and Infrastructure	**Straddling but Migrating to Contemporary Technology**	**Built with Cloud-Enabled Applications Infrastructure**

Infrastructure foundation

- **Legacy systems:** Operating primarily with outdated technology and infrastructure
- **Migrating to contemporary:** Reliant on legacy systems but implementing modern solutions
- **Cloud-enabled:** Built on or fully migrated to contemporary cloud-based applications and infrastructure

Innovation approach:

- **Small-scale experimentation:** Limited pilots and proof-of-concept projects
- **Innovation for competitive advantage:** Strategic technology investments support market differentiation
- **Industry redefinition:** Technology-driven transformation that reshapes entire industry segments

Groups A and B most often are beholden to legacy systems. While they recognize the benefits of improving their technology, they face internal concerns about compromising the known benefits and reliable results of legacy systems, and the cost commitments of making such changes.

Meanwhile, companies that can adopt contemporary technology show the transformative potential. For example, digital freight brokers that leverage AI for route optimization, real-time pricing, and automated matching of loads with carriers can achieve faster load placements with fewer tender rejections at levels that are impossible for legacy systems.

ELEVATED STAKEHOLDER EXPECTATIONS

The proliferation of sophisticated consumer technologies and growing public awareness of AI and cloud computing capabilities is raising stakeholders' expectations. Employees at these companies increasingly expect professional tools that match the speed and functionality of consumer applications. Shippers and buyers also are demanding features such as real-time tracking, intuitive interfaces, and seamless notifications - that are standard in rideshare and food delivery services - and expecting them to be available in areas such as freight management, logistics coordination, and supply chain visibility platforms.

At the same time, board members and senior executives, familiar with advanced identity tracking and account monitoring technologies in consumer applications, want these same capabilities for cybersecurity and operational visibility, putting more pressure on companies to adopt similar technologies for protecting goods, data, and operations.

By bringing consumer-grade experiences to business-to-business (B2B) interactions, companies may be able to differentiate themselves in the market, improve customer retention, and streamline operations through enhanced stakeholder satisfaction.

DISRUPTION BY TECHNOLOGY-ENABLED NEW ENTRANTS

Well-funded innovators are redefining industry norms with technology, creating competitive pressure on traditional companies and demonstrating the transformative potential of contemporary solutions.

In the past year, the number of companies using AI to improve demand forecasting, inventory management, and risk mitigation rose to 45% from 35%. In addition, 35% of transportation companies are using visibility data to track carbon emissions and select routes that improve fuel efficiency.[3]

In freight brokerage, for example, many leading companies are using AI and data science to optimize matching, pricing, and route planning. In fleet management, some new entrants use IoT sensors, predictive analytics, and automated maintenance scheduling to improve asset utilization and reduce operational costs.

Fleet maintenance represents one of the most critical areas in which AI and IoT integration can create value. Transportation companies—from rental car companies to trucking fleets—identify maintenance management as their biggest operational challenge. Advanced analytics can predict maintenance needs, optimize scheduling, and analyze entire vehicles or fleets to identify potential problems before they cause costly failures.

Companies that still rely on legacy systems may not account for the cost of service disruptions from unscheduled maintenance. Among Global 2000 companies, downtime costs an estimated $200 million annually, or about 9% of annual profit.[4] New entrants also are embracing advances in AI and large language models (LLMs) to enhance customer service with intelligent chatbots and automated support. Computer vision and machine learning are improving freight trailer loading and enabling predictive maintenance that prevents costly equipment failures.

Some companies are leveraging technology to generate new revenue streams. For instance, ride-sharing companies are introducing advertising screens within vehicles to generate additional revenue streams as traditional ride-sharing growth slows.

Private Fleet Net Zero, for example, is making private fleet capacity more efficient. “There’s something like 4 million trucks in the US,” Jones said. “So 45% of that, some 1.8 million trucks, are private fleet trucks and they’re empty something like 80% of the time.” That unused capacity could be worth as much as $350 billion a year, he estimates.

In some cases, these technology partnerships are reshaping fundamental business models. Unlike traditional companies that often struggle with technology scaling, new entrants design their operations around technology from inception, often using “asset light” strategies. This foundation enables them to implement new capabilities rapidly, adapt to market changes quickly, achieve greater operational efficiency—all at a lower cost than their legacy counterparts.

3 New Research from Tive Reveals that 37% of Companies Can’t Track In-Transit Cargo, Tive, March 4, 2025.

4 The Hidden Costs of Downtime, Splunk, Oct. 1, 2024.

RESOURCE CONSTRAINTS AMID MARKET PRESSURES

While the need to adopt new technology may be apparent, traditional transportation companies struggle to do so. They operate in an environment characterized by geopolitical uncertainties, volatile freight markets, and sustained pressure on profit margins. Narrow margins limit capital for technology investments, and companies need to balance the operational continuity of legacy systems against emerging technologies that require significant upfront costs and may not deliver the same results immediately.

"When you look at some of these consumer offerings that you can get on your phone, stakeholders are wishing they could have that," said a former chief information security officer for a major railroad. "If you consider [leading parcel and trucking corporations], they have completely different models for interacting with customers and meeting their transportation needs. They've left railroads so far behind."

The industry's historically thin profit margins exacerbate these financial constraints. In 2024, the average truck cost was $2.26 a mile. Truck and trailer payments rose 8.3% to a record 39 cents a mile.[5] In the truckload sector, for example, the top 10 players typically operate with margins of only three percentage points. This creates a challenging environment in which companies need to weigh technology investments against immediate operational needs.

The margin pressure means that technology investments need to demonstrate clear, measurable returns relatively quickly. The industry cannot afford lengthy implementation periods without visible benefits, making the business case for transformation both more critical and more difficult to establish.

How directors and shareholders value technology transformation can determine its effectiveness. Private equity owners, in particular, may not support the long-term investment benefits of modernizing technology. With their focus on quick returns, PE firms may be reluctant to fund multi-year transitions.

Transportation companies cannot afford operational disruptions during technology transitions. The need for continuous service complicates technology adoption, because companies may need to run parallel systems on a large scale as they implement the new technology, increasing costs and complexity.

The competitive nature of the business compounds the problem, especially in trucking. "Everyone's selling a commodity—a truckload of capacity—and it's hard for these carriers to make money, so they're going to be hesitant to add costs," Jones said.

Given limited resources, companies should prioritize technology investments that offer the greatest potential for innovation and competitive advantage. This prioritization requires sophisticated analysis of potential returns, risk assessment, and strategic alignment with long-term business objectives.

5 ATRI report: Rising costs continue to squeeze trucking industry, Freight Waves, July 4, 2025.

INCREMENTAL PROGRESS VERSUS BREAKTHROUGH INNOVATION

Technology executives in traditional transportation sectors may approach innovation more cautiously than other industries, resulting in incremental improvements rather than transformative breakthroughs.

"They may have a goal to get to a certain production level or some level of efficiency, and when they get it, they set that aside and go to another problem," said Matt Keyser, a freight industry consultant and former director of operations analysis for FedEx Corp.

While this strategy reduces risk, it also limits the potential for significant competitive advantages. The transportation industry's risk-averse culture stems from the high cost of service disruptions, but this can also create competitive disadvantages.

Others may invest judiciously in controlled technology experiments, focusing on incremental performance improvements. While this can demonstrate a technology's potential and reduce implementation risk, it raises questions about scalability, particularly for large organizations generating tens of billions in annual revenue.

Despite the potential, 75% of companies in a recent survey are either running pilot programs or are implementing AI, indicating interest is growing, though full-scale deployment remains limited.[6]

Even companies that decide to embrace technology may not follow through. Many halt progress once they achieve the minimal acceptable improvements or reach a basic production or efficiency level. This costs less than a full technology transformation, but it creates an environment in which companies solve problems in isolation rather than implementing comprehensive solutions.

"Good enough often stops continued progress," Keyser said. "They get it at a much lower cost than a full tech stack revolution, and they say, 'we're doing just fine.'"

This "all-or-nothing" approach often leads to failure. Companies that attempt to modernize all legacy applications simultaneously frequently underestimate the complexity and resources required. More successful approaches focus on customer-facing, revenue-generating systems first, allowing companies to demonstrate value while building momentum for broader transformation.

"The quicker you can prove the value and a couple of quick wins, the more trust you build."

Matt Keyser, a freight industry consultant and former director of operations analysis for FedEx Corp

This pattern of incremental, disconnected improvements can prevent companies from realizing the full transformative potential of modern technologies, particularly AI and cloud-based systems that deliver greater value when implemented as integrated platforms rather than isolated solutions.

The former Director of Operations mentioned that this cautious approach can frustrate stakeholders who anticipate rapid technological advancements and consumer-like experiences. Customers, employees, and partners may become dissatisfied with the pace of improvement, affecting customer retention and a company's competitive position in the market.

Strategic partners who can drive the full scope of technological change can help companies avoid getting stymied by incremental improvements

"Finding the right people may be more important than finding the right programs," he said.

Companies face a critical "one-shot" challenge. Failed initiatives not only waste resources but can also create organizational resistance to future technology investments. When leadership teams are fired following unsuccessful technology programs, incoming executives become even more reluctant to attempt similar initiatives, Keyser said.

Even successful small-scale adoptions can struggle when scaled across large, complex organizations. Barriers include integrating legacy systems, managing the adoption across workforces that may resist change, and the complexity of maintaining consistency across multiple geographic locations and business units.

Companies need to navigate the tension between the risks associated with aggressive innovation and the need for breakthrough improvements. Strategic investment in scalable technologies, combined with sophisticated risk management, can help bridge the gap between cautious experimentation and transformative change.

6 Gen AI transforming transportation: Lessons from the frontier of an emerging technology, Deloitte, Nov. 21, 2024.

THE INDUSTRY'S TECHNOLOGY EXPERTISE GAP

In addition, many transportation companies—both traditional and innovators—lack the necessary combination of industry knowledge and cutting-edge expertise.

Established transportation companies possess extensive industry knowledge, but they may not have the expertise to evaluate, implement, and optimize emerging technologies. Their experts often are focused on operational responsibilities, hindering their ability to provide input on technology adaptation.

Companies built on contemporary technologies may have significant technical capabilities and talent, but they may lack a nuanced understanding of the industry specific knowledge necessary for commercially viable solutions. This gap can lead to sophisticated technical solutions that fail to address real industry problems or cannot be integrated into existing operations.

Even when traditional companies and technology innovators form partnerships, execution issues persist. Differences in organizational culture, decision-making processes, and operational priorities can impede effective collaboration and slow the development of integrated solutions.

What's more, the specialized nature of transportation operations prevents the transfer of knowledge between industry experts and technology teams. Complex regulatory requirements, operational constraints, and customer expectations require deep understanding that cannot be quickly acquired or easily documented.

UNDERSTANDING AI'S TRANSFORMATIVE POTENTIAL

AI represents a fundamental shift in how transportation companies can approach many of their persistent challenges. Unlike previous technology waves that required extensive custom development, AI offers real-time applicability to core transportation operations while providing a pathway to more sophisticated capabilities.

Today's transportation executives recognize AI as a competitive necessity rather than an experimental tool. The convergence of talent shortages, regulatory pressures, cybersecurity threats, and aging legacy systems makes AI adoption imperative.

One of AI's most significant contributions is its ability to extract value from disparate, siloed data sources. Transportation companies typically have vast amounts of operational data trapped in legacy systems, unstructured documents, and isolated applications. AI can bridge these gaps, creating unified data systems that enable more sophisticated analytics and decision-making.

The technology also enables automation at scale that was previously unattainable. Jones said Private Fleet Net Zero uses AI to review data and match far more loads and trucks than could ever be done manually. "It would be humanly impossible to do by hand," he says. "We're thoroughly looking through all the available loads from our clients, and we're matching to all the available capacity of all the fleet cyber system."

Transportation operations generate enormous volumes of complex documents—bills of lading, shipping manifests, customs forms, and regulatory filings. AI can automatically extract, categorize, and analyze this information at scale, identifying patterns, potential delays, and optimization opportunities that would be virtually impossible to detect manually.

By analyzing trends, patterns, and outcomes from years of operations, AI can provide insights that improve long-term planning, market positioning, and investment priorities.

The most promising AI applications in transportation focus on areas in which companies can achieve significant operational improvements with minimal disruption to existing operations. Pricing and rating systems represent particularly fertile ground for AI, as they operate primarily in back-office functions and can leverage existing data without requiring major operational changes.

Advanced pricing optimization using AI can help transportation companies move away from legacy pricing that fails to account for actual profitability per lane or movement. By analyzing large datasets—potentially involving hundreds of variables across thousands of transactions—AI can identify profitable opportunities.

In addition, AI can help transportation companies improve sustainability and enhance environmental compliance. Increasingly, customers are demanding that transportation companies reduce their environmental impact even as they improve operational efficiency. AI can analyze fuel consumption patterns, route efficiency, equipment utilization, maintenance histories, and load optimization to help reduce companies' environmental footprint without compromising service.

Evolving environmental regulations create compliance issues for transportation companies, but AI can automate monitoring, reporting, and optimization processes to help facilitate ongoing compliance while identifying opportunities for additional improvements.

Meanwhile, companies that adopt contemporary technology show the transformative potential. For example, digital freight brokers that leverage AI for route optimization, real-time pricing, and automated matching of loads with carriers can achieve operational efficiency at levels that are unlikely for legacy systems.

Other areas in which AI is transforming core transportation processes include:

- Route optimization that considers real-time conditions, historical patterns, and predictive factors
- Dynamic pricing models that adjust to market conditions, capacity utilization, and customer requirements
- Predictive maintenance that analyzes equipment performance data to prevent failures and optimize maintenance schedules
- Automated customer service through sophisticated chatbots that can handle complex logistics inquiries

IMPLEMENTING TARGETED STRATEGIES

To realize the promise of emerging technologies, transportation companies should establish clear priorities for technology investments based on potential business impact, competitive necessity, and resource requirements. This prioritization should align with long-term strategic objectives while addressing immediate market pressures.

Rather than viewing technology adoption as discrete projects, successful companies adopt a continuous investment philosophy that allows for ongoing adaptation and improvement. This approach recognizes that technology advancement is a continuous process rather than a destination.

Successful technology transformation involves a strategic approach that builds trust through demonstrated results rather than promises of future benefits. Companies should focus on identifying areas in which technology can deliver immediate, measurable improvements that create momentum for broader transformation initiatives.

The most effective modernization strategies commonly use a gradual migration from legacy systems rather than a complete replacement. Companies should prioritize customer-facing and revenue-generating systems first to deliver visible benefits while building organizational confidence in the overall transition.

The most effective approach typically involves targeting back-office functions where data-driven professionals are already working with inadequate tools and are motivated to adopt better ones. They may be more receptive to new technology than operational staff who may view automation as a threat to their jobs.

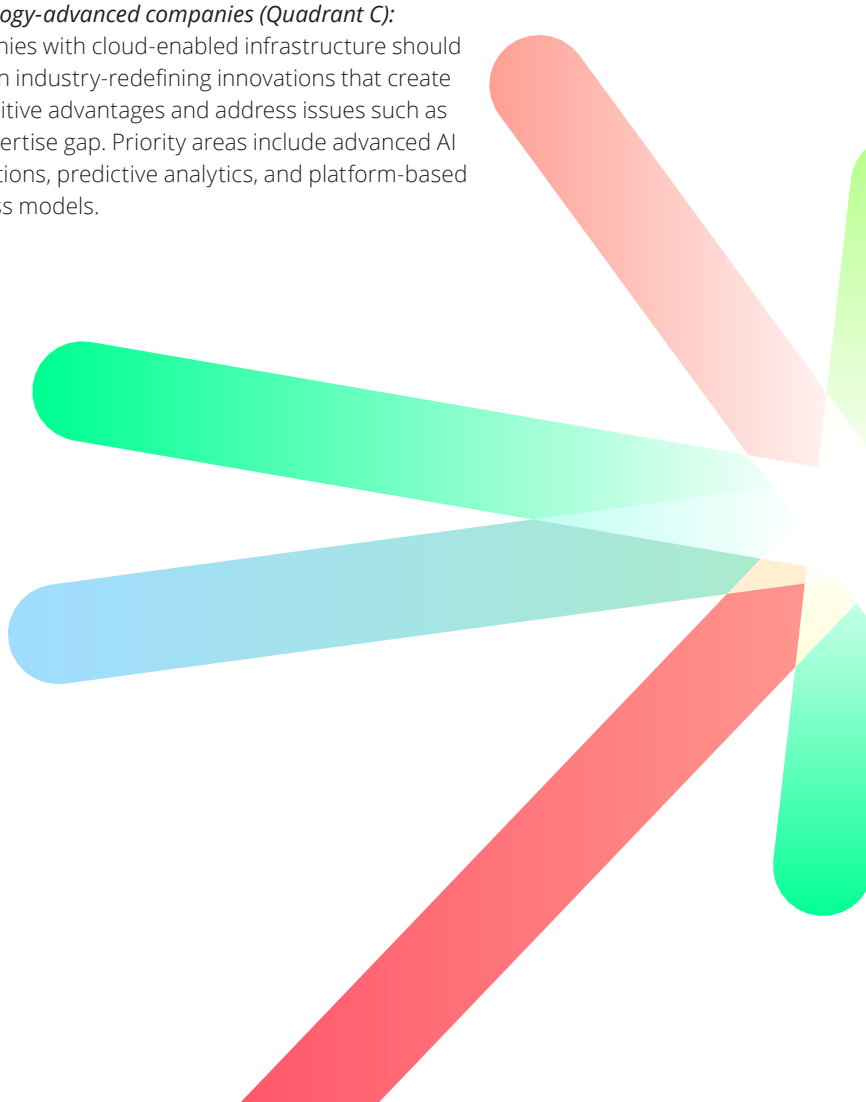
As part of these efforts, partnerships between traditional transportation companies and technology innovators can help bridge expertise gaps and accelerate innovation. However, these partnerships should be structured to leverage the strengths of both parties while addressing their respective limitations.

Based on the technology adoption matrix (Figure 1), companies can implement targeted strategies aligned with their current position and capabilities:

Legacy system companies (Quadrant A): Companies operating primarily with legacy systems should focus on foundational technology upgrades that enable future innovation. Priority areas include cloud migration for core systems, data integration platforms, and partnership development with technology providers to increase adoption and agility. Partners can also help legacy systems companies retool their talent to address the technology gap.

Transitioning companies (Quadrant B): Organizations migrating to contemporary technology should prioritize scalable solutions that build on their existing investments and strategic priorities or differentiators. Focus areas include advanced analytics capabilities, AI-powered optimization tools, and customer experience enhancements.

Technology-advanced companies (Quadrant C): Companies with cloud-enabled infrastructure should focus on industry-redefining innovations that create competitive advantages and address issues such as the expertise gap. Priority areas include advanced AI applications, predictive analytics, and platform-based business models.



LEADERSHIP AND GOVERNANCE REQUIREMENTS

Senior leadership should provide strategic oversight and decision-making support for technology initiatives. This includes establishing clear technology strategies, allocating appropriate resources, and creating organizational cultures that support innovation and change.

Successful transformation requires strong leadership commitment and consistency. Companies with frequent leadership changes face a greater disadvantage than those with stable leadership because transitions span multiple years and consistent executive support. Organizations should establish governance structures that maintain the momentum despite leadership transitions.

In addition, long-time employees may be resistant to change, creating barriers to adoption. Workers who have used legacy systems for decades may be reluctant to switch, requiring broad change management programs to build trust and ensure effective adoption.

Building on that support, technology executives play critical roles in driving adoption and innovation. Their responsibilities include technology strategy development, partnership management, cross-functional collaboration, and ensuring that technology investments align with business objectives.

Successful technology adoption also requires comprehensive change management programs that address workforce training, process redesign, and cultural transformation. Companies should invest in developing internal capabilities to support ongoing technology evolution and may consider creating incentives for employees to embrace the changes. This is especially important among companies still using legacy systems. Long-time employees who have used those systems for most of their careers may be reluctant to change. It is essential that companies develop processes to help them understand the new technology, use it effectively, and build trust in its outcomes.

Companies should invest in developing internal capabilities to support ongoing technology evolution and may consider creating incentives for employees to embrace the changes.

A PATH FORWARD

The transportation industry stands at a pivotal moment in which stakeholder expectations, competitive pressures, and technological capabilities are creating unprecedented opportunities. Companies that successfully navigate this transformation are likely better positioned to not only survive but thrive in an increasingly dynamic marketplace.

Success requires more than technology adoption—it calls for strategic thinking, continuous investment, and effective partnerships that bridge the gap between industry expertise and technological innovation. Companies should look to move beyond incremental improvements to achieve breakthrough innovations that can help them fundamentally enhance their competitive positions.

Looking ahead, the future of technology adoption in the transportation industry is exceptionally promising. Emerging trends in AI, IoT applications, autonomous systems, and advanced analytics continue to expand the possibilities for operational improvement and competitive differentiation.

Companies that embrace these opportunities proactively—setting clear priorities, investing continuously in technology capabilities, and forging strategic relationships with specialists who complement their core competencies—may be better positioned to succeed in the evolving transportation landscape.

The transformation is not merely about implementing new technologies but about reimagining what is possible in transportation operations, customer experiences, and industry collaboration. By taking decisive action today, transportation companies can build the foundations for sustained success in an increasingly technology-driven future.

AWS AND DELOITTE EXPERIENCE

AWS and Deloitte have extensive experience working independently and collaboratively with transportation industry clients. Our teams have helped companies set strategic priorities, design and implement technology experiments, and scale solutions across large, complex organizations. Through ongoing research on AI applications and continuous client engagement, we have observed significant progress and identified tremendous potential as companies advance their technological capabilities.

Our collaborative approach combines industry knowledge with cutting-edge technological experience to help our clients address the critical gap that often impedes successful technology adoption in the transportation sector. By leveraging demonstrated methods and providing implementation support and ongoing optimization services, we help transportation companies in their efforts to realize the full potential of emerging technologies.

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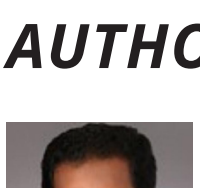

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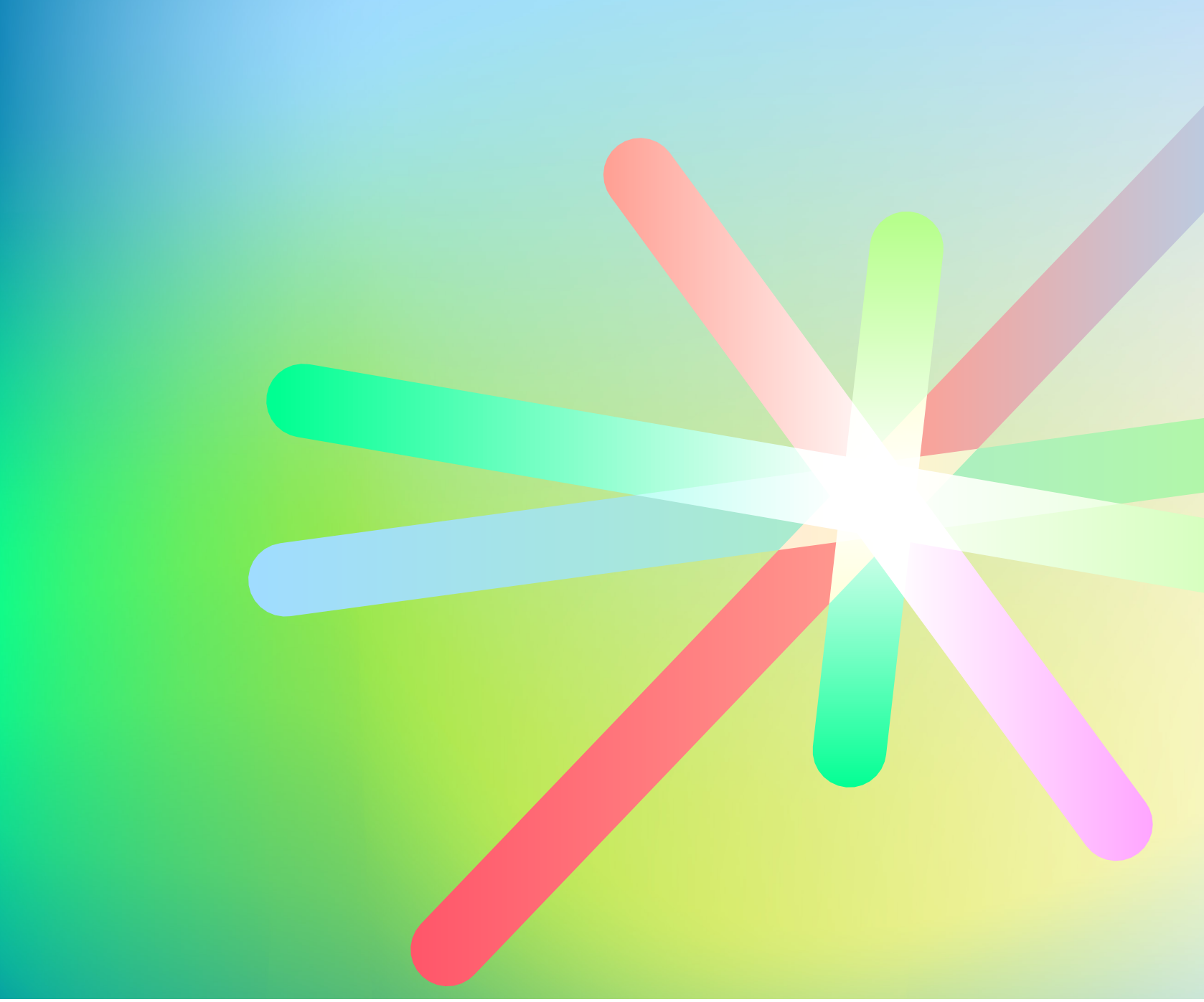

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