Embracing the automation revolution in trucking

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Building a better working world

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The trucking industry, which moves 70% of America's goods, has been navigating a maze of challenges impacting its effectiveness and profitability. An aging workforce and a waning interest among younger people in trucking careers have exacerbated labor shortages, which in turn have increased wages and caused delivery delays. In fact, labor costs account for about 40% to 45% of overall truck operation expenses.[1] The industry has also been battling rising maintenance costs and changing regulatory frameworks around emissions, drivers' hours of service and other operational aspects. In response to these challenges, trucking and other logistics companies are embracing automation and AI technologies for a variety of tasks.

[1] Alex Leslie, PhD, and Dan Murray, "An Analysis of the Operational Costs of Trucking: 2023 Update," *American Transportation Research Institute*, June 2023.

Top concerns of the trucking industry

Concern	2022	2021	2020	2019
High	Fuel prices	Driver shortage	Driver shortage	Driver shortage
	Driver shortage	Driver retention	Driver compensation	Hours of service
	Truck parking	Driver compensation	Truck parking	Driver compensation
	Driver compensation	Lawsuit abuse reform*	CSA (compliance, safety and accountability)	Detention/delay at customer facilities
Low	Economy	Truck parking	Insurance cost/ availability	Truck parking

*Also known as tort reform, which minimizes negative impact of excessive litigation on the industry's insurance costs
Source: American Transportation Research Institute (ATRI)
Period: 2019–22

Our research has shown four key trends emerging from automation and artificial intelligence (AI) technologies, which are revolutionizing the US trucking industry:

1. **Upgrading freight handling through automation:** Automation is becoming more common in the trucking industry as companies see what technology can do to boost performance and efficiency.
2. **Embracing AI to optimize routes:** AI brings changes to the supply chain, enabling fleet operators to reduce operating costs and fuel consumption.
3. **Improving the in-store experience through automation:** At truck stops, AI-supported technologies such as chatbots, virtual personal assistants and image recognition are being adopted.
4. **Automating back-office processes:** For brokers, trucking carriers, truck stops and logistics service providers, the shift toward automating back-office operations aims to streamline invoicing and other critical freight management functions.

Automation is remaking the trucking industry by using technology to eliminate service gaps and flaws that diminish productivity. The changes taking place today may only be the beginning of a new, more responsive trucking and logistics industry.

Trend 1

Upgrading freight handling through automation

Imagine a world in which automated warehouses can pick, pack, palletize and load goods into trailers with fully automated solutions. These capabilities increase the speed of cross-docking and trailer pack-out activities, while lowering the cost profile for logistics companies. While full-scale deployment is still early, this trend is driving improved productivity as more warehouses implement automation systems. According to Peerless Research Group, in 2022, nearly 23% of logistics and material-handling organizations were using robots in their warehouses, distribution centers and docking areas, while another 21% plan to begin doing so by 2025.[2]

That world in which automation becomes the norm in the trucking industry is already beginning to emerge today. Logistics and trucking companies are increasing adoption of automation technologies that can boost productivity and fulfill orders faster. Firms are leveraging robotics companies to collaborate on new customized solutions that can enhance operations. These companies are implementing productivity improvements across operational processes using various technologies, including robots, wearable devices and software bots. Small and midsize trucking companies are also moving toward automation through robotics.

A key driver of this trend is the decreasing costs for robot manufacturing. In the last five years, robot costs have halved. And there are estimates of a further 50%–60% decline in industrial robot prices by 2025.[3] Furthermore, the emergence of innovative business models is likely to make automation and robotic technologies even more accessible. The robots-as-a-service (RaaS) model is a prime example, gaining traction for its affordability and flexibility. This model allows businesses, especially small and medium-sized enterprises, to use robots without substantial capital expenditures.

Within loading docks and warehouse, companies are deploying different automated goods handling systems to move goods faster. Automated guided vehicles (AGVs), for instance, are used for transporting cases and pallets and use technology to make standard forklifts autonomous. Typical AGV applications include storage, retrieval and other activities in support of picking in warehousing and distribution applications. Also, automated trailer loading systems (ATLS) automate the process of loading and unloading goods onto trucks or trailers. This eliminates or reduces the need for manual labor and streamlines logistics operations in warehouses, distribution centers and shipping terminals.

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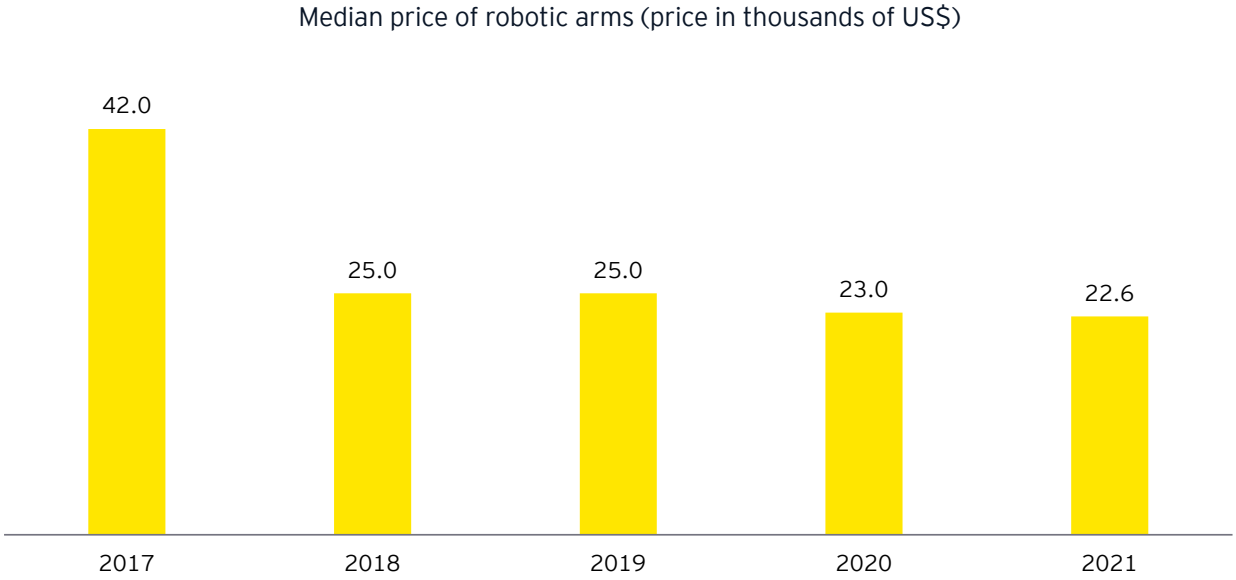
[2] Bridget McCrea, "Logistics Robots Have Arrived, Finds 2022 Robotics Survey," *Robotics 24/7*, May 8, 2022.

[3] Sam Korus, "Industrial Robot Cost Declines Should Trigger Tipping Points in Demand," *ARK Investment Management LLC*, April 17, 2019.

Industrial robotic arms price trend



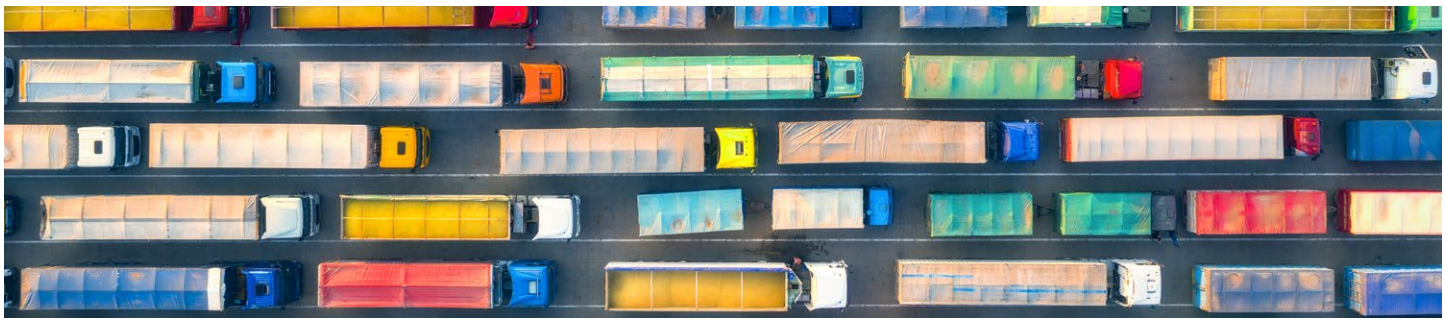
Source: Robotics 247
Period: 2017–21

Automation significantly reduces loading and unloading times, boosts overall efficiency, and cuts out manual work, reducing errors and speeding up goods handling. It also optimizes truck space and minimizes truck trips, decreasing operational costs and improving delivery times. Automatic loading platforms can load and unload an entire truck in just a few minutes, compared to over half an hour when done manually, thus increasing the number of goods dispatched and decreasing the time at the dock.

The use of advanced safety measures through automation eliminates accidents, mitigates risks and improves the overall safety of the logistics environment. It also results in cost savings by reducing the frequency of damaged goods. Inventory management is improved, and workforce optimization becomes easier to achieve. Employees in fulfillment centers and truck terminals are able to focus on roles that require informed decision-making and sound judgment, while robots handle the physically strenuous and repetitive tasks.

Metrics to watch as this trend evolves:

- Industry adoption of automation technologies
- Average loading and unloading times
- Proportion of industrial accidents at loading/unloading zones
- Labor costs for truck drivers, warehouse operators, etc.
- Median price of robotic arms



Trend 2
Embracing AI to optimize routes

Imagine a world in which trailers back into a dock at a large distribution center, which, using routing and telematics information tools, is already aware of the truck's arrival and knows the contents of the trailer and its packing structure. When the truck touches the dock, an inventory/chain of custody transfer is confirmed. Automated forklifts pull pallets off the trailer and put them into a staging area to be put onto racks. As soon as the trailer is empty, automated forklifts reload the trailer from a prepared staging area. When complete, final checks are performed, and the trailer is closed, all goods having been confirmed with radio-frequency identification (RFID) on entry to the trailer. The driver can pick up the trailer and be on their way.

Artificial intelligence is continuing to unlock these types of new efficiency benefits for companies operating in the freight transportation industry. AI brings changes to the supply chain, enabling fleet operators to reduce operating costs and fuel consumption. Logistics firms recognize the transformative power of AI, and many are investing heavily in the technology. Early adopters who have implemented AI in logistics have achieved remarkable improvements, reducing logistics costs by 15%, optimizing inventory levels by 35% and enhancing service levels by 65%.[4]

AI route optimization tools help drivers save time, fuel and resources by assessing multiple factors when selecting routes, including distance, traffic conditions and delivery windows, as well as historical data. Route optimization is a critical aspect of the trucking industry, enabling real-time route adjustments to avoid traffic jams, inclement weather or other potential delays.

Per a recent EY thought leadership on the impact of generative AI on supply chains, AI is emerging as an advanced application in the logistics sector, offering transformative benefits across various domains. It can improvise optimal delivery routes by analyzing historical and real-time data, reducing travel time and operational expenses. For example, one of the biggest logistics companies in the US is using a proprietary AI platform to optimize picking routes within its warehouses, boosting workforce productivity by about 30% while slashing operational costs through optimized space and materials handling.[5]

Moreover, AI-driven fleet management systems are transforming how trucking companies manage their vehicles. By using machine learning algorithms, these systems can predict vehicle maintenance needs, monitor driver performance and limit downtime. The technology can reduce trucking companies' expenses, for instance related to repairs and tires, by gathering and analyzing data and providing early alerts to potentially issues can be addressed proactively. It also enhances safety when the vehicle is in motion with lane departure warnings, collision avoidance and traffic jam assists.

[4] Dmytro Tymoshchenko, "Top logistics technology trends reshaping the industry in 2023," *Acropolium*, June 28, 2023.

[5] Sumit Dutta and Glenn Steinberg, "How supply chains benefit from using generative AI," *ey.com*, July 27, 2023.

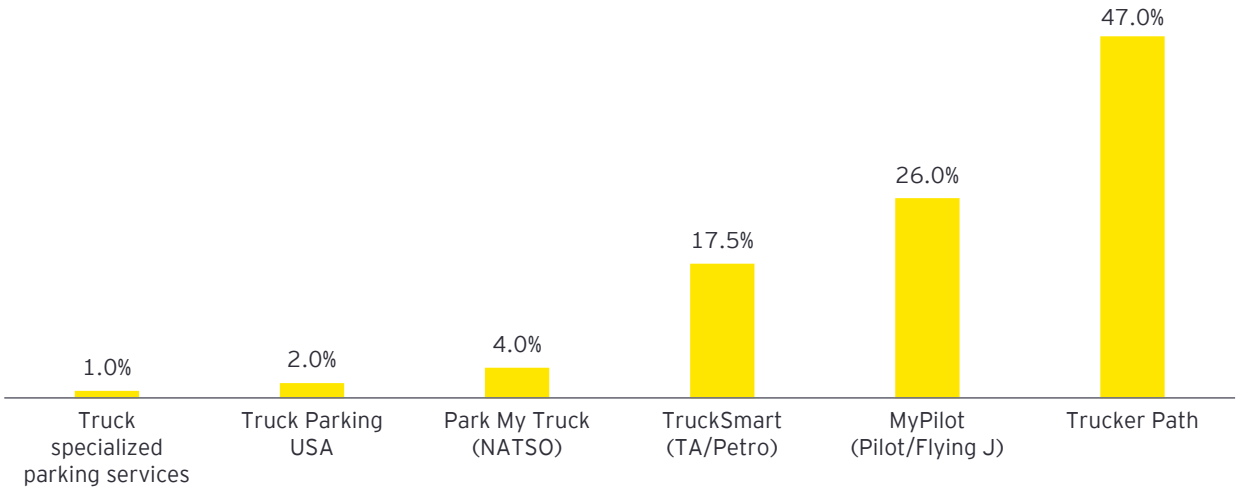
Trucks that use AI can cut fuel costs by up to 15%, potentially saving about $35 billion in fuel efficiency gains.[6] Many AI programs also have idle reporting and fuel monitoring features that allow trucking companies to analyze fuel waste and costs. Other benefits include reduced transit times for overnight deliveries and truck parking solutions that help truck drivers locate safe and legal parking spots, especially during mandated rest periods.

Parking has become a significant issue for truck drivers, as a noticeable uptick in the shortage of truck parking spots is evident in the US, with only around 313,000 registered stops as of 2020.[7] This scarcity means drivers, on average, lose about 56 minutes daily due to parking obstacles, which translates to a yearly loss of 9,300 potential revenue miles, amounting to an annual wage deficit of $4,600.[8] To combat these issues, diverse stakeholders are considering a spectrum of remedies, including technological solutions such as real-time parking availability apps, as well as regulatory interventions. It's another example of the ability of AI to provide solutions that help truck drivers and logistics companies maintain productivity.

Metrics to watch as this trend evolves:

- AI adoption rate in logistics sector
- Workforce productivity rate in logistics sector
- Transportation delivery time
- Trip safety and compliance score (e.g., injury rate, violations, fines)
- Share of deadhead miles

Truck parking apps used by truck drivers (ATRI 2021 survey)



Survey details: A total of 1,103 drivers participated in the ATRI survey from various demographics within the US
Source: American Transportation Research Institute (ATRI)

[6] "AI in the Trucking Industry: How it's Being Used to Increase Performance," *Double D Distribution*, December 14, 2022.

[7] Gregory Van Tighem, "Truck Parking Is Top Issue for Drivers," *Transport Topics*, January 10, 2023.

[8] "Truck Parking Development Handbook," *U.S. Federal Highway Administration Office of Operations*, September 2022.

Trend 3

Improving the in-store experience through automation

Imagine a world where truck drivers can share their preferences with truck stops through a voice chatbot. The driver's routing software indicates the available truck stops in the next 100 miles. The driver says "I want to stop in 30 minutes. I'll refuel and need to take a shower. While I'm there, I want a pizza, fresh fruit, soda and a newspaper." Tied to the truck stop's loyalty account, AI already knows the person's preferences and prior orders. When the driver arrives at the stop, a shower is reserved, having been recently cleaned by a robotic device. When the driver finishes showering, a newspaper and pre-selected food order are waiting. The cost has been automatically charged to a connected card, and the driver waves to the in-store employee on the way out.

The COVID-19 pandemic led to a transformation in the way retail companies function. Self-checkout terminals are now the dominant grocery checkout format, accounting for 55% of transactions in 2022.[9] Retailers have leaned into this trend, adding more self-checkout technology to improve the in-store shopping experience as well as combat rising labor costs and shortages. In 2021, the retail trade sector was the second-largest investor in robotic capital expenditures after manufacturing. As just one example, a US-based global retail company recently announced that by the end of fiscal year 2026, it aims to have 65% of its stores serviced by automation.[10]

Automation in store operations offers retailers the flexibility to identify and adjust inventory for changes in customer traffic and buying patterns. Large pattern models identify the types of goods and preferences in different areas of the country and on specific lanes across the US. This allows retailers to automatically stock inventory that will be in the highest demand. AI-powered chatbots and voice-to-voice interactions are providing customers with personalized product recommendations and advice, helping them to make informed purchasing decisions with an IT touch that still feels personal. AI in retail is constantly being used to foster behavioral analytics as well as feed on market demographics to improvise business projections.

Contactless checkout and robot deliveries give truck drivers a new way to recharge and refresh on the job by automating much of their experience in the retail environment. At truck stops, multiple AI-supported technologies, including chatbots, virtual personal assistants and image recognition, are being adopted.

Metrics to watch as this trend evolves:

- Percentage of retail stores using automation technologies
- In-store workers per square foot of retail space
- Share of in-store sales conducted via pre-orders on an app
- Order processing time
- Announced collaborations between tech companies and transportation and logistics firms

[9] Rajeev Sharma, "Latest MegaStudy by VideoMining shows a dramatic improvement in front end sales and adoption of self-checkout lanes by grocery shoppers," *VideoMining*, April 25, 2023.

[10] "Walmart aims to automate 65% of its stores by fiscal 2026," *Retail Insight Network*, April 5, 2023.

Trend 4
Automating back-office processes

In the near future, back-office functions could run lights out. They aren't outsourced, offshored or nearshored — they are "no-shored." All company data sits in core systems, loaded into an AI solution. Information is fully available to executives through a type or voice prompt. Transactions are settled seamlessly and automatically, with matching happening at the same skill as a human reviewer. Customer care satisfaction rates increase dramatically as customers engage with knowledgeable "agents," which are really AIs, trained on public and private data sets. Finance, accounting, tax, HR, payroll and other functions cost a fraction of what they used to, and are able to scale much more agilely with a changing business. The employees that remain are able to spend their time on higher complexity tasks, such as customer acquisition, growth strategies and competitive defense.

Historically characterized by extensive paperwork, manual data entry and administrative procedures, all industries are beginning to actively incorporate advanced technologies to drive down the cost of back-office functions. AI, robotic process automation (RPA) and process mining are transforming companies back-office operations to optimize processes, improve efficiency and reduce costs. Also, these technologies augment and enhance traditional back-office digital tools such as mobile apps, APIs and other cloud-based integrations, offering more efficiency, accuracy and predictive capabilities in logistics operations.

For brokers, trucking carriers, truck stops and logistics service providers, the shift toward automating back-office operations aims to streamline invoicing and other critical freight management functions. Document automation technologies can improve many areas that would previously have generated large amounts of data, such as document process, invoice generation, pricing, freight allocations, etc. The processing of invoices, bills of lading, rate sheets and other documents can be more easily managed. Those who have adopted these tools maintain a competitive edge over entities still adhering to conventional business methodologies.

Manual shipping tasks can be automated as well, from the initial pickup request to checking and reporting shipment status between internal systems and portals. With the help of RPA, shipment details are extracted from incoming emails, pickup times can be provided in customer/carrier portals, all with robots. Depending on the product characteristics, volume and dimensions of the shipment, the AI software determines the ideal packaging solution.

On the customer service side, using AI chatbots and voice assistant applications enables customer conversations to be both thoughtful and streamlined. AI software, driven by NLP (natural language processing) and ML (machine learning) algorithms, is taught and fed with the required information to answer diverse queries, error free.

Metrics to watch as this trend evolves:

- General and administrative cost as a percentage of revenue
- Employee headcount per $1b in general and administrative expense
- Adoption rate of AI chatbots and RPA systems
- Document/invoicing processing time
- Automation technology and AI adoption costs

Future of trucking industry

The transformation of the trucking and logistics industry via automation and AI technologies is still taking shape, and strategies are still being discussed and developed. But the technologies of the future are here now, and it's up to industry leaders to determine what happens next. The following are three plausible scenarios that we believe could transpire in the near future within the trucking and logistics industry.

Scenario 1

Accelerated adoption of automation and AI technologies

Trends

- Automating freight handling
- AI in trucking
- AI in retail
- Automating back office

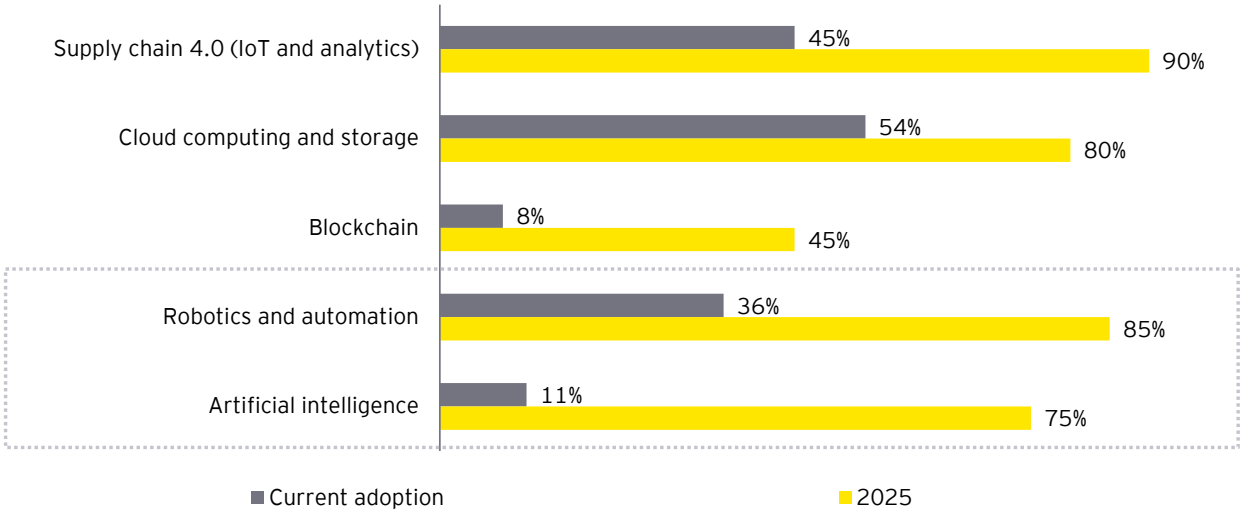
Select metrics that may indicate that this scenario is occurring:

- Dramatic increase in adoption of automated freight-handling technologies
- Decline in share of deadhead miles
- Increase in share of in-store sales conducted via pre-orders on an app
- Decrease in document/Invoicing processing time

In this scenario, various technologies are prominent in the trucking and logistics industry, boosting efficiency, cutting costs and elevating customer experiences. The LogisticsIQ market trend analysis predicts a rise in the adoption of these technologies by 2025.

The challenges brought about by the pandemic and recent geopolitical events underscore the need to fast-track the integration of automation technologies. In addition to these advances, sustainable and green technologies also gain prominence, given the increasing emphasis on environmental responsibility. Through AI and automation, tools such as route optimization and advanced driving systems narrow the distance to full autonomy. These technologies offer immediate efficiency, productivity and safety improvements for trucking and warehousing operations. Aspects like decreasing empty return trips, employing load-matching mechanisms and slashing wait times become fundamental in the logistics and transport sector.

Adoption of technology by 2025



Source: LogisticsIQ

Regulatory measures significantly shape the adaptation and growth of industries. In trucking and logistics, they dictate the pace and style of integrating automation and AI. Governmental incentives, such as tax deductions or grants, further boost the uptake of these innovations, steering the sector towards more streamlined processes.

Implications for trucking:

- **Long-haul volume:** Automated systems and AI technology are used to optimize routes, reduce idle times and minimize unnecessary detours, leading to more efficient use of trucks, meaning fewer trucks are required to move the same volume of goods and can reduce long-haul volumes due to increased efficiencies. With fewer accidents and safer road conditions (a potential outcome of widespread AI and automation adoption), there are likely fewer shipping routes and schedule disruptions, leading to more consistent and predictable long-haul volume.
- **Truck stop demand:** With an increasing reliance on automation, there is a strategic shift in the placement of warehouses, distribution centers and other essential infrastructure, which optimizes the movement of goods, thereby potentially reducing the need for long-haul stops and, in turn, impacting the demand for traditional truck stops. Integrating AI-powered systems allows for the enhanced optimization of routes, leading to fewer necessary truck stops. Additionally, with the evolution of trucks toward greater fuel efficiency and the adoption of alternative energy sources, the frequency of refueling stops declines. Existing truck stops undergo a transition to cater to evolving needs, such as transforming into logistics hubs, delivery points, charging stations for electric trucks, etc.

Scenario 2

Slow and cautious adoption of automation and AI technologies

Trends

Automating freight handling	AI in trucking	AI in retail	Automating back office
▲	▼	▼	▲

Select metrics that may indicate that this scenario is occurring:

- Incremental adoption of automated freight-handling technologies
- Marginal decline in transportation delivery time
- Moderate increase in share of in-store sales conducted via pre-orders on an app
- Status quo in document/Invoicing processing time

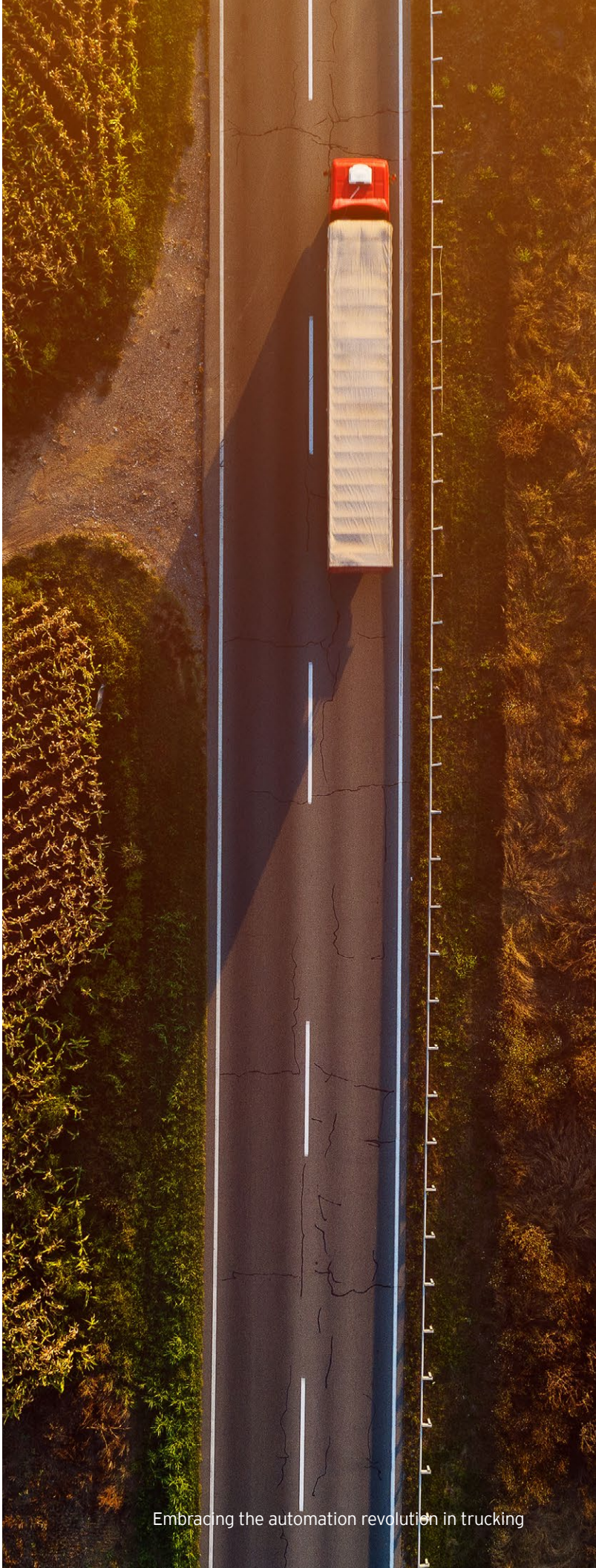
In this scenario, slow and gradual adoption grants businesses the strategic upper hand, enabling them to harness automation where it's most advantageous rather than rushing through indiscriminate deployment. Such a pace allows them to learn from both past case studies and the experiences of their peers. For example, the Electronic Logging Device (ELD) mandate introduced by the Federal Motor Carrier Safety Administration (FMCSA) in 2018, which requires operators of commercial motor vehicles to record data related to the operation of the vehicle and driver activity, was met with significant backlash, especially from small and owner-operators. It suffered challenges, such as higher attrition rate and sudden operational costs during the first implementation phase. New logistics firms learn from these complexities and plan better to understand the multifaceted implications of such tech mandates.

Companies that lag in integrating AI and automation are at a competitive disadvantage due to higher costs and longer delivery times, potentially estranging stakeholders. They also find it challenging to incorporate these systems later, as new infrastructure is developed and processes that once fit become incompatible with newer technologies.

Slow and cautious adoption allows companies to build a robust ecosystem of blended operations. This approach employs automation tools, robots and AI algorithms to carry out repetitive, mundane or high-volume tasks, increasing efficiency and precision while humans handle more intricate roles. However, labor costs only barely decrease as human expertise remains essential.

Implications for trucking:

- **Long-haul volume:** Concerns about truck driver shortages combined with the gradual uptake of automation and AI technologies pose substantial challenges to the long-haul freight sector, resulting in the logistics sector grappling with limited capacity and operational setbacks, impeding the efficient transportation of long-haul goods. Over time, other modes of transportation (e.g., rail or air) become more attractive, offering more reliability, speed or cost-effectiveness than road freight, leading to a shift in freight volumes away from long-haul trucking.
- **Truck stop demand:** As long as the trucking industry relies on human drivers, truck stops remain in demand. But as automation becomes more prevalent, systems prioritize fueling during off-peak times and at select locations based on fuel cost instead of driver needs. Consequently, truck stops adapt their offerings and services. The gradual adoption of automation and AI in the trucking sector provides a temporary cushion for truck stops. However, these businesses realize they must continue to be forward-thinking and prepare for the inevitable changes in the industry.



Scenario 3

Patchwork regulatory environment complicates technology adoption

Trends

Automating freight handling	AI in trucking	AI in retail	Automating back office
▶	▼	▲	▲

Select metrics that may indicate that this scenario is occurring:

- Increase in loading and unloading time
- Increase in transportation delivery time
- Decrease in percentage of retail stores using automation technologies
- Increase in document/Invoicing processing time

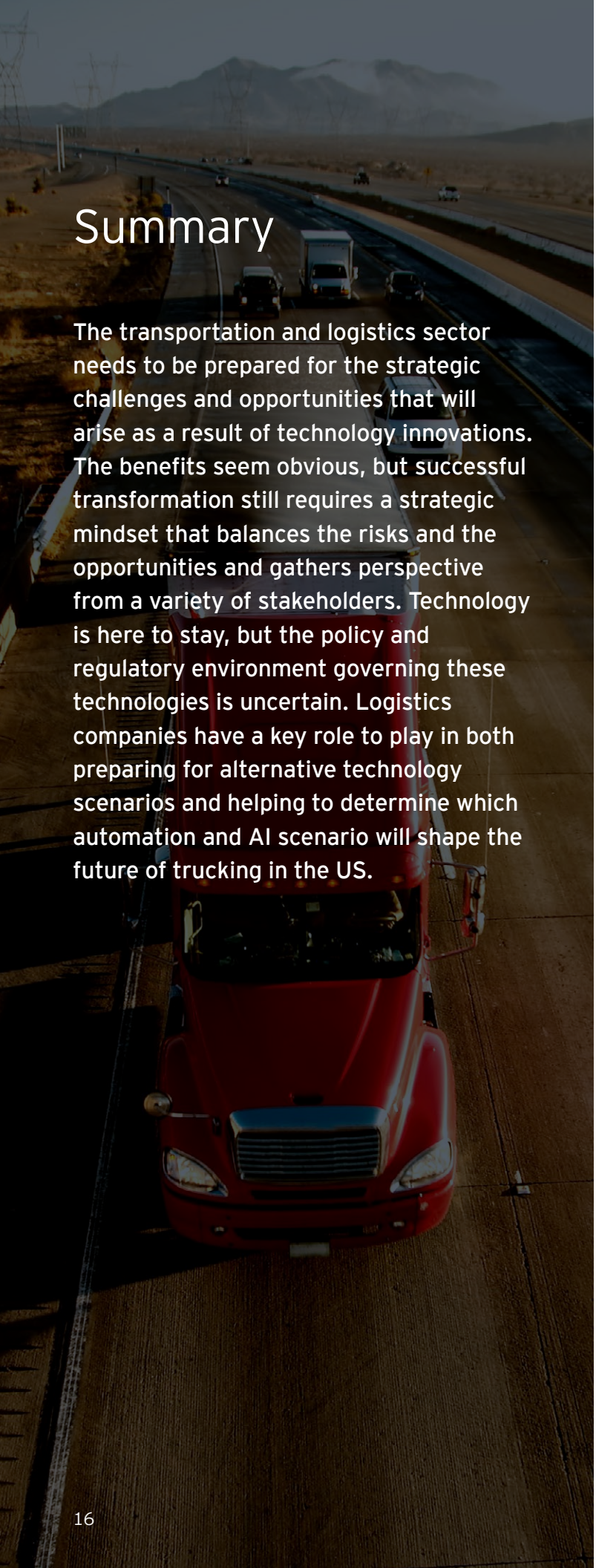
In this scenario, trucking and logistics companies navigate diverse regulations across different states. Inconsistent regulations slow down the research and development phase, and companies are reluctant to develop new solutions without being confident in the regulatory landscape they'll be entering. In the US, each state has its own set of guidelines, making it difficult for interstate operations. The pace at which states embrace automation varies, resulting in a complex landscape of regulations that businesses must navigate.

At the same time, logistics companies experience a backlash to automation from labor unions. The trucking and logistics industry provides a significant source of employment in the US. Labor unions are naturally concerned about the potential loss of jobs due to automation, and unions push back against adopting automation, requesting measures to slow the transition or safeguards for affected workers (such as retraining programs). As an example, in 2022, negotiations concerning 22,000 dock workers on the US West Coast left terminal operators and ocean carriers concerned about potential trade interruptions. The dock workers' union argued that automated ports diminish job opportunities and reduce productivity.

A third factor slowing the adoption rate of automation and AI technologies is technology integration challenges. Older IT systems used by trucking and logistics companies require significant investment to integrate new AI and automation technologies, creating technical challenges and increasing the transition cost. Companies with significant investments in legacy systems are reluctant to abandon or overhaul these systems, slowing the overall adoption rate.

Implications for trucking:

- **Long-haul volume:** Inconsistent regulations deter companies from investing in or deploying new technologies and lead to re-evaluating and changing freight routes to maximize efficiency and minimize regulatory challenges, resulting in increased volumes in specific corridors and decreased volumes in others. The future of long-haul freight volumes in such a setting depends on how industry players, regulators and policymakers address these challenges and collaborate to find optimal solutions.
- **Truck stop demand:** Truck stops diversify their services to cater to the unique needs of truckers navigating a complex regulatory landscape, including more extensive consultation services, regulatory compliance assistance or specialized maintenance services to cater to trucks designed for specific regional standards. A complex regulatory environment present both challenges and opportunities for truck stops. To thrive, these establishments become more adaptive, innovative and proactive to understand and meet the evolving needs of the trucking industry.



Summary

The transportation and logistics sector needs to be prepared for the strategic challenges and opportunities that will arise as a result of technology innovations. The benefits seem obvious, but successful transformation still requires a strategic mindset that balances the risks and the opportunities and gathers perspective from a variety of stakeholders. Technology is here to stay, but the policy and regulatory environment governing these technologies is uncertain. Logistics companies have a key role to play in both preparing for alternative technology scenarios and helping to determine which automation and AI scenario will shape the future of trucking in the US.

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