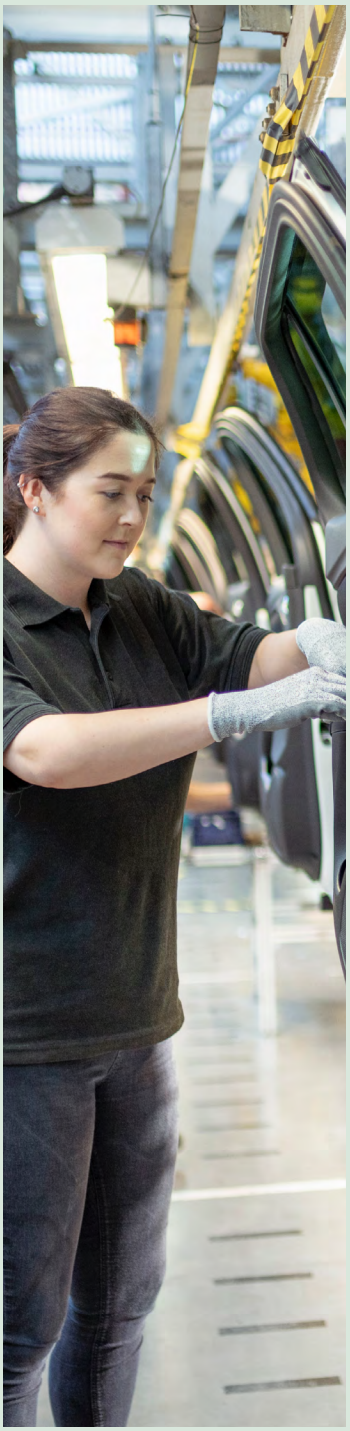
WHITE PAPER



AUTOMOTIVE RECALL: HOW TECHNOLOGY STREAMLINES THE PROCESS

Abstract

Automotive recalls pose challenges to Original Equipment Manufacturers (OEMs), regulatory authorities, and customers. Yet, recalls are necessary to ensure the safety of vehicles on the road. Several stakeholders are involved in the automotive recall process. OEMs have the primary responsibility for identifying safety issues, coordinating recall campaigns, and managing customer communication. Regulatory authorities oversee safety standards and enforce a recall when necessary. Dealers act as intermediaries, assisting in notifying customers, providing repair services, and managing logistics. At the same time, vehicle owners need to respond to a recall by following instructions from dealers, the OEM, and regulatory authorities.

A suite of advanced technologies such as Artificial Intelligence (AI), Machine Learning (ML), blockchain, Internet of Things (IoT), Augmented Reality (AR) and Data Analytics (DA) is set to revolutionize automotive recalls. This white paper provides insights into how these technologies support automotive recall management.

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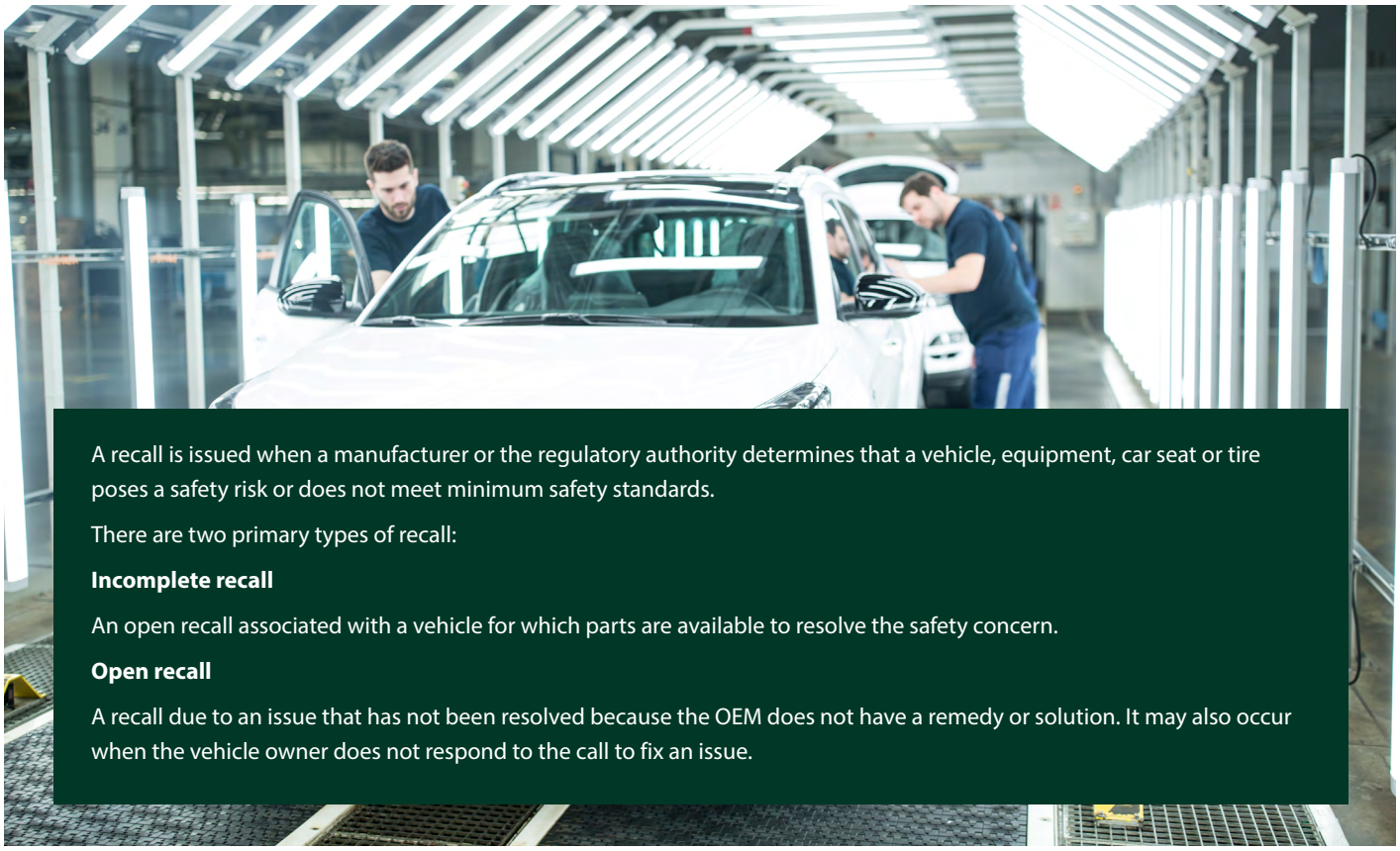
Vehicle recall – The issue

Figure 1 lists the most common causes of factory recalls in 2022, as reported by NHTSA, a federal agency of the U.S. Department of Transportation.

Cause of recall	Percentage of recalls (2022)
Equipment (change in material, design, or processes)	29%
Electrical system	20%
Power train	8%
Steering	7%
Structure	6%
Brakes, hydraulic	5%
Airbags	5%
Tires	4%
Exterior lighting	4%
Seats	4%

Figure 1



A recall is issued when a manufacturer or the regulatory authority determines that a vehicle, equipment, car seat or tire poses a safety risk or does not meet minimum safety standards.

There are two primary types of recall:

Incomplete recall

An open recall associated with a vehicle for which parts are available to resolve the safety concern.

Open recall

A recall due to an issue that has not been resolved because the OEM does not have a remedy or solution. It may also occur when the vehicle owner does not respond to the call to fix an issue.

Figure 2 describes the root cause of major safety issues leading to a vehicle recall.

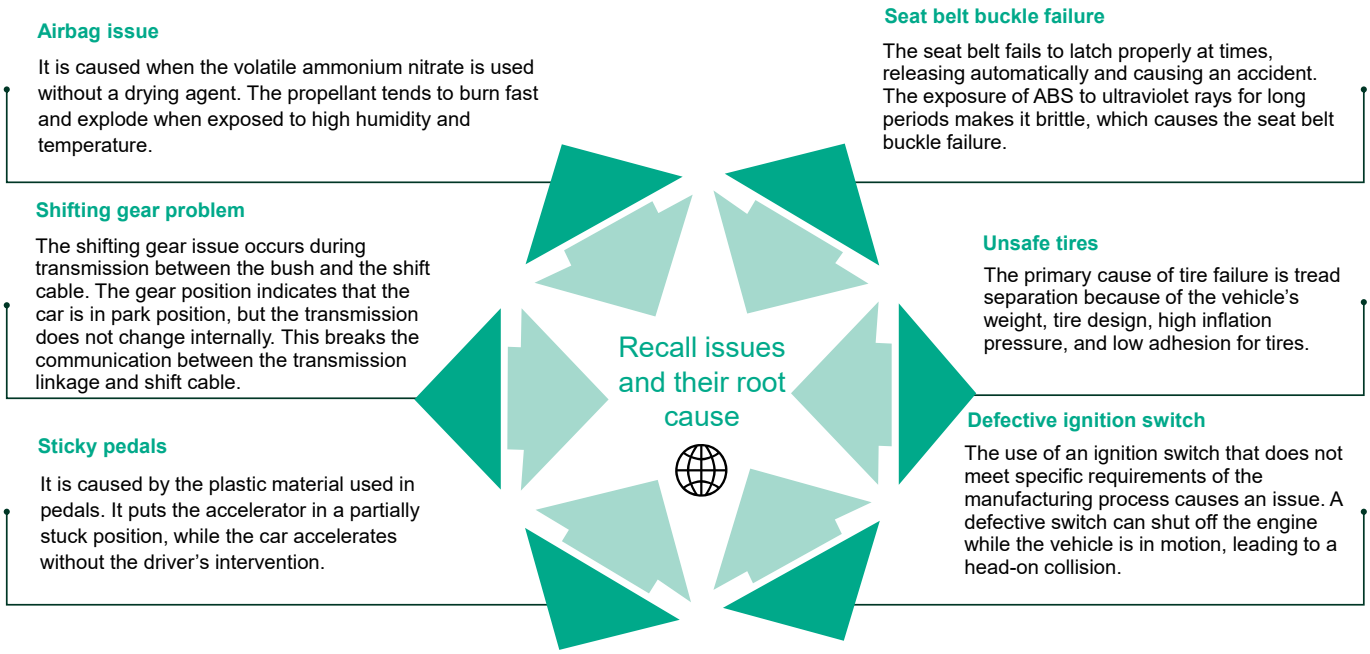
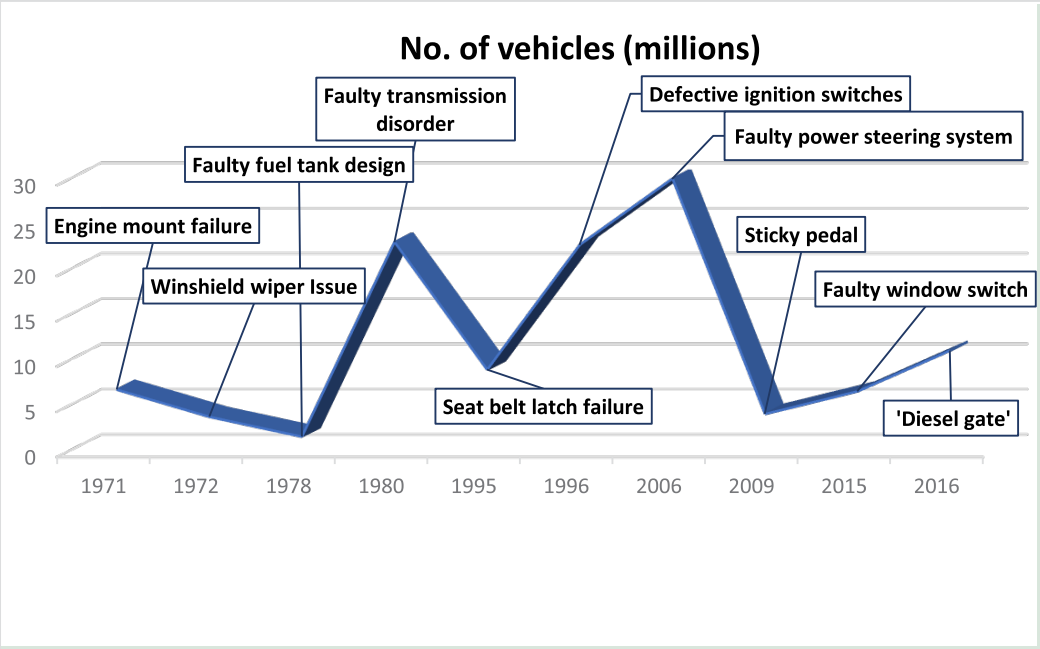


Figure 2

Figures 3 depicts the volume of recalls and the causes for recall in the US automotive industry.



Key Highlights

- ✓ In the 1990s safety became a more prominent concern, leading to the widespread adoption of airbags and anti-lock brakes in vehicles. The National Highway Traffic Safety Administration (NHTSA) introduced crash test ratings to inform consumers about vehicle safety.
- ✓ Due to the diesel scandal, many automakers abandoned plans to sell diesel cars which has also led to stricter emissions standards for all vehicles across countries.
- ✓ The integration of ADAS features like adaptive cruise control, lane-keeping assist, and automatic emergency braking has become common in modern vehicles and can lead to malfunctions or software glitches in ADAS systems.

Common cause for recalls

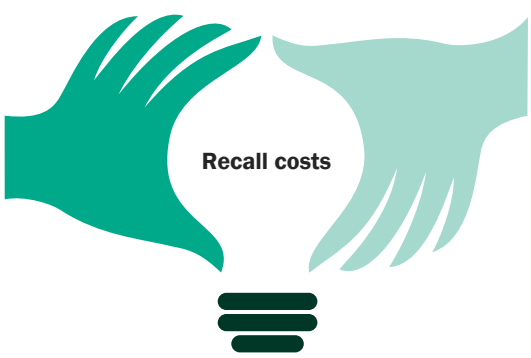
- ❑ Supplier Defects
- ❑ Change in Regulations
- ❑ Software and Electronics Issues
- ❑ Customer Complaints and Reports
- ❑ Data from Monitoring Systems
- ❑ Non-Compliance (Environmental and Safety regulations)
- ❑ Quality Control Failures

Figure 3

OEMs incur significant costs irrespective of the type of recall. Figure 4 highlights direct and indirect costs for voluntary and mandatory recall.

Legal costs

Class action lawsuits, legal expenses, and compensatory damages are a major cost. Liability insurance covers expenses, but the lawsuits impact share prices. In addition, manufacturers incur costs to mitigate reputational damage. A majority of OEMs publicly apologize for quality shortfalls through television commercials, print ads, and PR blitzes - each of which carries a hefty price tag.



Brand costs

Loss of brand value equates to opportunity cost and lost sales. In the highly competitive auto industry, a recall can adversely influence the buying decision of consumers.

Repair costs

The per vehicle cost of repair for an automaker is significantly lower than it is for a customer, given the lower cost of components and labor expenses for OEMs. But, it is far from being immaterial.

Figure 4

Each stakeholder in the ecosystem undertakes specific activites at different stages of the auto recall process (Figure 5).

Federal agencies

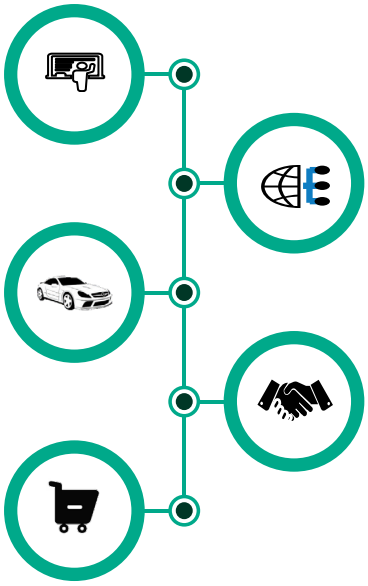
Federal agencies play a vital role in automotive recalls to ensure vehicle safety, protect consumers, and enforce compliance with relevant regulations

OEM

When a defect or safety issue is identified in a vehicle, the OEM is responsible for taking appropriate actions to safeguard customers and the general public

Logistics partners

Logistics service providers facilitate the efficient movement of vehicles and spare parts during a recall



Suppliers

Suppliers of specific components and systems used in affected vehicles should address the issue promptly, and support the recall process

Dealers

Dealers act as the interface between vehicle owners and the manufacturer, ensuring efficient execution of the recall procedure

Figure 5

The recall process can be classified into three distinct stages – pre-recall, recall and post-recall. Figure 6 explains the role of each stakeholder in the ecosystem, at different stages.

Stage	Federal Agencies	OEM	Logistics and Distribution Partners	Suppliers	Dealers
Pre-recall	Record customer complaints, review the alleged defects, and decide whether it merits an investigation. Undertake detailed analysis / research on crashes and fatal accidents to identify trends.	Collaborate with the local federal agency responsible for the safety of motor vehicles to assess the damages caused by fatal crashes / issues. Prepare a plan of action in partnership with the legal team for potential lawsuits from customers. Determine the cost of the recall to be announced and assess the loss of brand value due to the crisis.	Prepare for rapid distribution of new / replacement parts to suppliers. Collect from suppliers the specification and number of spare parts that need to be shipped during recall.	Prepare for the recall and collaborate with the legal / finance team to assess the loss incurred due to defective systems / parts.	Identify recall stakeholders / direct customers. Estimate the number of affected vehicles and source additional resources (technicians) to handle the recalls promptly. Create additional inventory of spare parts for the recall process.
During recall	Monitoring of recall performance by NHTSA may lead to an investigation in the event of inadequate recall planning or execution. NHTSA undertakes routine recall oversight activities, including review and monitoring of recall filings, owner notification letters, and other related documents. NHTSA also coordinates recall campaigns with OEMs.	Identify the affected vehicles, and communicate the issue to concerned dealers. Share recall information, such as vehicle identification number, via the enterprise portal / directly to customers. Establish a crisis management team to aceelerate the recall process.	Collaborate with the OEM to identify local dealerships where the replacement / new parts should be supplied for delivery to customers. Procure additional carrier capacity to distribute new spare parts at the lowest costs.	Help the OEM trace spare parts by providing a comprehensive list of batch numbers and shipping details. Collaborate with the OEM to determine the required quantity of additional spare parts.	Communicate the issue and the OEM's response to customers. Share the recall notice with customers and urge them to bring their vehicle to the dealer location for repair / replacement. Monitor the recall process and share progress reports with the manufacturer.
Post-recall	Modify safety rules and regulations based on the history of recalls for a vehicle. Improve testing methods for vehicle safety to ensure compliance with the Federal Motor Vehicle Safety Standards.	Identify the root cause and address design flaws to prevent defects in future products. Rebuild brand value after the crisis through advertisements.	Re-assess the inventory plan with suppliers and bill the OEM for the additional supply of parts.	Undertake an RCA of the defect and identify issues / bottlenecks across the product development cycle. Conduct failure mode and effects analysis (FMEA) along with rigorous regular testing. Ensure adequate inventory of parts.	Document the recall notification procedure. Schedule service appointments for vehicle inspection, and share pictures, videos and simple descriptors for customers to evaluate the health of their vehicle. Restore organizational credibility among stakeholders.

Figure 6

An effective automotive recall management system improves safety, enhances the customer experience, and ensures regulatory compliance. In addition, it helps automakers, suppliers, dealers, and regulatory authorities manage recalls seamlessly. Figure 7 depicts the key functionalities of a robust automotive recall management system.

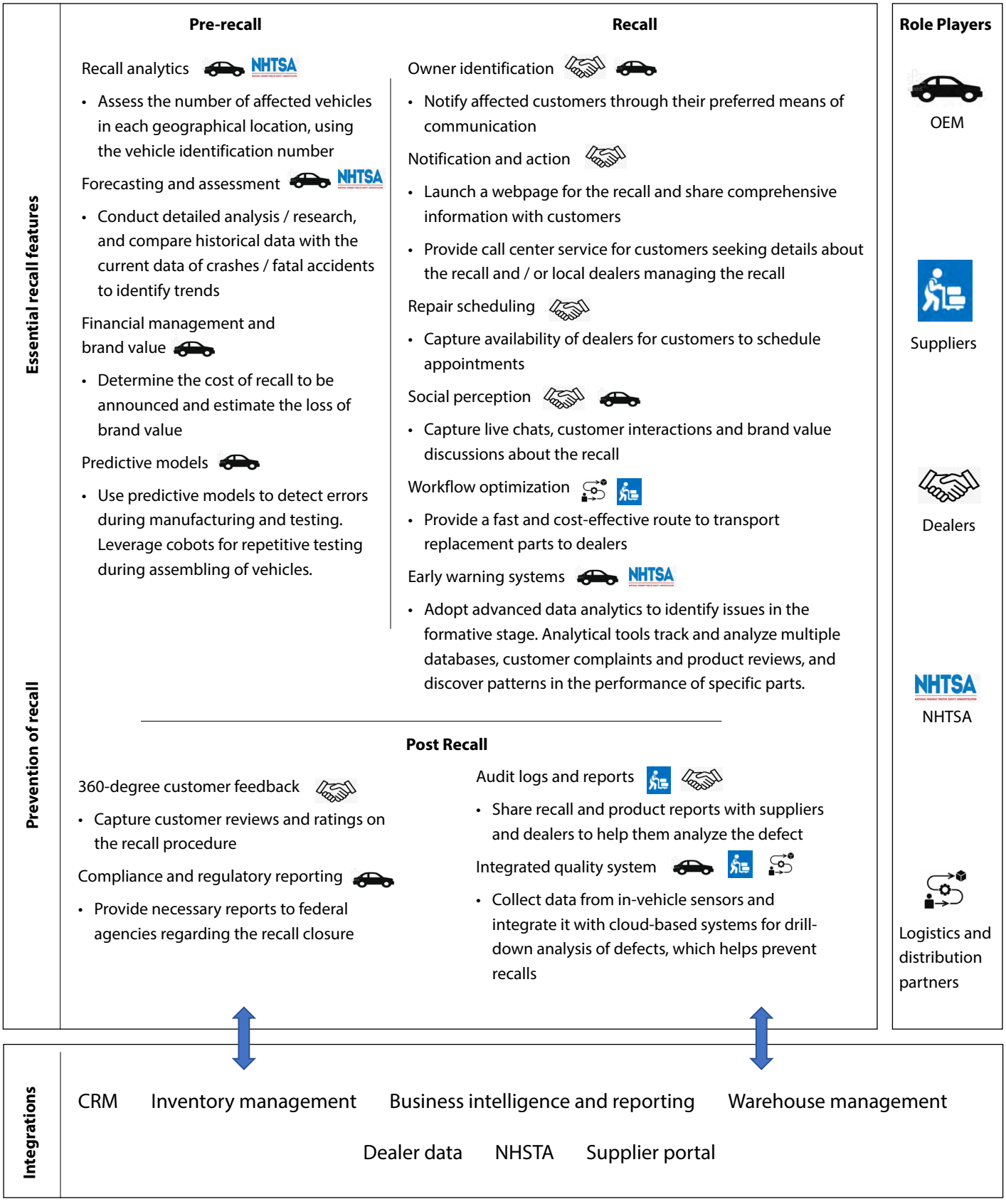


Figure 7

Artificial intelligence, machine learning, blockchain, augemented reality, data analytics and IoT technologies can combine to become a catalyst in automotive recalls by enhancing the detection, analysis and resolution of safety issues. Manufacturers can easily integrate advanced technology into vehicles, enterprise systems and business functions to prevent safety issues and minimize automotive recalls (Figure 8).

Pre-recall

Recall Campaign Optimization

DA models optimize the recall process by analyzing historical data. AI algorithms identify patterns and share insights that help manufacturers refine their recall strategies.

Consumer Awareness

AR apps help vehicle owners learn about recalls and necessary repairs. Customers can use AR applications to scan their vehicles and receive visual overlays indicating whether their vehicle is affected by a recall.

Training and Education

AR apps can be used to train technicians on recall-related procedures and repairs. Virtual training modules simulate various scenarios, allowing technicians to practice and learn in a safe and controlled environment.

Automated Data Processing

AL / ML tools automate the analysis of big data, reducing the time and effort required for manual inspection.

Predictive Maintenance

IoT data can be used to predict maintenance requirements and identify potential failures.

Early Detection of Issues

The analysis of data collected from IoT sensors uncovers potential defects / safety concerns, which facilitates proactive measures to mitigate issues and prevent escalation into large-scale safety recalls.

Early Warning Systems

AI / ML algorithms analyze vast amounts of data from various sources, such as customer complaints, social posts, sensors in vehicles, and maintenance records, to identify patterns and anomalies indicating potential safety concerns.

During Recall

Rapid Identification and Notification

The decentralized blockchain ensures that information is shared securely and efficiently, reducing the time taken to reach out to affected parties.

Enhanced Safety and Fraud Prevention

Blockchains prevent fraud and ensure the authenticity of automotive parts and components. Manufacturers can ensure that only genuine parts are used in the manufacturing process by recording and verifying the entire supply chain on the blockchain.

Traceability and Provenance

The blockchain ensures traceability of components and helps pinpoint defective parts and issues in the manufacturing process.

Real-time Guided Repairs

AR devices superimpose virtual overlays, such as arrows, text instructions and animations, on the physical vehicle. AR apps provide step-by-step visual guidance to technicians during the repair process.

Enhanced Vehicle Inspection

AR tools boost the accuracy and efficiency of vehicle inspections during a recall. It reduces human error and ensures that all issues are identified and addressed.

Targeted Recall

Manufacturers can use IoT data to identify specific units that require repair or update. A targeted approach streamlines the recall process and minimizes disruption for vehicle owners.

Post Recall

Improved Auditing and Compliance

The transparent and auditable blockchain simplifies auditing after a recall. Regulatory authorities can access the blockchain to easily verify compliance with recall procedures, track the progress of recalls, and ensure that necessary actions are taken by the manufacturer.

Root Cause Analysis

DA systems discover the root cause of a safety issue. AI algorithms identify factors contributing to an issue by analyzing large sets of data, including design specifications, manufacturing records, supply chain data, and real-time sensor data.

Customer Sentiment Analysis

DA helps analyze social posts, customer reviews, and other textual data to gauge public sentiment regarding a particular recall or safety issue.

Immutable Record-keeping

The blockchain provides a decentralized and immutable ledger of a vehicle's manufacturing process, supply chain, and maintenance history.

Remote Updates and Patches

IoT enables over-the-air updates, allowing manufacturers to deliver software patches and fixes to vehicles remotely. It helps owners avoid dealer visits.

Real-time Data Collection

IoT sensors in vehicles continuously collect various data, such as engine performance and air bag condition, which helps manufacturers monitor the health of vehicles in real-time, identify potential safety issues, and resolve them promptly.

Role Players

OEM

Suppliers

Dealers

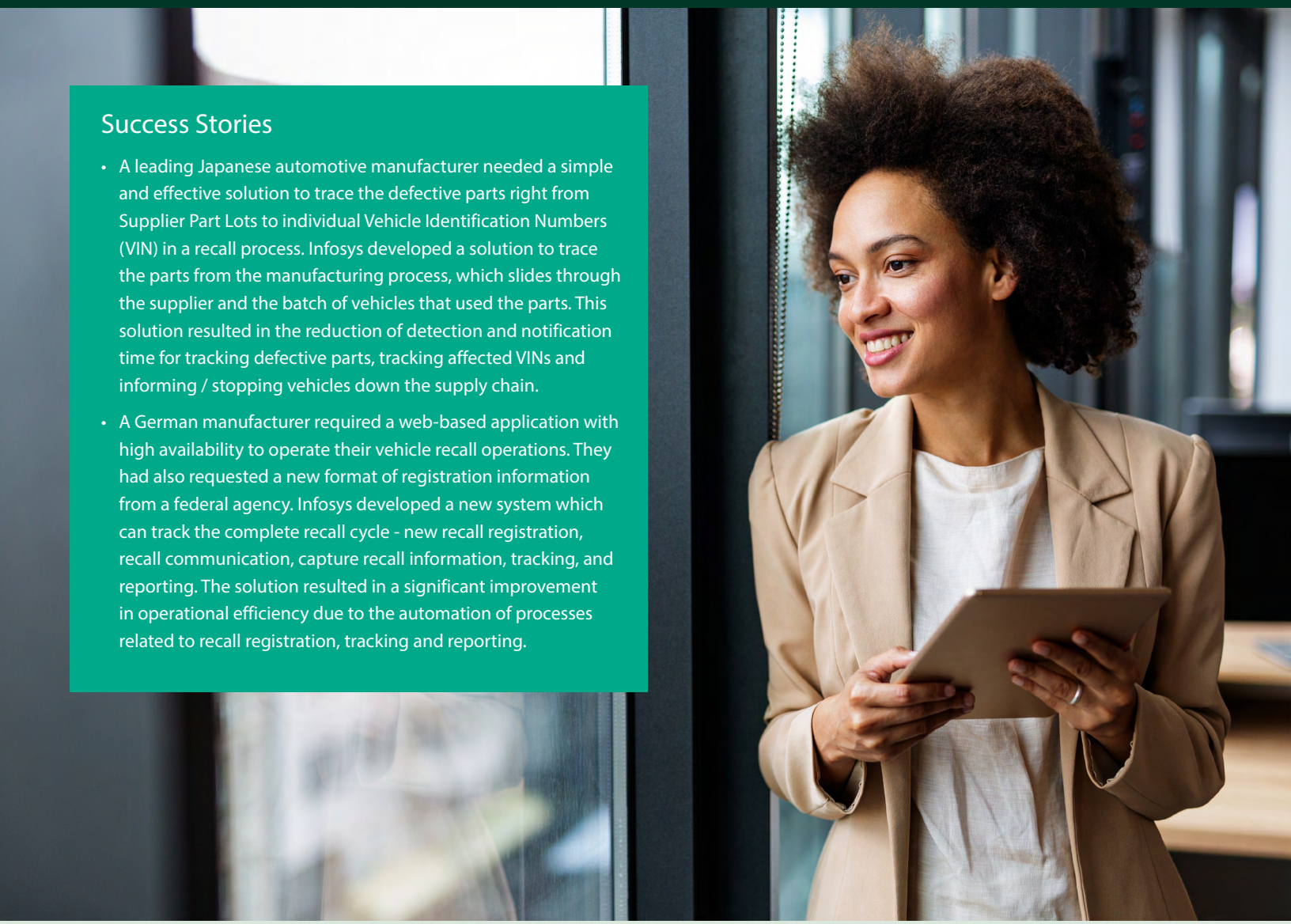
NHTSA

Logistics distribution

AI/ML → Internet of Things → Block Chain → Augmented Reality → Data Analytics

Figure 8

Technology-driven solutions enhance the efficiency of recall management. It accelerates detection and resolution of safety issues, enables prompt communication with affected customers, and ensures road safety. Significantly, an effective, accurate and proactive automotive recall process minimizes risks, boosts customer lifetime value, and restores trust in the brand.



Success Stories

- A leading Japanese automotive manufacturer needed a simple and effective solution to trace the defective parts right from Supplier Part Lots to individual Vehicle Identification Numbers (VIN) in a recall process. Infosys developed a solution to trace the parts from the manufacturing process, which slides through the supplier and the batch of vehicles that used the parts. This solution resulted in the reduction of detection and notification time for tracking defective parts, tracking affected VINs and informing / stopping vehicles down the supply chain.
- A German manufacturer required a web-based application with high availability to operate their vehicle recall operations. They had also requested a new format of registration information from a federal agency. Infosys developed a new system which can track the complete recall cycle - new recall registration, recall communication, capture recall information, tracking, and reporting. The solution resulted in a significant improvement in operational efficiency due to the automation of processes related to recall registration, tracking and reporting.

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