VIEW POINT

THE NEXT WAVE OF THE AUTOMOTIVE AFTERMARKET SUPPLY CHAIN

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Table Of Contents

1. Preface

According to a Chinese proverb, "When the winds of change blow, some people build walls and others build windmills." In an industry like the automotive sector where one constantly feels the breeze of innovation, companies should develop an intuition for boundaries and opportunities. In other words, they should set up their windmills when the time is right.

The fourth industrial revolution – Industry 4.0 – combines information technology and operations technology to create a landscape governed by supply chain digitization. This trend is having a significant impact on the automotive industry and its aftermarket. By making meaningful information available in real-time, it increases visibility, speed and efficiency, thereby reshaping how business is conducted with customers, suppliers and intermediary stakeholders.

This paper highlights the opportunities in the volatile, uncertain, complex, and ambiguous (VUCA) world and explores some of the latest technologies driving change in various phases of the aftermarket supply chain in the automotive industry.

2. Introduction to supply chains

A supply chain is a network of individuals, organizations, resources, activities, and technologies involved in the development and sale of a product. Typically, the cycle begins when raw materials are delivered from the supplier to the manufacturer and ends when the finished product is delivered to the customer through the distribution network. Thus, the purpose of a supply chain is to procure, produce, distribute, and deliver products at the right location, at the right time, in the right amount, and at the right cost to satisfy customers.

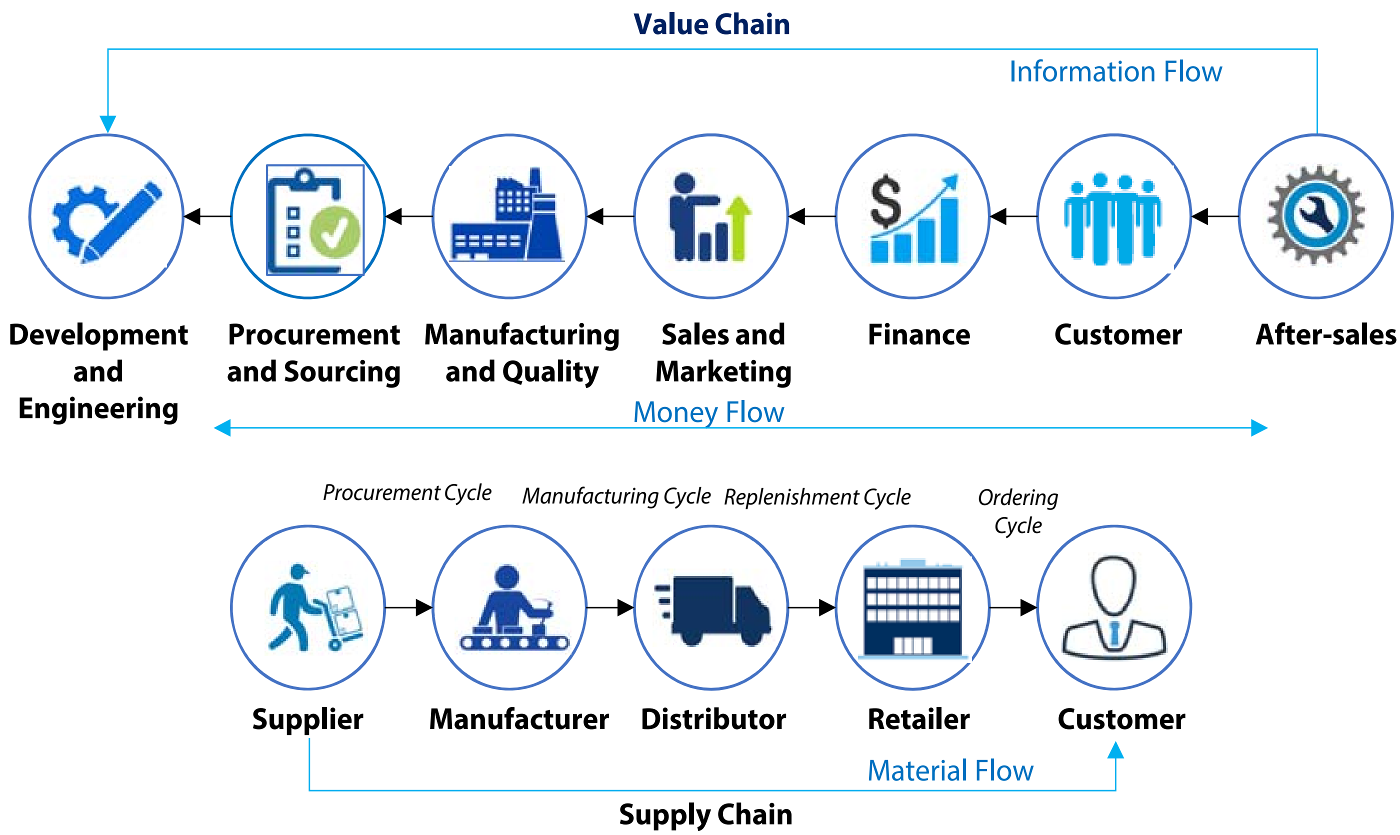

Fig 1: A typical supply chain with value chain components and flow of information/material/money *(Source: Infosys)*

Today, the supply chain business is undergoing disruption owing to new technological advances and process digitization. To cater to the rising demands of today's consumers, there is a need for modernized supply chains that are transparent, intelligent and predictive. Enabling this requires cognitive methods to mitigate disruption and risk, thereby delivering more value to the business

3. Overview of the automotive aftermarket supply chain

The automotive aftermarket is the secondary market of the automotive industry. It involves the manufacturing, distribution, retailing, installation, and re-manufacturing of vehicle parts, machineries and accessories. The automotive aftermarket suppliers supply chain consists of a tier system – T1, T2 and T3 as well as original equipment manufacturers (OEMs) besides dealers and end-customers as shown in Fig 2.

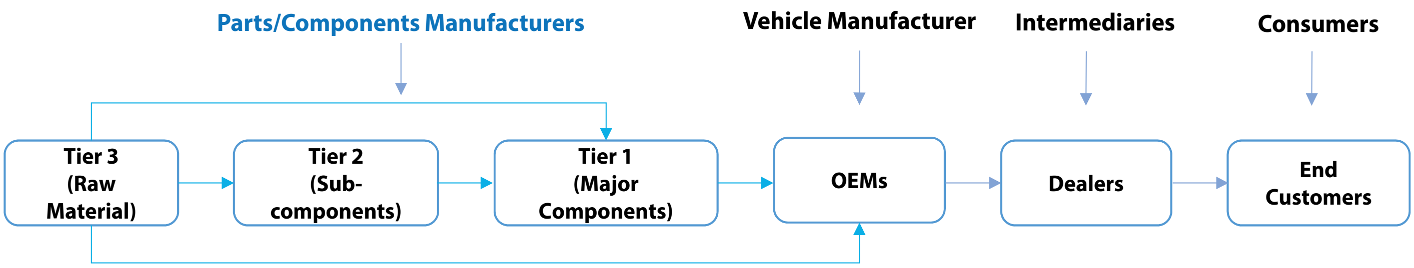

Fig 2: Automotive aftermarket suppliers supply chain *(Source: Infosys)*

- Tier 3 suppliers are companies that supply raw or close-to-raw materials like metal, plastic or rubber required for outfitting the exteriors and interiors of vehicles. They generally supply to all levels mainly through subcontracting. Some examples of Tier 3 suppliers are Arcelor-Mittal, Lubrizol and Bridgestone
- Tier 2 suppliers are companies that manufacture sub-components or supply parts/components to Tier 1 suppliers. They are often experts in their specific domain and are well-integrated in the supply chains of major Tier 1 suppliers. Some examples are LUK, Borgers and ATC lighting
- Tier 1 suppliers are those companies that supply parts or components directly to OEMs without using the service of intermediaries. These suppliers are highly integrated into the OEM supply chain and supply to multiple OEMs. Some examples are Delphi, Johnson Controls and Magna
- Automotive OEMs produce some of the original equipment. However, their focus is on three major areas namely designing and promoting vehicles, placing orders for parts and components from vendors, and assembling the vehicle

There are two parts to the automotive aftermarket – automotive services and the spare parts business. The automotive service business, which is the maintenance and repair of vehicles, generates about 45% of total aftermarket revenues while the remaining 55% comes from the retail and wholesale of vehicle parts. Together, the two businesses are an important part of the overall automotive industry. According to MarketResearchFuture, in 2017-18, these businesses generated approximately US $824 billion in revenue globally, amounting to nearly 20% of total automotive revenues with greater profitability than most of the industry's other subsectors.

Fig 3 demonstrates the end-to-end and cross-functional components of an aftermarket value chain. The major cross-functional areas are sales and marketing, supply chain, sourcing and procurement, warehouse management, and reverse logistics. Implementing these processes/ functions will help companies capture information in real-time and provide visibility to all business stakeholders.

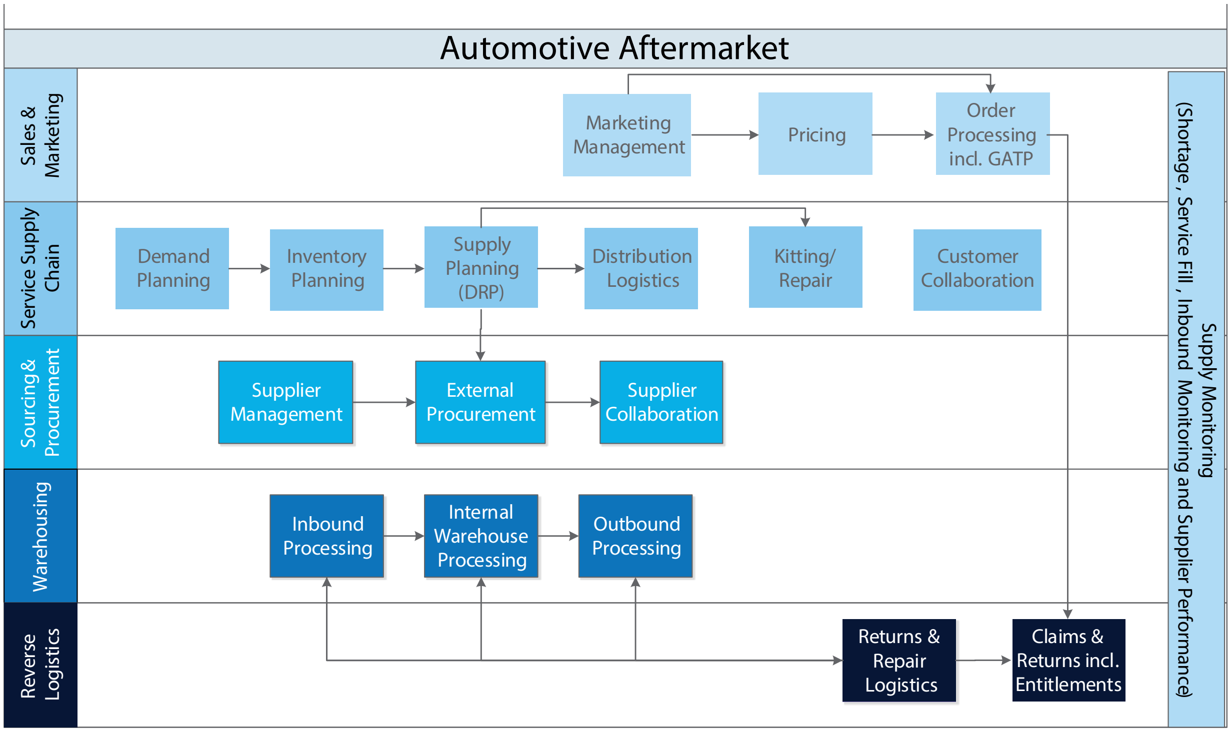

Fig 3: Automotive aftermarket value chain *(Source: Infosys)*

The automotive aftermarket is split into two main types of supplier models:

1 **Independent aftermarket (IAM)** –. In the independent aftermarket, parts are manufactured/marketed by a company other than the auto manufacturer. The parts can be produced in large volumes and tailored to fit the specifications of different types of vehicles, not just a single car make or model. They are similar to OEM parts and are comparatively cheaper.

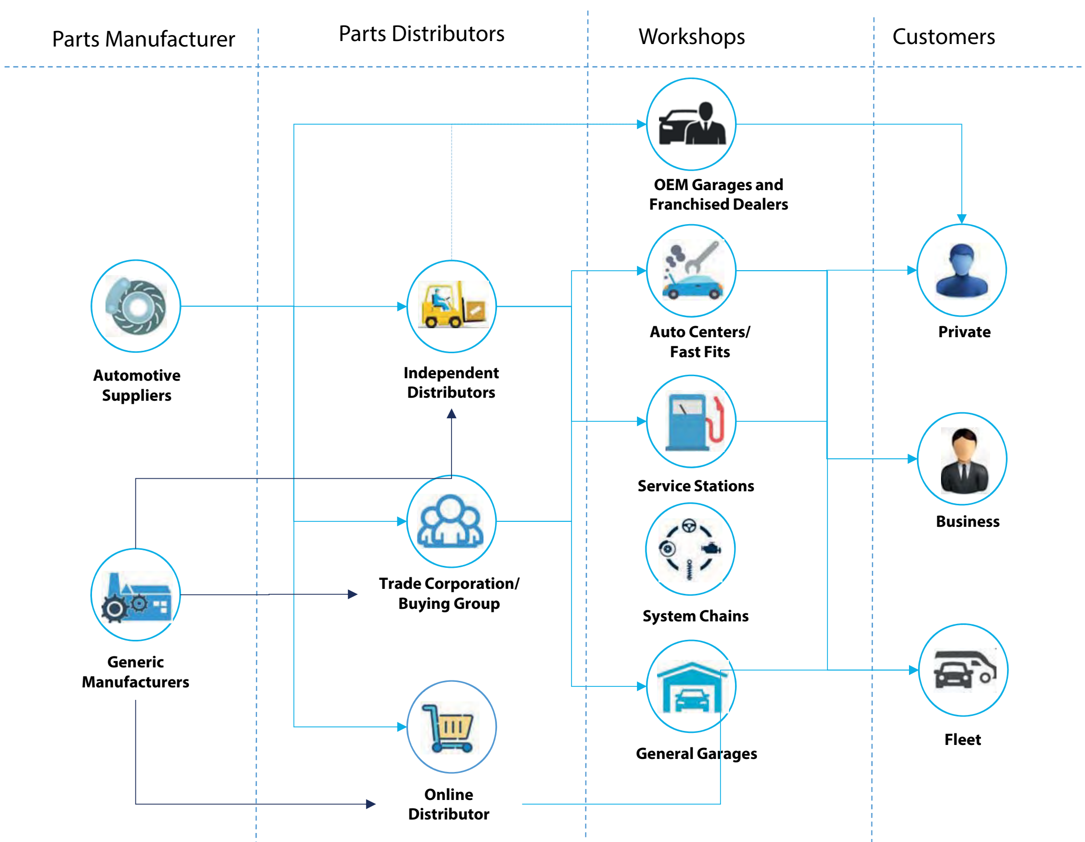

Fig 4: Independent aftermarket network *(Source: McKinsey)*

IAM stakeholders	Description and market examples
Automotive suppliers	Aftermarket parts manufacturersExamples: Bosch, Hella, Autoline, Federal-Mogul, GNA Axels, and ZF
Independent distributors	Providers of alternative and specialty parts to repair and accessorize automobiles and other vehicles Examples: LKQ, Mekonomen, IVECO Parts, and Mageti-Marelli
Buying groups/trade corporations	A group of warehouse distributors/businesses that purchase, sell and market parts under a common name. Parts are purchased directly from parts manufacturers. These offer warehouse distribution access as well as marketing, training and other services Examples: ATR, CARAT, and Pronto
Online distributors	Companies selling and buying parts through various online marketplaces Examples: Amazon, eBay and kfzteile24
Auto centers/fast fits	Companies that specialize in specific auto maintenance and repair service, i.e., transmissions, brakes and air conditioning/radiators Examples: AAMCO, ATU, and Midas
Service stations	Gas stations with at least one repair bay in operation Examples: Dealers of Exxon, Shell and Amoco
System chains	Workshops for any kind of auto service regardless of car make, car age and type of work needed Examples: AutoCrew and Meisterhaft
General garages	Garages owned by an individual or partners that provide repair and maintenance services to vehicle owners

Table 1: Types of independent aftermarket stakeholders

2. **OEM network** – In the OEM network, parts are manufactured/marketed directly by the auto manufacturer, not by a third party. As such parts fit the specifications of a particular make and model, they are more expensive than items sourced from the independent aftermarket. Most OEMs follow a 3-tier distribution network that includes entry warehouse, central warehouse and small regional distribution centers to serve the entire network. In addition, there are small-scale OEMs that employ 2-tier or direct distribution networks. Some examples of OEM networks include Ford, Daimler, Volvo, Volkswagen, BMW, etc.

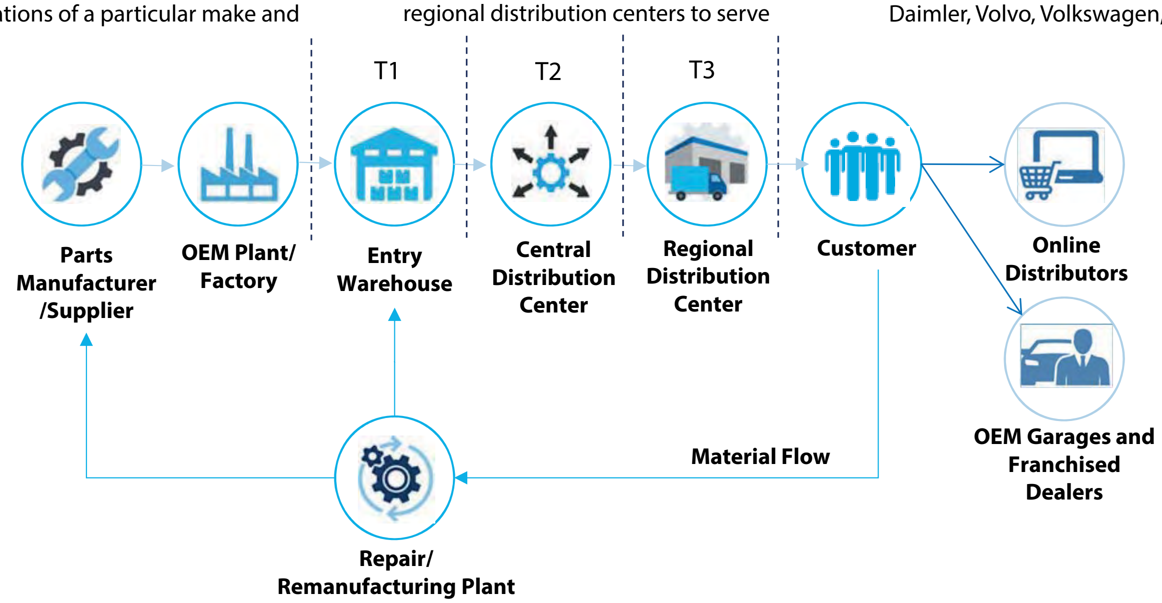

Fig 5: A 3-tier OEM-based supply network *(Source: Infosys)*

4. New business trends in the automotive aftermarket

- **Sequential vs. direct selling (e-commerce) business model** – In contrast to the traditional model where the aftermarket business is sequential, the contemporary aftermarket business model is shifting towards direct distribution where OEMs fulfill the needs of the customer through an in-house e-commerce business or by partnering with online retail giants like Amazon, eBay, etc. For example, Robert Bosch collaborated with the Chinese online retail site TMall in 2010. The gross merchandise volume (GMV) generated was US $290 million in 2015-16 (Source: www.alizila.com)
- **Wear-and-tear vs. service and diagnostics parts model** – Currently, half of the aftermarket revenue comes from wear-and-tear parts followed by crash-relevant parts. Going forward, it is expected that the demand for wear-and-tear parts will slow down due to improved part quality. Similarly, crash rates will decrease with enhanced safety features. Thus, growth will be driven through new diagnostics and services offerings, many of which are linked to digitization and car data. For example, connected vehicles and IoT sensors can generate prognostic data that predict a problem even before a part fails, e.g., a replacement alert before the end of life of rubber tires

5. Challenges in aftermarket planning and distribution

Even as the landscape of the automotive aftermarket changes with the emergence of new growth opportunities, there are key challenges in planning and distribution that must be addressed:

Area	Challenges
Organization	• Lack of investment/attention • Lack of strategic positioning/structures for the spare parts business
Procurement	• Low supplier delivery performance/reliability • Long lead time for sourcing components • Insufficient supplier relationship/collaboration • Counterfeiting of parts
Logistics	• High logistics and inventory costs • Inefficient warehouse management • Difficulties in managing outsourced service providers • Frequent parts recalls
Planning	• Lack of global processes/models • Lack of end-to-end supply chain visibility • Inadequate forecasting capability • Shortage of multi-echelon inventory management capabilities • Poor dealer collaboration
Technology	• Inefficient IT systems that lack a one-stop tool to address all spare parts market processes • Use of multiple, disconnected legacy systems that operate in silos • Inefficient data management and business KPI benchmarking

Table 2: Aftermarket challenges

6. Role of IT in the automotive aftermarket supply chain

Over the years, the role of IT has evolved in the automotive aftermarket. In the beginning, the function of IT was to support business transactions. Later, it became an enabler that supported planning, execution and collaboration through advanced tools. Now, IT has become a strategic driver by enabling digitization and implementing new technologies that accelerate transactions, increase operational efficiency and improve decision-making. Thus, IT will play a critical role in addressing the above challenges. With sophisticated IT, players can:

- Improve planning for all demand, inventory and procurement through advanced tools and techniques
- Enhance warehouse operations by integrating with latest technologies like robotics, RFID, augmented reality, etc.
- Provide a common platform for all stakeholders, thereby enhancing collaboration and data transparency
- Improve the customer experience by reducing response times
- Integrate data from various platforms to increase accuracy and speed
- Improve decision-making through real-time data and user-friendly trends and reports
- Empower organizations to shift from localized to global solutions by adopting best practices
- Leverage the above techniques to reduce overall cost and increase efficiencies

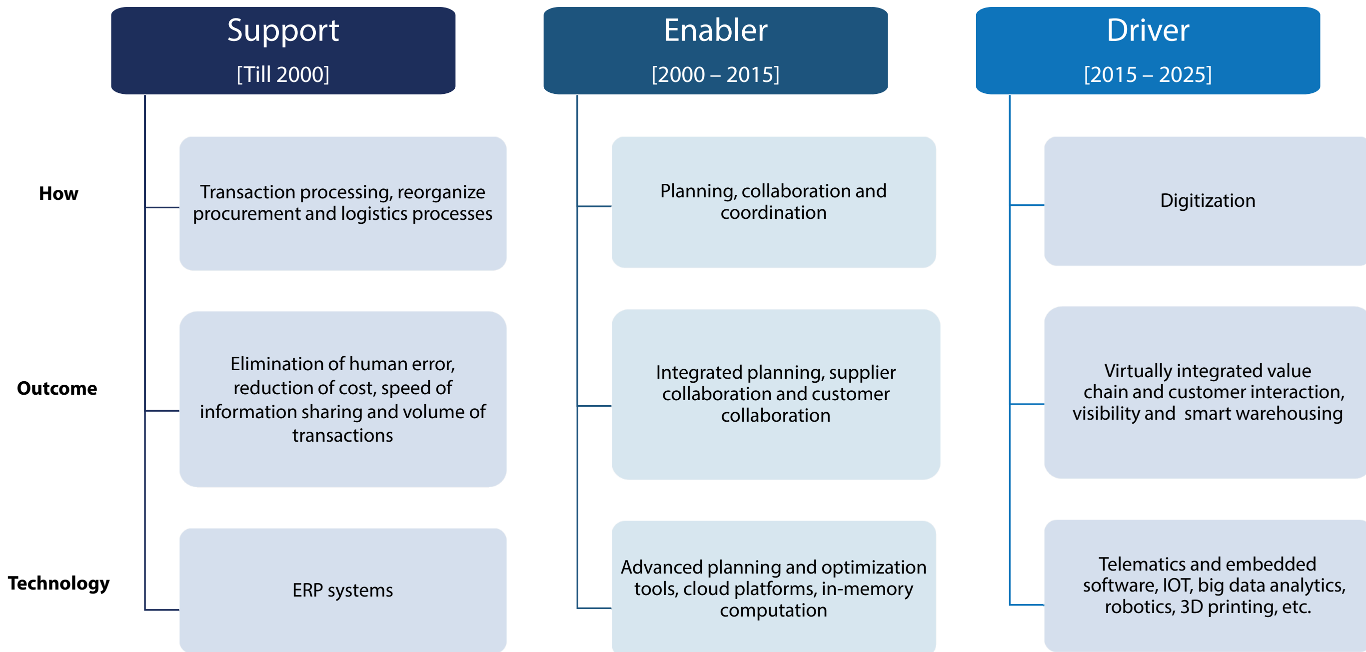

Fig 6: Role of IT in the automotive aftermarket *(Source: Infosys)*

7. Digitization in the automotive aftermarket

7.1

Big data and analytics for predictive demand sensing/reliability – Big data refers to large volumes of structured and unstructured data available within an organization. Data analytics refers to all the activities and methodologies that are used to analyze large volumes of big data in order to understand the internal and external ecosystem for better decision-making. While big data analytics can improve end-to-end supply chain operations from inventory forecasting to pricing, it requires cohesive integration across various functions and teams along the value chain so that the data generated from these functions and teams can be analyzed for quality demand forecasting.

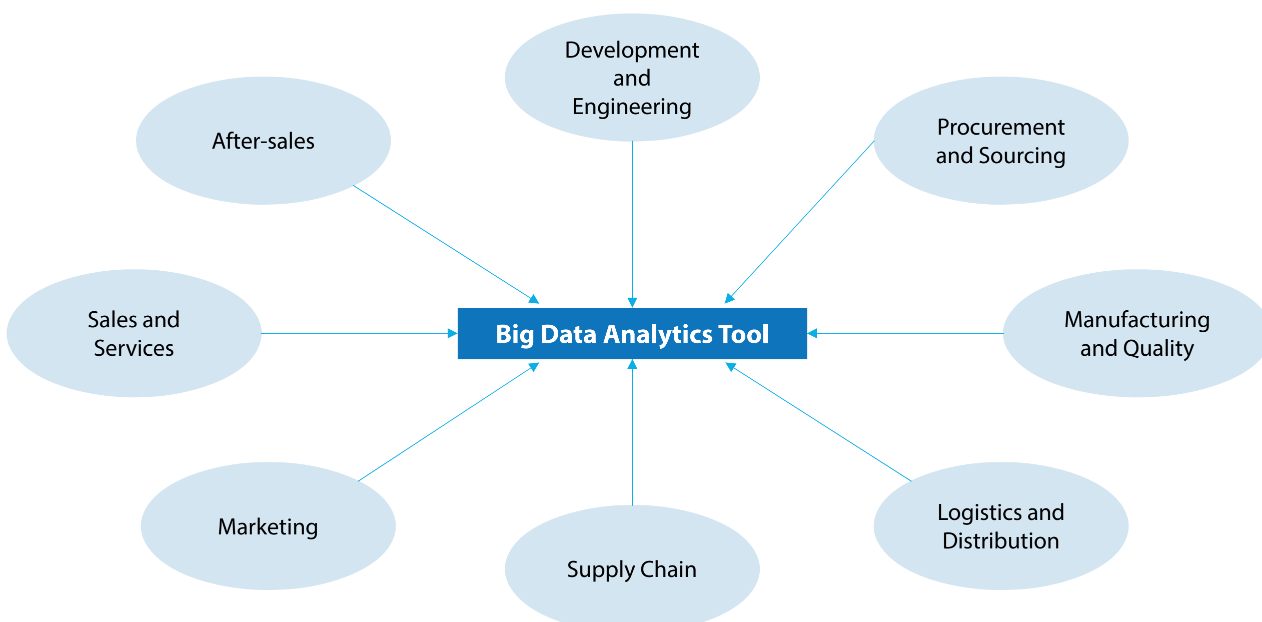

Fig 7: Data sensing model from teams across the organization *(Source: Infosys)*

Example – Supply chain planning with big data

An iconic manufacturer of trucks, buses, construction equipment, and industrial engines based in Europe	The OEM leveraged data gathered from pressure, vibration and temperature sensors as well as voltage and flow meters and integrated it with predictive modeling software that combines business intelligence and probable decision-making outcomes. This helped the OEM identify past patterns and gain future insights. So, now the company can identify the necessary parts and provides repair instructions, even before the truck arrives for service. As a result diagnostic time has reduced by up to 70 percent and repair time by more than 20 percent.

Business KPIs for big data analytics

Collection of data from multiple sources and processing it using analytics software can help make demand forecasting more accurate while enhancing the performance of the KPIs given below:

KPI	Category	Calculation	Description
Forecast error	Forecast accuracy	Forecast demand	Indicator of under-forecast or over-forecast
Absolute mean percent error (AMPE)	Forecast accuracy	Forecast error/ demand * 100	Measures the direction of the forecast error
Adjusted mean absolute percent error (AMAPE)	Forecast accuracy	Absolute forecast error/demand * 100	Measures the magnitude of forecast error
AMAPE ratio	Forecast accuracy	AMAPE/AMPE	Measures if the forecast is improving service quality <1: Forecast is taking variability into account >1: Forecast system is not compensating for the demand variability

7.2 **Telematics and IoT for improved reliability and agility** – Telematics uses devices that measure activities and events in an automobile and transmits this data through wireless communications to a remote server. Telematics leverages the use of several technologies such as GPS navigation, traffic information, infotainment, and crisis assistance. More importantly, particularly for the automotive aftermarket, it also uses vehicle diagnostics and dealer service contacts. IoT is a network of physical objects like devices, vehicles, buildings, etc., that are embedded with sensors and use software and Internet connectivity to collect and exchange data with other objects. Aftermarket telematics devices coupled with IoT technologies can monitor vehicle health, identify the need for preventive maintenance, send remote vehicle diagnostic reports when something goes wrong, and even schedule service appointments. In future, as the technology advances, vehicle 'repairs' may even be accomplished through remote downloads.

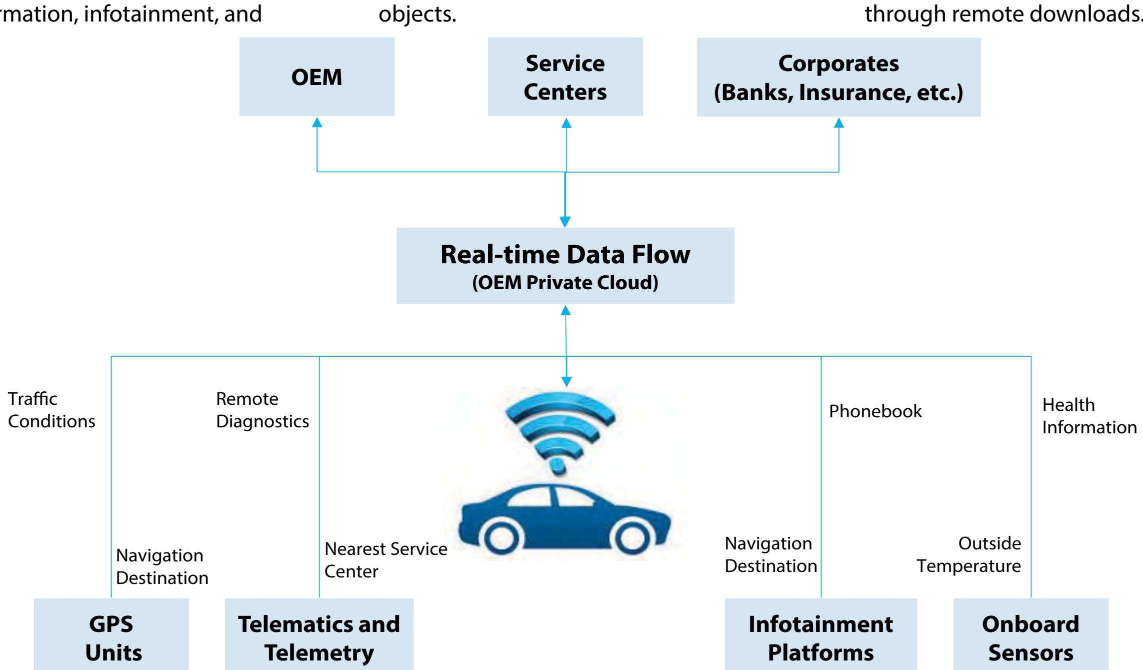

Fig 8: Connected vehicle using telematics and IoT *(Source: Infosys)*

By communicating directly with motorists through their vehicles, this technology can fundamentally change aftermarket relationships with consumers by transforming the spare parts supply chain into a responsive, competitive and efficient one.

Example – Supply chain planning with telematics

A leading Indian commercial vehicle company	The company is leading the telematics wave in India with an advanced fleet management system that allows them to remotely manage trucks by tracking movement, fuel consumption and maintenance needs. With a fully-equipped service network, this real-time tracking enables the preventive and corrective maintenance of nearly 2000 trucks, ensuring superior uptime.

Business KPIs for telematics and IoT

KPI	Category	Calculation	Description
Meantime between failure	Quality	Average hours and days between non-schedule repairs	Measures the product quality
Preventative maintenance compliance	Quality	-	Measures service dealer's ability to schedule preventative maintenance appropriately to reduce downtime cost
Customer satisfaction	Sales and service	CSAT	A reputation metric that can be used to evaluate how clients perceive the quality of performance, product or service
Net promoter score	Sales and service	Avg. percentage of promoters – Avg. percentage of detractors	Measures the loyalty of the customers
Customer effort score	Sales and service	Transactional survey	Measures how easy or difficult it is for a customer to resolve their issues, which in turn predicts customer behavior.

7.3

Smart warehousing with RFID and IoT for greater transparency and productivity – A smart warehouse leverages various interconnected warehousing technologies like RFID, IoT, drones, augmented reality, etc., that work together in an ecosystem where goods are received, identified, sorted, organized, and pulled for shipment automatically. Smart warehousing automates the entire operational lifecycle from suppliers to customers. This increases warehouse productivity and efficiency, minimizes the number of human workers and decreases errors.

A. Smart warehousing with RFID

RFID is an advanced method of controlling inventory. A digital tag is placed on goods and packages that travel into warehouses, thereby replacing paper labels with sensors and antennas. Radio waves are then used to transfer data to or between digital tags while an automated scanning system records the product information.

Using RFID technology for smart warehousing helps manufacturers:

- **Reduce labor cost** – Labor accounts for 50% to 80% of costs in a warehouse. RFID eliminates the need for manual operations by enabling inventory check-in, inventory count and shipment verification to be done in seconds or minutes with minimum human intervention
- **Improve inventory visibility** – By providing real-time inventory updates and faster scanning through readers placed at each portal or doorway, RFID improves the tracking and visibility of products including returns or recalled items as the goods re-enter the facility
- **Enhance traceability and reduce theft** – The use of returnable containers or pallets costs millions of dollars in capital investments. RFID provides a way to reduce these expenses

Example – Smart warehousing operations with RFID

A leading automobile company based in Europe	The company transports spare parts from Japan to Europe in cages and containers. They were using barcodes and scanners to identify incoming and outgoing movements whereby employees were required to scan and record each bit of information manually. The company deployed an RFID system that provides warehouse operators with a clear and accurate overview of all the cages that are located in the warehouse, with dealers or in transit.

B. Smart warehousing with IoT

IoT has pervasive applications for warehousing by enabling intelligent and real-time handling of material, inventory, people, pallets, and equipment through sensors. It measures the performance of assets and applies analytics to identify areas of improvement, thereby improving efficiency, cost-effectiveness and productivity.

Here is how IoT can be used to drive smart warehousing:

- **Asset and inventory visibility** – Wi-Fi-supported sensors, shelf-fitted sensors and weighing devices transmit inventory information to warehouse teams, providing them with real-time details on inventory location and levels. This streamlines warehouse management, eliminates inventory shrinkage and minimize theft
- **Picking-and-packing accuracy** – Picking-and-packing refers to a process in which human staff physically identify and collect items from around the warehouse based on the list of items in a received order, which are then loaded into a cart. IoT automates this entire process by leveraging cart-like robots that identify the location of each part in the warehouse, retrieve the items and deliver these to human workers who load them onto trucks in the correct order. Moreover, IoT-enabled robots constantly transmit their own location to remote monitoring teams. Thus, while IoT increases accuracy and efficiency, automation releases humans from repetitive jobs, allowing them to take on value-adding roles
- **Safer environments for employees** – Wearable wireless sensors along with data transmitters track employee movement around the warehouse, display the distance between employees and machines, and alert operators of machines that someone is close to his or her work area. Such sensors can also measure vital signs to determine fatigue, signaling recommendations for a break from work

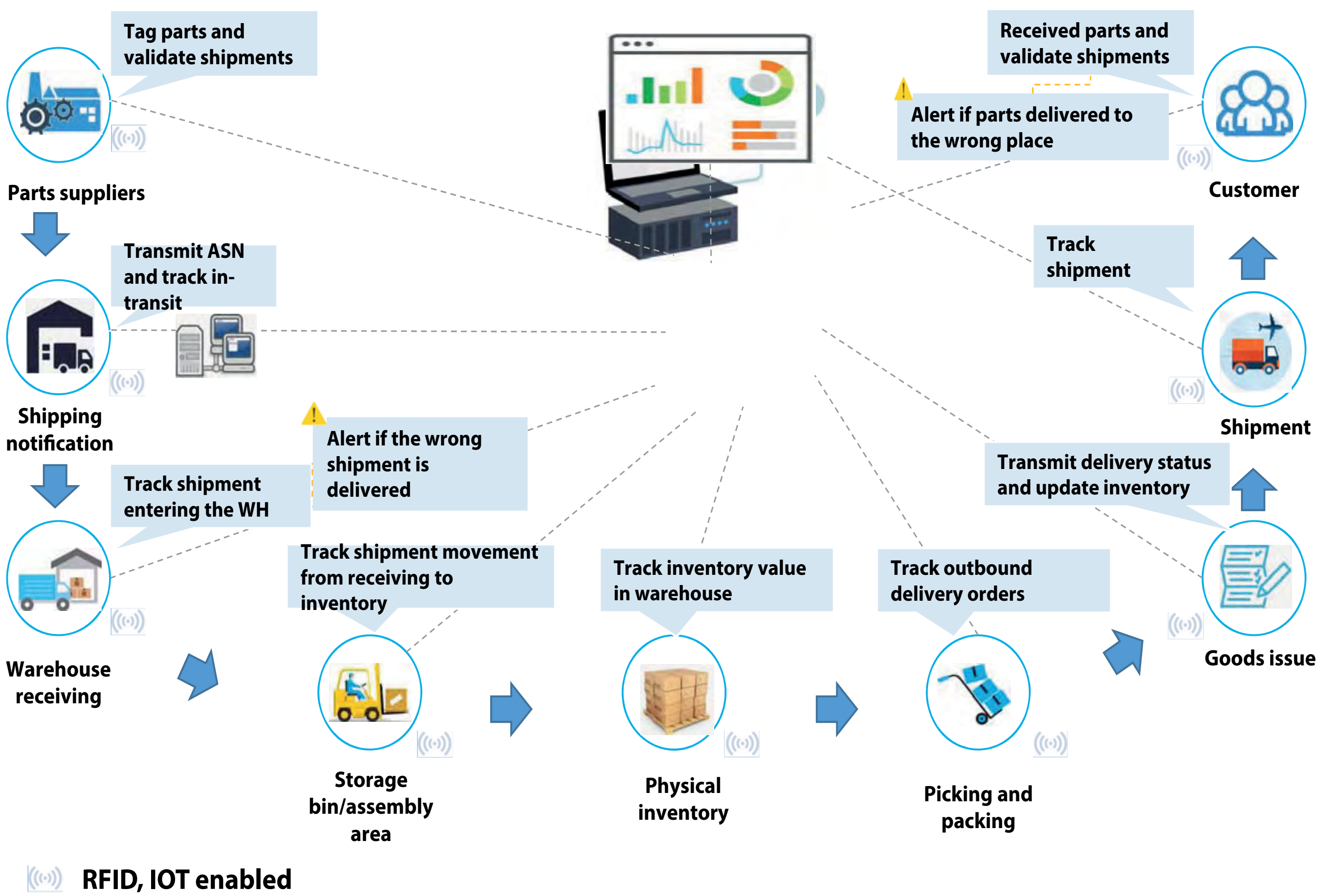

Fig 9 : RFID and IoT-enabled warehouse processes *(Source: Infosys)*


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Example – Smart warehousing with IoT technology

A leading logistics company based in Europe	The company is a global leader in logistics and supply chain services with a wide range of service offerings including national and international parcel delivery, e-commerce shipping and international transport for industrial supply chains. They implemented an IoT solution to monitor all warehouse operational activities in real-time including receiving and storage of goods, picking of products for order fulfillment and loading of products for delivery. The solution provides a responsive graphical visualization of operational data drawn from sensors on scanners. This enables decision-makers to interpret data more meaningfully, re-engineer processes or warehouse layouts to boost operational efficiency and address potential safety blind spots in the warehouse.

Business KPIs for RFID and IoT

KPI	Category	Calculation	Description
Inventory visibility	Physical inventory	-	Measures time from physical receipt of inventory to issuing the customer service notice of availability
Inventory accuracy	Physical inventory	Actual count/computer reported	Measures how closely official inventory records match the physical inventory
Lines received and put-away	Inbound operations	Total lines received and put-away/ total person hours worked in the receiving operation	Measures the productivity of receiving operations in lines processed and put-away per person hour
Picking accuracy	Outbound operations	Total no. of orders – incorrect item returns/total no. of orders * 100	An indicator of the controls set in place to ensure that shipments to customers contain the correct goods or materials
On-time shipment	Outbound operations	Number of orders ready for shipment on-time/number of total orders shipped	Provides the percentage of orders shipped at the planned time to meet customer requirements
Reduce product loss/ theft	Physical inventory	Ending inventory value – physically counted inventory value	Measures the reduction in inventory caused by illegal sales

7.4 **Blockchain to minimize parts counterfeiting and target recalls** – A blockchain network comprises a digital, decentralized and distributed ledger that provides a way for information to be recorded, shared and maintained by the members of the network. The distributed ledger records the digital transactions such as the exchange of assets or data among the network's participants. Participants in the network commonly govern and agree on the updates to the records in the ledger. Every record in the distributed ledger has a timestamp and a unique cryptographic signature, making the ledger an auditable, immutable history of all transactions in the network.

Here is how blockchain can be used for smart warehousing:.

- **Creating intelligent supply chains** – A manufacturing plant must coordinate effectively with multiple tiered suppliers and third party logistics and transportation companies to ensure timely delivery of parts and optimal inventory levels. A blockchain-based system can enable greater transparency of accurate information between the different parties, improving just-in-time logistics, reducing erroneous orders and raising inventory turns
- **Ensuring product provenance for spare parts** – Some service centers and garages in certain markets may knowingly (or otherwise) use counterfeit spare parts for customer vehicles. This is a concern for manufacturers as such parts can under-perform or cause accidents, jeopardizing the manufacturer's brand reputation. A blockchain-based system that links to IoT sensors and smart devices supports robust product provenance across the supply chain from the original manufacturer to the service center, car manufacturer and customer.
- **Enforcing warranty standards** – It is difficult and costly for warranty teams to identify if a warranty claim has been made against a genuine part as opposed to a counterfeit, grey market or end-of-life product. A blockchain system will provide full traceability of part history making it easier for the warranty team to identify counterfeits, thereby deterring fraudulent behavior and reducing warranty cost
- **Enabling targeted recalls** – In cases where a car manufacturer determines that a part is defective, they issue a recall notification informing vehicle owners to bring their car to an

authorized service center so that a replacement part can be fitted. However, car manufacturers often do not have granular information about every part in every vehicle sold. Hence, they end up using broad parameters like models types and model years, leading to blanket recalls of several thousand vehicles when only about a hundred actually have the defective part. A blockchain-based system can eliminate such costly recall processes and customer inconvenience by helping car manufacturers uniquely identify every single part and issue targeted recalls using individual vehicle identification numbers (VINs)

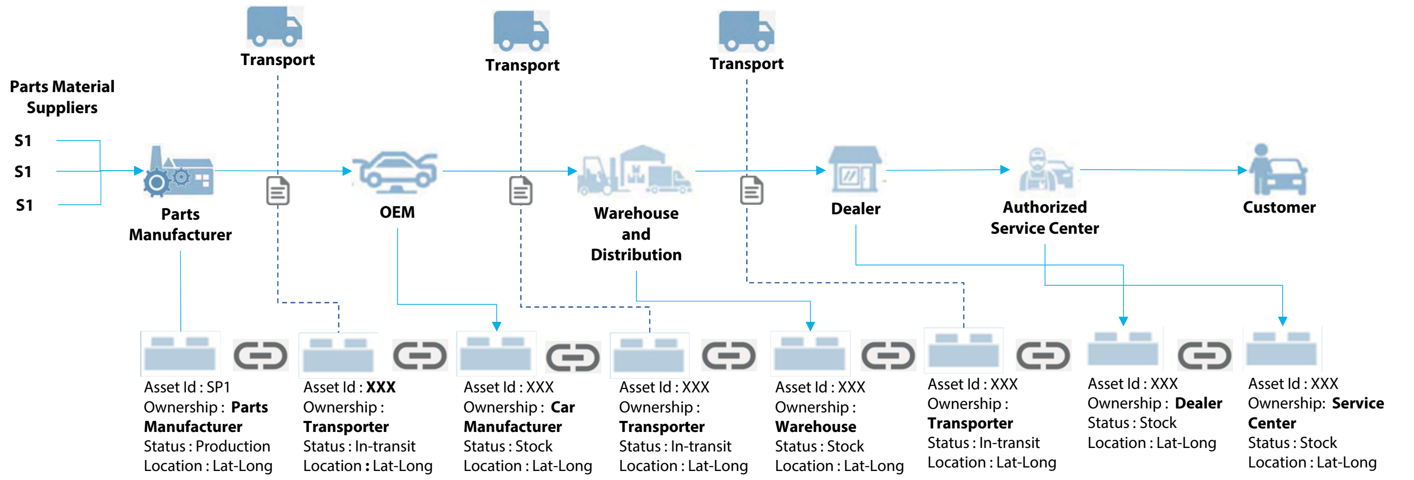

Fig 10: Blockchain in an automotive aftermarket supply chain *(Source: Motorjdi)*

Example – Enabling cross-border supply chains with blockchain

A global leader in transport and logistics based in Denmark	The company has collaborated with IBM to design the first-ever industry-wide cross-border supply chain solution on blockchain. The solution will help manage and track the paper trail of tens of millions of shipping containers across the world by digitizing the end-to-end supply chain process, enhancing transparency and enabling highly secure sharing of information among trading partners. When adopted at scale, the solution has the potential to save the industry billions of dollars.

Business KPIs for blockchain

KPI	Category	Description
Product traceability	Quality	Records the product status at each stage of production through blockchain. In the event of product recall, the company can also identify batches that are affected and who purchased these
Warranty cost as percentage of sales	Quality	Measures the cost of repairs and replacement of distributed units to sale. Total cost of warranty = Cost of recalls + counterfeit + product defect

Conclusion

The next wave of aftermarket supply chains can help automotive manufacturers enhance productivity, profitability and customer experience. The central theme behind the new generation of aftermarket supply chains is how it leverages new technologies to create a self-driving and self-correcting ecosystem with seamless end-to-end delivery and service. The combination of technologies such as blockchain, IoT, big data, data analytics, RFID, etc., can transform the supply chain landscape, delivering just-in-time solutions instead of just-in-case solutions for aftermarket support. With real-time insights and always-on connectivity, the next wave of technologies can help players in this ecosystem reduce costs, increase efficiency, promote trust and collaboration, and gain competitive advantage.

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Satish handles multiple large and marquee customer engagements in the Infosys SAP Practice. He has over 22 years of experience serving global customers in sectors like manufacturing, automotive, pharma, and logistics with over 20 years of experience in SAP. His interests include building reusable artifacts and identifying customer pain areas as well as technical areas that drive benefits for the customers. Satish holds a bachelor's degree in technology from Andhra University and an MS from BITS, Pilani.

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