

A hand holding a smartphone displaying a blue car in a desert landscape. The background is a dark, atmospheric scene with a road, trees, and mountains under a twilight sky. The smartphone screen shows a blue car parked on a road, with a person standing nearby. The overall tone is futuristic and digital.

DIGITAL RETAIL IN **AUTOMOTIVE**

Influence of Exponential Technologies

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The views expressed in this document are those of Debajit Ray, Rakesh Shinde & Sankalp Sinha.

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PREFACE

The views expressed in this document are personal; as a seasoned information technology professionals, having experience working for automotive industry clients and car enthusiasts. The document has blended marketing, immersing customer experience and selling strategies of OEMs and dealers, with the influence of current and upcoming exponential technology platforms.

INTRODUCTION

On January 29, 1886, Carl Benz applied for a patent for his “vehicle powered by a gas engine.” The patent – number 37435 – may be regarded as the birth certificate of the automobile.

This was a huge commercial success, setting a new horizon of innovations in mobility on wheels. Selling cars has remained relatively the same over the last century, despite the vehicles' oceanic technological and capability advancements. Manufacturers distribute cars to dealers who sell to customers. Hence customers' initial experiences with new vehicles are narrowed by dealers' expertise to explain and demonstrate. The skill of articulation results in various bands of customers' reactions during sales, from delight to enlightenment to disinterest. This trend continues; OEMs have large yet passive controls on the art of convincing, mainly due to the economics of selling supply chains and partly due to political and non-monopoly business compliances.

However, the winds have changed. OEMs like Tesla and Rivian are creating storms in selling, going directly to customers and prospects over hybrid mediums – digital and transiently physical sales points. Before 2020, only 2% of auto sales were completed online, but that's now more than 30% and climbing. More than 60% of consumers decide on brand, model, and price before they visit the dealership.

When they head to the showroom, there are, on average, only 2.4 dealers visited. The ubiquity of exponential technologies like IoT, Blockchain, Augmented and Virtual Realities, 5G, Artificial Intelligence and Machine Learning, and high-speed internet connections are the primary drivers for the success of this trend.

Customers can compare options across brands and dealers of the same brand, find attractive prices, personalization of the car models, finance options, immersive engagements on the glass, resale opportunities, information on post-sales services and parts availability, etc. Since customers switch between online and offline experiences at least four times, automotive dealers must create seamless transitions between every experience. Dealers engage in digital retailing as an all-in-one sales process encompassing marketing, leads, customer engagement, order, inventory management, sales, parts exchange, and post-sales services.



FOCUS

Exponential technologies such as artificial intelligence, augmented reality, and blockchain significantly impact digital retail for cars. AI-powered chatbots and virtual assistants improve customer service and personalization. At the same time, augmented reality enhances the car buying experience by allowing customers to visualize and customize their vehicles in real-time. Blockchain technology improves transparency and security in transactions, particularly in selling used cars. Additionally, the rise of electric and autonomous vehicles is changing how cars are sold and serviced, with new business models emerging to accommodate these changes. The automotive industry must continue adapting to these exponential technologies to remain competitive in digital retail.

DIGITAL RETAIL IT ECOSYSTEM

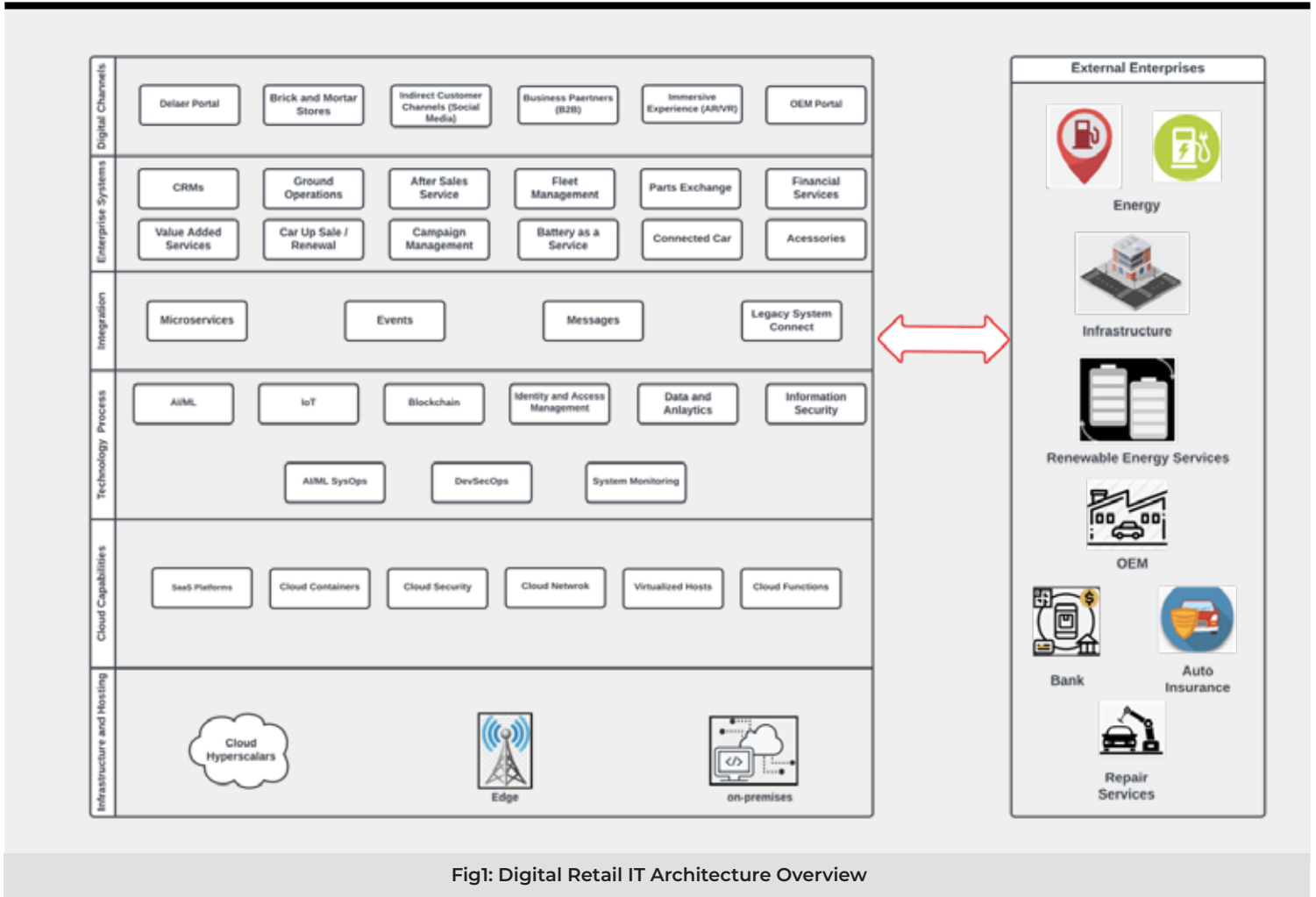


Fig1: Digital Retail IT Architecture Overview

The following table depicts overviews of different Digital Channels and Enterprise Systems

Capabilities	Consumers	Systems	Description
Digital Channel	Dealers	Dealer Portal	Web portal for customer interaction, including model search, pre-order payments, appointment scheduling, financial assistance etc
	Dealers and Customers	Brick and Mortar Store	Physical real estate of dealers – car showrooms with apt setup for customer/prospect engagements with car (including virtual using AR/VR)

Capabilities	Consumers	Systems	Description
	OEM, Dealers and Customers	Social Media	Digital channels on public internet for advertisements on new car launches and public/targeted campaigns
	OEMs, Dealers, Third Party Vendors and Customers	Partner Systems (B2B)	These include systems for insurance providers, accessory dealers, banks, infrastructure (parking/toll etc), which are business partners of the dealers. Dealer Portal acts as a single window for customers' pre-order and purchase needs through integration with these partner systems.
	Dealers and Customers	Immersive Experience(VR)	Dealers at their stores have setup equipment with VR glasses, body suits with gesture recognizing sensors, spatial audio etc. MG Verse is metaverse (browser based VR) platform of MG customer portal.
	OEM and Customers	OEM Portal	<p>Web and mobile portals of the OEMs showcasing all products, launches, news, campaigns, searches and customizations. Some OEM portals emulate dealer portals to a great extent to include pre-orders and financing.</p> <p>Most of the OEMs like Tata, MSIL, Hyundai have implemented 360 degree views of car models on websites and mobile apps, along with on-the-air projections (AR).</p>
Enterprise Capabilities	Dealers	Customer Relationship Management systems (CRMs)	<p>Customer Relationship Management (CRM) systems are crucial in the automotive industry for managing relationships with customers, improving sales, and enhancing overall customer satisfaction. Following are some of the capabilities of CRM in Automotive Industry</p> <ul style="list-style-type: none"> ■ Lead Management ■ Customer Data Centralization ■ Sales Process Enhancement ■ Marketing Campaigns ■ Analytics and Reporting ■ Customer Loyalty Programs

Capabilities	Consumers	Systems	Description
	Dealers	Ground Operations	<p>Ground operations systems refer to the technologies and tools used to manage various aspects of operations related to vehicle handling, logistics, and facility management. The capabilities include</p> <ul style="list-style-type: none"> Inventory Management Supply Chain Management Warehouse Management Fleet Management Vehicle Tracking and Telematics Facility Maintenance Quality Control Real-time Communication Compliance and Regulatory Data Analytics and Reporting
	Dealers, Service Centres	After Sales Service	<p>After-sales service in the automotive industry plays a pivotal role in ensuring customer satisfaction, retention, and fostering long-term relationships. It encompasses a range of services and support provided to customers after they purchase a vehicle.</p> <ul style="list-style-type: none"> Maintenance and Repairs Warranty and Extended Warranty Services Parts and Accessories Technical Support and Assistance Recall Management Roadside Assistance Training Programs Customer Feedback and Satisfaction Surveys Value-Added Services
	Dealers, OEMs and Fleet Owners	Fleet Management	<p>Fleet management in the automotive industry involves overseeing and coordinating a company's fleet of vehicles efficiently. This applies to various sectors, including logistics, transportation services, rental services, and corporate fleets.</p> <ul style="list-style-type: none"> Vehicle Acquisition and Disposal Maintenance and Repairs Vehicle Tracking and Telematics Driver Management Optimization of Routes and Scheduling Compliance and Regulations Insurance and Risk Management Fleet Analytics and Reporting

Capabilities	Consumers	Systems	Description
	Dealers, Suppliers	Parts Exchange	<p>Parts exchange in the automotive industry refers to a practice where used, refurbished, or reconditioned vehicle parts are exchanged or sold as replacements for damaged or worn-out parts in vehicles. IT systems are designed to streamline processes, manage inventory, and facilitate transactions between various stakeholders involved in parts exchange.</p> <ul style="list-style-type: none"> Parts Inventory Management Online Marketplaces and Parts Catalog and Compatibility Supply Chain and Logistics Management Payment and Transaction Processing Quality Assurance and Certification Tracking
	Dealers, OEMs, Financial Institutions	Financial Services	<p>Financial services systems within the automotive industry encompass a wide range of tools and platforms designed to manage financial transactions, lending, insurance, and other monetary aspects related to vehicle purchases, leasing, and ownership.</p> <ul style="list-style-type: none"> Finance and Insurance (F&I) Loan Origination Lease Management Systems Insurance Management Payment Processing and Billing
	Dealers and Urban Infrastructure Management	Value Added Services	<p>In the automotive industry, various IT systems support and facilitate value-added services aimed at enhancing the overall customer experience. These services go beyond the core product (vehicles) and provide additional features, conveniences, or enhancements.</p> <ul style="list-style-type: none"> Telematics and Connectivity Infotainment Remote Vehicle Services Subscription and Membership Management Predictive Maintenance Customer Engagement and Loyalty Programs

Capabilities	Consumers	Systems	Description
	Dealers	Car Upsale/ Renewal	<p>In the automotive industry, upselling and renewing services or products are crucial for fostering customer loyalty and increasing revenue. Various IT systems are utilized to facilitate upselling and renewal strategies, aiming to enhance customer engagement, extend service contracts, and encourage repeat business.</p> <ul style="list-style-type: none"> Subscription Management Digital Sales Automated Renewal Reminders and Notifications
	Dealers and OEMs	Campaign Management	<p>Campaign management systems in the automotive industry are designed to streamline marketing efforts, manage promotional campaigns, and engage customers effectively. These systems utilize various tools and functionalities to orchestrate marketing campaigns across multiple channels. Here are key aspects of campaign management systems in the automotive sector:</p> <ul style="list-style-type: none"> Customer Segmentation Multi-Channel Campaign Content Management and Creation Campaign Planning and Scheduling Analytics and Performance Tracking
	Dealers and OEMs	Battery-as-a-Service	<p>Battery-as-a-Service (BaaS) is an emerging model in the automotive industry that involves providing electric vehicle (EV) batteries, as a service, often separate from the vehicle itself.</p>
	Dealers and OEMs	Connected Car	<p>These systems operate digital connectivity of cars with external ecosystems including remote operations, urban infrastructure and other vehicles. Components of the systems are hosted across Cloud, EDGE and vehicles. Key capabilities of these systems are</p> <ul style="list-style-type: none"> Remote operations (remote engine start, door lock/unlock, AC start/shutdown etc) Real time updates (traffic, weather, road conditions, infotainment etc) Real time diagnostics of invehicle components and runtime parameters (speed, fuel efficiency etc)

Capabilities	Consumers	Systems	Description
			<ul style="list-style-type: none"> Remote location awareness and notifications Integration with infrastructure like parking, fuel/charging stations, road tolls etc
	Dealers and Accessory Vendors	Accessories	<p>IT systems in the automotive industry play a crucial role in managing car accessories, ranging from sales and inventory management to customer engagement. The key aspects of these systems are</p> <ul style="list-style-type: none"> Inventory Management Supply Chain Management Digital Catalogues and Product Inventory Forecasting and Analytics Warehouse Management Order Management and Fulfilment Vehicle Customization

The following table maps the technology platforms with consuming systems and channels

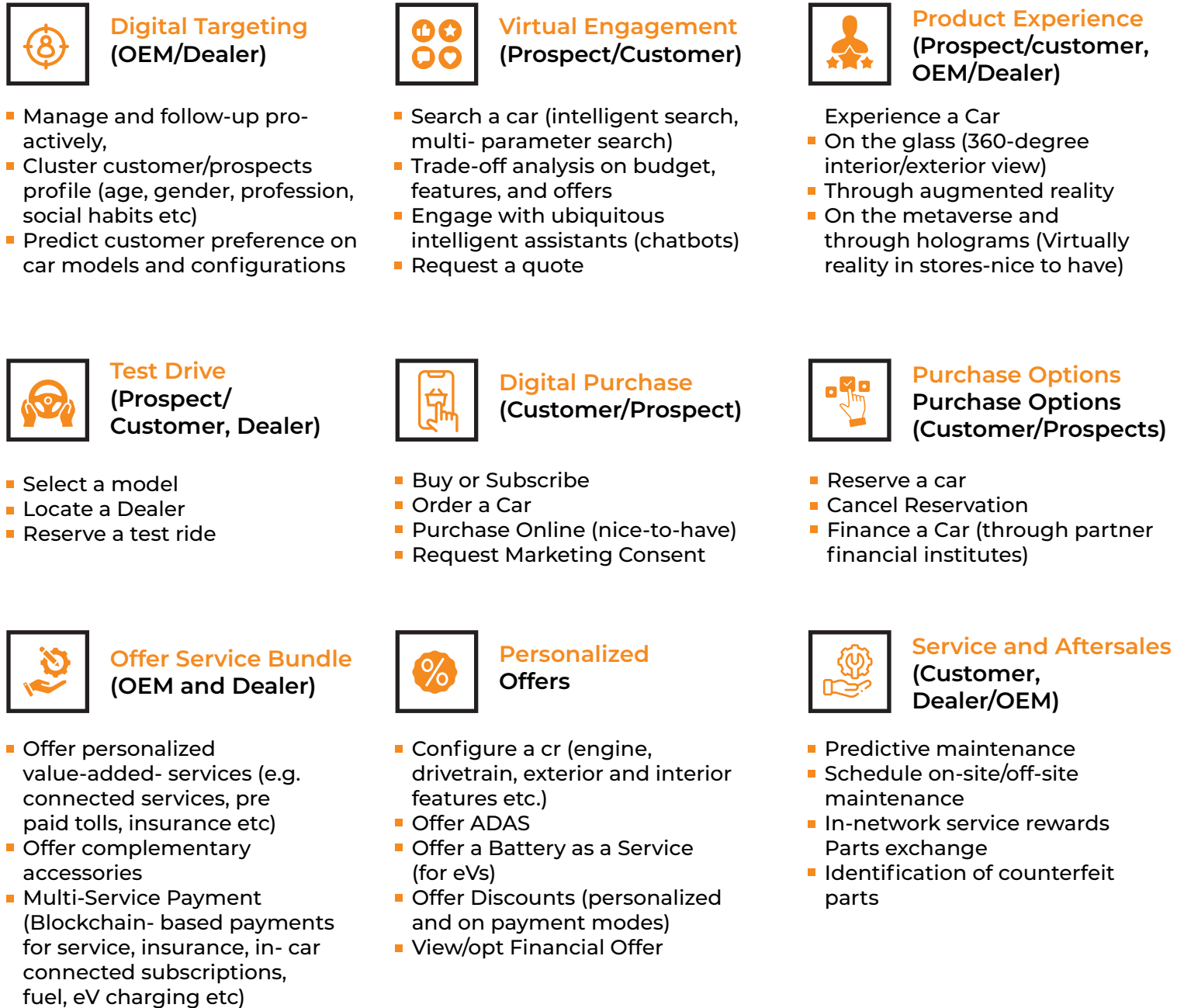
	Technologies	Consuming Systems
Integration Platforms	Microservices	All participating IT systems
	Events	Connected Cars, Battery as a Service, Ground Operations
	Messages	
	Legacy Systems Connect	CRMs, Fleet Management
	AI/ML	Immersive Experience, Campaign Management, OEM Portal, Parts Exchange
	IoT	Connected Car, Battery as a Service

	Technologies	Consuming Systems
Integration Platforms	Blockchain	Accessories, Value Added Services, Ground Operations, Parts Exchange
	Identity Management	All Digital Channels All Integration and Technology Platforms
	Data and Analytics	All Digital Channels All Enterprise Capabilities All Integration and Technology Platforms
	Information Security	
	System Operations (SysOps)	
	DevSecOps	
	System Monitoring	
Cloud Capabilities	Software-as-a-Service (SaaS)	CRMs, Indirect Customer Channels
	Cloud Containers	Dealer Portal, OEM Portal, All Enterprise Capabilities
	Cloud Security	All systems deployed on Cloud
	Cloud Network	
	Virtual Hosts (IaaS)	All systems deployed on Cloud hosts (VMs)
	Cloud Functions (PaaS)	All systems using native Cloud services, including those hosted on-premise
Infrastructure and Hosting	Cloud Hyper-scalars	Enterprise Systems (as per Cloud model recommendations) and Digital Channels
	EDGE	IoT, EDGE Computing for AI/ML
	On-Premise (including Data Centres)	Primarily Systems like CRMs and Fleet Management (not yet migrated to Cloud and/or as recommended for data confidentiality and legacy technology)



USE CASES

Use Cases for Automotive Digital Retail



About half of the aftersales revenues come from wear-and-tear parts, crash-relevant parts, diagnostics products, and other parts. Going forward, the growth of wear-and-tear parts is expected to slow down due to increasing part quality, e-llioBaiLy, and price pressure. Similarly, crash rates will decrease as a result of enhanced safety.

Fig 2: Use Cases

DIGITAL TARGETING

As of 2023, automotive dealers' adoption of digital retailing tools has been significant worldwide. According to CDK Global's 2023 Trendsetter's Guide to Automotive Retail, approximately 44% of dealers have transitioned away from traditional sales methods to enhance the vehicle buying experience. This transition includes using digital tools like photos and videos for service recommendations. Notably, the report indicates that 48% of forward-thinking dealers, termed "Trendsetters," have enhanced their digital retailing capabilities, compared to 36% of traditional dealers who rely on digital retailing from their web channels.

Cox Automotive's 2023 Digitization of Car Buying Study further supports this trend, revealing that nearly all car dealers currently using digital retailing tools have seen positive impacts on their business, particularly in customer experience and satisfaction. The study found that nearly 4-in-10 dealers now offer customers the ability to complete all steps of a vehicle purchase online, an increase from 3-in-10 in the previous year. This shift indicates a growing mainstream acceptance of digital retailing as an essential tool for automotive dealers. These findings highlight the increasing reliance on digital tools and online platforms in the automotive retail sector, demonstrating a significant shift towards digital retailing among dealers worldwide.

As per GrantThronton Bharat, in India, as of 2021, online penetration of auto retail stood at ~0.7% and is estimated to reach 6-8% by 2025 due to the acceleration of digital adoption. It is expected that the same trend will make its way to India as well where end-to-end digital purchasing is likely to happen along with a redefined in-store experience.

OEMs and automotive dealers depend significantly on marketing their newly launched and existing products through digital channels and media (print and electronic). However, their target prospects are only sometimes attracted to the products since the personal preferences on attributes (e.g., safety, price, level of autonomy, connected features, price, financing, etc.) need to be more aptly highlighted.

To achieve higher sales conversions from investments in campaigns, the OEMs and dealers need a closer look at prospect engagement through the creation of valuable content based on customer segmentation through three sixty degrees analysis on

- Previous purchases - preferences on brands, body structures (sedan, SUV, MPV, cross, etc.), drive trains (manual, auto), pre-owned/new, etc.
- affordability
- preferred driveways – urban, rural, highway, hills, etc.
- lifestyles – adventurous, fashionable, no-frills, eco-enthusiast
- residency – urban, suburban, rural, availability of public transport, etc

The information sources for such insights are public surveys (online or paper), social media posts, comments on brand advertisements, and click-to-digital campaigns. These interactions generate enough raw and unstructured information, persist in Cloud Data Lakes, are transformed and filtered through Data Pipelines, and are

- either unified to create Data Warehouse (or Data Mesh/Data Fabric) records to render present and predictive trends (through statistical models) or
- use AI/ML engines to generate insights on text, visual, and audio corpus to extract insights.

The exponential technology platforms suffice the sellers' needs to target the correct cluster of customers and merge with information on entities like weather and air pollution levels (IoT sensors) and event calendars to strategize schedules and hosts (regions, cities, strategic places, distribution channels) of the campaigns.

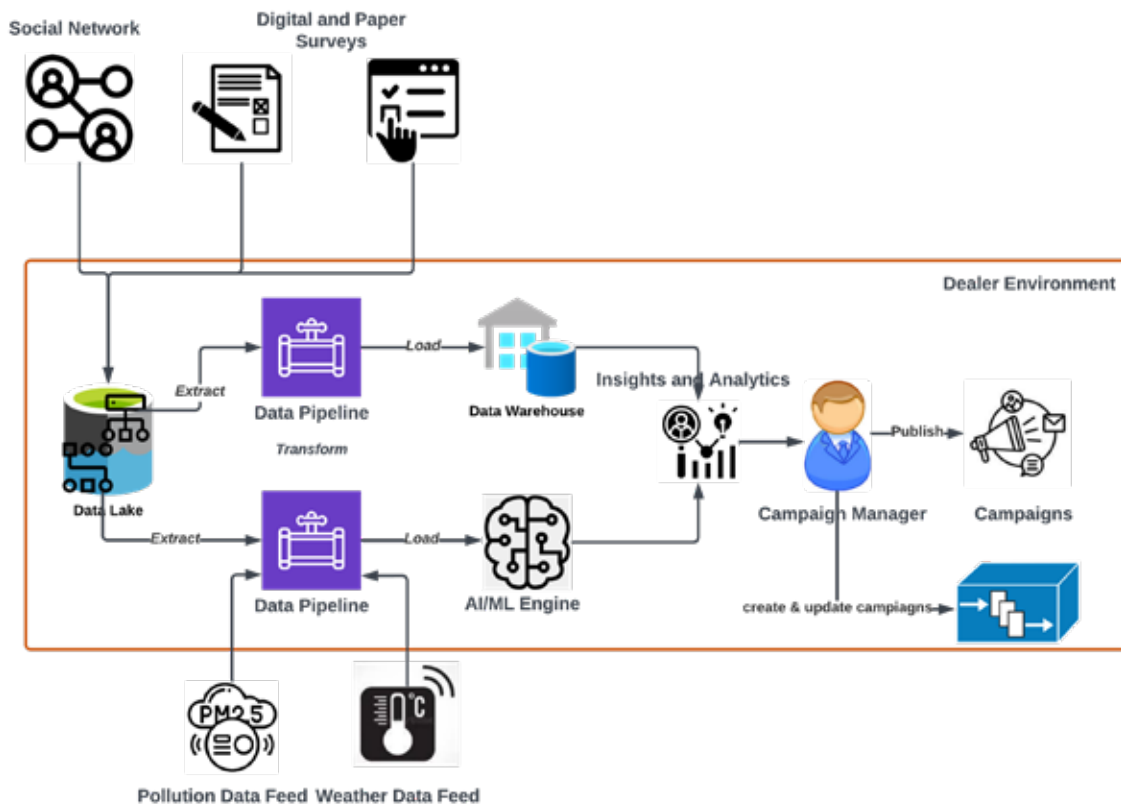


Fig 3: Components for Digital Targeting



VIRTUAL ENGAGEMENT, OFFER & SERVICE BUNDLE

Car dealers are motivated towards online sales, not only because the potential customers are adept at navigating digital channels to choose and purchase products but also because dealers have a clear edge in migrating to digital retail to :

- Improve values through extensive customer engagements by enabling varied touchpoints on digital channels, including but not limited to available models, delivery pipeline, pre-order, assurance of doorstep delivery, financial assistance, customizations of chosen models, remote or on-site immersive experiences, etc.
- Getting better information, getting in contact online, and then pulling the customer into the dealership
- Enable real-time views of inventories transparent to customers, earning the necessary trust for customer stickiness.

The automotive industry is undergoing an omnichannel retail transformation. A typical car dealership involves around 900 individual touchpoints that pervade across websites, digital advertising, OEMs, suppliers, dealer networks, CRMs, call centers, etc. The challenges of integrating all these data points are opportunities for exponential technologies that satisfy and build customers' expectations to work just as-is seamlessly and offer wows.

Following are some value propositions for automotive dealers to implement using IoT and Blockchain in addition to immersive product experiences using AR and VR

- IoT +AI/ML–
 - Today's cars are equipped with multiple sensors that gather information from the sensors about driving behavior, e.g., sudden brakes and acceleration, traffic signal violations, using turn signals, attention deficiency, etc. The data is collected through an IoT broker, stored, and analyzed by an AI/ML engine at the dealer's IT environment to recommend insurance providers best suited for the owner.
 - Messages from sensors also contain the performance of the cars' different mechanical and electronic components. Dealers' AI/ML engines can analyze these for predictive maintenance by after-sales service.
- Blockchain + AI/ML –
 - Dealers participate in Blockchain platforms for infrastructure and utilities, e.g., fuel and charging stations, parking, road taxes, retail outlets, theatres, etc.

- The participants register the cars' transactions with each on the Blockchain and create an ecosystem where values are exchanged on decentralized, immutable trust, e.g., all participants decide to offer discounts on prices based on usage of one or more of the services frequently; deals on on-site charging hubs at the parking lots, discounts on road taxes based on the frequency of refueling within the city limits and so on.
- The dealers extract information on the transactions, analyze them on a hosted AI/ML platform, and recommend the next best choice for each category.
- The customer is happy that the dealers deliver all the driving needs and most of the lifestyle, thereby indulging in a conscious stickiness.

Blockchain-

- Dealers participate in Blockchain platforms with accessories manufacturers and suppliers, assuring the genuineness of every accessory, and can be tracked to all touchpoints, i.e., manufacturer, accessory dealer, transporter, car dealer, and customer.

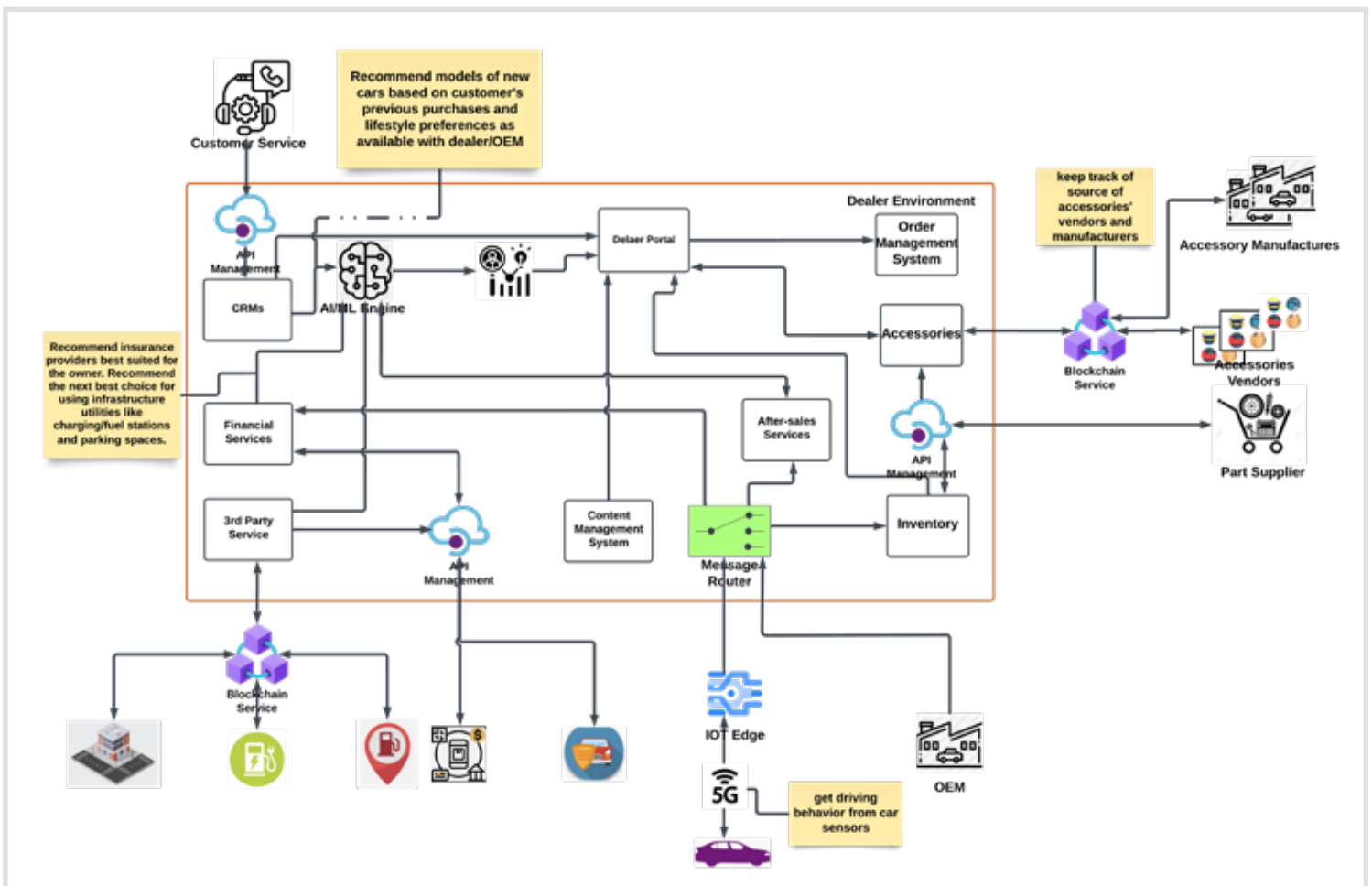


Fig 4: Components for Virtual Engagement



PRODUCT EXPERIENCE AND TEST DRIVE

Verifying a car’s capabilities before the purchase has transformed into a sensory experience for present-day buyers. We want to be engaged in the process through audio, visuals, and haptics.

Augmented Reality (AR) platforms built on AppleAR, AR.js, ARCore, etc., are often used to educate customers more compellingly on the technical details of cars. OEMs and suppliers like Audi and Delphi, respectively, create AR experiences using interactive 3D models of the cars’ internals. The models serve as digital twins of the actual cars and offer prospects to choose from myriad options to pick and choose variations like engines, thermal systems, sensors, etc.



AR Aerography is one of the latest applications for car customizations that OEMs and dealers leverage to allow buyers to visualize the cars with available internal and external cosmetic choices and accessories, e.g., the color of the body, interior upholstery, in-vehicle infotainment systems, wheel dimensions and types, floor carpeting, operable sky view, towing capabilities, Advanced Driving Assistance Systems (ADAS), etc. This facilitates the customers to decide on the needs of each choice to respective lifestyle and trade-off between option and expense, determining the final price.

The global Virtual Reality (VR) in the automotive market size was valued at \$759.3 million in 2019 and is projected to reach \$14,727.9 million by 2027. A VR environment can be available in any showroom, showing the customer exactly how a car will behave while driving (cruise, accelerate, brake, ADAS on varied road conditions, etc.). The capital investment for the dealers will be low considering the ubiquity of VR headsets and implementation platforms like Amazon Sumerian, Google VR for Everyone, ARToolkit+, BRIO, etc. Product experiences are vastly improved by VR instrumentation in dealer showrooms, e.g., MG, Tata Motors, and MSIL NEXA in India.

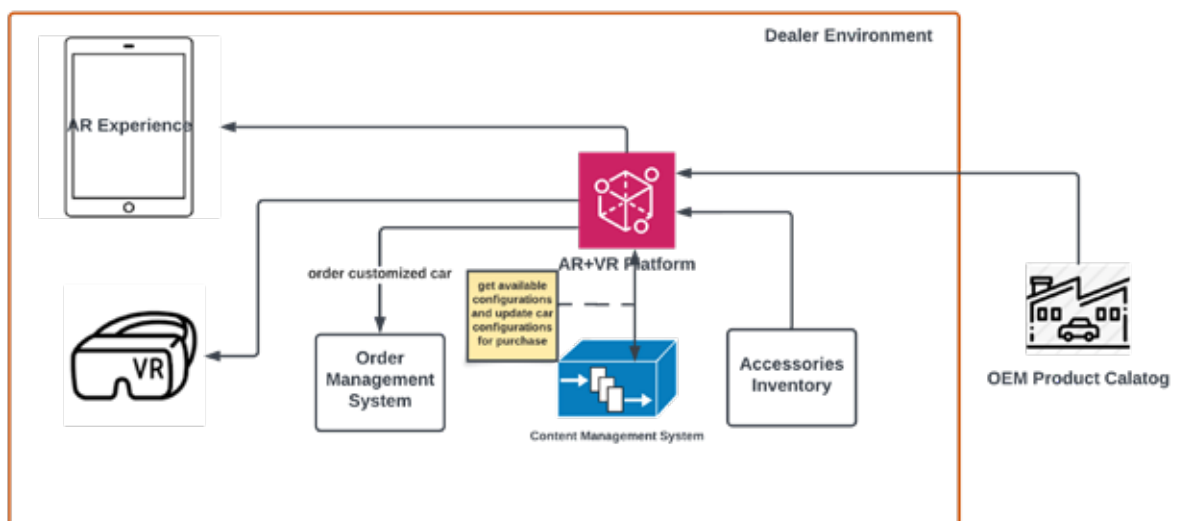


Fig 5: Components for Product Experience

DIGITAL PURCHASE AND PURCHASE OPTIONS

If consumers are moving around and across various channels, so should the point of sale – a single-channel world is no longer sufficient

(Source: Deloitte Report - Disruption in the automotive industry. How digital is changing car sales)

One of the significant changes in COVID-19 years is exponential growth in the origin of service requests through digital channels across industries – Retail, FMCG, BFSS, Utility, Telecom, and M&E. This also started a significant shift in choosing cars, search on the internet and decide, instead of visits to dealers. The final purchase is still majorly after further hands-on experience on look, feel, and test drive, yet the trend of contactless purchase and delivery at the doorstep is catching up fast. OEMs, dealers, and their partners put consumers first by using technology to alter their selling processes and reshape how consumers engage fundamentally.

- Buy or Subscribe – OEMs understand that buying a car is a significant capital investment for most customers and offer recommendations based on insights from publicly available sources to recommend the ownership mode, i.e., buy or subscribe. Subscription relieves the customers of many issues like insurance payment, regular service, infrastructure fees, etc., all handled by OEMs (and dealers), e.g., MSIL. In contrast, the customers pay a monthly amount for a specific period. The OEMs, dealers, vendors, and other service providers are implementing/reusing their integrated IT ecosystem to abstract the intricacies of subscription capability from the customer, often using Blockchain.
- Manage Car Reserve and Purchase Online – Potential car buyers search third-party aggregator sites to study the pros, cons, and suitability of cars to their needs and lifestyles. They want to extend their experience reserving cars, particularly the recently launched models. The OEMs provide facilities for reserving through their websites, and mobile apps often guide the customers on the available financing choices with AI-based Trade-Off Analytics on the amount of down payment, interest rates, models, and financing institutes. The buyers pay the initial order amount, and OEMs register it with a specific dealer to process it further. Customers can also cancel reservations, modify models, and modify chosen financial options within a certain period through online services. Some OEMs like Tesla, Rivian, and LUCID Motors also offer the entire online order and purchase process, that does not involve dealers.

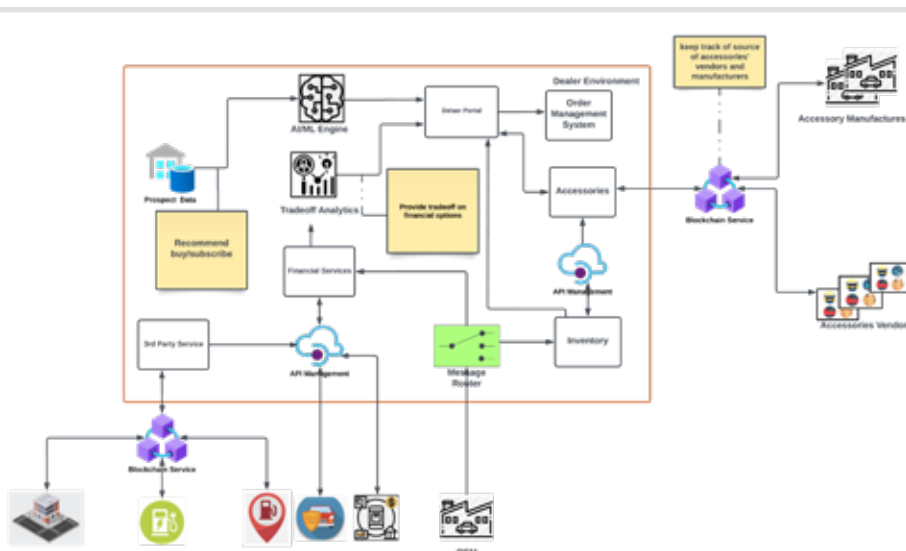


Fig 6: Components for Digital Purchase

PERSONALIZATION OFFERS

Disruptive technology transformations in the industry, primarily Software Defined Vehicles (extended to various levels of ADAS), connected services, and electric vehicles, boost the new revenue streams.



- Financial Offers – Most car buyer’s major challenge is balancing personal choice and financial capability. Car models that entice the buyer are often not pocket-friendly. To pacify this anxiety, dealers develop various personalized financing options, from recommending low interest rates to low down payments and extended repayment periods. The recommendations are often determined by credit scores and collaborations with preferred financial institutes that are guaranteed volume business from the dealers and OEMs.

However, new trends will come up with the higher adoption of Software Defined Vehicles (on the backbone of Cloud, AI, EDGE, IoT, and 5G), where the initial payments are low with fixed mechanical and hardware architecture for the car's lifetime. In contrast, the cars' capabilities are improved over time through over-the-air updates on software and the electrical/electronic architecture firmware. Thereby, higher capital investments from OEMs and customers are offset by periodic operational expenses, offering more flexibility to the customers.

With open architecture specifications like AUTOSAR, ubiquitous CLOUD services for IoT/AI, and accelerated adoption of 5G and EDGE, we are not very far from drifting away from conventional OEMs manufacturing cars, but collaborations between OEMs and electronics product developers (e.g., Honda and Sony) or even generic manufactures with sufficient investments (crowdfunded) to build cars, akin to open-source software and hardware.

- Personalized Loyalty Programs – Many OEMs/dealers use loyalty programs for customers who buy multiple cars from the same dealership and/or use the dealers' service centers.
 - Predictive maintenance programs use
 - IoT to gather insights into customers' driving behaviors
 - AI/ML models to predict the next service schedules, maximum distance before the next service, nearest service centers to the car's current location, and even recommend leisure destinations to the nearest service centers (both leveraging GPS and AI).
 - OEMs also use mobile fencing or beacon services through NFCs of customers' mobile phones to prioritize attention and push personalized offers to loyal customers.
- Configure a Car - Accessories per customers' tastes are discounted. Customers engage in immersive experiences using AR/VR platforms and AI, with data from multiple channels.

- Offer Battery as a Service (for eVs) – OEMs for eVs will revolutionize (Bounce Infinity bikes already use it, and Jio BP is planning to launch battery swap services for commercial and private eVs soon across India) vehicle offers through Battery-as-a-Service (BaaS),

Battery-as-a-Service (BaaS), leveraging their networks of battery manufacturers and charging stations. The OEMs attach short-lifespan batteries for cars, thereby reducing the initial cost of ownership, then use the networks to change batteries at end-of-life through their networks. The cars are Software Defined (IoT, AI/ML), monitoring battery health and predicting/notifying the owners when changes are needed. The primary advantages of BaaS for vehicle owners are

- Ready access to charged batteries
- Availability of reliable power source in-vehicle
- Low/no concern about battery maintenance or purchase
- Low /no concern on availability of charging stations beyond city limits
- Low latency for full mobility

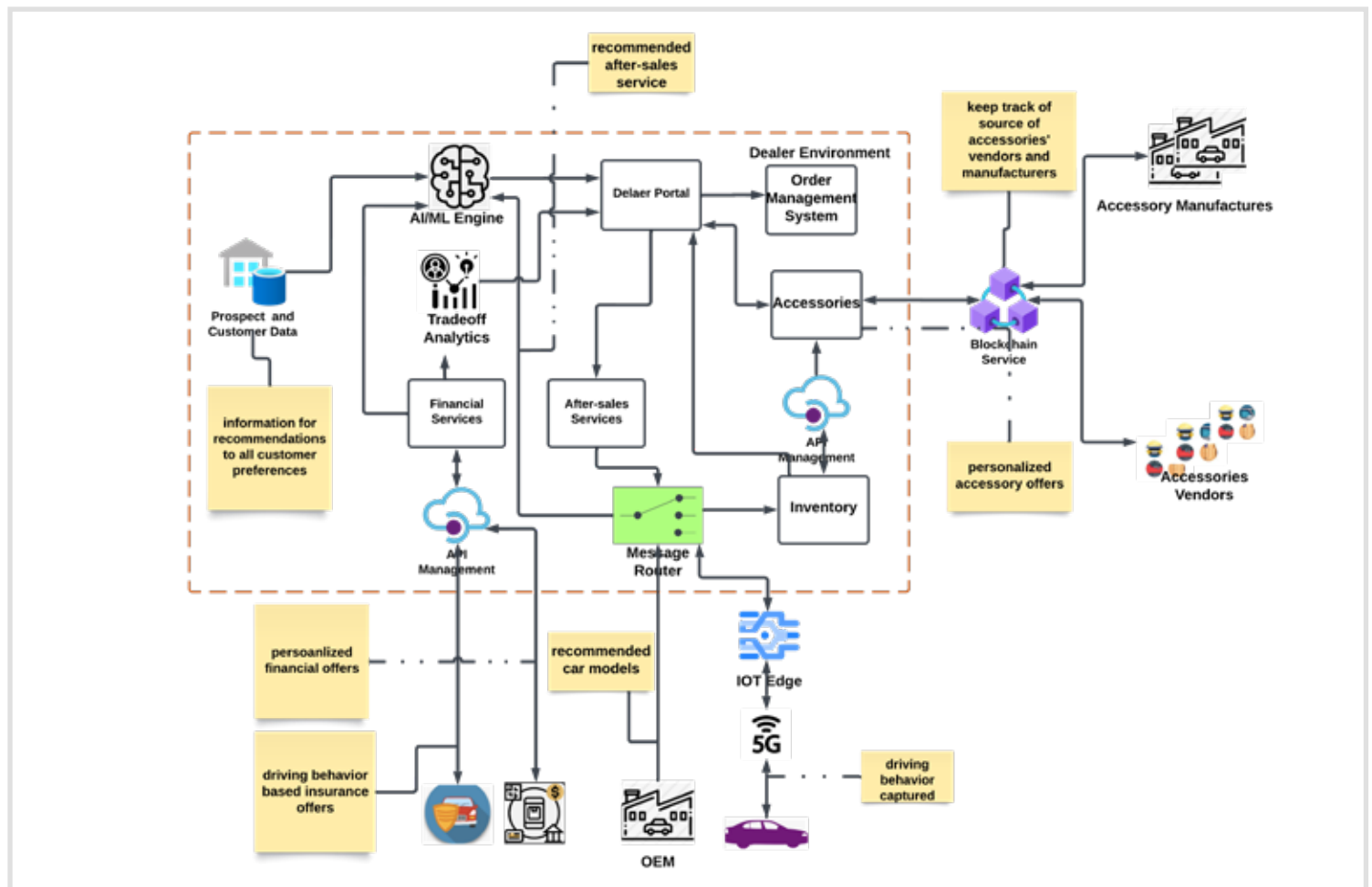


Fig 7: Components for Personalization Offers



SERVICE & AFTERSALES

Customers are demanding seamless experiences from purchase to after-sales services through omnichannel. Dealers and OEMs are meeting the demands by making service requests possible through digital channels and adopting high-value capabilities to retain customer affinity.

- Predictive maintenance – Today's cars have enough sensors to collect health diagnoses on all components of the mechanical and electrical/electronic architecture affected by generic wear and tear, natural elements, and accidents. Cars' on-board software systems that monitor and manage components through Domain Control Units like drivetrain, suspension, brakes, infotainment, seats, doors, lights, etc., collect sensor information and broadcast (through IoT-backed connected vehicle platform over 5G) the same in real-time. Health data analytics is done on the vehicle using advanced onboard AI/ML models or on EDGE or CLOUD, depending on the urgency of needs for actuation (commands back to the cars as per events). These intelligent systems often predict upcoming issues, warning the owners of the potential time to failure, maximum distance to failure, and even the most optimized routes to a destination with service centers en route. Dealers'/OEMs' service centers retrieve the cars' diagnostics before the vehicles' reach the centers, ready with requisite parts and workflows needed for repair.
- Parts exchange – The car parts market is flooded with duplicates denting OEMs' and dealers' reputations, revenues, and customer loyalties. Genuineness of parts is ensured through a distributed trust created on Blockchain, which ensures authenticity is propagated through the key stakeholders – parts manufacturers, distributors, dealers, service centers, and customers. Any defect can be traced to the originator of the problem and rectified at the source.
- Warranty – Car warranties cover most components, mechanical or electronics, from everyday wear and tear. Data for a new car's components (identifiers, manufacturers, service level assurance, etc.) are stored as warranty contracts in trusted Blockchain ledgers. Health conditions of these components are collected by onboard sensors (IoT), in real time, and compared with Blockchain data to ensure that the parts are not deliberately tampered with and requests for warranty period replacements are valid.



IMMOVABLE OBJECT AGAINST RELENTLESS FORCE

IMMUTABLE CUSTOMER PSYCHE

The primary challenge in adopting digital retail in cars is the customer psyche.

- Car owners want to have touch-and-feel experiences with the cars they buy; the cars extend the owners' personalities. Hence they insist on "kicking tyre."
- New owners want to use the visual, auditory, and haptic senses to validate purchases of high-value products.
- We also have a notion that test-drive cars are actual twins of the new cars to be bought and want to verify if the campaigns about the features and technologies are good enough.

OEMS AND DEALERS ARE CHALLENGED

OEMs' and dealers' foray into the digitization of their sales and aftersales processes have their impediments.

- Developing a more significant online presence
- Dealing with the increased complexity of vehicles' servicing.
- Skills to sell benefits of connected vehicle platforms
- Convincing customers to pay for value-added-services on exponential technologies
- Servicing a wide variety of vehicle types, including electric vehicles, and justifying the costs associated with the replacement of E/E components instead of repairs

YET, TECHNOLOGY WILL CALL THE SHOTS.

Exponential technologies influence OEMs, dealers, and customers to embrace car retail through digital technologies; the entire car purchase process is on the path to being wholesomely digitized beyond human touchpoints.

- The ever-growing usage of Large Language Models promoted, commercialized, and released for public consumption by the exponents of the IT industry, including Microsoft, and Alphabet are integrated into the most popular search engines like Bing and Google. This opens a vast horizon for car buyers to search online for the brands, models, features, and customizations entwined with their preferences and lifestyles.
- AR/VR/Hologram will continue to be widely adopted across the automotive ecosystem to provide immersive experiences to prospects and customers on the air and the glass.
- Recommend the best choices of models and features as per prospects' and customers' preferences through AI/ML models.
- Blockchain will be the standard platform for distributed trusted ledgers between manufacturers, suppliers, dealers, and customers to assure the genuineness of accessories, parts, and ownership.
- Level 5 autonomy in mobility will enable carriers will deliver the cars to the doorstep from OEM sites or dealers' warehouses, reducing or eliminating the operational complexities and expenses of maintaining a fleet for manual delivery at the dealers' site.
- The dealers and OEMs will offer infrastructure, energy, insurance connectivity, advanced in-vehicle infotainment, Advanced Driving Assistance Systems, Over-the-air software, and firmware upgrades, predictive services to the cars through combinations of NFC, IoT, EDGE, AI/ML, and Blockchain.

The above will be realized shortly in the next 15 to 20 years. Yet,

"At least 103 million people worldwide have been forced to flee their homes. Among them are nearly 32.5 million refugees. There are also millions of stateless people, who have been denied a nationality and lack access to fundamental rights such as education, health care, employment and freedom of movement."

– UNHCR.

Technology will be bound by the servitude of our desires and intent, despite being the RELENTLESS FORCE.

APPENDIX

IMPACT OF ELECTRIC VEHICLES ON AUTOMOTIVE RETAIL

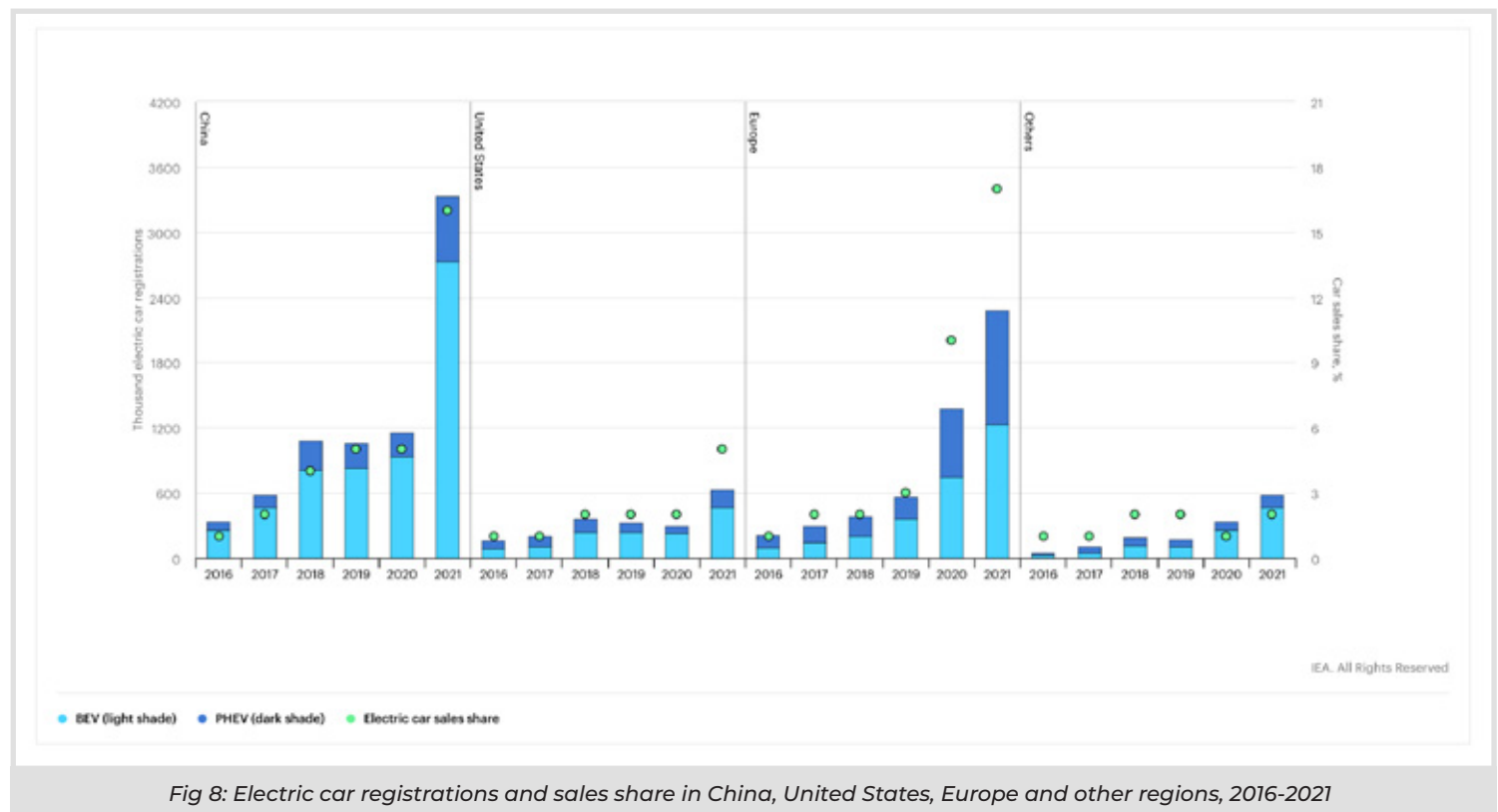


Fig 8: Electric car registrations and sales share in China, United States, Europe and other regions, 2016-2021

(source: <https://www.projectdriven.eu/new/owning-an-electric-vehicle-in-europe-could-be-cheaper-than-you-think-new-research-shows/>)

The diagram above shows EV sales and percentages sold across major personal car ownership regions until 2021. China and the EU are the clear leaders, having 16% and 17% share, respectively. EVs can significantly impact car dealers' business models, considering the following factors:

- Car dealers' primary source of income is not sales (usually below 10%) but after-sales maintenance and repair services. With the advent of EVs, cars now have fewer moving parts than those with combustion engines, and thereby endure less wear and tear (no need for an engine oil change, tuning, and other aftersales service-driven cash cows), entailing seldom trips to the service centers, undermining the overall profitability of the dealer.
- Cars are software-defined; capabilities (mobility and convenience) are primarily enhanced through over-the-air (OTA) updates of in-vehicle firmware and software rather than hardware and mechanical components. Vehicle recalls for changes and upgrades to the internals for performance (and security, reliability, safety, etc.) are typically supplemented by OTA updates in frequent cycles.
- IoT, Fintechs, Augmented Reality (AR)/Virtual Reality (VR), etc., for customer engagement virtualization. These disruptive technologies and businesses can drive customers away from the dealers in multiple situations. In the post-pandemic times, customers are leaning towards touchless delivery experiences, including
 - full and final payments, insurance payments (payment gateways owned by FinTechs like PayTM, GPay, etc.)
 - subscriptions to infrastructure services (e.g., IoT-enabled FASTag by the National Highways Authority of India)
 - immersive on-the-air car model demonstration through AR-enabled mobile devices and VR wearables as started by a few Indian OEMs like Tata Motors, MSIL NEXA, MG

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GLOSSARY

TERMINOLOGY/ ABBREVIATION	DESCRIPTION
BaaS	Battery as a Service
AR	Augmented Reality
VR	Virtual Reality
IoT	Internet of Things
AUTOSAR	Automotive Open System Architecture
SDV	Software Defined Vehicle
E/E	Electronics and Electrical
MSIL	Maruti Suzuki India Ltd
MG	Morris Garage
UNHCR	United Nations High Commission for Refugees
OEM	Original Equipment Manufacturer



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