

Model C

A Blockchain Use Cases Guidebook for Automotive Leadership

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Sea of change

Once again, the carmakers seemed to have caught off guard. While 2020 was a no-show for automotive players, 2021 extended a mixed bag for the major ecosystem players. In the wake of a post-covid setting, the manufacturers saw robust sales in the first half of the year, and when it seemed all certain that the targets could well exceed the projections, the OEMs were forced to sit idle, thanks to the global shortage of computer chips. An unforeseen supply chain disruption saw automakers grappling to complete orders and announcing significant rollbacks, lowering their expected revenue by about billions of dollars.

On the demand front, customers showed an increased inclination towards personal mobility. The demand for car ownership was higher than expected but had to contend with long wait times and choose from fewer models owing to low inventory levels. The dealers were able to sell vehicles even above MSRP¹, but their archaic business models based on showroom visits were increasingly threatened with the rise of online retail.

But probably if you were to look at the numbers, a lot of it does make sense in the chaos. The automotive industry is clearly accelerating towards CAEVs (Connected Autonomous Electric Vehicles), and 2021 has only augmented the same.

- EVs saw record sales of 5.6 million units, which is about 83% higher compared to 2020 and about 168% from 2019.
- Nearly 62% of all new cars sold worldwide in 2020 were equipped with OEM embedded telematics systems, up from 51% in 2019. The trend stayed intact in 2021 with a CAGR projected at 19% till 2025.
- Automobile majors were keen on importing AV capabilities through a set of mergers and acquisitions. Toyota Motor Corp. acquired autonomous vehicle division of LYFT for \$550 million. Electric AV maker Ati Motors raised \$3.5 million in its pre-series round of investment. Cruise, the AV subsidiary of GM motors, has signed an agreement with Dubai to be the exclusive provider of self-driving taxis through 2029.
- On the regulation front, the Biden administration has set an ambitious target of 500,000 charging stations at a budget of \$7.5 billion. The goal is to improve the sales shares of electric vehicles to at least 50% before 2030. We see federal regulations in Europe largely permitting the use of autonomous vehicles for testing purposes. But Germany has recently allowed Level 4 autonomous vehicles to operate on the country's roadways.

¹ Manufacturer's suggested retail price

The word is loud and clear. Right through this decade, we will witness a proliferation of Electric Connected Cars with Autonomous Vehicles not far behind. What this means to automakers: That they will have to reinvent themselves as mobility providers. This would mean a flurry of investments towards software, electrical and electronic capabilities. But the operating framework underpinning this transformation (towards Electric Connected Autonomous Mobility) will be dependent on decentralized ledger technologies.

Blockchain has the potential to cancel out information asymmetries between the ecosystem players. It ensures transparency in the value chain – both upstream and downstream in a privacy-preserving way. When automobiles are evolving into live data centers, automotive leaders look up to blockchain to unlock 10 strategic benefits:



Fig 1: Blockchains in Automotive: 10 Strategic Benefits

Basics of Blockchain

What is the core function of a Blockchain?

Blockchain's core purpose is to record the transactions. But the way it records makes all the difference. It works as a shared ledger. The ledger is digitally distributed across all the nodes on a network. So, when a transaction is initiated, every copy of the ledger residing at every node would have recorded the transaction.

What is Blockchain-as-a-service?

Blockchain-as-a-service companies insulate enterprise customers from complexities associated with the technology. The customer organizations can focus on the business use case, making use of a pay-as-you-go scalable infrastructure and related technical resources. For example, Blockedge provides an end-to-end infrastructure automation platform giving a zero-code framework to manage blockchain applications with ease.

What is a smart contract?

A smart contract, in simple terms, is an if-then contract. If certain conditions occur, then the transaction is automatically triggered. For example, between a manufacturer-supplier, a smart contract could mean an automatic release of payment to the supplier, once the manufacturer has accepted the receipt of goods. [A temperature-sensitive part during transit can be exposed to an out-of-temperature range](#). In such a case, a smart contract tied to the automotive part can alert respective parties in the network.

How does Blockchain ensure data security?

Blockchain arranges these data in the form of blocks. A single block could only hold x number of transactions. These blocks are linked to each other through a cryptographic hashing function. To avoid detection, an ambitious hacker must change not just one block but other blocks linked to it. [Technically that would mean changing the hash value of every block to make the books legitimate](#), which would require an enormous amount of computing power, ultimately outweighing the benefits. This provides one layer of security. The transactions are encrypted through public-private key cryptography. Also, in a private network, only authorized members can read/write onto a network.

How does a blockchain promise transparency and privacy at the same time?

A transaction that has happened on a blockchain network is always time-stamped. All relevant parties in the network will know that the transaction has happened. At the same time, the nature of transacted data is encrypted. Also, Blockchain masks the identity of the individuals transacting the data. Through a private key, you can sign and initiate transactions to a particular public key. The intended receiver who holds the public key will decrypt the transactions through their private keys.

See through the Hype

Present studies project blockchain as a remedy to existing supply chain woes and as solution to future mobility challenges. Naturally, we find sporadic blockchain use cases spread across the value chain, piloted in “making of the car” through “buying/selling of the car” to “using the car.” We feel that automakers and relevant stakeholders, if they are to be armed with a holistic perspective about blockchain, they must view blockchain applications in relation to the growth of CAEVs (Connected Autonomous Electric Vehicles). As such, blockchain investments will be justified only if they enable the acceleration towards CAEVs. Nevertheless, this transformation towards Connected, Autonomous Electric mobility will happen in phases. But do we have enough clarity on this phased transformation? Because then we will clearly know what blockchain applications will assume priority now and what applications could dominate later.



*Simply put, blockchain applications will act as digital enablers of CAEVs. The transformation towards CAEVs will happen in phases. If we understand the phased transformation, then we could predict a **use case model** for automotive blockchain adoption.*

‘Smart’ Analogies

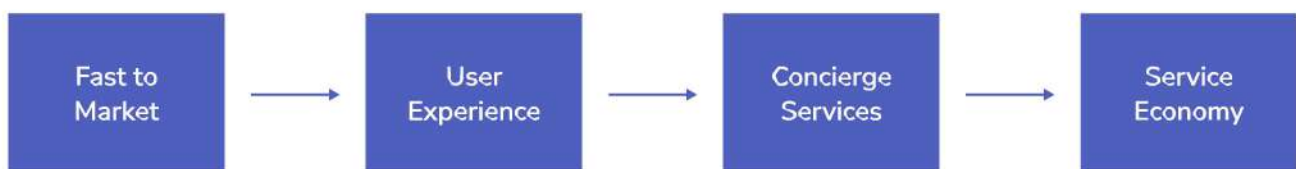
Drawing parallels with smartphones is not new to the automotive industry. In 2011, Toyota Motor Corp. President unveiled a concept car and termed it as “smartphone on wheels.” With 4G on the rise, the analogy became widespread. In 2015, Daimler’s head Dieter Zetsche quoted that car is becoming “smartphones on wheels.” Right through the past decade, we had encountered multiple instances where the thought leaders kept coming back to the “gadgets on wheels” analogy.

And the industry doesn’t just use the analogy to compare cars with a phone. There is concise action from the other side as well. Apple, the world’s largest smartphone maker is reportedly aiming for an electric vehicle by 2024. Telecom equipment giant, Huawei Technologies has partnered with Beijing-based EV manufacture, BAIC Blue Valley to launch a luxury electric car equipped with Huawei’s smart driving system. Chinese smartphone giant, Xiaomi, plans to invest \$10 billion into the next decade, which will go into the manufacture of electric cars.



As the passenger vehicles transform into a mass set of advanced electronics, we would like to wonder if this transformation would be more similar to what we have witnessed with smartphones. The transformation of smartphones from its humble beginnings holds a near-perfect analogy to CAEVs transformation and will help us prioritize blockchain use cases and their proliferation within the automotive landscape.

4-Phase Transformation



Phase 1: Fast to Market

In phase 1, we will have the disruptors challenging the status quo of incumbents. When Nokia N95 was celebrated as the all-in-one multimedia computer, the industry witnessed a turn of events once iPhone entered the scenes. Though iPhone was not technically superior to N95 (it was a 2G device and not a 3G one. Camera was 2, not 3 megapixels), the smartphone giant turned thinking on its head by successfully converging three different technologies: personal computing, mobile technology, and internet services. “iPod, phone, and an internet communicator” Steve Jobs famously announced while unveiling the product in 2007. Though a larger part of the success must go to Apple’s superior product innovation and design, part of the success should be credited to its supply chain resilience. End-to-end integrated supply chains, A close-knitted relationship with suppliers, and a faster inventory turnover ratio helped Apple become a consistent supply chain leader in the world.

We are yet to see a clear winner in electric cars. However, much of the electric car popularity must be attributed to Tesla, though its market share continues to be challenged by the incumbents such as Ford, GM Motors, Volkswagen, and the like. But a clear winner would again have successfully converged three different technologies at a faster pace – in this case, Connected, Autonomous, and Electrified vehicles. Much of the market leader’s focus centers on ramping up electric charging infrastructure, complete ownership of supply chains, and bringing Level 4 autonomous cars much before its peers.

Phase 2: User Experience

Phase 2 would see players contesting in the platform arena. While some will choose to work in silos and make it a closed platform, others will collaborate and co-create. The licensing model proves a tried and tested strategy in the platform development game. While in the earlier stages, when several handset manufacturers began working on standard operating systems, Nokia acquired the Symbian OS and released a series of mobile phones from 2002-2008. But the transformative impact came through iOS, which was, though released as a closed platform, stood superior in terms of user experience when compared to the then operating systems. In contrast, the newly acquired Android by Google was promoted as a licensed platform open to phone manufacturers. It should be noted that an unmatched user experience delivered by the iOS and Android platforms helped them consolidate the fragmented market.

Similarly, in automotive, we see market participants choosing to develop their own end-to-end software platform (e.g., Volkswagen). Co-creation is again being sought by automakers coming together for joint software development (GM Motors, Renault, Nissan-Mitsubishi). We also see platforms being licensed and sold to car manufacturers. Android Automotive OS, for example, provides a comprehensive suite, requiring only minimal up-front investments, deeply integrated into the automotive hardware. Each approach has its own set of advantages. But the winner of the Electric Vehicle/Autonomous (EV/AD) Platforms will be the one that would have delivered a superior personalized user experience for the rider.

Phase 3: Concierge Services

In concierge services, a dominant platform would extend into an ecosystem when it achieves a critical mass of complementors and customers. In an ecosystem, typically networks of players provide an interconnected set of services and solutions, fulfilling a variety of user needs, and delivering an integrated customer experience. The dominant platforms of iOS and Android were able to garner a large number of developers who created applications through SDKs, APIs, and various other quality assurance processes. The reason to use a smartphone extended beyond voice calling or texting. Mobile applications provided enough impetus to access the phone for communication, networking, discovery, learning, and transactions.

As the self-driving pick up, concierge services will gain ground. Because once the user is relieved of their driving duties, there will be ample time to enjoy on-demand connected services. These services fall in three categories: advanced infotainment, telematics, and V2X communication. The offerings would get integrated with the digital lives of a user, delivering personalized in-car experiences, providing entertainment, navigation, vehicle maintenance, payment services, and open marketplaces. The value-added services will enable automakers to assert their position and as well as open new monetization avenues.

Phase 4: Service Economy

In a service economy, the dominant manufacturers would receive a sizeable portion of their revenues from value-added services. The loyal premium user base enjoyed by Apple in the developed markets such as the US, Europe, and Japan, helps the smartphone giant operate at a higher level of profit. A strong service strategy enables the company to receive a bulk of its revenues from its other ecosystem offerings (iCloud, Apple Arcade, Apple music, News+). But service economy also pushes for the commodification of products. Gated features which were otherwise available only in high-end phones are democratized and offered in lower-priced offerings.

In automotive, we will continue to witness strong brand affiliations that will enable market leaders to sustain significant profits. A sizeable proportion would come from their ecosystem service offerings. But as connected, autonomous electric cars become available in mid to lower price ranges, we will again witness to an extent commodification of the product. The mindset will change from ownership of automobiles to consumption of mobility. This change in mindset would lead to the advent of Mobility-as-a-Service (MaaS). MaaS is the integration of various forms of transport and transport-related services into a single, comprehensive on-demand mobility-as-a-service. MAAS will be accessed by the users through subscriptions, pay-as-you-go models, and further amplified by fleet-based shared mobility.



It is true that the industry leaders have their hands on the technology. Some of them are in the pilot phase, a few of them are in production, and very few are live and poised to scale. But are they in sync with the 4-phase transformation, or are they just randomly chosen without far sight? We set out to find these answers and rather found convincing results.

So, we clearly made a scenario of how this phased transformation would come about. Also, we earlier started how blockchain should be seen as an enabler for this phased transformation towards Connected Autonomous Electric Mobility. Now you might be genuinely interested to know whether the current blockchain applications really enable this transformation? Or are they randomly chosen without far sight. We set out to find these answers and rather found convincing results.

Blockchain Applications Enabling Fast to Market

Track and Trace

The distributed ledger technology can help verify the provenance of raw material or track its route all the way from the mines. Automotive supply chains are inherently complex. Numerous players located at varied geographics are involved at different delivery stages. And the products often undergo rapid changes. Blockchain provides a way to seamlessly track and trace the movement of parts or materials along the supply chain.

When blockchain recordkeeping is employed, the respective assets are given unique identifiers that serve as digital tokens. The participants in the network are given unique digital signatures to add or verify a transaction. The product and information flows are recorded as time-stamped entries in chronological order. These flows are encrypted and distributed in the network, which means every authorized member within the network has access to the full copy of the ledger. So, at any time, the participants can look up the ledger and query a product's status or location in real-time. This eliminates counterfeiting, compliance violations and brings authenticity along the value chain.

Strategic Benefit	Use Case	Impact
Supply chain Transparency	PartChain was constituted as a pilot program between BMW and Marelli for the traceability of headlamps, rear lamps, and lighting modules. Three Marelli Automotive lighting plants (located in Italy, Mexico, and the Czech Republic) and two BMW plants (US and Germany) were connected through the application.	As part of the pilot, the application was managing 100,000 data points directly referred to parts and vehicles. The intended aim was to ensure seamless traceability of components at the click of a button. In 2020, the project was scaled to include 10 of BMW's suppliers.



As the market moves towards mass electrification, demand for minerals such as cobalt, nickel, lithium, copper, and nickel continue to be on the rise. On one side, the automakers must ensure to source from certified mines. Because a greater proportion of these minerals are available in politically unstable regions, and regions with poorly enforced labor laws. The pressure from governments and regulators would mean that automakers must deliver on the promise of ethical and sustainable sourcing.

Strategic Benefit	Use Case	Impact
Ethical Sourcing	Responsible Sourcing Blockchain Network (RSBN) was started as a pilot program to ensure ethical sourcing of mineral supplies. The RSBN sees continued participation of founding members, including Ford, LG Chem, Volkswagen, and Huayou Cobalt. In light of the compliance guidelines set by OECD and industry bodies, the RSBN facilitates real-time supply chain mapping and faster audits for key battery mineral supply chains.	The digital supply chain has moved beyond the pilot phase. In the testing phase, the network demonstrated, how the cobalt produced at a Huayou mine site could be traced through LG chem's cathode unit and battery plant in South Korea, and finally to its destination – a Ford plant in the United States. The platform has entered live operation and began to track other minerals such as lithium and nickel.
Ethical Sourcing	Tesla uses two different blockchain solutions to trace the origin and movement of cobalt and nickel respectively. One connects the cobalt miners from the Democratic Republic of Congo and the other traces nickel from mining firm, BHP in Australia.	<p>As of May '21, the solution for cobalt tracing is being tested in real operating conditions. Multiple on-site pilots have been commenced in Europe, Asia, and the US</p> <p>As of Aug '21, a three-month pilot is already completed, which tracked nickel all the way from BHP's operations in Western Australia to the production line at Gigafactory, Shanghai.</p>
Automated Compliance	Spurred by the new market surveillance regulations that came into force in Sep. 2020, XCEED aims to track and certify the compliance of vehicle components from design to production. The solution was a joint effort of Faurecia, Groupe Renault, Knauf Industries, Simoldes, and Coşkunöz, in association with IBM.	The solution is now inviting other OEMs and suppliers to join after the successful testing at Renault's Dubai Facility.

Blockchains for bill of lading

A typical blockchain network would include a transferor, transferee, carrier, and port operator. The objective would be to reduce the time to clear the cargo through trustless transactions, reducing humungous paperwork and associated operational costs.

Strategic Benefit	Use Case	Impact
Automation in Operations	Tesla is part of an experimental blockchain solution to improve the time taken to import cargo into China. The blockchain network also hosts Shanghai International Port Group (SIPG) and Chinese cargo ship operator, COSCO.	The pilot has proved to show significant efficiency gains not only in cargo release time, but also in downstream supply chain planning. A single source of shared truth streamlines the entire process, removes documentation hassles, and accelerates cargo pickups.

Targeted Recalls

In 2020, the number of vehicles that were recalled stood at around 13 million. The average cost of a major product recall is approximately \$12 million USD. The defective parts making their way into a vehicle could pose serious safety threats and a bad reputation for the automakers. Existing solutions don't necessarily pinpoint the exact batches that need to be recalled. Batch processing and tracking are mostly done for higher assemblies. Some leading ERPs offer tracking for smaller components, but this is again limited to only Tier 1 OEMs. Disparate data systems between supply chain partners complicate the traceability function and create disagreements between partners with respect to part failures.

A typical blockchain solution will have a user interface through which manufacturers can connect the defective part both upstream – to the individual vehicle and downstream – to the supplier who supplied the part. If the manufacturer claims to have defective parts, the supplier can be immediately notified through the shared blockchain ledger.

Supplier Onboarding

One of the key reasons that compounded the problems of chip shortage was the absence of a seamless supplier onboarding solution. Supplier qualification and subsequent onboarding is a lengthy and time-consuming process. Added to the fact, the automotive supply chains are characterized by a numerous suppliers located in multiple geographies. A 'know your supplier' solution on the blockchain can reduce operational expenditures by as much as 50%.

A supplier onboarding solution includes a digital identity for the enrolled suppliers. The suppliers own their identities and can update their information instead of manual entries from the buyers' end. These updates can be broadcast to the network in real-time. The supplier's credibility is further validated and verified by third parties in the network. Since the data required from a supplier is similar across the industry, the solution is easily scalable and can drastically bring down costs associated with data duplication and redundancy.

Blockchain Applications Enabling User Experience

Car Passport

As many of 50% of used cars could have the odometers tampered, estimates European parliament. The value of used cars is illegally boosted to an average of 2000 – 3000 euros. If odometer frauds are curbed, then it would restore the public confidence in used cars. Residual values will prove to be accurate further benefitting fleet and leasing companies. Fraud prevention can also level the market for honest sellers.



The problem that blockchain aims to address is trust in the used car segment. For secondhand buyers, blockchain guarantees a predictable user experience. Since the odometer readings get stored in an immutable, distributed database, the data becomes tamper-proof.

Strategic Benefit	Use Case	Impact
Vehicle Ownership	BMW, in association with VeChain, has showcased the VerifyCar application that serves as a digital passport. The application helps users to monitor odometer and maintenance reports.	The application was piloted in 2019 to provide a reliable source of information containing ownership history, mileage, maintenance, and insurance history. A secondhand buyer can verify the information by scanning the QR code presented on the Seller's VerifyCar app.
Vehicle Ownership	CarVertical, a platform that verifies car history, uses blockchain as an authenticity validator. The company provides a reliable starting point for people looking to buy a used vehicle. When a user provides the Vehicle Identification Number, high-quality data reports for the particular vehicle get generated from cross-referencing different global sources. The company evaluates and gives a scoring from 1 to 10 based on three factors: damage data, mileage records, and model faults.	The company uses machine learning to generate insights and conventional neural networks that can extract car data from images submitted by the users. The platform generates vehicle reports for American and Europe Vehicles.

Encrypted Vehicle Access

Strategic Benefit	Use Case	Impact
Cybersecurity	Porsche is reportedly the first company to test blockchain applications within cars. One of its pilots is concerned with encrypted vehicle access. A secure communication happens between smartphones and sensors in cars, which enables authorized locking/unlocking of the car. The process was found to be six times faster than existing solutions (~1.6 seconds). The solution also allows owners to grant temporary authorizations to others. The owner can digitally track these authorizations and revoke access at any time.	The 3-month pilot was successfully demonstrated. The test was carried out in association with the Xain mobility platform within Porsche's Panamera. The solution promises unhackable safety, thanks to a fully decentralized blockchain application. It extends to other use cases, such as recording/receiving traffic data over the blockchain in communication with other vehicles.

Usage-based Insurance

Personalizing insurance rates based on mileage and driving behavior. Customers now challenge the concept of flat rates and expect insurers to charge based on their driving patterns. Driving parameters include speed, acceleration, hard braking, hard cornering, miles-driven, time of day, phones while driving, etc. Blockchain can alleviate certain barriers that hinder the progress of usage-based auto insurance. The immutable shared ledger ensures data authenticity and hence genuine claims. In the case of an accident, smart contracts on top of blockchain can trigger and automate claims processing.

Strategic Benefit	Use Case	Impact
Personalization	Car manufacturer MG would have a digital passport implemented in its new SUV model MG Astor. The car owners can access the digital passport through MG's app. The passport data, which includes driving scores and car history, is owned by the drivers and explicit consent is required before sharing information with the insurers.	MG Astor will be the first commercialized car in India to have a digital passport. The blockchain-based platform includes automakers, insurers, and even resellers who will use the data for accurate resale values.

Predictive Maintenance

Strategic Benefit	Use Case	Impact
Personalization	Predictive maintenance is seen as an added feature as part of the Vehicle ledger. Truck Manufacturers, TMW systems have introduced, fault predict solutions in their vehicles that analyzes vehicle fault codes and provides insight into vehicle performance. The information can help alert fleet owners to replace failing parts before they result in vehicle downtime.	The preventive system is aimed to maximize vehicle uptime, reduce unnecessary maintenance costs, and help truck manufacturers save hundreds of millions of dollars that go into warranty claims.

Auto Leasing & Finance

Auto leasing companies can benefit from the car ledger. Tracking a car right from the OEM, history of ownership, maintenance records, mileage data over a distributed ledger helps companies accurately determine the residual value at the end of the lease. Accurate quantification of the end-of-lease costs based on predefined smart contracts eliminates end-of-lease disputes between the parties concerned.

Auto finance agreements between manufacturers and investors get facilitated through blockchains. Execution of financial transactions right from the origination, distribution, execution, allocation, through to the repayment and interest is recorded on a shared blockchain ledger. This eliminates redundant paperwork, ensures transparency between lenders, investors, automakers, debtors, and improves regulatory compliance in capital markets.

Strategic Benefit	Use Case	Impact
Vehicle Ownership	In 2017, Daimler launched a €100 million corporate Schuldschein (a bilateral loan) in association with LBBW. Savings banks, Esslingen-Nürtingen, Ludwigsburg and Ostalb acted as additional lenders.	The initial project entailed additional paperwork owing to regulatory requirements. The follow-up project commenced in 2020, goes fully digital with a loan volume of €25 million and a term of two years.

Blockchain Applications Enabling Concierge Services

Geofencing

Geofencing through GPS technology can enable Plug-in hybrid electric vehicles (PHEVs) to automatically trigger electric mode when the hybrid cars happen to enter an emission-free zone. The green miles are subsequently documented in a tamper-proof blockchain ledger and then securely shared with the concerned regulatory authorities.

Strategic Benefit	Use Case	Impact
Value-added Service	Geofencing helps drivers understand when and where the emission restrictions are in place and ensures automatic switching to electric mode. In the 12-month trial, each of the 12 PHEVs featured the FordPass (a connect onboard cellular modem) and a plug-in device that enabled geofencing and blockchain capabilities.	The project also saw Ford as an official partner of SmartCity Cologne, initiated by the City of Cologne and regional energy supplier, RheinEnergie AG. With this project, Ford is looking to improve the green credentials of its plug-in hybrid vehicles.

Reward Tokens

Functional Area	Use Case	Impact
Value-added Service	Fiat has launched its blockchain-based rewards initiative available to customers of New 500 Fiat. The users will be rewarded with KiriCoins for good driving patterns, which can then be redeemed in the Kiri marketplace. Driving data is automatically converted into KiriCoins, which gets collected in the car eWallet.	The calculation and conversion of kilometers to KiriCoins are instant and the highest eco scorers can avail offers from Amazon, Netflix, Spotify, and Apple.
Vehicle Ownership	In 2019, Jaguar Land Rover was reportedly testing a blockchain-based smart wallet technology that enables its users to earn rewards in return for useful road-condition data.	The company has partnered with the IOTA foundation to use distributed ledger technology for sending/receiving payments. Drivers can redeem rewards (IOTA tokens) for electric vehicle charging, toll & parking fees, and even buy a coffee. The carmakers forecast to include around 75 billion devices by 2025.

In-car Entertainment

Strategic Benefit	Use Case	Impact
Value added Service	Holoride GmbH, an in-car virtual reality entertainment start-up, now uses distributed ledger technology to track user-engagement time related to the content and proportionately rewards its content creators. The platform also has NFTs (in-game tokens and collectibles) traded on the blockchain network.	Backed by Audi, the platform provides immersive experiential content that adapts itself according to vehicle motion, time travel, and routes.

Earn as you drive

Strategic Benefit	Use Case	Impact
Value-added Service	Continental, in partnership with Hewlett-Packard, provides an earn-as-you-ride service that rewards drivers for on-street parking data. The offering also gives manufacturers legally compliant service-relevant customer data, which can be used to improve user experience. The manufacturers can choose to sell it to other service providers on the trading platform.	The partnership aims to enable a broad and dense network of data availability that is both transparent and secure. The value-added service benefits not only manufacturers and mobility-related services but also governments for better infrastructure planning in connected cities.

NFT

Strategic Benefit	Use Case	Impact
Value added offering	<p>MG Motor India has launched its maiden non-fungible tokens – authentic digital artifacts that cannot be replicated.</p> <p>VinFast launches its VinFirst NFT to reward early-bird reservations. Customers who pay the reservation will be awarded a certificate of priority membership that resides as an NFT. Also, the carmaker will drop time-to-time perks, which are again tokenized and can be traded between customers.</p>	<p>1111 units of digital creatives are available on KoineArth's NgageN platform. The launch is the first of its kind among automakers in India.</p> <p>NFT is employed to woo super early adopters, a first of its kind among automakers.</p>

Blockchain Applications Enabling Service Economy

Vehicle Identity Standard

Strategic Benefit	Use Case	Impact
V2X	The MOBI consortium is a non-profit alliance of the world's largest manufacturers, including Groupe Renault, Ford, BMW, among others. The foremost objective is to establish a vehicle identity standard for every vehicle. A vehicle identity standard should be seen as identifying the 'birth of a vehicle.' Subsequent phases will include product definition, vehicle ownership, vehicle records, etc.	MOBI aims to create a foundation for driverless mobility in smart cities. As a first step, the VID will enable peer-to-peer trusted, secure, transparent transactions between vehicles to vehicles, vehicles to infrastructure, and vehicles to everything. As of now, two phases are completed. The VID II phase includes vehicle registration and maintenance records.

Electric Charging Infrastructure

Electric charging infrastructure is needed to accelerate electric mobility. A charging infrastructure on blockchains could support bi-directional charging between Vehicles to Grid (V2G), enabling EVs to participate in the energy markets.

Strategic Benefit	Use Case	Impact
V2G	Volkswagen Group Innovation and Energy lab is reportedly testing an open-source software for seamless end-to-end electric energy participation for EVs. The Audi e-Tron models have successfully tested intelligent and grid-optimized charging that prevents overloading of the local power grid.	The newly released Audi e-Tron and e-Tron sport come with the smart supplier charging capability. The company intends to equip its future electric models with the intelligence system.

Ride Hailing

Strategic Benefit	Use Case	Impact
Shared Mobility	Drife is a decentralized ride-hailing service connecting drivers and riders over a peer-to-peer network. Unlike existing services, the company does not take commissions from rides but instead asks its drivers to subscribe on a yearly basis. Terms set in smart contracts set the prices and enable both the riders and drivers to fairly negotiate. DRF tokens are employed to incentivized loyalty and community participation.	As of July 2021, Drife had completed seed and private token sales of \$2.7 million. According to the firm, the private sale has subscriptions of about \$90 million – oversubscribed of about 3 times and was led by Master Ventures, 18 Ventures, GD10 Ventures, AU21 Capital, FBG Capital, and Titan Ventures.
Shared Mobility	Ridesharing company Lyft enters into a partnership with blockchain startup Solve.Care to automate payments for healthcare transport-related arrangements. Solve.Care is a decentralized blockchain platform focused on healthcare administration and services for insurers and patients. Through this partnership, the patients using Lyft can enjoy timely access to care, reduced wait times, and transportation subsidies.	The objective is to improve continuity of care by reducing patient no-shows at the hospital. The integration of Lyft within the care.wallet app enables patients to easily schedule transportation, to and from appointments, automated payments, and fewer hassles in the journey.

Mobility on demand

Strategic Benefit	Use Case	Impact
Mobility on Demand	EY's Tesseract is a blockchain-based integrated mobility platform. In tesseract, single vehicles, pool of vehicles and other transport services are available on the platform. The solution enables fractional ownership, meaning users can pool together and jointly invest in a car fleet. They pay for what they use. If they have invested more than they can use, they get the returns from others who have used the vehicles more.	The platform requires the collaboration of multiple stakeholders: OEMs, mobility and transport companies, cities, and infrastructure providers. The solution in its simplest sense will help a rider go from any point A to any point B using multiple modes of his/her choice all within the same platform. The vehicles and trips are digitally logged. Instantaneous and immutable transactions happen without an intermediary, and the entire process is automated through smart contracts.

Internet of Vehicles

Strategic Benefit	Use Case	Impact
Shared Mobility	DAV Foundation is a blockchain-based open-source global transportation network consisting of manned, unmanned vehicles, and autonomous vehicles. The network enables peer-to-peer transportation allowing anyone to share their manned or autonomous vehicles, including drones, trucks, cars, and rovers.	The non-profit aims to create a decentralized transportation infrastructure. Through the system, the users can securely opt for pick/drop of people and things. The vehicles communicate with each other enabling end-of-mile delivery.

Deriving a Use Case Model for Automotive Blockchain Adoption

So, we see a list of active blockchain implementations enabling the four phases. But how are these applications prioritized? Which comes first? Which are the most strategic ones? Which comes later? Which needs a wait and watch?

Deloitte's analysis² of blockchain use-cases using value-complexity matrix is a good reference point to start with.

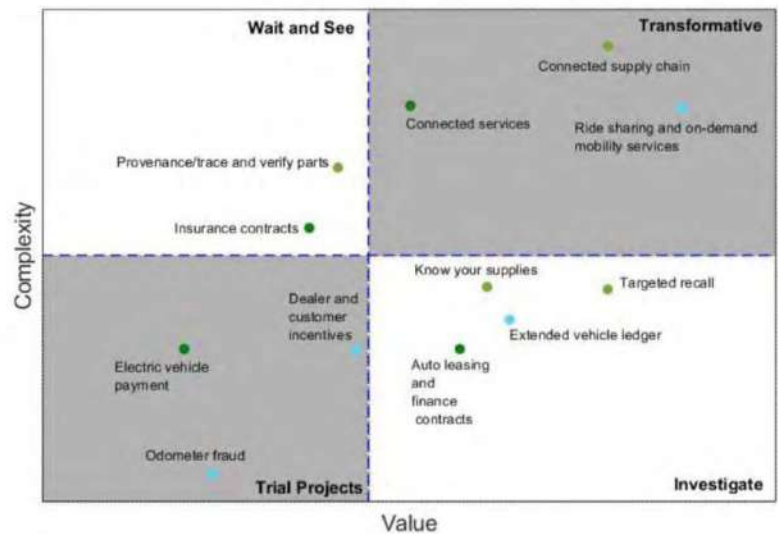


Fig 3: Deloitte's value-complexity graph

- The business will first seek low hanging fruits i.e., high value–low complex ones (Investigate).
- The seemingly low value–low complexity ones (Trial) can be pursued now or later.
- And the low value-high complexity (Wait and See) ones can be avoided or at least prioritized later.
- The high value – high complex projects (Transformative) need significant investments but have a transformative impact.

Does the automotive industry prioritize blockchain use cases based on value-complexity indices?

Yes, but there are some noticeable deviations:

- Provenance/track and verify parts (Wait and see) seem to find the most adopters.
- Electric vehicles payments could be good for trial but must be seen within the context of charging infrastructure, which is right now a strategic battleground for automakers such as Volkswagen or Tesla. These companies are now ramping up the infrastructure to ensure their electric cars require superchargers when they need them. Volkswagen says it plans to spend around 400 million euros on building the charging infrastructure, a move to catch up with Tesla, which enjoys a global network of 30,000 fast chargers. But these are drops in the ocean. The EU says it needs 5 billion euros every year until 2040 to expand charging infrastructure on the continent. When we take into all these numbers, we realize, blockchain-based electric payments in the long term could bring huge returns to the stakeholder involved. We necessarily have to park them in Lane 4.

² Accelerating technology disruption in the automotive market, Deloitte LLP

- Usage-based insurance is now increasingly seen as a lucrative option for automakers. Tesla predicts that at some point 20-30% of revenues would come from its proprietary insurance wing. Toyota is using blockchain to store vehicle usage information for setting insurance rates. Mobility Open Blockchain Initiative wants to use blockchain to change the way customers pay for insurance. Automakers such as GM motors are also testing their own usage-based insurance models. Now, this combined with the fact that there is increasing acceptance of blockchain-based car passports, it would be only some time before insurers track data using the digital passport. Clearly, blockchain-based insurance contracts are not in the scenario of wait and watch.

So, the blockchain use cases do not necessarily get prioritized based on their individual value-complexities. What if we could try and view the value-complexity position from a macro perspective?

We know that any industry as a whole will seek solutions that are critical in the short term (high value -low complexity). It would then pursue ones with low value – low complexity. The low-value – high complexity projects are either ignored or parked for a later phase. And high value – high complexity ones will be seen as critical in the long term.

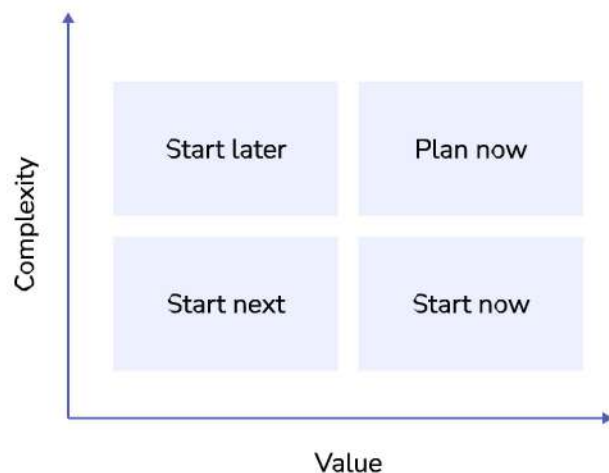
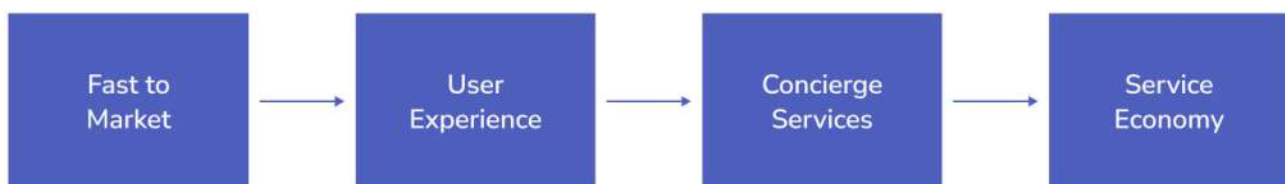


Fig 4: Value-complexity matrix from an industry perspective

Earlier we have argued how the industry will undergo a 4-phase transformation.



Now, if we equate our 4-phase transformation with industry value-complexity matrix, we will derive the below graph.

Model C

Fast-to-market solutions get parked in Lane 1 (high value – high complexity). The user experience would come in Lane 2 (low value – low complexity), Concierge services see themselves in Lane 3 (low value – high complexity). Finally, service economy will occupy Lane 4 (high value – high complexity).

On that account, we propose that automotive blockchain adoption will take a linear route beginning with fast-to-market solutions, followed by solutions that enable user experience, concierge services in the later stage, and finally, applications that lead to the service economy.

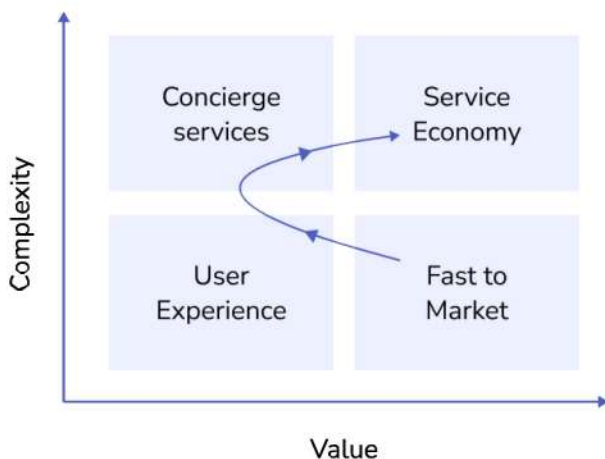


Fig 6: Model C

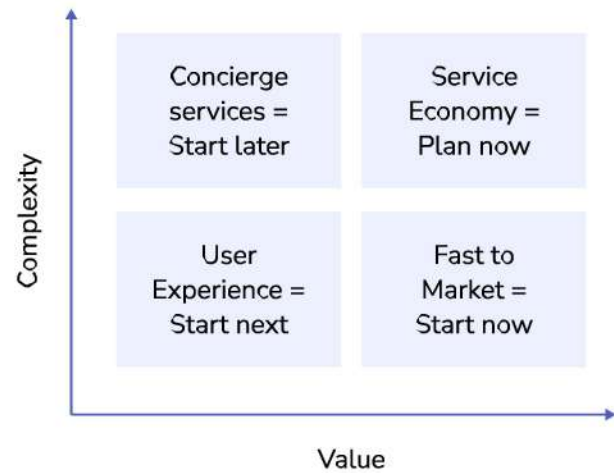


Fig 5: 4-Phase Transformation vs. Value-complexity

We predict that blockchain use cases, irrespective of their individual value-complexities could see faster adoption if they happen to be in the earlier stages of transformation. For example, provenance or track & trace, according to Deloitte was a wait and watch solution. But it is seeing greater adoption among companies since it happens to be a fast-to-market solution.

At a time when the industry is moving towards electrification, fast-to-market blockchain applications will be increasingly sought to enable a frictionless and transparent supply chain to track and trace car parts, prove origins of raw materials, bolster tight supplier connections, make targeted recalls, and reduce operational costs through improved automation.

Solutions such as car passports, odometer frauds preventions, usage-based insurance, auto leasing and finance, and predictive maintenance will become central to user experience, and hence occupy the next stage in blockchain adoption. These solutions will not only enable in-car experience but also would lead to seamless experience related to the buying/selling of the vehicle. It should be noted that central to these solutions will be a blockchain-based car ledger that proves vehicle ownership and tracks driving patterns.

The software-defined vehicles will soon see value-added personalized services building on top of user experience solutions. Tokenomics will come into play to engage drivers for good driving behavior, data sharing, and customer engagement. Added to this will be third-party infotainment and entertainment solutions that will propel users to make more in-car purchases. As of now for the automakers, these services will not be a direct revenue generator, though in-car purchases could be used to cover some expenses. But they are likely to see mass adoption once autonomous cars come into the foray, i.e., driver becoming the rider.

Transformation to a service economy will lot depend on the outcomes of consortiums such as MOBI. It would be interesting to see how masses welcome peer-to-peer decentralized mobility solutions such as Drife. It remains to be seen whether shared mobility will bring down vehicle sales in developed countries, though that will be hugely offset by demand in developing countries. But we predict that pay-as-you-go mobility will only go along, and in fact, complement personal mobility. Once V2X communication standards are established, autonomous cars become a mass reality, transportation becomes integrated, ownership becomes flexible (full or fractional), the automakers would have already transformed into mobility solution providers.

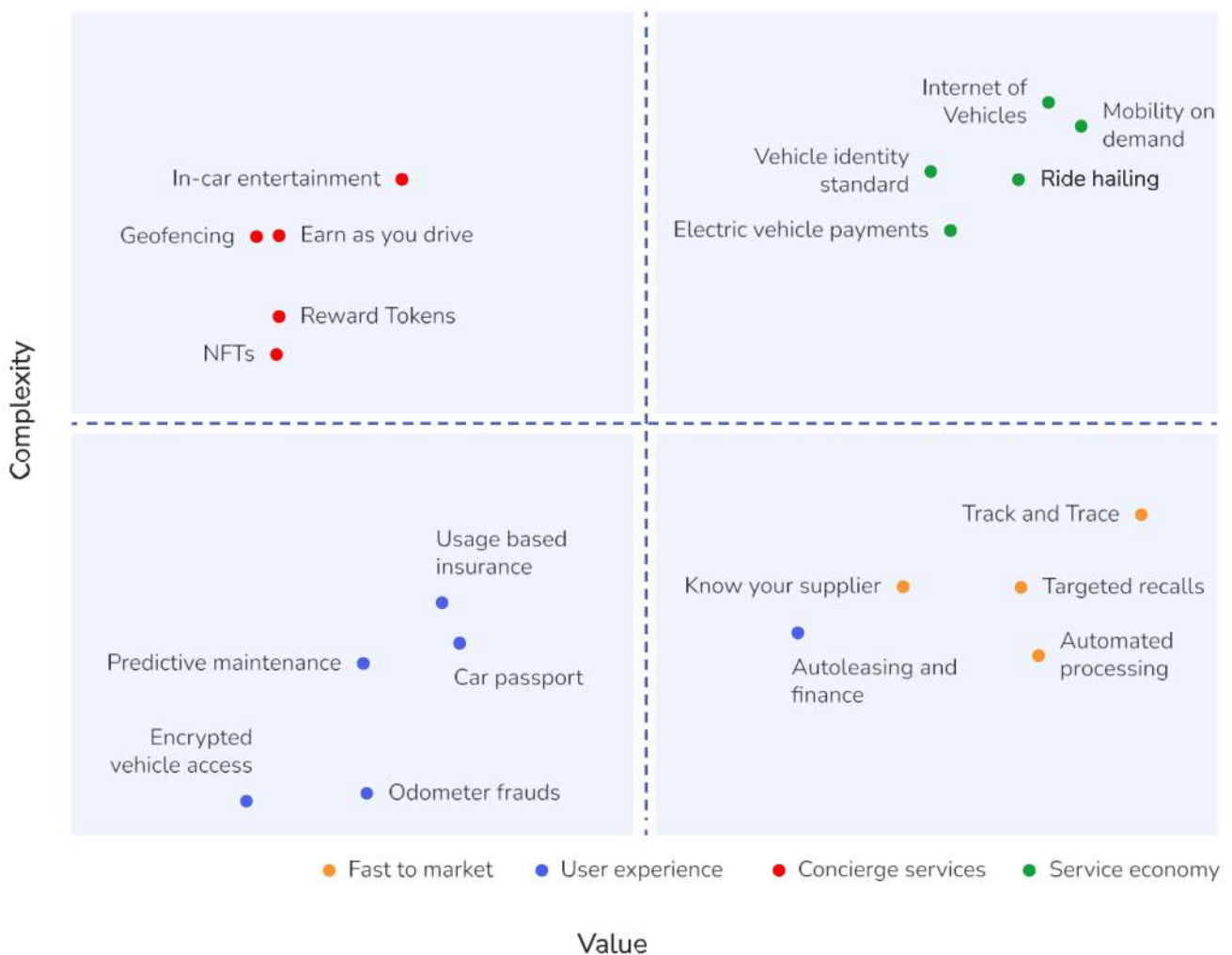


Fig 7: Use Case Model for Automotive Blockchain Adoption

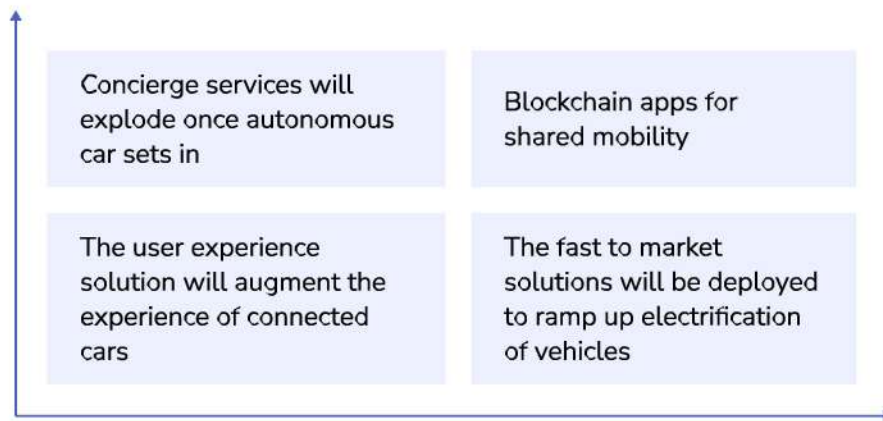


Fig 3: Blockchain solutions enabling CASE (Connected Autonomous Shared Electric Mobility)

Correlation with our Earlier Research

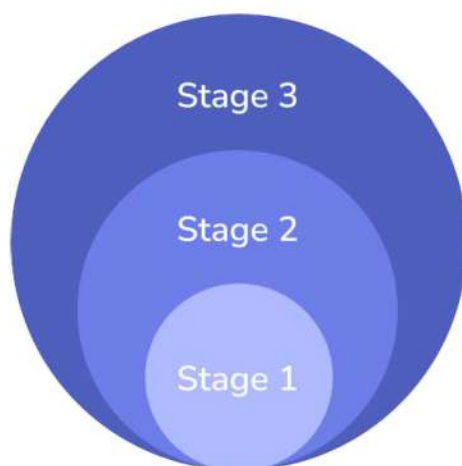


Fig 4. Circles of Trust: Blockchain Adoption Spectrum by Business Gain

Phase 1

Dominant Use-Case Type

Truth Ledger & Product Provenance

Business Gains

Process Innovation Driving Cost Efficiencies

Phase 2

Dominant Use-Case Type

Asset Tokenization

Business Gains

Introduction Of Newer Products/
Services From Existing Business

Phase 3

Dominant Use-Case Type

Blockchain Cooperatives

Business Gains

Disruptive Innovation, New Markets

- Model C agrees with the findings of our previous research: Circles of Trust.
- In Circles of Trust, we had observed that enterprise blockchain adoption will progress “in circles.”
- The first stage would see most businesses seeking blockchain for its core features: Immutability, Encryption, and Distribution. Accordingly, applications that provides information transparency and product traceability will be the ones that are most sought after. In Stage 1, blockchains will be used primarily to achieve cost savings.
- The second stage would see tokenization coming into play when companies start introducing new products and services based on Tokenomics.
- Complete decentralization and the emergence of Trivergence (Blockchain, AI, IoT) will characterize Stage 3.
- In our Model C, the first two phases (Fast-to-market and User experience) mimic stage 1 of Circles of Trust. The fast-to-market solutions (automated processing, track & trace) employ the features (Immutability, Encryption, Distribution) for information transparency and product visibility. On the other hand, the user-experience solutions (Car Passport and others) are based on an immutable ledger, which stores and shares encrypted information that cannot be hacked. Both solutions are employed as part of process innovation enabling operational improvements and cost savings.
- Concierge services (third phase) use the concept of Tokenomics - tokenized rewards for better driving behavior, data sharing, etc., Also, the carmakers will introduce their own version of NFTs, which can be traded in a secondary marketplace.
- In the final phase, Model C predicts a similar transformation as emphasized in Circles of trust. A service economy will be possible only within a smart infrastructure, one that encompasses V2V, V2I, V2X, sustained within a union of Blockchain, AI, IoT.

Final Word

The objective of this research has been to find out what use cases will assume priority now, and what must come later. Gone are the days when the understanding of blockchain was limited to cryptocurrency and enterprise applications was only existing in theory. Now we witness a growing interest among industry leaders investing in blockchains to bring down overheads and attain significant cost savings. But in the automotive industry, we sense an immense possibility for a holistic blockchain transformation. Hence you see decentralized applications being deployed for sourcing of minerals to building internet of vehicles. But we must acknowledge the fact that the automotive is gearing towards a greater transformation – CASE (Connected Electric Autonomous Shared mobility). And the leaders must view blockchain as an enabler of this transformation. It is within this context that we based our research and the findings have been satisfactory.

We discussed how the industry will take a 4-phase transformation to reach CASE. In phase 1 – you would see fast-to-market blockchain solutions gaining momentum. Track and trace applications, automation of operations, and compliance will be increasingly sought to reap benefits at the level of supply chains. These solutions will be majorly focused on ramping up the electrification of vehicles.

Once blockchain proves its merit in fast-to-market solutions, we will see its prevalence driving the connected in-car experience. Blockchain applications in Phase 2 will be preferred for personalization, vehicle ownership, and enhanced security. The basis of these solutions will be an immutable car ledger that proves vehicles ownership and tracks driving patterns.

Phase 3 will see concierge services built on top of a dominant in-car experience. As autonomous cars set in, we will witness an explosion of blockchain-based value-added services that would provide incentives, convenience, entertainment, and infotainment solutions enabling customers to make more in-car purchases signaling the start of a new revenue model based on services.

Phase 4 will see the advent of a service economy brought in by the increasing adoption of pay-as-you-use mobility. Shared mobility and mobility-on-demand will become preferred mobility options once the transformation towards CASE becomes complete.

Blockchain will become more than just an enabler and in fact, will come to be an operating framework for the transformation towards decentralized mobility. But managing native blockchain applications would not be a piece of cake especially when automotive organizations are transitioning towards software-defined engineering environment.

It remains to be seen how blockchain-as-a-service companies could help automotive organizations focus on their business use case and insulate them from the complexities of the technology, providing a scalable infrastructure platform, as blockchain continually justifies its promise within the automotive landscape.

End Notes

https://www2.deloitte.com/content/dam/insights/us/articles/disruptive-strategy-product-platforms/DUP_3056_Products-to-platforms_v2.pdf

<https://www2.deloitte.com/cn/en/pages/consumer-business/articles/blockchain-in-the-automotive-industry.html>

<https://hbr.org/2016/04/products-to-platforms-making-the-leap>

<https://www.tradegecko.com/blog/supply-chain-management/apple-the-best-supply-chain-in-the-world>

<https://www.zdnet.com/article/the-car-of-the-future-is-connected-autonomous-shared-and-electric>

<https://www.vtpi.org/avip.pdf>

<https://cleantechnica.com/2020/11/27/electric-vehicle-adoption-about-to-explode-or-slow-steady>

<https://www.ledgerinsights.com/mg-to-launch-car-with-blockchain-digital-passport>

<https://www.forbes.com/advisor/car-insurance/usage-based-insurance/>

<https://www.mindtree.com/insights/blog/are-auto-insurers-ready-usage-based-insurance-ubi>

https://medium.com/@yihuanlin_22022/biilabs-and-transiot-drive-blockchain-technology-into-usage-based-insurance-ubi-8bb7ab5ab289

<https://www.utimaco.com/current-topics/blog/how-blockchain-can-improve-car-insurance-industry>

<https://www.nasdaq.com/articles/driving-future-blockchains-part-four-introducing-usage-based-insurance-2017-07-19>

<https://www.ibm.com/blogs/internet-of-things/iot-blockchain-automotive-sales>

<https://www.cnbc.com/2019/11/23/teslas-plan-to-leave-auto-industry-behind-on-in-car-entertainment.html>

<https://www.ledgerinsights.com/daimler-develops-blockchain-car-wallet>

<https://techcrunch.com/2017/12/05/gm-launches-marketplace-for-in-car-shopping-and-reservations>

<https://www.globenewswire.com/news-release/2022/01/05/2361838/0/en/VinFast-Launches-VinFirst-NFT-for-EV-s-Early-Bird-Reservation.html>

<https://www.startus-insights.com/innovators-guide/10-blockchain-startups-disrupting-the-automotive-industry>

<https://www.hyundai.com/worldwide/en/company/newsroom/hyundai-motor-group-introduces-industry-first-smartphone-based-ev-performance-control-technology-0000016215>

<https://thenextweb.com/news/blockchain-tech-v2v-connected-cars-autonomous-vehicles>

<https://www.peaq.io>

<https://auto.economictimes.indiatimes.com/news/passenger-vehicle/cars/mg-motor-india-to-launch-nft-collection/88314598>

<https://cointelegraph.com/press-releases/how-drife-and-blockchain-are-disrupting-the-ride-sharing-industry>

<https://cointelegraph.com/magazine/2021/12/29/introducing-trivergence-transformation-blockchain-ai-iot>

<https://www.audi-mediacycenter.com/en/press-releases/preventing-blackouts-with-intelligenceaudi-e-tron-is-ready-for-grid-optimized-charging-13585>

<https://www.smart-energy.com/industry-sectors/energy-grid-management/blockchain-technologies-set-to-help-grow-electric-vehicle-adoption>

<https://www.smart-energy.com/industry-sectors/electric-vehicles/energy-web-volkswagen-partner-on-blockchain-charging-for-electric-vehicles>

<https://medium.com/wearedrife/the-utilities-and-tokenomics-of-drif-e400dfd8fbae>

https://medium.com/@rohitgupta_82488/eyes-tesseract-and-its-impact-on-gm-andlyft-1305109322a

<https://www.forbes.com/sites/forbestechcouncil/2020/03/11/how-blockchain-is-driving-new-opportunities-in-mobility/?sh=563bc7d043b5>

<https://coinrivet.com/dav-foundation-taps-blockchain-tech-to-disrupt-autonomous-vehicle-sector>

<https://economictimes.indiatimes.com/tech/tech-bytes/volkswagen-powers-up-the-grid-to-take-on-tesla/articleshow/87761722.cms>

<https://www.ericsson.com/en/blog/2021/12/connected-car-data>

<https://www.ibm.com/blogs/blockchain/2017/12/blockchain-security-what-keeps-your-transaction-data-safe>

<https://medium.com/blockchain-stuff/protecting-sensitive-data-by-utilizing-block-chain-distributed-leader-technology-a7540d628dd9>

<https://diginomica.com/global-microchip-shortage-automotive-industry-reinforces-need-better-supply-chain-planning>

<https://www.reuters.com/markets/commodities/us-faces-tough-choices-2022-mines-electric-vehicle-metals-2021-12-22>

<https://www.coindesk.com/tech/2021/02/05/what-does-hashrate-mean-and-why-does-it-matter>

https://cdac.in/index.aspx?id=print_page&print=blog_blockchain_exp_CFS

<https://www.natlawreview.com/article/smart-supply-chains-using-smart-contracts>

<https://www.greencarcongress.com/2021/08/20210816-resource.html>

<https://edition.cnn.com/interactive/2019/08/business/electric-cars-audi-volkswagen-tesla>

<https://indianexpress.com/article/explained/explained-mobile-phone-handsets-makers-cars-apple-huawei-sony-7709980>

<https://www.westga.edu/~bquest/2017/tesla2017.pdf>

<https://smbp.uwaterloo.ca/2015/06/apple-a-global-leader-in-supply-chain-management>

<https://www.scmglobe.com/a-brief-overview-of-ev-supply-chains>

<https://www.investopedia.com/tesla-success-depends-on-autonomous-driving-tech-5210135>

<https://www.forbes.com/sites/geraldfenech/2018/10/30/the-link-between-autonomous-vehicles-and-blockchain/?sh=63f7e5565a21>

<https://www.igi-global.com/chapter/future-blockchain-technology-for-autonomous-applicationsautonomous-vehicle/291678>

<https://www.jabil.com/dam/jcr:c85c79bf-6bfe-4bfa-9766-970dfd185886/Electrification%20whitepaper%20Final.pdf>

<https://syncfab.com/supply-chain-traceability>

<https://www.pwc.com/us/en/industrial-products/publications/assets/pwc-merge-ahead-electric-vehicles-supply-chain.pdf>

<https://www.oecd.org/corporate/mne/mining.html>

<https://mspoweruser.com/renault-partners-microsoft-blockchain-based-digital-car-maintenance-book>

<https://www.ledgerinsights.com/daimler-commerzbank-blockchain-digital-cash-machine-payments>

<https://storymaps.arcgis.com/stories/43449bc48bbc4937b440e9ed3e2ea11c>

<https://www.adlittle.com/en/insights/report/how-realize-promise-mobility-service>

<https://www.altoros.com/blog/automotive-blockchain-from-manufacturing-to-security-to-insurance>

<https://logisticstrendsandinsights.com/the-changing-automotive-supply-chain>

<https://cef.ceew.in/masterclass/explains/blockchain-technology-and-its-impact-on-electric-vehicles>

<https://thenextweb.com/news/blockchain-tech-v2v-connected-cars-autonomous-vehicles>

<https://thenextweb.com/news/web-3-0-and-creates-new-opportunities-for-connected-mobility>

<https://eleks.com/blog/blockchain-for-connected-cars>

<https://ftnnews.com/technology/41883-why-automakers-want-to-bring-blockchain-technology-to-your-car>

<https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/how-the-automotive-industry-is-accelerating-out-of-the-turn>

<https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-great-acceleration>

<https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-irresistible-momentum-behind-clean-electric-connected-mobility-four-key-trends>

<https://explodingtopics.com/blog/auto-industry-trends>

<https://www.power-technology.com/news/electric-vehicle-sales-surge-in-2021>

<https://www.nytimes.com/2022/01/04/business/toyota-car-sales-2021.html>

<https://www.utilitydive.com/news/global-ev-sales-rise-80-in-2021-as-automakers-including-ford-gm-commit-t/609949>

<https://analyticsindiamag.com/how-the-autonomous-vehicle-industry-shaped-up-in-2021>

<https://www.jdsupra.com/legalnews/the-year-in-driverless-cars-2021-4608591>

<https://www.jdsupra.com/legalnews/germany-takes-the-lead-with-a-new-law-7746782>

<https://analyticsindiamag.com/toyota-acquires-autonomous-vehicle-division-of-lyft-for-550-million>

<https://www.fortunebusinessinsights.com/industry-reports/connected-car-market-101606>

<https://www.statista.com/topics/1918/connected-cars/#dossierKeyfigures>

<https://smartcar.com/blog/connected-cars-worldwide>

<https://www.counterpointresearch.com/us-connected-car-market-2020>

<https://www.nytimes.com/2022/01/02/business/tesla-sales.html>

<https://cointelegraph.com/news/volkswagen-pilots-blockchain-to-integrate-electric-vehicles-with-power-grids>

<https://www.electronicdesign.com/markets/automotive/article/21806892/v2x-is-here-to-staynow-lets-use-it-for-autonomous-cars>

<https://www.frontier-enterprise.com/connected-cars-keep-payments-moving>

<https://www.pymnts.com/news/2022/amazon-stellantis-signed-deal-to-build-connected-in-vehicle-experiences>

<https://www.automotiveworld.com/articles/big-tech-vs-the-automakers-the-battle-for-the-connected-car>

<https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/consumer-business/deloitte-nl-cb-ths-rise-of-mobility-as-a-service.pdf>

<https://otonomo.io/blog/the-rise-of-the-automotive-concierge-economy>

<https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/defining-and-seizing-the-mobility-ecosystem-opportunity>

<https://medium.com/@ResourceLeaders/v2x-and-v2v-a-one-way-road-to-great-business-opportunities-3a898c291d9c>

<https://www.automotiveworld.com/articles/in-vehicle-connected-services-the-moving-computer/>

<https://time.com/4837176/iphone-10th-anniversary>

<https://www.press.bmwgroup.com/global/article/detail/T0307164EN/bmw-group-uses-blockchain-to-drive-supply-chain-transparency?language=en>

<https://siliconangle.com/2020/04/01/bmw-announces-partchain-supply-chain-blockchain-tracking-automotive-parts>

<https://siliconangle.com/2019/01/16/ford-motor-company-joins-ibm-blockchain-pilot-track-cobalt-mined-congo>

<https://siliconangle.com/2019/04/23/volkswagen-puts-minespider-blockchain-use-tracking-raw-materials-batteries>

<https://www.coindesk.com/business/2020/04/07/tesla-completes-blockchain-pilot-to-speed-china-imports-process>

<https://www.ledgerinsights.com/tesla-cargo-blockchain-shipping-pilot-cosco-shanghai-port-gsbn>

<https://www.cnbctv18.com/auto/the-future-of-mobility-in-the-new-normal-10180201.htm>

<https://www.forbes.com/sites/sarwantsingh/2020/09/21/skateboarding-into-the-era-of-electric-and-autonomous-vehicle-platform-development/?sh=10eea8a778a5>

<https://theconversation.com/nokia-had-the-worlds-best-smartphone-then-came-the-inferior-iphone-70958>

<https://www.forbes.com/sites/sarwantsingh/2021/01/27/top-10-global-automotive-trends-2021/?sh=52c2ab61605b>

<https://www.automotiveworld.com/articles/what-is-mobility-as-a-service-and-how-can-automakers-fit-in>

<https://link.springer.com/article/10.1007/s10842-011-0105-6>

<https://otonomo.io/blog/the-rise-of-the-automotive-concierge-economy>

<https://www.sciencedirect.com/topics/computer-science/platform-ecosystem>

<https://techcrunch.com/2018/09/25/the-new-era-in-mobile>

<https://www.capgemini.com/2021/08/a-car-isnt-a-smartphone-on-wheels-yet>

<https://analyticsindiamag.com/how-the-autonomous-vehicle-industry-shaped-up-in-2021>

<https://www.businesswire.com/news/home/20211115005601/en/Global-Automotive-OEM-Telematics-Market-Report-2021-2026-Featuring-Major-OEM-Telematics-Propositions-Connected-Car-Ecosystem-Players---ResearchAndMarkets.com>

<https://www.utilitydive.com/news/global-ev-sales-rise-80-in-2021-as-automakers-including-ford-gm-commit-t/609949>

<https://explodingtopics.com/blog/auto-industry-trends>

<https://insights.conduent.com/conduent-blog/it-s-not-hype-blockchain-could-revolutionize-fleet-management-and-mobility-services>

<https://www.automotiveworld.com/articles/hurdles-aplenty-in-a-post-pandemic-automotive-industry>

<https://www.ledgerinsights.com/toyota-blockchain-collaboration-plans>

<https://cleantechnica.com/2021/02/25/how-ford-is-using-blockchain-technology-to-improve-urban-air-quality>

<https://www.livemint.com/opinion/columns/the-dirty-secret-of-ev-supply-chains-that-can-t-be-overlooked-11636305711440.html>

<https://thenextweb.com/news/web-3-0-and-creates-new-opportunities-for-connected-mobility>



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