



IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY



VOLUME : 5 ISSUE : 7 Print / Issue Publication Date: 20-Jan-2021



ISSN : 2455-2143



DOI : 10.33564/IJEAST.2020.v05i07.014

Indexed In



WWW.IJEAST.COM

editor@ijeast.com



BLOCKCHAIN USE CASES EXPLORATIVE STUDY FOR INDIAN AUTOMOTIVE INDUSTRY

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Abstract: Blockchain technology that has numerous benefits like immutability, finality and consensus is expanding its footstep in industrial world. Many countries and industries has started its initial usage and now Government of India has also shown interest to utilize its potential barring its usage with crypto transactions and piloted prototypes in registry of land records, health care etc. Sooner or later the technology will impact the Indian auto industry as many global auto players has started various initiatives based on blockchain, however the decision to use technology has to be driven with rationale and business logics rather than herd mentality. Many use cases has been theorized, forecasted, prototyped and implemented by industry and researchers on this technology. Blockchain along with IOT, AI and big data has potential to transform the way industry operates and has application potential across all sectors and functions. The analysis and conclusion reveals that automatic software update is one of the use case of block chain technology where Auto Industry can immediately work upon. Other conclusion that is drawn is use cases related to supply chain, traceability, targeted recalls, smart manufacturing, extended vehicle ledger, connected services, smart, EV segregated aggregate shall be reviewed after three years ,uses cases related to shared fleets/mobility as a service, asset registry, automatic transactions/cross border payments, finance, regulatory compliance, dealer and customer incentives, odometer fraud and warranty handling to be reviewed after span of five years and futuristic use cases of smart grid interoperability , retail and digital retailing and communication in autonomous vehicles to be reviewed after seven years.

Keywords— Automotive, traceability, software, vehicle ledger, automatic transactions, asset registry, regulatory compliance, warranty, recall

I. INTRODUCTION

Block chain in the new technology buzzword in the industry and researchers and Industry consultants has forecasted it as next disrupter in the business. Block chain was first implanted in 2008 by a pseudonym Hashimoto Takemoto which could be an individual or group pf Individual in the field of

cryptocurrency “bitcoin” (Sowichaya Supranee, 2017) (Zibin Zheng, 2018). Block chain in Simple words is a decentralized public ledger, where all transactions are stored in blocks and when new transactions are added to it the chain grows. These blocks are stored at same time in peer to peer network. Blockchain removes friction, reduces risk by enabling the near real-time settlement of recorded transactions. As this technology is based on principles and trust of cryptography and peer to peer network, it removes the need of third party and two hence two parties can transact directly. The peer -to-peer networks enables recording a public history of transactions. As the block chain contains verified record of every single transaction at each node hence this ledger is irreversible and immutable and hence no abuse, manipulation, fraud can be done. Pre-defined legally enforceable business procedures called smart contracts can also be defined in block chain that can be executed without involvement of third party (Zibin Zheng, 2018). There are three different types of blockchain i.e. public, private and consortium blockchain with the latter two for industrial usage. Hyperledger project was kicked off by Linux Foundation to provide an open source platform for industrial application. This project is funded by almost all Industry majors like Boeing, IBM, Daimler etc. (<https://www.hyperledger.org>, 2017). Bitcoin a cryptocurrency is the most famous application of blockchain application, but it can be applied in many diverse applications in conjunction with IOT, AI, Big data etc. Globally, amongst enterprises, block chain revenue is concentrated in 3 key industries: banking, manufacturing and services. Manufacturing is second most expected industry to make use of block chain. Industry consultants like Deloitte, Accenture, and Capgemini have forecasted use cases and have also developed and commercialized business solutions on the same. On similar lines many researchers have also forecasted use cases in Industry like EV battery swapping, supply chain automatic software update etc. Many uses cases like traceability in supply chain, Tracking provenance of parts, supplier contract management, digital thread, anti-counterfeiting, security, product recall (Sudhir Pai,Manuel Sevilla, Jerome Buvat,Ralph Schneider-Maul,Olivier Lise,Adrien Calvayrac,Tarun Karanam,Ramya Puttur, 2017), supply chain and its integration with manufacturing, fractional ownership model of vehicles (Brody Paul, Schartau Philip, 2018), Digital services in Automotive ecosystem. (Schade Martin, Pytel



Philipp, 2017). Niti Aayog have piloted prototypes on pharmaceutical supply chain for identification of spurious drugs, fertilizer supply chain eliminating subsidy leakage and digitization of land records. (Niti Aayog Recommends use of blockchain in land records, PDS and Healthcare, 2019) and various state governments in India are also working on the technology with service providers. Various Auto Giants like GM, Ford, Renault and many others have already ventured in blockchain applications. Worldwide different countries have adopted different approaches towards the technology.

Automobile companies in India today do not have deep insights of blockchain technology and its potential applications in automotive business. Indian automotive business environment is becoming tougher day by day due to hyper competition in the market, availability of alternate mobility solutions, vehicles getting complicated due to increasing electronics and software contents in vehicles and regulations evolving at fast pace. To have a competitive edge at the market place it is necessary to have a complete overview of current and emerging technologies, their impact on business process, application areas, automotive use cases and regulatory framework. Blockchain is one of emerging technologies and hence it is necessary to have an insight on it. This study is done to provide basic insights of the technology. This study provides basic understanding of business logic that decides the application of blockchain technology in a business process use case. This study also provides an overview of probable areas of application of blockchain technology in business process of automotive companies with a timeline roadmap where technology use case is recommended to be immediately explored for further feasibility and implementation or reviewed in future backed by qualitative rationale. In this study data is collected through primary sources mainly write-ups by industry consultants, research papers, and data of Global OEMs in public domain to understand the potential areas of blockchain usage by auto companies. Interview conducted with lead users of the technology provides deep insight on decision criteria to use blockchain technology as a solution and same is utilized to conclude on particular use case.

Technological introductions in the business environment and society has always brought a radical change in the way world operates. Those who are ahead in decision making curve and make a correct decision have a competitive edge over the competitors and those who take wrong decisions while implementing any technology based on herd mentality suffer the losses. Blockchain is one of these technology where at one side it is forecasted as one of the industry disrupter (White, 2017) and on other side its implementation is yet to pick up momentum. Blockchain technology which is a distributed ledgers was first used by Satoshi Nakamoto a virtual user/group for crypto currency Bitcoin where all records were kept in ledgers available (Blockchain Technology : Implications for operations and supply chain management) in different nodes of a network. In a central ledger, central authorities

transfer actual value between two parties and multiple intermediaries are required to facilitate transfer of assets and create trust hence central ledger is expensive, it has manual interventions for record matching, it is inefficient and time consuming, it involve resources and is vulnerable and prone to attacks. On the other hand blockchain distributed ledger keeps records in distributed nodes and maintain a shared source of information. Trust is enabled by cryptographic algorithm that provides single source of truth, finality, immutability, consensus and provenance, with provision of smart contracts that can be executed with in build smart logics.

5.2 Block chain Basics: “A block chain is a digital, immutable, distributed ledger that chronologically records transactions in near real time.” Block chain works on peer-to-peer network where each transaction is stored in each nodes in form of blockchain. As the name blockchain suggests a transaction is stored in one block and subsequent transactions are added in the chain as another block and so on. Before the data is attached to each block, transaction is validated by participating nodes to endorse as valid transaction.

Block chain works on principle of cryptography where each unique input can be converted to unique Hash (#) output. There are different hash output even for almost similar input. This input can be anything right from single letter to complete data of Wikipedia that can be converted into alphanumeric string and each string output is unique. shows concept where each data is attached in such a way that it forms a tree known as merkel tree with data in the root. Each block has hash of previous block, a time stamp, a merkel root and a nonce. Hence it is impossible to change, temper or modify a data as each block is connected through hash of previous block, and modifying all blocks is almost impossible. Moreover one have to change the data in all blocks of blockchain at all nodes at one point of time which makes it impossible to temper the data. Hence it is also an immutable distributed ledger. Blockchain has many benefits. It has information consensus across all the parties involved. This is made possible by sophisticated cryptographic authorization and verification mechanism that ensures trust in multi-party network. It also has time stamp that means the chronology of events are maintained. As there are secure encryption and decryption mechanism available, hence transaction with untrusted members can also be done. Digital signature ensures complete authenticity and non-repudiation. Business to business ownership of assets and provenance can also be tracked. As explained above, the architecture makes the network resilient and hence data loss becomes a non-issue. Because it works on peer-to-peer network, there is no need of any third party as a controlling agency. Smart Contracts which are sophisticated encrypted business logics can easily be built upon block chain that can be executed automatically once a transaction is validated.

Blockchain in Real world: There are three types of block chains. The first one is public blockchain where there are



many unknown participants with read and write permission to all and validation is done by consensus proof of work. The crypto currencies like Bitcoin and Ethereum are example of this category of blockchain, These block chains have write permission to all, read permission to all, consensus by Proof of work. However there are limitations like less number of transactions due to slow speed and huge requirement of computing power and resources. The second category of blockchain is Private Blockchain which has known Participants from one organization, write permission centralized, read may be public or restricted, multiple algorithms for consensus. The third category of blockchain works as consortium blockchain which has known participants from multiple organization, write requires consensus of n participants, read may be public or restricted, with multiple algorithms for consensus. Private and Consortium blockchain is more suitable for business applications. Hyperledger project initiated by Linux foundation to promote and make blockchain accessible to business world with open source technology. Leading Global organizations across sectors have recognized the business value of blockchain hence have funded the hyper ledger project. Example of companies associated with the projects are IBM, Airbus, Daimler, Cisco, SAP, Accenture, Intel, Accord, Hitachi, Fujitsu etc. Globally, amongst enterprises, block chain revenue is concentrated in 3 key industries: banking, manufacturing and is second most expected industry to make use of block chain by year 2022 followed by financial services (NASSCOM Avasant India Blockchain report 2019). Indian business ecosystem is in early stage of experimentation.

Global Scenario of block chain:52 countries are participating or have members observing development of blockchain standards with International Standards Organization (ISO). Approximately 40 countries have mandated licenses as a requirement for trading ,sale of cryptocurrencies, operations of Initial Coin Offerings or Crypto exchanges. 26 Countries have a regulatory sandbox to enables startups to test their products with limited number of customers for a trail period where there are exempted from regulations. While most of the countries apply existing regulations to blockchain, 7 countries have developed regulations specific to distributed ledger technology. Japan has realized cryptocurrencies and these can be exchanged if they are registered with Japanese Financial service agency (NASSCOM Avasant India Blockchain report 2019). The investment done by venture capitalists in field of blockchain in year 2018 accounts for USD 3.17 billion which is more than the investment done in the last five years. In India the approach of Indian Government is cautious leading to very low investment done and is about 8.5 million USD in year 2018 hence Indian startups and Indian entrepreneurs are finding their ways towards countries like Malta, Switzerland, Singapore and UK where the regulatory framework is more conducive. Indian startups also find it difficult to be cited by global investor due to the cautious approach of Indian

Government and restriction of trading and conversion of cryptocurrencies with real currencies.

In India Although Approach of government is cautious till 2018, recent shift towards approach has been noticed since year 2018. Niti Aayog targeted following for first use blockchain technology in year 2018.

- Land / Property registry, as two third of law suits pending in Indian courts are title suits.
- Supply management in public distribution system and pharmaceutical supplies to control subsidy leakage and fraudulent drugs control. (Year End Review 2018 :Niti Aayog, 12 , Dec 2018).

In 2019 proof of concepts were demonstrated by Niti Aayog. (Niti Aayog Recommends use of blockchain in land records, PDS and Healthcare, 2019). Future potential areas forecasted by Niti Aayog are EV battery swapping, Supply chain, Organic produced certificates, health records. As per the vision of Niti Aayog following are the top action areas .Govt. need to enable application of block chain by legal system change.

- India need skilled manpower and exploration if help to block chain companies
- India to be champion of block chain technology. (Aayog), 2018).

*Different Indian states have identified areas of usage of blockchain with land registry, farm insurance as top use cases

In Dec 2018 IBM institute of business value and Oxford Economics conducted survey on automotive domain. The views of Automotive Industry Professionals were asked about future of blockchain in automotive space. The results revealed that 62% of automotive executives are convinced that blockchain will be a disruptive force in automobile sector by the year 2021. It was also found that 54% of Auto companies are planning their first commercial block chain network at large scale within the next three years (ZIGURAT, 2018). Block chain applications are already in use in case of complex supply chain (Lakhani, 2017)

Blockchain use cases in Industry:

Following are the key use cases of block chain in Financial Sectors. (Karanjla Binalfar, Laxman Shankar, Goswami Saurajit, 2017)

Capital Markets.

- Trade settlements: Securities and payments are transferred faster and trading cost are reduced as intermediaries are removed.
- Commercial Papers Issuance and Trading: Issuance and allocation of commercial papers and delivery and payment settlements to investors based on smart contracts.

Public Sector



- Digital Identity: Blockchain based, management of digital identity for near real time contract management of partners
- Customer On boarding: Digital identities are leveraged to improve customer on boarding.
Banking Industry
- Trade Finance: Trade finance process are streamlined and shortened with minimum involvement of intermediary
- Regulatory Reporting and Compliance:
- Financial information are stored and manual audit errors are reduce and reporting costs are also reduced
Insurance Industry:
- Underwriting: Identities are verified, completeness of applications are ensured, risk evaluated and complete quoting and binding is processed.
- Claims Processing: Smart contract based claim processing.
Smart Identity
- Redistributed ledger and smart contracts based identity management system for customers, agents and employee ecosystem.
Transfer Pricing
- Smart contract for solving process and information fragmentation alongside ensuring compliance with corporate governance and regulatory guidelines.
Loyalty
- Blockchain usage for employee reward system and customer loyalty program. Reward points are traded as assets.

Blockchain use cases other than finance industry are

Oil and Gas digital supply chain

A Blockchain-based tracking of oil (asset) through the entire supply chain

- All events are recorded and viewed through the lifecycle in immutable ledger.
- Lease execution and termination are smart contract based that results in reduction in legal costs
- Enhanced financial management.
Retail & CPG: Warranty Receipts
Usage of chatbot to store warranty receipts on the Blockchain, to help
- Reduction in disputed between retailers and customers for lost receipts and unreadable receipts etc.
- Track history of ownership.
Telecommunication: Roaming Fraud
Smart contract based solutions aimed at
- Roaming contract based on call / event data are automatically triggered.
- Near instantaneous charging and reduction in roaming fraud

- Third-party clearing house are eliminated reducing the costs.
Public Sector: Land Registry
Blockchain based land registration system
- Costs will be reduced and errors will be eliminated in blockchain based transfer of ownership
Healthcare and life sciences: Patient Record Management
Blockchain based record management system to enable companies
- Simplify claim processing
- Secure medical records
- Monitor the Pharma supply stakeholders
Trade Finance
- Successfully executed transactions in international trade finance and remittance using Blockchain
Supply chain Financing
- Cloud-based application to transform supplier-to-manufacture trade finance transaction through a permissioned distributed ledger.
- Real time payments to suppliers based on blockchain based platforms.
- e-KYC Document Management
Management of KYC document of partners and participants.
Cross-border Payments
- Stellar has partnered with four financial in situations to enable low-cost global money transfer to the Philippines and cross-border payments to and from India, Europe, Kenya, Ghana and Nigeria.
Employee Loyalty / Rewards
- Deloitte India is working on Blockchain based rewards and recognition program.

Unique use cases of blockchain: There are many use cases of blockchain, however few unique ones are mentioned below.

- The World Wildlife Fund (WWF): “bait-to-plate” Tuna Project is implemented which is RFID and QR code based. This helps customers to know the source of the fish, till the level of fisherman who has caught the fish. On similar lines a London based NGO has developed a solution to trace yellow fin Tuna. Cap Gemini has developed a similar solution for traceability, provenance and connectivity of farmers and fisherman with high end restaurants. Similar solutions have huge potential in many sectors like pharmaceuticals, luxury goods etc. As an estimate €966 billion opportunity exists for brands to have transparent sustainability credentials (Sudhir Pai et al 2017). This opportunity is created as consumers are more aware and concerned about the traceability of products. (Sudhir Pai et al. 2017)
- A Startup in Australia has developed a platform on permissioned distributed ledger for anti-counterfeiting of wine bottle exports. Similarly-



JD.Com (a Chinese Ecommerce giant) is combatting counterfeit products with a solution developed on hyper ledger platform. Within few months ten companies in field of alcohol, food, tea, and pharma registered to the platform. Deloitte Attractive is a platform for tracking authenticity of art works. Similar solutions have great potential in aeronautics, manufacturing, automotive as many cases of counterfeiting of products exists for example -In 2017, 500,000 counterfeit car parts were seized in a raid in Abu Dhabi. Blockchain based solutions have ability to trace parts. (Blockchain for the Automotive Industry , worldwide survey results, 2017).

- Blockchain has potential to trace the environmental conditions during transportation of products. A combination of IOT sensors can update the temperature, humidity data on blockchain and customer can know all the environmental conditions that a product has gone through till final
- Blockchain potential can be easily extended to fractional ownership of vehicle. A vehicle can be broken down to different components like battery, powertrain. Each component can be tracked separately. Services like dynamic insurance can be implemented on blockchain. Separate spends on each component of vehicle can be tracked. Tokenized model of economy enables sharing of portion of car with connected users. (Westland Duncan)
- Blockchain potential is extendable to digital services like automated payment of parking, fuel refilling etc. Dynamic insurance, service booking appointment can easily be built by smart contracts. A vehicle ledger can easily store the vehicle history right from the birth of the vehicle. (Schade Martin et al. 2017).
- Supplier contract management is another area where blockchain potential can be unearthed. Foxcon which is Apple Inc.'s largest subcontractor has launched a supply chain finance platform called Chained Finance to provide working capital to suppliers. A 6.5 million\$ loan was disbursed to suppliers in no time during the sandbox trial without keeping bank in loop. Similarly Deloitte Trace chain which is end-to-end supply chain solution seamlessly order or sell, track and pay, create documentation update, view and verify on blocks. It also initiates automatic payments with smart agreements (e.g. between seller and customs authorities, seller and shipping company and between seller and buyer). Extended IOT sensors and smart devices also records the condition of shipments inform final settlements e.g. if goods have been damaged). (Sudhir Pai,et al. 2017).
- Use cases of product recall has been prototyped. Walmart's block chain pilot in China enabled them to trace a package of mangoes from store to farm in a few seconds. Previously, this would have taken days

or weeks. Deloitte Trace chain is a blockchain based solution enabling car makers to identify specific vehicles that contain defective parts. Hence they can recall specific cars reducing less convenience to customers and also reducing cost of recall. In addition the solution can summarize how many defective vehicles have been recalled, that is normally asked by the regulatory bodies. (Blockchain for the Automotive Insustry , worldwide survey results, 2017)

- Even security systems has seen use cases of blockchain. The Government of Dubai has demonstrated a proof of concept of digital passports. This works on biometric verification with blockchain that creates a gate less border and through blockchain customer shares information through security officials and airlines. Only pre cleared passengers walking through biometric tunnel can cross the security gate. On similar lines London based ObjectTech have developed an application for digital passports where individuals can control the view access of the information. They can also chose to add extra details such as financial information, addresses and location from a mobile device. A scanning technology is used to scan the faces of people entering the airports. These uses cases have emerged as todays solutions are not foolproof, time consuming and manual. (Sudhir Pai et al.2017)
- In the field of electric distribution and electric mobility The University of Tokyo Toyota and Trende (electricity distribution company) working on future use case of electric vehicle ecosystem. Prototype has been made where battery of electric vehicle can be used as reservoir and connected through grid. Electricity can be sold when car is not in use. (<https://www.automotivetestingtechnologyinternational.com/news/rd/toyota-testing-electricity-system-that-uses-blockchain-technology.html>, n.d.)
- In e-commerce market a blockchain platform known as Coup is designed to verify reputation of buyers and sellers. A hash is generated an uploaded in block with each single transaction like sale, purchase, claim registered, ticket raised, issue resolved etc. This information is useful for authorized users for future transactions.
- In the field of background verification applications are made so that fake resumes and CVs are not even entertained. This need has arisen from industry as despite of time consuming and costly background check there are many cases of employees with fake academic credentials emerge frequently. (<https://appii.io/features/>, n.d.)



II. RESEARCH METHODOLOGY

The study has followed following design approach.

- Literature review -

Basic Understanding of Topic, Legal political arena at global level and in the country, exploration of Use cases of the technology.

Review of Technical Papers/ Reports published by Industry Consultants like McKinsey, Earnest and Young, Deloitte, Cap Gemini etc. to find out the forecast, recommendations, models demonstrations of auto industry use cases.

Researchers forecast, demonstrations, models, on use cases for auto industry.

Use cases implemented, prototyped, and researched by auto industry globally.

- Data Collection

As this is exploratory research, interview is used as a tool to collect the feedback of lead user group, professionals (from companies, service providers etc.) who are working on blockchain technology to understand their views and insights on the use cases they are working upon. The interview questionnaire is framed and refined during first two three interviews. The main aim of interview is intended to understand why this technology is used for a particular business process and why not for other. What were the business logics decided the use of this technology? The interviews are summarized and collated.

Literature review, is the secondary source to find out the use cases by consultants and researchers for auto industry.

Analysis and Interpretation:

The use cases coming from interview is analyzed qualitatively to find the decision making criteria. For the analysis Eliyahu M. Goldrat matrix (pot of gold, Alligator, mermaid alligator 4 by 4 matrix) (Winson, n.d.) is used, along with business environment review.

The common use cases from voice of (consultants, researchers, Auto OEMs) is analyzed through Goldrat Matrix to analyze whether a use case makes a sense for business process of auto companies to immediately work upon adaptation of technology. Analysis also helps to understand whether it does not makes a business sense. Also the use cases can be kept on hold to be reviewed after a time period.

Conclusion: The Analysis is concluded as a summary with recommendations where auto companies should immediate work on the use case, and review the use case after some time

III. DATA COLLECTION

Through Secondary sources data collected. Collation of application areas/ use cases of blockchain recommended, forecasted, and prototyped and implemented by industry consultants (refer Annexure Table 6.1)

Researchers have documented their findings in the various published research reports and journals. (Annexure Table 6.2) represents the collation of use cases / application areas of blockchain technology as recommended, forecasted, and prototyped and implemented by researchers on this field.

Table 6.3 represents of collation of use cases / application areas of blockchain recommended, forecasted, and prototyped and implemented by Auto Companies

Key findings of interview with service providers/ lead users and experts who have explored and insights on the usage and feedback received (refer table 6.4)

IV. DATA ANALYSIS

Common recommendations and use cases from researchers and consultants are clubbed in Table no.8.3 and uncommon use cases/recommendations ignored

Analysis of uses cases from Lead users/ service providers/ consultants done to find out the reasons of selecting blockchain as a solution, shown in tables (8.4 to 8.12 refer annexures)

Use case applicability analysis for auto companies in India and Conclusion:

Each common use case between consultants and Researchers (refer annexures table 8.3.1 to 8.3.13) are analyzed for its applicability in automotive business. In addition smart grid interoperability use case is also analyzed as it is the only use case from Auto OEMs that is not a part of use case in table 8.3 Few use cases are not considered for further analysis on Gold rat matrix as adequate conclusion is sought through prevailing business scenario as shown in Table 8.2.14

Following conclusions are drawn based on the analysis and interpretation

V. CONCLUSION

Conclusion on business logic to adapt blockchain technology

Blockchain technology has vast scope in almost all fields of business, however the selection of blockchain technology as a solution is mainly driven by government regulations and pull from the market as a customer preference. The implementation of blockchain solution is also dependent on ecosystem readiness which is not always in control of an organization, hence to unleash the potential of the technology industry consortiums are mostly needed. In India at present there is almost no pull from the market or government that is compelling the auto manufacturers and also the ecosystem to invest and implement the technology. However the technology has potential, Government has recently shown interest on the technology implementation and the trends observed worldwide will definitely impact auto industry in future and hence annually a close watch is further needed to see the



evolution of business scenario, Government regulations and pull from market for the technology.

Conclusion on use cases where Indian Auto companies should work, review in future:

Roadmap shown (refer annexure fig 9) concludes following - Blockchain use related to extended vehicle ledger, connected services, EV segregated aggregate are shall be reviewed after three years. These use cases are regulations driven and hence an OEM can only keep a watch on evolving regulations and react to it.

-Blockchain use cases related to Shared Fleets/MaaS, Asset registry, Automatic transactions/cross border payments, finance, regulatory compliance, dealer and customer incentives, Odometer fraud and warranty handling to be reviewed after five years.

- Blockchain use cases of smart grid interoperability, retail and digital retailing and communication in autonomous vehicles to be reviewed after seven years as these use cases are applicable to future and needs to be proven first. Also the need will arrive in future only which depends on evolving market scenario.

VI. ACKNOWLEDGEMENT

I sincerely acknowledge researchers, firms, organizations for their publications, white papers, presentations, research paper made available on public domains on blockchain technology, use cases, regulations etc. Further I acknowledge the participants from lead users and technology service provider for providing deep insights on the technology during the interview.

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VIII. ANNEXTURES

Table 6.1: Blockchain use cases by consultants

S.No.	Application area	Consultant organization	Source
1	supply chain (know your supplier)	Deloitte	(Woodward Michael et al. 2018)
2	Inbound logistics and smart manufacturing	Deloitte	
4	provenance , trace and verify parts	Deloitte	
5	connected supply chain	Deloitte	
6	Targeted recall	Deloitte	
7	Dealer and customer incentives	Deloitte	



8	Extended vehicle ledger	Deloitte		
9	Odometer fraud prevention	Deloitte		
10	Insurance contracts (dynamic pricing)	Deloitte		
	Ride sharing and on demand mobility service(Maas)			
11	Auto leasing and finance	Deloitte		
12	connected services (Paying for parking etc.)	Deloitte		
13	Electric vehicle payments	Deloitte		
14	Retail and CPG	Deloitte		
15	Digital supply chain (Oil and gas)	Deloitte		
16	Patient record management (healthcare)	Deloitte		
17	Roaming fraud management(telecom)	Deloitte		
18	Land registry	Deloitte		
19	supply chain	AMW world		(Blockchain for the Automotive Insuustry , worldwide survey results, 2017)
20	Software management smart car hacking protection	AMW world		
21	safety of autonomous vehicles	AMW world		
22	Dynamic car insurance	AMW world		
23	leasing	GMC		
24	Dynamic insurance	GMC	(Schade Martin et al. 2017)	
25	Vehicle ledger	GMC		
	Smart assembly	GMC		
26	Supply chain	GMC		
27	Retail and CPG	GMC		
28	Digital thread	CapGemini		
29	Production tracking	CapGemini		
30	Tracking asset maintenance	CapGemini	(Sudhir Pai,et al. 2017)	
31	Tracking recalled products	CapGemini		
32	Tracking Provenance	CapGemini		
33	Tracking asset conditions	CapGemini		
34	Regulatory compliance	CapGemini		
35	Providing warranties	CapGemini		
	Tracking critical parameters			
36	Retail	CapGemini		
37	Supplier contract management	CapGemini		
38	Shared leasing	AT Kearney		(Mathur Manish et al. 2019)
39	Insurance	AT Kearney		
40	Secure payments	AT Kearney		
41	Sourcing and procurement	AT Kearney		
42	Traceability of products and components	AT Kearney		
43	Supply chain	AT Kearney		
44	Smart contracts	AT Kearney		
45	Bank guarantee	AT Kearney		
46	Cross border payments	AT Kearney		
47	shared fleets and fractional ownership	Ernst and Young	(Brody Paul , Schartau Philip , 2018)	
48	Segregated aggregates of Electric vehicles	Ernst and Young		
49	Mobility as service	Ernst and Young		



50	Smart Contracts	Ernst and Young	(Westland Duncan)
51	Fractional ownership	Ernst and Young	
52	Supply chain	Ernst and Young	
53	Digital identities of vehicles	Roland Berger	(Boyle Brandon , 2018)
54	Car e- wallets	Roland Berger	
55	Smart Contracts	Roland Berger	
56	Secure communication	Roland Berger	
57	Supply chain	Roland Berger	
58	Biometric security	Accenture	(Borrows Maisieet al. 2017)
59	Smart Contracts	Accenture	
60	Financial services	Accenture	(Meszaros Richard et al. 2016)
61	e-KYC	Mckinsey	(Higginson Matt et al.)
62	Fraud Preventions	Mckinsey	
63	Insurance and Smart Contracts	Mckinsey	

Table 6.2: Blockchain use cases by researchers

Sr.No.	Application area	Source
1	Automotive safety/public safety	(Bohl Greg)
2	Liability attribution of autonomous vehicles	(Chuka Oham1, 2018)
3	Dynamic insurance	
4	Proof of Service	
5	Supply chain	(Chuka Oham1, 2018)
6	Asset registry	(Melanie Swan, 2018)
7	Real time valuations	
8	Smart Contracts	
9	Payment Channel	
10	Vehicle ledger	
11	Financing	
12	Insurance	
13	Legal	
14	EV Charging	(Alejandro Ranchal Pedrosa UPMC – Sorbonne Université, 2018)
15	Parts tracking	(Ioannis Konstantinidis, 2018)
	Cross border transactions	
16	Energy	
17	Data Storage	(Song Hua, 2018)
18	Battery swapping	
19	Smart Contracts	
20	Transportation	(Fthi Arefayne Abadi, 2018)
21	Vehicle ledger for maintenance	
22	Automotive software update	
23	Vehicle diagnosis	
24	Transactive energy	
25	Smart cities and home	
26	Drones and robots	



27	Manufacturing	
28	Supply chain	(Kouvelis Panos, 2019)
29	Logistics	(Britchenko, 2018)
30	Smart contract	
31	Anti-counterfeit products	
32	Transparency in supply chain,	
33	Product safety	
34	Food safety	
35	Supply chain	
36	Transparency	(Colonna Simone, 2018)
37	Cost rollup	
38	Parts traceability	
39	Connected supply chain	
40	Targeted recall	
41	Dealer and customer incentives,	
42	Extended vehicle ledger	
43	Odometer fraud	
44	Ride sharing,	
45	Dynamic insurance	
46	Auto leasing and finance	
47	Connected services	
48	Electric vehicle charging	
49	3 D printing	
50	Counterfeited product	(Michael Crosby (et al. 2018)
51	Smart contracts	
52	Financial markets	
53	Token economy	
54	Insurance and ledger	
55	Data storage and sharing	
56	Anti-counterfeit operations	(Dr Gareth R.T. White, 2017)
57	Global supply chain management	
58	Certification of product quality	
59	Verified consumer review	
60	Data recording and storage	(Huckle Steve, 2016)
61	Autopay	
62	Smart contracts	
63	Digital right management	(PAULA FRAGA-LAMAS, 2019)
64	Smart manufacturing	
65	Odometer fraud	
66	Digital retailing and customer personalized experience	
67	Claim processing	
68	Usage based insurance	
69	Maas	
70	Peer to Peer lending leasing financing	
71	Connected services	
72	Connected vehicles	
73	Smart charging services	
74	Autonomous self-driving vehicles	
75	Forensics	
76	Extended global vehicle ledger	

Table 6.3: Blockchain use cases by Auto Companies



Sr.No.	Application area	Auto Company	Source
1	Contract Management	Mercedes-Benz Daimler	(https://www.daimler.com/innovation/blockchain-2.html, n.d.)
2	Maas		
3	Regulatory Documentation		
4	Tokenization		
5	Supply chain – cobalt	Ford	(ZIGURAT, 2018)
6	Odometer fraud prevention	Volkswagen	
7	Supply chain	Hyundai	
8	Cobalt mining and supply chain	Volvo	(https://www.volvogroup.com/en-en/news/2019, n.d.)
9	EV smart grid interoperability	GM , Honda, Toyota	(https://asia.nikkei.com/Business/Automobile/Honda-and-GM-join-in-smart-grid-and-electric-car-research, n.d.) (https://www.automotivetestingtechnologyinternational.com/news/rd/toyota-testing-electricity-system-that-uses-blockchain-technology.html, n.d.)
10	Supply chain Financing	Mahindra	(https://www-03.ibm.com/press/us/en/pressrelease/51147.wss, n.d.)
11	Self-Driving Car (MOBI initiative)	GM, Renault, BMW	(https://media.group.renault.com/global/en-gb/media/pressreleases/94238, n.d.)

Table 6.4: Inputs summary given by blockchain lead users

Sr.No	Organization	Key inputs
1	Telecom company (lead user)	-Forthcoming Regulation forced Telecom as TRAI has mandated distributed ledger technology to stop unsolicited telemarketing calls and messages (to avoid spam and subscribers convenience). -Started Alone , now working as consortium -No other fields are explored further
2	Company 1 Bangalore (Service provider)	Key findings after interview revealed following Organization Working on solutions with EY , KPMG for foreign clients (Auto and Aviation sector) on -Provenance of parts and supply chain smart contracts(customer preference as primary reason ,transparency , liability) -Connected car speed monitoring (safety requirement as primary reason) -Automated payments (customer preference as a reason) -Software updates and ant hacking of CAN (security, cost and convenience to customer is a reason)
3	Company 2 Delhi (Technology Consultant)	-Working on Product for qualification and background verification. Market is big and demanding a solution and hence they are developing a product
4	Company 3 (blockchain products)	-Working on invoice discounting product. Market is big and demanding a solution and hence they are developing the product
5	Company 4 (blockchain products)	-Working of Land Registry, anti-counterfeiting solutions in pharma sector solutions with Governments. Government is driving the initiative



6	Company 6	-Weighed blockchain solution for traceability in organic food category, but after studies pulled back as there was no customer pull (appreciation) in Indian consumers. Hence will review the same later on.
7	Company 7 (consultant)	-Working on supply chain projects for overseas clients. - Market pull and ecosystem is needed for blockchain success as technology.

Table 8.3: Common use cases researchers and consultants

Consultant	Frequency	Researchers	Frequency
Extended vehicle ledger/Digital Identities of vehicle /track assets/dynamic insurance /maintenance and monitoring /Record management	6	Extended vehicle ledger/Digital Identities of vehicle /track assets/dynamic insurance maintenance and monitoring /Record management /real time valuations/remote diagnostics/proof of service	10
Supply chain	4	Supply chain/transparency	5
Connected services/Car wallets /Electric vehicle charging	3	Connected services /Car wallets /Electric vehicle charging's/payment channels	8
Shared Fleets / fractional ownership /Ride sharing /shared leasing/MaaS	5	Shared Fleets / fractional ownership /Ride sharing /token economy /peer to peer lending /MaaS	5
Provenance/trace/verify parts	3	Provenance/trace/verify parts	6
Inbound logistics/Smart Manufacturing/Production tracking/sourcing and procurement	4	Inbound logistics/Smart Manufacturing/Production tracking/sourcing and procurement	3
Connected supply chain/Digital thread	2	Connected supply chain/Digital thread/ /auto cost rollup / record management	3
Fraud prevention/Odometer fraud prevention/Roaming fraud	3	Fraud prevention/Odometer fraud prevention	2
EV segregated Aggregates	1	EV segregated aggregates/ battery swapping	2
Secure payments/bank guarantee/Cross Border Payments/ Automatic transactions	2	Secure payments/bank guarantee/Cross Border Payments/ Automatic transactions	1
Targeted recall /Tracking recalled products	2	Targeted recall /Tracking recalled products	1
Land registry(asset registry)/biometric registry	2	Land registry(asset registry)/Biometrics security	1
Smart car hacking protection	1	Automatic software update/ smart car antihacking	2
Safety of Autonomous vehicles	1	Secure communication in autonomous cars/Safety of Autonomous vehicles	2
Financial services	1	finance /financial markets	2
Regulatory compliance	1	Regulatory compliance /legal	1
Providing warranties	1	Providing warranties/claim	1



		processing	
Retail	1	Retail /digital retailing	1
Dealer and Customer incentives	1	Dealer and customer incentive's	1

Table 8.4: Analysis of Telecommunication use of blockchain to verify list of tele callers to stop unsolicited calls and message

Pot of Gold	Verified list of tele callers.
Broken limbs	Revenue loss as many tele callers will be screened out, cost involved.
Mermaid	----
Alligator	Non fulfilment of regulation will throw companies out of business.
Business Scenario	No such initiative by telecom companies. Stopping unsolicited calls was thought as loss of revenue as such tele callers would move to other service providers.
Key insight	<ul style="list-style-type: none"> Forthcoming Regulation forced telecom companies to go for blockchain. Consortium model is needed as it is ecosystem dependent.

Table 8.5: Analysis of Software company use case of Provenance of parts and supply chain, smart contracts for foreign clients in Auto and Aerospace.

Pot of Gold	Complete traceability of parts, Liability attribution, -Targeted recall, transparency in contracts and penalties
Broken limbs	Cost involved
Mermaid	----
Alligator	Customers will not buy products without this, Difficult to prove liability, Cost of recall, Difficult to impose penalties on suppliers in case of contract breach.
Business Scenario	Customer preference for transparency, liability laws are primary reasons for its implementation in overseas markets. Auto industry is not coming forward in India for this initiative as liability laws and customer preference are not strong enough.
Key insight	<ul style="list-style-type: none"> Market and stringent liability laws are forcing organizations to have blockchain based solutions. Consortium based models are used No such initiative by Auto OEMs in India

Table 8.6: Analysis of Software company use case of connected car speed monitoring for overseas clients in Auto Sector

Pot of Gold	Comply with local traffic requirements
Broken limbs	Cost involved
Mermaid	----
Alligator	Local Regulations will not allow sale of vehicles without such feature.
Business Scenario	Stringent regulation by local authorities
Key insight	<ul style="list-style-type: none"> Safety requirement by local authorities is the prime reason for adopting the solution No such initiatives by local authorities or Auto OEMs in India

Table 8.7: Analysis of Software company use case of automated payments in cars for foreign clients

Pot of Gold	Customer will prefer vehicles with such solutions.
Broken limbs	Cost involved.
Mermaid	----
Alligator	Customers will not buy the vehicles without such feature.
Business Scenario	Customers are aware about solutions and are demanding the feature.
Key insight	<ul style="list-style-type: none"> Customer preference is the primary reason for such solution and also



	ecosystem exists in overseas markets.
	<ul style="list-style-type: none"> No such initiative in India by Auto OEMs, lack of ecosystem.

Table 8.8: Analysis of Software Company use case of Software updates and anti-hacking of Connected Area network

Pot of Gold	Customer will prefer vehicles with such solutions, Liability avoidance for OEM as the ledger helps in Court of Law in case of unforeseen events.
Broken limbs	Cost involved.
Mermaid	----
Alligator	Customers will not buy the vehicles without such feature and competitor may adopt the feature. Liability threat on vehicle manufacturer .Huge cost of updating the software.
Business Scenario	Customers are aware and demanding , Laws are stringent and litigations are costly,
Key insight	<ul style="list-style-type: none"> Customer preference and avoidance of liability is the primary reason for OEMs to prefer block chain based solutions. No such initiative in India by auto OEMs.

Table 8.9: Analysis of Software company 2 use case of Qualification and background verification platform

Pot of Gold	Revenue through new product
Broken limbs	Cost involved.
Mermaid	----
Alligator	Someone else wins the potential market.
Business Scenario	No such solution in the market, there is potential for such product that industry might need.
Key insight	Market driven product as market is big and demanding a solution.

Table 8.10: Analysis of Analysis of Software company 3 use case of invoice discounting product

Pot of Gold	New market.
Broken limbs	Cost involved.
Mermaid	----
Alligator	Someone else wins the potential market.
Business Scenario	Industry desperately need such product. No regulation restricts the product.
Key insight	<ul style="list-style-type: none"> Market driven as market is big and demanding a solution.

Table 8.11: Analysis of Retail company use case of blockchain solution in organic food category

Pot of Gold	Interested customers.
Broken limbs	Cost involved.
Mermaid	No USP.
Alligator	Someone else win the business.
Business Scenario	After detailed survey found that customers are not aware and are not appreciating such products (price still dominates the market)
Key insight	Project was aborted in absence of customer demand for such solutions

Table 8.12: Analysis of Global Service Provider use case of supply chain projects for overseas clients

Pot of Gold	Increased efficiencies.
Broken limbs	Cost involved.
Mermaid	----
Alligator	No improvements over baselines.
Business Scenario	High pressures on profit margins is pushing such solutions.
Key insight	<ul style="list-style-type: none"> Ecosystem is needed for success of this technology, even foreign players



	struggle in absence of supportive ecosystem Hence to have success either enterprise have less dependence on stakeholders , or are not dependent on ecosystem or they go for consortium model to influence stakeholders. <ul style="list-style-type: none"> • Auto industry in India is silent
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Table 8.3.1: Use case analysis of extended vehicle ledger/Digital Identities of vehicle /track assets/dynamic insurance maintenance and monitoring /Record management/real time valuations/remote diagnostics/proof of service

Pot of Gold	Customer satisfaction through convenience, transparency and hence upper edge in the market.
Broken limbs	Cost of development and implementation.
Mermaid	----
Alligator	Market will be lost if others implement the same solution.
Business Scenario	No such initiative in India by automakers or service providers like insurance companies. No regulations by government to have distributed ledger technology. No market pull or customer demand. Consortium model will be needed.
Conclusion	Future use case and hence keep a watch and park the use case, review after 3 years.

Table 8.3.2: Use case analysis of Supply chain solution.

Pot of Gold	Streamlined supply chain, cost efficiency.
Broken limbs	Cost of development and implementation.
Mermaid	Credit policy is beneficial to auto companies.
Alligator	Rate of improvement in supply chain efficiencies and effectiveness will be less.
Business Scenario	Neither a customer requirement, nor a regulatory requirement... Consortium model will be needed to implement this initiatives with supplier. Hence can be taken as an initiative at SIAM level.
Conclusion	Implement other initiative first. Initiative that can be pursued at consortium level (SIAM) as it will benefit all industry players. Review after 3 yrs.'

Table 8.3.3: Use case analysis of connected services (Car wallets/EV charging)

Pot of Gold	Customer satisfaction through convenience, transparency and hence upper edge in the market.
Broken limbs	Cost of development and implementation.
Mermaid	----
Alligator	Market will be lost if others implement the same.
Business Scenario	Neither a customer requirement, nor a regulatory requirement. Other options like RFID tags coupled with e-wallets are available in the market. There is no consumer awareness and pull for blockchain model. Ecosystem related regulations are not available. The trend might be relevant after some time by the time connected vehicles becomes a necessity.
Conclusion	Review the use case after 2-3 yrs. Strategic collaboration with e-wallet company can be done if regulation comes.

Table 8.3.4: Use case analysis of shared Fleets / fractional ownership /Ride sharing /token economy /peer to peer lending /MaaS.

Pot of Gold	Increased sales due to unique feature.
Broken limbs	Cost of development and implementation.
Mermaid	----
Alligator	Market will be lost if others implement the same.
Business Scenario	Not a current market demand, neither a regulation. This is a future use case, not even implemented in mature markets. No such business visibility in next three years.
Conclusion	Review the use case after 5 yrs.



Table 8.3.5: Use case analysis of provenance/trace/verify parts

Pot of Gold	Traceability of parts.
Broken limbs	Cost of development and implementation.
Mermaid	----
Alligator	Difficulty to prove traceability of parts fitted at manufacturing plants premises and after sales during service. After sales market that is filled with counterfeited product remains untapped
Business Scenario	Industry is not yet ready with basic Industry 4 infrastructure
Conclusion	Review after 2-3 yrs. to take traceability on block chain along with parts fitted at dealer end to cover the risk imposed leftover post sales portion as well as to tap the full potential of spare part market .

Table 8.3.6: Use case analysis of inbound logistics/Smart Manufacturing/Production tracking/sourcing and procurement/Connected supply chain

Pot of Gold	Reduced cost, improved efficiencies and Quality.
Broken limbs	Cost of development and implementation.
Mermaid	----
Alligator	Rate of improvements in terms of efficiencies, Quality remains low.
Business Scenario	Lot of Scope exists to improve internal efficiencies. However conventional tools like JIT/ Kanban are under progress. Also this case needs infrastructural support like IOT sensors, scanners etc. Consortium model will be beneficial and supply chain solutions on blockchain goes hand in hand with smart manufacturing.
Conclusion	Review the use case after 2-3 yrs.

Table 8.3.7: Use case analysis of Targeted recall /Tracking recalled products

Pot of Gold	Targeted vehicles during recall.
Broken limbs	Cost of development and implementation.
Mermaid	----
Alligator	Difficulty to prove traceability of parts fitted at plants and after sales during service.
Business Scenario	Industry is not yet ready with basic Industry 4 infrastructure
Conclusion	Review after 2-3 yrs. to take traceability on block chain along with parts fitted at dealer end to cover the risk imposed leftover post sales portion as well as to tap the full potential of spare part market .

Table 8.3.8: Use case analysis of asset registry

Pot of Gold	----
Broken limbs	Cost of development and implementation.
Mermaid	----
Alligator	----
Business Scenario	No such regulation/rule that mandates distributed ledger. This will be purely depending upon future govt. regulation
Conclusion	Review after 5 years.

Table 8.3.9: Use case analysis of automatic software update/ smart car antihacking.

Pot of Gold	Reduced cost of software update. Traceability of software's in vehicles. Fool
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	proofing
Broken limbs	Cost of development and implementation
Mermaid	----
Alligator	Increased cost with current Manual process where vehicle needs to be brought to Dealership for software upgrade. Vehicle software remains vulnerable to external threats.
Business Scenario	No regulation. Software content is increasing in vehicles with every product launch in India
Conclusion	This can be immediately reviewed for industrial feasibility and economic viability with a dedicated CFT.

Table 8.3.10: Use case analysis of EV segregated aggregates

	EV market
Pot of Gold	EV market
Broken limbs	Cost of development and implementation.
Mermaid	----
Alligator	Competitors may develop.
Business Scenario	No such regulation from government. However due to complexity of Indian market, government may float a regulation where EV batteries must have provision for removal and re-fitment.
Conclusion	Keep close watch on regulation and the use case in 2-3 yrs.

Table 8.3.11: Use case analysis of secure payments/bank guarantee/Cross Border Payments/ Automatic transactions

Pot of Gold	Ease of payments.
Broken limbs	Development cost.
Mermaid	----
Alligator	----
Business Scenario	No such demand. No regulations. Ecosystem is still a question mark.
Conclusion	Review after 5 years.

Table 8.3.12: Use case analysis of odometer fraud prevention

Pot of Gold	----
Broken limbs	Development cost.
Mermaid	----
Alligator	If competitor markets as USP this might be a remote threat.
Business Scenario	No regulations. Market has already evolved through second hand car sellers. Customer's preference can be checked during clinics.
Conclusion	Review after 5 years.

Table 8.3.13: Use case analysis of dealer and customer incentives

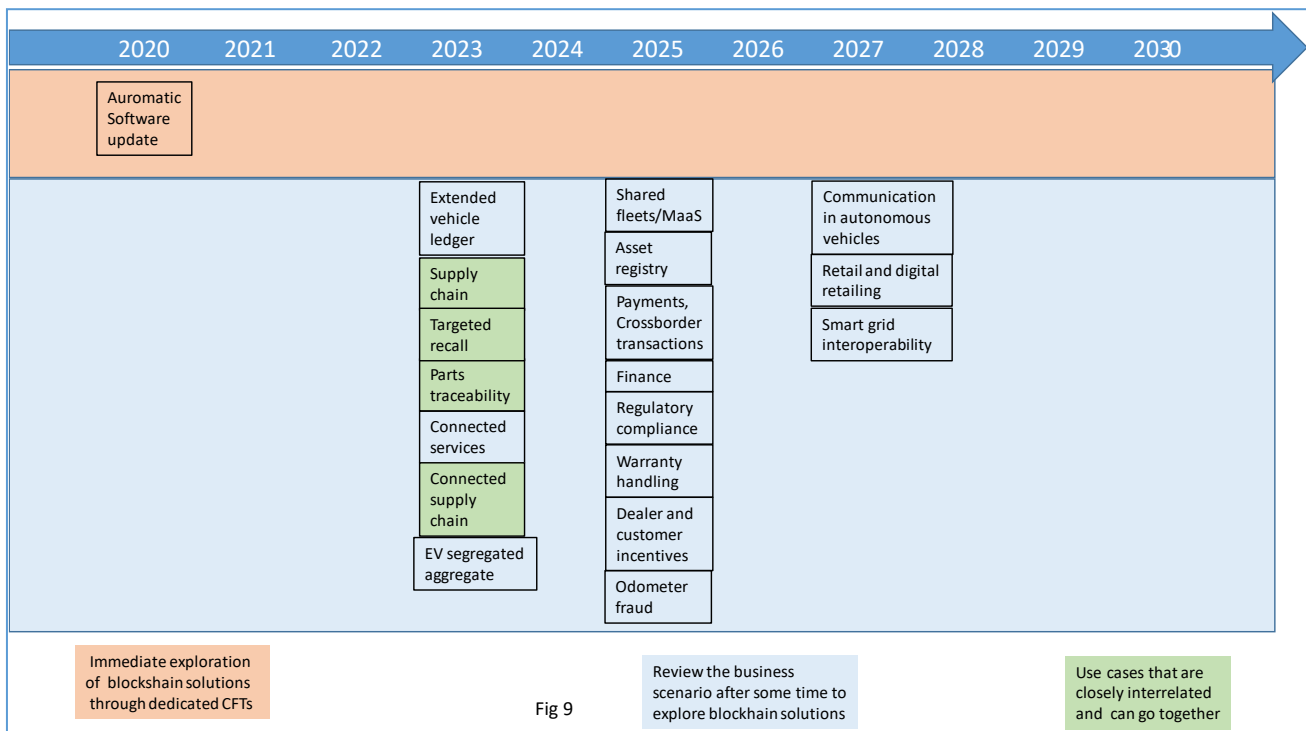
Pot of Gold	Loyal dealers and customers , repurchase
Broken limbs	Development cost
Mermaid	----
Alligator	----
Business Scenario	There are other tools available in Auto sector to have similar solution like CRM and its full potential is yet to be realized. Dealer improvement programs are first priority for auto companies in India.
Conclusion	Review after 5 years.



Table 8.3.14: Analysis and conclusion of block chain use case with business scenario

Use cases	Business scenario	Conclusion
Secure communication in autonomous cars/Safety of Autonomous vehicles	No forecast of Autonomous vehicles in Indian Market	Review after 7 yrs.
finance /financial markets	Driven by Financial institutions. Auto OEM can participate as auto OEM partner	Review after 5 yrs.
Regulatory compliance /legal	No such regulations , alternate methods are sufficient to address current scenario	Review after 5 yrs.
Providing warranties/claim processing	No such market pull	Review after 5 yrs.
Smart Grid interoperability	EV market is still a question mark and the smart grid model is still a research subject	Review after 7 yrs.
Retail /digital retailing	No such market pull	Review after 7 yrs.

Fig 9: Roadmap of use cases for Indian Automotive industry



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