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To cite this article: F Gîrbacia *et al* 2022 *IOP Conf. Ser.: Mater. Sci. Eng.* **1220** 012026

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Toward blockchain adoption for the automotive industry

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Abstract. Blockchain proves to be a powerful technology that can drive forward the automotive industry. This paper describes how blockchain has been applied, which automotive areas are most interested in the technology, as well as the benefits and challenges of blockchain for the automotive industry by a systematic literature review. Blockchain offers many advantages, such as: transparency, security, high speed of operations. There are numerous areas where this technology could be applied in the automotive domain: better protection against counterfeit spare parts and materials, effective preventive maintenance, by informing the services based on the data received from the car sensors, monitoring of the cars by the rental companies, the safe storage of the data used by intelligent navigation systems, in order not to affect the safety of the passengers, autonomous transactions, triggered by the vehicle for making payments in charging stations, all with the purpose of facilitating a good and safer medium for drivers. The future vehicle will be connected both with other vehicles, but also with the existing infrastructure, so a database containing cryptographically secure information is needed, and blockchain is such a solution that can be applied in the dynamic nature of traffic.

1. Introduction

The automotive industry is facing a number of challenges related to the design, manufacturing, promotion, sale, insurance and history of vehicles and their components. The automotive sector needs to adopt novel technologies to stay ahead of the competition. Blockchain is a disruptive technology that has the potential to provide an answer to most of these problems (such as just in time delivery, ownership verification and counterfeit protection), being a reliable and transparent tool for collecting, storing, managing and using car data in a more efficient way [1]. Furthermore, artificial intelligence (AI), machine learning and blockchain are seen as three technologies that go hand-in-hand. When it comes to the automotive industry, the implementation of AI within vehicles can make driving more intuitive for users, as well as enhancing safety and security for drivers. A blockchain, which has as its basic unit the data block, is a distributed mechanism that records transactions efficiently, verifiably and permanently, in a linked structure. Thus, the complexity of the process and implicitly the costs are reduced, eliminating the intermediaries between the two parties. The user of an application using blockchain technology could track the complete history of a vehicle, without the risk that they have been falsified.

Traditional automotive companies like Volkswagen [2], BMW [3], Porsche [4], Mercedes Daimler [5], Renault [6] working on their own blockchain initiatives or testing the existing blockchain protocols IOTA or Stellar. In this paper, we discuss recent use cases that have been developed in representative automotive domains.



2. The blockchain technology

The blockchain technology works much like a digital ledger that is public, decentralized, and distributed. Transactions are kept with distributed hash-chains that form a peer-to-peer network of nodes (a node is a user). The “decentralized” part means that no one can manipulate the database. Additionally, the databases themselves aren’t held by any single party, and they are also interconnected to the internet in a way that prevents data manipulation. Because the ledger is public, anyone can see and verify transactions in real time. Additionally, the ledger is secured by cryptography, with new transactions signed and hashed into the ledger.

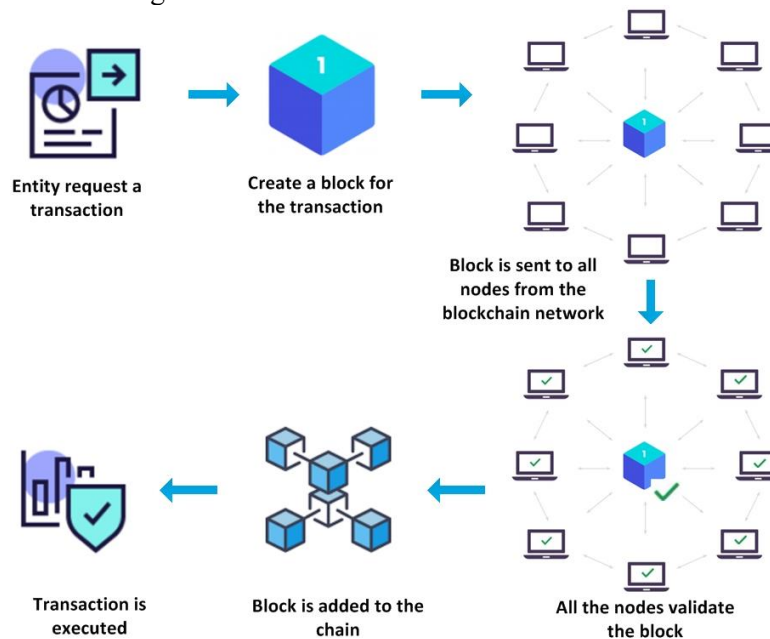


Figure 1. The blockchain technology.

Nodes of the network will execute computations and solve complex problems in order to verify a newly added transaction. Once the nodes have all verified the transaction the node that solves the problem first creates a block of transactions and generates a block header (see figure 1). This header contains a block identifier, a block height and a transaction list (consisting of hashes of the new transaction and hashes of the old transactions). Another node of the network compares this block header with their own block headers and verifies that the contents are the same. When the contents of a block header are verified by all the nodes, then the block is a valid block and will be added to the list of all the blocks.

3. Blockchain for the automotive industry: use cases

The following subsections present the different types of use cases (see figure 2).

3.1. Autonomous vehicles

Several studies target the use of blockchain technology in autonomous vehicles (AVs). One of the first approaches was related to simply storing data parameters of the current state that are received either directly from the car’s operating system or from neighbouring vehicles [7]. Moving on, the proof of liability in the case of unforeseen events (accidents) was another idea explored by the research community. The problem that resides here is who is to blame in case of an accident, since the control is entirely autonomous. In [8], the authors propose a framework that can be used by stakeholders (car owners, insurance companies, automotive manufacturers) to solve this issue. Forensic data storage is also explored in [9], where authors use the Hyperledger Fabric network to prove such a system is feasible. Security problems of AVs are a concern of several studies.

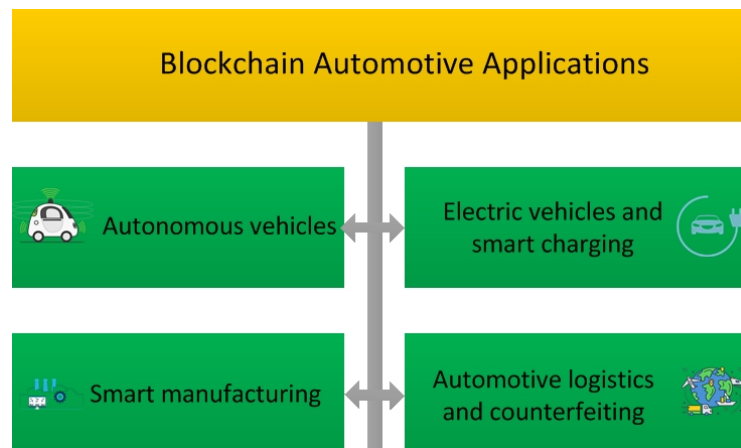


Figure 2. Automotive applications in which the blockchain was experimented.

Researchers try to capitalize on the benefits of the blockchain (immovability, transparency, decentralization and consensus) for solving attacks such as denial-of-service, GPS spoofing, timing or man-in-the-middle [10]. Mitigating security and privacy issues with blockchain is already an effervescent field of study, with experts focusing on data control, trackability, accountability, fault tolerance and scalability, to name just a few areas of research [11]. Refuelling is another use case on the list. According to the EU, all new vehicles, including the future AVs, will be electric starting with 2035 [12]. That means that refuelling with electricity should also suffer major improvements, to cope with the increasing consumer numbers. Authors from [13] use Ethereum Virtual Machine based smart contracts to organize this activity. The firmware update paradigm is another sensitive area that can use blockchain to increase its resilience [14]. Other blockchain uses refer to the management of the AVs traffic. Imagine a scenario within a crowded city. Based on a simple smart contract that is implemented on a blockchain that supports fast and inexpensive micro-transactions, some vehicles could allow others to automatically move faster, depending on a fee-based algorithm.

3.2. Electric vehicles

Today, Electric Vehicles (EVs) have sparked a lot of interest owing to improvements in battery life and reduced emissions, but there are still some challenges related to their market penetration, of which the most important is related to the charging process [15]. Due to the limited quantity of charging stations, there are issues with home charging as well as public charging. Drivers of electric vehicles must also be informed and find out where charging facilities are located in public areas. This lack of charging infrastructure which causes range anxiety [16], can be prevented by using blockchain-based applications, which allow drivers to share their private chargers with others. Such an example is presented in [17], a peer-to-peer (P2P) framework for private charging pile sharing systems. Another implementation of a smart charging system based on blockchain is proposed in [18], with the aim to reduce load congestion of the electric power distribution grid. In addition, the benefits of blockchain technology include real-time payments using cryptocurrencies and increased security [19]. As shown in [20], blockchain technology could also motivate EV users to share their energy surplus with others, improve the availability of clean energy, and reduce range anxiety. Among other opportunities offered by technology in the field of Evs, are: enhanced security of energy trading, online monitoring of EVs, managing the charging infrastructure, developing the concept of the internet of EVs, promoting the role of shared energy [21, 22].

3.3. Smart manufacturing

The new production methods and processes that are needed to manufacture the next generation of vehicles will be based on the integration of Industry 4.0 smart concepts [23, 24]. One of the difficulties

of smart manufacturing is the increased number of interactions between manufacturing entities. The blockchain technology can be used to streamline the smart manufacturing process of vehicles by improving the integration of shared systems and components maintained by different companies and organizations. In this context, the blockchain technology allows improvement of security, traceability and immutability of smart manufacturing shared data [25, 27, 29].

The possibilities for blockchain as a manufacturing service are multiple. An example of a middleware solution that implements blockchain features for smart manufacturing is Man4Ware [25]. The blockchain services implemented in this platform allows improvement of security, traceability and immutability of smart manufacturing shared data. Another blockchain-based conceptual framework design for a smart manufacturing system is presented in [28]. The framework relies on the blockchain to facilitate device data transmission and manufacturing services. In [26] blockchain services are used for quality assurance by providing more transparent and secure data related to material provenance and production equipment management. Another example is presented in [30], a platform that uses the Internet of things (IoT), Machine Learning (ML) and the blockchain technology for monitoring the manufacturing system. The blockchain technology allows preventing fake data and improving the security of data transmission and costs. The proposed system was evaluated for automotive manufacturing in South Korea.

3.4. Counterfeiting prevention

The automotive industry is estimated to expand by 8%-10% in 2021, making it a key component in any nation's economy [40]. Therefore, there is an increased need for automotive manufacturers to improve their protection against supply chain counterfeiting and to raise their security standards against malicious attacks [31]. A possible solution to mitigate counterfeiting is to use permissioned blockchains such as Hyperledger Fabric by means of a distributed consensus algorithm [32].

3.5. Automotive logistics

The automotive sector is under pressure to rapidly innovate and release products that are competitive, environmentally friendly and have a reasonable price. Therefore, one important issue is resolving the complexity of supply chains and logistics [33]. Blockchains and other disruptive technologies such as IoT, Big Data and AI have a high potential of transforming supply chains and logistics by 2023 [34]. For example, tracking tools and blockchain coupled with smart contracts can facilitate payments to suppliers once goods were successfully delivered to their destination.

A proper integration of blockchain technology (BT) with other cutting-edge technologies (cloud computing, IoT, big data analytics, cybersecurity) can build trustworthiness, transparency, immutability and reliability in a supply chain network [35]. A blockchain-based logistics monitoring system was proposed, programmed and tested on Ethereum and its main scope was to allow parcel tracking [36]. Another study focused on resolving traceability issues and proposed TokenTrail, a decentralized blockchain application based on the semi-fungible ERC 1155 token [37]. Smart contracts can be used to create a network of hyperconnected logistics by leveraging blockchain and IoT [38]. Vehicle tracking and freight management could also be significantly improved by the use of BT, although a high-scale deployment is far from reality [39].

4. Conclusion

The blockchain can provide to the automotive industry services which can have a significant impact on a large number of different aspects, from the mobility of vehicles to the manufacturing and maintenance of them. Blockchain has already shown potential on improving autonomous, electric or shared vehicles through decentralized apps. Based on the presented use cases, it can be concluded that blockchain represents the future of the vehicles. It will improve the driving experiences, safety and even the possibility of sharing information between entities.

5. Acknowledgments

This work was supported by a grant of the Romanian Ministry of Research, Innovation and Digitization, CNCS/CCCDI – UEFISCDI, project number PN-III-P2-2.1-PED-2019-4366 within PNCDI III (431PED).

References

- [1] Fraga-Lamas P and Fernández-Caramés T M 2019 A review on blockchain technologies for an advanced and cyber-resilient automotive industry IEEE access 7 17578
- [2] Putting blockchains on the road, Volkswagen, <https://www.volkswagenag.com/en/news/stories/2018/08/putting-blockchains-on-the-road.html#>, Last accessed 14.07.2021
- [3] How blockchain automotive solutions can help drivers, BMW, <https://www.bmw.com/en/innovation/blockchain-automotive.html>, Last accessed 14.07.2021
- [4] Blockchain: the key technology of tomorrow, Porsche, <https://newsroom.porsche.com/en/company/porsche-blockchain-technology-opportunities-digitization-16800.html>, Last accessed 14.07.2021
- [5] Once round the block, please! Daimler, <https://www.daimler.com/innovation/blockchain-2.html>, Last accessed 14.07.2021
- [6] The blockchain, transformation vector for the future of the automotive industry, Renault, <https://www.renaultgroup.com/en/news-on-air/news/the-blockchain-transformation-vector-for-the-future-of-the-automotive-industry/>, Last accessed 14.07.2021
- [7] Narbayeva S, Bakibayev T, Abeshev K, Makarova I, Shubenkova K and Pashkevich A 2020 Blockchain technology on the way of autonomous vehicles development *Transportation Research Procedia* **44** 168
- [8] Oham C, Kanhere S S, Jurdak R and Jha, S 2018 A blockchain based liability attribution framework for autonomous vehicles arXiv preprint arXiv:180205050
- [9] Guo H, Li W, Nejad M and Shen C C 2020 Proof-of-event recording system for autonomous vehicles: A blockchain-based solution IEEE Access, 8, 182776
- [10] Gupta R, Kumari A and Tanwar S 2021 A taxonomy of blockchain envisioned edge-as-a-connected autonomous vehicles *Trans. on Emerging Telecommunications Technologies* **32**(6) e4009
- [11] Gupta R, Tanwar S, Kumar N and Tyagi S 2020 Blockchain-based security attack resilience schemes for autonomous vehicles in industry 4.0: A systematic review *Computers and Electrical Engineering* **86** 106717
- [12] EU to Urge 2035 Goal to End Combustion-Engine Era in Autos, Bloomberg <https://www.bloomberg.com/news/articles/2021-07-09/europe-to-propose-end-of-combustion-engine-era-in-green-overhaul>, Last accessed 14072021
- [13] Pedrosa A R and Pau G 2018 ChargeltUp: On blockchain-based technologies for autonomous vehicles *Proc. of the 1st Workshop on Cryptocurrencies and Blockchains for Distributed Systems* p 87
- [14] Baza M, Nabil M, Lasla N, Fidan K, Mahmoud M and Abdallah M 2019 Blockchain-based firmware update scheme tailored for autonomous vehicles *Conf. IEEE Wireless Communications and Networking 2019* p1
- [15] Florea B C, Taralunga D D 2020 Blockchain IoT for Smart Electric Vehicles Battery Management *Sustainability* **12**
- [16] Pevec D, Babic J, Carvalho A, Ghiassi-Farrokhfal Y, Ketter W and Podobnik V 2019 Electric Vehicle Range Anxiety: An Obstacle for the Personal Transportation (R)evolution? *4th Int. Conf. on Smart and Sustainable Tech. 1*
- [17] Fu Z, Dong P, Li S, Ju Y and Liu H 2021 How blockchain renovate the electric vehicle charging services in the urban area? A case study of Shanghai China *J. of Cleaner Production* **315** 128-172
- [18] Okwuibe G C, Li Z, Brenner T and Langniss O 2020 A Blockchain Based Electric Vehicle Smart Charging System with Flexibility *IFAC-PapersOnLine* **53**(2) 13557

- [19] Foti M, Vavalis M 2021 What blockchain can do for power grids? *Blockchain: Research and Applications Res. and Apps.* **2**(1) 100008
- [20] Lasla N, Al-Ammari M, Abdallah M and Younis M 2020 Blockchain Based Trading Platform for Electric Vehicle Charging in Smart Cities *IEEE Open J. of Intellig Transp Systems* **1** 80
- [21] Hasankhani A, Hakimi S M, Bisheh-Niasar M, Shafie-khah M and Asadolahi 2021 Blockchain technology in the future smart grids: A comprehensive review and frameworks *Int. J. of Electrical Power and Energy Systems* **129** 106811
- [22] Wang Q, Li R, Zhan L 2021 Blockchain technology in the energy sector: From basic research to real world applications *Computer Science Review* **39** 100362
- [23] Jadoon G, Ud Din I, Almogren A and Almajed H 2020 Smart and agile manufacturing framework, a case study for automotive industry *Energies* **13**(21) 5766
- [24] Alptekin B, Tunaboylu B, Zaim S and Perlo P 2020 Smart Manufacturing of Electric Vehicles *The International Symp. for Production Research* p767
- [25] Mohamed, N and Al-Jaroodi J 2019 Applying blockchain in industry 4.0 applications Conf. IEEE 9th annual computing 2019 p 0852
- [26] Zhang Y, Xu X, Liu A, Lu Q, Xu L and Tao F 2019 Blockchain-based trust mechanism for IoT-based smart manufacturing system *IEEE Trans. on Comp. Social Sys.* **6**(6) 1386-1394
- [27] Leng J, Ye S, Zhou M, Zhao J L, Liu Q, Guo, W and Fu L 2020 Blockchain-secured smart manufacturing in industry 4.0: A survey *IEEE Trans. on Sys, Man and Cybernetics: Systems* **51**(1), 237
- [28] Lee C K, Huo Y Z, Zhang S Z and Ng K K H 2020 Design of a smart manufacturing system with the application of multi-access edge computing and blockchain technology *IEEE Access* **8** 28659
- [29] Zuo Y 2020 Making smart manufacturing smarter—a survey on blockchain technology in Industry 4.0 *Enterprise Information Systems* **1** 31
- [30] Shahbazi Z and Byun Y C 2021 Smart Manufacturing Real-Time Analysis Based on Blockchain and Machine Learning Approaches *Applied Sciences* **11**(8), 3535.
- [31] Oham C, Michelin R A, Jurdak R, Kanhere S S and Jha S 2021 B-FERL: Blockchain based framework for securing smart vehicles *Information Proc. and Management*, **58**(1) 102426
- [32] Lu D, Moreno-Sanchez P, Zeryihun A, Bajpayi S, Yin S, Feldman K and Kate A 2019 Reducing automotive counterfeiting using blockchain: benefits and challenges *IEEE Int. Conf. on Decentralized Applications and Infrastructures (DAPPCON)* 39
- [33] Viriyasitavat W, Da Xu L, Bi Z, and Sapsomboon A 2020 Blockchain-based business process management (BPM) framework for service composition in industry 4.0 *J. of Intellig. Manufacturing* **31**(7) 1737
- [34] Pournader M, Shi Y, Seuring S and Koh S L 2020 Blockchain applications in supply chains, transport and logistics: a systematic review of the literature *Int. Journal of Production Res.* **58**(7) 2063
- [35] Kamble S S, Gunasekaran A, Subramanian N, Ghadge A, Belhadi A and Venkatesh M 2021 Blockchain technology's impact on supply chain integration and sustainable supply chain performance: evidence from the automotive industry *Annals of Operations Res.* 1
- [36] Helo P and Hao Y 2019 Blockchains in operations and supply chains: A model and reference implementation *Computers and Industrial Engineering* **136** 242
- [37] Kuhn M, Funk F, Zhang G and Franke J 2021 Blockchain-based application for the traceability of complex assembly structures *J. of Manuf. Sys.* **59** 617
- [38] Betti Q, Khoury R, Hallé S and Montreuil B 2019 Improving hyperconnected logistics with blockchains and smart contracts *IT Prof* **21**(4) 25
- [39] Kamble S, Gunasekaran A and Arha H 2018 Understanding the Blockchain technology adoption in supply chains-Indian context *Int. J. of Production Res.* **57**(7) 2009
- [40] Global auto sales forecast, S&P, <https://www.spglobal.com/ratings/en/research/articles/210511-global-auto-sales-forecasts-the-recovery-gears-up-11952032>, Last accessed 14.07.2021