



Corresponding authors:

Prof. Dr. Hans-Georg Schweiger: hans-georg.schweiger@thi.de

ABSTRACT

There is worldwide interest in digitizing the battery supply chain. The supply chain is complex and is made up of many actors who have contrasting interests.

Batteries, their components and their raw material come from different parts of the world, different companies and have different types of operating conditions and therefore have different life estimates. Transparency and traceability prevent clandestine markets, brand damage, battery usage outside technical specifications and pollutant emissions.

Logging data on a blockchain-based platform allows new applications to be applications focused on business models such as battery swapping. Blockchain technology also enables the creation of digital twins and battery simulation (failure prediction, reverse design, root cause identification of problems, etc.).

Blockchain technology also allows the implementation of public policies based on the reward and punishment mechanism in which companies that meet quality and greenhouse gas emission targets are rewarded and companies that do not meet these targets are punished.

Another module of the platform is that with the data entered in this platform, it is possible for a machine learning model to consume this data in order to indicate the best way to obtain tax incentives, the best tax liability practices, how to obtain value through correct use benefits, such as having correct tax planning, etc.

The platform is able to indicate the best tax regime or the main ways to obtain tax incentives. Companies have a security of their data, so they can share their data securely and transparently with network participants. Various business models can be implemented with this platform which is flexible and adaptable to different contexts.

BRIEF EXPLANATION OF THE SYSTEM OPERATION

Figure 01 shows a brief explanation of how the blockchain-based platform could work in a practical situation.

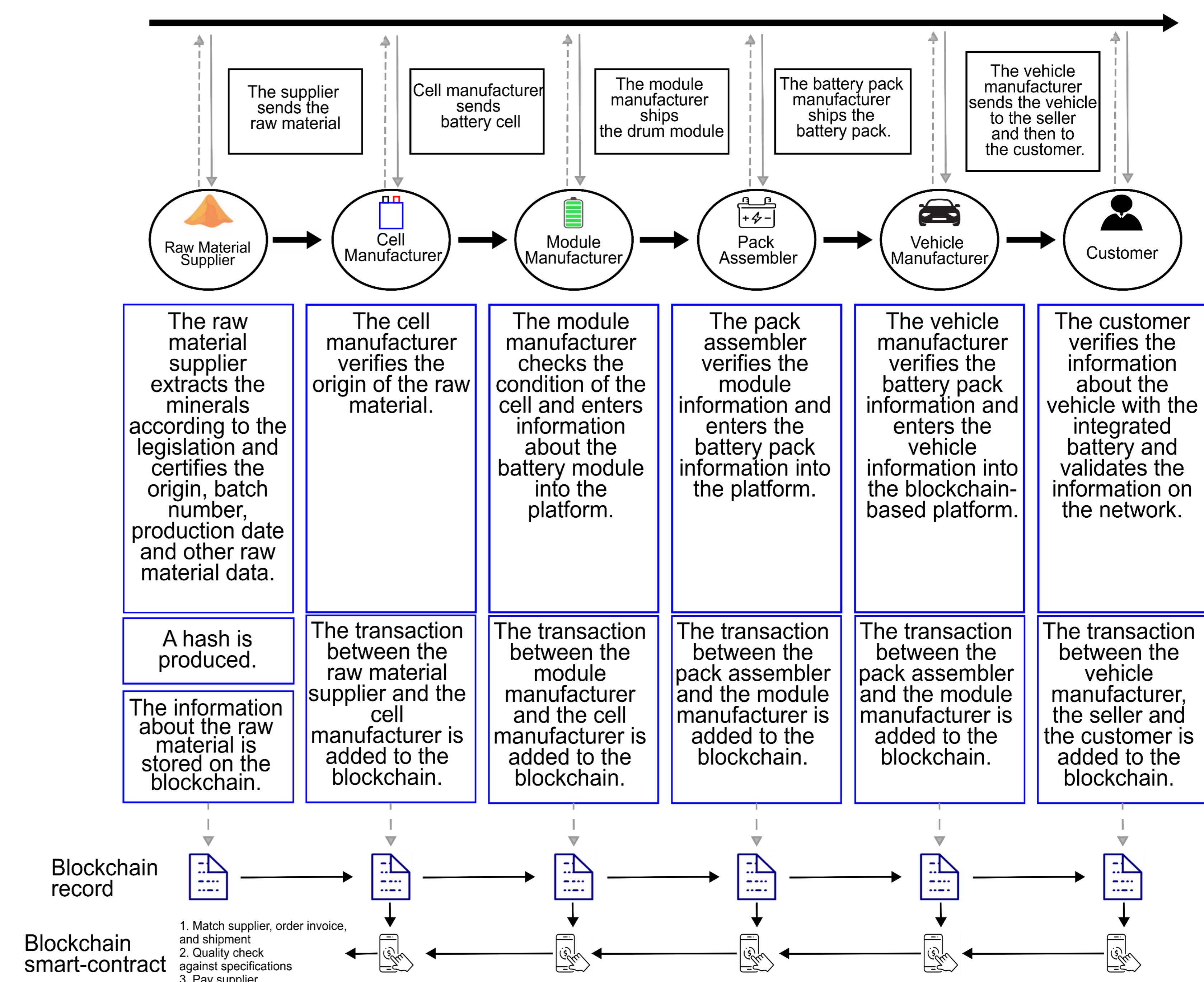


Figure 01: Brief explanation of the system operation in the practical situation.

SYSTEM OVERVIEW

The developed blockchain-based platform aims to collect and analyze battery information at all stages of your supply chain. In this way, it will be possible to track and send error messages to users of applications where batteries are inserted.

Several types of information services (please see Figure 02) can be offered, such as: battery maintenance documentation, predictive maintenance, alert history, battery performance information (capacity, internal resistance, power, state of charge, health status, etc.), certification based on tests performed on the battery, information about the second use, recycling, life cycle analysis, taxes and incentive mechanisms, quality, among others.

The use of blockchain technology for the second life of batteries can be important to resolve conflicts of interest, especially in situations that are not clear in the rules and legislation. Despite the desire to avoid them, these situations are common in the battery sector, for example:

- In scenarios where a company exports a battery to another country, new tests are often required for battery validation and certification.
- Situations in which the owner, user and manufacturer of the battery are not defined in the literature. And therefore, it is unclear who is responsible for the second use and recycling.
- Situations in which it is necessary to inhibit battery tampering, tax evasion, corruption, among others.
- Situations in which it is necessary to reduce uncertainties regarding the availability of raw materials, reduce waste and ensure a circular supply chain.

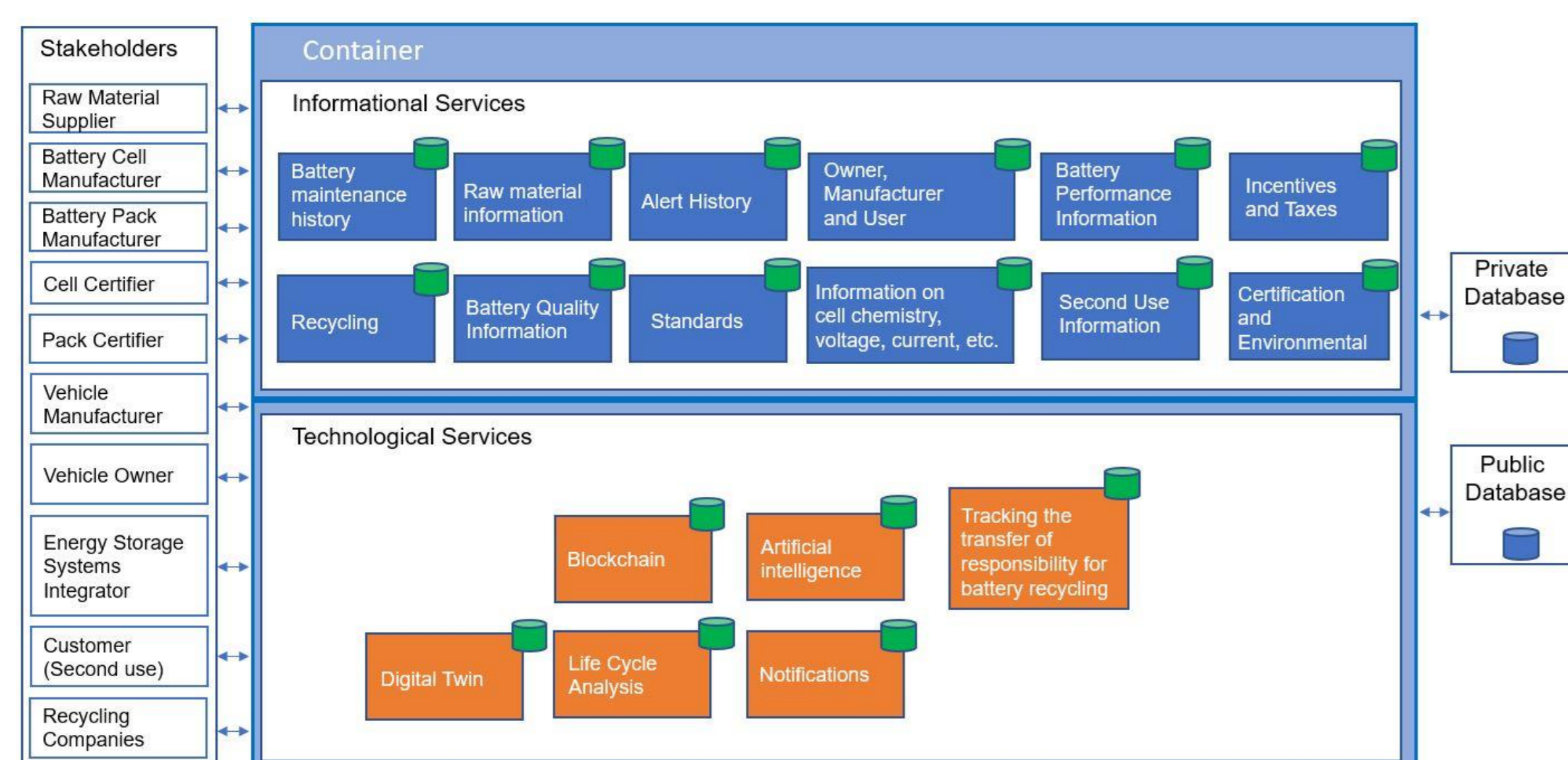


Figure 02: System overview.

CONCLUSIONS

- Blockchain technology will increase security, transparency and guarantee confidentiality and intellectual protection of data. In this way, it will be possible to reduce several scenarios in which there are conflicts of interest.
- Blockchain technology will allow you to track battery alerts and errors in real time.
- The blockchain-based platform will reduce or avoid the need for battery replacement.
- Data stored on the blockchain-based platform can be used to avoid expensive and time-consuming battery testing.
- Blockchain technology fits very well in the supply chain where it is necessary to share different information with different actors securely.
- Avoiding battery tampering, tax evasion and environmental impacts is a benefit that can be achieved with this platform.

ACKNOWLEDGEMENT

Authors would like to thank financial National Council for Scientific and Technological Development (CNPq, Brazil) (159332/2019-2, 301486/2016-6), São Paulo State Research Support Foundation (FAPESP, Brazil) (2014/02163-7, 2017/11958-1, 2018/20756-6) and also Shell oil company through Brazil's National Oil, Natural Gas and Biofuels Agency (ANP, Brazil) funded part of this research. The authors would also like to thank the BloRin Project – “Blockchain for renewables decentralized management”, PO FESR Sicilia 2014/2020 – n.08PA711210063 - Action 1.1.5 – identification code: SI_1_23074 n. CUP: G79J18000680007 for all the support given to the authors. The authors would also like to thank the PRIMA Batteries Project – “Predictive Industrial Maintenance Agent for Batteries” – identification code: DIK-2107-0007//DIK0384/02 for all the support given to the authors.