Automotive Supply Chain Visibility

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Introduction

The Prasaga eXtensible Block Object Model (XBOM) enables supply chains to build a digitised line of communication and object-oriented data sharing mechanism between vendors and suppliers. By creating an auditable and immutable chain of proof and certification which not only reduces risk in the final product, it allows for a more open and accessible value chain.

In the world of automotive manufacturing, where the final product has sincere safety implications for the user, this burden of proof falls largely to the Original Equipment Manufacturer (OEM). This task is further complicated by consumerism and the desire to offer almost infinite optionality on the final product.

To date there are limited and insufficient ways to track all of these configurations, making it almost impossible when you want a picture or historical audit trail throughout the whole supply chain. It is this complexity that eXtensible Block Object Model (XBOM) on Blockchain is providing a solution to.

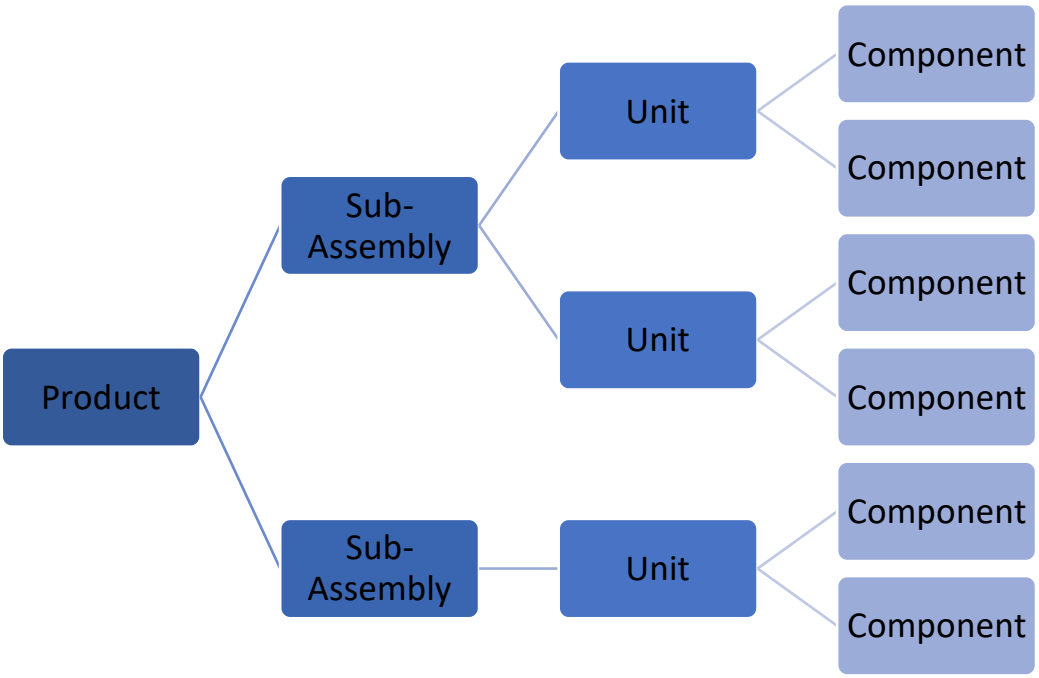
An Automotive Hierarchy & Optionality

In the automotive industry, the OEMs are understandably always the primary company responsible for the overall safety of the vehicles they produce. This however, is the tip of a hierarchy of responsibility that proliferates throughout their supply chain.

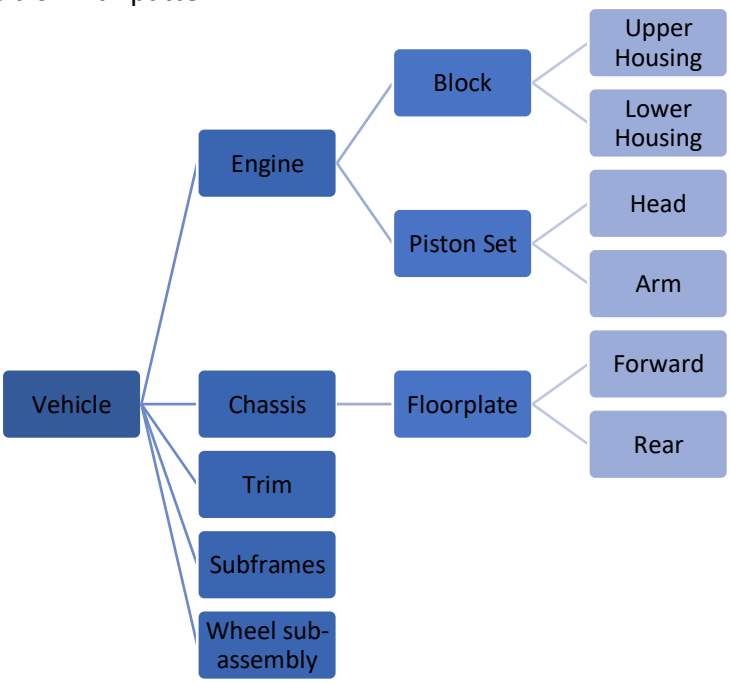
Some items in the Bill of Materials (BoM) such as the safety related items such as airbags, are individually serialised and tracked in multiple systems accordingly, including certificates of conformity/ sign-off, etc. Other items however are less obvious, yet still require the OEM to take on the final responsibility for the end product. This can include the sheet metals used to fabricate the panels and crush zones, the rolled or extruded metals used to construct roll cages, chassis and safety frames. These latter items are not serialised, yet contribute to the safety of the passengers of the vehicle and require the OEM to know sufficient details about each, in order to sign off the vehicle as road worthy.

Complicating that process further is the fact that customers want flexibility and choice in their end vehicle. All of which mean multiple potential parts and configurations for a single vehicle line; in some extreme cases can amount to hundreds or thousands of configurable options.

A typical product has a fairly generic hierarchy:



A vehicle follows a similar pattern:



These appears outwardly simple to manage, a structured relational datastore building out this hierarchy would solve it. However, optionality must be overlaid into the picture.

For each vehicle, sub-assembly, etc., there are one or more options a customer can choose from. Some options are mutually exclusive; others can be combined into the final specification of the vehicle the customer desires. Onto this overlay the supply chain picture. Now for each option, there may be one or more suppliers (especially for in-demand options, complicated options, safety related features, etc.) to ensure the supply base can cope with anticipated vehicle build demand.

Every part that goes onto a vehicle has a design specification. Depending on the part, the tolerances can be really wide open (i.e. no safety impact, purely decorative, things that have little impact on the end vehicle appeal) or they can be super tight. These tolerances and design specifications are passed, and indeed competed, to the supply chain such that the resulting chain has a collection of best priced, within tolerance components that allow the vehicle to be profitable. During vehicle build, QA evidence must be collated together in order to form the per vehicle audit trail that ensures its certificate of conformity/QA, etc. before it will be allowed to drive on public infrastructure.

The more difficult aspects to track are where the items are delivered in a more 'raw' state to the OEM. Consider the coils of rolled steel for cutting into blanks and then pressed into forms that are the panels of the vehicle, or the rolled or extruded metals used for the safety chassis and underframe of the vehicle. None of these parts are serialised; they are bulk/ batch items delivered usually from multiple suppliers all of which 'meet' the tolerances and specification laid down by the OEM. Even though every coil of steel, every extruded bar of aluminium, whilst having been created using the same defined process with QA checks along the way, will have pure metallurgical properties of the material based upon where it was mined from will impact the characteristics of the finished product. These differences, when present in the pressing process, may be enough to cause hidden faults or weaknesses in the final products, which in turn leads to risks and liabilities for the OEMs.

How These Problems are Solved Today

By and large, the above supply chain and audit accountability is a very long paper trail. Some of which is digitised through the advent of Enterprise Resource Planning (ERP) solutions and Manufacturing Execution Systems (MES). The first of which has knowledge of the hierarchy and in the latter, the collated audit reports of testing throughout the build process. In some cases, there are QA systems which provide a focal point for the data but in many cases that is not present, instead relying upon standard data stores for PDFs, scans of build reports, faxes of certificates, etc.

All of the above require massive infrastructural and people investment which in turn results in delays to certifications (mislaid paperwork chief amongst the culprits) or huge cost additions to vehicle programs. In order to minimise this outlay, OEMs will typically take the shortest path to compliance This will mean QA tests run on the production line will store minimal data necessary and only the main KPIs are stored along with pass/fail indication. For the supply chain, typically this works via site wide ISO manufacturing certificates, which therefore have independently shown they can manufacture using their processes to the

appropriate standard. In the event of any issues the OEMs have a contract which rests liability at the supplier's door.

This is the way it has always been done and, left unchecked and unchallenged, the way it will continue for the foreseeable future. However, this multi-dimensional model of almost infinite variety and conditions, coupled with the increasing complexity of vehicles, will ensure that in the near future this method of compliance will fail and will be unmanageable.

A Modern Solution to an Industrial Scale Issue

Most if not all of the issues identified above can be solved through the studious deployment of appropriate technology. If the entire supply chain is enabled with a mechanism that allows for the creation and collection of mini-hierarchies of auditable test data, digitally signed with unique identifiers that are collated branch by branch into the product level model, options and all, then all of the audit trail is automatically created, always available and irrefutably integral.

Suppliers in the chain, much as any organisation in the internet world, can be provided with digital certificates and credentials, verifiable by any independent party and globally recognised. As they produce whatever part of the product hierarchy they are responsible for, the end output is attached to this certificate and result data. All of which can be done by machines (and therefore subject to far fewer errors than human input). The OEM is thus provided with digital content, as part of their digital supply chain backhaul just as they would be delivered the finished articles.

Certification will provide smarter means for comparing suppliers at contract award time, as their credentials cannot be falsified. This reduces the overall risk in the supply chain, thus reducing costs.

The entire supply chain will run leaner, faster, and smarter, thus reducing costs of manufacture.

This will allow for more competition where smaller suppliers with the correct and independently verified credentials can bid for contracts which until now may have been unreachable because of their scale, or connections. This enables a truly global competitive market.

The solution above is enabled by XBOM on Blockchain.

The eXtensible Block Object Model enables anyone in the supply chain to digitally characterise their product hierarchy, quality criteria and test results into a single collection of immutable, digital objects, which reside on a global Blockchain. The model will accurately and unequivocally define the ancestry and inheritance of each component in the vehicle.

Every account on the Blockchain holds a valid and verifiable digital certificate for the items they produce allowing for immutable and autonomous audits to be performed.

All of this operates currently on the Hyper-Ledger Fabric, '*the'* supply chain backhaul for the digital era, enabling a smart and connected set of suppliers and consumers, globally, in a standardised model of connectivity that today is near impossible.