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PLM ESSENTIALS

8. CONFIGURATION MANAGEMENT

QR_

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8 CONFIGURATION MANAGEMENT

At the heart of all complex engineering and associated manufacturing processes is Product Data Management (PDM) - the business function that organises, maintains and reports all product data.

PLM captures and tracks information on the individual parts, components and modules that constitute a finished product throughout its lifecycle, including changes made during development.

This includes part numbers, supplier details, CAD drawings and more, with everything stored in databases easily accessible to the likes of project managers, engineers, salespeople, purchasing and QA teams.

Efficient management of product data enables faster product development, getting them to market more quickly while also driving down costs.

CONFIGURATION MANAGEMENT

MONITORING EVERY PART MODIFICATION

With the ability to customise almost every aspect of their new car – from the model, colour and engine size down to the tiniest details of the interior trim – customers have never had so much choice.

But with choice, comes complexity, and the need for automotive manufacturers to manage every feasible variant and combination in the background. They do this with robust Configuration Management.

To show you how this works, we've put together a detailed case study of a Configuration Management setup we recommended for a leading London-based electric vehicle manufacturer.

WHAT IS CONFIGURATION MANAGEMENT?

A configuration is the arrangement of a product's parts in a particular form, figure, or combination.

Automotive customers expect modern Original Equipment Manufacturers (OEMs) to offer multiple variants and customisation of their products, so the selection and arrangement of parts that make up a vehicle must be carefully managed.

Without some form of Configuration Management, a separate structure would be needed for each and every variant. Configuration Management allows you to capture the complexities of each variant, either with different structures for each variant or a smaller number of configurable structures.

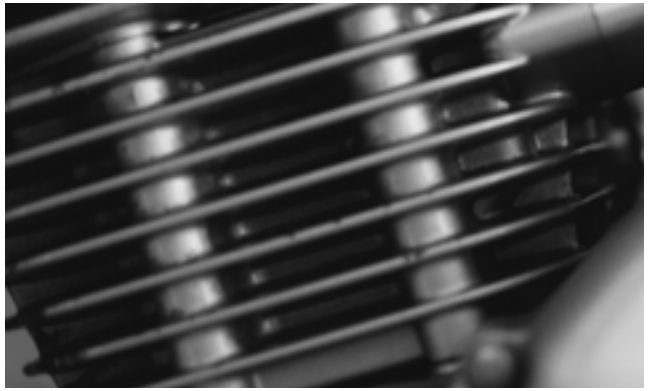
Structuring multiple variants is time consuming, admin intensive and can lead to mistakes if all variants aren't updated correctly. But this is conceptually the simplest solution.

Configuration can theoretically reduce part duplication in the Bill of Materials (BOM) to zero, allowing multiple variants or even models to be managed from the same BOM, but with much more complexity.

WHO USES CONFIGURATION MANAGEMENT?

Any function that needs information about a particular variant will be impacted in some way by Configuration Management. The choice of process will impact the workload and needs for each of these functions:

- **Engineering**
  Variants must be structured or configured.
  The difference will affect how CAD is displayed and the structures required for release
- **Styling and Marketing**
  The initial product definition must be defined, communicated and updated in line with the configuration strategy chosen
- **Purchasing / Finance**
  With a condensed BOM, options must be carefully selected to maintain a consistent and accurate view of vehicle cost
- **Supply Planning & ERP**
  Specific product configuration will be the main input into part demand forecasting



CONFIGURATION MANAGEMENT AT THE MANUFACTURER

There's no configuration management system or structure in place at the manufacturer.

INDUSTRY EXAMPLES

A LARGE MULTI-NATIONAL OEM – COMPLEX PRODUCT

For some of the largest OEMs who are designing, procuring, manufacturing and distributing across multiple continents, the configuration of orderable variants needs to be extremely robust.

To capture the full range of complexity in BOM structure would be unmanageable, so separate systems are maintained, with teams allocated to maintain good communication and alignment.

Initially, Sales, Marketing, Business Analytics and Engineering - along with input from additional departments - feed into a team that develops the Product Definition Document.

This document captures all the options possible for a given product, along with all the related interdependencies. It's created both as a system object and as a physical, readable object.

The system object is used to apply rules to incoming orders. One typical example is that OEMs in the UK must demonstrate they have taken steps to make sure.

Tyre Pressure Monitoring System (TPMS) sensors are fitted to all vehicles. This system will make sure that a TPMS code is attached to the order.

The physical document is distributed to various PLM and integration teams who then begin the process of coding the BOM. In this particular OEM, 'Characteristics' or 'Feature Codes' are used as opposed to freely coding individual parts.

This requires the Programme Definition team to have set up and configured the list of available characteristic values or feature codes ahead of time – as well as defining all of the interdependencies between them – and simplifies the task of coding, as logic is built into the coding structure.

In essence, any two feature codes from the same 'feature family' have an implied 'OR' logic, whereas any two from separate families have an implied 'AND' logic.

Take parking assist as an example. This may be available as an option on T4 long and medium wheelbase, but not available on the short wheelbase. So, the feature coding, or characteristic values, would look something like:

T4, WB-LONG, WB-MED

As there are two codes from the same family (or characteristic) for wheelbase (WB-), an 'OR' is implied between the two, so this part is selected for any long or medium wheelbase.

There's also a code from a different family, which implies an 'AND'. This part is only available for vehicles that are long or medium wheelbased AND are T4 trucks.

Once a BOM item has been coded, this information is passed to another team who make sure that the CAD system is set up correctly.

In this example, the rear parking assist system will likely have the same parts across wheelbases, but the positioning will be different. The front assist system may well be in the same position.

As part of the CAD configuration, this team creates CAD instances of each set of positioning and assigns them the relevant coding. It's through this process that the BOM and CAD tree are linked.

Although lengthy and a little complex, this process allowed the OEM to maintain tight control over configuration management and have the minimum number of CAD instances as well as BOM items.

But the trade-off was the reliance on the Programme Definition team, the length of time needed to update a configuration, and the manual (and error-prone) translation of one BOM into another system.

A MEDIUM START-UP

In this example, there is a slight reduction in the configuration complexity at the expense of BOM complexity and duplication. This OEM structured each variant of each assembly for each positioning instance needed, giving the top-level node a descriptive name whilst keeping all the child content the same.

They also used the 'Feature Family' or 'Characteristic' based coding seen in the previous example, managed by a small in-house PLM team and configured by an external contractor.

CAD configuration was driven directly from the BOM, which meant changes were reflected in the CAD structure extremely quickly, and there was no intermediate process by which errors are introduced. But this meant that multiple releases must be carried out for what was the same content, just in different positions.

A SUPERCAR MANUFACTURER

Using a bespoke PLM system, this client could avoid duplication of work or any dual management of systems by enabling a small team of PLM specialists to handle all structuring and configuration on behalf of engineering.

Each BOM line could be given an arbitrary number of codes, and with each, a quantity. Each 'item' in that quantity then creates a CAD instance linked to that code – so there's no double structuring, and changes can be made in close to real-time.

The downside of this approach was the specialist skillset needed to run the PLM system and the communication effort needed between PLM and engineering.

'Feature Families' were not used here. Raw code must be entered instead, which gives flexibility but makes the task harder.

DECISION CRITERIA FOR SELECTING A CONFIGURATION MANAGEMENT SETUP

The configuration management strategy must:

- Be scalable
- Be intuitive
- Minimise duplication in all areas
- Minimise the need for specialised teams or knowledge
- Provide support for control model cost and weight reporting
- Minimise opportunity for error

THE CONFIGURATION MANAGEMENT SETUP WE DECIDED ON

Ultimately, the exact implementation of configuration management depends on the system deployed, so the preferred process must either be brought into line with system operation or make a modification to an 'off the shelf' system.

A 'characteristic' is a feature, option or quality belonging to a vehicle. Characteristic values must be mutually exclusive – so 'drive side' is a characteristic, as a vehicle cannot be both. The same goes for the engine being mounted, or the wheel style chosen.

Audio system and door style cannot be considered part of the same characteristic, as they're not mutually exclusive, so they must be considered separate. They can be configured using the characteristic values to be exclusive (i.e. a particular audio system matches a particular door style), but must still be considered separate characteristics of the vehicle.

The use of characteristics and characteristic values simplifies the task of coding the various assemblies in the BOM, allowing for more control globally.

By creating rules that govern the interaction of the various characteristics, it stops undesirable combination input in the BOM (for example, that a part is only selected when a vehicle is both RHD and LHD).

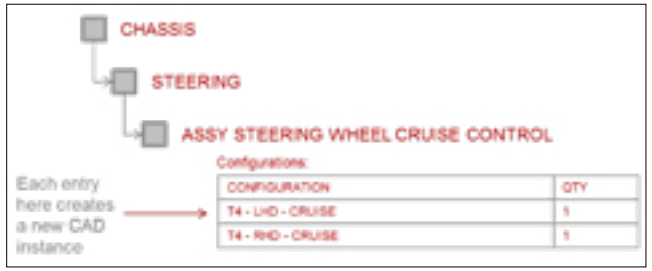
This simplification means that initial part configuration can easily be carried out by engineering when creating new parts, so a specialist or outsourced team is not needed.

Ultimately, both CAD and the BOM must be configured to track BOM and vehicle attributes (such as cost and weight) against orderable (or buildable) configurations, while also engineering these buildable combinations.

The configuration of each also needs to be aligned, with the potential for error being drastically reduced if the configuration is taken from a single, master source.

We would highly recommend that the manufacturer finds a way to allow the configuration coding to be placed not against a BOM item, but against CAD instances attached to those BOM lines.

This means buildable combinations viewed in CAD will reflect those tracked in the BOM, but also that repeat BOM structures are not needed.



It is also important to be able to add multiple rules within a single CAD instance, to avoid the need to position two sets of CAD in the same place.

For example, if a T3 project shared the same cabin and positioning as the T4, but came with cruise control as standard, the coding **T3 – T4 – LHD – CRUISE** would be invalid, as this would need the T3 to also have the CRUISE option (different Characteristics / Feature Families imply an AND).

So, the CAD instance would need to contain two sets of code, and the completed configuration table would look like this:

CONFIGURATION	QTY
T4 – LHD – CRUISE / T3 – LHD	1
T4 – RHD – CRUISE / T3 – RHD	1

JUSTIFICATION & EVIDENCE FOR THE NEW SETUP

Configuration coding is a complicated process, establishing and capturing all the logic needed to implement the variants of a product as defined in a product definition document or equivalent.

What we have witnessed in the industry, is that without the use of Characteristics or Feature Families, configuration coding quickly becomes inaccessible to all but a dedicated team, as the understanding and product knowledge needed to configure a BOM is large.

By using these structures, a smaller, dedicated team can create and maintain the Characteristics, their relationships and rules, and implement changes to product definition as defined by the business.

Engineering can then take care of coding their individual items without going through a lengthy process of communicating this to another team.

The maintenance of separate systems for managing BOM and CAD instances as we've seen in previous engagements has usually been driven by the existence of various legacy systems.

In almost all cases, the potential benefits of maintaining these separately are completely swamped by both the cost of maintaining a team of sufficient size to keep the two aligned, and the impact of the errors that inevitably result from misalignment.

That's why it's crucial that the BOM is the master and drives the CAD configuration from the code in the BOM. When we've seen this implemented in the past, most BOM errors are identified as they are also seen in CAD, along with issues with cost and weight control models.

RISKS OF THE NEW SETUP

As discussed previously, the choice of configuration management is a trade-off between structure simplicity and configuration simplicity.

The choice made here leans far more towards the structural simplicity side, so there's a risk that the configuration needed becomes more complex and could lead to errors.

We believe this to be a justified risk as the manufacturer isn't currently intending to offer configurable and complex optionality and leaning more heavily on configuration reduces the need for engineering support roles and minimises BOM structure complexity.

An additional risk to this decision is that the PLM software decided on may not support this manner of configuration management, and modifications may be expensive or unfeasible. The approach may need to be modified to align with system functionality.

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ABOUT QUICK RELEASE_

Quick Release_ is the leading Product Lifecycle Management consultancy. QR_ has 350+ professionals across three continents working alongside some of the largest, most innovative and prestigious vehicle manufacturers, aerospace technologists and Tier 1 suppliers.

Our mission is to enhance competitive advantage by bringing products to market faster and more efficiently. We do this by improving product data quality and flow through every part of a business from concept to manufacture, working with senior management teams to tackle the biggest blockers of productivity; we release engineers to focus on the product, not the data.

Leveraging bespoke tools, methodologies and benchmarking, our professionals offer the full spectrum of PLM services designed to guide start-ups through the unknown unknowns, take businesses looking to scale to the next level, and facilitate transformation in established manufacturing and technology OEMs. Read more: Why does PDM matter?

ALL CLEAR ON CONFIGURATION MANAGEMENT?

If you'd like to know more about the systems and processes we've covered here, or any other aspect of PLM, we'd love to hear from you.

QR_ have advised on and implemented configuration management for EV start-ups, specialist, volume, and commercial vehicle manufacturers.

Our SMEs would love to hear your configuration management headaches and explore quick, unobtrusive solutions that deliver lasting, whole-business value.

UK: Paul Crabtree | paul.crabtree@quickrelease.co.uk

US: George Creasy | george.creasy@quickreleaseinc.com

ES: Gemma Monje | gemma.monje@quickrelease.es

AUS: Patrick McDivitt | patrick.mcdivitt@quickrelease.com.au

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