INNOVATION THOUGHT LEADERSHIP SERIES: MASS CUSTOMIZATION
INNOVATION THOUGHT LEADERSHIP SERIES: MASS CUSTOMIZATION

Introduced by Simon Croom PhD, Professor: Supply Chain Management Institute, University of San Diego
Brown’s Lane, Coventry Assembly Plant - 1974
XJS – 1975 Development time, 12 years
XJ6/8 - 1994 Development time, 2.8 years
X Type – 2001 *Development time, 2.2 years*
Bridging the Product Configuration Gap

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University of San Diego
Introduction
Rationale for this Presentation

Consumers want the freedom to buy a car when, where and how they want and the flexibility to get the **personalised** car that they want.

Looking ahead five years from now, **how do you expect to shop for a vehicle?**

The use of product configurators has been highlighted as one of the more important IT enabled technologies to facilitate the realisation of **mass customisation**.

Jaguar Land Rover consider configuration technologies as a **key enabler** to the tailoring of our products to our customer needs.
Introduction

Rationale for this Presentation

Configuration gaps have emerged due to the proliferation of configuration capabilities across enterprise and specialist IT applications.

The challenge facing companies would appear to be the navigation of the myriad of applications and the avoidance of unnecessary duplication of configuration activities.

This presentation seeks to highlight the practical challenges of product configuration in an Assemble-to-Order environment.

This presentation proposes an integrated approach for the consolidation of configuration capabilities via the concept of Configuration Lifecycle Management.

The F-TYPE Coupe is Jaguar’s definitive sports car - the most dynamically capable, performance-focused sports car that Jaguar has ever produced.

F-TYPE COUPE
Price £51,250.00

NEW DISCOVERY SPORT
The most versatile compact SUV

BUILD ➔
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In 2013/14, Jaguar Land Rover sold 434,311 vehicles (up 16%) and almost 11,000 manufacturing jobs have been created in the last 3 years.

Almost 28,000 people are employed in the UK, rising to almost 30,000 globally, with a further 190,000 UK jobs supported in dealerships, suppliers and local businesses.

Jaguar Land Rover is one of the UK’s largest exporters by value (11bn in 2011/12 Fiscal year) and generates in the region of 85% of its revenue from exports.

In the 12 months to 31 March 2014, Jaguar Land Rover generated profit before tax of £2.5bn with revenues of £19.4bn.
Jaguar Land Rover
Investing in our Future

JLR is the largest UK automotive investor in R&D and will invest circa £3.5bn in its product and facilities in the financial year to March 2015.

JLR’s joint venture in China will start production in Q4 2014, with an annual capacity of 130,000 units. JLR is investing £240m in a new plant in Brazil to produce 24,000 vehicles annually.

Investing £1.5bn in an all-new aluminium vehicle architecture. First model being the new Jaguar XE premium sedan, creating 1,700 new jobs at Solihull.

A new £500m engine plant to produce advanced, aluminium engines. This investment will create almost 1,400 jobs plus 3,500 jobs in the supply chain.
Jaguar Land Rover
Investing in our Future

• The National Automotive Innovation Campus opens in 2016, doubling the size of the advanced research team to 500 based at the University of Warwick.

• JLR has entered into a new collaboration with Intel, opening a new Infotainment R&D centre in Portland, Oregon.

• 283 graduates joined JLR in September 2014, whilst over the last 4 years over 1200 graduates have been recruited.

• JLR are ranked 2nd in the Guardian Top Graduate Employers for Engineering, Design & Manufacture in the UK and ranked 16th overall in the Times Top 100 List of Graduate Employers.
Brand Expansion
Jaguar XE and Discovery Sport
Configuration Management
Building the Right Foundations

Product Platforms and Modularisation: Build the right product and process foundations. *Modularise to meet unique customer needs.*

Customer Centric Digital Strategy: Customers interact with technologies that help them to personalise their configuration journey and put the *virtual configurable vehicle* at the centre of the digital experience.

Configuration Technology: The use of new artificial intelligence technology to create the rules that define the *total range of product configurability.*
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What do we have in Common?
Investment in Configuration Technologies
Automotive Configuration Trends
Personalise the Configuration Journey

“Cater to the quick dip check on price and colour, the petrol head who wants all the specs, the business shopper who needs to see the tax implications, the decision-maker who wants detailed information”

“Reflect my priorities”
Show me:
Ecology, Family, Outdoor Lifestyle, Connectivity, ...

“Fit my journeys”
Show me:
Commuting, Motorway use, Around town, Off road, ...

“Let me choose from the feature options”
Show me:
Model range, Exterior, Interior, Wheels, ...

“Meet my budget”
Show me:
Costs, Consumption, CO2, Emissions, Power Output, Benefit in Kind, ...

*Capgemini: Cars Online 2014
Configuration Management
What is Product Configuration?

- At the simplest level product configuration is an interactive process in the selling of a vehicle whereby a customer chooses an option, which is then validated via a configuration engine before allowing the customer to make the next choice about the remaining options to be configured.
- The apparent simplicity of this process hides a significant amount of complexity to construct and validate the rules used to drive the configuration process over the entire product lifecycle.

Define Configurations
Validate Configurations
Sell Configurations

Product configuration is an essential part of Product Lifecycle Management
Jaguar Land Rover
Strategic Configuration Objectives

JLR Business Principles
- Growing premium manufacturer in a global market.
- The need to maximise the return on each order.
- A batch of one concept for ordering and manufacture.
- High product variety through bespoke products for individual customers.
- A pull mentality – retail focus.
- Responsive to customer and market demands.

Strategic Configuration Objectives
- A consistent approach to configuration for all departments, functions, products, and users.
- Avoid failure to comply with legal-market specific regulations.
- Enable consistent validation, pricing, and output across all functions.
- Less time and effort required to maintain configuration rules and product data.
- Reduced IT support burden.
- Faster response to new or changing market needs.

Strategic Benefits
- Increased sales effectiveness.
- Improved customer satisfaction.
- Fewer product errors.
- Faster time to market for new products and features.
- Reduced time and cost across multiple functions.
- Greater competitive advantage in a dynamic market place.
A product model is developed which consists of a set of parameters called feature families, a set of possible values called features, and rules describing the dependencies among the features.

Technical Configuration of the Product
- Used to define the Bill of Material
- Used to cost products.
- Used to control complexity

Market Configuration of the Product
- Used to drive orders and schedules.
- Used to price products
- Used to predict sales and capacity.

Engineering Intent defines the rules used to control technical constraints of the product.

A single source of configuration data for the complete product lifecycle.

A modern car such as a Range Rover Sport has more than $5.8 \times 10^{10}$ buildable combinations, available in 170+ markets.

Configuration gap due to multiple sources of data
Buildable combinations are expressed as feature usage statements in the BOM.

Buildable combinations are controlled using technical features and rules: Homologation rules, engineering dependencies, restrictions and manufacturing limitations.

Orderable combinations use marketing features which do not over ride technical feature rules.

Marketing features: Derivative definitions, trim levels, options and packs tailored to market requirements.
Configuration Lifecycle Management

Types of Configurators

Sales Configurators (CRM)
Manufacturing Configurators (ERP)
Product Configurators (PLM)

Applications typically **optimise** configuration capabilities for a particular business function
Challenges:

- **Multiple sources** of configuration data.
- **Misaligned** definitions.
- **Lack of centralised** product definition and configuration data.
- **Inefficient** business processes.
Configuration Lifecycle Management
An Enterprise-wide Perspective

A single source of configuration truth from Programme Start to Job Last
Configuration Lifecycle Management
Core Functionality

1. The configuration application is the **single source of configuration** for the enterprise (both the engineering and marketing) through which all configuration rules are authored and validated.

2. The application is able to receive pricing information from an outside source and the configuration engine is able to determine the current product price simultaneously as a part of the configuration process.

3. The application is able to be integrated to an external visualisation technology to support visual configuration services such as through a 'build my car' configurator on a website or in a dealership.

4. The application provides **support for sales configuration** via a content management solution and can be integrated into a sales front-end.

5. The application provides **support for order generation** or can be integrated into an order processing back-end.

6. The configurator is able to **support guided selling** options whereby a customer can be walked through the selling process in a predetermined manner.

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1. Prime Authorship of all Configuration Rules
2. Support for Product Pricing
3. Support for Visualisation
4. Support for Sales Configuration
5. Support for Guided Selling
6. Support for Guided Selling
Configuration Technologies
Barriers to Adoption

Lack of Technology
• The difficulty of finding a solution that meets the varied configuration needs of a company

Lack of Resources
• The time and maintenance associated with the creation of product models and their rules across the multiple domains

Integration Complexity
• The complexity associated with managing and synchronising configuration master data across consuming applications such as PLM, ERP, and CRM
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Configuration Lifecycle Management
Comparison of Approaches

PLM

- Purpose: Supporting product knowledge management
- Approach: Project-based
- Time Cycles: Supports Time to Market
- Types of Constraints Authored: Technical constraints
- Configuration Space: Partially defined configuration space biased towards technical features

CLM

- Purpose: Supporting configuration lifecycle management
- Approach: Supports project-based and transactional view. One set of configuration master data
- Time Cycles: Supports both Time to Market and Time to Customer
- Types of Constraints Authored: Technical and commercial constraints coexist
- Configuration Space: Fully defined configuration space linking technical and commercial features

ERP

- Purpose: Supporting operational business requirements
- Approach: Transaction-based
- Time Cycles: Supports Time to Customer
- Types of Constraints Authored: Commercial constraints
- Configuration Space: Partially defined configuration space biased towards commercial features
Enterprise-wide View on Configuration
Develop

- Identification of the allowable legal and technical feature combinations used to scope the configuration space.
- Analysis of allowable configurations to determine take-rates, optional variety and the overall cost and profitability of the proposed product offering.
Enterprise-wide View on Configuration

- When bringing the products to the market, need to define **market specific rules** for 160+ markets.
- Market specific **brochure models**.
- Market defined **option packs** and trim levels.
- Market and channel specific **prices**.
- Language specific **texts**.
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ACE Application
Our Vision: A Systemic Approach

Define Product

Enhance Product Offering

Define Engineering Constraints

Model Marketing Constraints

Model Engineering Constraints

Define Marketing Constraints
ACE Application
Modelling Innovations

Rule Authoring Functionality
• Text Rules (including rule snippet editor)
• Tabular Rule Editor
• Feature Applicability (marketing view)
• Pack Rules Editor

Testing Functionality
• A Configurator
• Automated Testing Routines
• User Defined Tests
• Explain Why?

Feature Rule Visualisation
• Feature Trees
• Dependency Graphs
ACE

**Night Vision** added to the New F-Type

Video highlights how the **Night Vision** feature relates to other features and rules.
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Bridging the Configuration Gap
Making CLM a Reality

Product configuration applications continue to be implemented via a myriad of technical solutions.

Configuration data is increasingly distributed across multiple applications.

Consideration needs to be given to the concept of a master system of record for product definition logic and configuration via a CLM solution.
Configuration Lifecycle Management
Building upon the Foundations

The ability to associate **predicted market take** rates to features and **calculate part volumes** compounded from those take rates.

The ability to compare **feature commonality** or differences between products and product types.

The support for architectural analysis and cross carline analysis to **optimize commonality** and **complexity** targets.

The ability to **analyse parts usage** in BOMs based on what configurations are valid over time.
Future Research Opportunities
Breaking down the Silos

• On the whole research into this field is focused upon computer science, artificial intelligence and information modelling with limited research on issues of integration for businesses.

• Forza and Salvador (2007), Product Information Management for Mass Customization remains the key introductory text into the principles underpinning product configuration and back office integration.

• Walcher and Piller (2012), Customization 500 is a benchmarking study which compared 500 online configurators and provided guidance on improving the online customer experience.
Pairs of Non-decomposable Design and Production Activities

- Assumes no interaction with other components
- Allocation of design/production responsibilities needs to take into account issues of integration when activities are non-decomposable

Integrate activities

Information flows

Material flows

Product specifications

Component design

Component production

System design

Final assembly

Final product

- New/emerging production
- Process
- No established design rules

- Component quality
- Difficult to measure
- High demand
- Volatility
- Fragile/perishable components
- High inventory costs
- High product variety

- Unstable component technologies
- New component designs
- Integral product architecture

Source: Ulrich and Ellison, 1998
The start of an exciting journey ahead

#GoodToBeBad