Controlling Complexity at McLaren Automotive with Model-Based Design

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Overview

- Why we need to make the most from our models
- Challenges to reusing models and lessons learned
- Six solutions to help you succeed in Model-Based Design
- What it looks like and the scale that has been achieved so far
- What we’re looking forward to
The Journey

- McLaren Technology Centre opens 2004
- McLaren Production Centre opens 2011
- P1 worlds first Hypercar released 2012
- 570S released 2013
- 540C released 2014
- P1 GTR released 2015
- 720S released 2017
- Senna released 2018
- Product lines Complexity Timescale 2019
- GT released Speedtail released 2019
- £1.2 billion investment in new products
- 18 new models and derivatives to be launched
- Production to reach 6,000 vehicles per year
- McLaren sportscar and supercar range to be 100 per cent hybrid
- A new Ultimate Series car as a successor to the McLaren P1™
Learning the hard way

What are the problems?

- Customization of the toolchain
- Bespoke software stacks
- Large components
- The MATLAB path, base workspace
- Standardization via documentation
- Manual integration and releases
Getting it right

Six steps to scalability
Getting it right

1. Configure and consult before customizing.
2. Abstract your control systems from the platform.
3. Encapsulate small components within Simulink Projects as micro services.
4. Use a project hierarchy to manage the path, along with data dictionaries.
5. Standardize using templates and deploy using toolboxes.
6. Automate with continuous integration
1. Configure and consult

Instead of jumping into customization

- Align your processes
- Discover existing functionality
- Contribute to future development
- Minimise to keep agile
2. Abstract your control systems from the platform

Instead of implementing bespoke software stacks

- Normal model
- AUTOSAR is abstracted
- Share models across 10 different platforms
- Reuse validated models without rework/porting
3. Encapsulate small components in Simulink Projects

Instead of managing large components

- Performance is up, prioritize reuse.
- Small, meaningful microservices

- Distribute work
- Update in isolation
- Reuse and improve
- Built in parallel
- Lean agile delivery
- Fewer resources
- Coverage
- Released package
4. Project and data dictionary hierarchy

Instead of managing the MATLAB path and base workspace

- Use projects and dictionaries in a hierarchy
- Promote common elements
- Project, Model, and Dictionary references.
- Generation and cache access/precedence
- Published data access
- Project manages environment
5. Standardize using templates and deploy using toolboxes.

Instead of relying on documentation

- Custom model advisor checks
- Project and model templates
- Report generation templates.
- Frameworks for test and automation.
- Various utilities for productivity improvements.
- Everyone can contribute

*Minimart, David Sampson
MATLAB Expo 2016
6. Automate with continuous integration

Instead of local/manual integration and releases

- Test upgrades
- Continuously check for regressions
- Gather metrics for quality
- Improve traceability
- And much more
Does it work?
Does it work?

Scalability

- 198 projects and data dictionaries referenced (88 unique).
- 89 models referenced from the largest top model.
- 4420 total blocks within the largest top model.
- 7054 data dictionary items.
- 495 Jenkins jobs (1841 including branches).
- 2 weeks to upgrade from 2017b to 2019a.
- Limitations
What does it look like?
What does it look like?
Project and model layout
What are we looking forward to?

- Sub system references (2019b).
- Project and toolbox deployment capabilities (2019b).
- Observers within Simulink test to monitor signals (2019a).
- Adaptive AUTOSAR (2019a)
- Top models without sub model dictionaries (2019a)
- Improved requirements management (2019a)
- Reinforcement learning toolbox (2019a)
Steps to remember

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