



OPTIMISING VEHICLE DYNAMICS DEVELOPMENT WITH MATLAB

MATLAB EXPO 2018

Chris Johnston
Group Leader, Method and Tool Development

GROWTH IN COMPLEXITY

THEN...

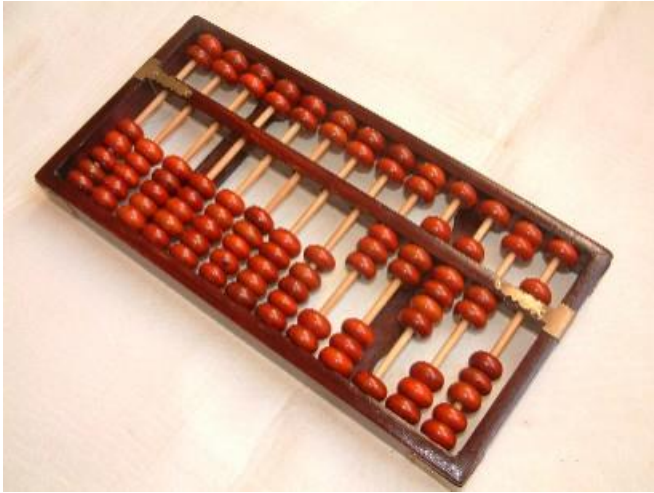


NOW...



GROWTH IN COMPLEXITY

THEN...

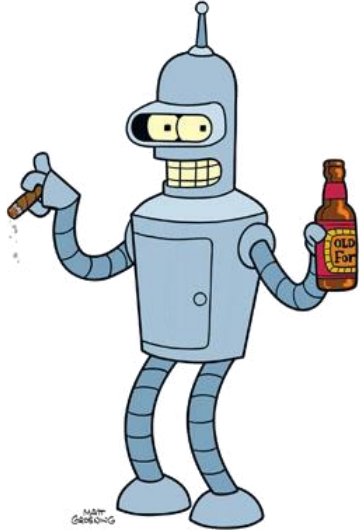


NOW...



GROWTH IN COMPLEXITY

THEN...



NOW...



GROWTH IN COMPLEXITY – PROPULSION

THEN...



NOW...



GROWTH IN COMPLEXITY – HMI

THEN...



NOW...



GROWTH IN COMPLEXITY

THEN...

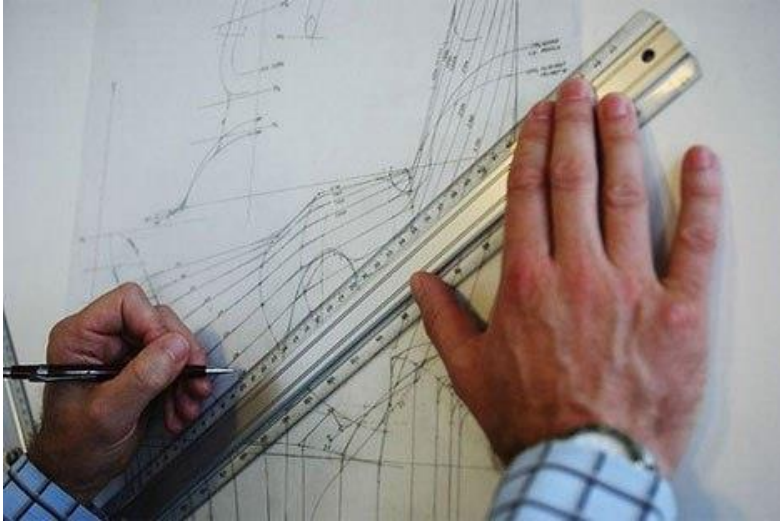


NOW...



GROWTH IN COMPLEXITY – ENGINEERING METHODS

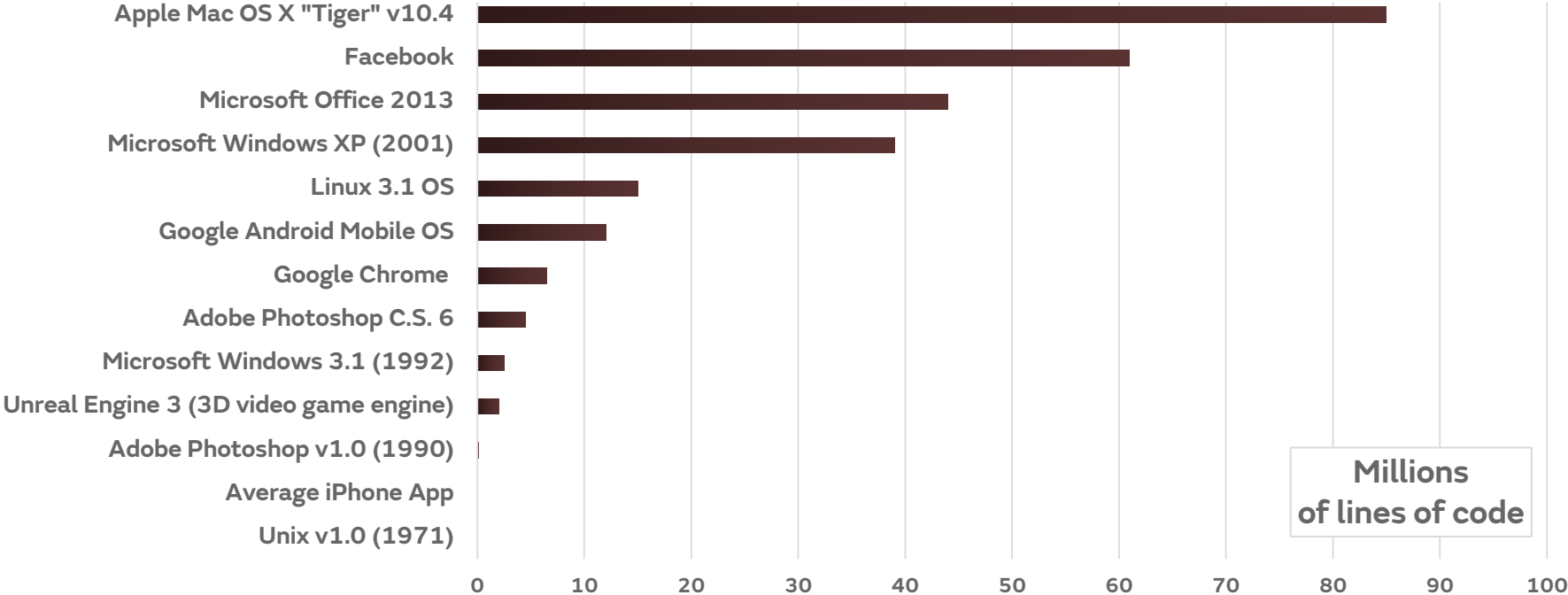
THEN...



NOW...



GROWTH IN COMPLEXITY – SOFTWARE MEGATREND



INNOVATION



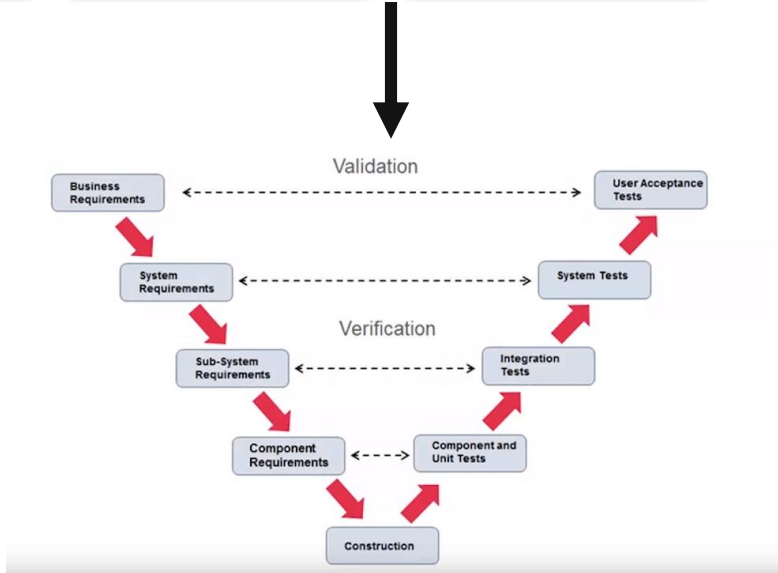
“Never before in history has innovation offered promise of so much to so many in so short a time.” – Bill Gates

PRODUCT CREATION AND DELIVERY SYSTEM

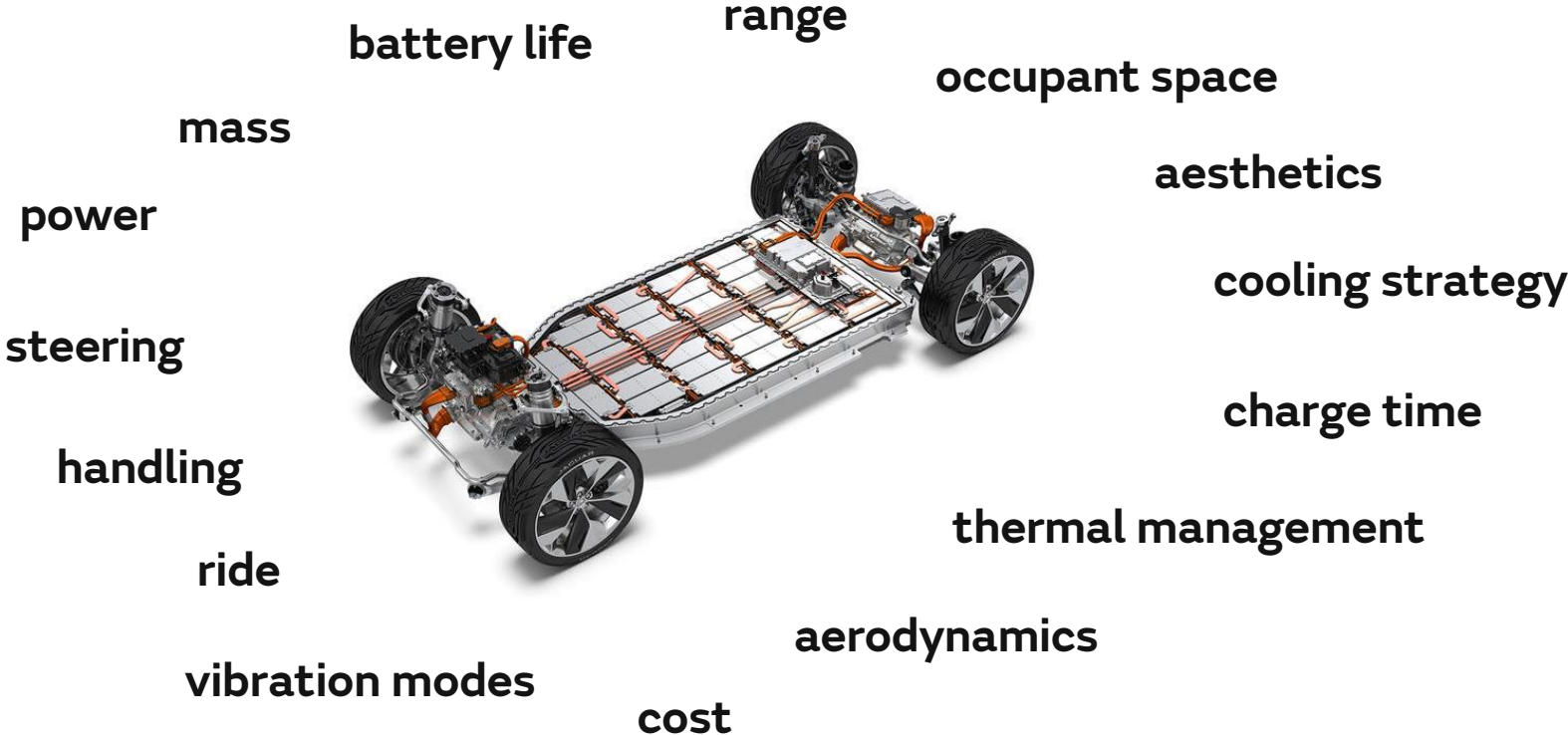
PS



Job 1



WHAT SIZE OF BATTERY IS REQUIRED?



EVERY GATEWAY.. We do this



JLR APP STORE RELEASE MECHANISM

The screenshot displays the MATLAB Store interface. At the top, there are logos for Jaguar and Land Rover, and the text "MATLAB Store". Below this, there's a navigation bar with "Upload Add-On" and "Control Panel: Administrator Recommender". A search bar and a list of authors are on the left. The main content area shows a list of applications:

- Vehicle Feedback XML Analyser Application** (Version 1.0): 1 rating, 0 comments, 4 tags, 194 downloads.
- Engineering Data Toolbox** (Version 1.3.0): 3 ratings, 5 comments, 4 tags, 144 downloads.
- App Manager** (Version 3.4): 3 ratings, 1 comment, 1 tag, 162 downloads.

The "App Manager" application details are expanded, showing its description, owner (R2015a), upload date (2016-02-05), and compatibility (Works with MATLAB from R2012b to R2015a). A comment from Barry, David (D.) is visible at the bottom, dated 18 Dec 2015, 09:35.

App Store:

- 180+ Apps
- 3000+ users
- 500 downloads per month
- 25,000+ downloads
- Huge productivity driver
- Competitive differentiator

File View Help Admin Personal TC Target Catalogue

Programme View Development/Tuning View Admin View

D7a X761 17MY Target Catalogue

D01 2.0L I4 Diesel (Mid) - A1200 Drive: AWD Damping: Active Sus: Coil (Front) - Coil (Rear)	D02 3.0L V6 Diesel - TDV6 Drive: AWD Damping: Passive Sus: Coil (Front) - Coil (Rear)	D03 3.0L V6 Diesel - TDV6 Drive: AWD Damping: Passive Sus: Coil (Front) - Coil (Rear)	D04 3.0L DOHC GDI SC V6 GAS - A1126 Drive: AWD Damping: Passive Sus: Coil (Front) - Coil (Rear)	D05 2.0L I4 GTDi Drive: RWD Damping: Passive Sus: Coil (Front) - Coil (Rear)	D06 3.0L V6 Diesel - TDV6 Drive: AWD Damping: Active Sus: Coil (Front) - Coil (Rear)
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Display Mode

- Table View
- DIA View
- DIA View (Generic Ranges)
- Plot View**

Dataset Filter

- Show All Datasets
- Hide Unticked Datasets

Metric Search & Filters

Search

- A00 Product Efficiency Metrics
- A08 Vehicle NVH Metrics
- Body Metrics
- Data source
- Driving Dynamics Metrics
- Handling Metrics
- Mass & Mol Metrics
- Off Road Capability
- Ride Metrics
- SDS Metrics
- SST Metrics
- Steering Metrics
- Tyre Metrics

Metric Name

- Driving Dynamics
- Driving Dynamics
- Driving Dynamics (System)**
- Steering
- Steering (Vehicle System - VDS)**
- Response Window (LGSS120)
- Response Time Delay (FR120)
- Roll Control Straight Path (FR120)
- Response Agility (FR120)
- Response Bandwidth (FR120)
- Response Gain (OC75)
- Understeer Gradient (HGSS575)
- Understeer Gradient (CR)
- Response Gain Linearity (OC75)
- Roll Control Cornering (HGSS575)
- Roll Control Cornering (CR)
- Total Roll at 0.1g
- Total Roll at 0.2g
- Total Roll at 0.3g
- Total Roll at 0.4g
- Total Roll at 0.5g
- Total Roll at 0.6g
- Total Roll at 0.7g
- Total Roll at 0.8g
- Total Roll at 0.9g
- Torque Build Up Cornering (HGSS575)
- Torque Build Up Cornering (CR)
- On Centre Hysteresis (OC75)
- Off Centre Hysteresis (OC75)
- Effort Level (HGSS575)
- Effort Level (CR)
- Low Speed Response Gain (OC50)
- Low Speed Torque Build Up (OC50)
- Parking Efforts Standstill (PE0)
- Parking Efforts Rolling (PE7)
- Steering Angle Demand
- Response Gain Straight Path (OC50)
- Response Gain Straight Path (OC75)
- Response Gain Straight Path (OC100)
- Response Gain Straight Path (OC120)
- Response Gain Straight Path (OC160)
- Response Gain Straight Path (OC200)
- Response Gain Straight Path (OC240)
- Response Gain Straight Path (OC280)
- Response Gain Straight Path (OC320)
- Friction Feel (OC50)
- Friction Feel (OC75)
- Friction Feel (OC100)
- Friction Feel (OC120)
- Friction Feel (OC160)
- Friction Feel (OC200)
- Friction Feel (OC240)
- Friction Feel (OC280)
- Friction Feel (OC320)
- Response Gain Linearity (LGSS550)

On Centre Response vs Velocity

Avg On Center Yaw gain vs Speed - On Center Test, ay=0.2g

Velocity (km/h)	Blue Line Yaw Gain (deg/m/100deg BW4)	Green Line Yaw Gain (deg/m/100deg BW4)	Orange Line Yaw Gain (deg/m/100deg BW4)
50	~1.5	~1.5	~1.0
75	~3.5	~3.5	~1.5
100	~5.5	~5.5	~1.5
120	~5.5	~5.5	~1.5
160	~4.5	~4.5	~1.5
200	~3.5	~3.5	~1.5
240	~2.5	~2.5	~1.5
280	~1.5	~1.5	~1.5
320	~1.0	~1.0	~1.0

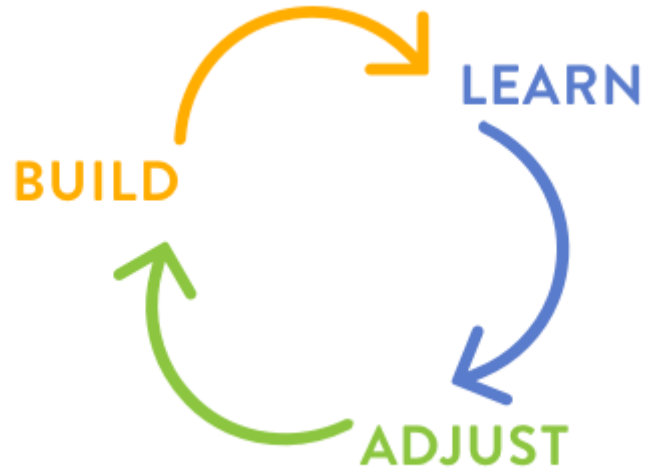
GATEWAY MEETINGS (NEW WAY)



Data-driven decisions
Live “what-if” discussions
Collaboration
Efficiency
Quality
Morale

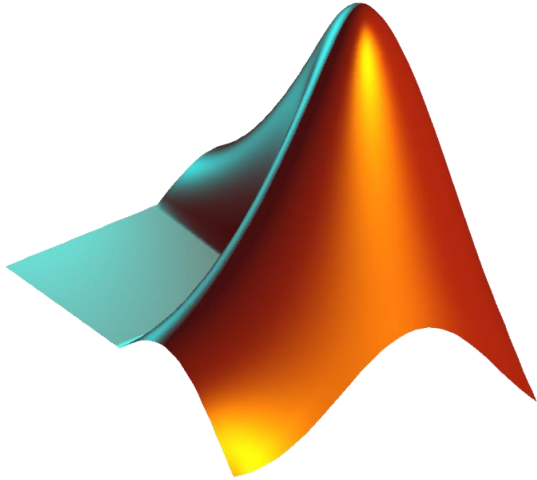
Repeat meetings
Program delays
Judgement calls
Blood pressure

HOW TO BUILD IT



1. Do what others don't want to do!
2. Get something out there fast
3. Sit next to the customer

WHY MATLAB?



- **Built-in libraries**
- **Use interactively or programmatically**
- **Optimised for scientists and engineers**
- **Nice bunch to work with!**

FUTURE



THANK YOU

Chris Johnston

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Vehicle Dynamics

Chassis Engineering

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Recommended further reading:

The Elements of Scrum by Chris Sims & Hillary Louise Johnson