



IBM Internet of Things

Optimizing Change Impact Analysis with a Digital Thread across complex multi-physics designs and operations

*Bringing the digital thread to life with
IBM Continuous Engineering and
ANSYS advanced modelling and simulation*

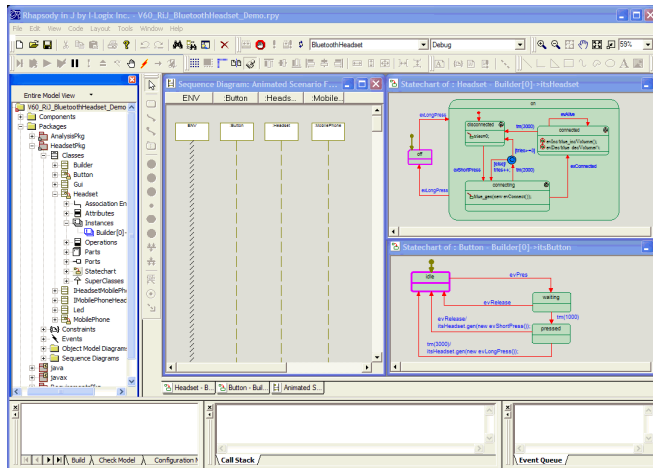
Charles-Henry JURD, IoT Solution Architect, IBM
charles-henry.iurd@fr.ibm.com



IBM IoT focuses on the Digital Twin & Digital Thread



as Designed

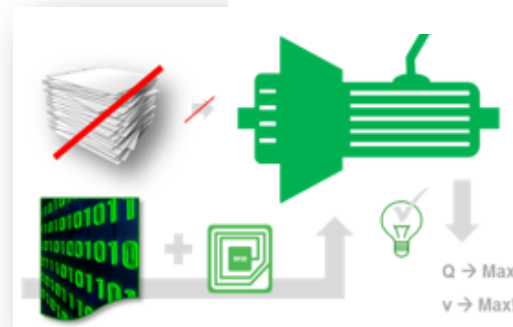


as Built

Paperless Production



JOHN DEERE



as Operated
as Maintained



IBM Continuous Engineering

IBM IoT for Manufacturing



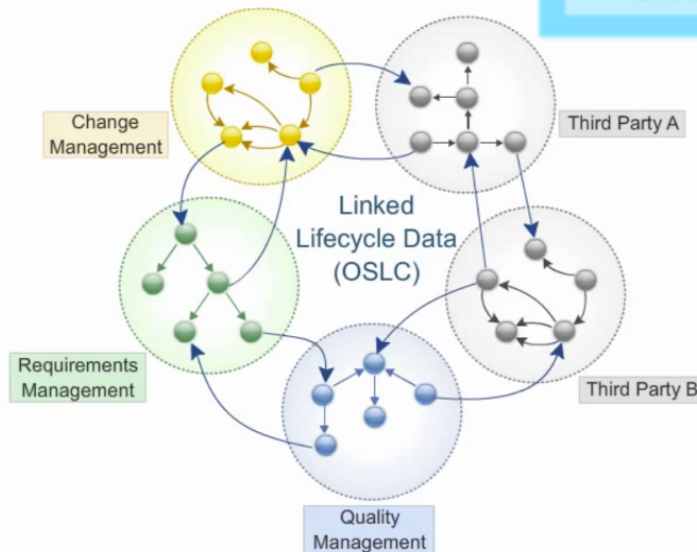
IBM IoT Solutions



IBM Watson Internet of Things

OSLC to turn Engineering Insight into outcomes

Access, unlock and understand
all engineering information
no matter where it resides



Airbus adopted Continuous Engineering to unlock vast stores of engineering knowledge.

- **Reduced** impacted analysis times from weeks to days
- **Increase visibility** into product-development processes, to effectively track and monitor production for product's lifecycle
- **Enhance scalability** to simplify integration of future data sources and other applications

**Enable the right decisions
at the right times**

IBM Continuous Engineering built on OSLC

Live, Integrated Engineering Information Across Disciplines



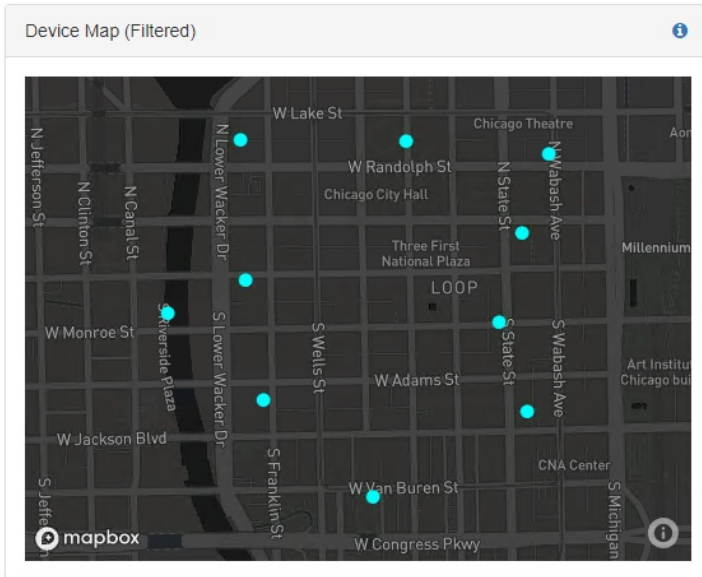
Eco-system partners

						Your Custom Tools
Real-Time Testing	Electrical Design	Product Lifecycle Management	Product Line Engineering	Multi-domain Simulation	Functional Mockup Interface (FMI)	

Operations manager identifies a possible issue with the ADAS solution that is resulting in excessive brake wear

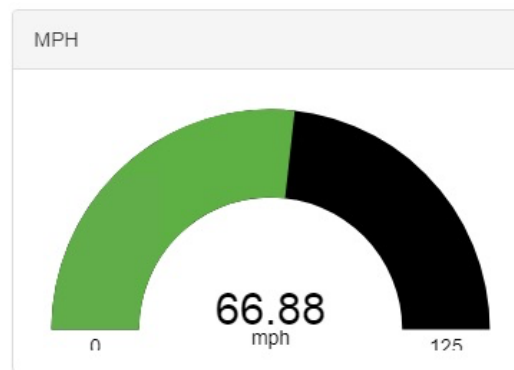
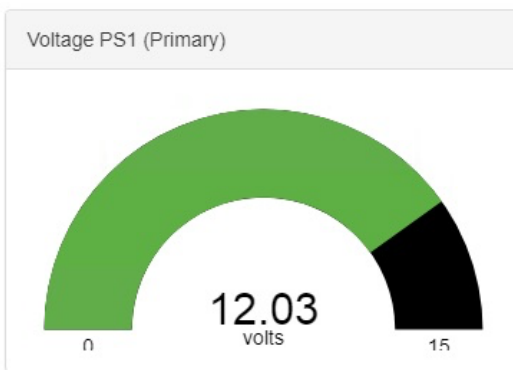


Operations Manager device dashboard



Recent Devices (Filter: "Downtown Chicago")

Type	ID	Model	Warnings
DT112	ICE59aa2e900	DT112	✓
DT112	ICEeb1c25901	DT112	✓
DT112	ICE5067f3902	DT112	⚠
DT112	ICEd0a810903	DT112	✓
DT112	ICE09fcf5904	DT112	⚠
DT112	ICE8247fd905	DT112	✓
DT112	ICEe8a72e906	DT112	✓
DT112	ICE834d01907	DT112	✓
DT112	ICEb44c0d908	DT112	✓
DT112	ICE698121909	DT112	✓



RPMs

0 RPMs

Predictions

- Battery Failure (Replacement Required)
⌚ Within 90 days, confidence 32%
- Excessive Brake Wear (Replacement Required)
⌚ Within 90 days, confidence 65%

Impact Analysis – Digital Thread



Adaptive Cruise Control Planning ?

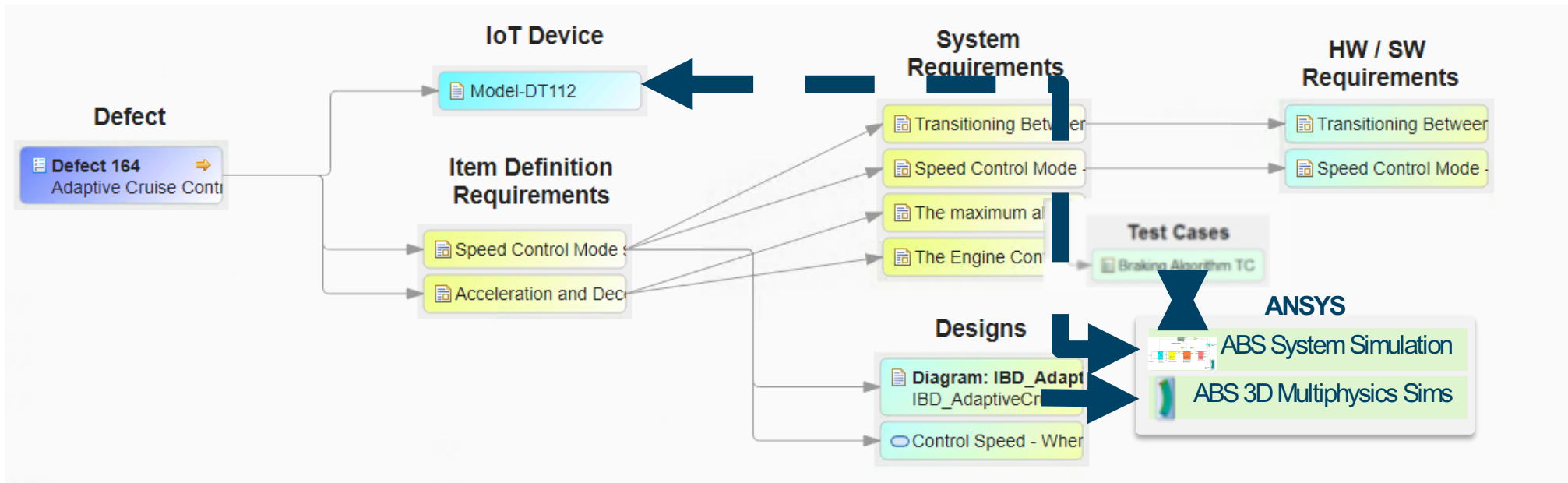
General +

Defects (2)

- 164: Adaptive Cruise Control is Causing Excessive Pad Wear
- 163: Failing Test Case "it shall be possible for the driver to manually turn off the ACC in the case of obstructions using the brake or off switch"

Related Artifacts

Defect Traceability View



Adding/changing requirements



VIEW SIMILAR REQUIREMENTS REQUIREMENT SCORING BATCH REQUIREMENT SCORING

This is the Watson Requirements Analyser. Please enter your requirement below and we'll score it for you:

The logo must be displayed correctly.

Ask Watson!

Requirement Score: 58

Unknown Quantity

Watson

The logo must be displayed correctly.

The information you have provided is not enough to be certain it can be met, please provide more detail.

Please ensure that the exact positioning is clear within your requirement.

Thank you

Write your message here... Send

Comments

702: Speed Control Mode shall employ bas... (2)

- Pete to Susan 1 hour ago (1 reply)

Define Basic ?

Can we add a definition for 'basic' Cruise Control functionality please ? I'm not sure it's at all clear ?

Thanks 😊
- Susan to Pete 30 minutes ago

RE: Define Basic ? [RE: #1]

No problem Pete I'll put something in the [Glossary](#)

Revisions **Audit History**

Today (0)	Yesterday (0)	Past Week (0)
Previous 1 2 3 Next		
Expand All Collapse All		
<p>Susan modified resource 866: Time Gap Control Mode shall be based upon determining the time gap between the vehicle and the vehicle directly</p> <p>Primary Text Show changes</p> <p>Title Time gapGap Control modeMode shall be based upon determiningdetermining the t</p> <p>Susan added a link 866: Time Gap Control Mode shall be based upon determining the time gap between the vehicle and the vehicle directly in fro</p> <p>Link added: Link Source: 866: Time Gap Control Mode shall be based upon determining the time g References Term Target: 1199: Time Gap Control Mode</p>		

Where Artifact Used (2)

- In Module (1)
 - 684: IDR M3 ACC Item Definition Requirements
- In Review (1)
 - Item Definition Requirements Review

Continuous Traceability



- A defect is raised in engineering:

Adaptive Cruise Control Planning ^[?]

General +

Defects (2)

- 164: Adaptive Cruise Control is Causing Excessive Pad Wear
- 163: Failing Test Case "it shall be possible for the driver to manually turn off the ACC in the case of obstructions using the brake or off switch"

- Related Artifacts
 - Defect Traceability View
- Related Change Request
 - ECR-100002: Update CC ECU
- Affects Plan Item
 - 165: Update Braking Algorithm
- Tracks Requirement
 - 702: Speed Control Mode shall employ basic Cruise Control functiona
 - 729: Acceleration and Deceleration control shall be limited to approxin
- Attachments
 - 1: New Requirements for ACC from Operations.doc (Size: 37 KB)

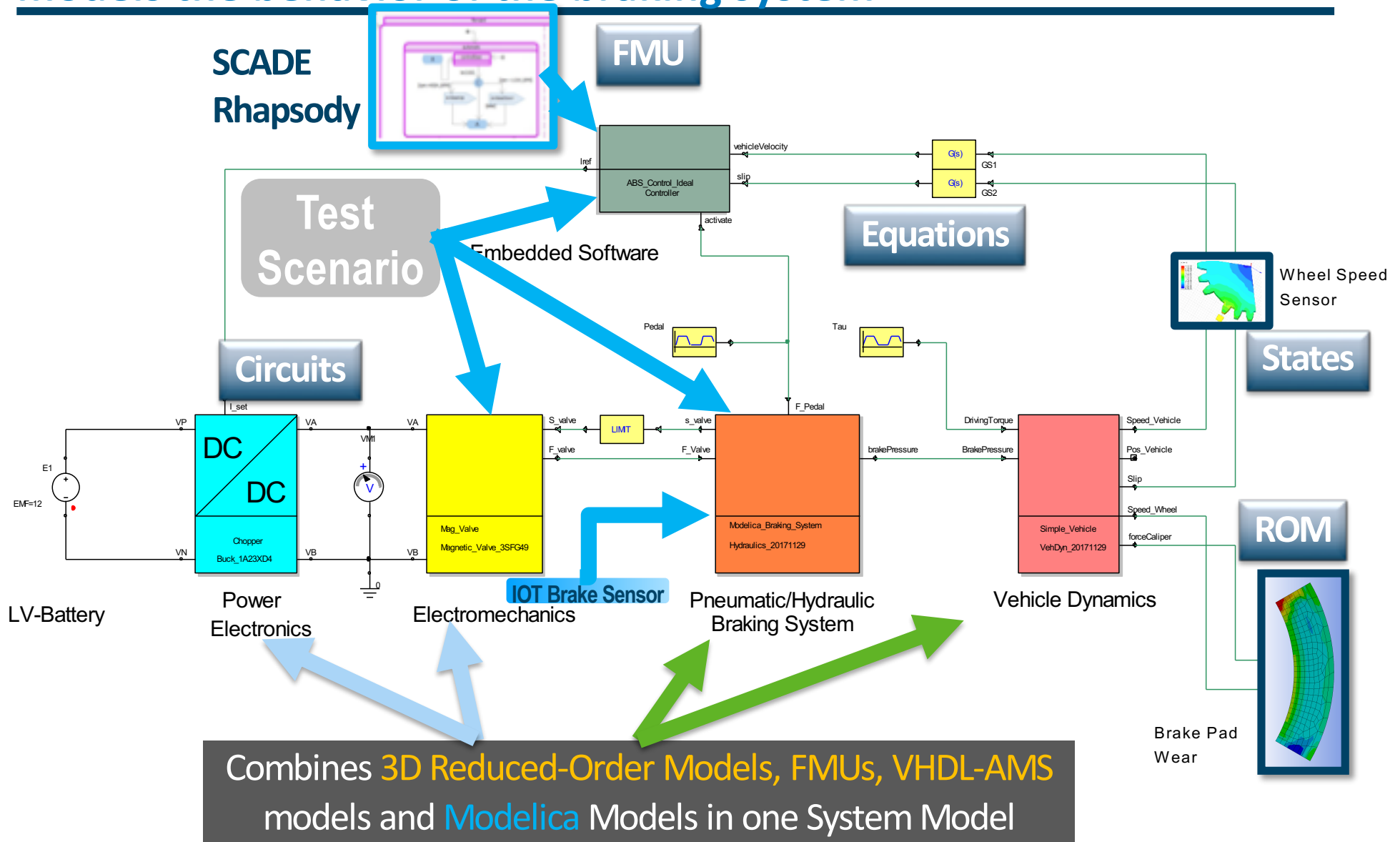
Impact analysis view

Result: ECR in PLM and CR in CE

Initial assessment of impacted requirements

New req doc

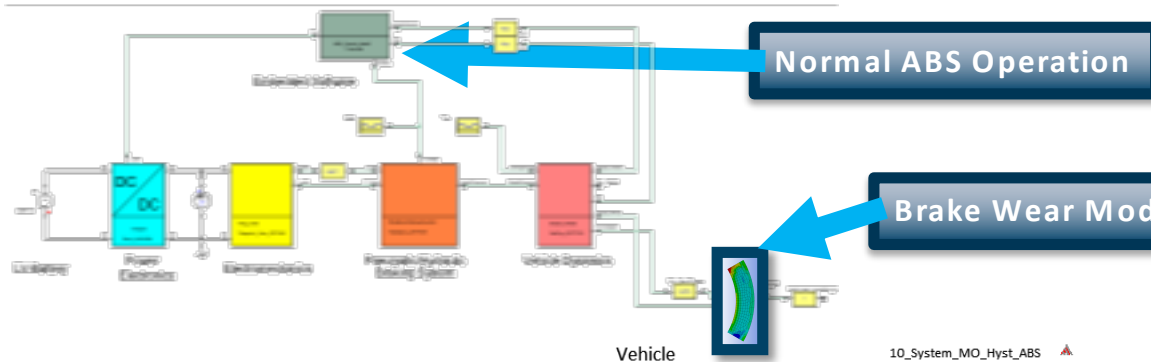
The simulation architecture built using ANSYS TwinBuilder models the behavior of the braking system



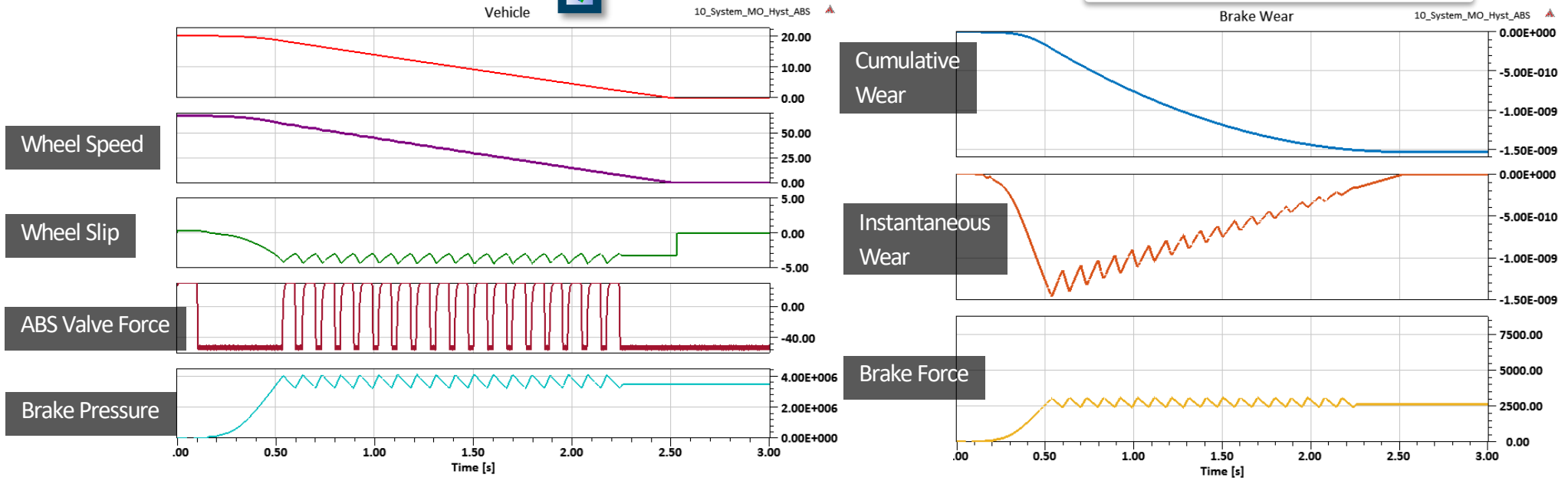
Test cases executed using simulation verify that the work done by the engineering team addressed the new defect



Validation of model against requirements



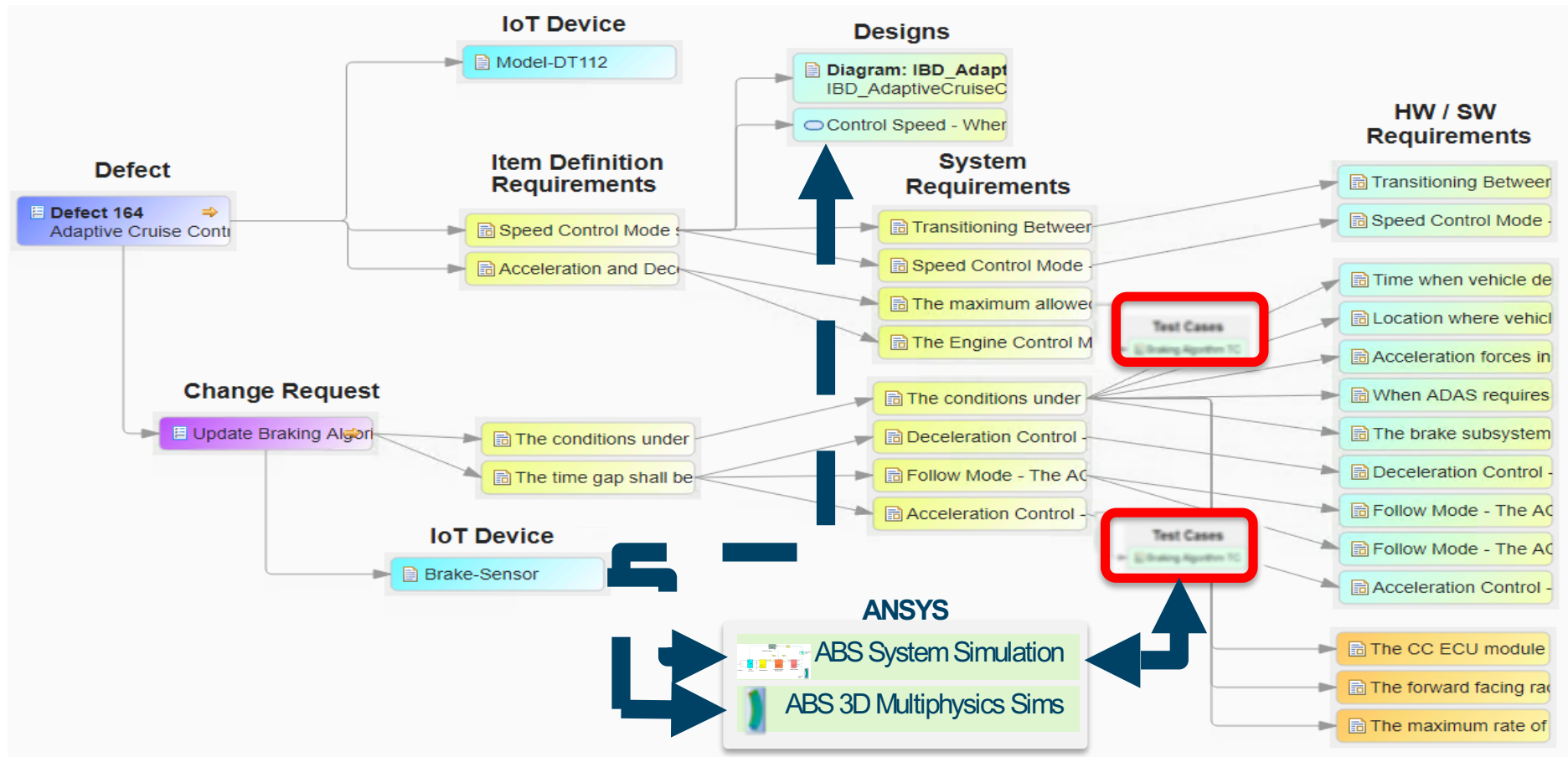
Baseline brake wear result with ABS operation



Impact analysis after simulation indicates the problem has been found, solved and verified, and can be deployed



Existing artifacts



New work

Complex systems require version and variant management across the entire system lifecycle



- Sketching, Global Configurations, Comparison between Streams, Variants, Baselines

ID	Contents
699	-1 Range Sensor ECU requirements
786	The hardware shall provide a layer to communicate with a FlexRay and CAN bus systems
877	The hardware shall run on a 12 v dc power bus
703	The hardware shall provide a standard 32 bit +/- 5 V i/o board
697	The hardware shall provide a standard 16 bit +/- 12 V Analogue to digital converter
834	The hardware shall provide a standard 16 bit +/- 5 V digital to analogue converter
1229	-1.1 Forward Facing Radar
1230	There shall be two forward-facing radar sensors
1231	

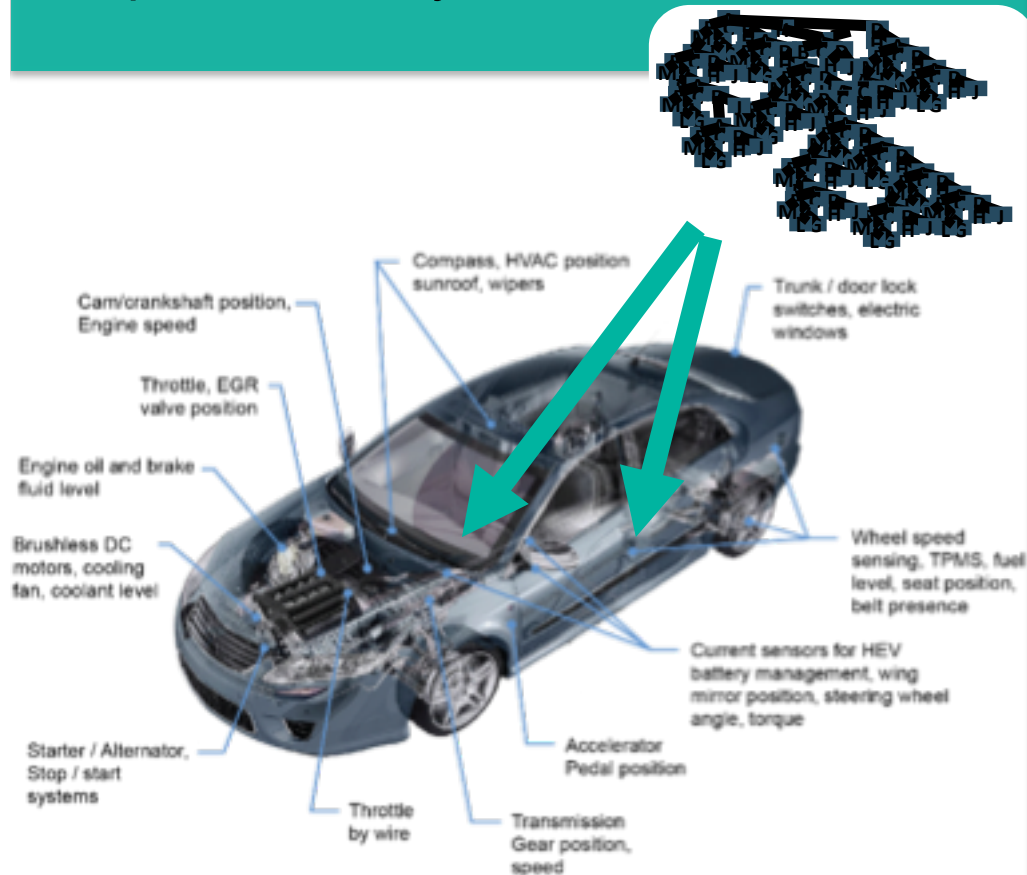
693:Rad HW Sub-System Hardware Requirements

Content	Attributes
Premium Adaptive Cruise Control Requirements	
699	1 Range Sensor ECU requirements
786	The hardware shall provide a layer to communicate with a FlexRay and CAN bus systems
877	The hardware shall run on a 12 v dc power bus
703	The hardware shall provide a standard 32 bit +/- 5 V i/o board
697	The hardware shall provide a standard 16 bit +/- 12 V Analogue to digital converter
834	The hardware shall provide a standard 16 bit +/- 5 V digital to analogue converter
1229	1.1 Forward Facing Radar
1230	There shall be two forward-facing radar sensors
1231	
1232	The forward facing radar sensors shall cover an angle of 60 degrees +/- 5 degrees
1233	1.2 Side Facing Radar
1234	There shall be two side-facing radar sensors
1235	
753	2 Range Sensor SubSystem Safety HW reqs
709	A watchdog running at 2 Khz shall be used by the ACC module to determine if the Range Sensor subsystem fails due to loss of power
762	When a signal corruption is detected by the Range Sensor Arbitrator, the adaptive cruise control system shall be switched off within 100 ms.
824	The Range Sensor ECU hardware shall provide the means to interface with four Range Sensor sensors
742	The Range Sensor ECU hardware shall provide the capability to deal with the onboard processing of four sets of Range Sensor data

Content	Attributes
Basic Adaptive Cruise Control Requirements	
699	1 Range Sensor ECU requirements
786	The hardware shall provide a layer to communicate with a FlexRay and CAN bus systems
877	The hardware shall run on a 12 v dc power bus
703	The hardware shall provide a standard 32 bit +/- 5 V i/o board
697	The hardware shall provide a standard 16 bit +/- 12 V Analogue to digital converter
834	The hardware shall provide a standard 16 bit +/- 5 V digital to analogue converter
1229	1.1 Forward Facing Radar
1230	There shall be two forward-facing radar sensors
1231	
1232	The forward facing radar sensors shall cover an angle of 60 degrees +/- 5 degrees
753	2 Range Sensor SubSystem Safety HW reqs
709	A watchdog running at 2 Khz shall be used by the ACC module to determine if the Range Sensor subsystem fails due to loss of power
762	When a signal corruption is detected by the Range Sensor Arbitrator, the adaptive cruise control system shall be switched off within 100 ms.
824	The Range Sensor ECU hardware shall provide the means to interface with two Range Sensor sensors
742	The Range Sensor ECU hardware shall provide the capability to deal with the onboard processing of two sets of Range Sensor data

Digital Twin and Digital Thread are emerging as key in helping industries bring together systems to gain a coherent and up-to-date view of software, hardware and sensors across the product lifecycle

IBM and Schaeffler are partnering to develop offerings to address specific cross-domain scenarios which will provide full system level traceability. These offerings will enable engineering, manufacturing, sales and operations professionals to have a full understanding of Schaeffler's product lines.





IBM Internet of Things

Thank You

