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

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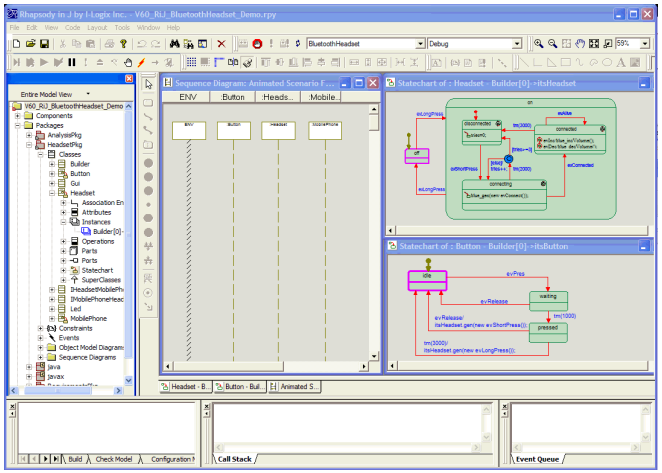
IBM

IBM IoT focuses on the Digital Twin & Digital Thread

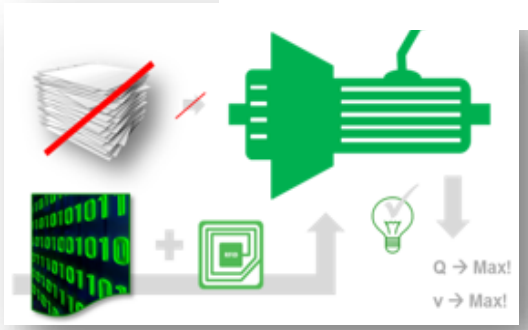
as Designed



as Built

Paperless Production

JOHN DEERE



as Operated
as Maintained

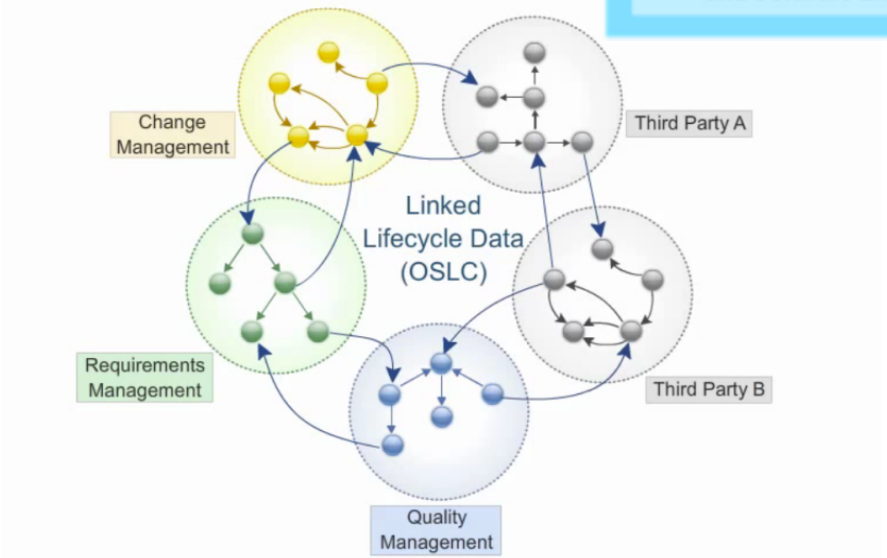
IBM Continuous Engineering

IBM IoT for Manufacturing

IBM IoT Solutions

OSLC to turn Engineering Insight into outcomes

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



AIRBUS

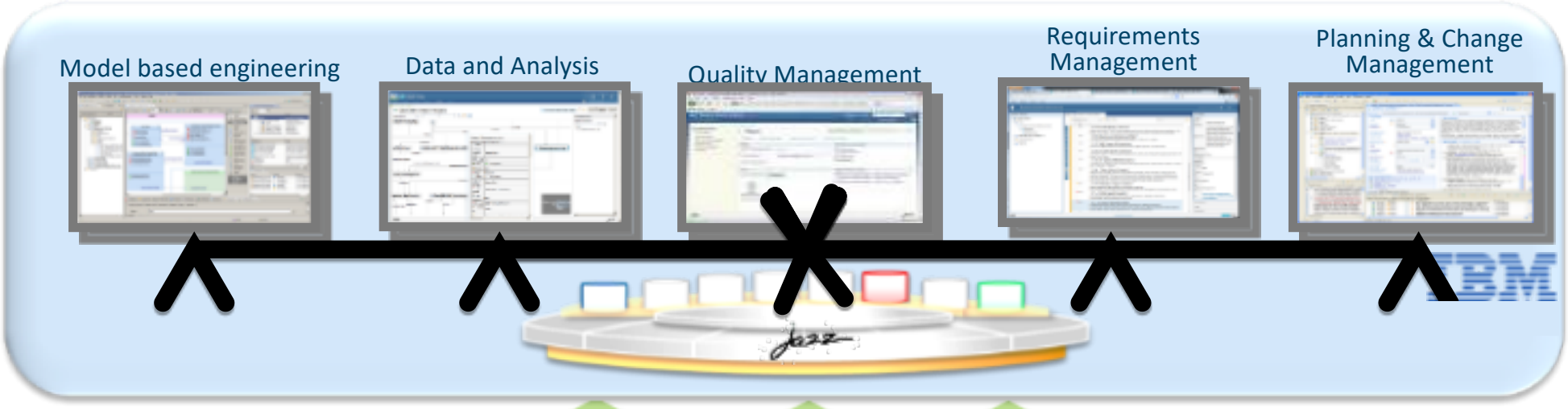
Airbus adopted Continuous Engineering to unlock vast stores of engineering knowledge.

- **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

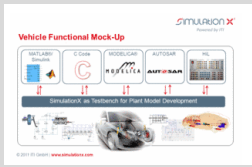
Real-Time Testing

Electrical Design

Product Lifecycle Management

Product Line Engineering

Multi-domain Simulation



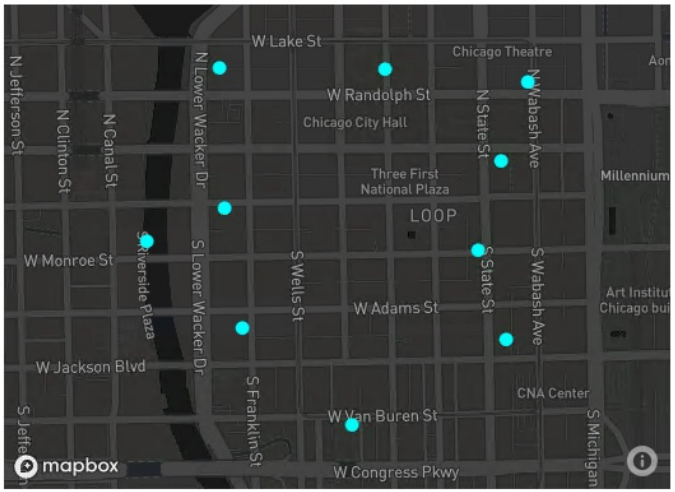
Functional Mockup Interface (FMI)

Your Custom Tools

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

Operations Manager device dashboard

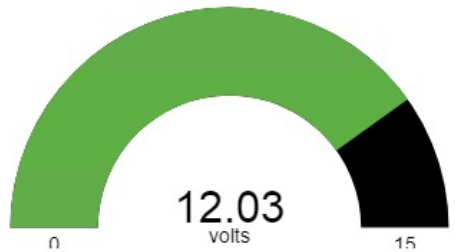
Device Map (Filtered)



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	✓

Voltage PS1 (Primary)



MPH

RPMs

Predictions

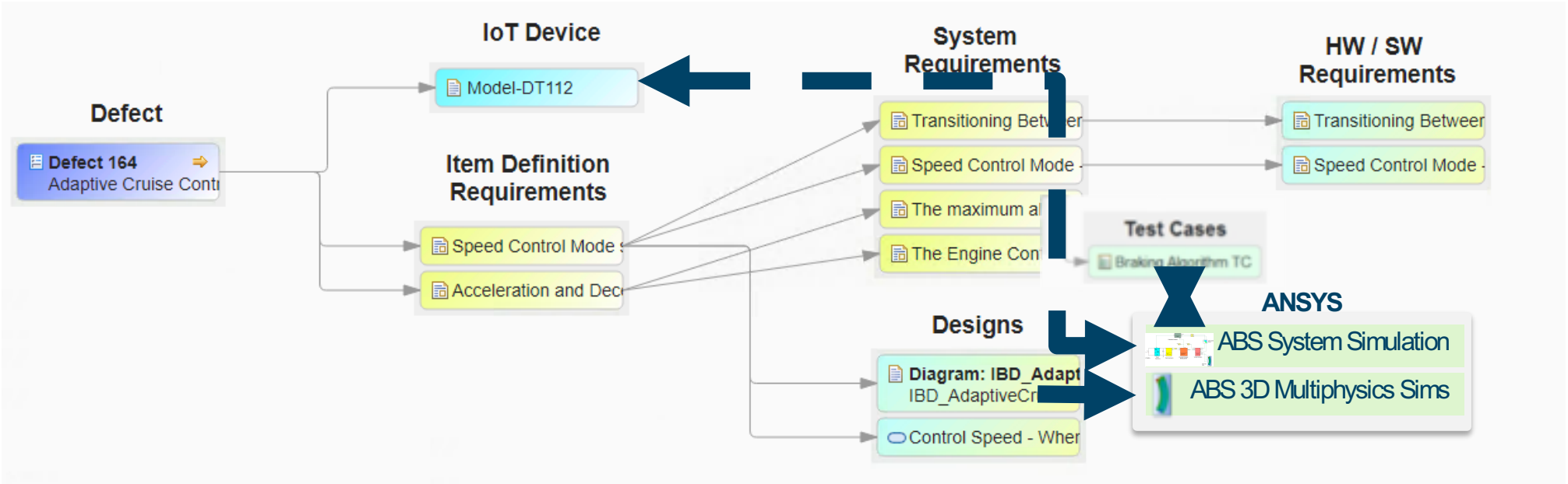
Battery Failure (Replacement Required)

Within 90 days, confidence 32%

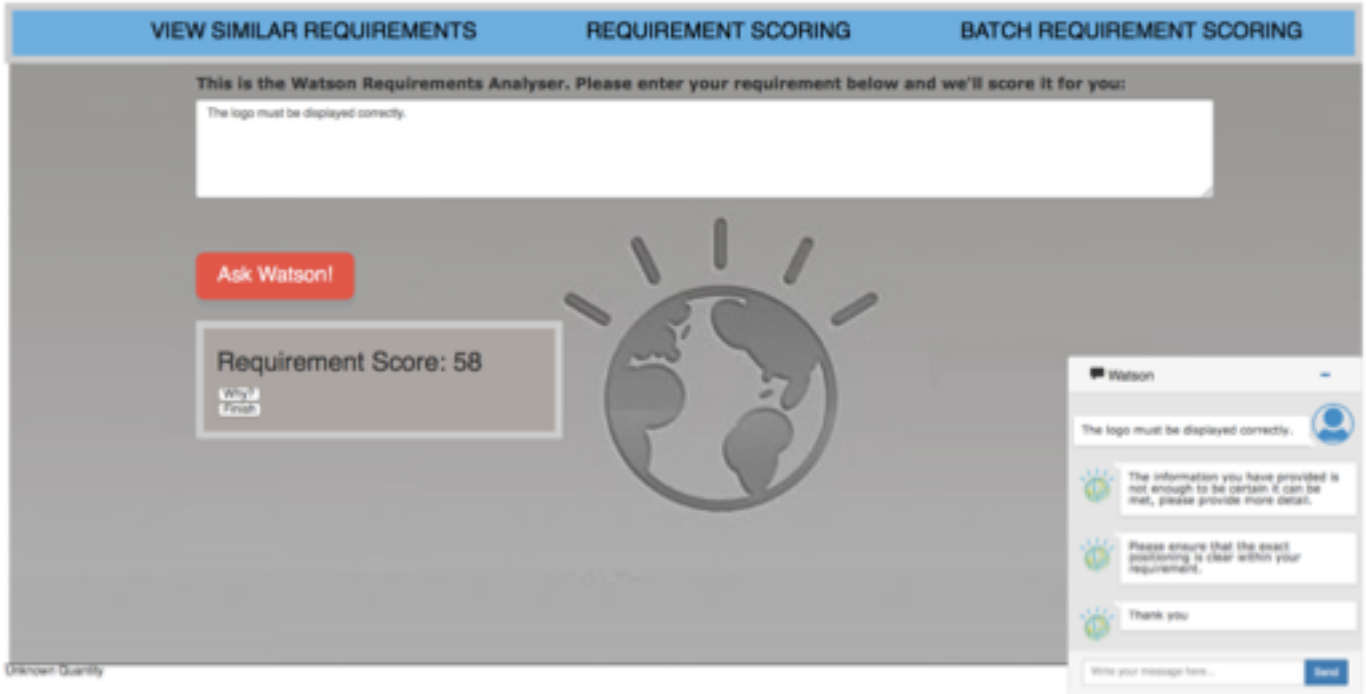
Excessive Brake Wear (Replacement Required)

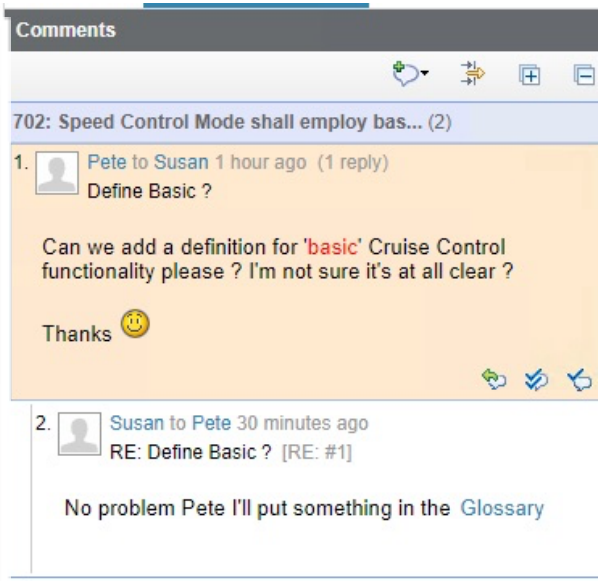
Within 90 days, confidence 65%

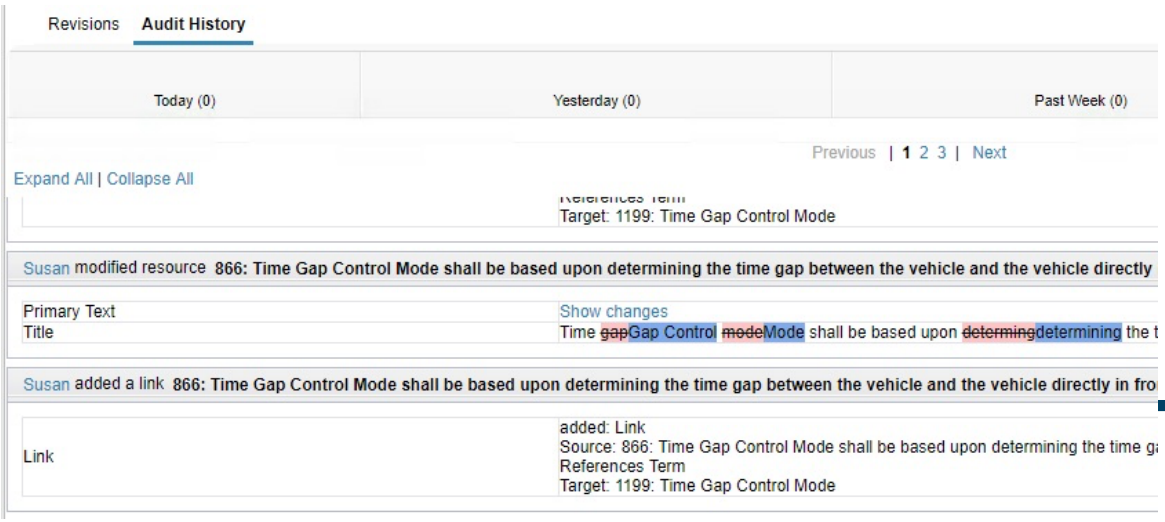
Impact Analysis – Digital Thread

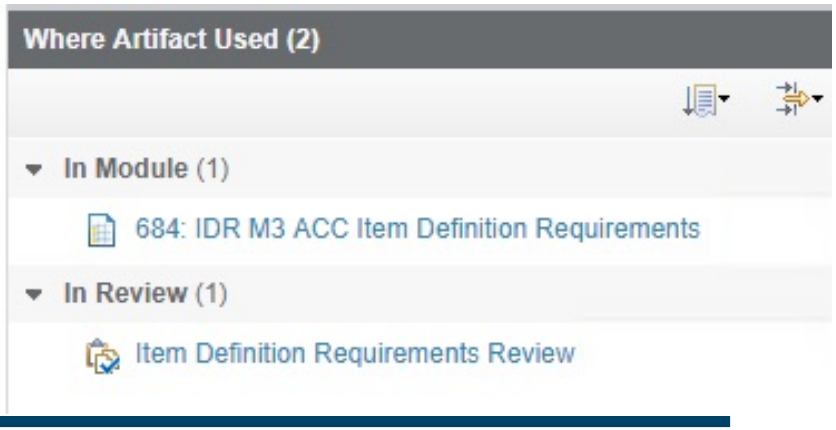


Adding/changing requirements



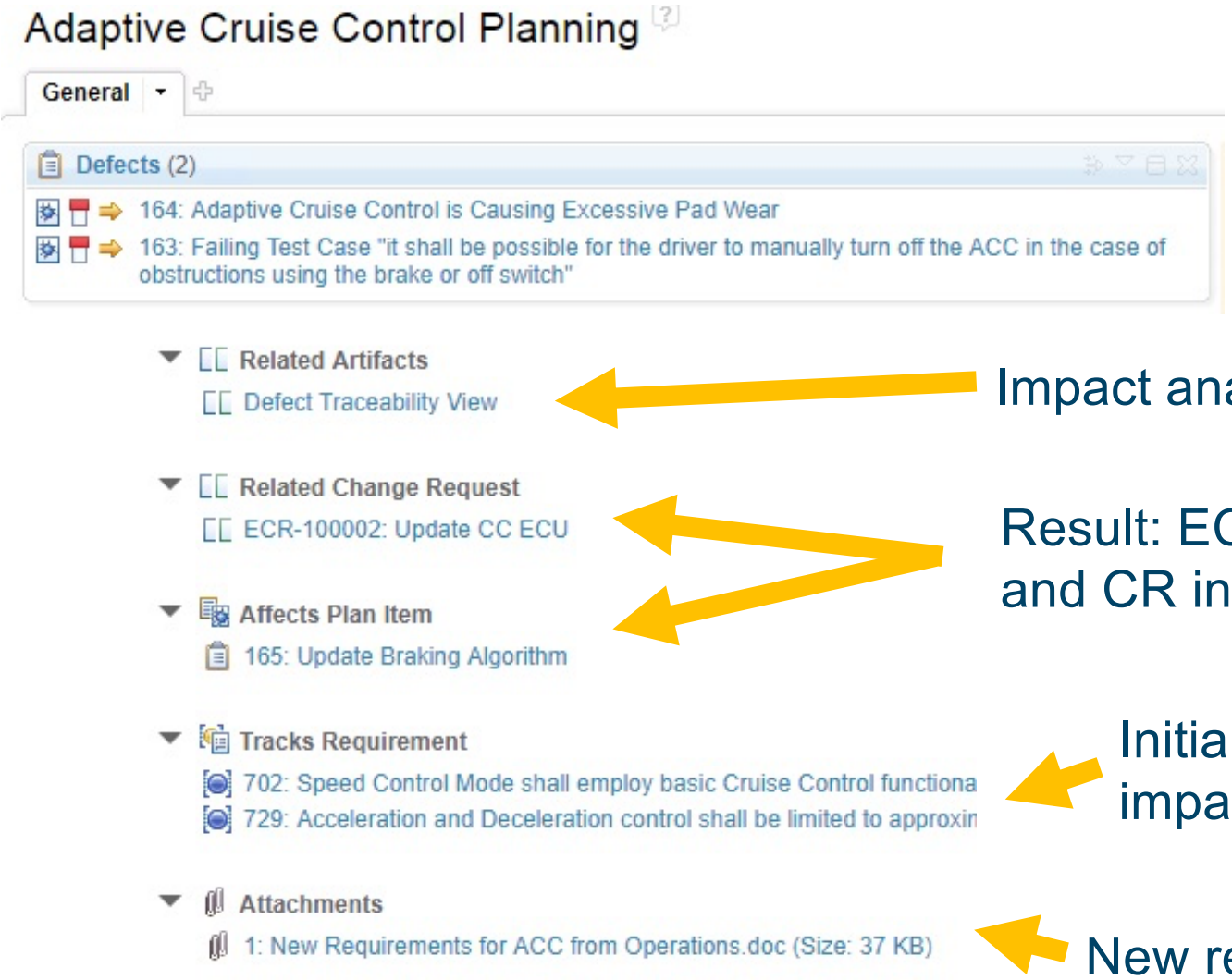




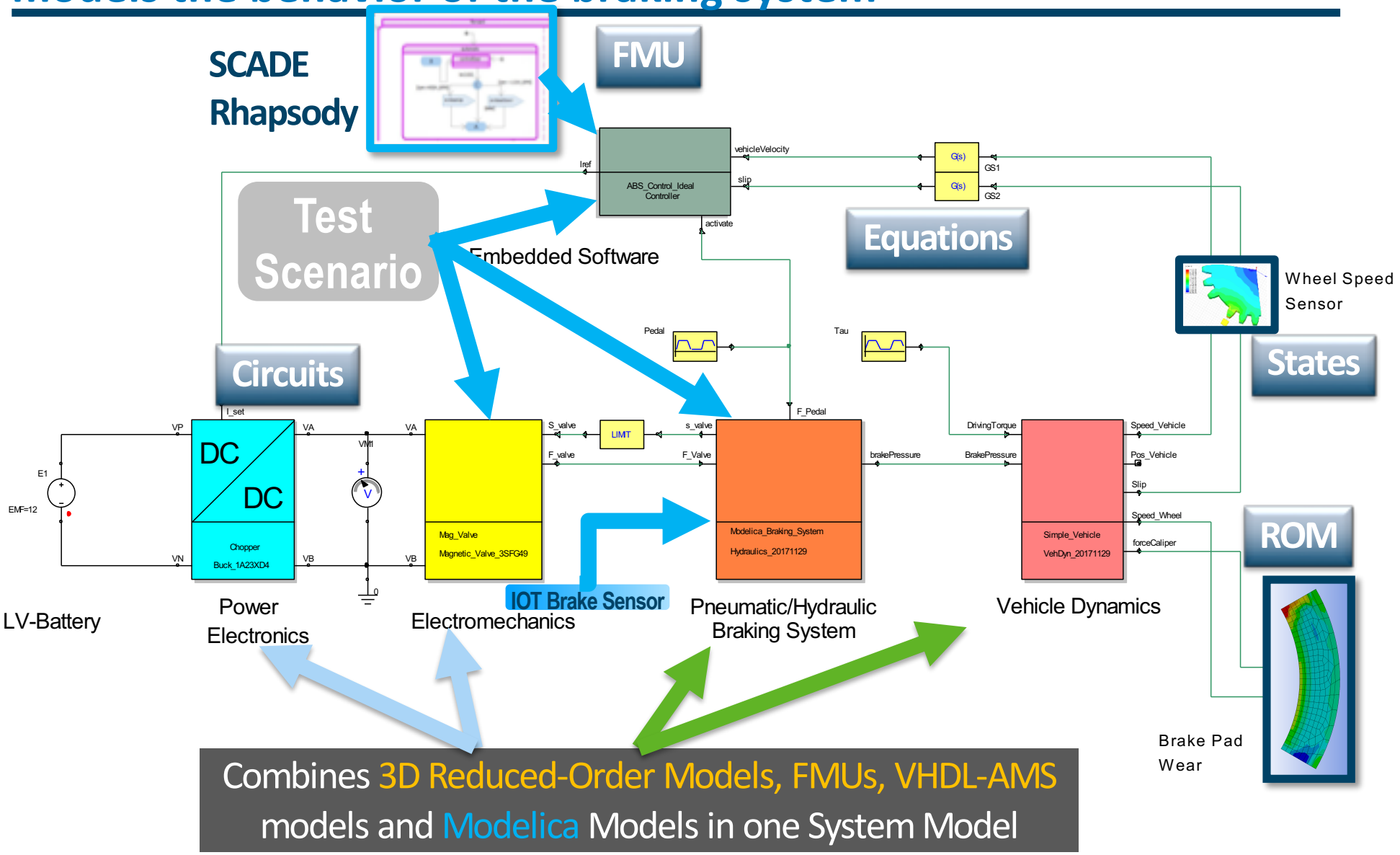


Continuous Traceability

- A defect is raised in engineering:

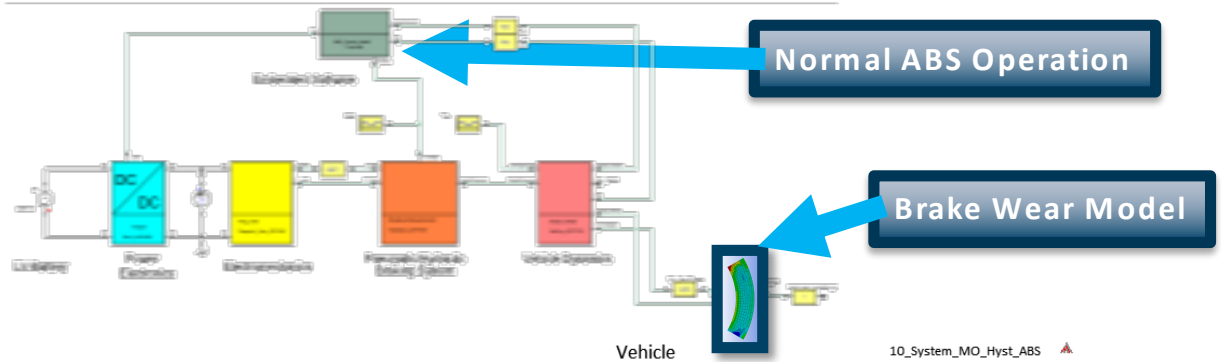


The simulation architecture built using ANSYS TwinBuilder models the behavior of the braking system

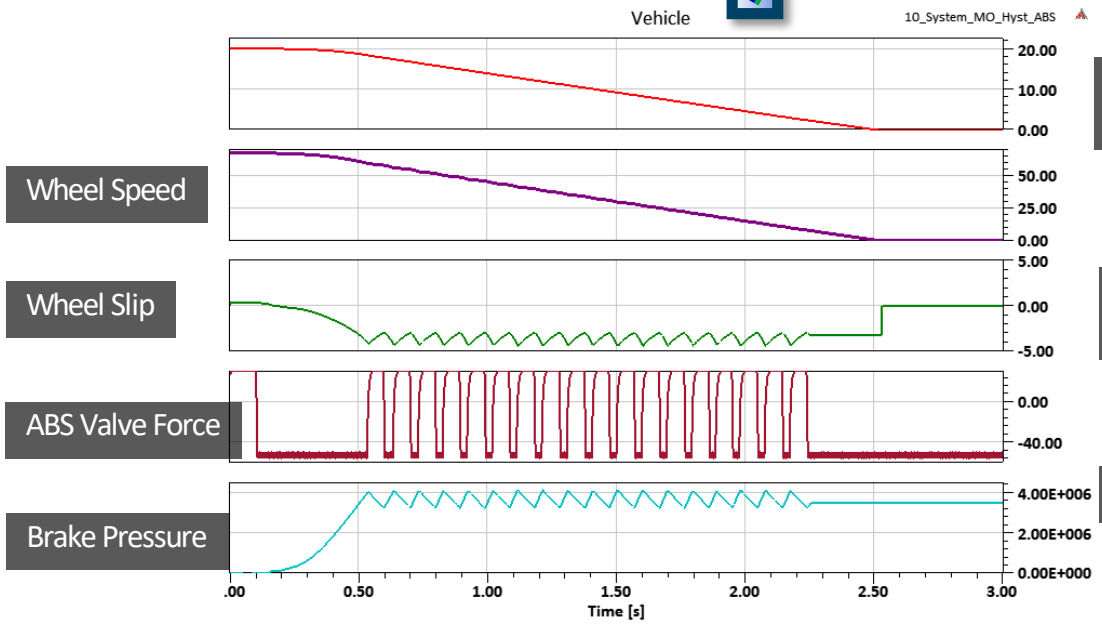


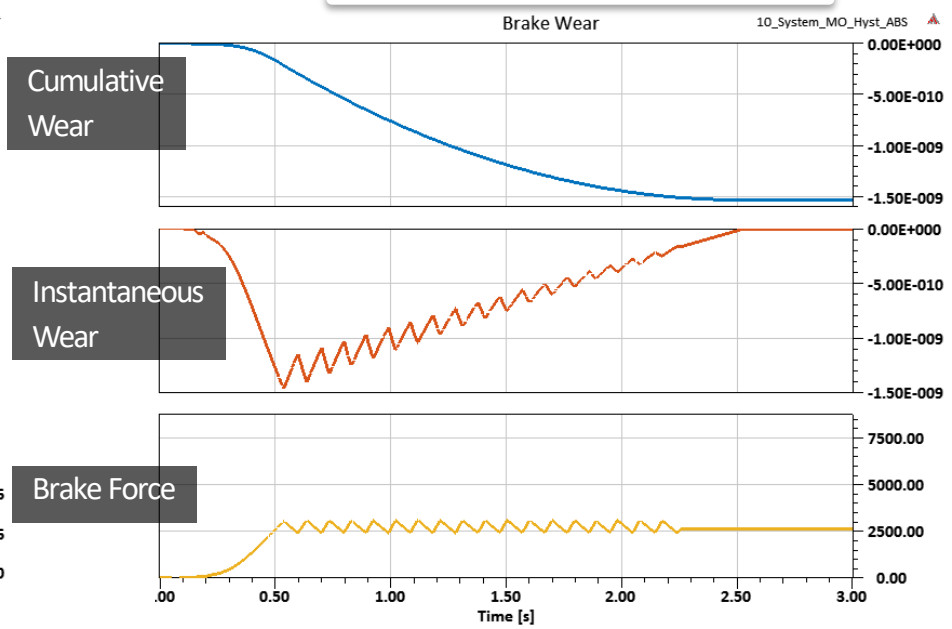
Test cases executed using simulation verify that the work done by the engineering team addressed the new defect

Validation of model against requirements



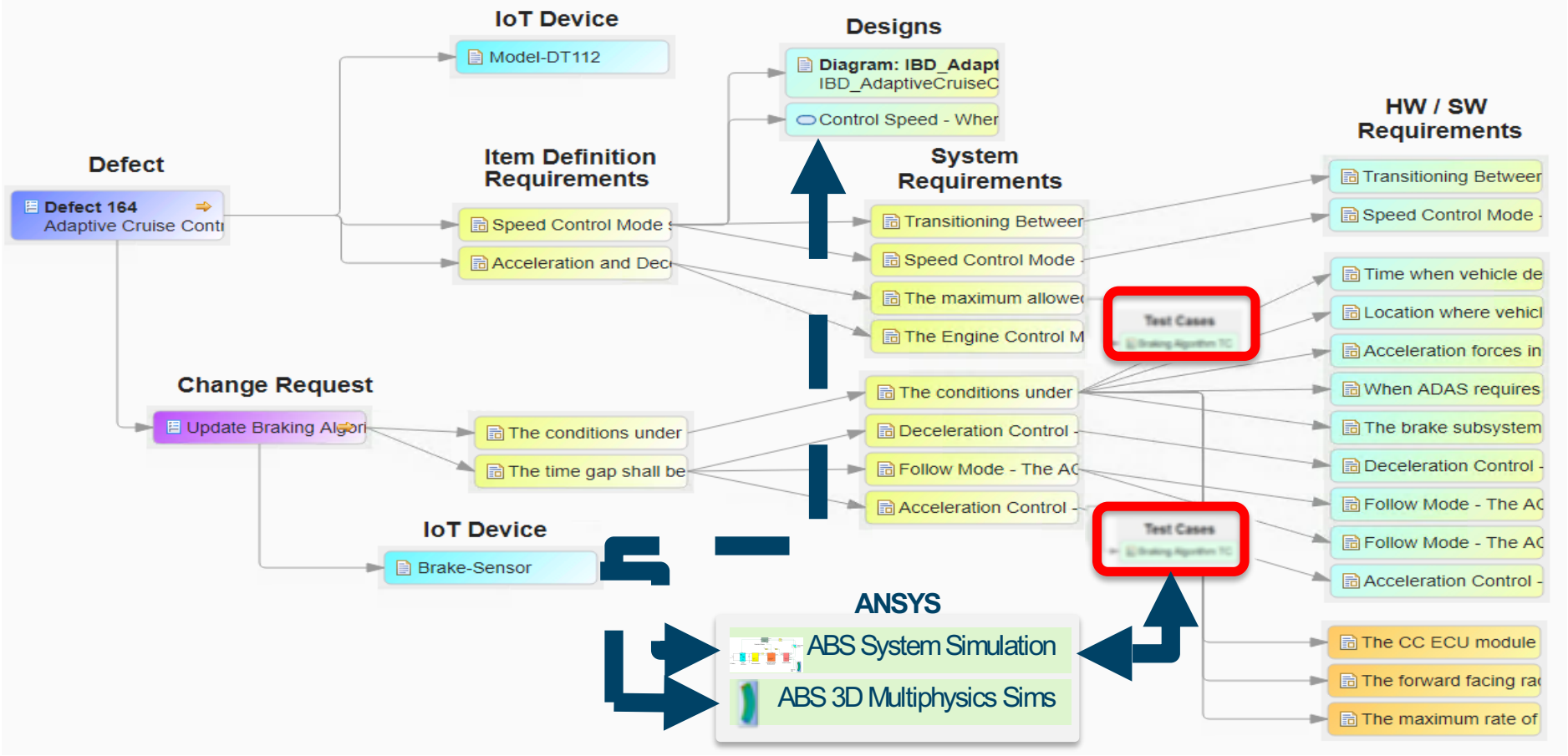
Baseline brake wear result with ABS operation





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

Existing artifacts

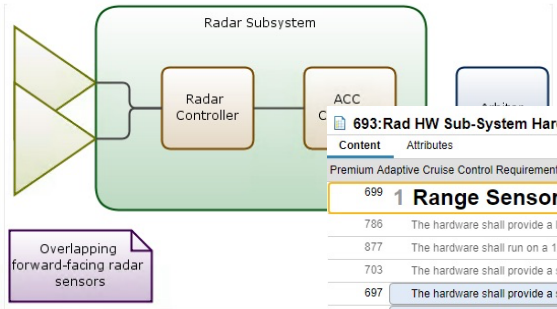


New work

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 borad
	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



693:Rad HW Sub-System Hardware Requirements

Content | Attributes

Premium Adaptive Cruise Control Requirements		Basic Adaptive Cruise Control Requirements	
699	1 Range Sensor ECU requirements	699	1 Range Sensor ECU requirements
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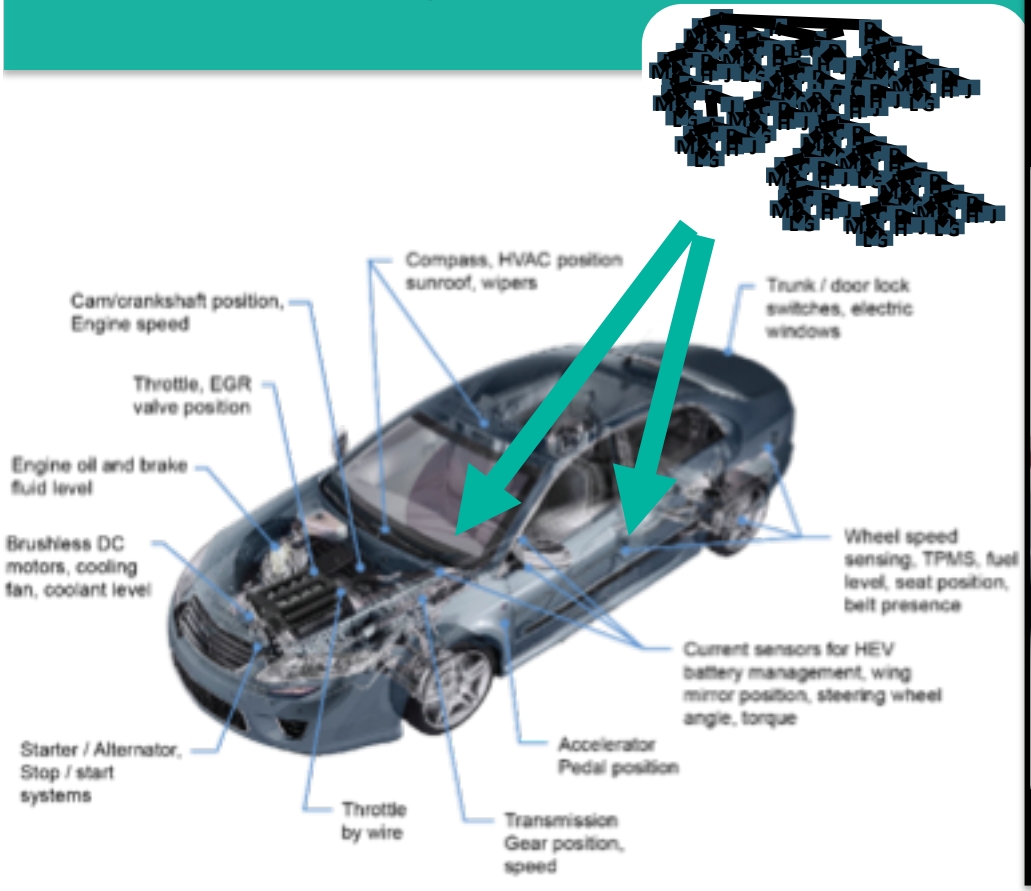
1229	1.1 Forward Facing Radar	1229	1.1 Forward Facing Radar
1230	There shall be two forward-facing radar sensors	1230	There shall be two forward-facing radar sensors
1231		1231	
1232	The forward facing radar sensors shall cover an angle of 60 degrees +/- 5 degrees	1232	The forward facing radar sensors shall cover an angle of 60 degrees +/- 5 degrees
1233	1.2 Side Facing Radar	753	2 Range Sensor SubSystem Safety HW reqs
1234	There shall be two side-facing radar sensors	709	A watchdog running at 2 Khz shall be used by the ACC module to determine if the Range Sensor subs to loss of power
1235		762	When a signal corruption is detected by the Range Sensor Arbitrator, the adaptive cruise control syste switched off within 100 ms.
753	2 Range Sensor SubSystem Safety HW reqs	824	The Range Sensor ECU hardware shall provide the means to interface with two Range Sensor sensor
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	742	The Range Sensor ECU hardware shall provide the capabilty to deal with the onboard processing of t Sensor data
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 capabilty to deal with the onboard processing of four 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.



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Thank You