DiM300とADAMS RT / SWIFT RTの乗心地官能評価への活用

Utilization of Driving Simulators in Ride Comfort Performance Development

Vehicle Dynamics Performance Division / SUBARU CORPORATION

Sep. 12, 2025

Tomoki Nagashima

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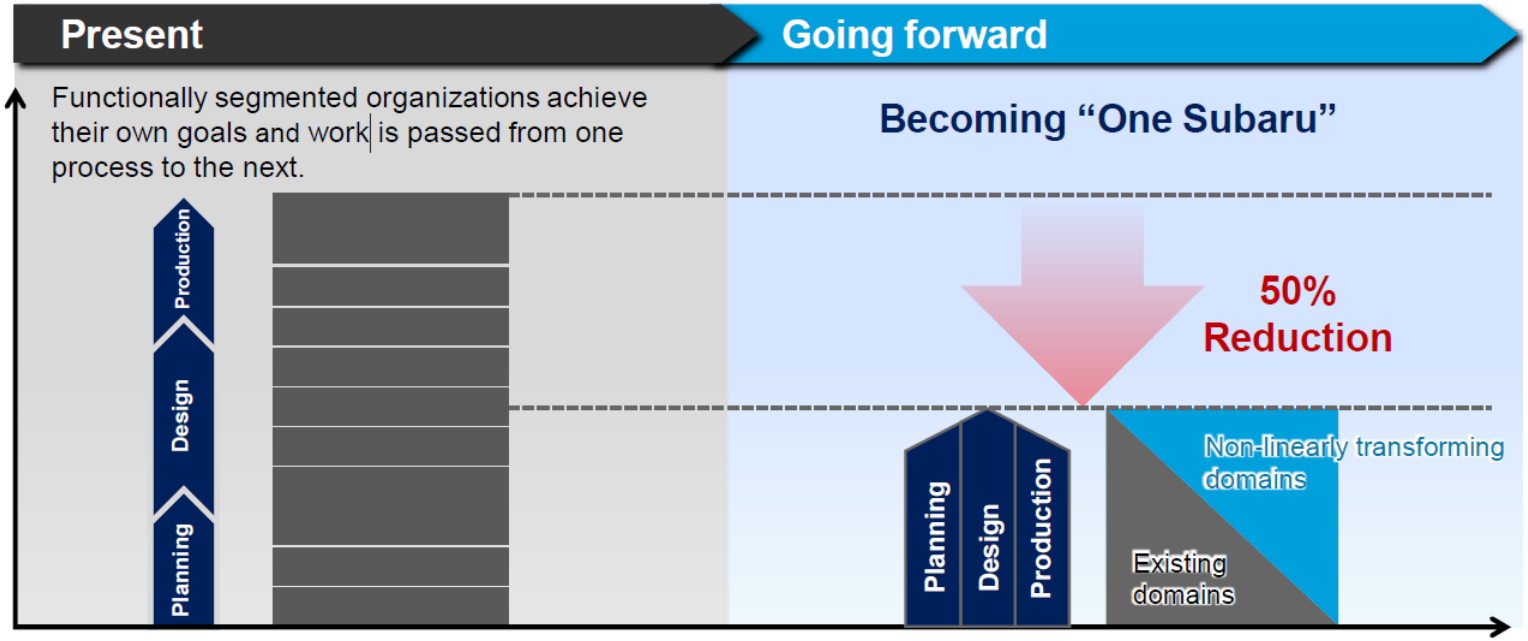
Introduction



Platform Development:

- ✓ New development of many components (chassis changes: suspension type, mounted e-axle, etc.)
- ✓ Rapid and parallel development of new models in limited prototypes

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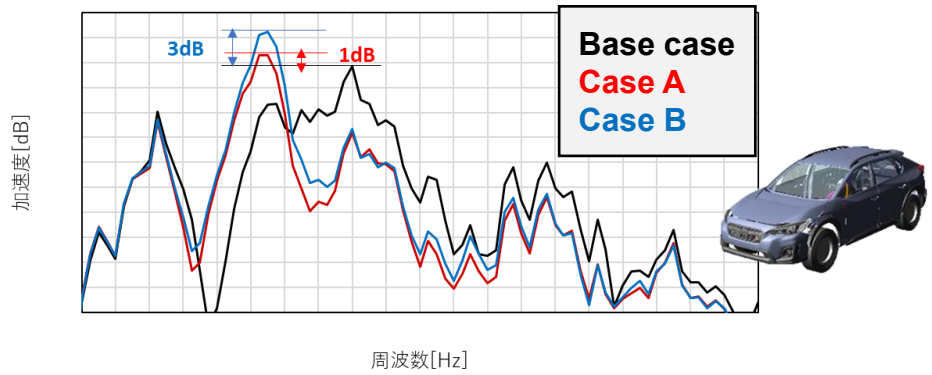
The motivation of driving simulator (DS) initiatives

We realize to achieve platform development by utilizing driving simulator (DS)

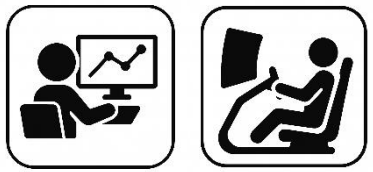
【Current Process（CAE）】

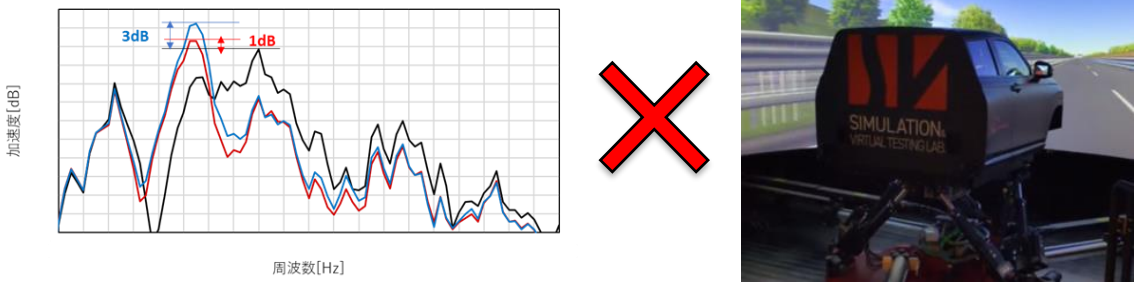
Although the vibration level and waveform changes are generally well reproduced compared to the actual vehicle, It is difficult to determine which case is appropriate based solely on CAE results..



【Trial Process（CAE × DS）】

Ahead of prototypes, assessment on DS and feedback **enable early definition** of vehicle characteristics.





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Digital Development Process for Vehicle Dynamics Performance

accelerate the digital development process in collaboration with S&VL (DS) and suppliers (MBD)

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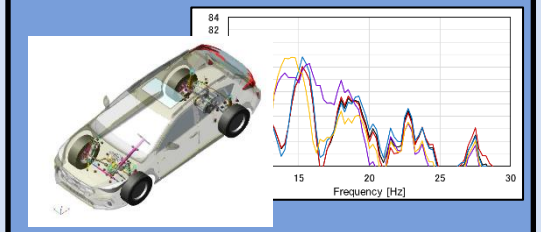
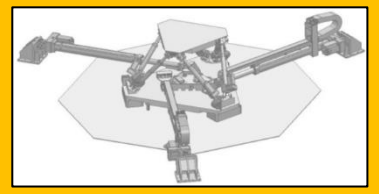


In-house vehicle models
and their applications

DS

Hardware/software resources

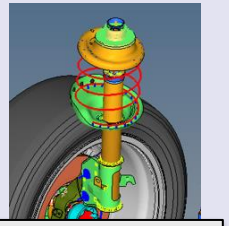
SIMULATION& VIRTUAL TESTING LAB.



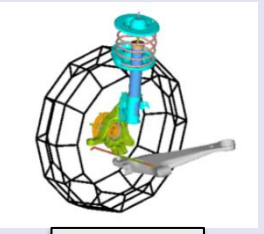
Outstanding skills and experiences for
modeling and operating DS

MBD

Suppliers



Damper



Tire

Detailed subsystem models
based on supplier's outstanding knowledge

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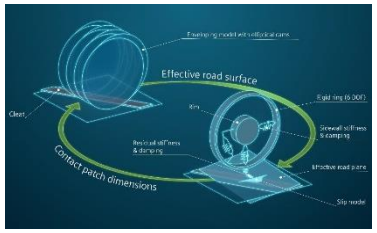
History of Ride Comfort development with Driving Simulator

FY23		FY24			
Jul.	Jan.	Oct.	Dec.	Feb.	Mar.

Verification of Practical Use of DS

★Real-time adaptation of the ADAMS model

★ADAMS-RT and MF-SWIFT-RT verification



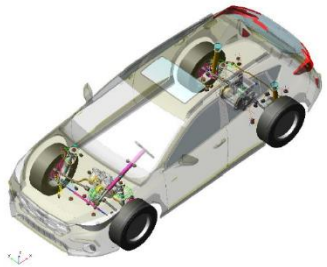
★DiM150 @Saginomiya

Achieving Real-Time DS with SUBARU ADAMS Model

Applying to Platform Development

★Evaluation and Selection of Bushing

★Evaluation of Damper



★ DiM300 @S&VL

Validation of Reproducibility and assessment of Suitability for Development Use

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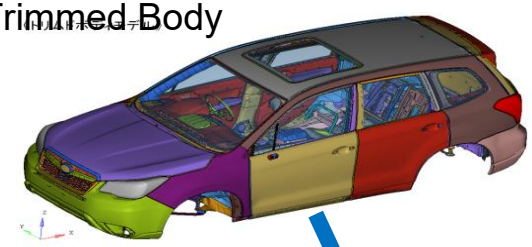
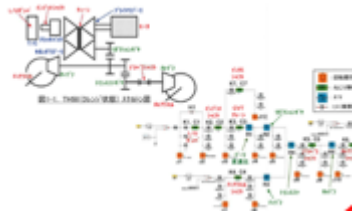
ADAMS Model for Ride Comfort Evaluation

- A model is constructed by combining components such as suspension, body rigidity, and tires.
- Design drawings and component characteristics is used, but no tuning for CAE purposes is applied.

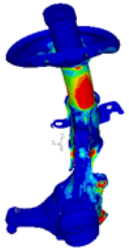
Trimmed Body

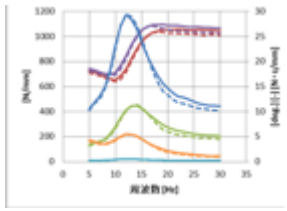


Power Train

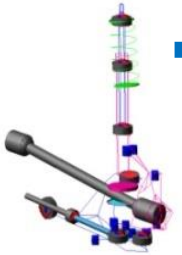


FLEX model

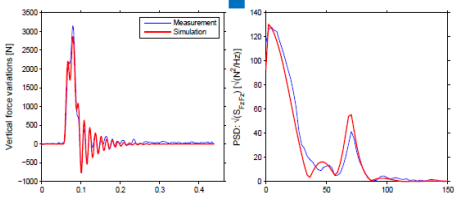




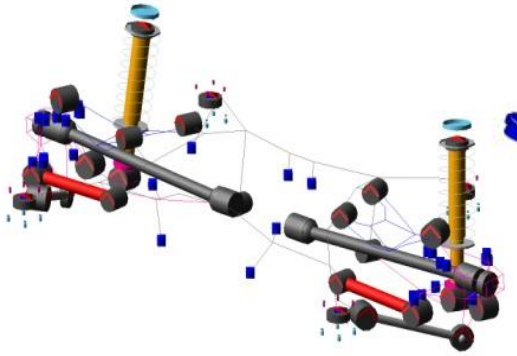
Non-Linear Bushing



Front suspension

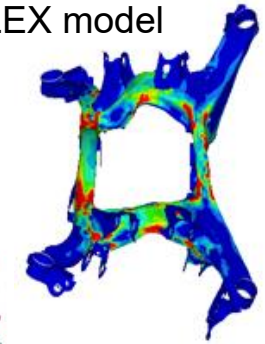


MF-Swift tire



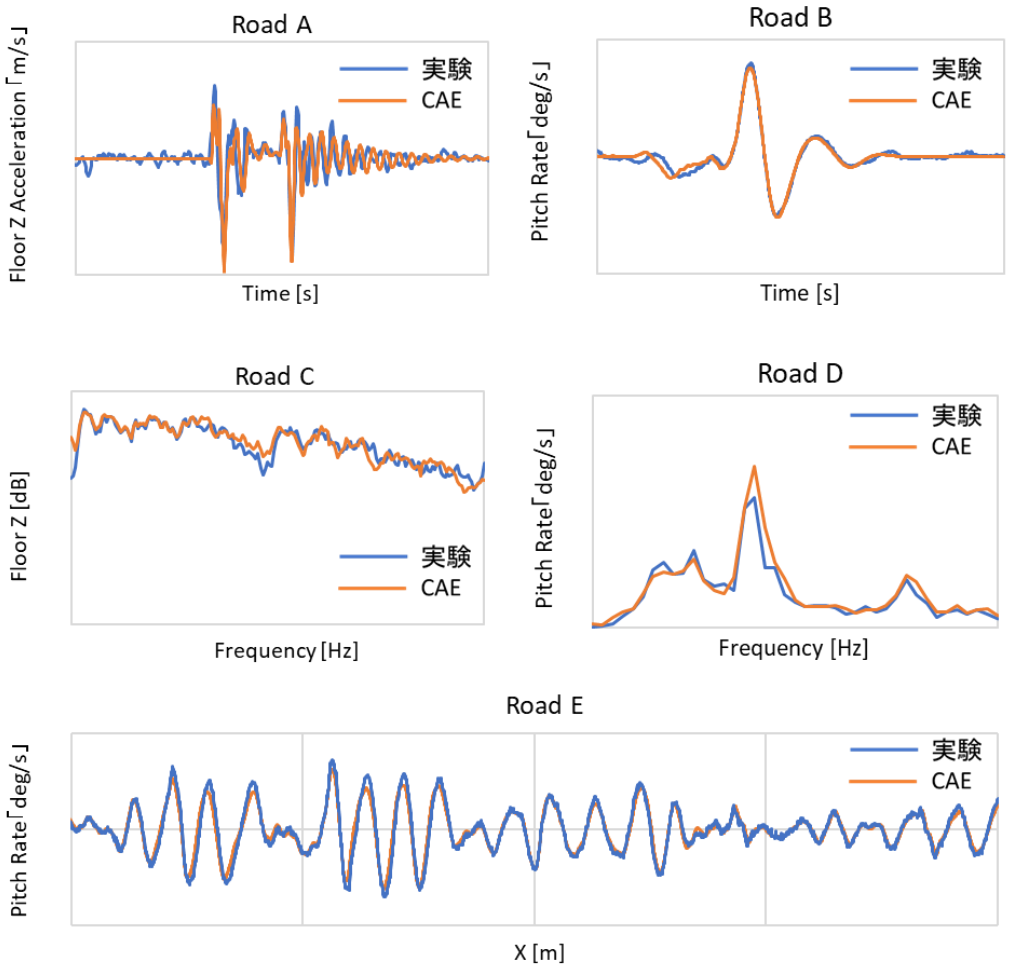
Rear suspension

FLEX model

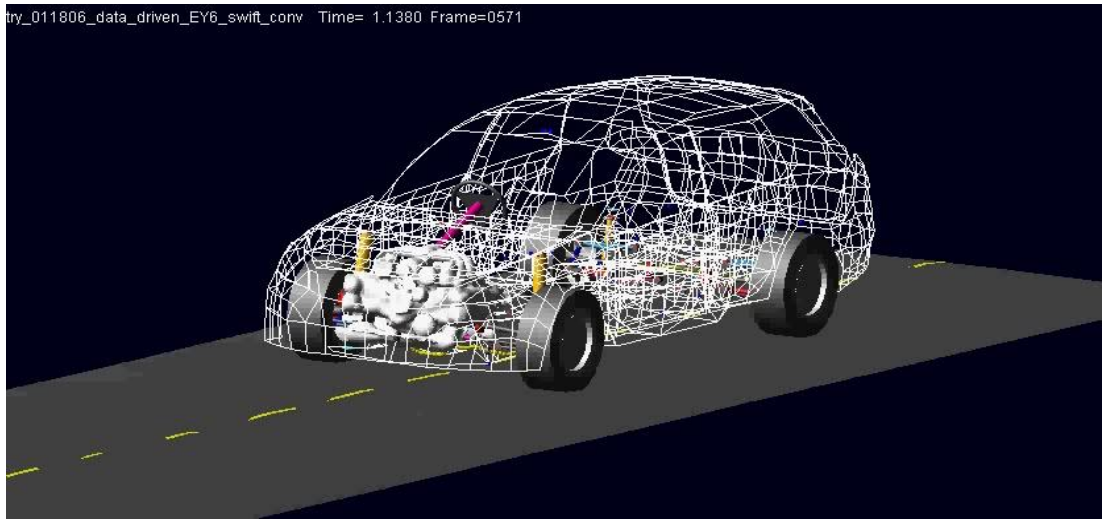


Fidelity of ADAMS Model

The CAE response waveforms accurately reproduce the acceleration level trends up to around 50 Hz.



No	路面名	評価内容	車両評価指標
1	Road A	継ぎ目のショック	フロア前後、上下加速度の大きさと収束性
2	Road B	大入力でのピッチ収束性	ピッチレートの収束時間
3	Road C	乗心地の滑らかさ	フロア前後、上下加速度の大きさ
4	Road D	上屋のピッチ(中速)	ピッチレートの大きさ
5	Road E	上屋のピッチ(高速)	ピッチレートと車体上下Gの大きさ



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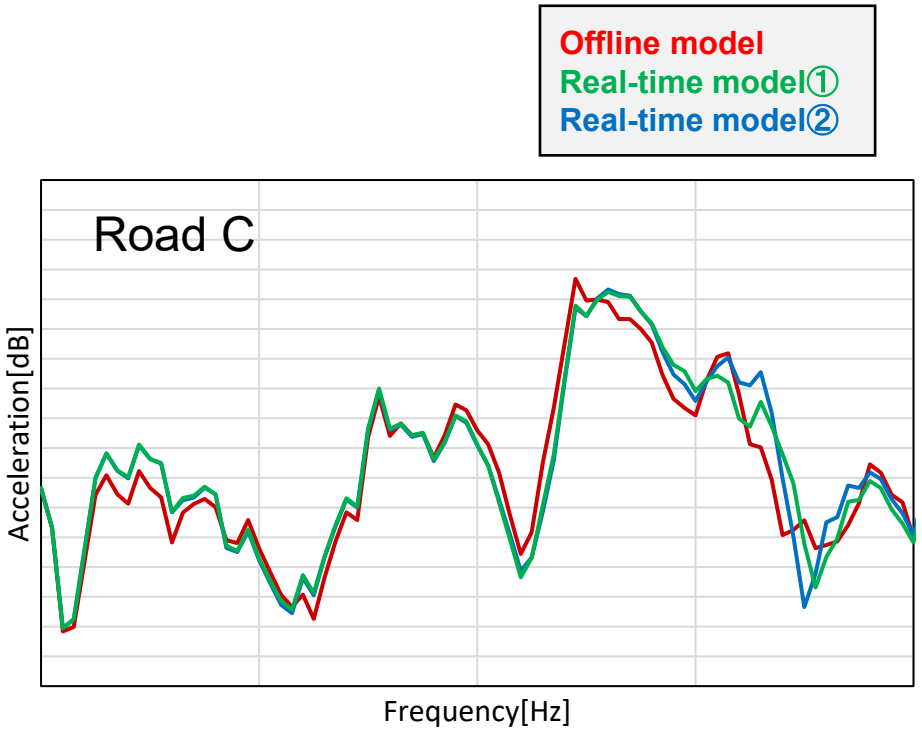
Verification of ADAMS Real Time Model

- The real-time (RT) model is constructed with reduced degrees of freedom based on the offline model.
- Differences between the offline model and the real-time model were also checked in advance.

		Offline model	Real-time model①	Real-time model②
subsystems	Body	flex	Rigid	Rigid
	Ft suspension		Rigid	Rigid
	Rr suspension		Partially flex	Rigid
	tires		MF-Swift Real Time	
Degree of freedom		1900	280	260
Real-time index		—	1.6	1.3

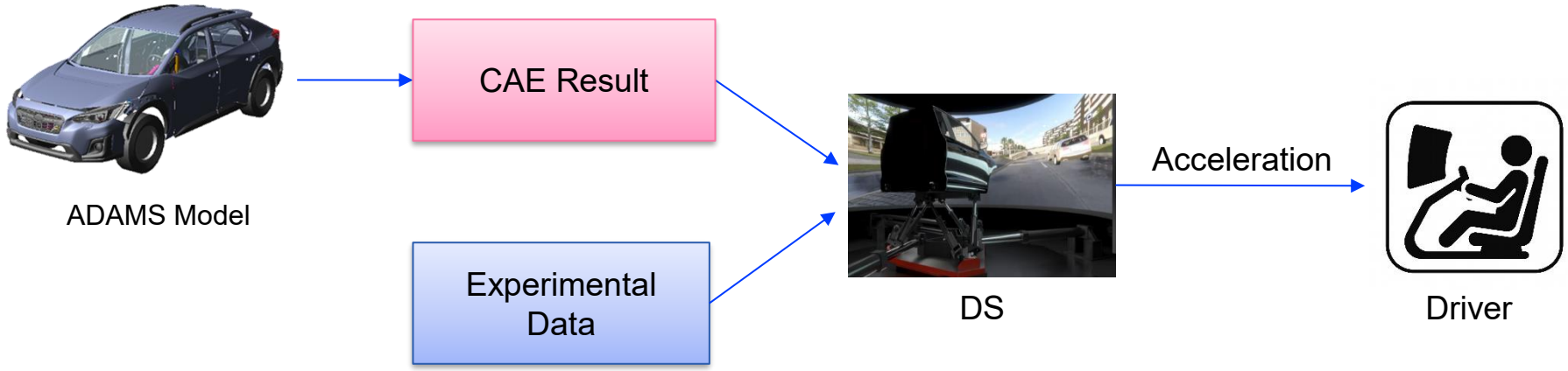
Real-time available（RTI ＜ 2）



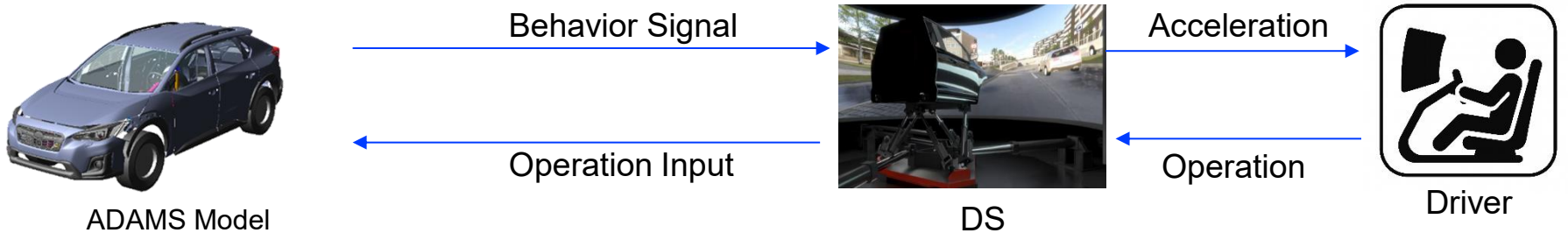
Offline model vs Real-time model

Test Drive to Verify Effectiveness by Experimental Engineers

Off-Line (Replay) Evaluation



Real-Time Evaluation



Strong positive feedback on real-vehicle reproducibility and spec differentiation
led to agreement on immediate application to development

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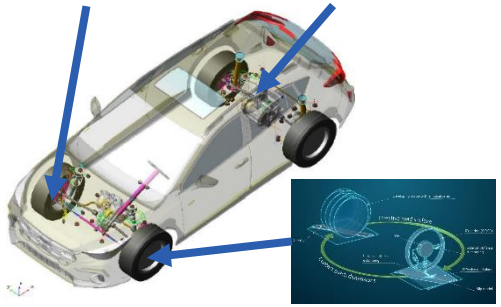
Pilot test of Ride Comfort development

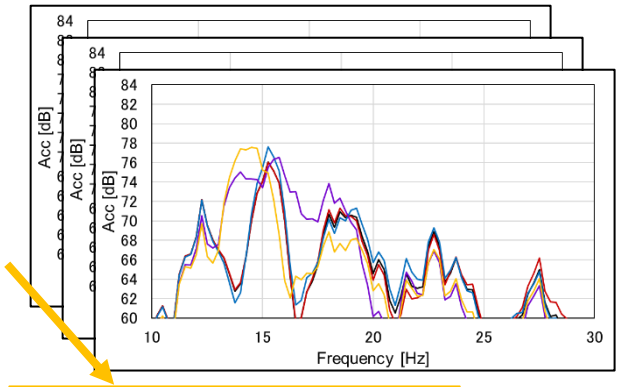
Trial scenario：evaluation of bushing mounted on new platform
Evaluate ride comfort by changing bushing **stiffness** and **damping**
→2 bushings（Front and Rear） × 5 properties × 7 situations = **70 cases at 5 days**

Adams modeling → CAE analyzing → DS evaluating → **Bushing characteristic determined**

Front bushing Rear bushing

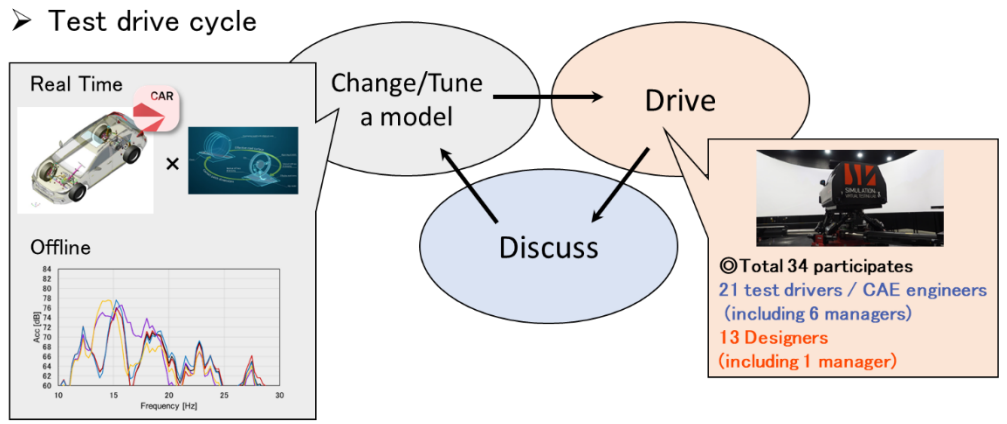


Build new platform
ADAMSRT × SwiftRT model



Various road and situations

Analyze results quantitatively and select bushing



the project team drove and discussed about the best bushing

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MBD Collaboration with Damper Supplier

Establish the direction of damper characteristic and practical feasibility before prototypes
by utilizing supplier's detailed models and outstanding knowledges

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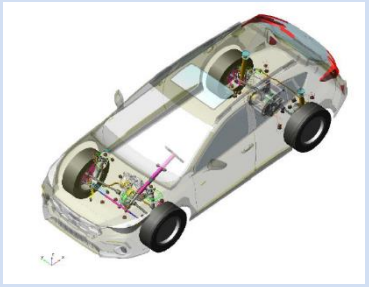
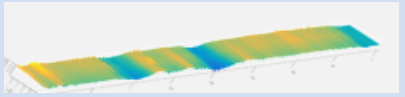


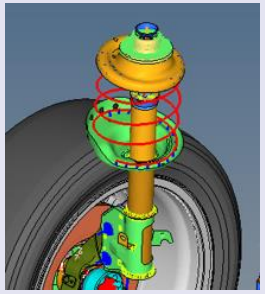
ADAMS model



Road data

×

Supplier



Detailed damper model
considering friction and feasibility

- standardizing each analysis environment (road, calculate condition, postprocessing) to discuss about the same results
- providing necessary characteristics while mutually sharing encrypted models for protection of confidential

Both SUBARU and supplier evaluate ride comfort with DS in various specifications and situations

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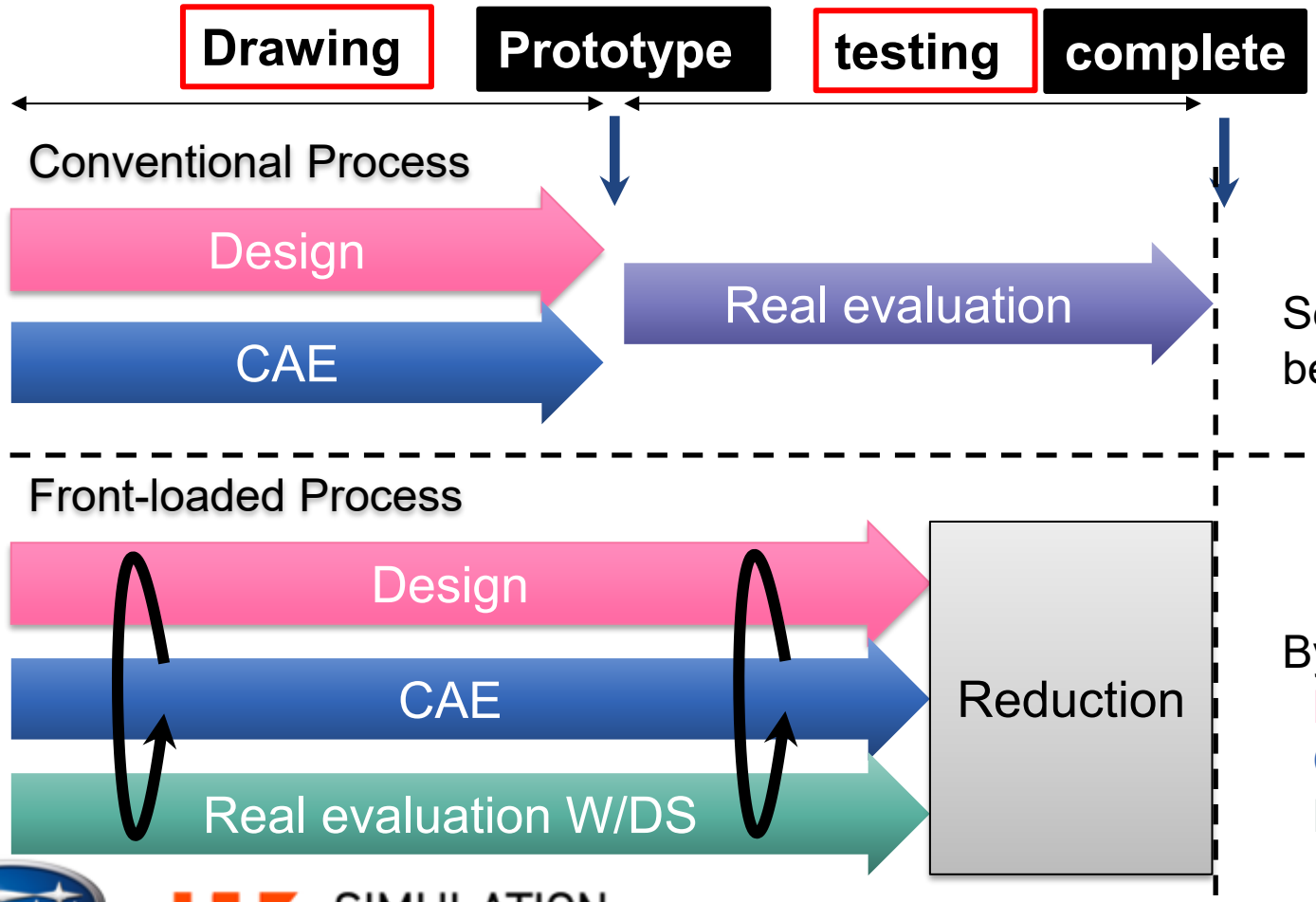
Conclusion

We completed ride comfort performance a year earlier.
DS application will be expanded to handling and body structure.



Separated responsibility
before and after prototypes

By discussing in parallel,
Design) **draw more confidently**
CAE) **evaluate wider characteristics**
Real) **involve before prototypes**

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Thank You!