

CAE current status and future plan in Nissan Motor

October 29, 2010

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Integrated CAE Department
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- **CAE History of NISSAN**
- **CAE value definition and current status**
 - related with Process innovation as Nissan V-3P —
- **CAE cover range and its expansion plan**
 - with reference of R&D technology strategy—
- **Summary**

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History of CAE

Computer-aided engineering (often referred to as **CAE**) is the use of information technology to support engineers in tasks such as analysis, simulation, design, manufacture, planning, diagnosis, and repair.

Wikipedia

SDRC (**Lemon**) is well known globally as one of the first to coin the term "**MCAE**" (Mechanical Computer Aided Engineering) in the **70's**. He said,

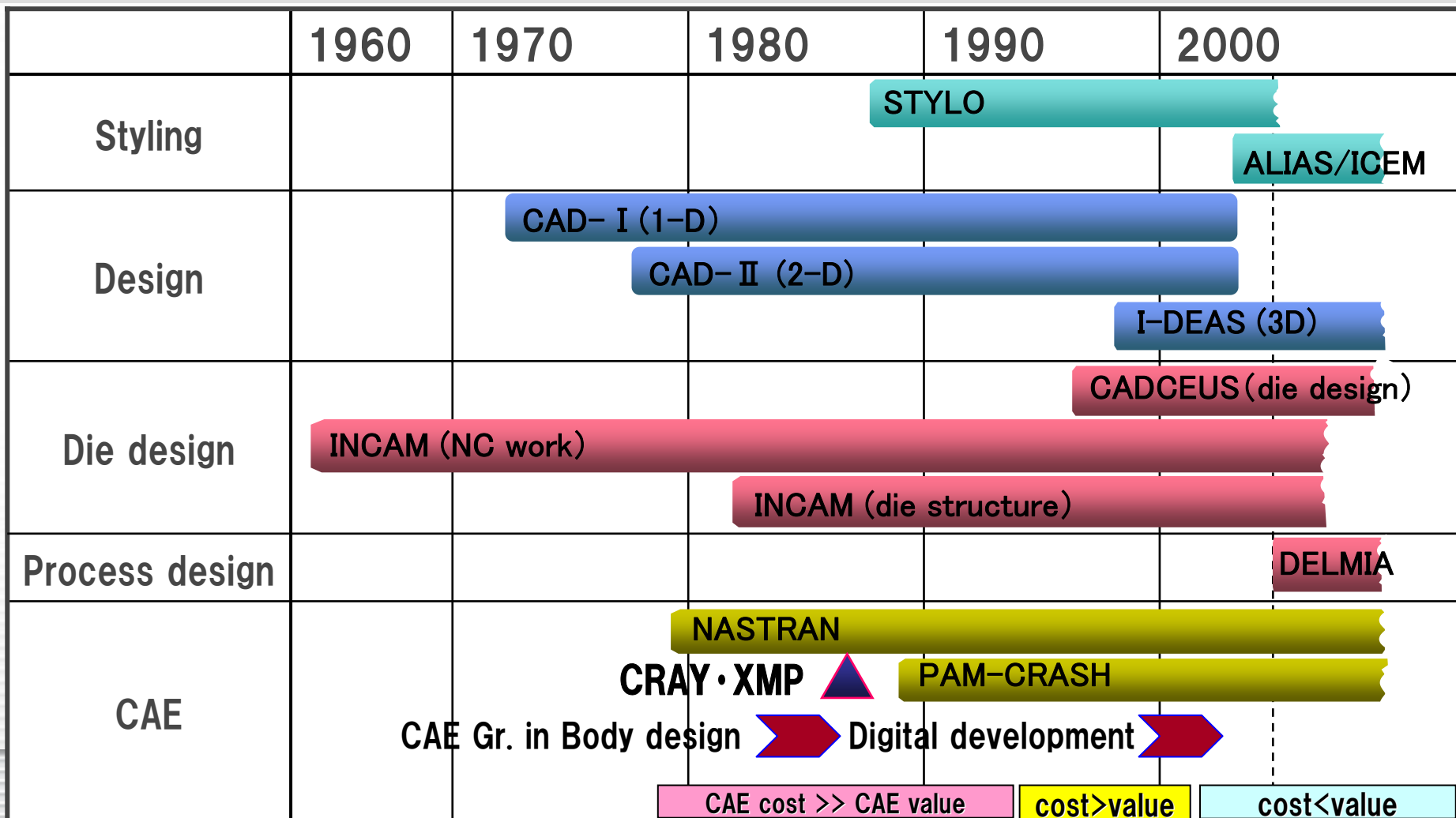
- Only CAE can innovate the design process.
- Long term, huge investment will be needed for CAE to be embedded in development process.
- But CAE will contribute to reduce process and to develop differential products



Dr. Jason R. Lemon, University of Cincinnati

History of Nissan CAE

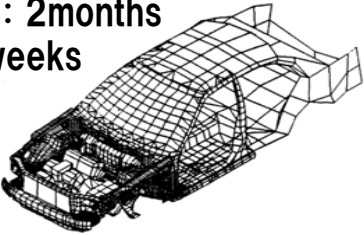
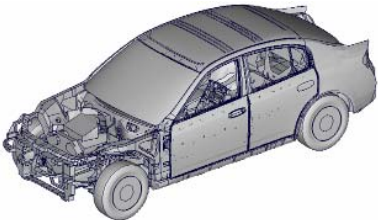
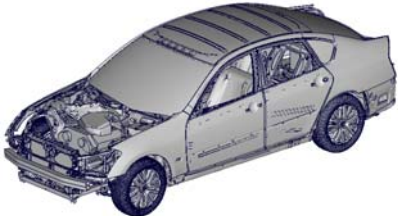
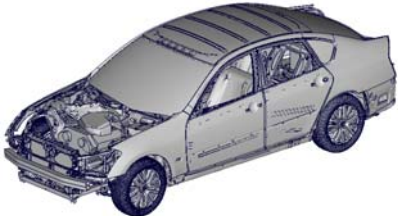
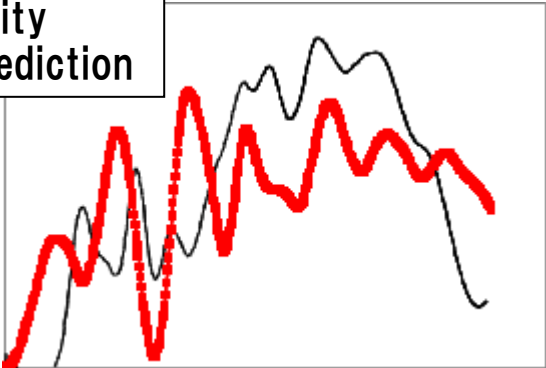
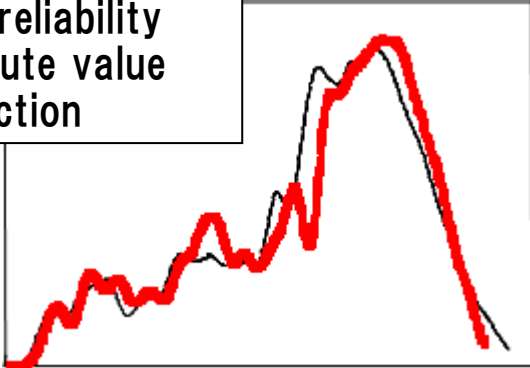
- Nissan started CAE in the late 70's and expand after CRAY install at 1986.
- Up to 2000, CAE cost was bigger than the value created by CAE
- Around 2000, almost all system gathered and digital development started.



History of Nissan CAE

Example (Crash CAE)

- More than 1M elements for detail modeling (2005~)
- Become able to predict absolute value of performance

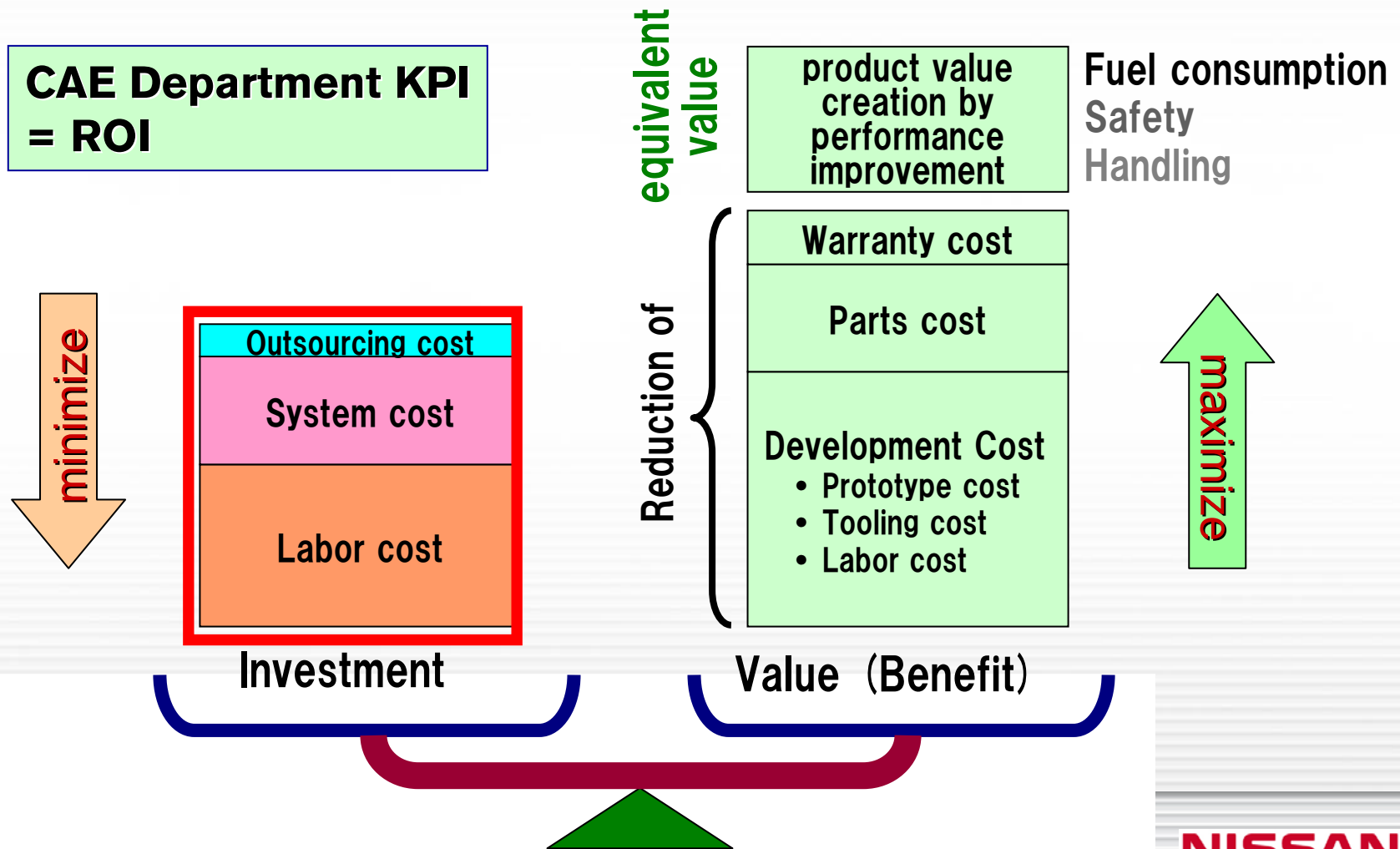
	1990	1995	2000	2005
Model	10~20K elements modeling : 2months calc.: 2 weeks 		200K elem. 	1M elem.~ modeling : 3 weeks calc. : less than 1day 
Accuracy	<div style="border: 1px solid black; padding: 5px;"> low reliability relative prediction </div> 		<div style="border: 1px solid black; padding: 5px;"> High reliability absolute value prediction </div> 	

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CAE value definition and current status

< Basic Concept for CAE investment >

Value created by CAE should be bigger than its cost



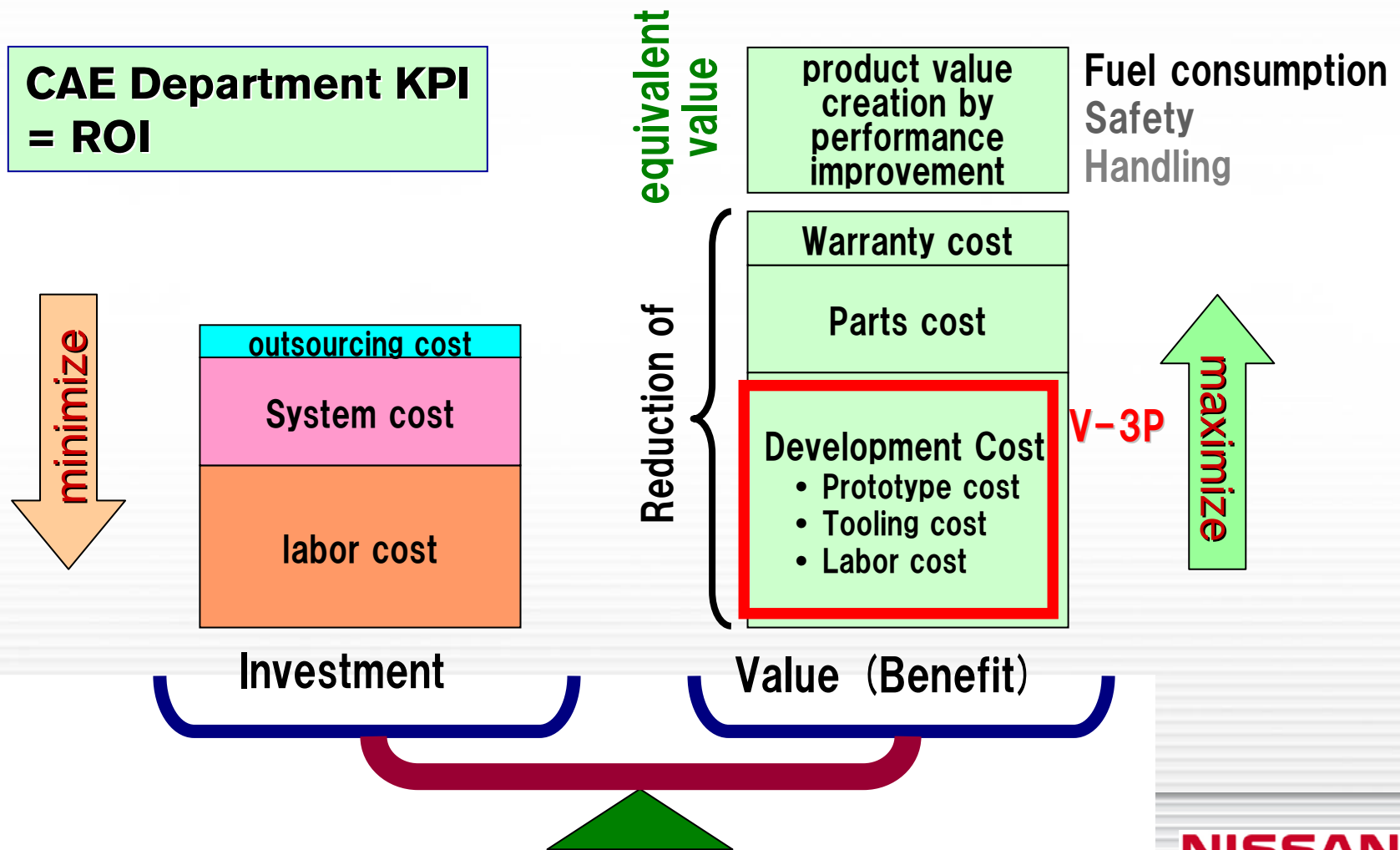
CAE value definition and current status

- Minimize CAE cost with combination of software cost and labor cost (Automatization/LCC utilization).
- Software cost is controlled strongly by TOP manamement.
- Regarding model building, we need **“CAD to FE-model 24h”** is quite welcome. ⇒ **waiting for Altair’s tool**

CAE value definition and current status

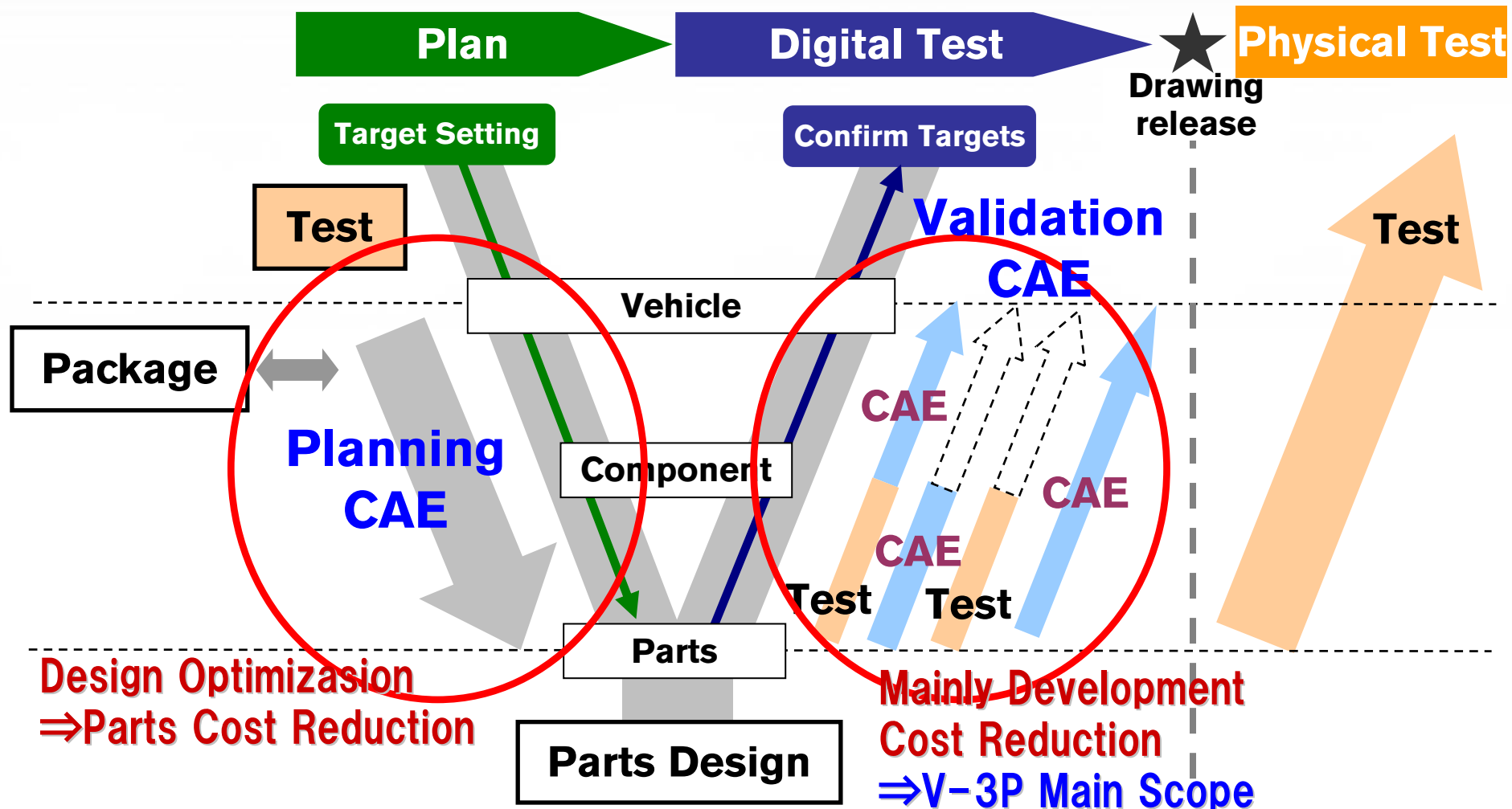
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Value created by CAE should be bigger than its cost



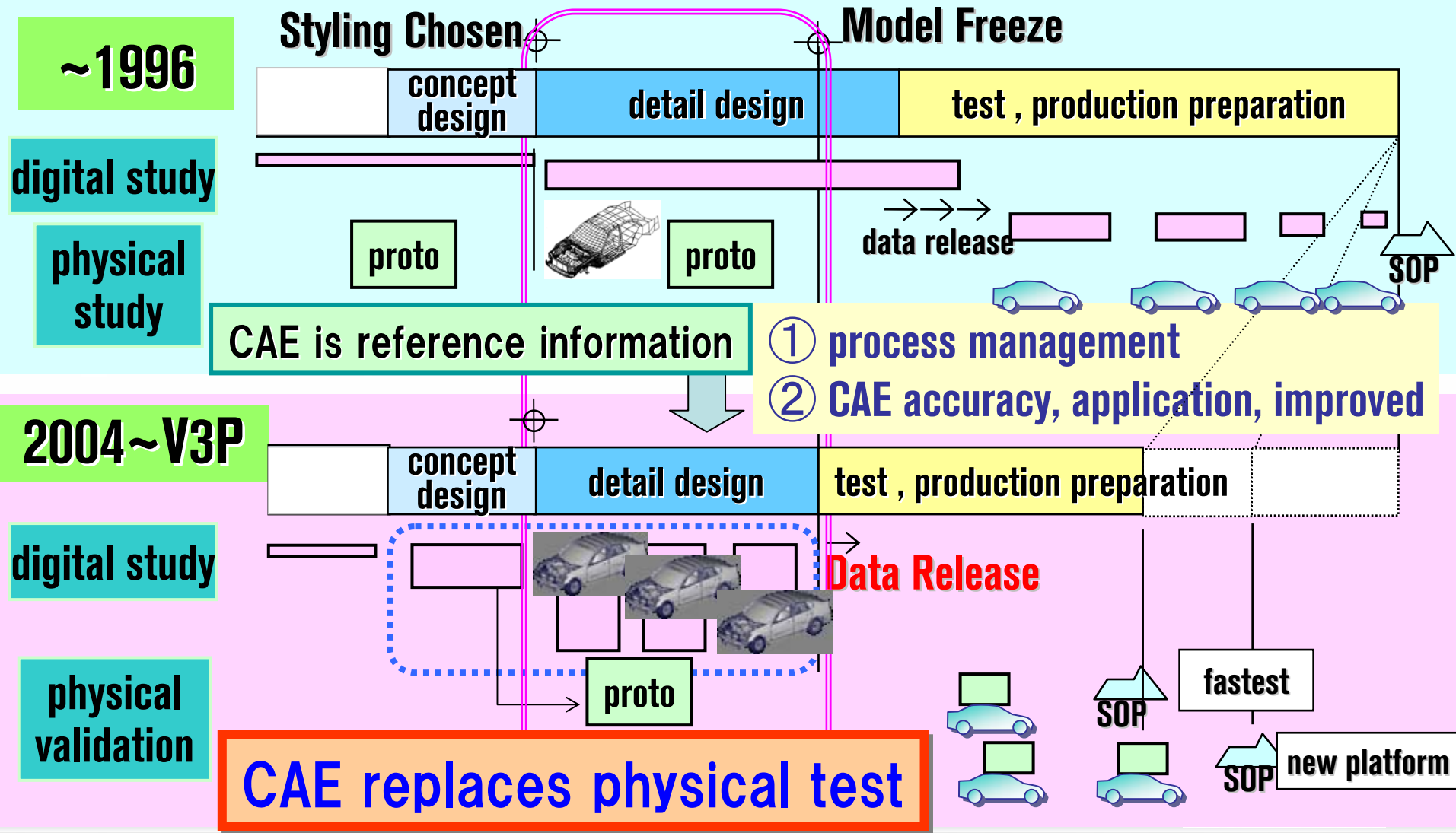
CAE value definition and current status

Validation CAE contribute to development cost reduction
Planning CAE has big opportunities for parts cost reduction



CAE value definition and current status

- V3P has 3 digital lots
- All performance should be validated till **Data Release**



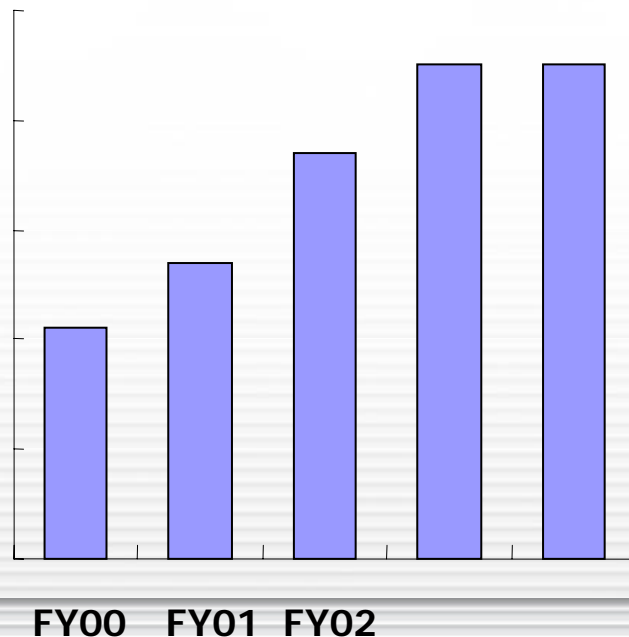
CAE value definition and current status

The Result of Performance CAE

- Up to 2004 : Expanded the scope of analysis application approximately twice as well as improved the analysis accuracy
- Proto-type 1st test OK rate reached record high of 95%.

Components of
Performance Evaluation

OK Rate of Trial Production Vehicle
on "NOTE" and "Wingroad"



Example : Crash CAE

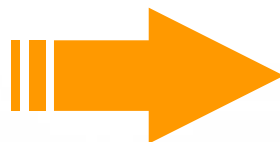
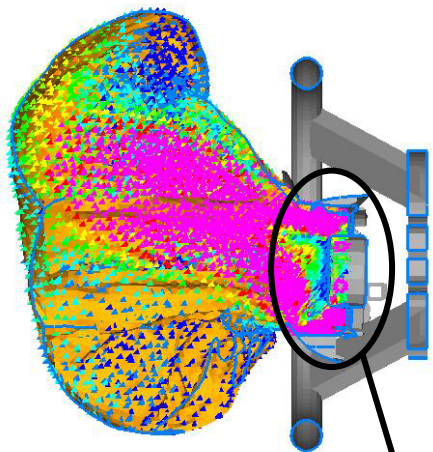
Injury Prediction CAE technology for
test reduction

CAE value definition and current status

Example of Key technology of Crash safety

Representation of Air-bag deployment : gas flow

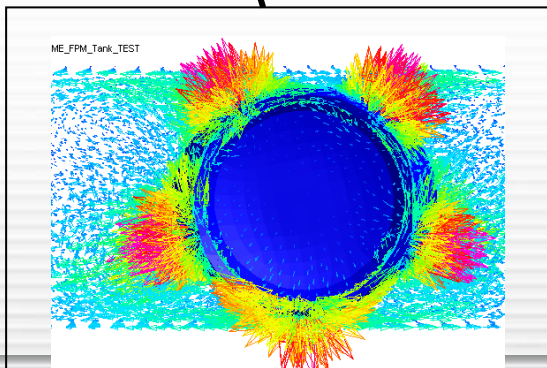
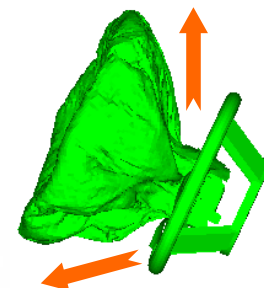
Accurate airbag CAE is achieved with FPM to represent gas flow.



Test



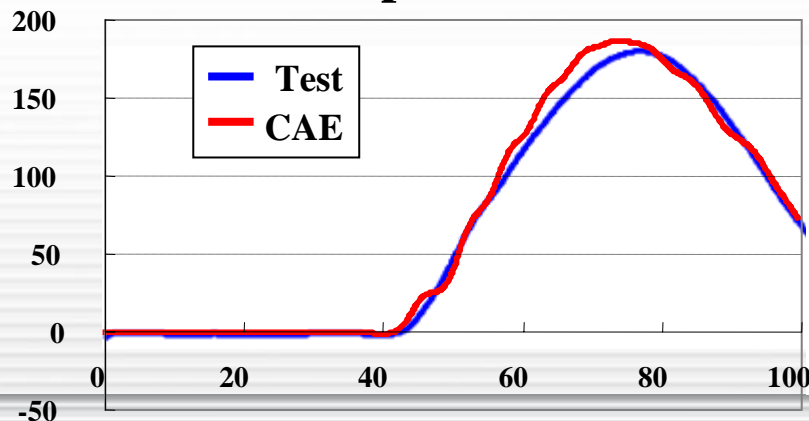
CAE



around gas generator

G(m/s²)

Impact test



Current status of CAE cover range and value

Example of Key technology of Crash safety

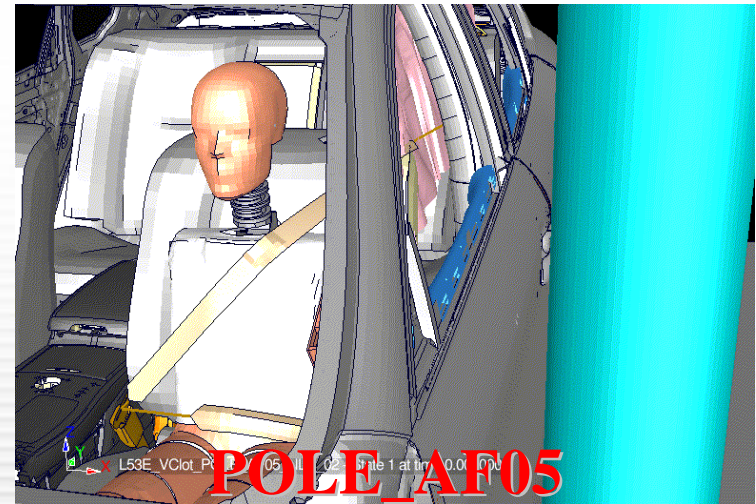
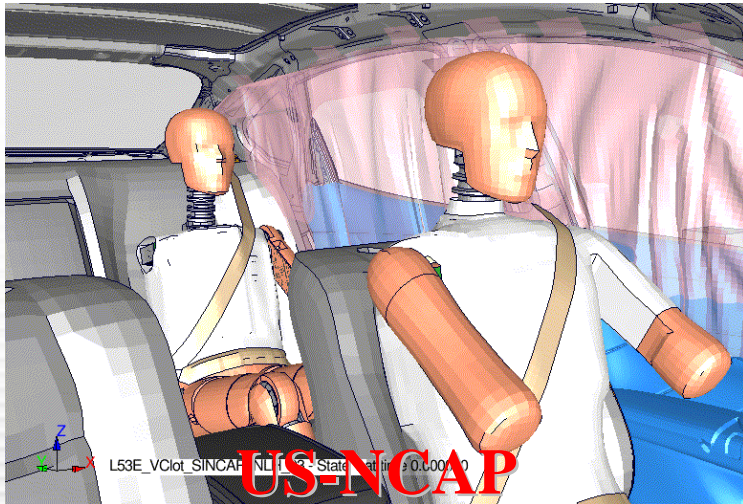
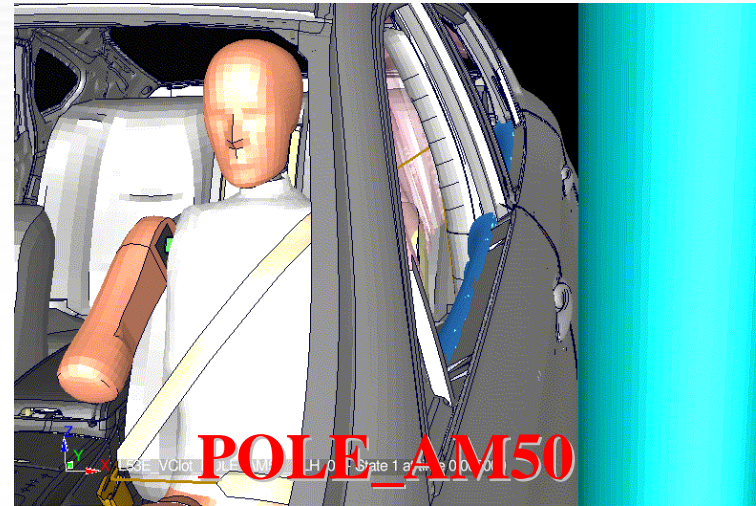
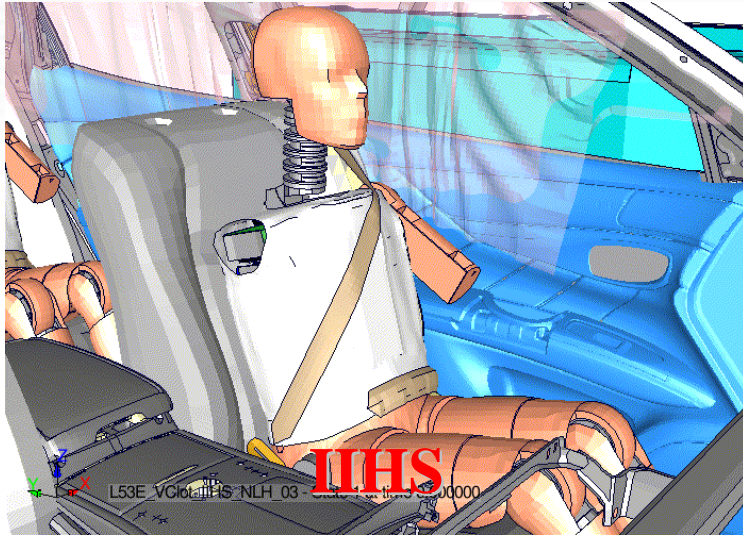
Representation of Air-bag deployment : bag folding

Sim-folder is quite effective to fold air-bag model.



Current status of CAE cover range and value

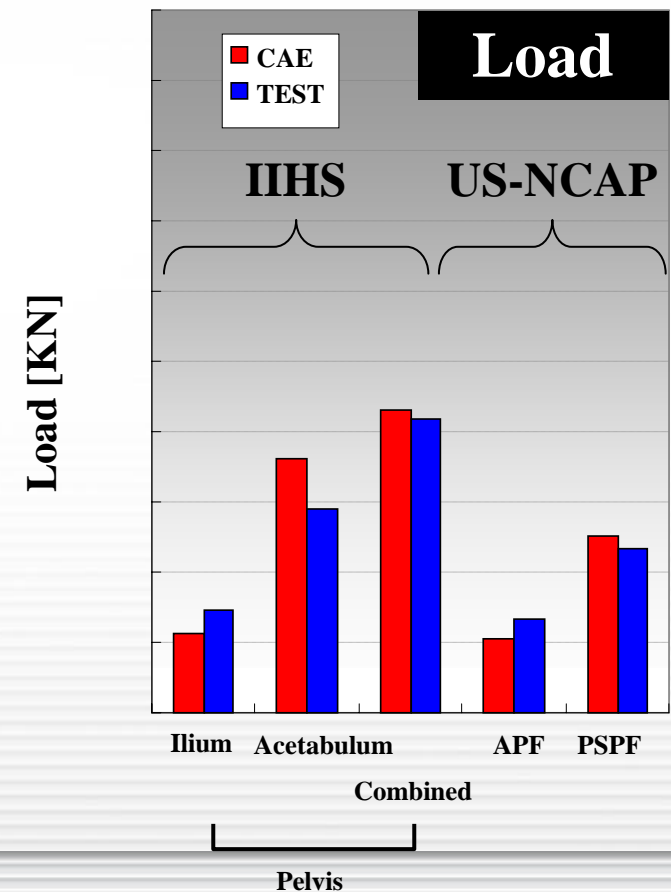
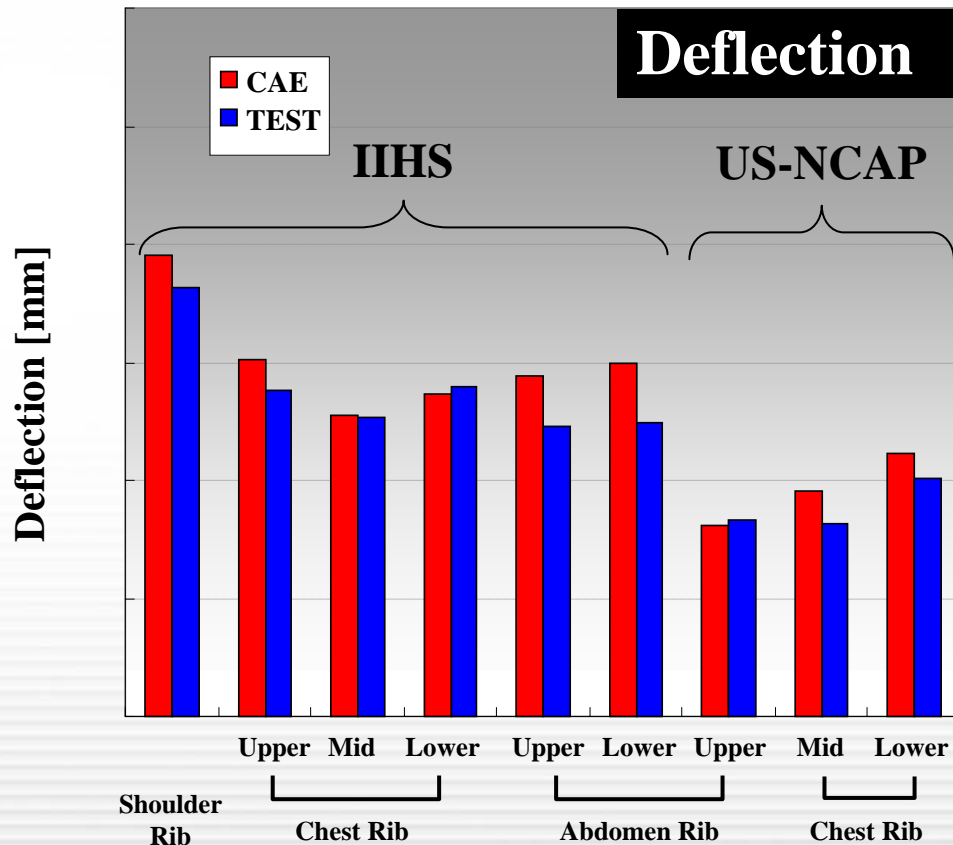
Side Impact : this technology applied to 7 regulations



Current status of CAE cover range and value

Side Impact : Injury value prediction accuracy become enough to validate the design

⇒by this technology, **test reduced**

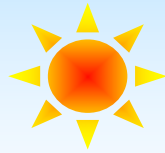


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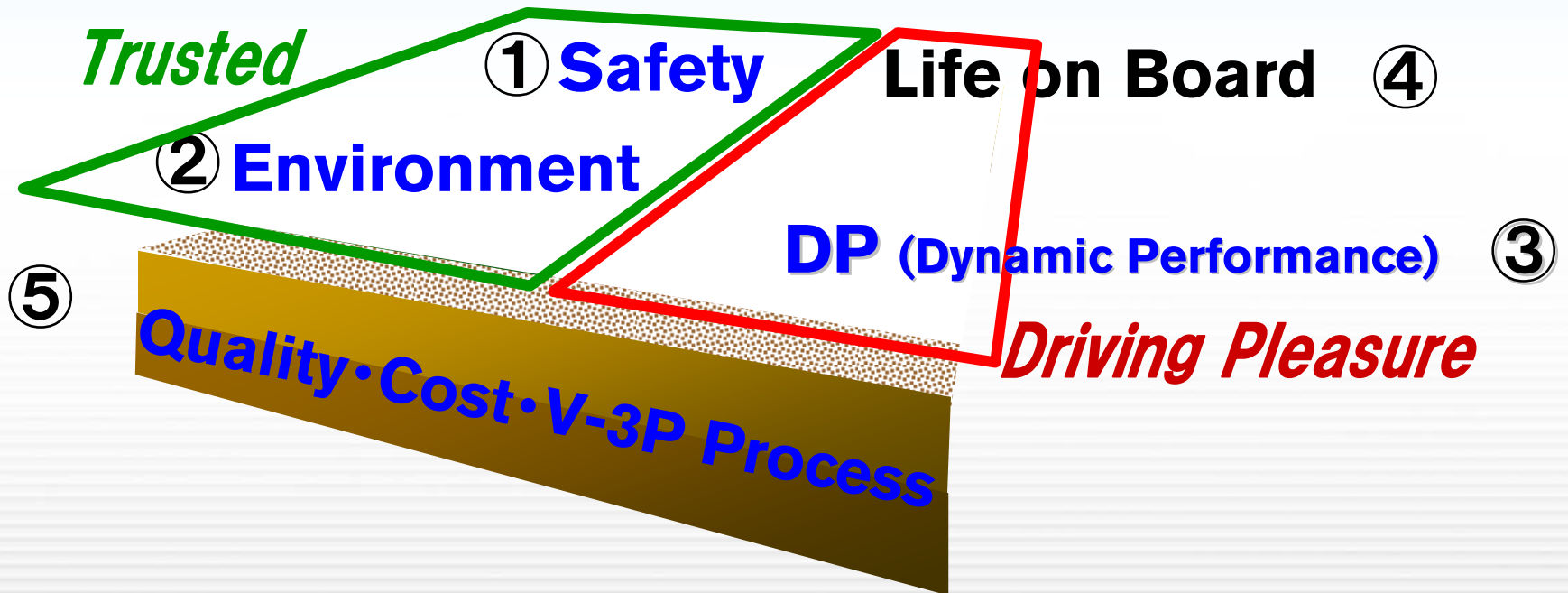
Nissan's Four Strategic technology Fields (2006~)

Nissan's Core Technology Values:

Trusted Driving Pleasure



For each field, technology development will be achieved based on a defined target (Vision 2015) and detailed roadmap

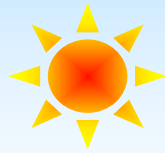


CAE contribution domain

Nissan's Four Strategic technology Fields (2006~)

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Safety

Life on Board

Environment

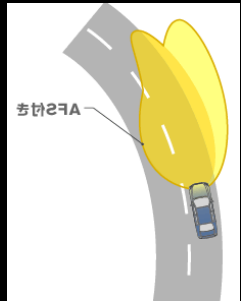
DP (Dynamic Performance)

Quality • Cost • V-3P Process

CAE cover range and expansion plan –Safety–

Safety Shield Concept *“The Vehicle That Helps Protect People”*

The vehicle activates various barriers to help the driver, passengers and other road users avoid danger from normal driving conditions through post accident conditions.



Risk has not yet appeared

ex) Adaptive Front-Lighting System (AFS)

Risk has appeared

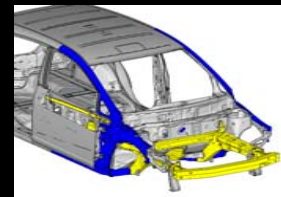
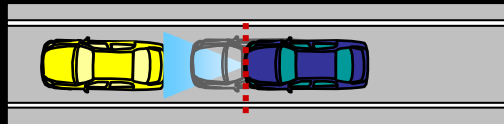
ex) Lane Departure Prevention (LDP)



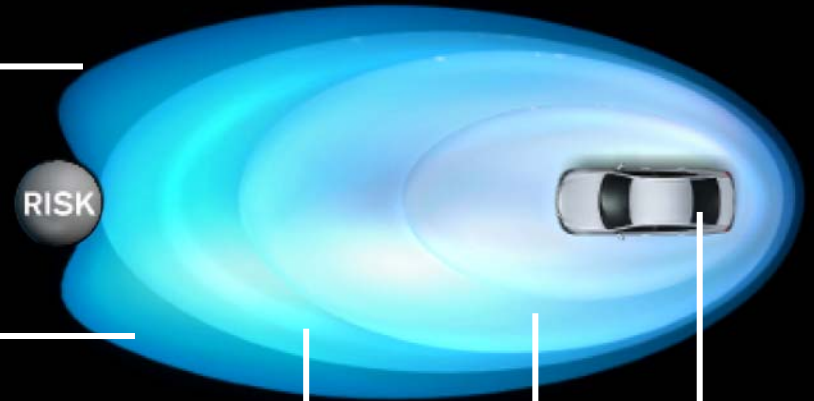
Crash may occur
ex) Vehicle dynamics control (VDC)

Crash is unavoidable

ex) Intelligent Brake assist , Pre-crash Seatbelt



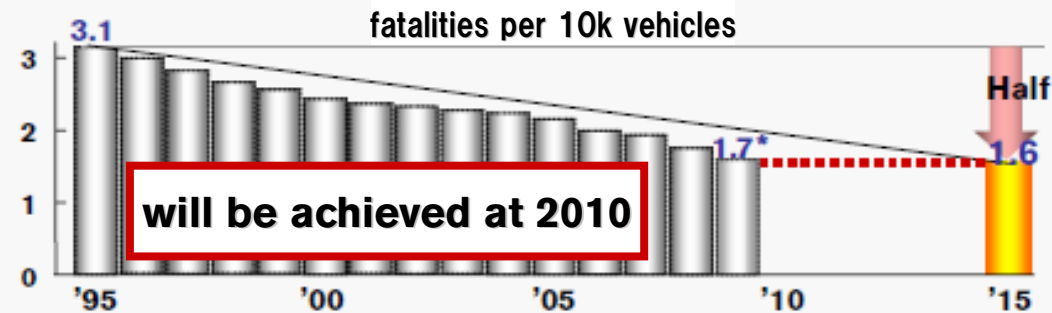
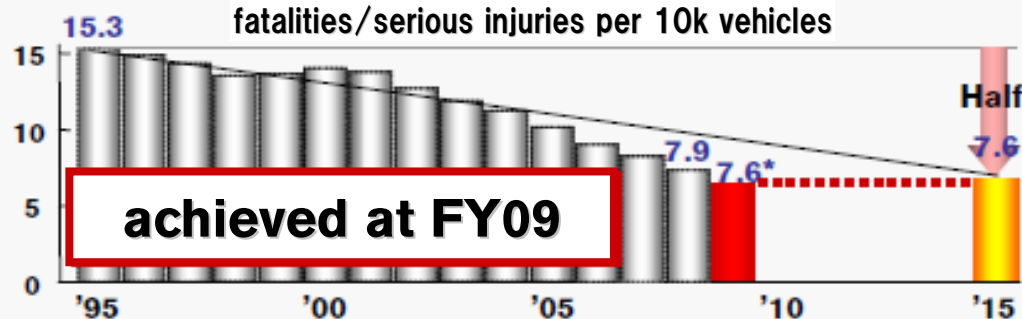
Crash
ex) Zone Body , Pop-up Engine Hood



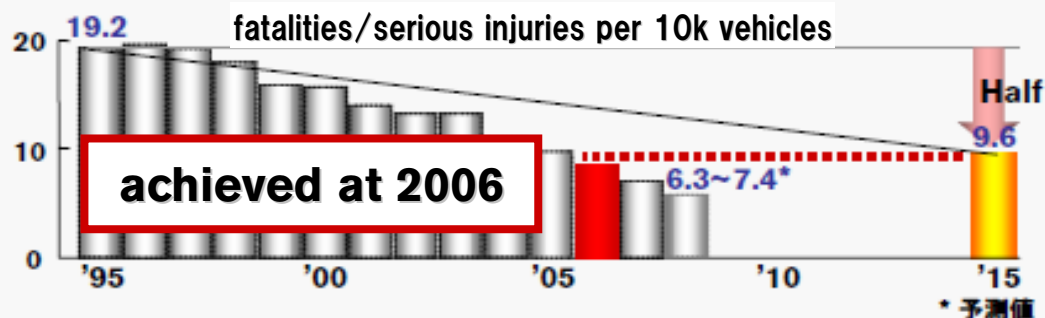
CAE cover range and expansion plan - Safety -

Safety

Reduce **fatalities/serious injuries** involving nissan vehicles to **half** of 1995 rate by 2015



(incl. UK)

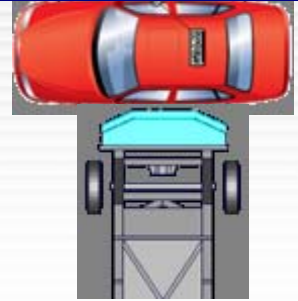


CAE cover range and expansion plan - Safety -

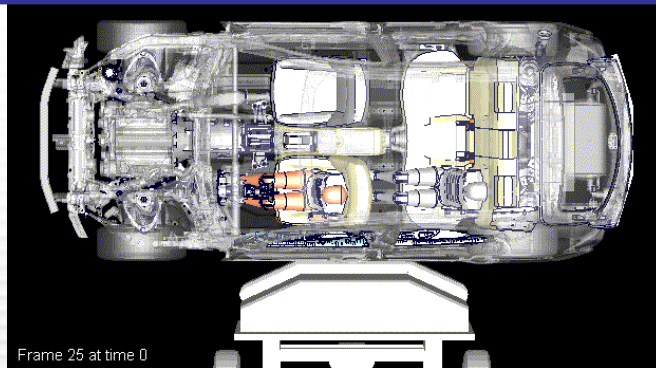
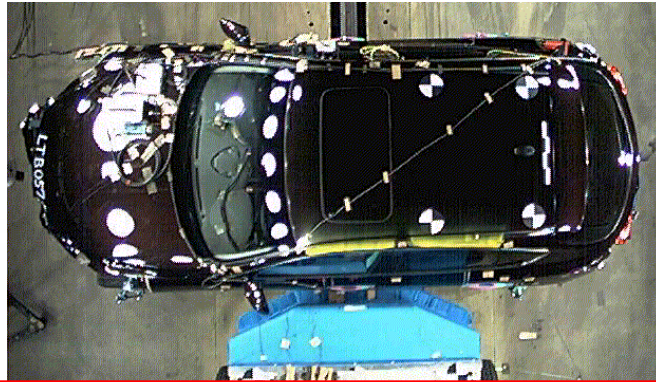
Passive Safety CAE technology

Already expanded to Injury Value Prediction

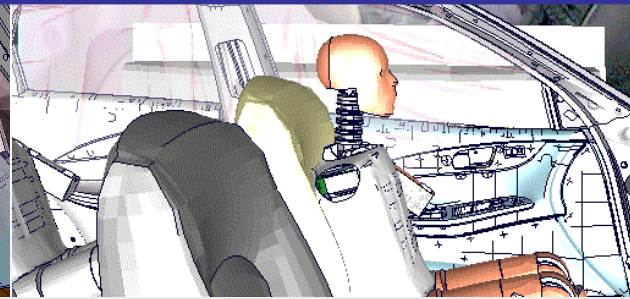
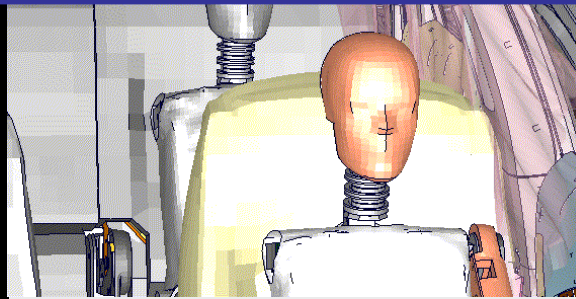
MDB Velocity : 50km/h



TEST



Frame 25 at time 0



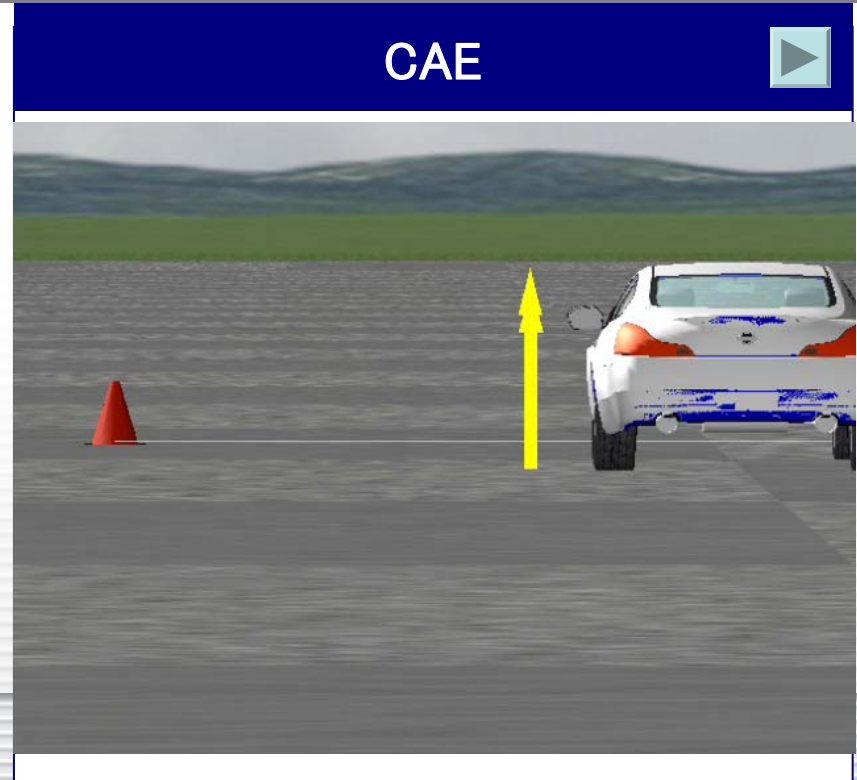
CAE

CAE cover range and expansion plan –Safety–

Active Safety CAE technology : ESC regulation

Should be expanded to “Active Safety with Control Technology”
like followings ; SILS,MILS,HILS...

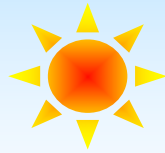
- US:FMVSS126, E/J:ECE R13H, Australia:ADR31-02 based on gtr No.8 (Global Technical Regulation)
- CAE can select worst case to test



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CAE cover range and expansion plan -Environment-

Start of Sales : 2010 December (JPN,US)
2011 (EUR)



Capacity	5 persons	Max. SPEED	140kph over
DRIVE	FWD	BATTERY	LAMINATED Li-ion BATTERY (AESC)
MOTOR (O/P•Torque)	High Response Synchronous AC MOTOR (80kW•280Nm)	BATTERY CAPACITY/ POWER	24kWh/90kW over
RANGE	160km over (US LA4)	OTHER	Dedicated IT System

CAE cover range and expansion plan -Environment-

■ Nissan original Hybrid : Light weight / Compact

- No torque converter.
- 1 Motor for both drive and electric generator.

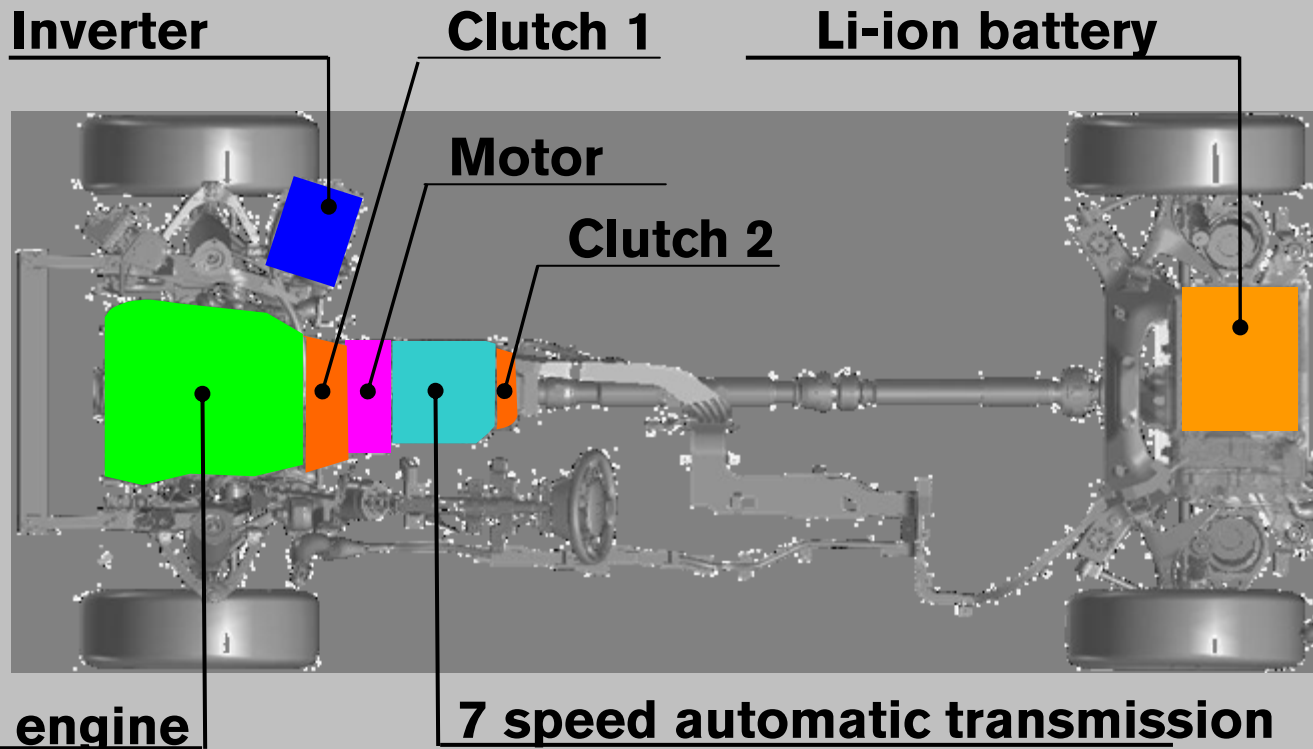
Clutch control is quite difficult (drivability/fuel efficiency...). But test based development ⇒ Many design changes had done.

SILS for PT/Chassis control should be developed.

November, 2nd



Infiniti M HV : 5.26L/100km



V6 3.5L engine

7 speed automatic transmission

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Summary

- CAE is constituted in vehicle development process and contributed to reduction of “development cost”, “part cost”, “development term”, and “quality & performance improvement”.
- Furthermore we expand CAE coverage and CAE quality to achieve practical value, especially in EV/HV domain.



Thank you for your Attention

