



**CASPER**

CHILD ADVANCED SAFETY PROJECT FOR EUROPEAN  
ROADS

## Dummy Modelling

*COVER Workshop November 29th/30th  
Munich, Germany*



# Agenda

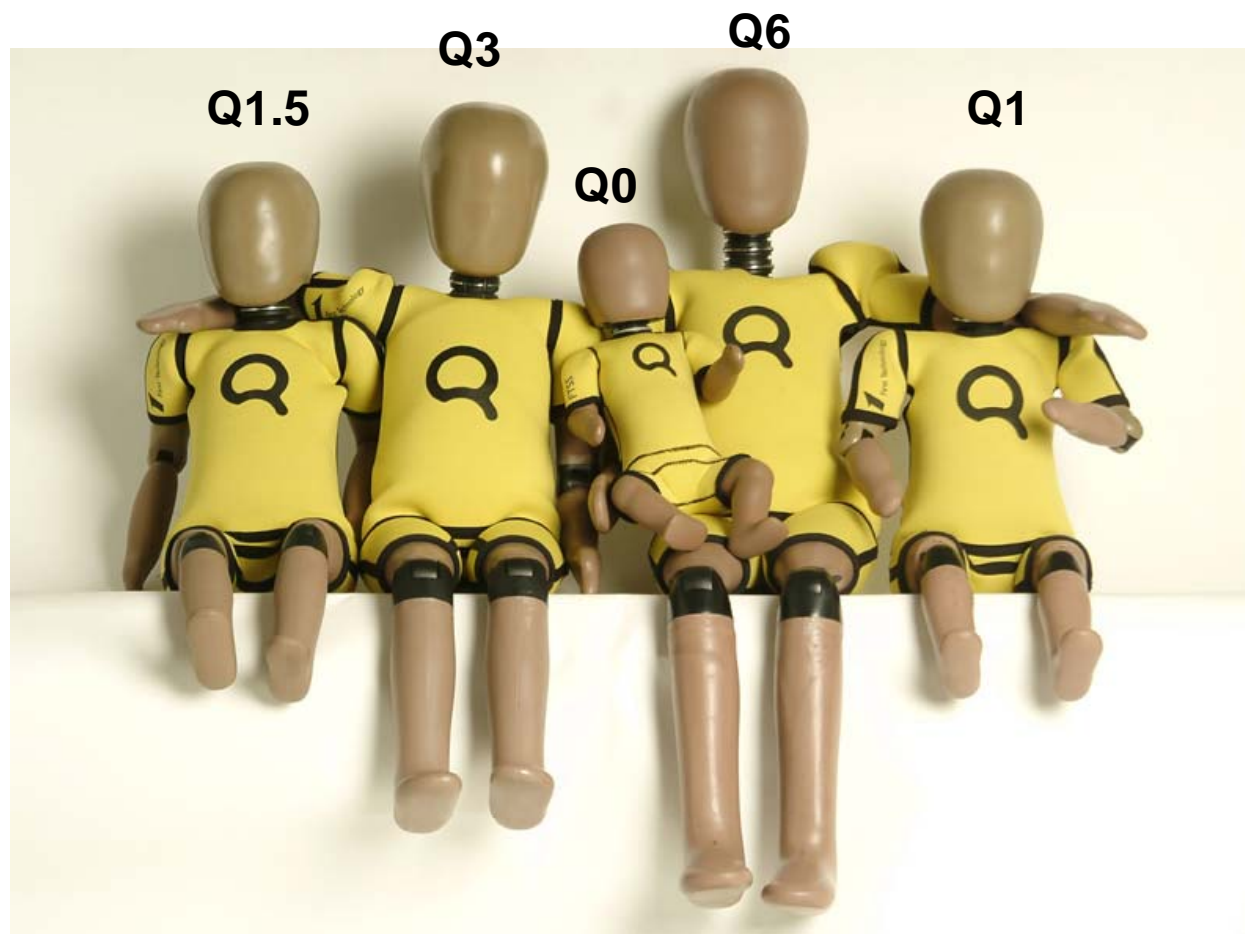


1. Situation at the beginning of the CASPER project
2. Status CASPER Dummy models
3. Future activities

# 1. Situation at the beginning of CASPER



## Hardware dummies



# 1. Situation at the beginning of CASPER



## Hardware dummies 2

Q10

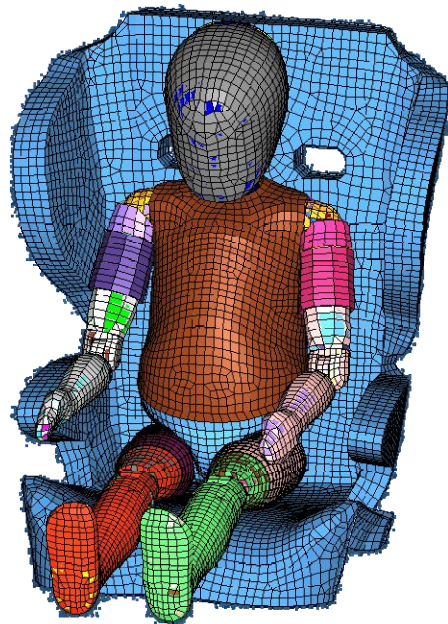


# 1. Situation at the beginning of CASPER



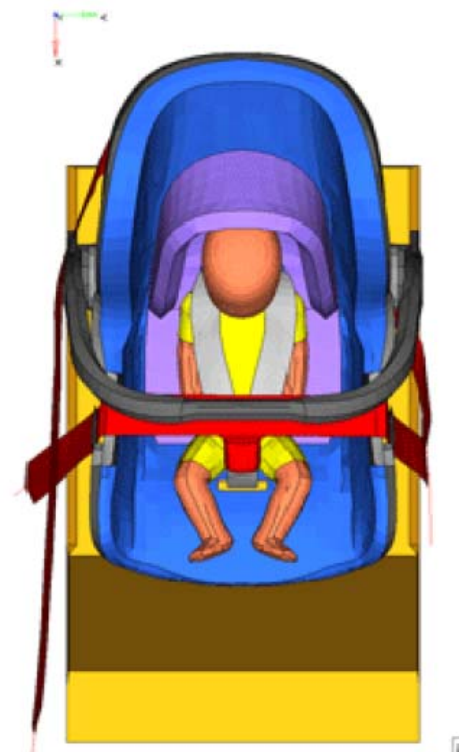
## Dummy models (FE)

Q3



**Commercial model**

Q0



**TUB model (CHILD result)**

# 1. Situation at the beginning of CASPER

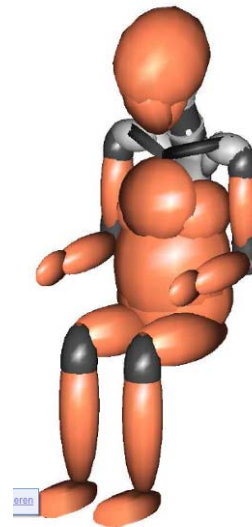


## Dummy models (MBS)

Q1.5 and Q3

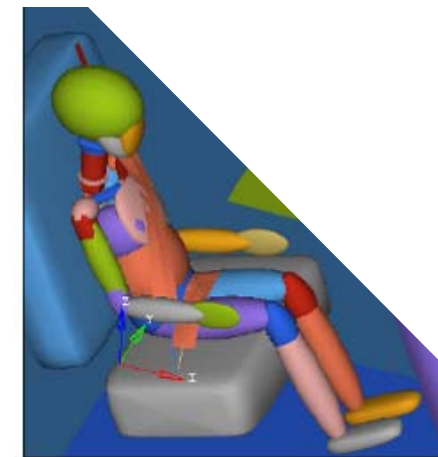
Q0

FE model derived from Dyna model with limited validation quality and high computational costs



**Commercial models**  
**Q1.5 derived from scaled Q3**  
 [MADYMO Model Manual Release 7.2, Jan. 2010]

Q6



**TUB model (CHILD result)**

**TUB model**

# 1. Situation at the beginning of CASPER



## External influence

- Missing tools prevent industry from using simulation methods in a large scale
- Euro NCAP discusses to change child safety rating towards larger children
  - expectations that car manufacturers become more responsible for child safety
  - Euro NCAP discussions on Virtual Testing
  - examples pedestrian safety (HIT and headform tests)

# 1. Situation at the beginning of CASPER



## CASPER Aims

- It is expected that FE codes will be the future w.r.t. child safety simulation
- Agreement on one code for dummy and human models
  - LS-Dyna
- Completion of Q dummy model family
  - Q0 overcome obstacles for exploitation
  - Q1, Q1.5 and Q6 to be modelled
  - Q10 not considered at the beginning of the project

## 2. Status of CASPER Models



### Internal + external model requirements 1

- Representation of latest hardware level
- Correct implementation geometry, mass, inertia
- Correct material properties
  - (e.g., separation vinyl and foam)
- Integration of all sensors

## 2. Status of CASPER Models



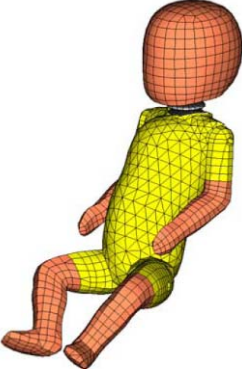
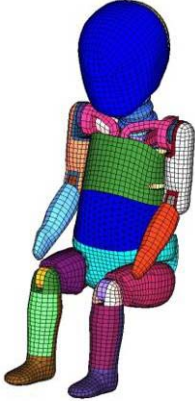
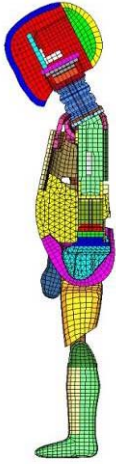
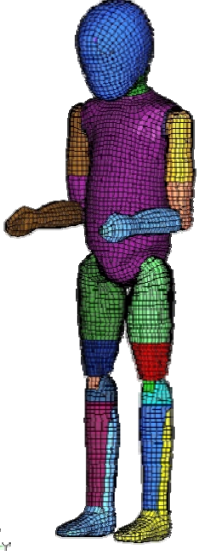
### Internal + external model requirements 2

- Time step approx. 1 micro second without mass scaling
- Detailed report of validation process
- Validation based on
  - Certification tests
  - Simplified loading tests representing relevant loading conditions

## 2. Status of CASPER Models



### Release

Dummy	Q0	Q1	Q1.5	Q6
				
Release		V1.0Beta CASPER internal	V1.0Beta CASPER internal	V1.0Beta CASPER internal

## 2. Status of CASPER Models



### Dummy model validation (Q1, Q1.5, Q6)

- Component: Head drop tests (frontal & lateral) ✓
- Component: Neck pendulum tests (Frontal & lateral) ✓
- Component: Lumbar pendulum tests (frontal & lateral) ✓
- Full dummy: Thorax impact tests (frontal and lateral) ✓
- Full dummy: overload impact test on thorax to check model stability ✓


## 2. Status of CASPER Models



### Validation mass distribution

(Q1.5 as an example)

Assembly	Physical [Kg]	Tolerance ±	FEA Model [Kg]
Head+neck	2.41	0.10	2.45
Torso	4.21	0.25	4.18
Upper Legs (Left and Right)	1.00	0.10	0.92
Lower Legs (Left and Right)	0.82	0.10	0.85
Upper Arms (Left and Right)	0.45	0.10	0.43
Lower Arms (Left and Right)	0.44	0.10	0.42
Suit	0.27	0.05	0.27
Total	9.60	0.30	9.53



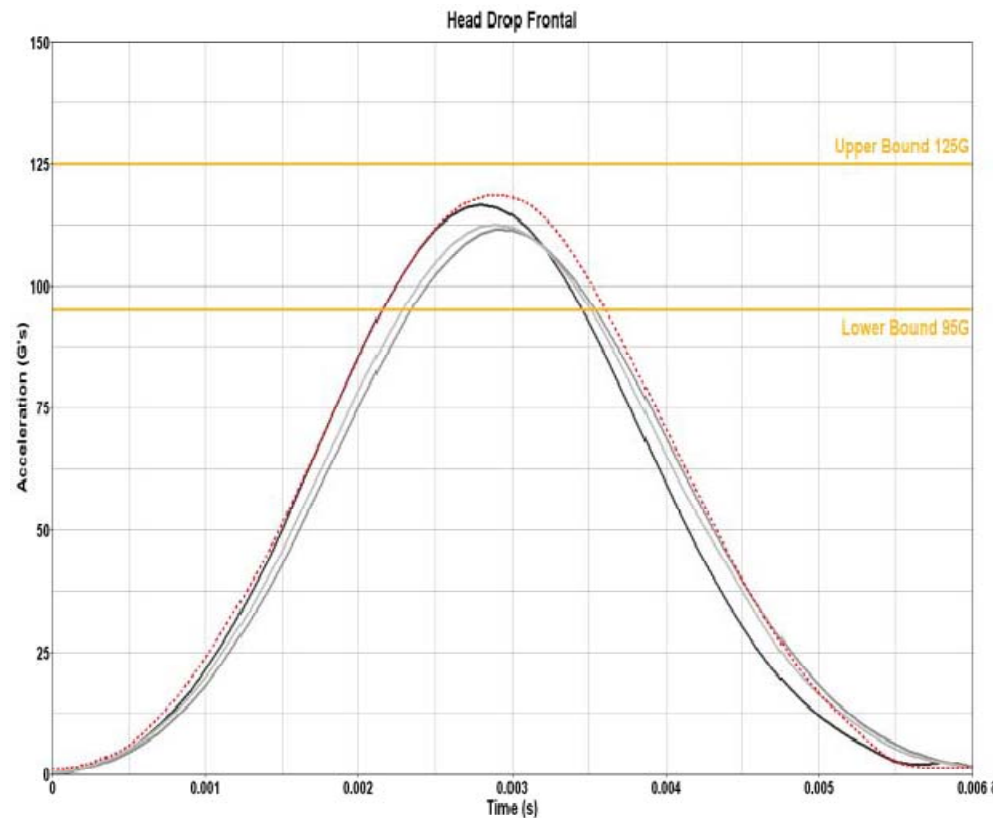
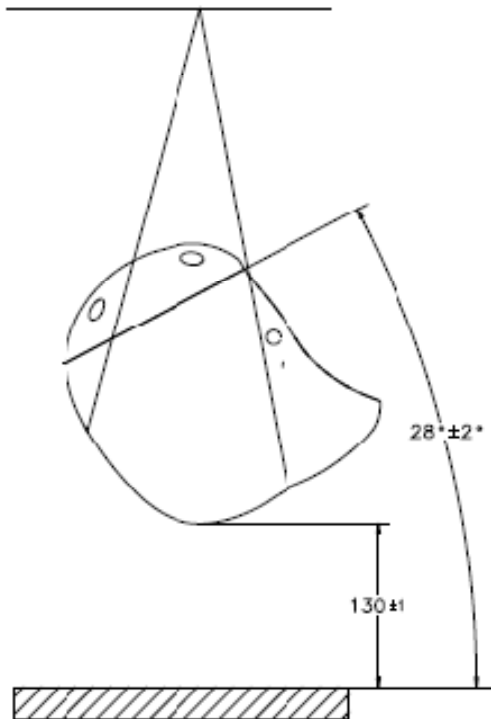
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## 2. Status of CASPER Models



### Validation head drop test

(Q1.5 as an example)

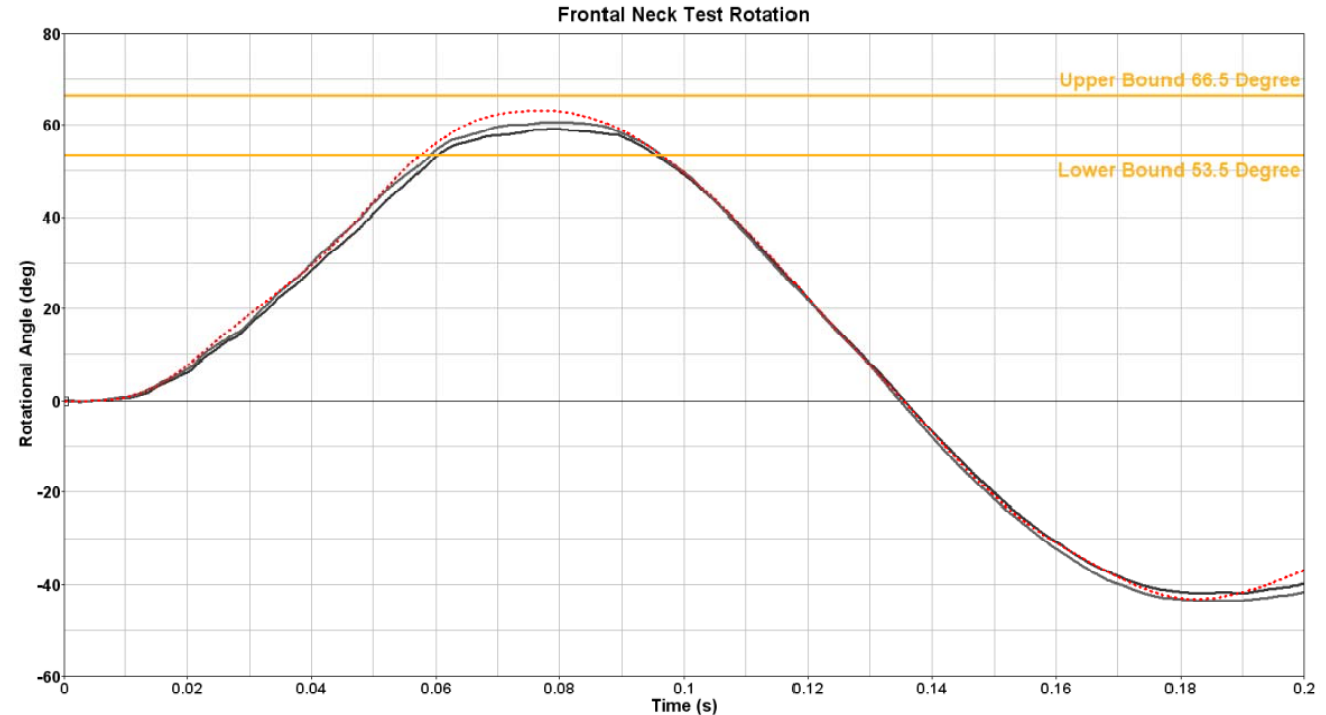
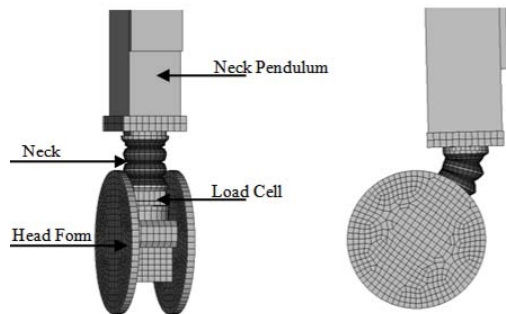


## 2. Status of CASPER Models



### Validation neck pendulum test

(Q1.5 as an example)

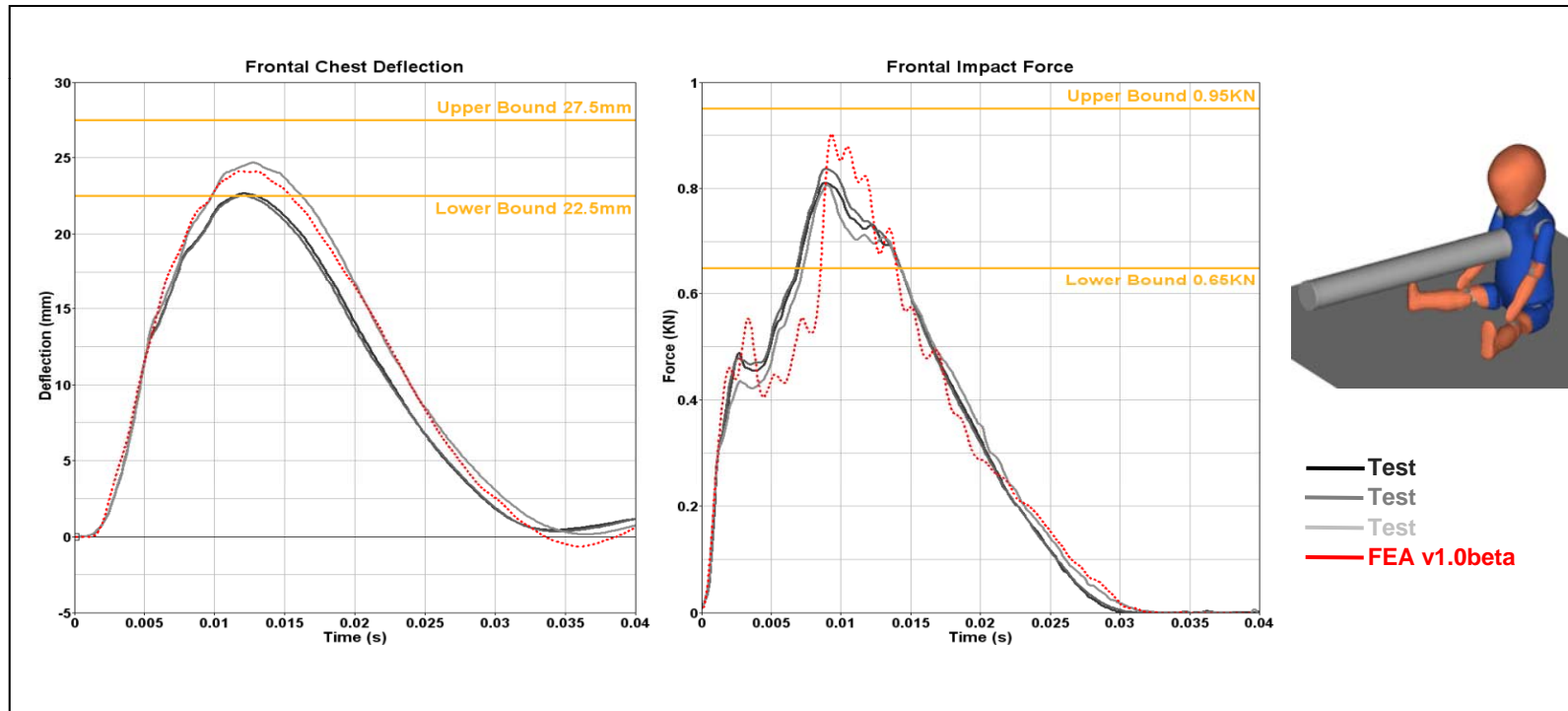


## 2. Status of CASPER Models



### Validation thorax pendulum test

(Q1.5 as an example)



## 3. Future Activities



### Q6 Model Consortium

- Aim
  - to improve Q6 Dyna model quality
    - material validation
    - sled test validation
    - full dummy component test validation (where appropriate)
  - to develop high quality Q6 model in other codes
    - PAM
    - ABAQUS

## 3. Future Activities



### Q6 Model Consortium

- Partner (to date)
  - Humanetics
  - Verein für Fahrzeugsicherheit Berlin e.V.
  - Technische Universität Berlin
  - Audi
  - Adam Opel
  - BMW
  - Mercedes
  - Porsche
  - Volkswagen

### 3. Future Activities



#### Q10 Model?

- Dummy hardware is existing
- CASPER aimed at completion of dummy family
- Q10 model could be of interest with respect to future Euro NCAP activities
- Currently no CASPER budget available



# Questions?

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**[www.childincarsafety.eu](http://www.childincarsafety.eu)**