Global CAE & Testing approach
at faurecia automotive seating

Christophe LEMAITRE
Validation Director
christophe.lemaitre@faurecia.com

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Faurecia overview

Key figures 2009

- 62,000 employees
- 200 sites
- 33 R&D centers
- 32 countries
- Sales: €11.3 billion*
  - Europe: 73%
  - North America: 14%
  - Asia: 8%
- Listed on Euronext Paris (SBF 120 - compartment A)

6th largest equipment manufacturer worldwide

World’s top automotive equipment manufacturers (2009 sales in billions of euros)

1. Denso 24.5
2. Bosch 23.8
3. Continental 20.1
4. Aisin Seiki
5. Magna
6. Faurecia 11.4
7. Delphi
8. ZF
10. JCI automotive
11. TRW
12. ThyssenKrupp
13. BASF
14. Valeo
15. Lear
16. Toyota Boshoku
17. Moeris
18. JTEKT
19. Hitachi
20. Sundance electric

Faurecia #6 from #9 in 08 (incl. Emcon & Plastal)

*Total Sales, including Emcon and Plastal Germany pro forma
Leader in four core Business Groups

2009 sales by Business Group*

- **Automotive Exteriors** (faurecia)
  - No.1 in Europe
  - €1.3 billion

- **Interior Systems** (faurecia)
  - No.1 worldwide
  - €2.6 billion

- **Automotive Seating** (faurecia)
  - No.3 worldwide
  - €4 billion

- **Emissions Control Technologies** (faurecia)
  - No.1 worldwide
  - €3.4 billion

Group sales: €11.3 billion

*Information given in this presentation includes pro forma figures for Emcon and Plastal, Germany.
Faurecia Automotive Seating at a glance

€ 3.7 bn
Product Sales 2009
(€ 5 bn 2014)

27,000
employees

73 plants

20 countries

Challenging CAE topics on a key automotive product!
Our game field

**Regulations:** ECE 14 / ECE 17 / FMVSS210 / FMVSS201 / Low speed FMVSS202a / ...

**Safety:** Front crash / Rear crash / Luggage impact / Low speed Whiplash / ...

**Functional:** Static & Dynamic comfort / Mechanical resistance / Misuse / Climate ageing / Cycling / Vibration ageing / Squeak & Rattles / ...

Red = simulable by FEA

Different materials behaviors: Steels / Foams / Plastics
Different modeling scales: seat frame / seat mechanisms
Integration of restraint systems
Integration of dummies
Main OEMs expectations

Cheaper products:
- Lower engineering costs (CAD, prototypes)
- More Product & Process design optimizations

Shorter development time

Lighter parts

More product requirements:
- Regulations
- Occupants safety
- Comfort
- Perceived quality

More quality / robustness:
- Less PPM
- Low product sensibility
- More product durability

Higher reactivity / adaptability:
- More product versions
- More changes on styling / specifications

Design

FEA

Testing
Our 4 Validation Fundamentals (VALIDATION = FEA + TEST)

Focus FEA/Test pilots on results analysis & **product design**

Use Innovative + Robust + Lean FEA/Test standards

High interaction between FEA and TESTING

Use FEA as an upfront design tool (CAE ➔ CAD)
Validation on projects

Lab operations
- Labs equipments
- Standard test methods
- Measurements uncertainties
- Labs quality system
- OEMs lab certifications
- Lean testing

FEA operations
- FEA equipments
- Advanced FEA T&M
- FEA quality system
- OEMs FEA certifications
- FEA LCC

Project KPIs

From our 4 Validation Fundamentals to our Validation roadmap
From our 4 Validation Fundamentals to our Validation roadmap

**Validation on projects**

- FEA/Test Pilots organization
- Pilots skills development
- Validation tools
- Project KPIs

**Lab operations**

- Labs equipments
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**FEA operations**

- FEA equipments
- Advanced FEA T&M
- FEA quality system
- OEMs FEA certifications
- FEA LCC
FEA and TEST people integration on R&D projects

Previous organization

-Working modes:
  - FEA Eng = FEA results provider
  - Test Eng = Test results provider
  - LCC FEA = meshing/models provider
  - FEA/Test managed by 1 “non expert” leader

- Consequences:
  - Low motivation of FEA/Test Eng in project
  - FEA used as validation tool ➔ more CAD cost
  - High risk of bad FEA/Test correlations
  - Low FEA/Test interaction ➔ no cost optimization
Organizational chart
FAS R&D / Validation Department

Central Services
- FEA Methods & Tools
- Testing Methods & Equipments
- Quality & Lean

STRATEGY & STANDARDS

DELIVER INNOVATIVE + ROBUST + LEAN FEA and TEST STANDARDS
APPLICATION OF FEA and TEST STANDARDS ON PROJECTS

FEA + TEST PEOPLE IN 1 DEPARTMENT ➔ 1 UNIQUE MANAGER
Organizational chart
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STRATEGY & STANDARDS

OPERATIONS
- Validation France
  - Cust. Validation
  - FEA & Test Pilots: Brières
  - Test Operations: Brières/Sel.

- Validation Germany
  - Cust. Validation
  - FEA Pilots
  - Test Operations

- FEA Poland
  - FEA Engineers
  - FEA Pilots
  - Test Operations

- Validation Brazil
  - FEA & Test Pilots
  - Test Operations

- Validation USA
  - FEA Pilots
  - Test Operations

- Validation China
  - FEA & Test Pilots
  - FEA Engineers
  - Test Operations: Shanghai
  - Test Operations: Wuxi

FEA PILOTS + TEST PILOTS in 1 DEPARTMENT ➔ 1 UNIQUE DIRECT MANAGER
Pilots integration on R&D projects

Current organization

Program Manager

Program Manufacturing Leader  Program Buyer  Program Sales Leader

Program Development Leader
w/ Design leaders and CAD

Program Quality Leader  Program Controller

Working modes:

• FEA Pilot = Design by FEA engineer
• Test Pilot = Design by Test engineer
• LCC FEA = FEA Calculations & Analysis provider
• FEA/TEST managed by 2 expert engineers

Consequences:

• High motivation of FEA/Test Pilots in project
• FEA used as design tool ➔ less CAD cost
• Low risk of bad FEA/Test correlations
• High FEA/Test interaction ➔ cost optimization
Pilots integration on R&D projects

Best organization

Working modes:
- Validation Pilot = Design by FEA/Test engineer
- LCC FEA = FEA Analysis & Design solutions provider
- FEA/TEST managed by 1 expert engineer

Consequences:
- High motivation of FEA/Test Pilots in project
- FEA used as design tool → less CAD cost
- No risk of bad FEA/Test correlations
- Automatic FEA/Test interaction → cost optimization
RESULT = WIN / WIN between FEA HCC and LCC engineers

Significant increase of key competencies:
- **Pilots**: product design, project management, leadership, communication, negotiation, customer relations management...
- **FEA LCC engineers**: FEA analysis, product design, ...

Higher project involvement and design proactivity

Less resignations and people turnover in LCC

High increase of LCC FEA on HCC projects ➔ X m€ dev. cost saving!

HCC pilots satisfaction on LCC FEA LCC engineers:
- 57% meet expectations
- + 25% above expectations
- = 82% positive expectations!
From our 4 Validation Fundamentals to our Validation roadmap

### Validation on projects

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<th>FEA/Test Pilots organization</th>
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### Lab operations

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</thead>
</table>

### FEA operations

- **FEA equipments**
  - Advanced FEA T&M
  - FEA quality system
- **OEMs FEA certifications**
  - FEA LCC
How to deliver the same FEA quality for all customers on all projects?

How to reduce cost to get best FEA quality?
Consequences for Faurecia:

- Significant cost to maintain competencies on all softwares
- Difficulties to manage differences in FEA results because softwares
- FEA pilots spend more time in FEA issues than design products
- No standardization FEA tools & methods & databases
- No optimization of softwares licenses costs
- Difficulties to capitalize correlations and best/bad practices
- High cost to develop and deploy new advanced FEA
- Inefficiencies to share and exchange FEA models between products
- High cost to integrate new collaborators
- High training cost
- Less headcount flexibility between projects and sites
- ...

Consequences for customers:

- Able to integrate directly Faurecia FEA models
- But not the best FEA models from Faurecia!
1 WORLDWIDE STANDARD FEA SYSTEM

Key benefits:
- Same FEA Quality for all customers on all projects on all sites
- Huge possibilities for standardization / knowledge capitalization / FEA improvements
- Costs reductions:
  - Training: -60%/year
  - Licences: -33%/year
  - FEA inefficiencies time: -31%/year

> 3 m€/year
Faurecia:

- Uses its FEA system and is responsible of its results
- Is responsible to design a seat compliant w/ OEM specifications
- Delivers FEA models compliant w/ OEM requirements @ key project milestones
- Provides support for models conversion
- but can NOT be responsible of differences in FEA results between softwares
- Organizes regular exchanges w/ OEMs to share FEA best practices
- Develops a policy of OEM FEA certifications
Process = AUDIT + BLIND TEST

STEP 1
- faurecia FEA system audit

STEP 2
- FEA results Loadcase 1
- FEA results Loadcase 2
- FEA results Loadcase N

STEP 3
- Compare FEA / test results Loadcase 1
- Compare FEA / test results Loadcase 2
- Compare FEA / test results Loadcase N

- Certification Loadcase 1
- Certification Loadcase 2
- Certification Loadcase N

Faurecia task
OEM task
**Faurecia benefits:**
- Strong competence recognition
- Less sterile discussions about FEA results robustness during projects
- More responsibilities on FEA results

**OEM benefits:**
- Deep knowledge of Faurecia FEA robustness
- Sort suppliers on FEA robustness
- **Reduce FEA cost by not remaking FEA already done**
From our 4 Validation Fundamentals to our Validation roadmap

Validation on projects

**FEA/Test Pilots organization**
**Pilots skills development**
**Validation tools**
**Project KPIs**

Lab operations

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FEA operations

- FEA equipments
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- FEA LCC
Standard test methods

Objectives:
- To standardize execution of testing between labs
  - Same reading and understanding of OEMs specifications & regulations
  - Same test set up and measurements set up
  - Same testing execution
  - Same quality of testing deliveries
  - Same best practices
- To reduce test results variability & uncertainty
- To help people learning and integration
- To improve test methods by capitalizing experiences

3 quality levels:
- Test for FEA correlation
- Application test
- Serial life test

→ Technical audits to control application of standard test methods
1 Worldwide FEA quality system

Objectives:

- To facilitate people learning & integration
- To standardize FEA know how / processes / best practices
- To reduce results variability induced by FEA people
- To secure quality of FEA deliveries and design decisions
- To improve correlations between FEA & Test results
- To improve FEA quality by capitalizing knowledge & experiences

Tools:

- Documents:
  - FEA guidelines
  - Standard FEA method

 ➔ Technical audits to control application of FEA quality system
## FEA Quality Docs:

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<tr>
<th>Guidelines</th>
<th>Available</th>
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<tr>
<td>LS Dyna core guidelines</td>
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<td>FEA audit process</td>
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<td>FEA LCC outsourcing process</td>
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<td>FEA report</td>
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<td>Correlation process</td>
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<td>FEA method</td>
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<td>H point and HRMD</td>
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<td>ECE 17 backrest</td>
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<td>ECE 17 headrest</td>
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SAME FEA/TEST RESULTS BETWEEN R&D CENTERS
From our 4 Validation Fundamentals to our Validation roadmap

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Project KPIs
Project KPIs

INPUTS
- Product design
- FEA
- CAD
- Manufacturing Process & Tools
- Quality
- ...

PRODUCT DESIGN
MFG DESIGN
MATERIALS

OUTPUTS
- TESTING

How to measure efficiency of product engineering?
Classical approach = 1 budget for each engineering activity

⇒ but no direct link to engineering efficiency !!!
FAS approach = 1 budget for each engineering activity + cost of minimum test validation plan as engineering efficiency metric!
ALL SPECIFICATIONS

Engineering efficiency metric

<table>
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<th>Phase</th>
<th>Actual/Budget</th>
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Convergence to minimum test plan cost

Test plan cost - actual
Test plan cost - budget
Minimum test plan cost

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<th>Issues</th>
<th>Description</th>
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### Project KPIs

#### ONLY SIMULABLE SPECIFICATIONS

![Graph showing convergence to minimum test plan cost]

**Engineering efficiency metric / FEA**

#### Convergence to minimum test plan cost

<table>
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<th>Minimum Test plan KPI</th>
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#### PDCA

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Conclusions

Huge steps towards Worldwide FEA & Testing standardization

Same FEA & Test results and services between R&D centers

Very positive feedback from project teams and customers

Significant testing costs reduction. Next challenge = no prototype phase

Our original approach needs talented people... join faurecia!
THANK YOU
FOR YOUR LISTENING!
Technical perfection, automotive passion.