



ESI Group

**пионер и мировой лидер в области
виртуального прототипирования**



1973 - 2013
40 YEARS
OF INNOVATION

MECAS ESI s.r.o.
September 2014



● Headquarters
● Subsidiaries
● Offices
● Agents and distributors

- Более 30 стран
- 15 филиалов
- Средняя численность персонала: 1000 человек

Paris, France



Eschborn, Germany



Pilsen, Czech Republic



San Diego, CA, USA

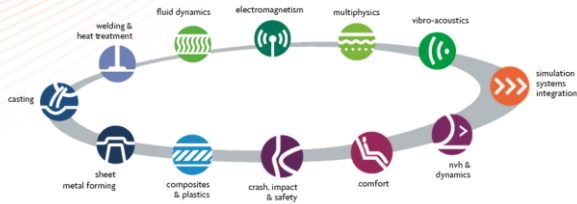


Beijing, China



Tokyo, Japan



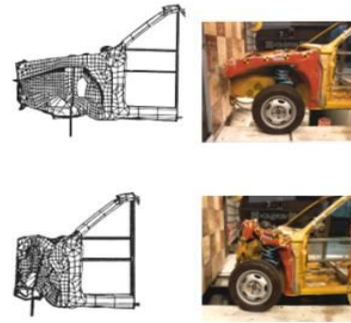


- Software editor of applied mechanics; worldwide expansion

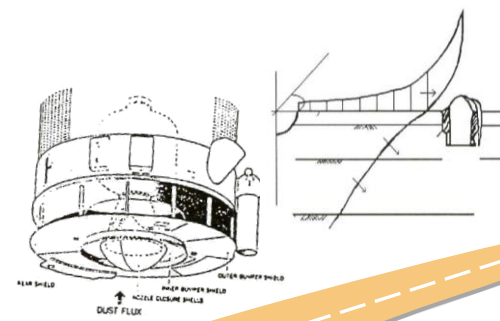


- On the stock market: listed in Euronext Paris

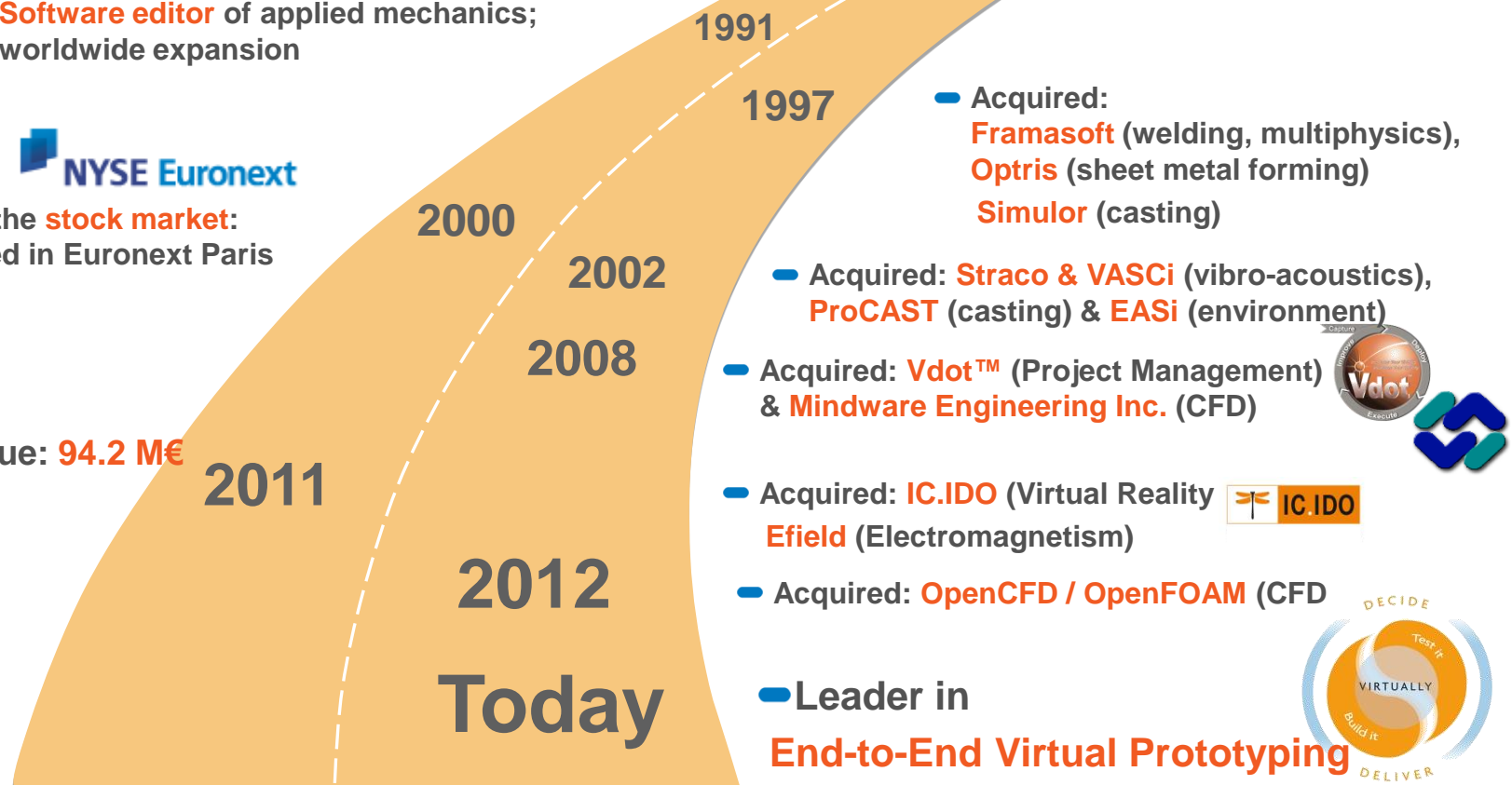
- FY11 revenue: 94.2 M€



- First full car crash simulation



- ESI founded; expert in physics of materials



Engineering Simulation for Industry

Инженерное моделирование для промышленности
с учетом международной системы управления качеством ISO 9001:2001

→ **Быть ведущим мировым игроком в области MCAE для**
‘реалистичного моделирования’

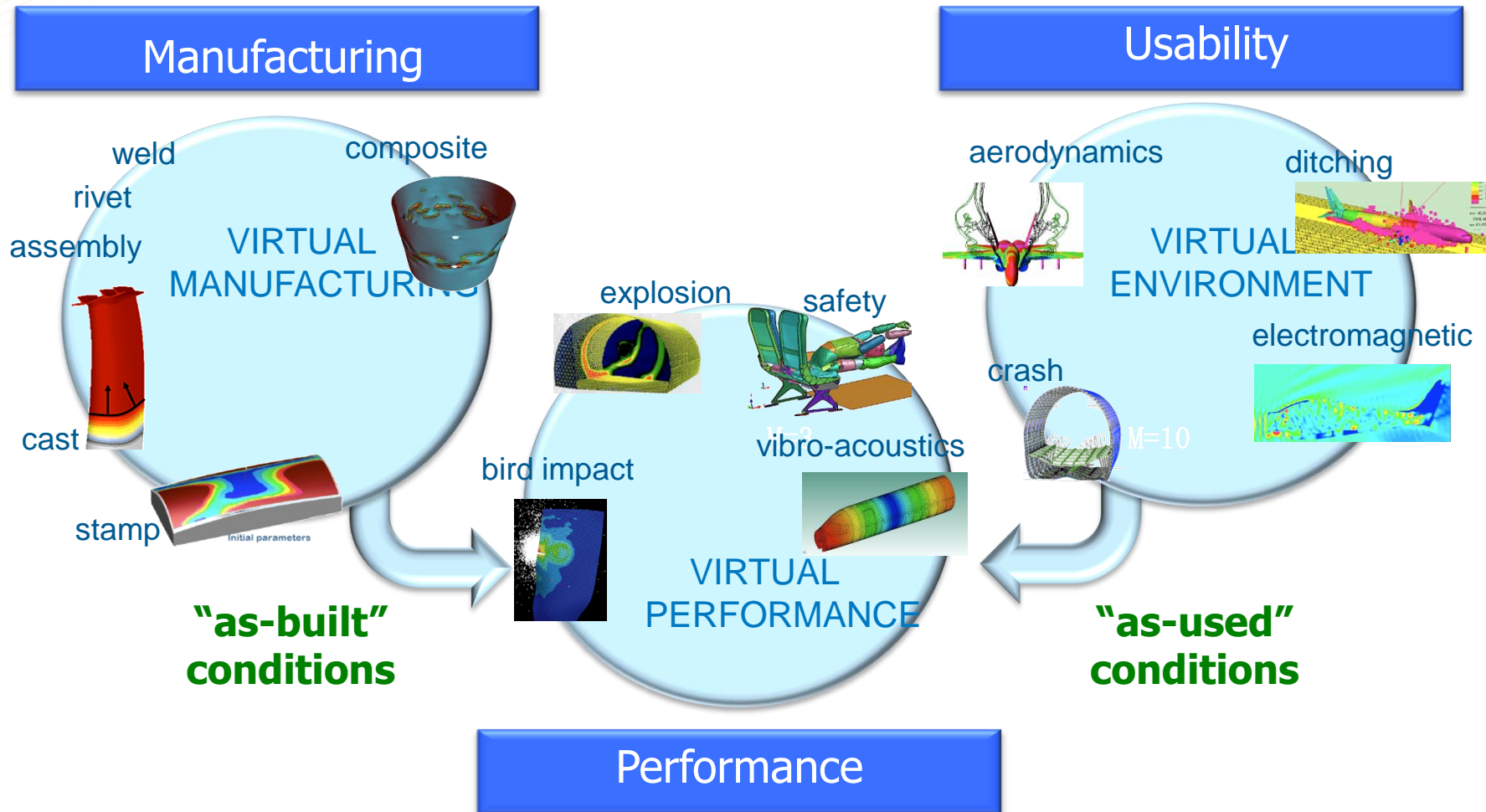


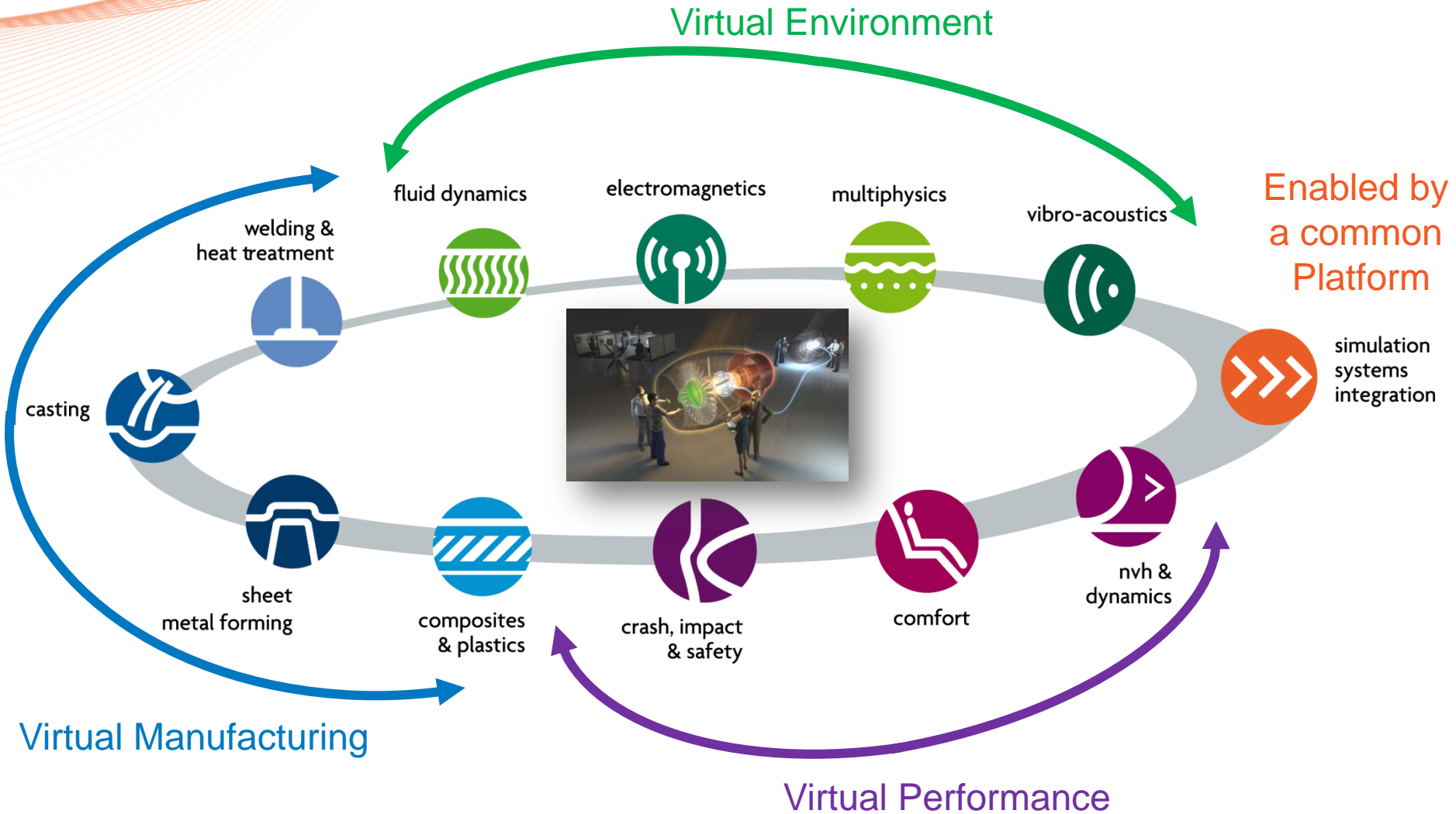
End-to-End Virtual Prototype Strategy

End-to-End Virtual Prototyping

**Avoid surprises coming from tests
by virtually fabricating, building and
testing the product, part & component.**

- End to End Modeling: include manufacturing effects in model





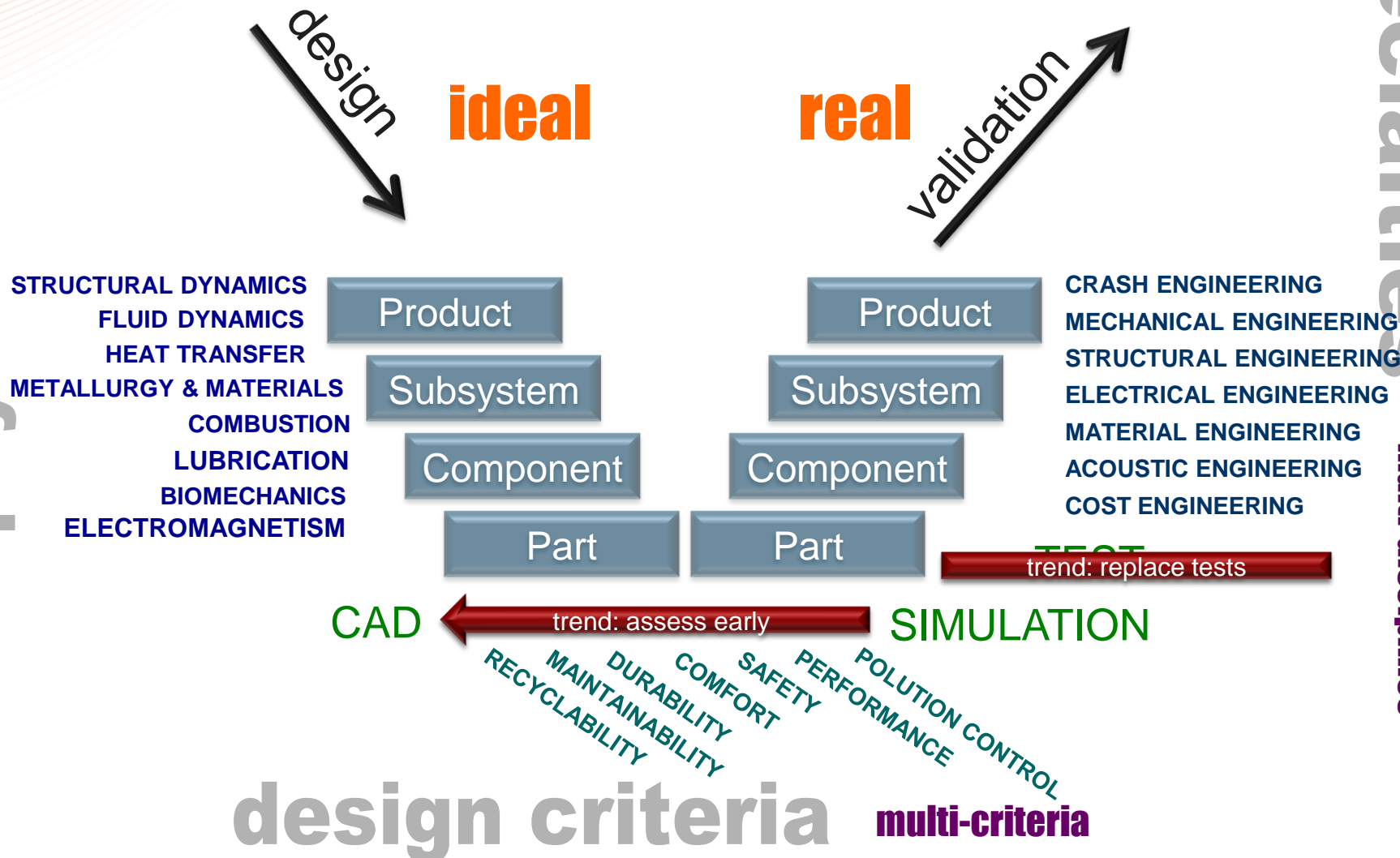
Engineering design practice: complex process

physical fields

multi-physics

specialties

multi-disciplines

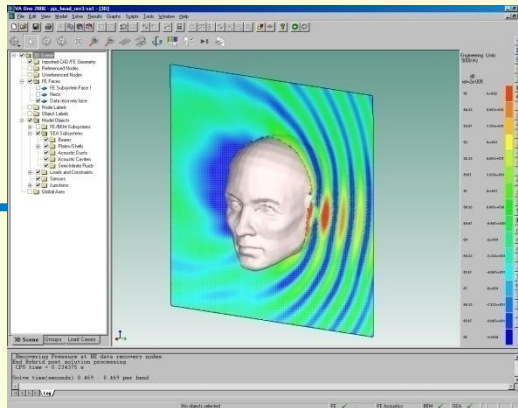




VIBRO-ACOUSTICS Solution

A complete solution for simulating noise and vibration across the full frequency range

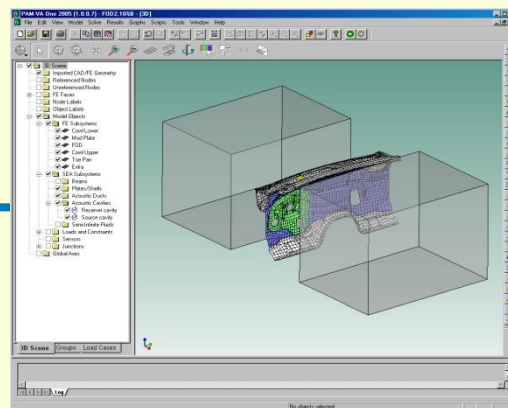
FE/BEM



Low Frequency

- FE structure module
- FE acoustic module
- BEM fluid module

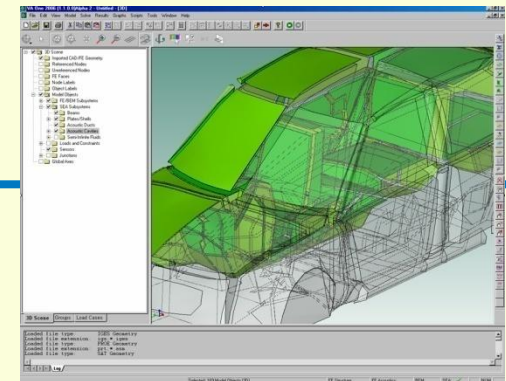
Hybrid FE/SEA



Mid Frequency

- Hybrid FE/SEA/BEM module

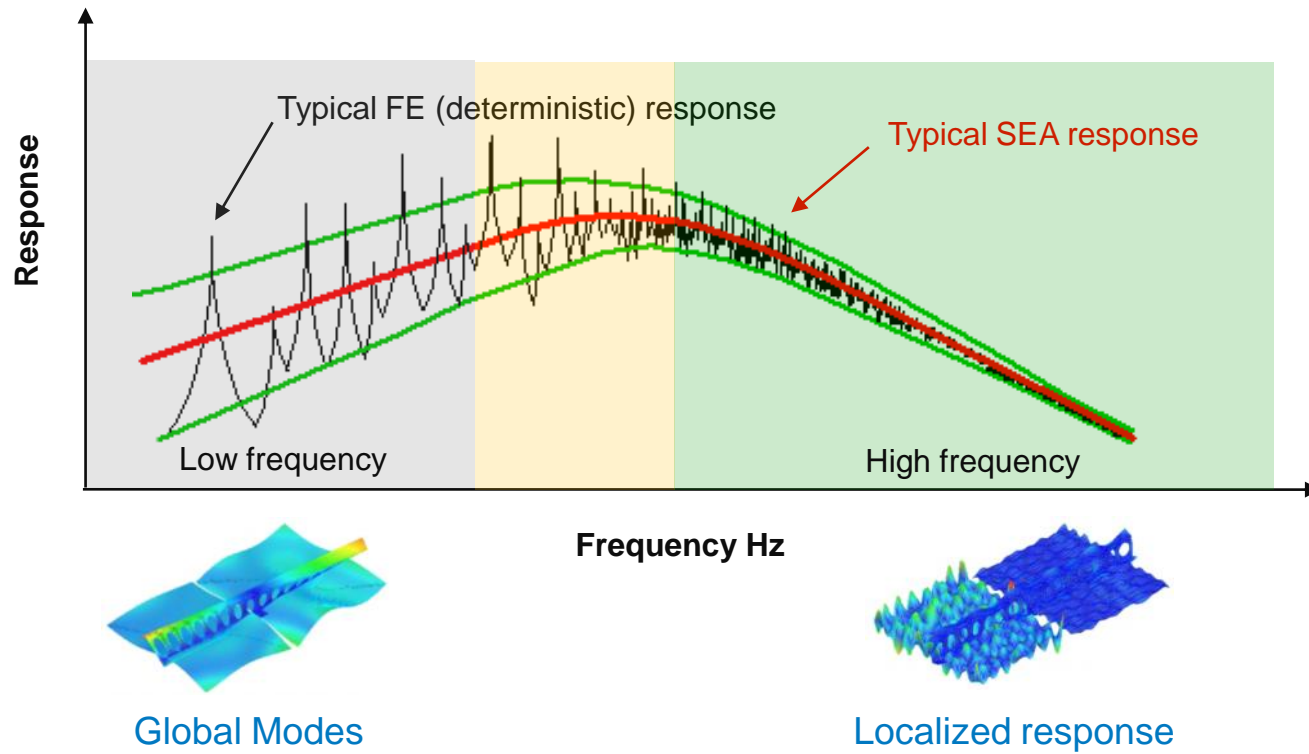
SEA



High Frequency

- SEA/AutoSEA2 module

Frequency domain of interests



Main modules

Model structure
with FE



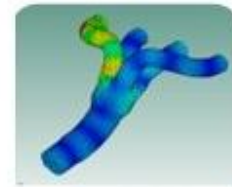
Structural FE



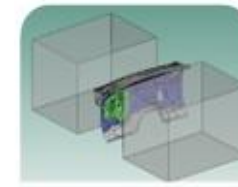
Acoustic BEM

Model bounded or
unbounded fluids
with BEM

Model bounded
fluids with FE



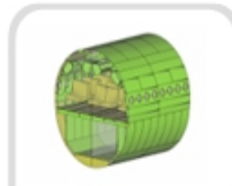
Acoustic FE



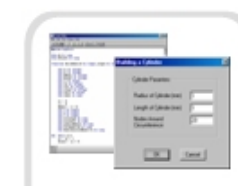
Hybrid

Couple FE and SEA
together for fast
models at mid-
frequencies

Quick system level
models of complex
systems at high
frequencies



SEA



Extensions

Extension modules
for customization
and advanced
analysis

VA One

Main modules and extension modules

FE structure



FE acoustic



SEA

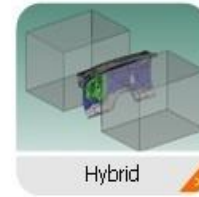


VA One

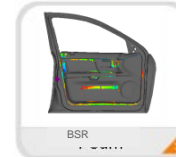
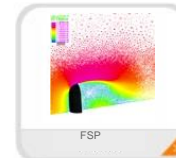
BEM



Hybrid



Aero-Vibro
Acoustics



Squeak
& Rattle

Foam



Periodic

Stress



Design
Optimization

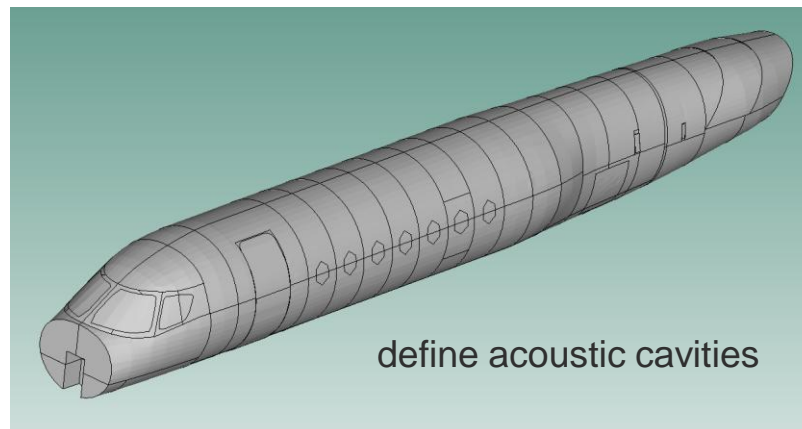
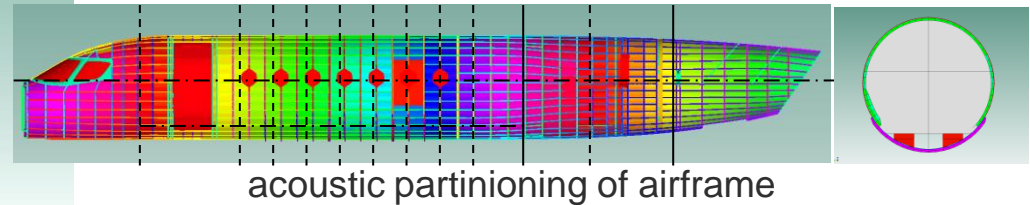
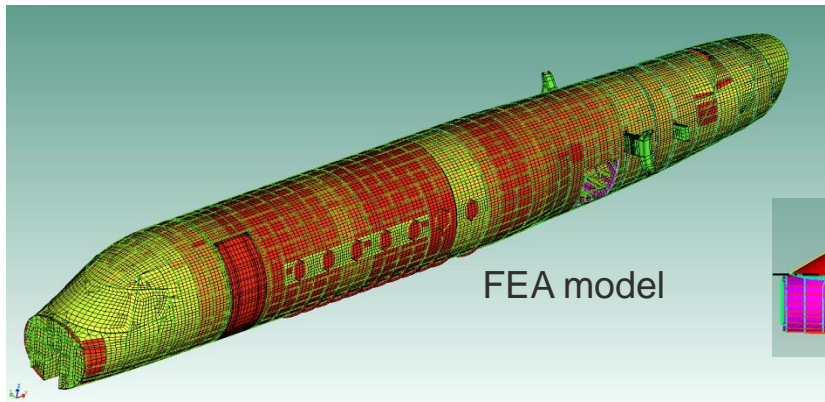
Developer kits



BEM Grid

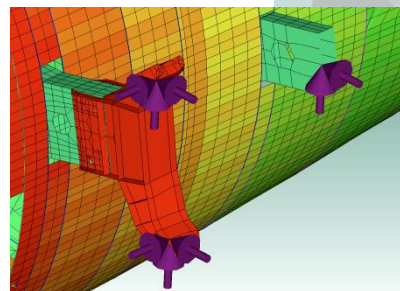
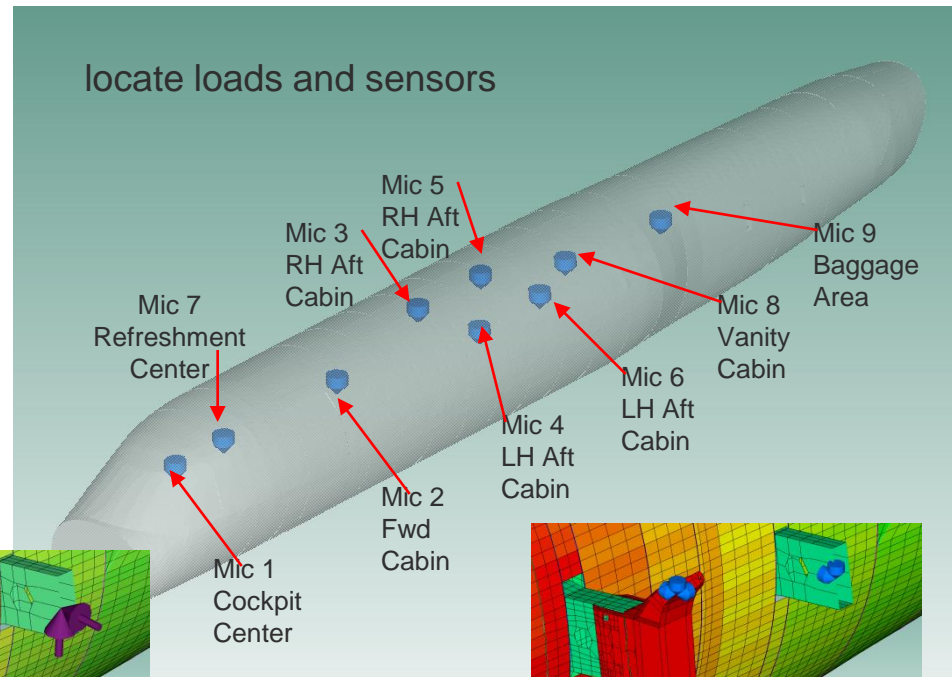
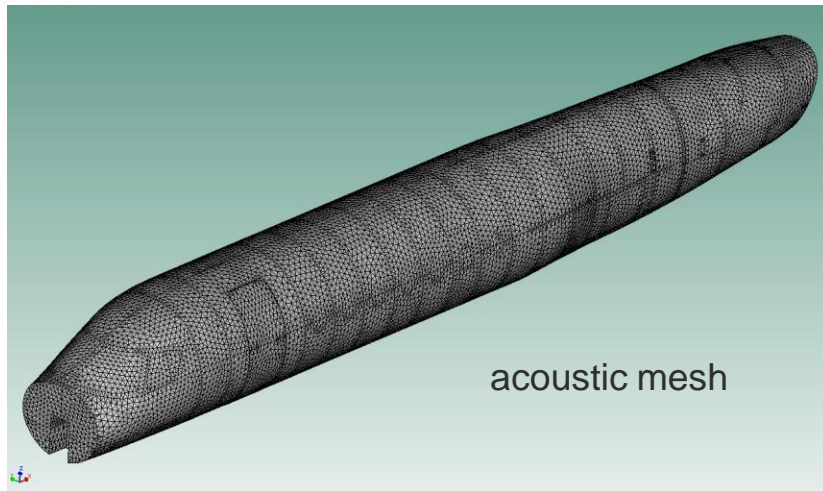
**VA One Extension
modules**

- **Prediction of Vibro-acoustic Levels in Airframe**
 - 1 - generate a SEA mesh from a structural FEA model

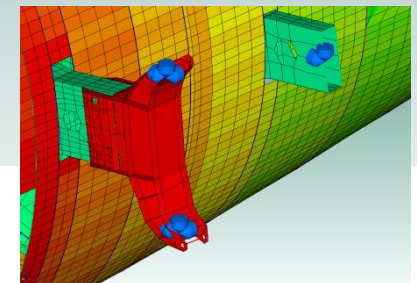


VA-ONE

- Prediction of Vibro-acoustic Levels in Airframe**
 - 2 - generate a SEA model from the SEA mesh



Point Excitation Loads

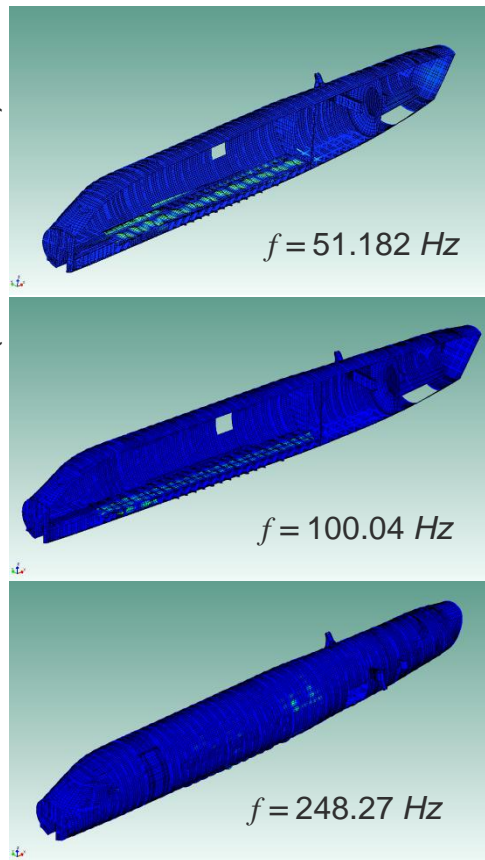


Structural Sensor Locations on Yoke and Aft Beam

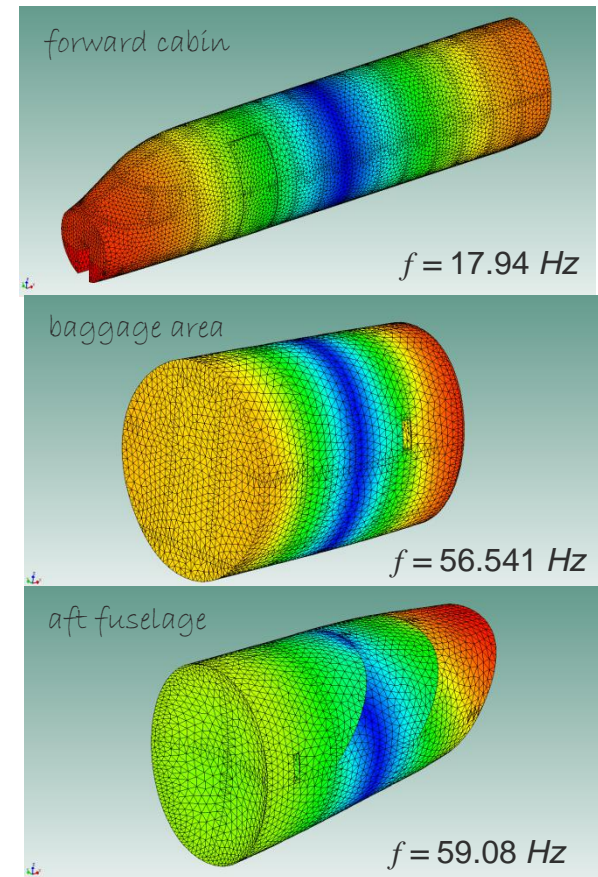
VA-ONE

- Prediction of Vibro-acoustic Levels in Airframe**
 3 – run intermediate solvers

FE structural modes (~1361 modes)



acoustic modes groups



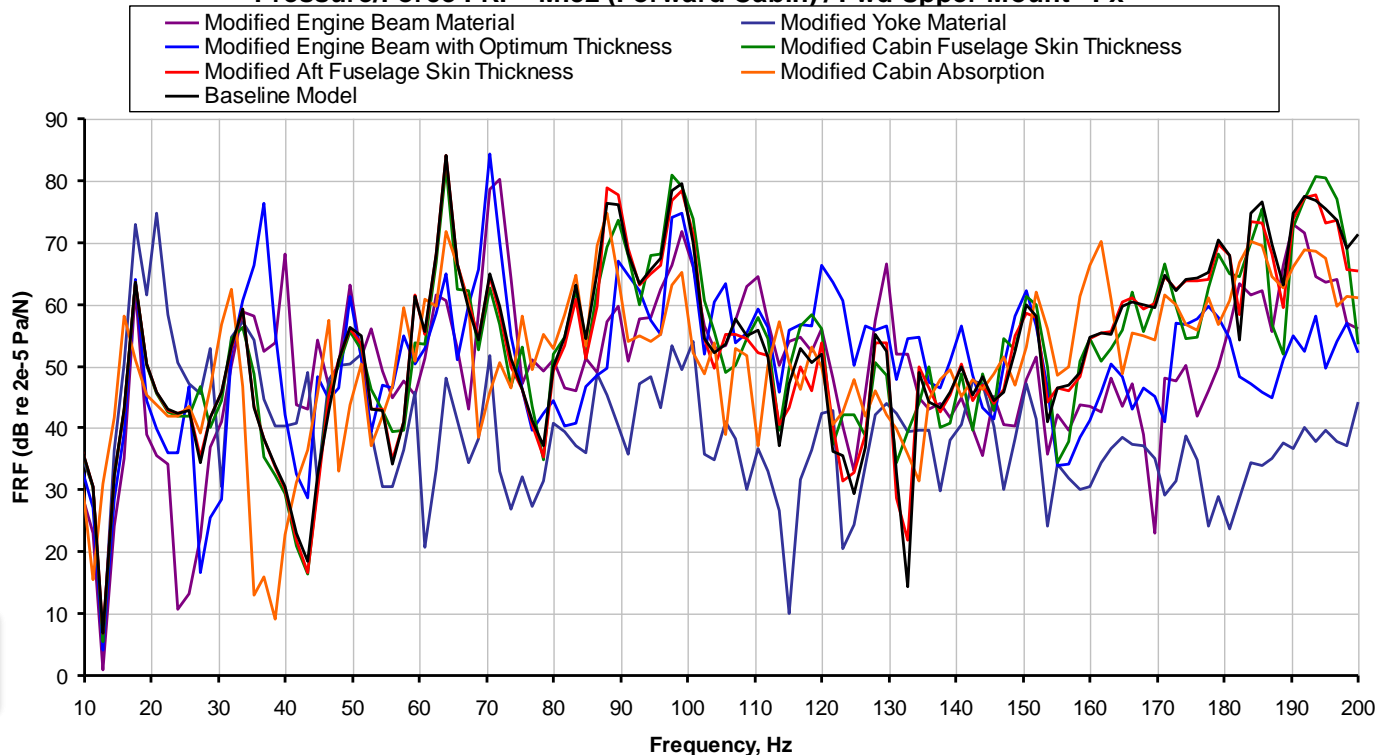
VA-ONE

Prediction of Vibro-acoustic Levels in Airframe

4 –deduct acoustic results

Sensitivity Tests ->	Modified Engine Beam Material	Modified Yoke Material	Modified Engine Beam with Optimum Thickness	Modified Cabin Fuselage Skin Thickness	Modified Aft Fuselage Skin Thickness	Modified Cabin Absorption	Baseline Model
Overall Levels (dB/N)	84.73	78.79	86.63	90.64	90.59	82.74	90.93

Pressure/Force FRF - Mic2 (Forward Cabin) / Fwd Upper Mount - Fx



VA-ONE

VIBRO-ACOUSTICS Solution

- **diagnose potential noise and vibration problems up front in your development process**
заранее диагностировать области потенциальных шумов и вибраций в процессе разработки
- **create system level noise and vibration models and get solutions in a matter hours**
создавать модель уровня шума и вибраций и получать решение в считанные часы
- **rank sources and identify dominant transmission paths quickly**
установить источники и быстро определить основные пути перераспределений

Who uses VA One?

ESI Offices with VA expertise



- International distribution
- More than 500 customers
- ...

Automotive OEM's

- Audi
- BMW
- Daimler
- Opel
- Peugeot
- Porsche
- Renault
- SAAB
- Volvo
- VW
- Chrysler
- Ford
- GM
- Honda
- Mitsubishi
- Nissan
- Isuzu
- Hyundai
- ...

Automotive Suppliers

- Carcoustics
- Dow Chemical
- Faurecia
- Magna Steyr
- PAP
- JCI
- IAC
- Rieter (autoneum)
- Valeo
- 3M
- ...

Industrial

- Alstom
- Bombardier
- IVECO
- Caterpillar
- John Deere
- Sandia
- IBM
- Seagate
- Johns Manville
- Owens Corning
- Carrier
- GE
- Otis
- Daikin
- ...

Marine

- DCN - France
- DRA – UK
- BAE Systems
- Rolls Royce
- Van Cappellen
- Damen Shipyards
- Fincantieri
- Cetena
- US Navy
- Newport News
- Lockheed
- BBN
- Hitachi
- ...

Who uses VA One?



Space

- EADS
- ESA
- Alcatel Alenia
- Thales Space
- OHB
- Ruag
- Lockheed Martin
- Boeing Aerospace
- The Aerospace Corporation
- NASA (Goddard, Marshall, Lewis, Kennedy & Langley)
- JPL
- Northrop Grumman ST (TRW)
- Orbital Sciences
- Aerojet
- Swales
- Kawasaki
- Mitsubishi
- IHI
- NASDA
- KARI

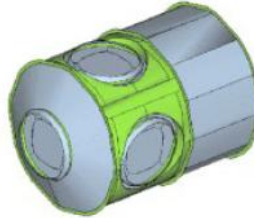
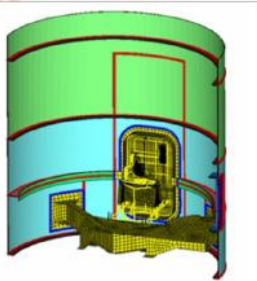
Air and Rotor

- Boeing
- Airbus
- Dornier
- Raytheon Aircraft
- Bombardier
- Embraer Air
- Cessna
- Bell Helicopter
- Boeing Helicopter
- UT Sikorski
- GNK/Westland

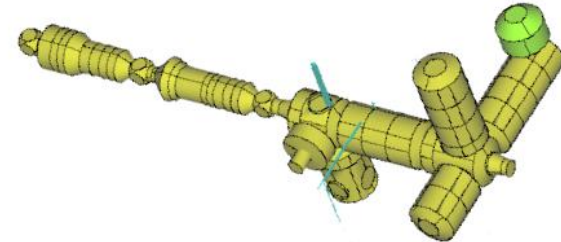
Examples in Aero Space



Ares IX, RCS - ATA



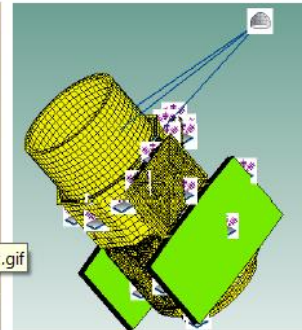
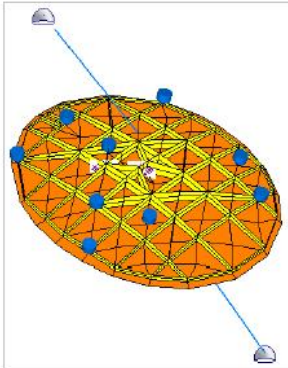
ISS Node3 -
Thales Alenia Space



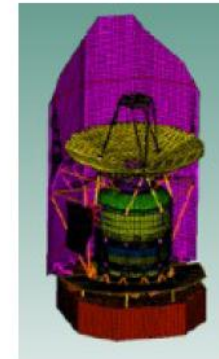
International Space Station –
Boeing Integrated Defense



ACTS Antenna - NASA



CALIPSO spacecraft -Thales Alenia Space



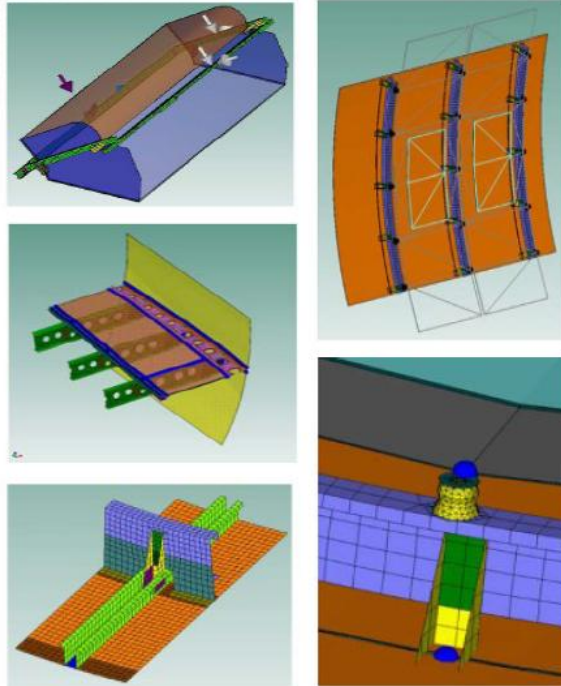
Herschel -ESA



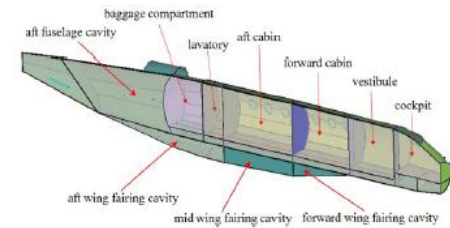
ThalesAlenia
Space



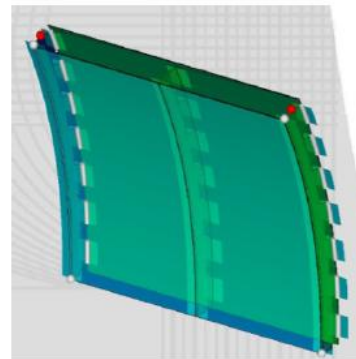
Examples in Aircrafts



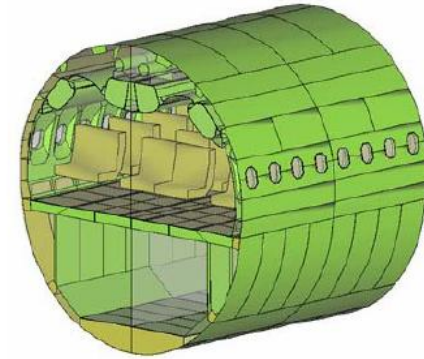
Advanced modeling of aircraft Noise
Boeing, NASA, ESI



Hawker Horizon aircraft –
Raytheon Aircraft Company



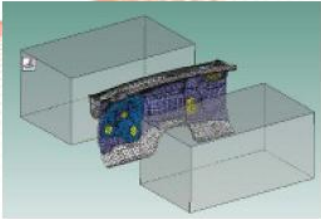
FE/SEA and EFM modeling of
sidewall - EADS



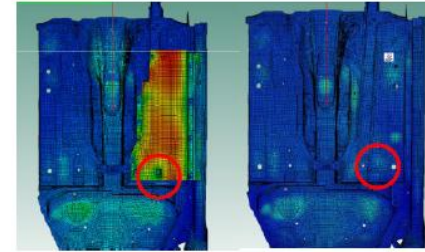
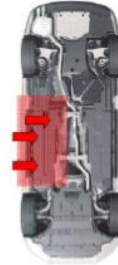
Aircraft Fuselage Section –
Boeing



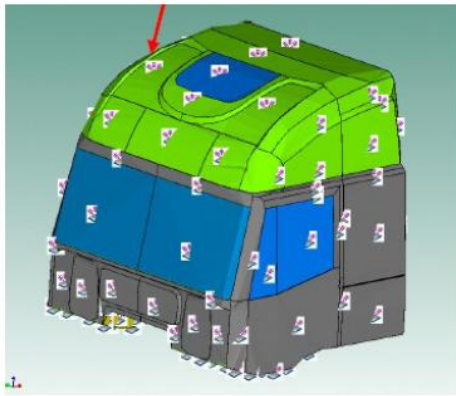
Examples in Automotive



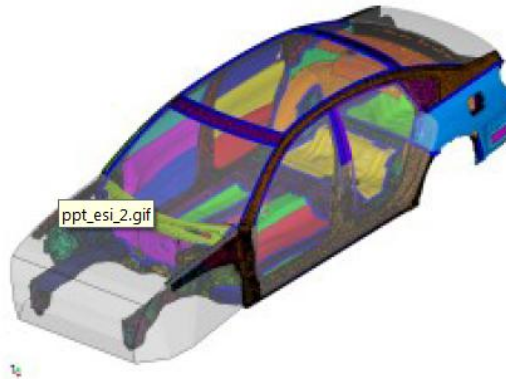
Dash TL – General Motors



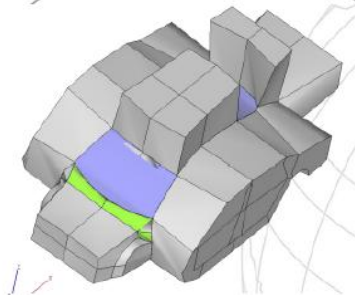
Windnoise cover design – AUDI, TUM, ESI



Cab Acoustic Comfort - IVECO



FE/SEA structureborne prediction - Nissan



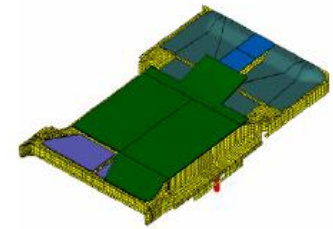
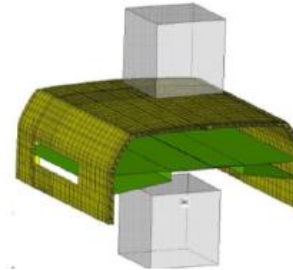
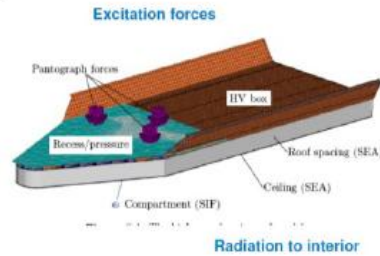
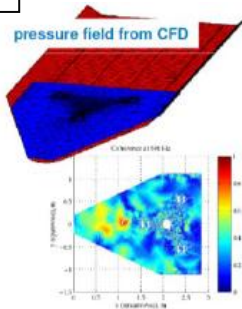
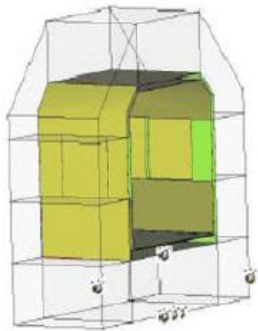
External sound field – Opel, Arrk

IVECO



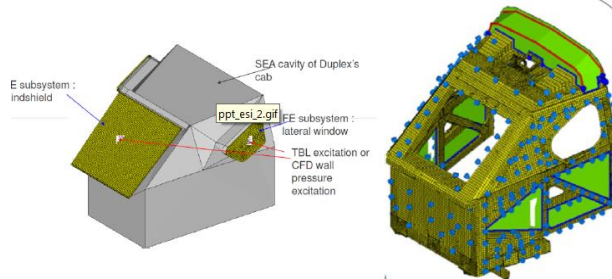
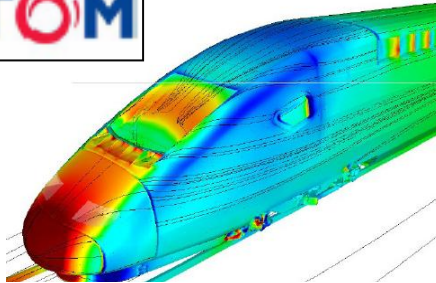
Examples in Transportation

BOMBARDIER



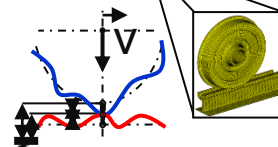
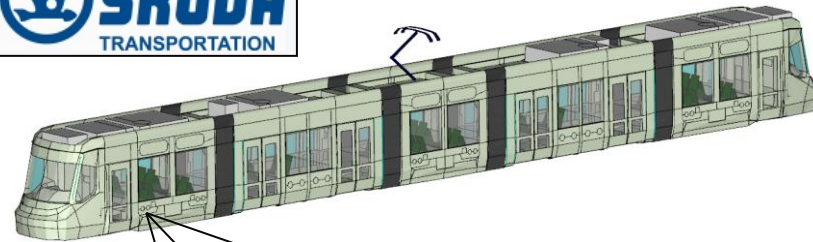
FE/SEA Structure-borne and wind noise prediction

ALSTOM



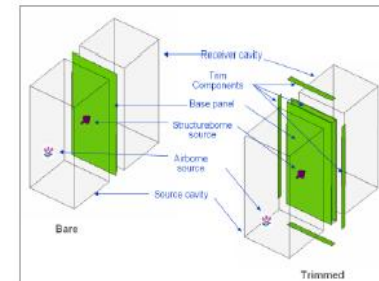
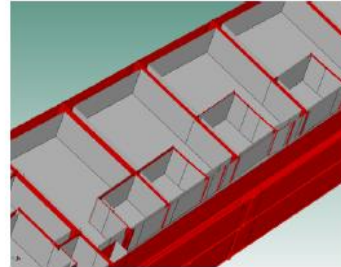
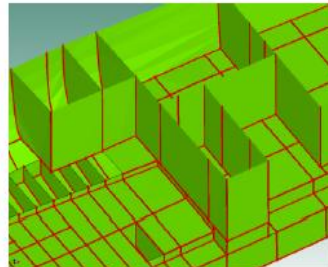
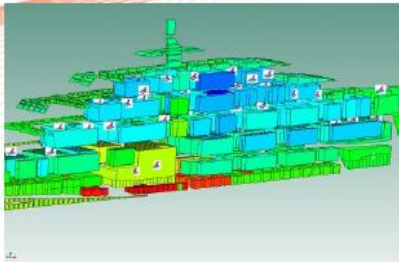
FE/SEA structureborne and windnoise predictions

ŠKODA TRANSPORTATION

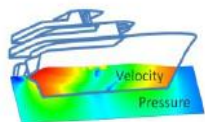


SEA Air-borne and rolling noise prediction

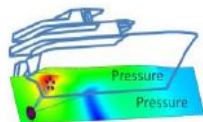
Examples in Marine



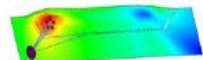
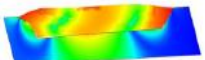
SEA structureborne and airborne insulation design – Van Cappellen



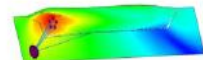
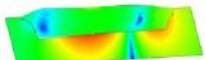
50 Hz



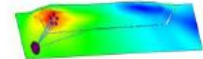
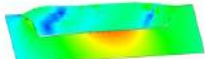
100 Hz



150 Hz

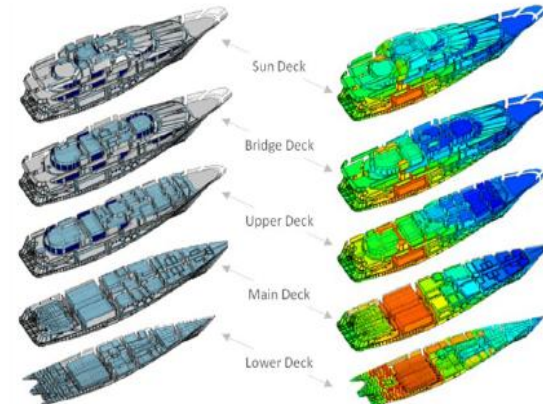
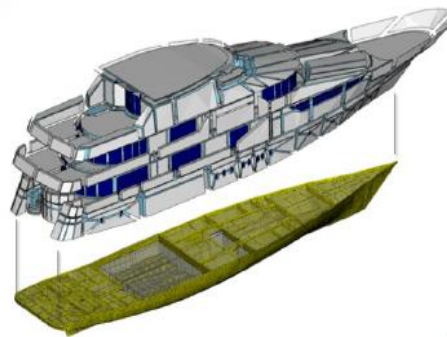


200 Hz



Underwater Radiation from
vibrating hull panels

Underwater wave propagation
from propeller point sources

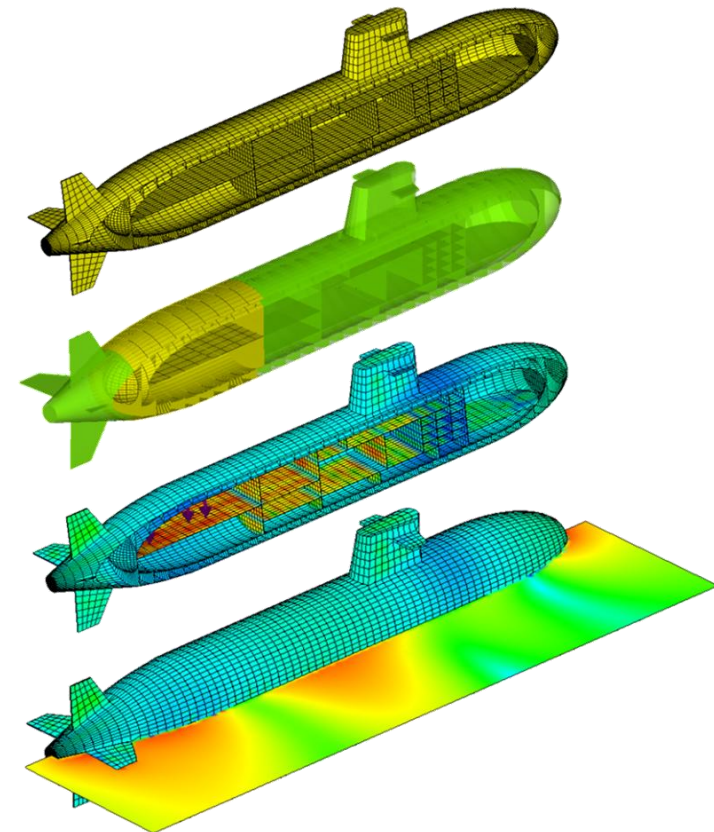


FE/SEA structureborne, airborne and propeller noise predictions - ESI



Examples in Marine

- Submarine acoustic signature
 - Engines
 - Propeller shafts
 - Fuel pumps
 - Air conditioning systems
 - Etc.
- Surface ship signature
- Interior noise
 - Crew quarters
 - Command center
 - On-ship transfer path analysis
 - Engine mount analysis and optimization
- Torpedo self noise
- Sonar self noise
- Advanced materials analysis and design



Top to bottom: Full FE geometry, FE/SEA model, Panel vibration, Underwater radiation

3 questions for...



Katsunori Shimazaki and
Shinichi Hirakawa from the
Structural Engineering Laboratory
of Technical Research Center at
Universal Shipbuilding Corporation.

Universal Shipbuilding Corporation is a Japanese shipbuilder which specializes in tankers, bulk carriers and is the only company in Japan that possesses the ability to build icebreakers such as Shirase, the Antarctic observation/transportation ship. Universal Shipbuilding Corporation uses ESI's VA One software for analyzing inboard noise and underwater radiated sound.



One of the largest means of transportation on earth: Malacca type VLCC ISUZUGAWA. 333m long and a loading weight of approx. 300,000 tons.

What are the fundamental challenging aspects in regard to noise control aboard ships?

"Ships are simply large. For example, there are ships such as the Malacca type tanker which extends to a length of 333 meters. This is equivalent to the length of the Tokyo tower turned on its side, and one of the largest means of transportation. Because this huge bulk of iron is manoeuvred only with the revolutions of propellers, the engine is accordingly massive. Although ships are the only means of transportation which allow people to enter the engine room while running, it is virtually impossible to carry on a conversation near the engine. The use of earplugs is mandatory when working, and the number of work hours per shift is also restricted. It is somewhat challenging to control this noise. In order to meet the noise standards of the International Maritime Organization (IMO), the hull structure and the positioning of the engine room and residential compartments etc. must all be decided appropriately."

So does this mean it is more difficult to control the acoustics of larger ships than smaller ones?

"No, it is just the opposite; controlling the acoustics of smaller ships is more difficult. For instance, controlling the noise level in a 70-meter ship is more difficult than in a 333-meter tanker. While it is true that the engine of a large ship is proportionally bigger and the noise of the engine is accordingly



Universal Shipbuilding Corporation

louder, the engine room can be further away from the residential compartments. Noise levels can be substantially mitigated by simply inserting a few walls in the intervening space. In other words, we can control noise levels using 'just the standard measures'.

With special small boats (for example, a 68-meter tug and supply vessel), however, the distance between the engine room and residential compartments is less and standard measures are not applicable. Innovation is required to devise other forms of noise control measures.

Noise control is also difficult in icebreaking bulk carriers. Icebreaking bulk carriers are vessels that break ice while navigating in the arctic seas. Icebreaking bulk carriers require more horse power than normal bulk carriers as they need to break ice along the way. This makes the engine noise louder accordingly, and therefore, noise control becomes more critical than in normal bulk carriers.

Lastly, the important point to remember is that it is not accepted to leave the noise level high on special small boats and icebreaking bulk carriers even if it is too challenging to come up with measures. The IMO standards demand that noise levels of small special boats and icebreaking bulk carriers are controlled to a similar level to those of other vessels."

You have been using ESI's VA One software to perform Vibro-Acoustic simulations for over 10 years. How would you evaluate the software?

"I believe the following are the advantages of VA One:

Credibility of analysis - When reporting analysis results at academic meetings, it is easy for the audience to approve the credibility of analysis reports if VA One is used because VA One is a reputable tool. In contrast, one would have to start his/her presentation by "proving the credibility of analysis results" if a home-grown program is used as a tool instead.

Ability to respond quickly to new material or structural design - Even when acoustic analysis of a new unknown substance or new material is required, VA One can be used to resolve such challenges by asking ESI to add a macro or to customize the software. We had difficult times back when we were using our own home-grown software for analysis, because we had to develop it in order to meet new requirements. Now, it is effortless as the version of VA One gets upgraded periodically, allowing us to deal with new substances or new materials."

► Find out more:

www.esi-group.com/va-one

► visit Universal Shipbuilding website:

www.u-zosen.co.jp

Commercial shipping

- Structure-borne Noise and Vibration
- Optimize insulation content
- Control noise to meet IMO standards
- Underwater environmental noise

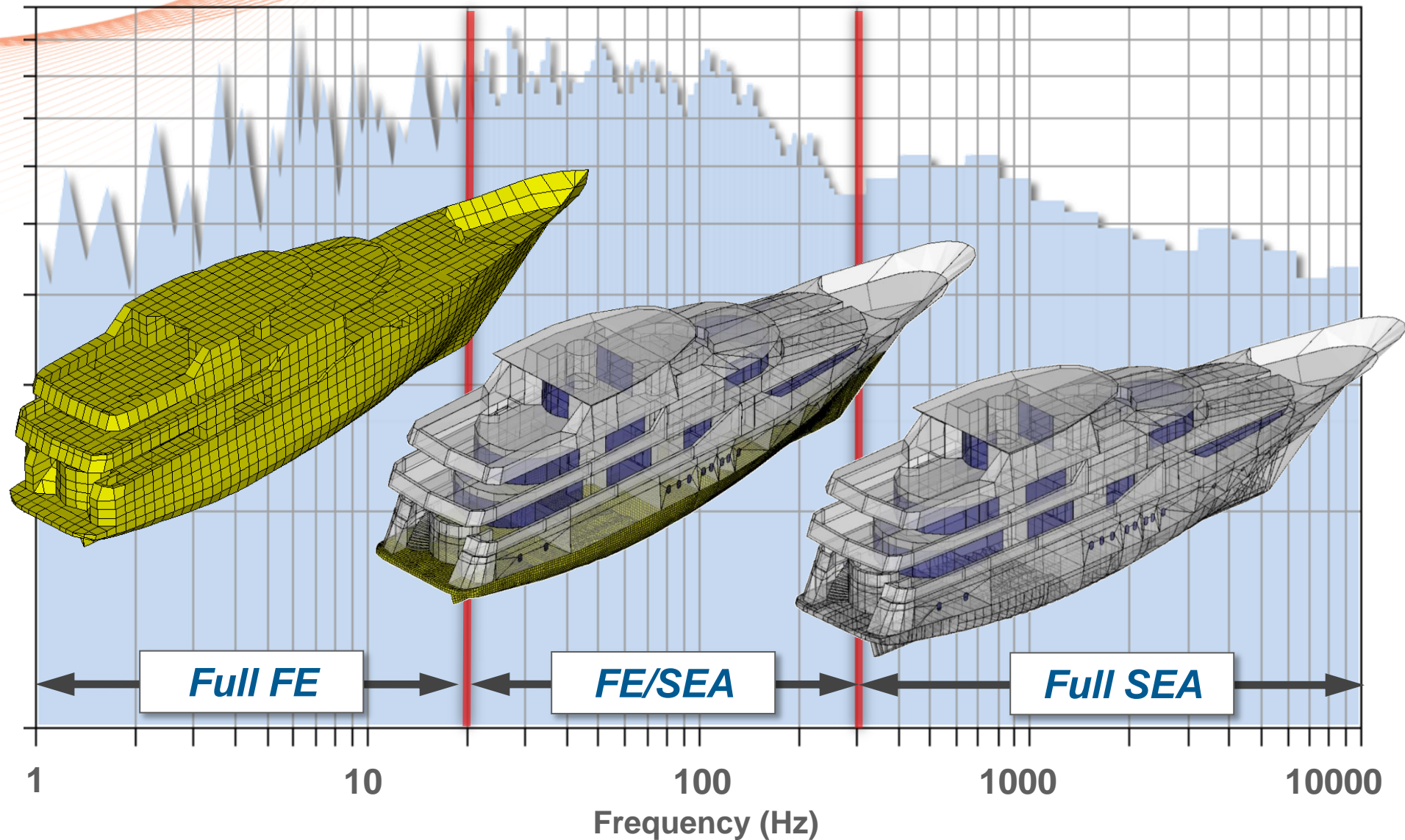


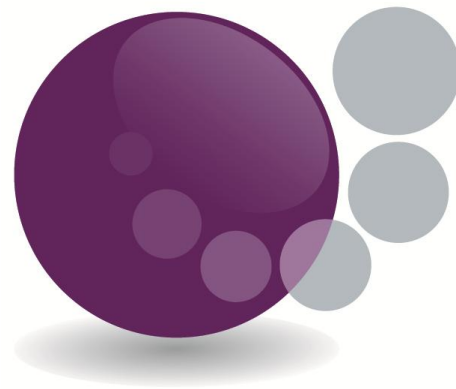


- Passenger Cabin Noise
- HVAC Noise
- Optimization of insulation
- Certification



VA One provides Full Frequency Analysis

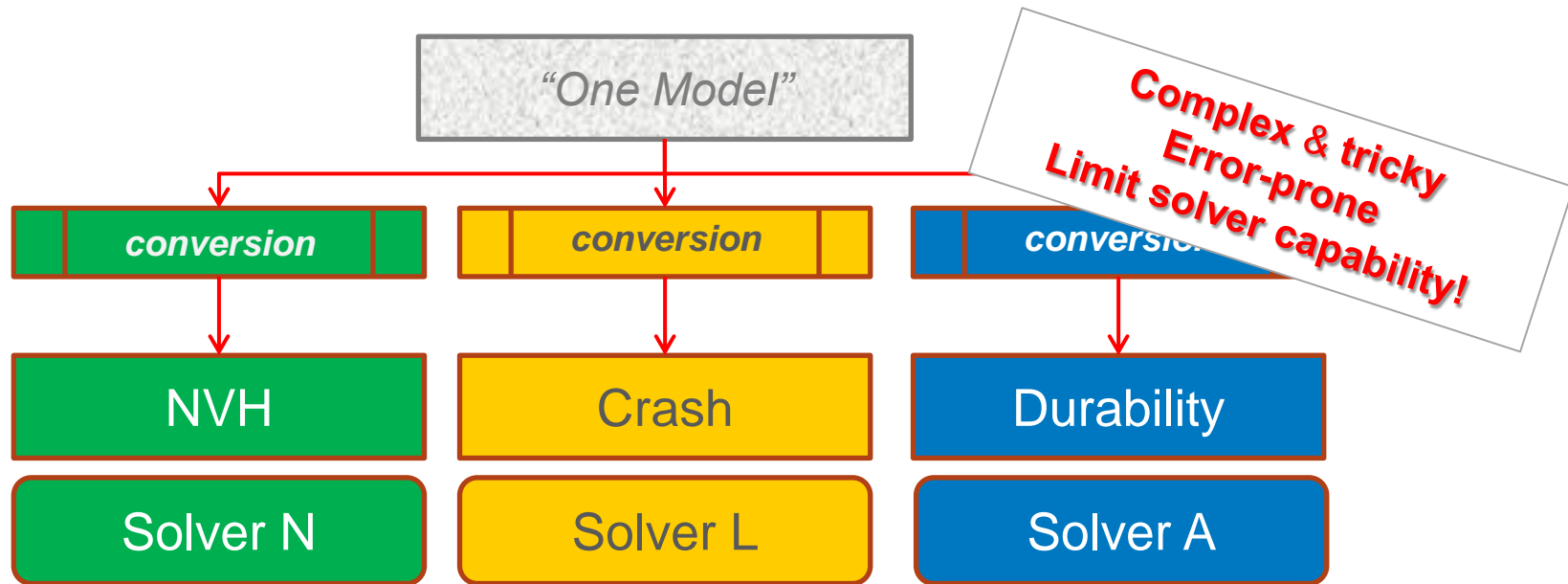




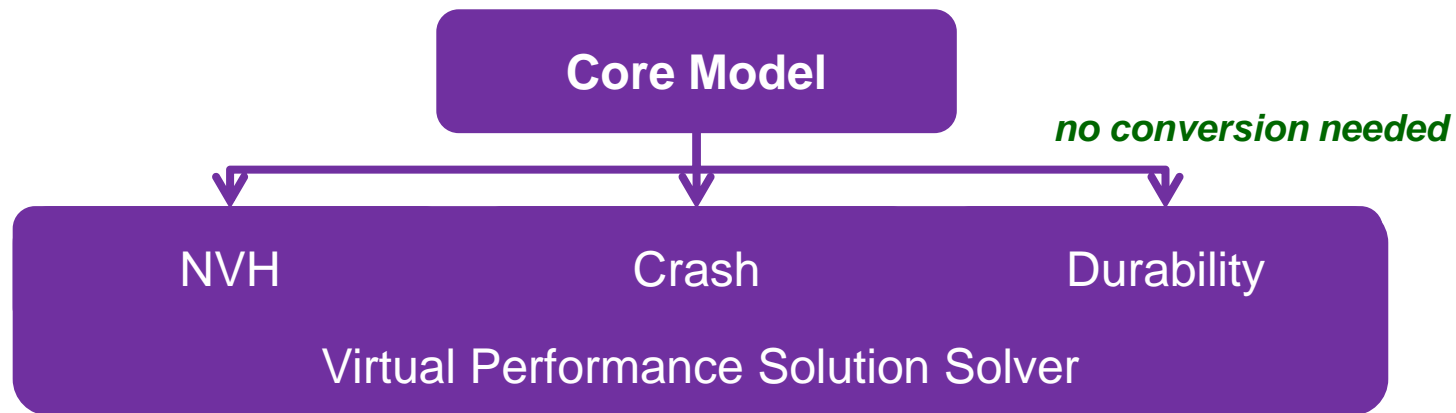
Virtual
Performance
Solution

STEP TOWARDS END-TO-END VIRTUAL PROTOTYPING

— Classical approach

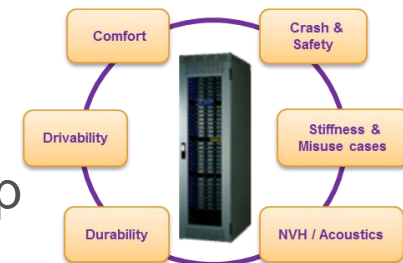


- Single Core Model (“common modeling language”)



- Benefits

- By default, instantaneous **synchronization** across domains
- Reusability** of parts, components and sub-systems
- Reduction of resources & time** for model building
- One hardware** platform reducing costs of ownership



Explicit-based solutions

- **PAM-CRASH**
- **PAM-SAFE**
- **PAM-MEDYSA**
- **PAM-SHOCK**
- Linear and non-linear materials, large displacements
- Restraint systems
- Non-linear Dynamics
- High velocity impact

One
Executable

Implicit-based solutions

- **PAM-STATICS**
- **PAM-NVH**
- **PAM-ACOUSTICS**
- Linear and non-linear materials, large displacements
- Eigenmode Extraction, Harmonic and Transient Analysis
- Interior acoustics, Porous Elastic Materials

→ Structural
Departments

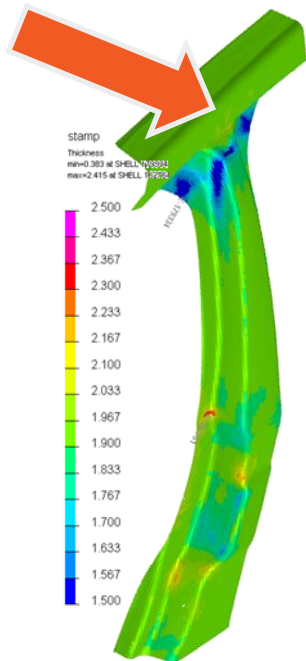
for Sound Package
→ **VAOne**

Chaining with Manufacturing

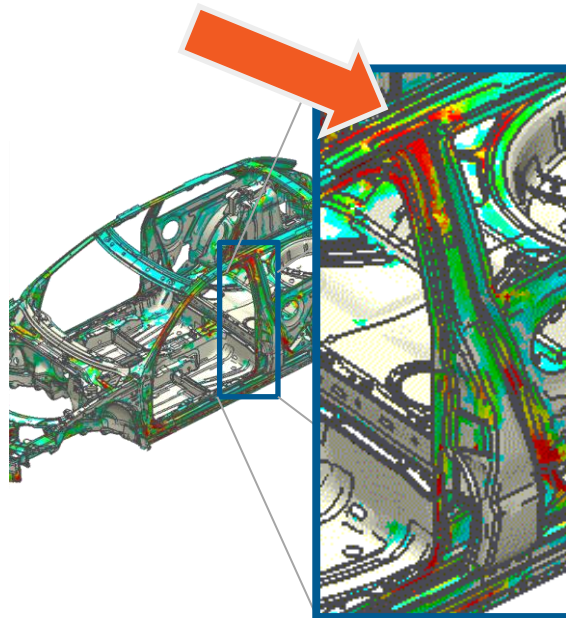
!!!

- B-pillar is sensitive for NVH performance on **manufactured parts**

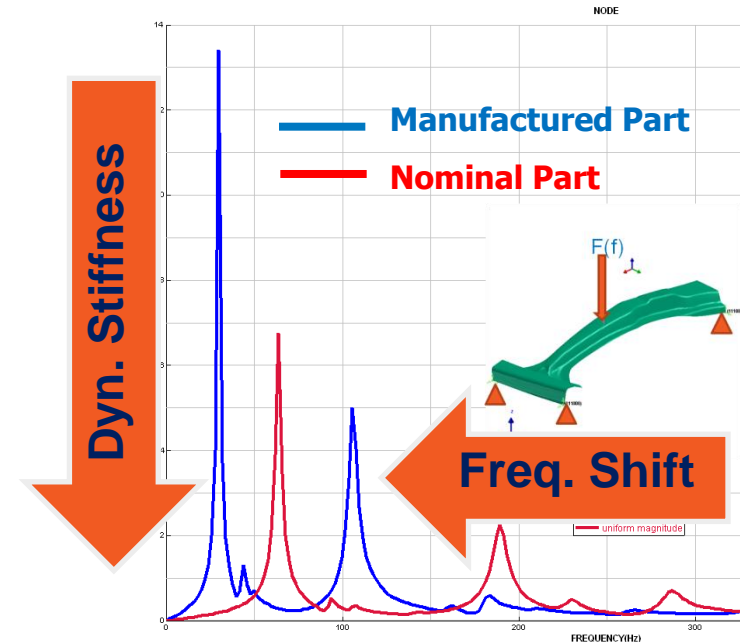
After hot forming
based on real properties:
→ **decreased** part thickness

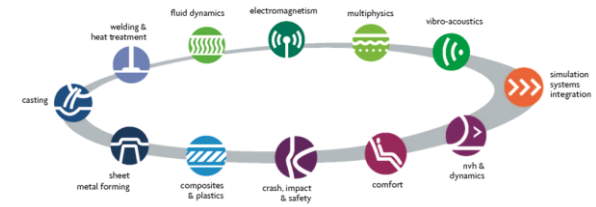


After optimization based
on nominal properties:
→ **increase** part thickness



Driving Point Analysis





Mission

Provide to industry **virtual solutions** for design and manufacture of products in order to **eliminate physical prototypes** that require high consumption of time, raw materials and energy.

Vision

Be the **leader of virtual prototyping** spurring **innovation of products and processes** to reinforce the **social value** of our customers' products (safety, comfort, performance,...).

■ Консультации и поддержка

- Онлайн поддержка пользователей
- Расширенные тренинги
- Системная интеграция HW & SW



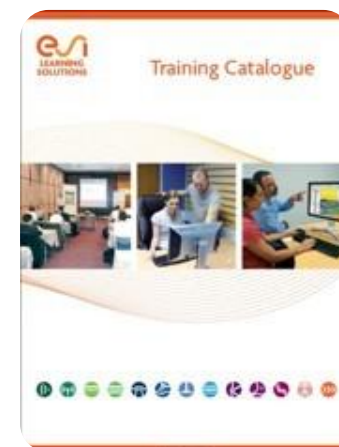
■ Инженерные исследования

- Проекты по требованию
- Консультации и возможность предложить
- технологических изменений на основе предыдущих результатов



Тренинги и семинары

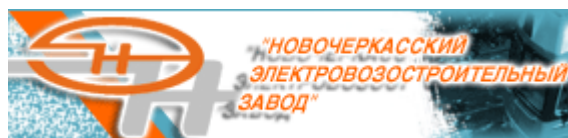
- В заранее определенное время или в соответствии с индивидуальными требованиями заказчика
- В соответствии с конкретными потребностями и уровню знаний участников частности
- В помещениях компании или в любом месте, выбранном клиентом
- Демонстрации и практические упражнения во время тренировок
- Печатная документация, сертификация посещаемости



Пользователи в России



ЦЕНТРАЛЬНЫЙ АЭРОГИДРОДИНАМИЧЕСКИЙ ИНСТИТУТ

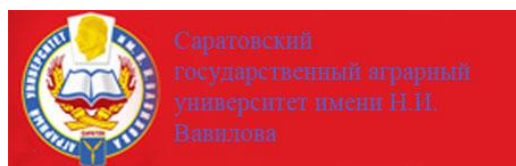


Пользователи в России



НАЦИОНАЛЬНЫЙ
ИССЛЕДОВАТЕЛЬСКИЙ
ИРКУТСКИЙ ГОСУДАРСТВЕННЫЙ
ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ

NATIONAL RESEARCH
IRKUTSK STATE
TECHNICAL UNIVERSITY



МОСКОВСКИЙ АВИАЦИОННЫЙ ИНСТИТУТ
(НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ)

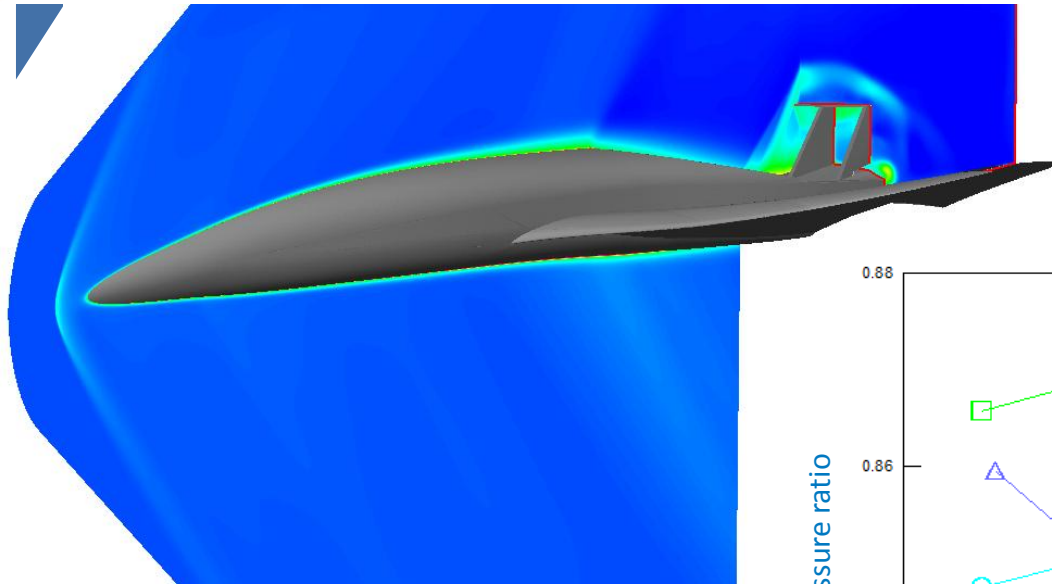


Уральский
федеральный
университет
имени первого Президента
России Б.Н. Ельцина



Example of cooperation in Russia

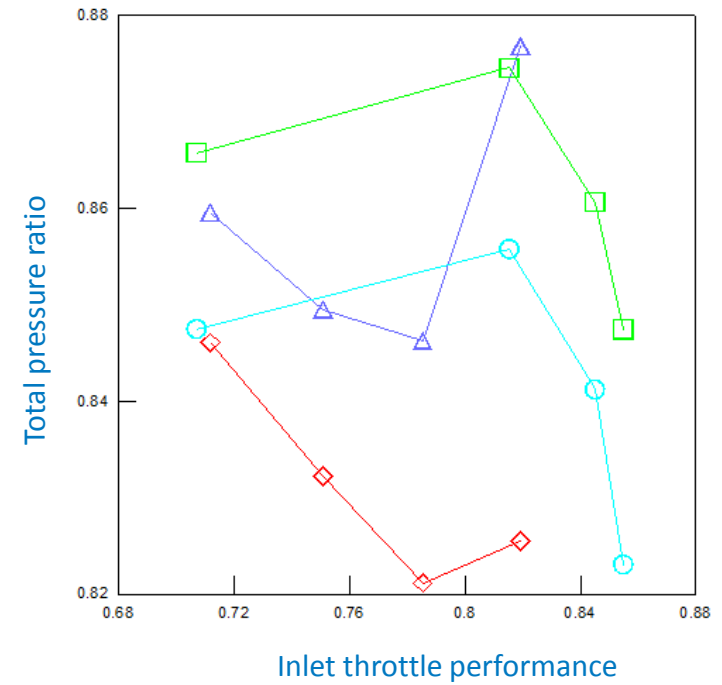
INLET RESEARCH OF SUPERSONIC CIVIL AIRCRAFT IN INTEGRATION WITH FLYING VEHICLE



CFD FASTRAN

19 mln cells
24 cores
45 hours

High-efficiency 3D inlet with boundary layer ingestion through perforation.
Flight at altitude 16 km. $M=1.8$





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