# Hacia la automatización de procesos de simulación estructural y vibro acústicos

# Agenda

Gemelo Digital

Generación de modelos de simulación

Simulación estructural y multifísica

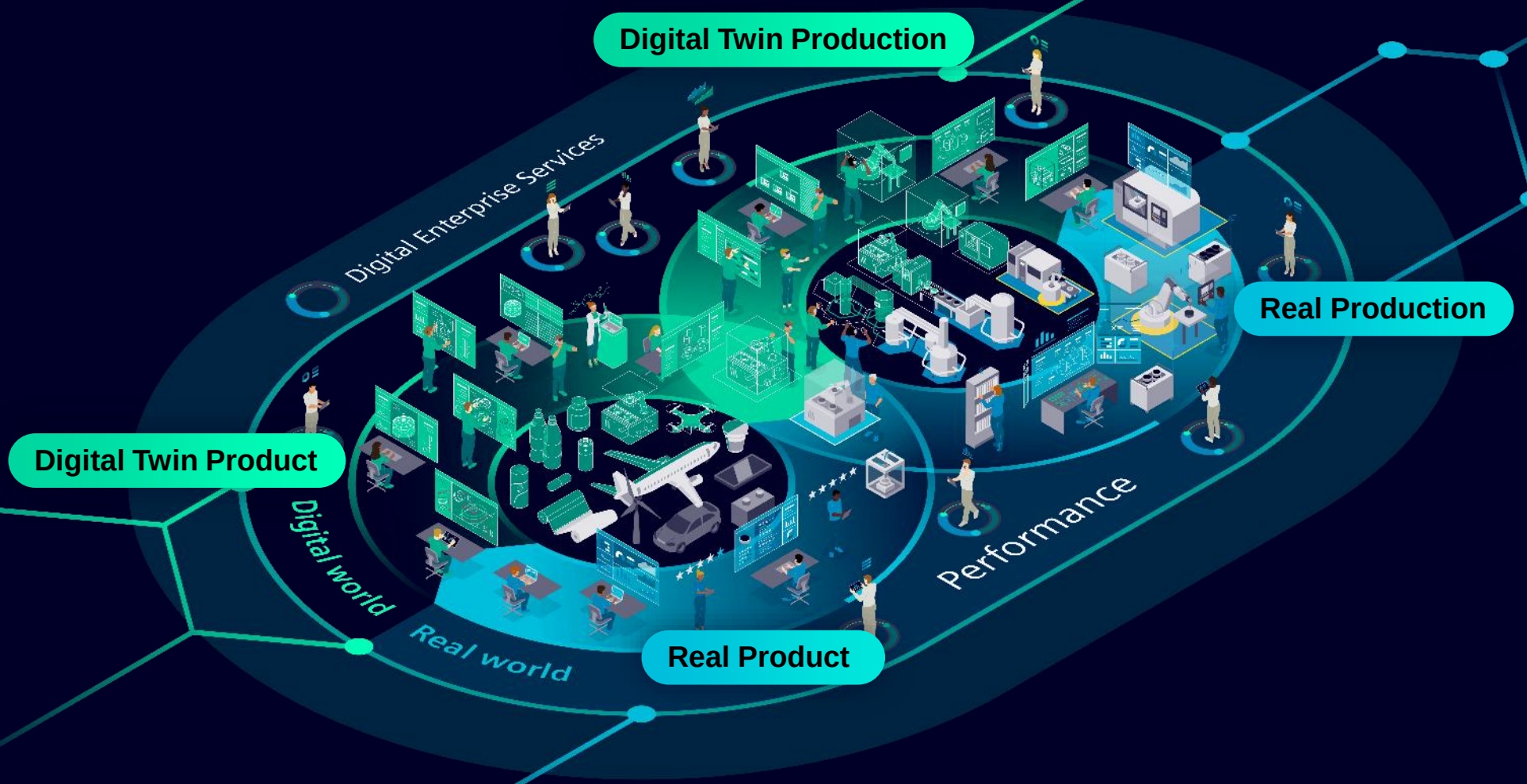
# Gemelo Digital

X-Plan
Ingeniería Colaborativa

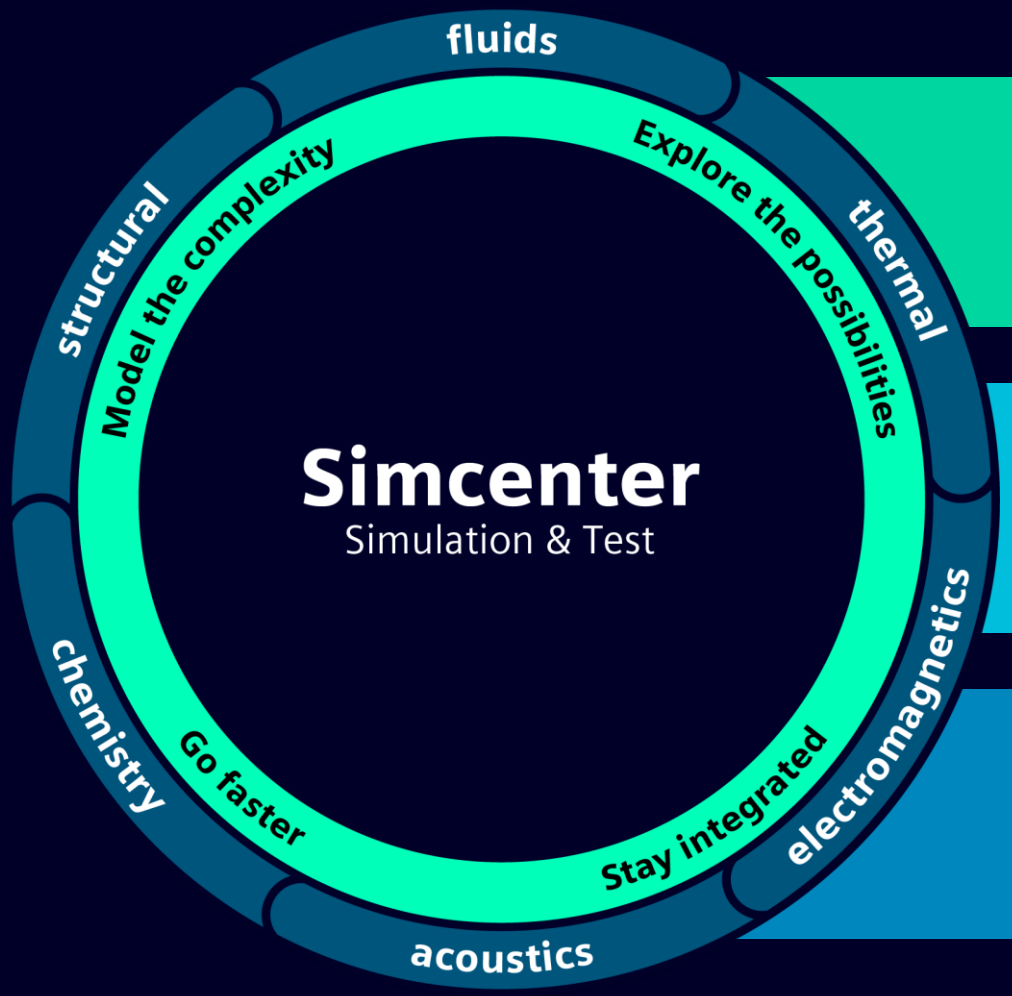
Expert Partner
Digital Industries Software

SIEMENS

# Comprehensive Digital Twin



# Enabling Simulation Process and Data Management for Simcenter




## System Simulation

Simcenter Amesim, Simcenter Flomaster
Simcenter System Architect, Simcenter System Analyst
Simcenter Embedded Software Designer,
Simcenter Prescan

## CAE Simulation

Simcenter 3D, Simcenter STAR-CCM+,
Simcenter Nastran, Simcenter Femap, Simcenter FLOEFD,
Simcenter MAGNET, Simcenter Madymo, Simcenter Tyre,
Simcenter Motorsolve, Simcenter Speed

## Physical Testing

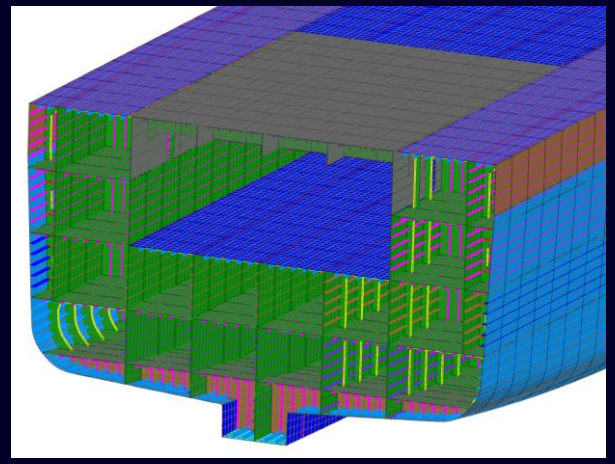
Simcenter Testlab, Simcenter Testxpress
Simcenter Tecware, Simcenter T3STER,
Simcenter TERALED, Simcenter POWERTESTER

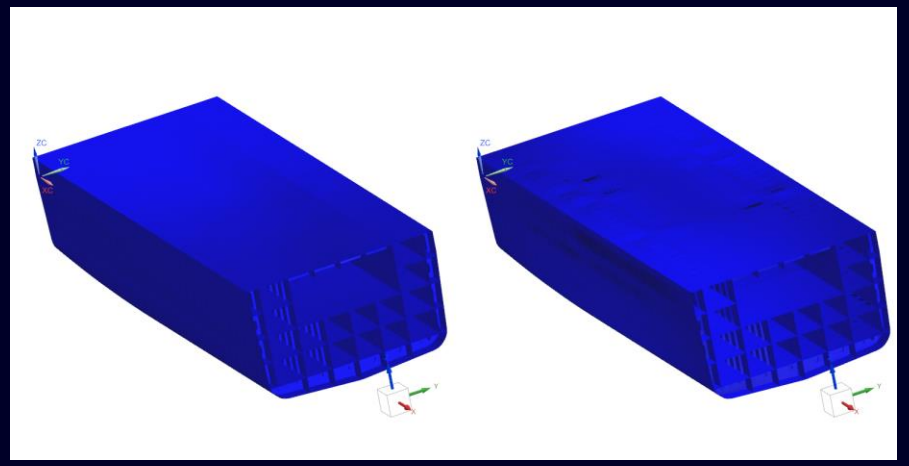
Exploration & Analytics - HEEDS

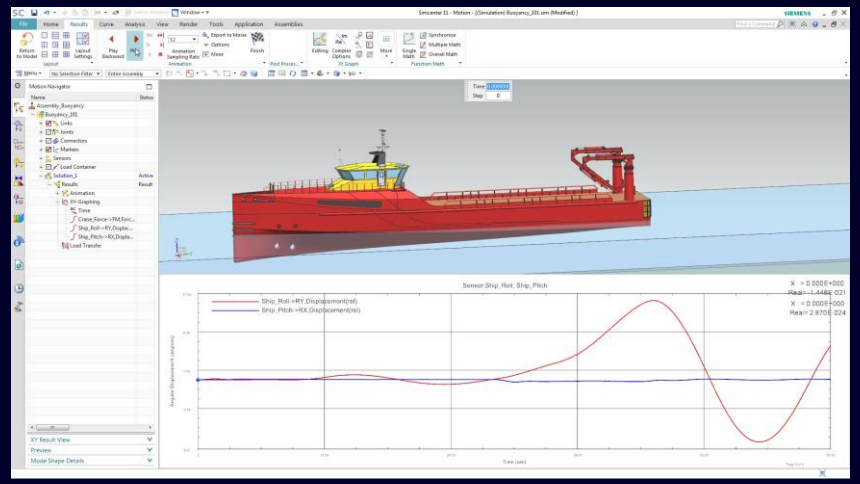
Data & Process Management - Teamcenter Simulation

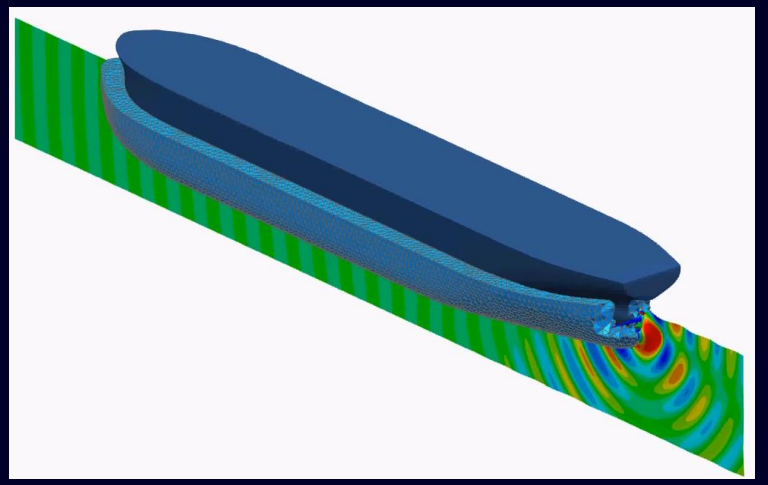
 

# Simcenter 3D









## Predict mechanical performance across physics domains with comprehensive, fully-integrated CAE solution

- Common engineering desktop integrating multiple disciplines
- Streamline multiphysics workflows
- Seamlessly connect with data management and CAD
- Scalable for discipline experts, general analysts and designers

# Generación de modelos de simulación

X-Plan
Ingeniería Colaborativa

Expert Partner
Digital Industries Software

SIEMENS

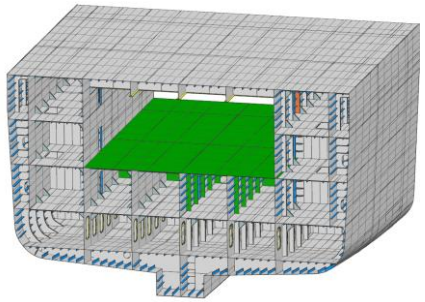
# General CAD – FEM Process

X-Plan Ingeniería Colaborativa | Expert Partner Digital Industries Software | SIEMENS

**Design** | **CAE**

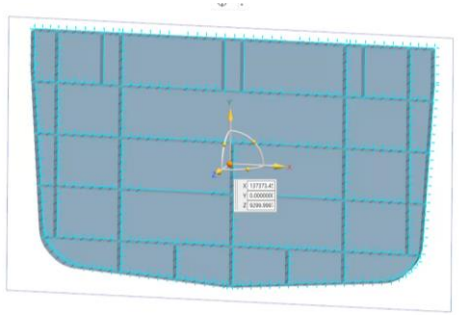
## Ship Structure

Geometry and –possibly- some Metadata

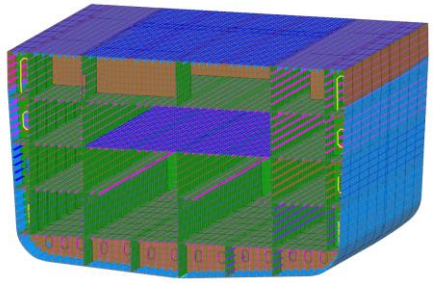


**Simcenter 3D**

**CAE Geometry preparation**

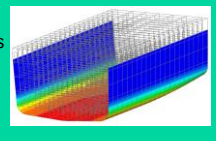


**Meshing and properties definition**



**Multi-Physics Applications**

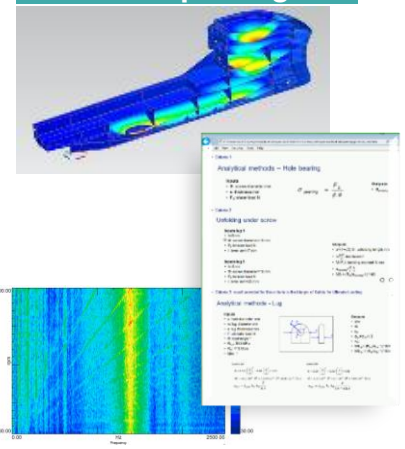
Strength and Stiffness
Fatigue
NVH and Acoustics
Electro-Magnetics
Multi-Body
…



**Integrated Solvers**

Simcenter Nastran
Acoustics FEM and BEM
Motion
Test-CAE correlation
1D co-simulation
3rd party - LS-DYNA, …

**Post-Processing and reporting**



**Data and Lifecycle Management** | **Structure Management and Automation** | **Tool and Process Management** | **Simulation Results Visualization, Reporting**

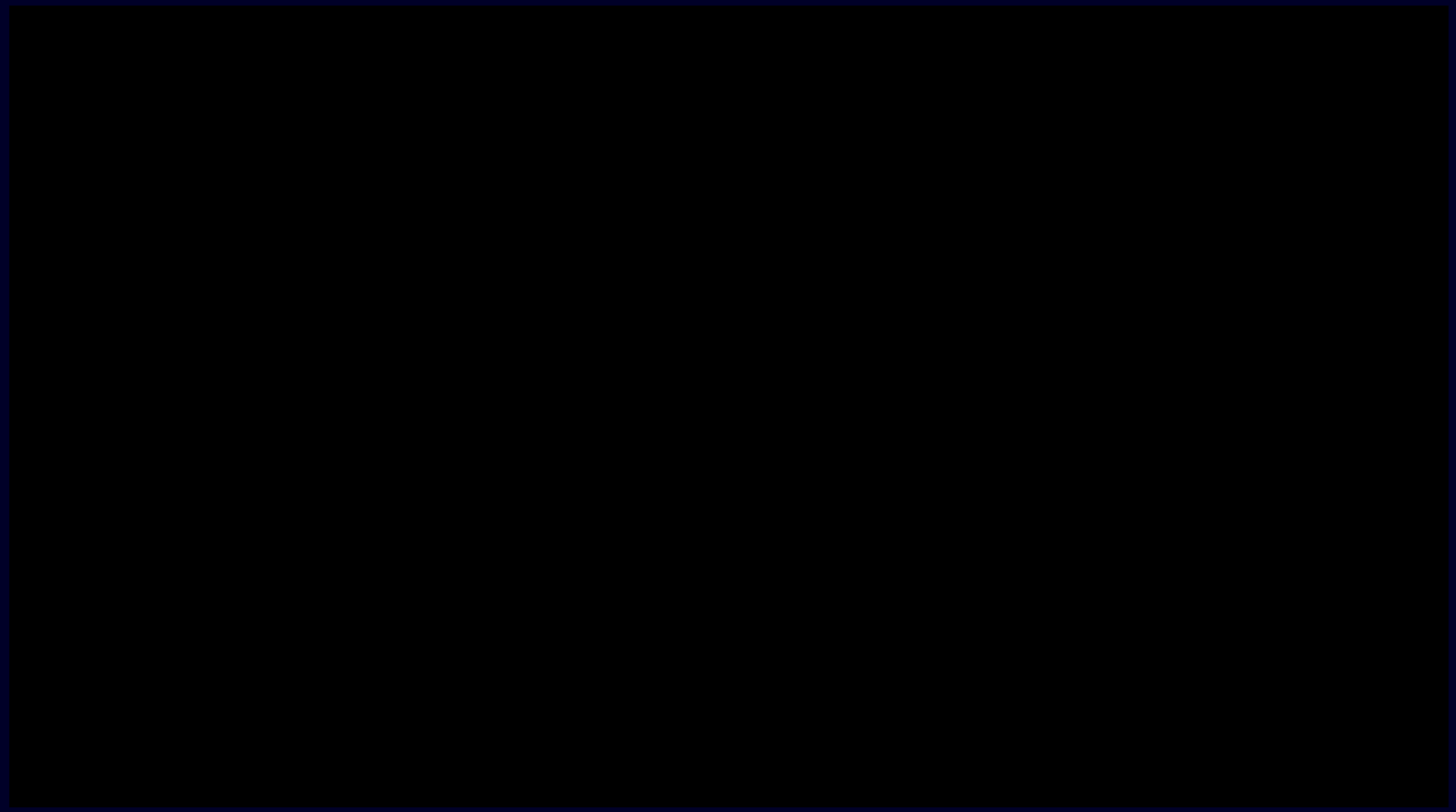
**Simulation Process and Data Management**
Teamcenter for Simulation

# **Structural analysis**
## Geometry Preparation

Robust Mid-surfacing tool

Reduce number of manual operations to fix sheet bodies

Dedicated geometry tools to “heal” CAE geometry



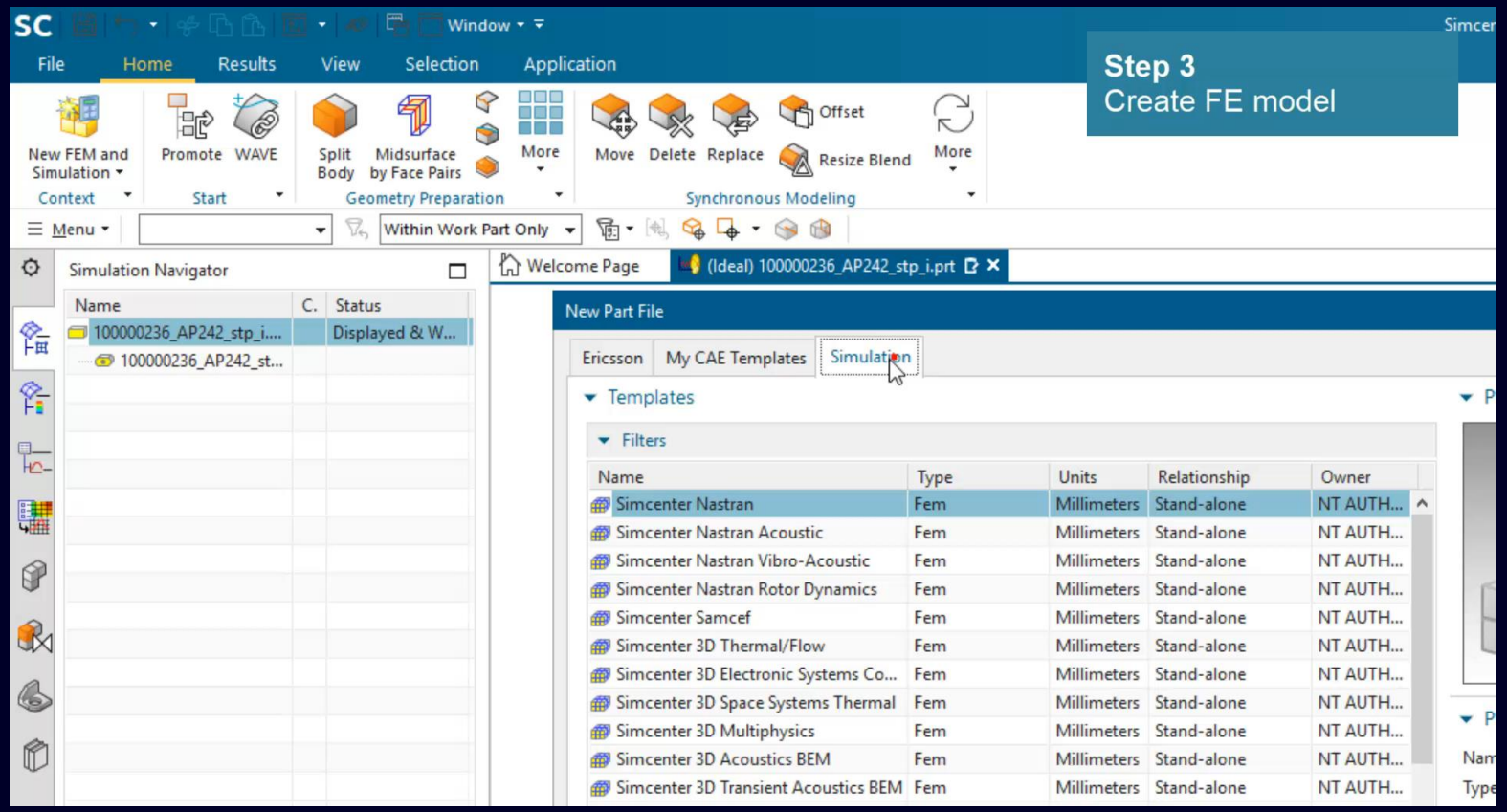
 

# Structural analysis
## Meshing and properties definition

Visual CAE Geometry audit

Shell meshing

Automated thickness definition based on geometry

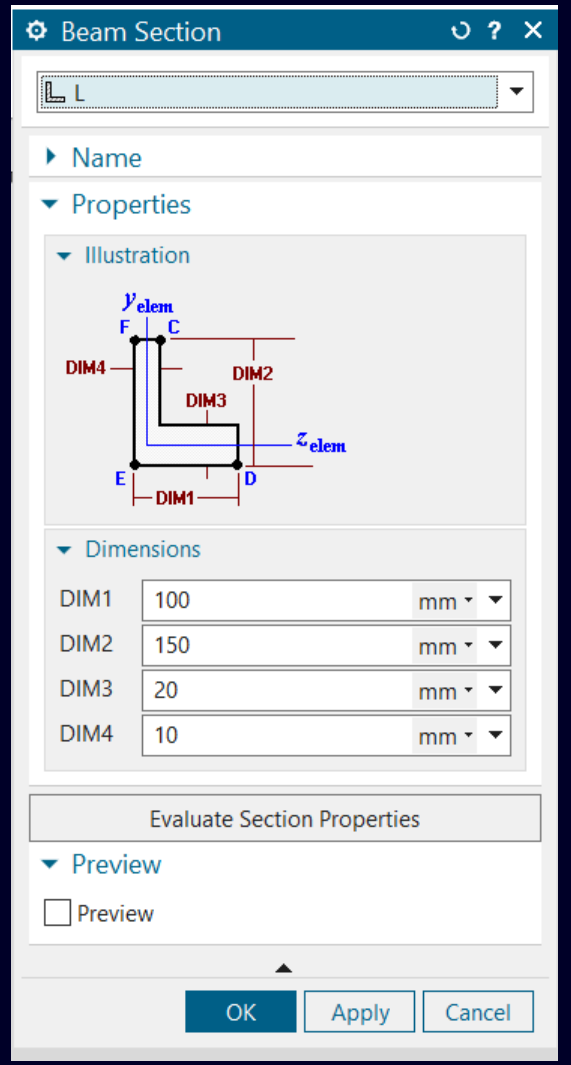


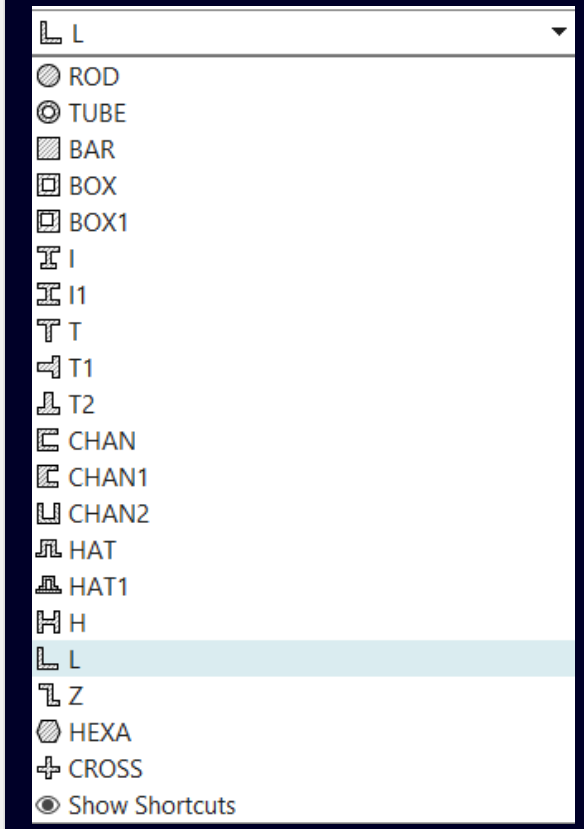
# Structural analysis
## Meshing and properties definition

One of the most time consuming tasks is the definition and mesh of beams.

In Simcenter 3D your can inherit the beam definition from CAD (metadata) and use it for the beam profile and plate thickness

Alternatively you can define the profiles and mesh all the beams with the same profile by meshing the CAD lines where they merge with the plates



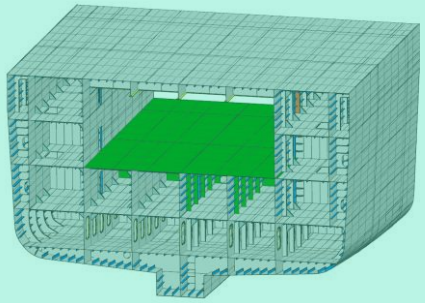
# General CAD – FEM Process

Design

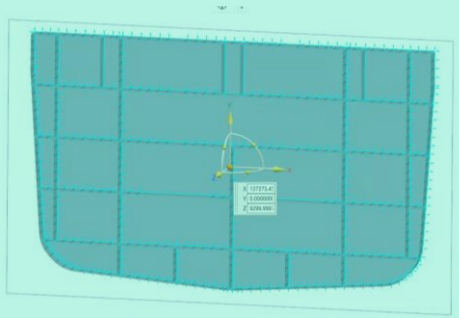
CAE

## Ship Structure

Geometry and –possibly- some Metadata

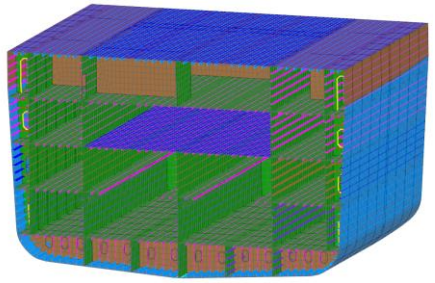


CAE Geometry preparation



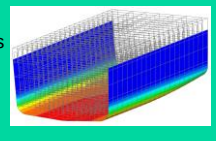
Simcenter 3D

Meshing and properties definition



Multi-Physics Applications

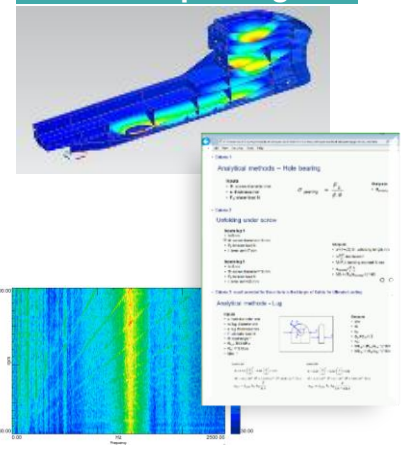
Strength and Stiffness
Fatigue
NVH and Acoustics
Electro-Magnetics
Multi-Body
…



Integrated Solvers

Simcenter Nastran
Acoustics FEM and BEM
Motion
Test-CAE correlation
1D co-simulation
3rd party - LS-DYNA, …

Post-Processing and reporting



Tool and Process Management

Simulation Results Visualization, Reporting

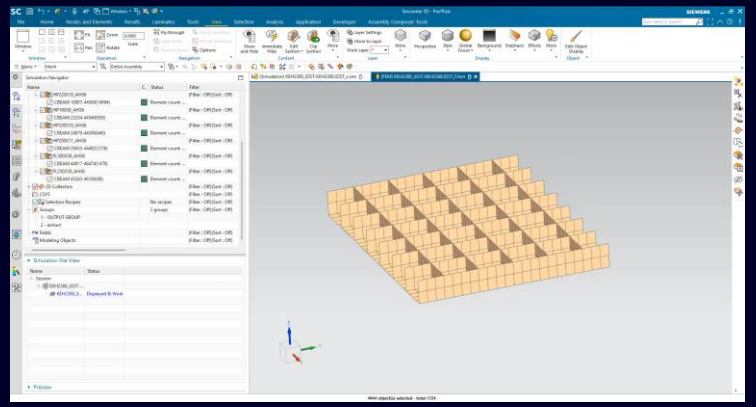
**Simulation Process and Data Management**
Teamcenter for Simulation

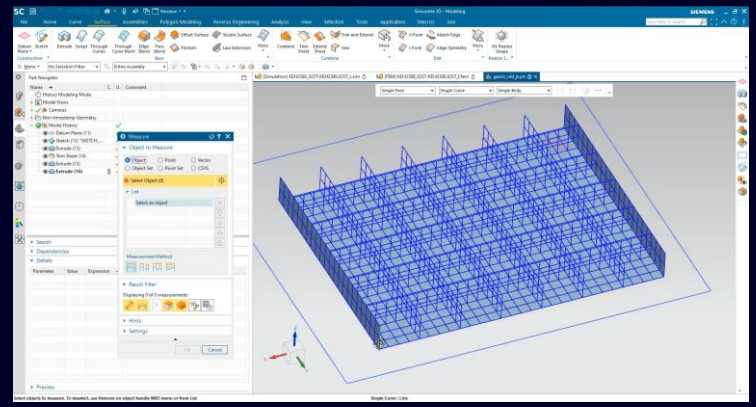
# Structural analysis
## Working with meshes

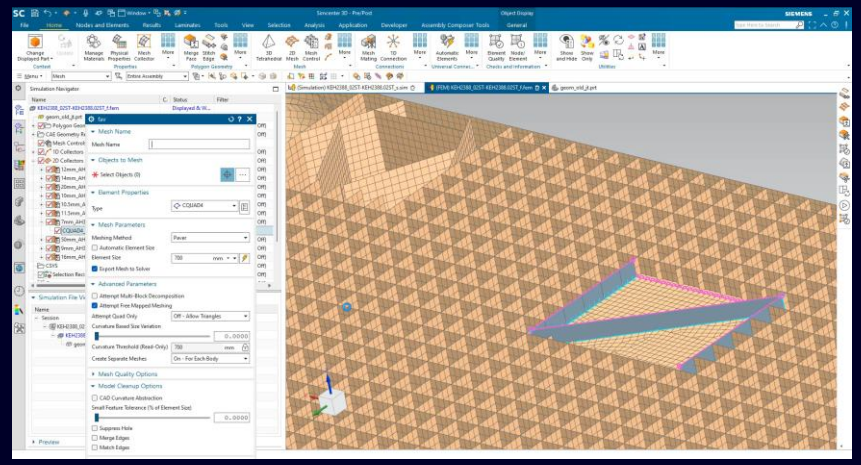
Create associated geometry via *.jt format

Modify as required

Update the mesh and re run the simulation





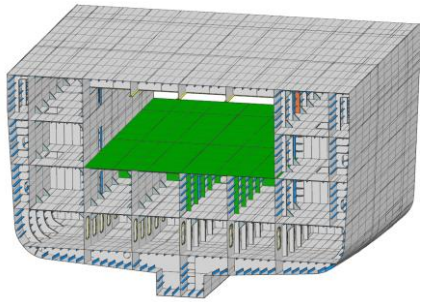


# General CAD – FEM Process

Design | *Integrated Design – CAE platform* | CAE

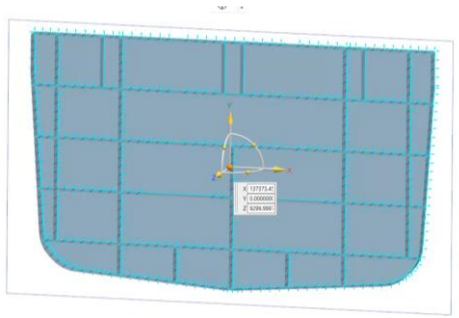
## NX Ship Structure

Ship arrangement, Materials, Cross Sections, Attributes,…

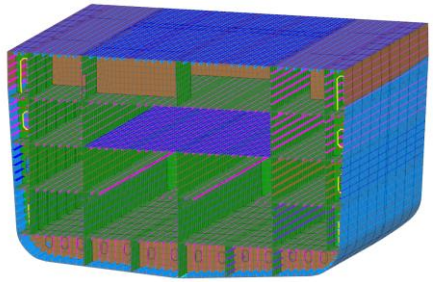


## Simcenter 3D

**CAE Geometry preparation**

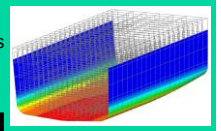


**Meshing and properties definition**



**Multi-Physics Applications**

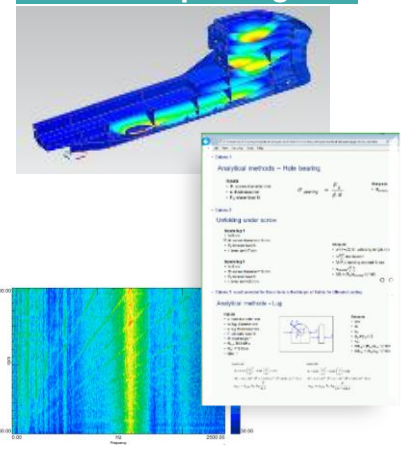
Strength and Stiffness
Fatigue
NVH and Acoustics
Electro-Magnetics
Multi-Body
…



**Integrated Solvers**

Simcenter Nastran
Acoustics FEM and BEM
Motion
Test-CAE correlation
1D co-simulation
3rd party - LS-DYNA, …

**Post-Processing and reporting**



**Data and Lifecycle Management**

**Structure Management and Automation**

**Tool and Process Management**

**Simulation Results Visualization, Reporting**

## Simulation Process and Data Management

Teamcenter for Simulation

# Integrated workflow
## CAE Geometry preparation

X-Plan Ingeniería Colaborativa

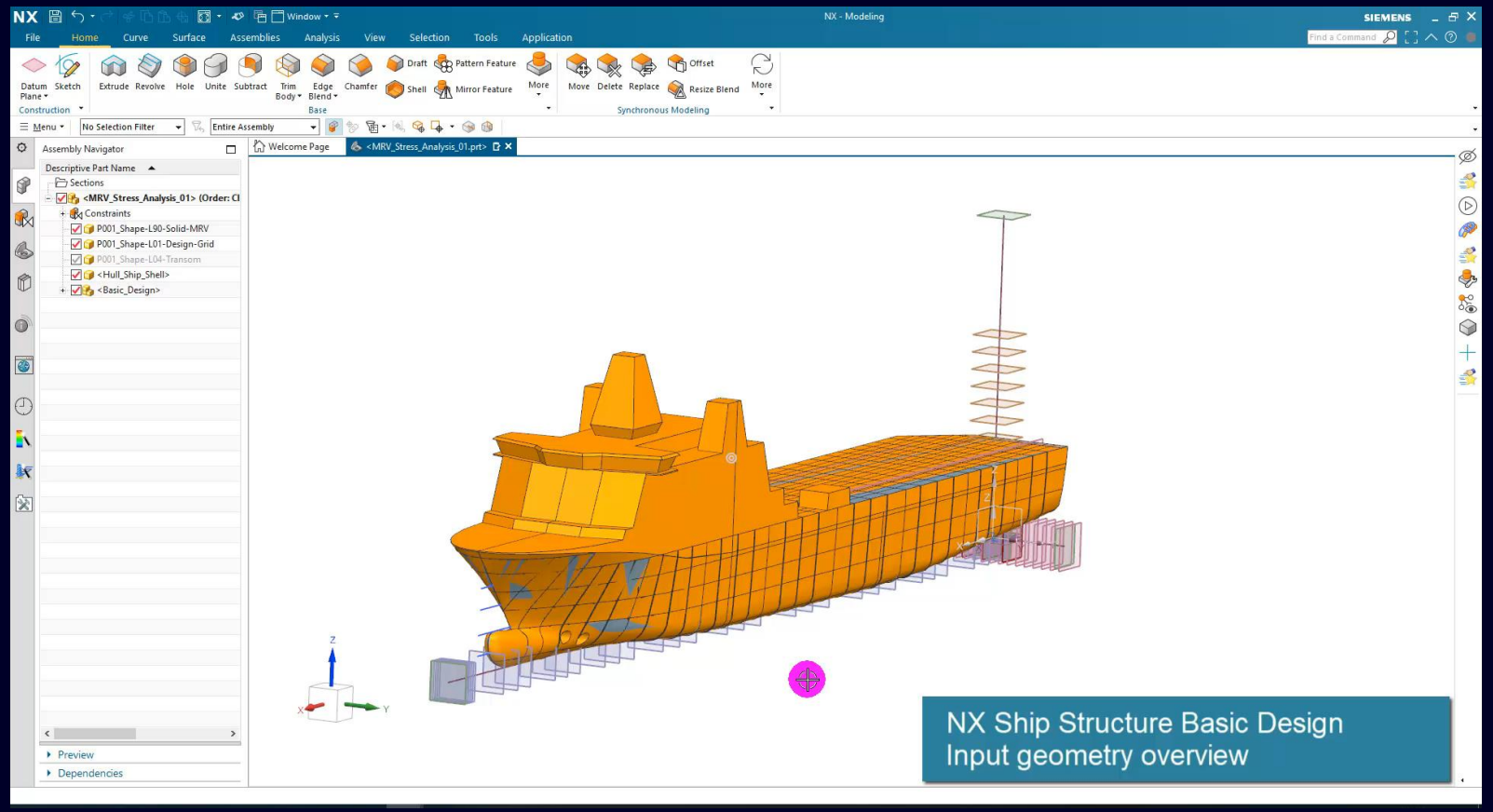
Expert Partner
Digital Industries Software

SIEMENS

**Benefits**

Almost “one click” to get geometry ready for meshing for a complete ship structure, ship section, area of interest…

Sheet bodies (panels) and geometry edges (stiffeners) are properly splited and connected (no gaps)



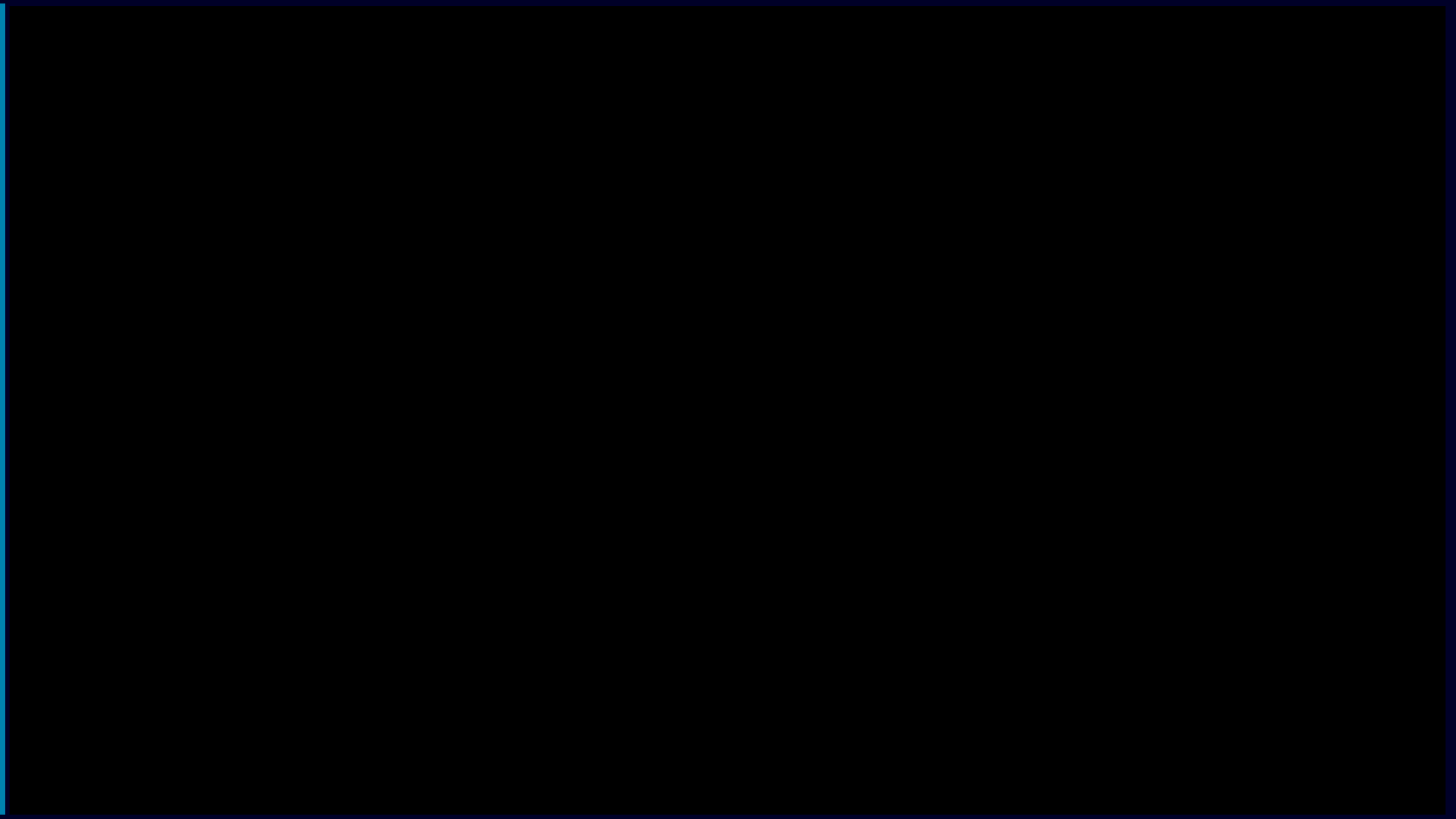
# Integrated workflow
## Meshing and properties definition

Dedicated beam and shell meshing

Automation of mesh properties definition:
- Materials
- Thickness for shells
- CS properties for beams

Well organized (grouped) FE model according to properties

Color-based thickness validation



# Simulación estructural y multifisica

X-Plan Ingeniería Colaborativa

Expert Partner

Digital Industries Software

SIEMENS

# Structural analysis
## Load case definition

Extraction of forces and moments for specific area of interest

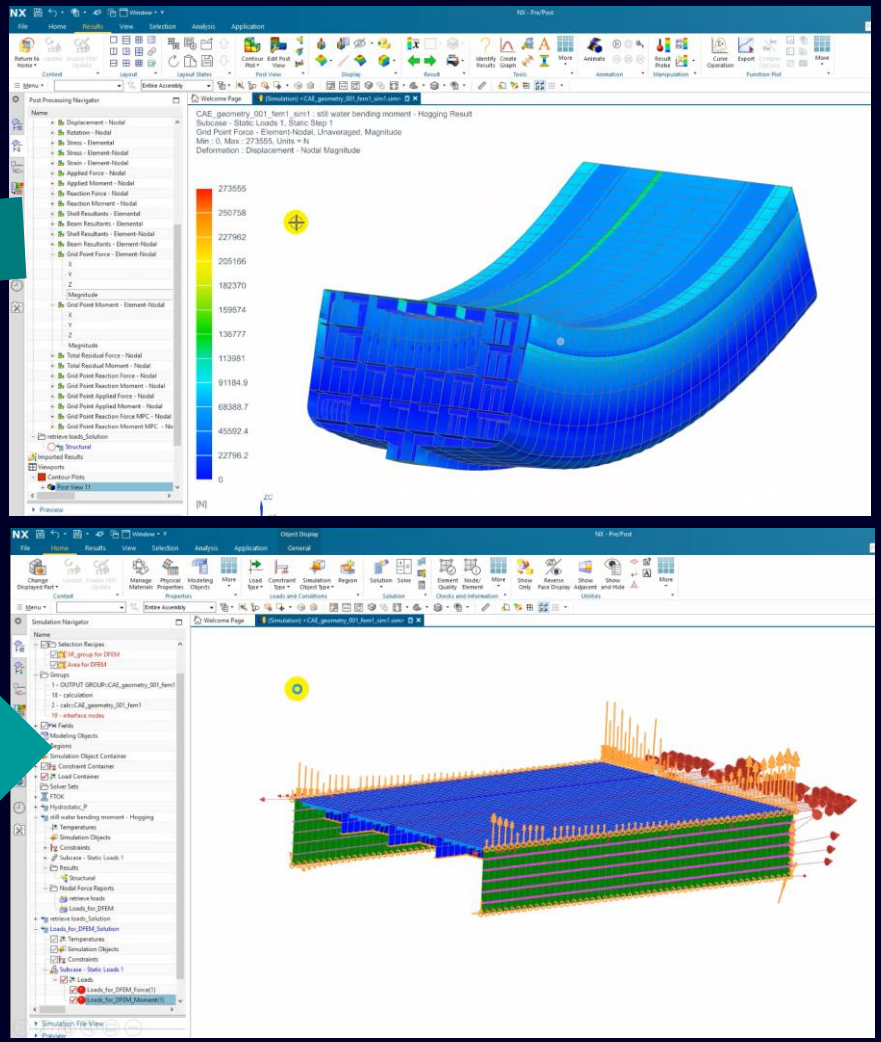
Use loading templates for standardized loading scenarios

Export solution for subsequent analysis on detailed structure and or Multiphysics

Library of formulas for load value calculation, e.g. Hogging

Hogging conditions:

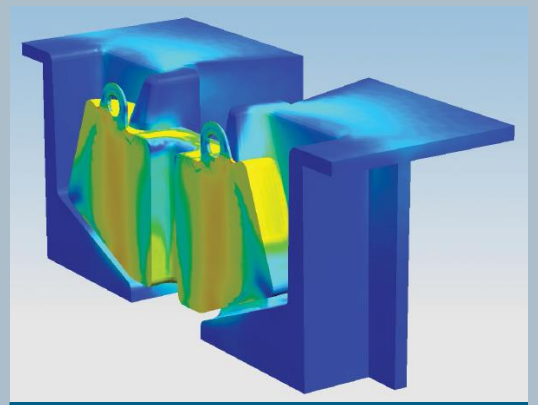
$$M_{sw-h-min} = f_{sw}\,(171 C_w\, L^2\, B(C_B + 0.7)\, 10^{-3} - M_{wv-h-mid})$$



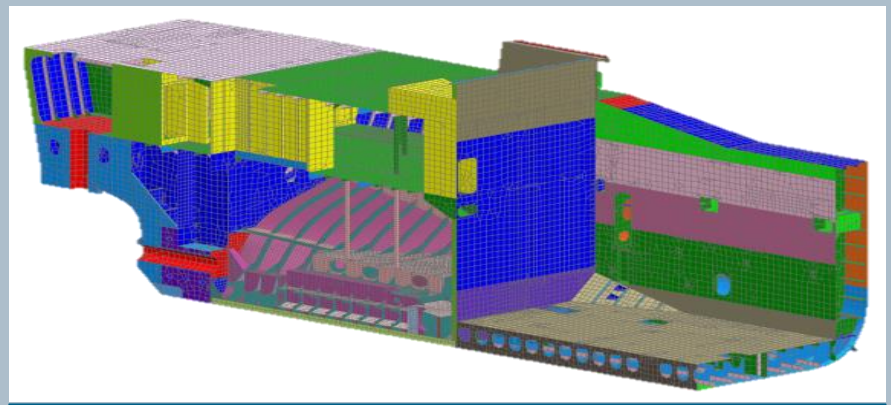
# Damen Shipyards
## Using DMP Simcenter Nastran Capabilities for Faster Design Evaluation

- **Faster evaluation of many design options**
- **Provided clear insight that vibrational energy flow from engine is below design limits for noise on board**
- **Enhanced ability to use very large models**

### Streamlining ship development with integrated digital simulation



**Coupling between barges**



**Modal analysis of very large FE model**

- Using Simcenter Nastran scalable DMP Solution for fast modal analysis
- Synchronous technology for fast design iterations

**“SC Nastran DMP allows the possibility to evaluate many design options.”**

Jerry Baffa, Damen CAE Specialist

# Vibro-Acoustic Simulation

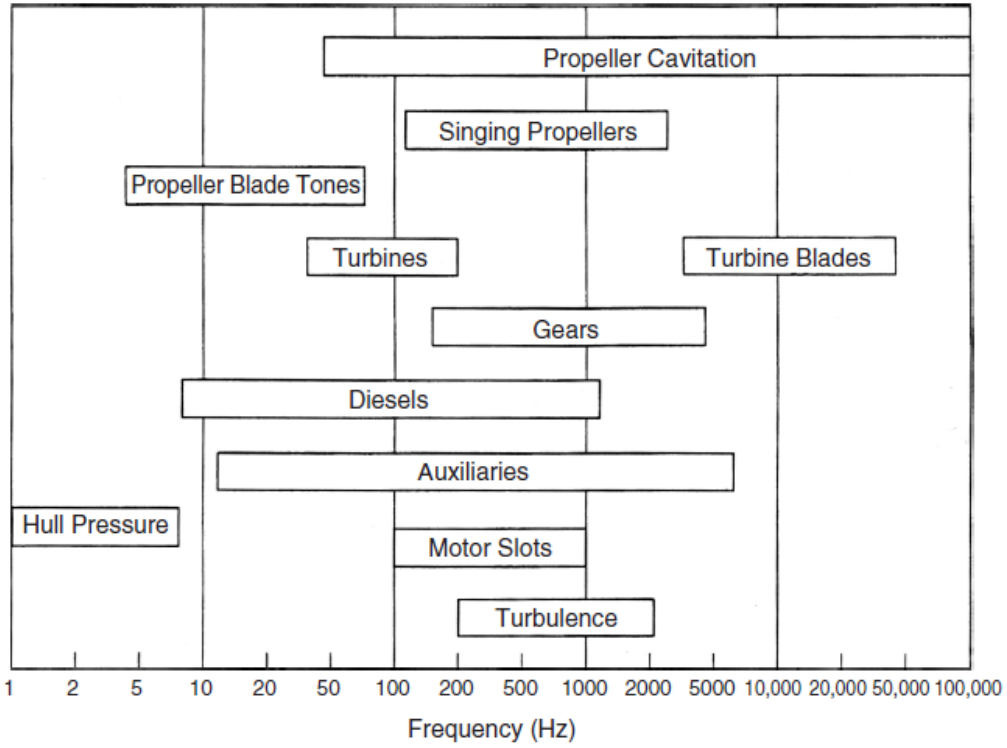
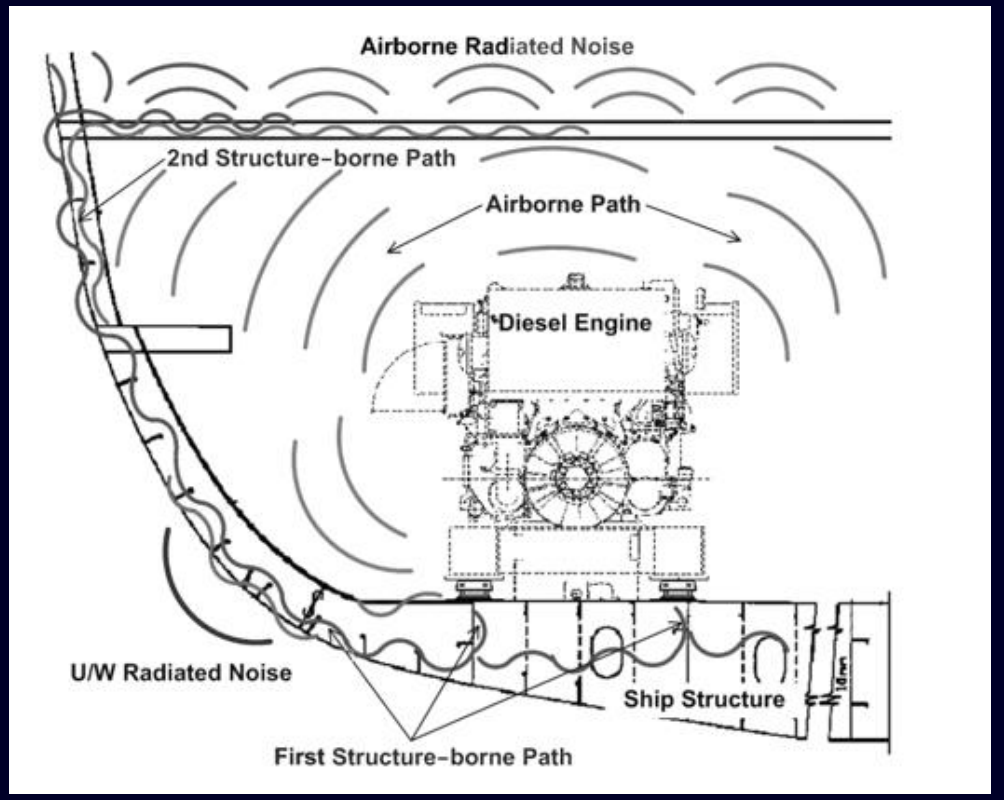


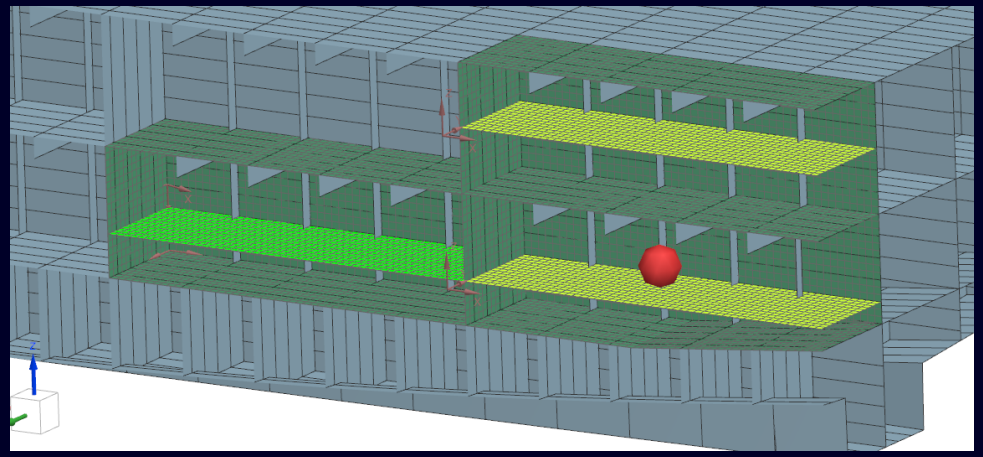

**Figure 4** Frequency ranges of noise radiated by ship noise sources.[21] (From Ref. 18, Chapter 46, Fig. 3.)

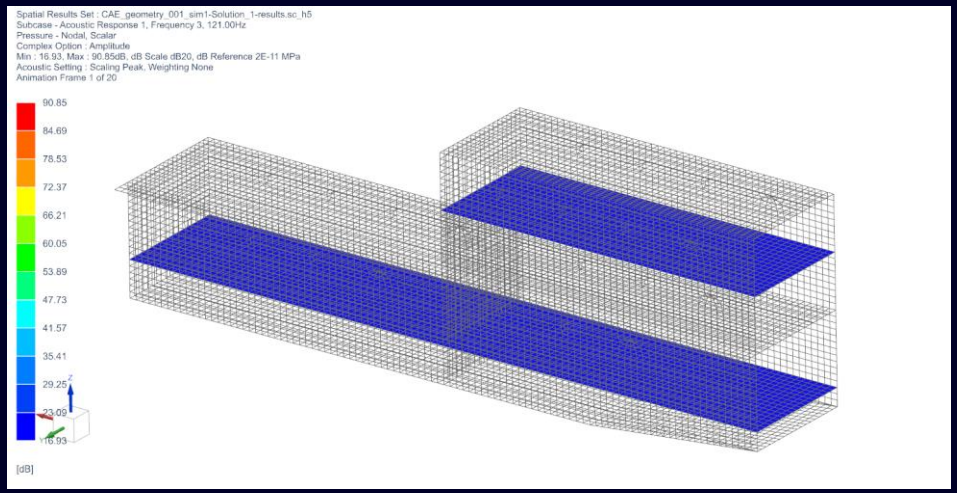


# Vibro-Acoustic Simulation
## Noise transmission through partitions

Noise contribution from equipment by airborne noise (e.g. centrifugal pump) covering, as far as possible, modelling of:

- Equipment airborne noise pressure level, measured at 1m
- Space airborne noise properties (insulation, reverberation, etc) as applicable
- Airborne noise to underwater radiated noise transmission path

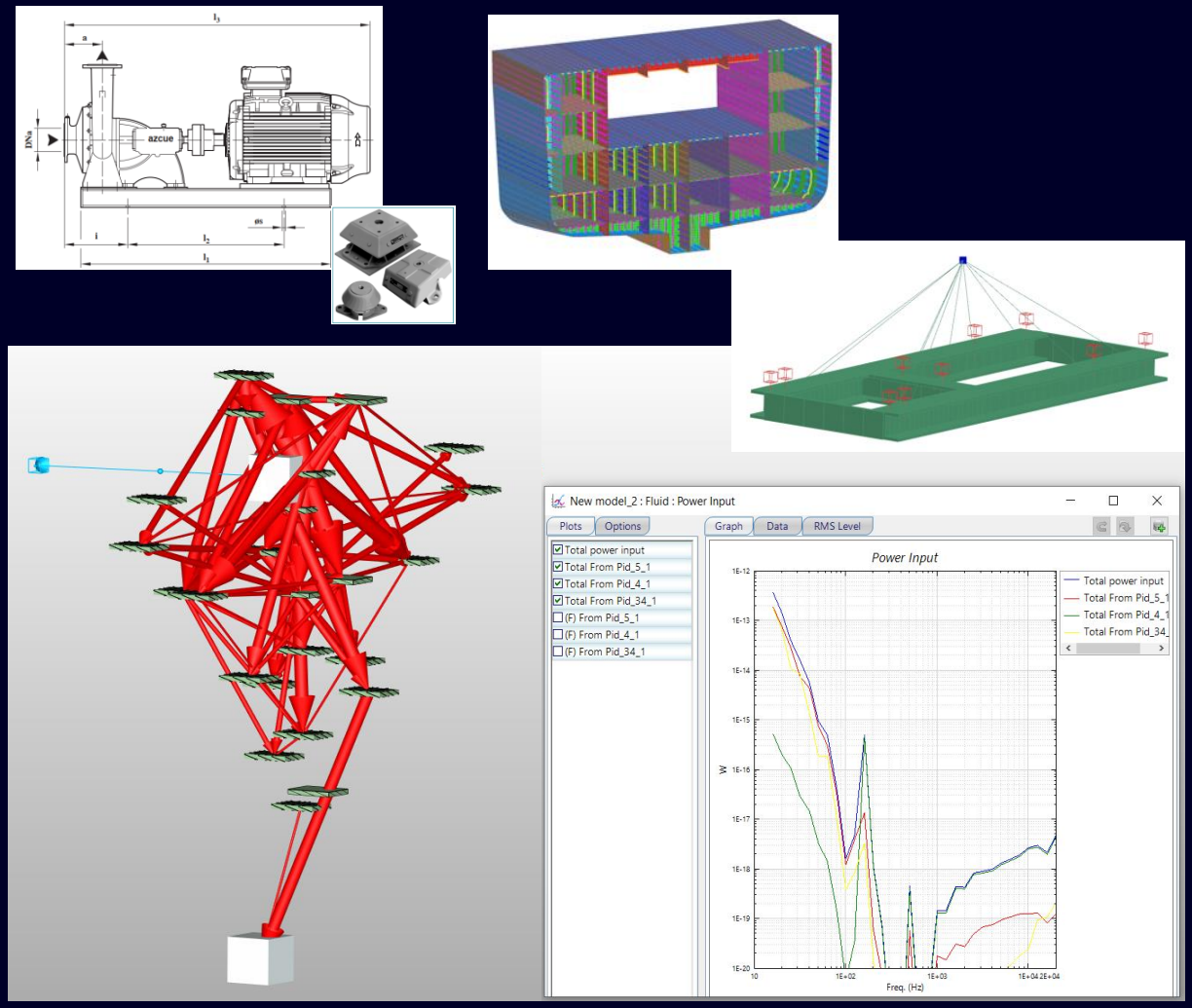




# Vibro-Acoustic Simulation

Noise contribution from equipment (e.g. centrifugal pump) vibration covering, as far as possible, modelling of:

- Equipment vibration levels on elastic mounts (source data)
- Elastic mount properties (manufacturer data)
- Foundation mechanical properties from analysis of 3D model
  - Foundation mechanical properties from mobility tests, to be used on a later stage after tests are done on first of class
- Ship hull and local structure
- Noise transmission through flexible connections



# Contact

Published by Siemens XX

**First name Last name**
Job title
Group / Region / Department XY
Street 123
12345 City
Country

**Phone +49 123 45 67 89**
Mobile +49 123 45 67 89 0

**E-mail** firstname.lastname@siemens.com