

# TERRIFIC

## Towards Enhanced Integration of Design and Production in the Factory of the Future through Isogeometric Technologies

September 1, 2011-August 31, 2014

[www.terrific-project.eu](http://www.terrific-project.eu)

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Call FP7-2011-NMP-ICT-FoF

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# European collaboration

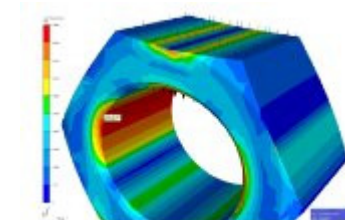
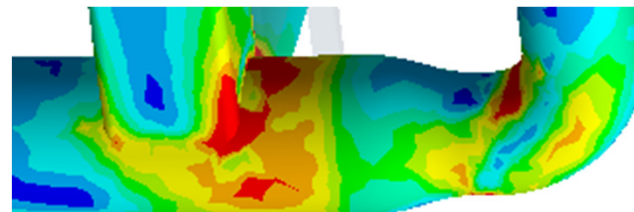
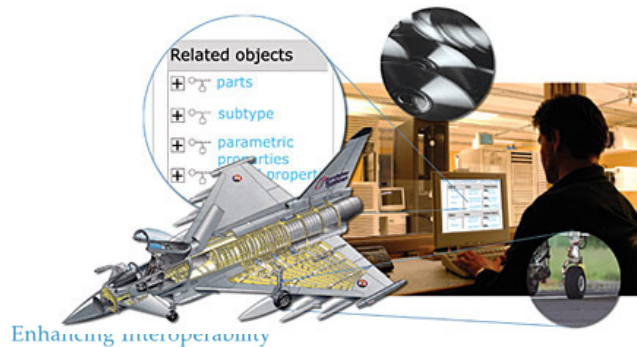
The partners grouping is a well balanced mix of members coming from the contributing countries



# Our vision is to .....

- provide and disseminate tangible evidence of the performance of the isogeometric approach in comparison to traditional ones in four important application areas as well as addressing interoperability and other issues that necessarily arise in a large-scale industrial introduction of isogeometry.

Isogeometric analysis introduced by Prof. T. Hughes in 2005 as a disruptive approach for the integration of CAD and Finite Element Analysis.



# From abstract

- The project aims at significant improvement of the interoperability of computational tools for the design, analysis and optimization of functional products.
- An isogeometric approach is applied for selected manufacturing application areas (cars, trains, aircraft) and for computer-aided machining.
- A general uptake of isogeometric approaches in industry can only be expected if there exist convincing technically verified and validated case studies showing real advantages over the current approaches, using both qualitative and quantitative indicators.
- Our vision is to provide and disseminate tangible evidence of the performance of the isogeometric approach in comparison to traditional ones in four important application areas



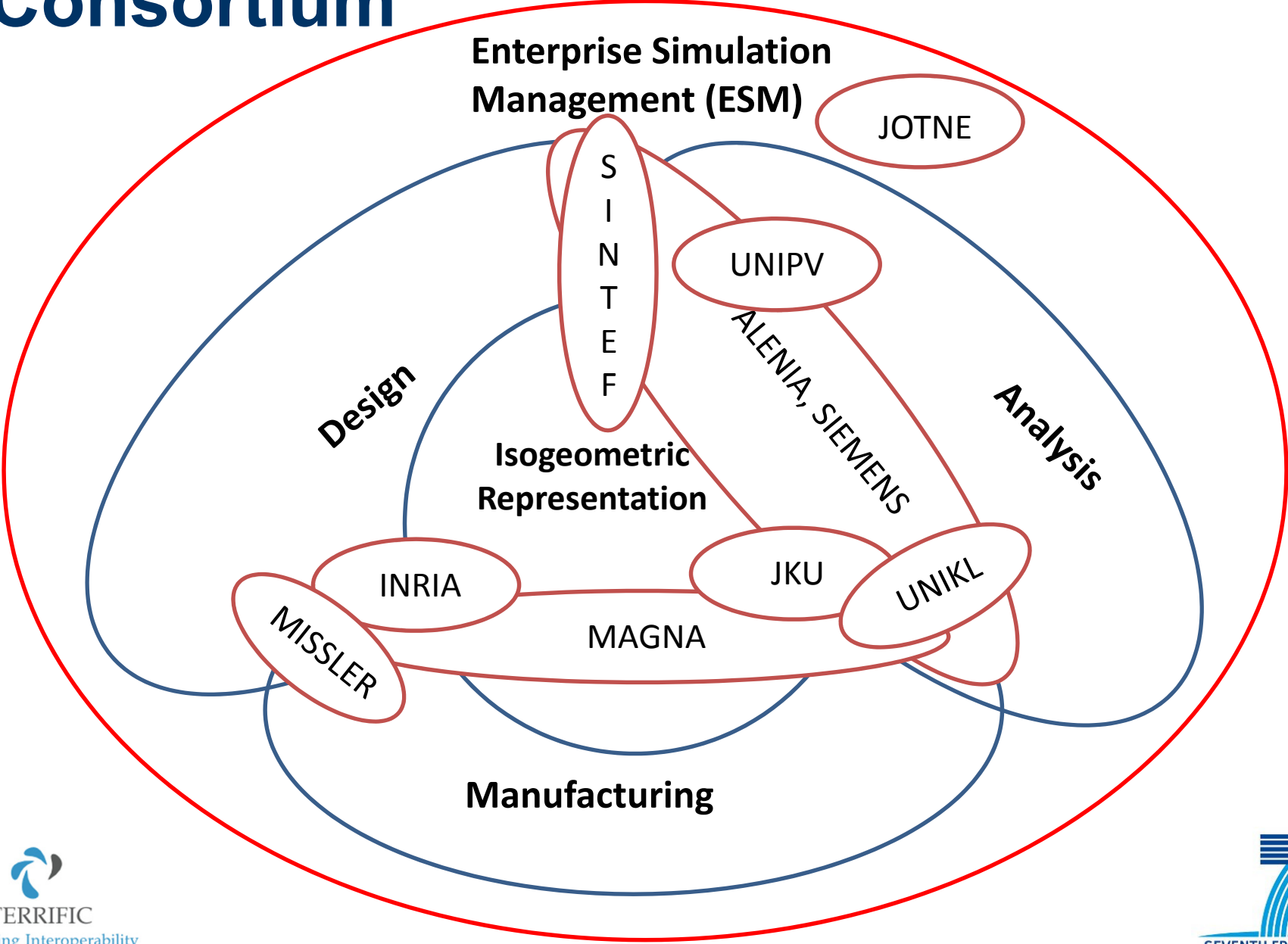
TERRIFIC

Enhancing Interoperability

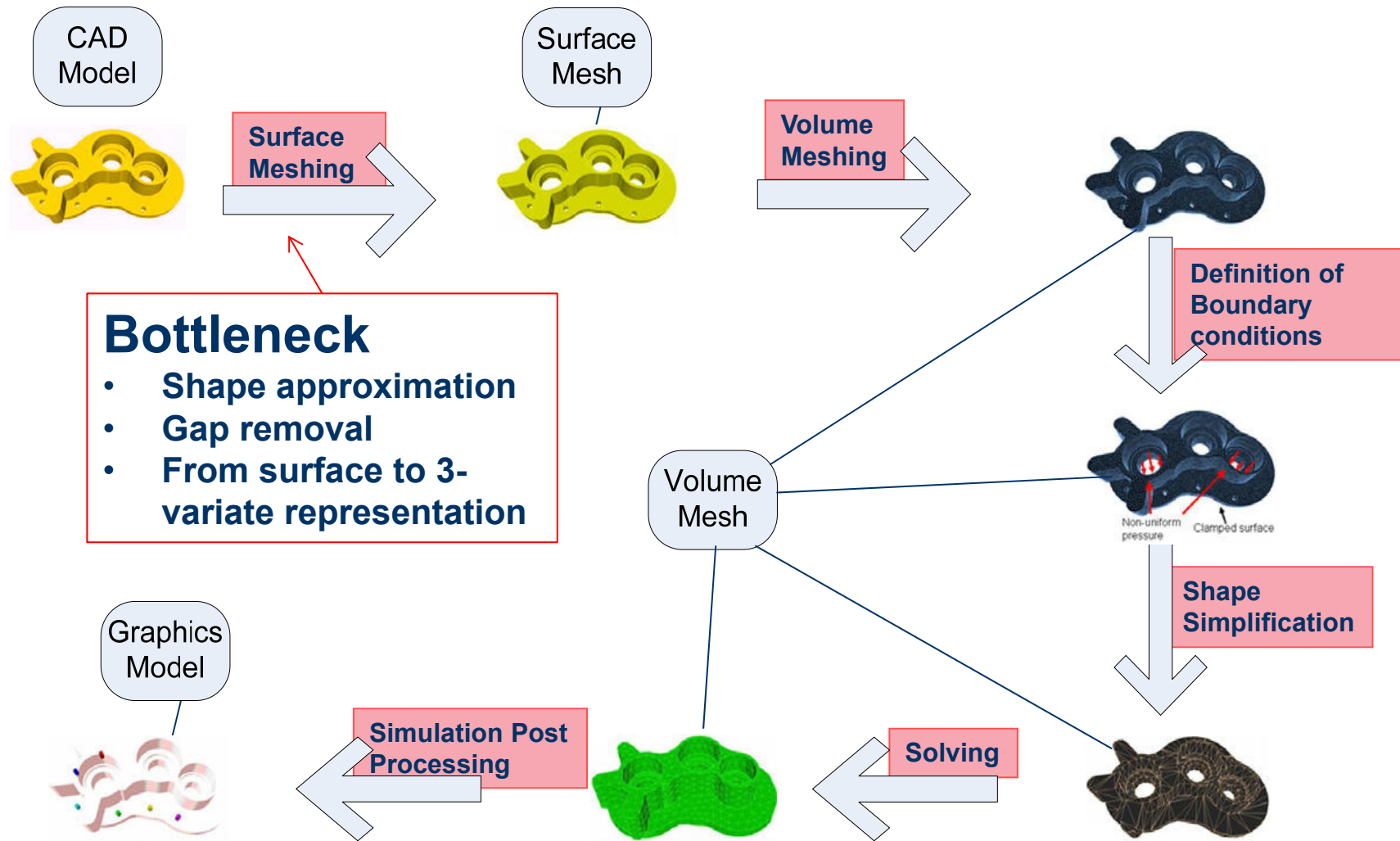


SEVENTH FRAMEWORK  
PROGRAMME

# Consortium

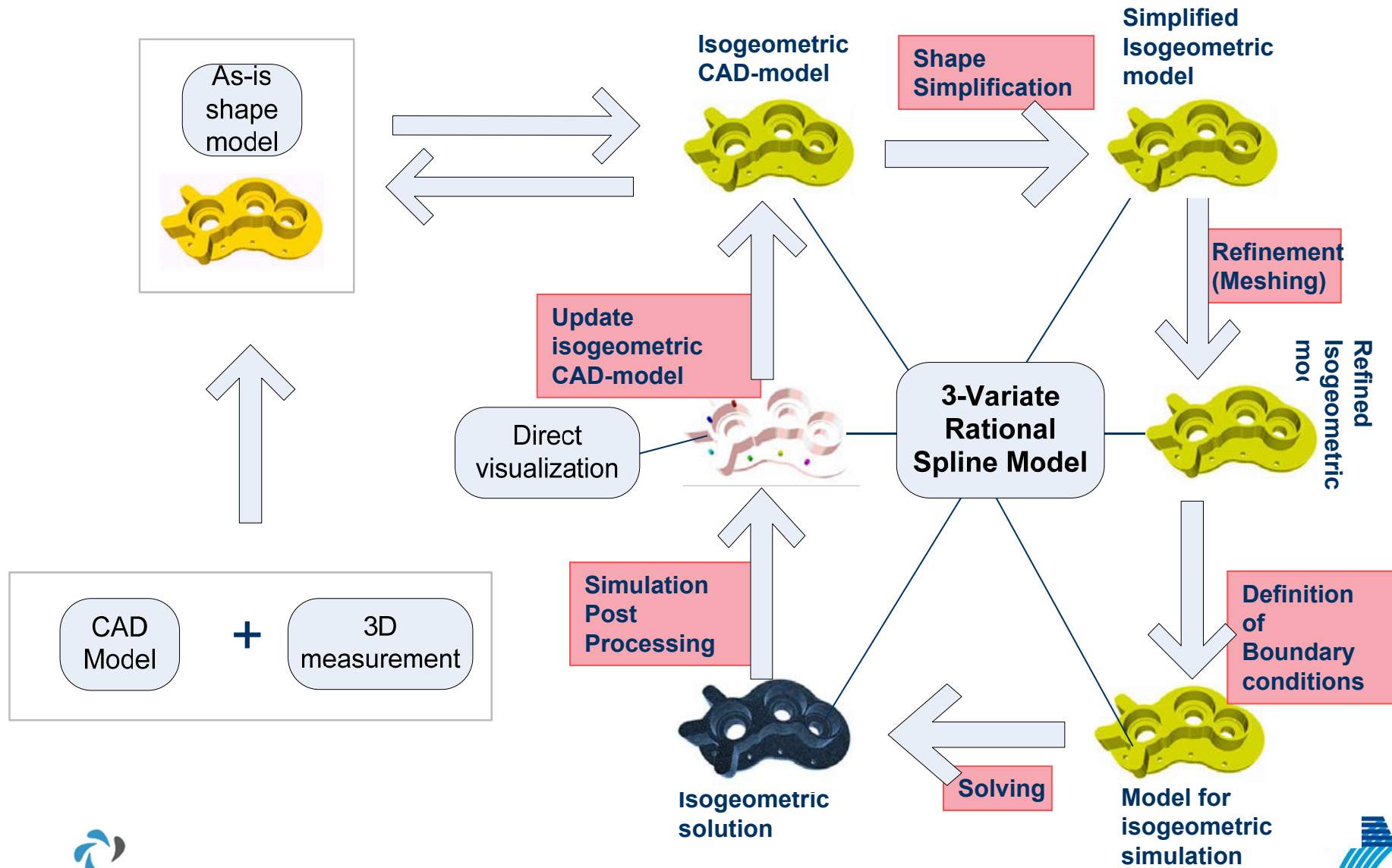


# Traditional simulation pipeline



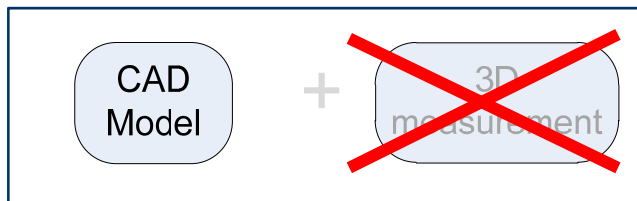
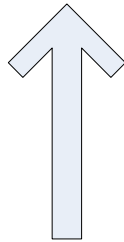
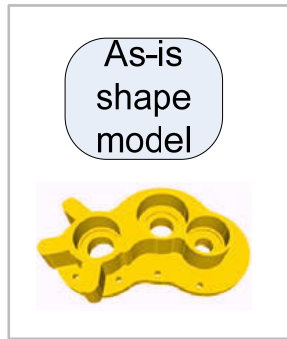
Limited mathematical and semantically consistency of models

# Isogeometric simulation pipeline



Mathematically and semantically consistency of models

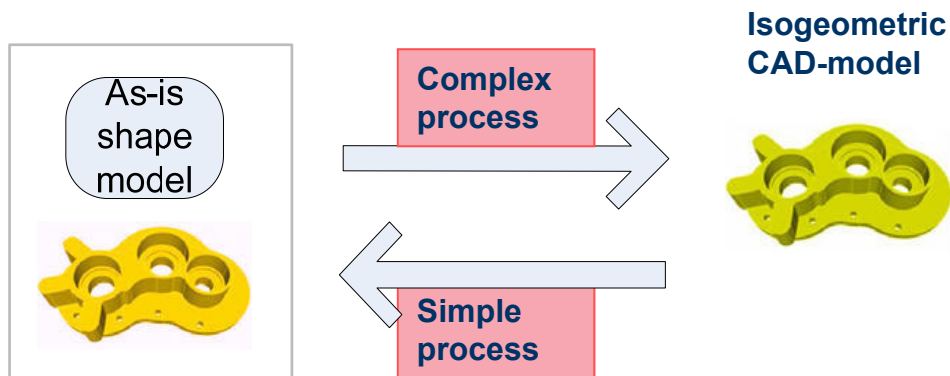
# Four major challenges:



1. Create isogeometric suitable “as-is” model
  - In TERRIFIC from CAD

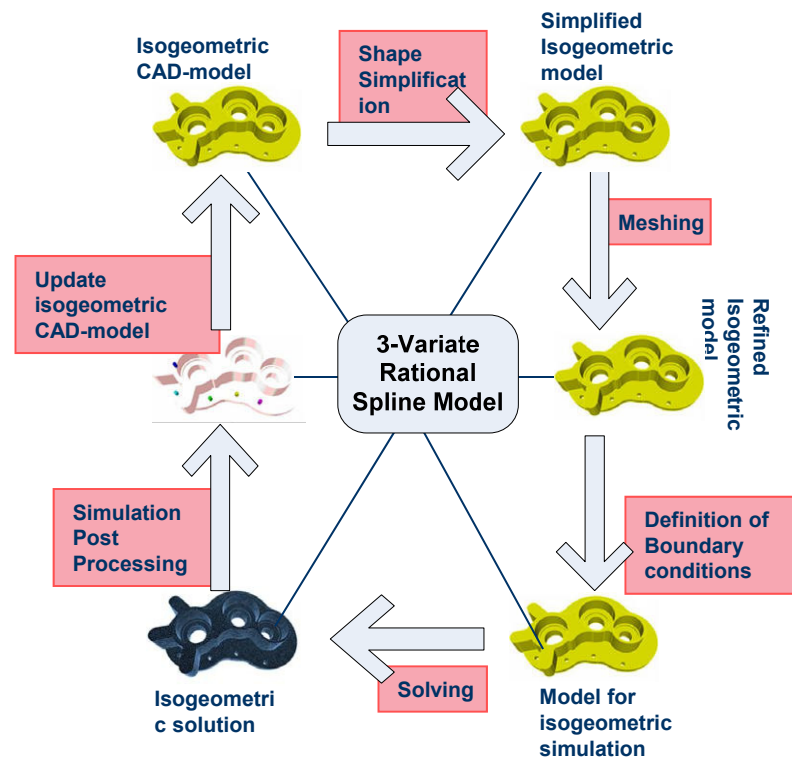


# Four major challenges:



1. Create isogeometric suitable “as-is” model
  - In TERRIFIC from CAD
2. Create 3-variate isogeometric model
  - Main focus of TERRIFIC

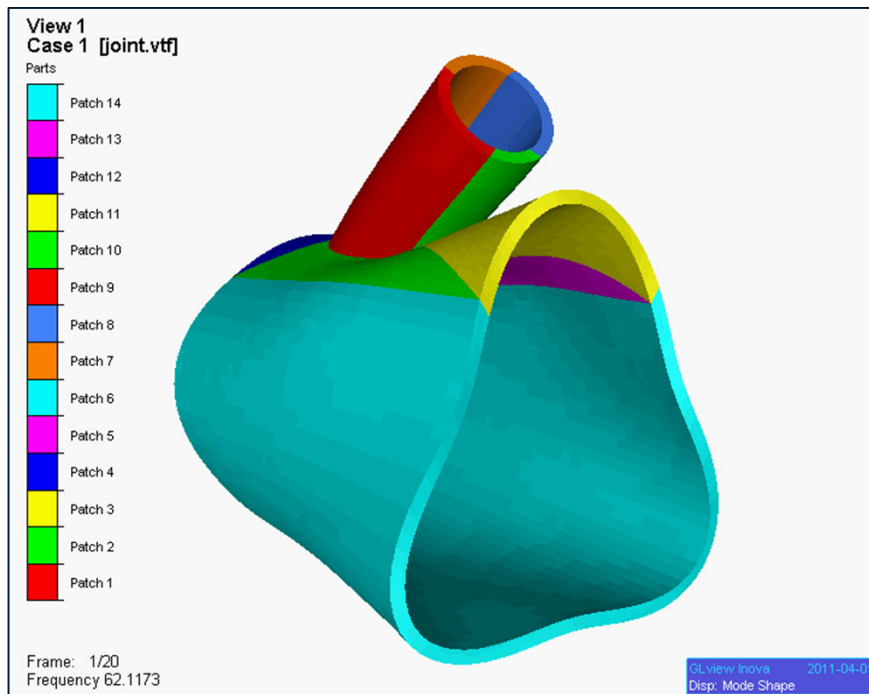
# Four major challenges:



1. Create isogeometric suitable “as-is” model
  - In TERRIFIC from CAD
2. Create 3-variate isogeometric model
  - Main focus of TERRIFIC
3. Isogeometric analysis
  - In TERRIFIC for some application areas
4. Isogeometric visualization
  - Not addressed in TERRIFIC

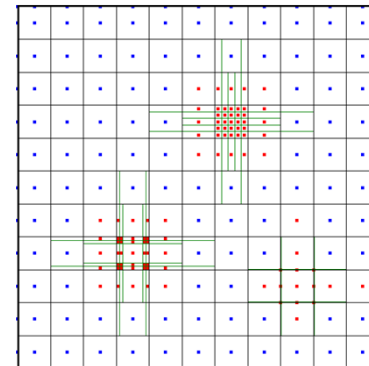
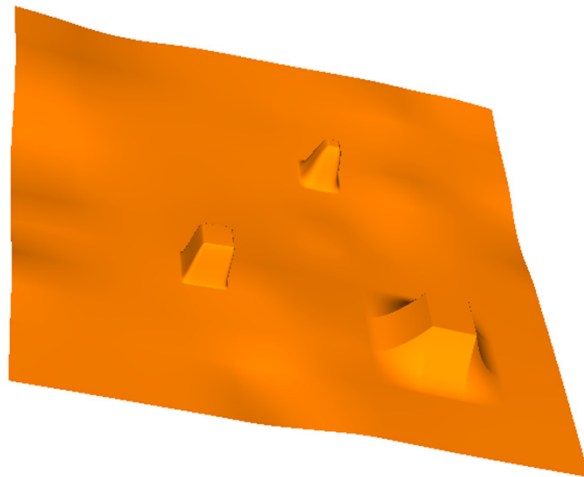
# Example 3-variate NURBS-model of tubular joint

- NURBS volumes replace standard Finite Elements
- At any time during the simulation the object surface is represented by NURBS and compatible with CAD

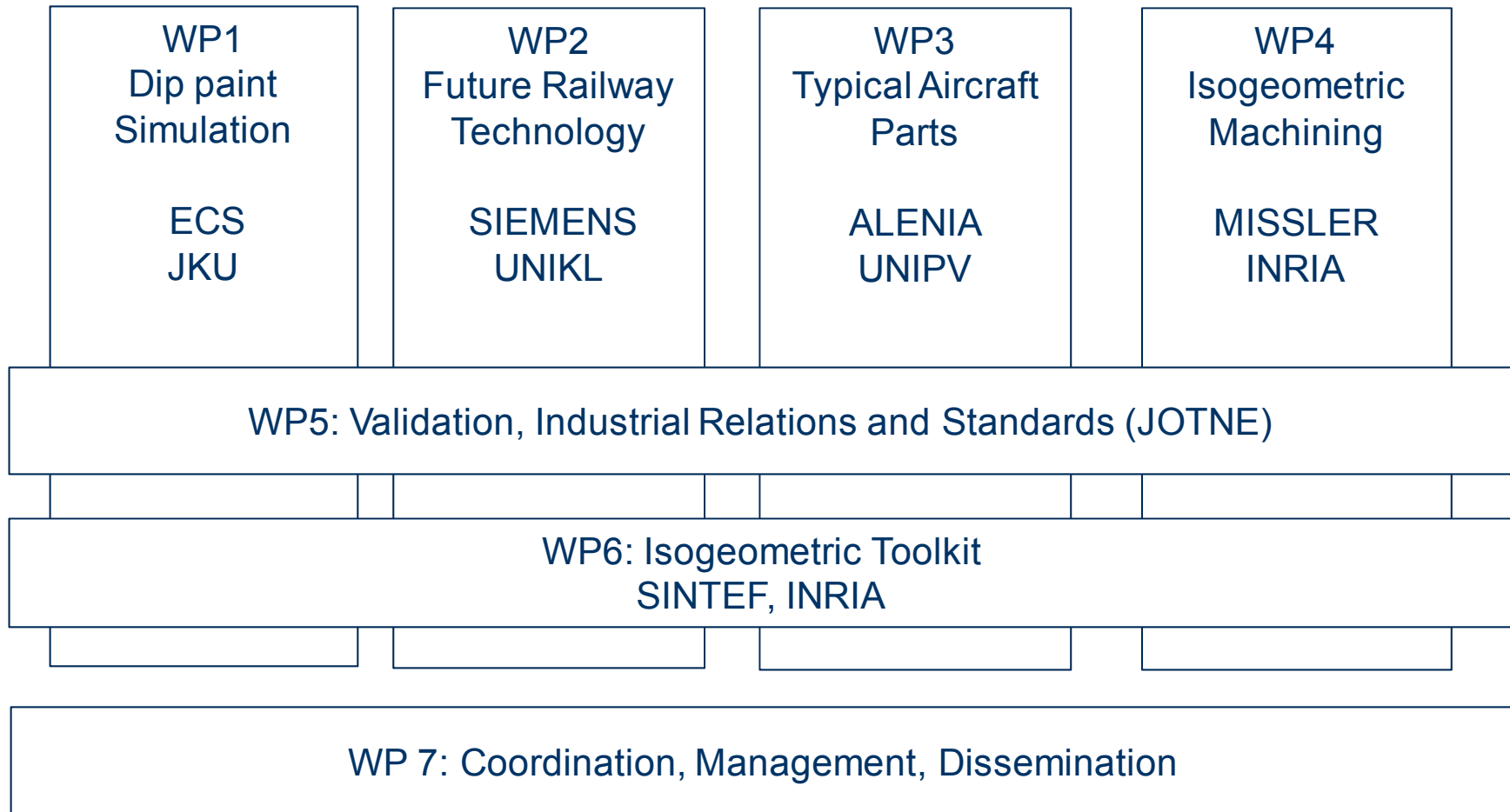


# Augmentation of ISO 10303-STEP necessary for the deployment of Isogeometric Analysis

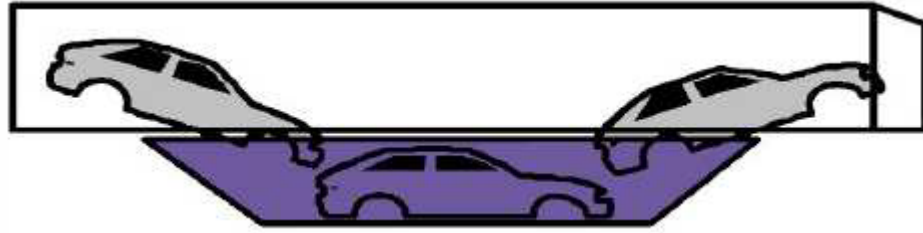
- Relation to ISO 10303-STEP through TERRIFIC Partner JOTNE
- Topology structures for 3-variate volumes
  - A face connects two volumes
  - An edge connects many faces
- Need support of local refinement needed in analysis
  - Locally refined splines such as T-splines or Locally Refined B-splines



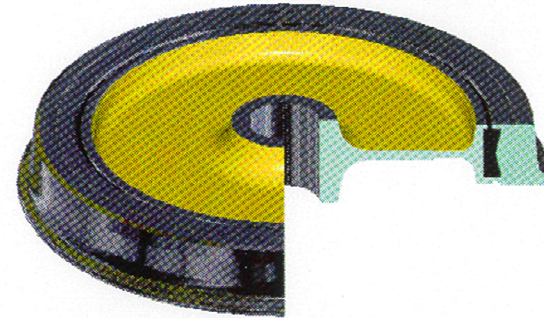
# Workpackages – main responsibilities



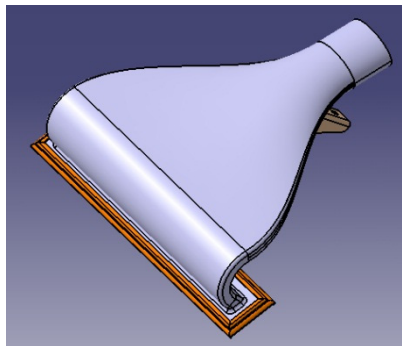
# Application areas



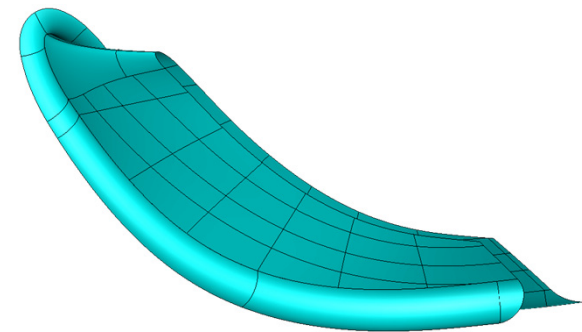
WP1: Dip painting (ECS)



WP2: Railway technology (SIEMENS)

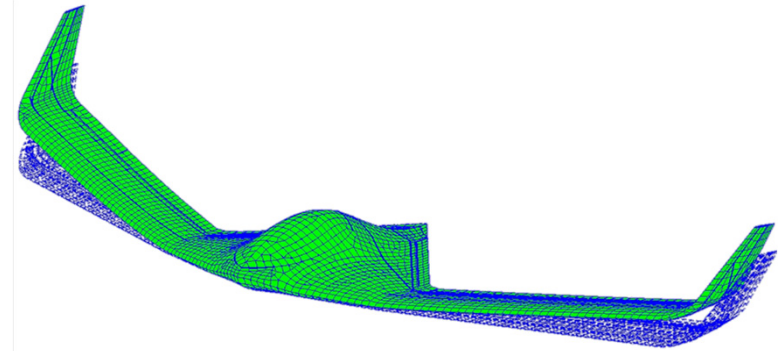


WP3: Aircraft parts (Alenia)



WP3: Machining (MISSLER)

# Development of the TERRIFIC Isogeometric Toolkit



- Build toolkit based on
  - GoTools and SISL from TERRIFIC Partner: SINTEF
  - Axel from TERRIFIC Partner: INRIA
  - Isogeometric Solvers from TERRIFIC Partner: UNIKL
  - Open Source version as well as commercial versions of the components will be available
- Use of available commercial ISO 10303-STEP tools from TERRIFIC Partner JOTNE
  - EXPRESS Data Manager (Data model exchange using STEP)
  - Relation to LOTAR (Long Term Archiving) / LTDR (Long Term Data Retention) through TERRIFIC Partner JOTNE

# TERRIFIC and IMS project I-PLM



**TERRIFIC at a glance : Towards Enhanced Integration of Design and Production in the Factory of the Future through Isogeometric Technologies** FP7-2011-NMP-ICT-FoF 284981 is a 3 year program part of the EU "Factories of the Future" (FoF) initiative which is a € 1.2 billion programme in which the European Commission and industry will support the development of new enabling technologies for EU manufacturing which have cross-sectoral benefits and contribute to greener production.



## **IMS I-PLM Archiving**

The Intelligent Manufacturing Systems Program (IMS) is an industry-led, global, collaborative business innovation program focused on manufacturing processes. A project being proposed under the IMS umbrella is the Implementation of Digital PDM and PLM Data Archiving and Retrieval (I-PLM Archiving) project.

I-PLM Contact;  
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Current planned stakeholders includes Automotive Industry Action Group (USA), PDES, Inc. Consortium (USA), Shipbuilding, Nuclear and Utility (Korea) and the TERRIFIC project (EU)





# TERRIFIC started September 1, 2011

- First specification of the four application Workpackages completed in 2011
- Synergy and Isogeometric Toolkit
  - Tools based on available background available to all partners
  - Specification of Toolkit extensions available soon
- Participation in I-PLM meetings (IMS)
- Planning proposals of extension to ISO 10303-STEP.
- Active presentation of TERRIFIC to the isogeometric analysis community
- Interoperability of design, simulation and manufacturing extremely important for cloud services
  - Facilitate interoperability of cloud apps from large and smaller independent suppliers to the manufacturing industry



TERRIFIC

Enhancing Interoperability

