

# Big Data Value Norway

## *Engineering applications (CAx/PLM) and Big Data – Simulation Data Management*

28. april, 2016, Oslo, Norway

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1. Business verticals and Product updates
2. Lockheed Martin partnership
3. R&D Portfolio
  - Big Data



## Built Environment



## Defence



## Aeronautics

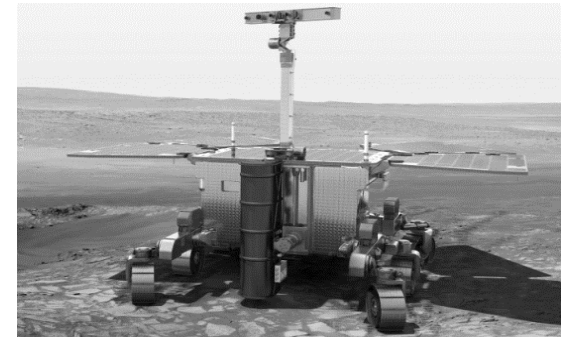


### ABOUT JOTNE IT

The leader in product data exchange and sharing  
Jotne EPM Technology data products have  
successfully reduced development and product  
lifecycle costs through the use of intelligent data  
management in the areas of Defence, Aeronautics,  
Oil & Gas, Built Environment and Aerospace.



## Space



# Product update



ISO 10303-203

ISO 10303-214

ISO 10303-239

ISO 10303-209e2

1994

1999

2005

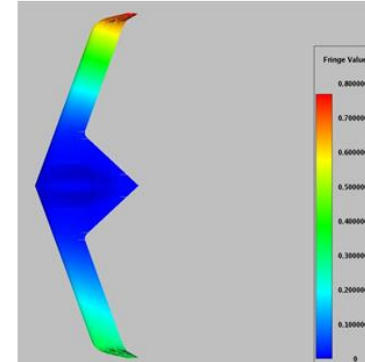
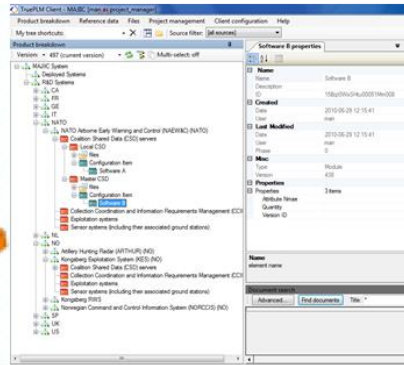
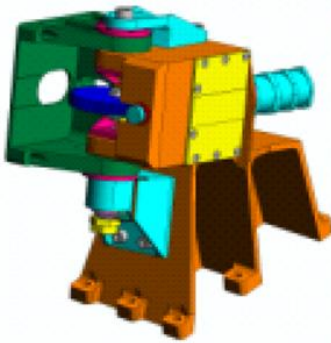
2012

CAD

PLM

ILS

CAE-SDM



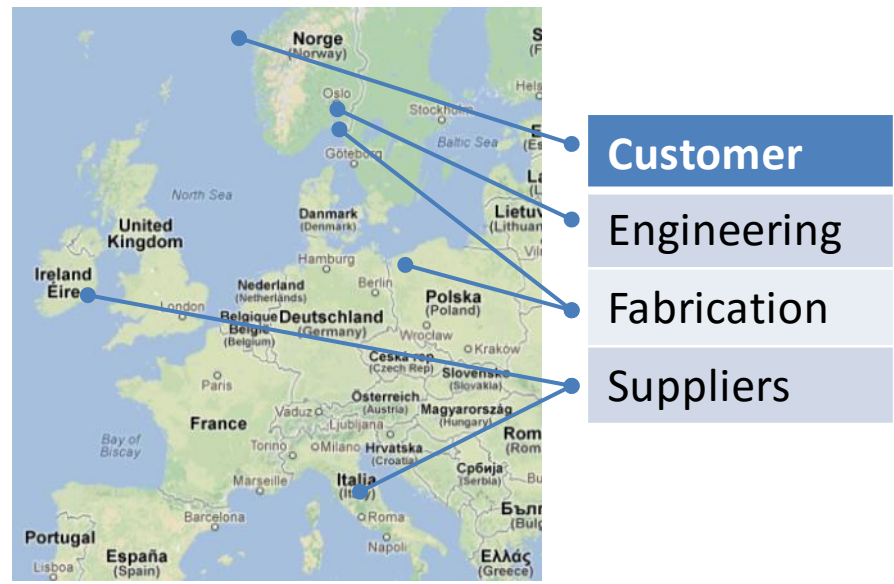
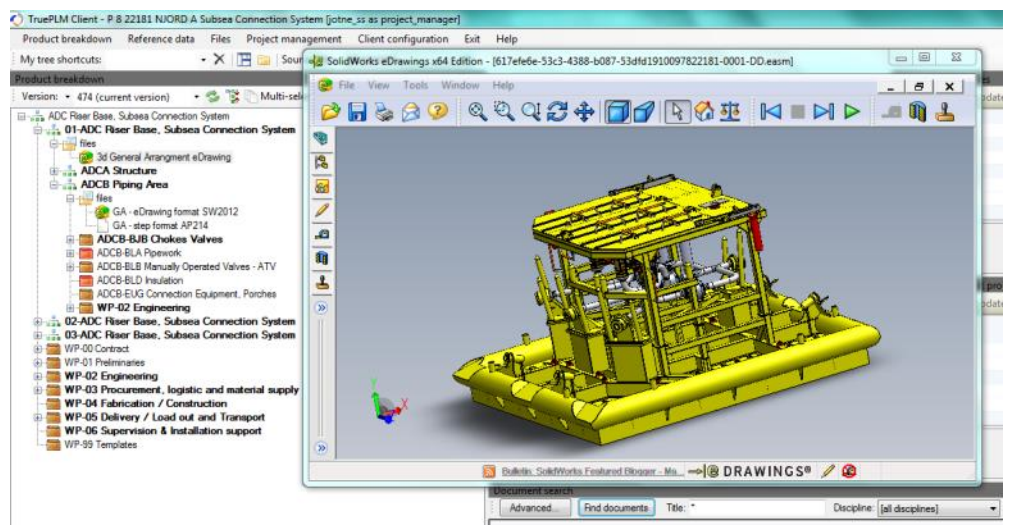
STEP/IFC tool-kits

Exchange, Sharing and Archiving of AP239

Exchange, Sharing and Archiving of AP209

# Use cases – Summary

- **Product breakdown structure oriented engineering**
- **Document and data management**
  - E-mails as documents
  - Search
  - History tracking
  - Configuration control
  - Dependencies / sticky notes
- **Concurrent engineering**
  - Project cooperation
  - Supply chain management
  - Notifications
  - Review capability
- **Lifecycle support**
  - Record data along the life cycle
- **Interoperability**
  - Communicate with external formats
  - Import/export using STEP/PLCS DEX
- **Archival**
  - Retention over long periods of time
  - Retrieval application independent



Out of 230 new TruePLM features, users will benefit in many areas.

Only a few example listed here:

Import of requirements for each system, using DOORS (Req-IF OMG standards)

RIDs handling

Reading and writing metadata to and from office documents

Enable the storage and reuse of most commonly needed search criteria

Browse through deadlines, deliverables and budget

Browse through different representations of the same document

Browse through ICDs and versions of them

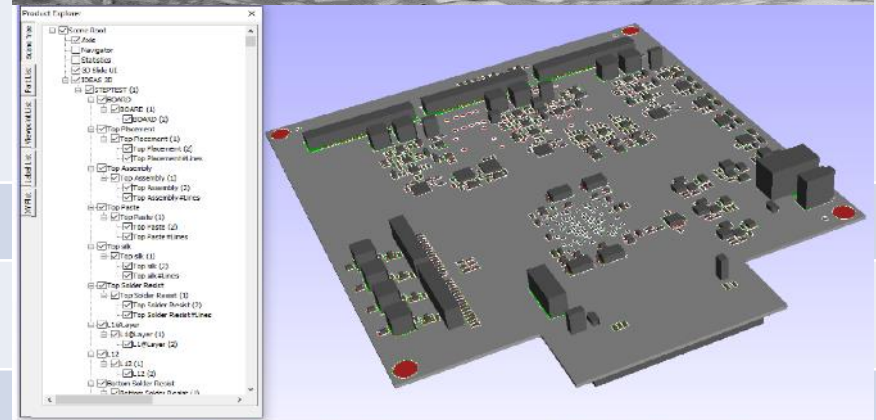
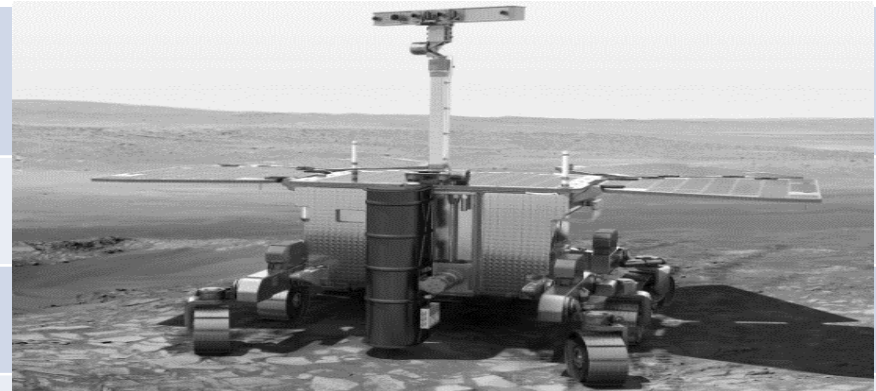


Figure 1: Visualisation of the STEP-representation of a PCB modelled in CadStar

**PLCS-IF Testbed available**


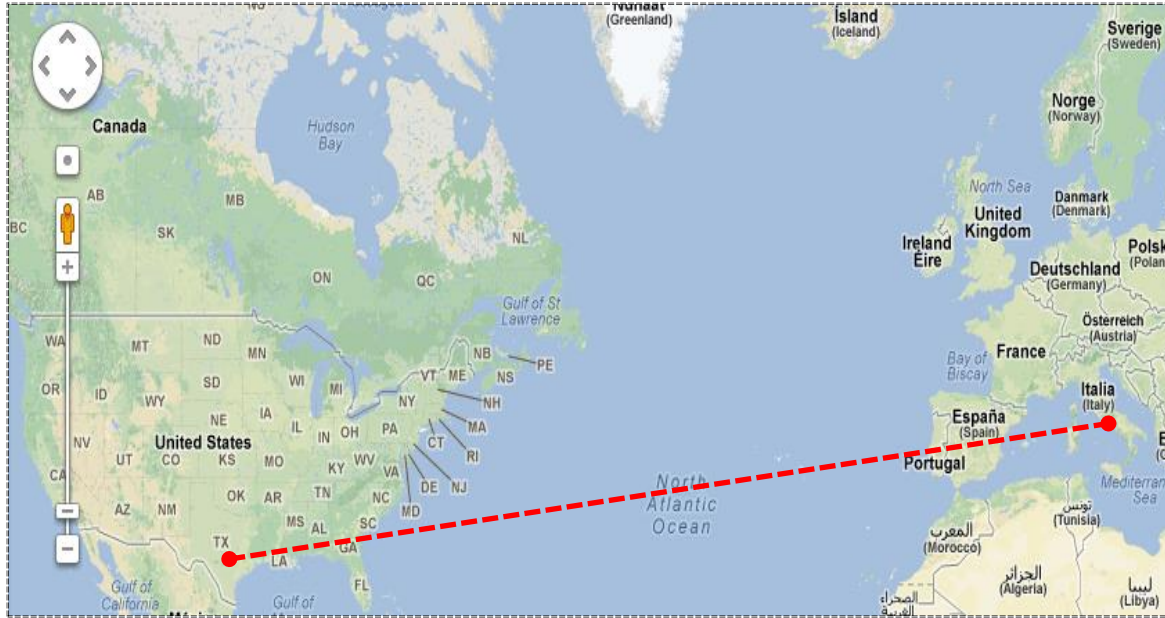


**LOTAR Validation Properties**




***Jotne partnership with  
Lockheed Martin***

# The Lockheed Martin partnership F-35 FACO




# F-35

## Interoperability of Information



**JOTNE INVOLVEMENT IN THE F-35 PROGRAM INCLUDING THE FACO (ALENIA)**

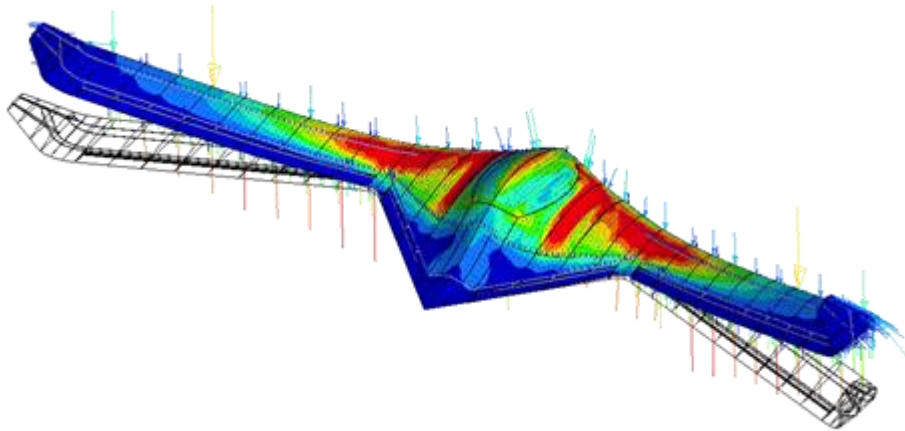
- DATA GOVERNANCE, VALIDATION AND VERIFICATION
- DATA EXCHANGE, SHARING AND ARCHIVING
- DATA IN MOTION BETWEEN MANY SYSTEMS
- INTEROPERABILITY USING ISO STANDARDS





## Simulation and Test Data Management using AP209

<http://www.jotneit.no/products/edmopensimdm>



## Jotne Selected by Lockheed Martin to Develop a Software System for Open Simulation Data Management

Oslo, Jan. 28, 2016 - Lockheed Martin awarded Jotne a three-year program to develop its existing software system known as Open Simulation Data Management (Open SimDM) platform to include new capabilities in test data management and other application areas.

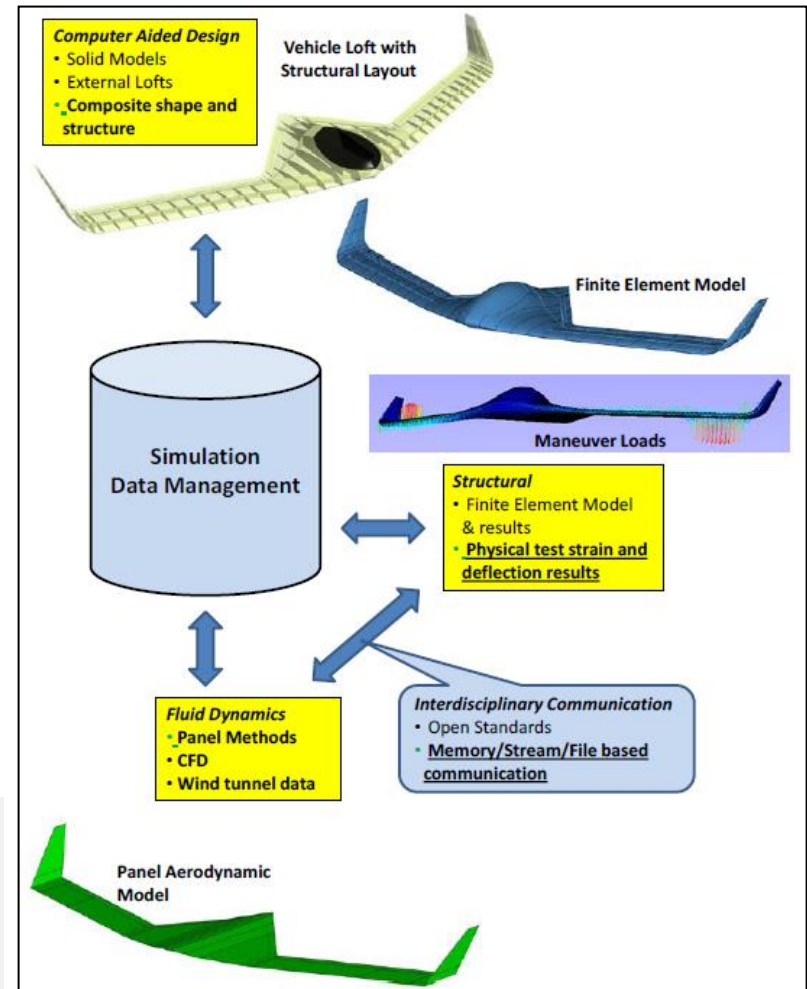
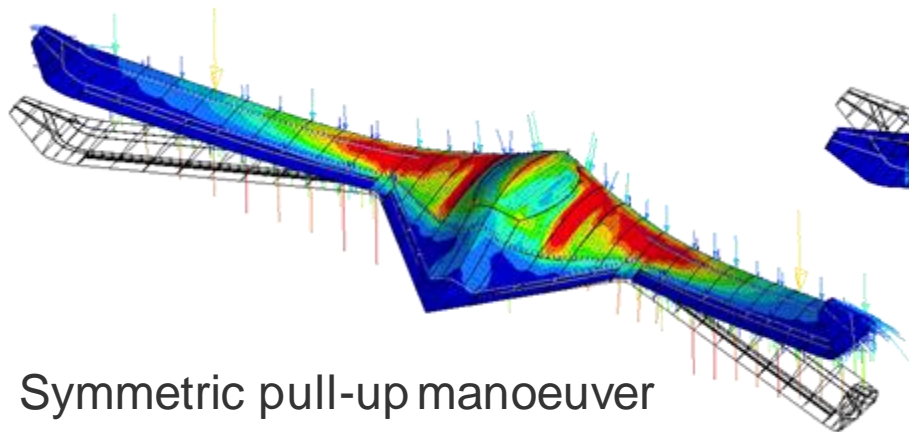


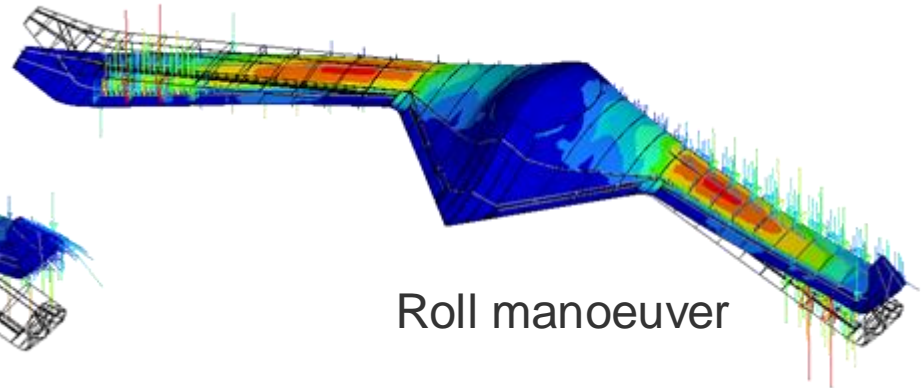
Illustration of STEP AP209e2 scope

Source: Lockheed Martin

- Solution data for public glider model
  - Representative load cases and results

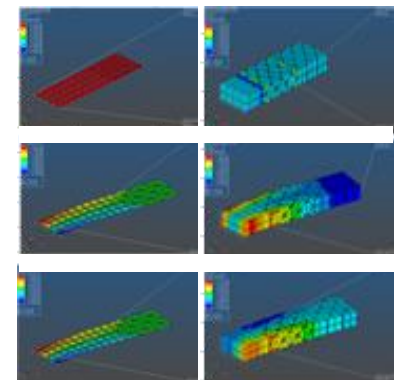


Symmetric pull-up manoeuver



Roll manoeuver

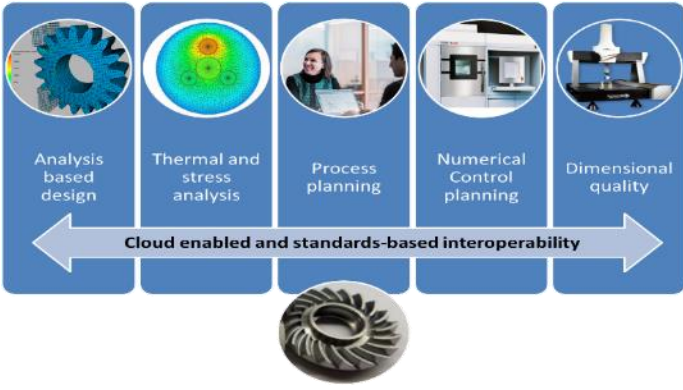
- Solution data for results verification
  - Unit test model solutions for simple load cases
  - Approximates classical solutions



# R&D Portfolio

**CaxMan** – on-going ([www.caxman.eu](http://www.caxman.eu)):

Jotne provides and further develops the Product Lifecycle Management (PLM/SDM) repository in the Cloud for collection and integration of design and simulation data required for additive manufacturing processes. Jotne leads the task of applying and improving relevant standards, particularly ISO 10303, STEP.



## Computer Aided Technologies for Additive Manufacturing (CAXMan)

The objectives of Computer Aided Technologies for Additive Manufacturing (CAXMan) are to establish Cloud based Toolboxes, Workflows and a One Stop-Shop for CAX-technologies supporting the design, simulation and process planning for Additive Manufacturing.

AP242



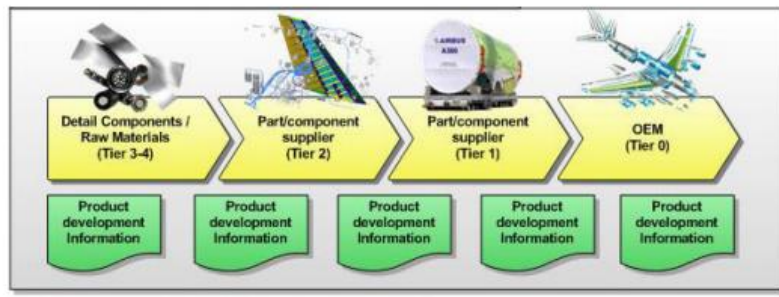
computer aided technologies for additive manufacturing

AP209



**IDEALISM** (<https://itea3.org/project/idealism.html> )

KBE/SDM like requirements for Aerospace. The IDEALISM - Development framework for Multidisciplinary Design and Optimisation - solutions lie in three main deliverables: an advanced integration framework for distributed Multidisciplinary Design and Optimisation, an Engineering Language Workbench (a set of domain specific and high-level modelling languages, ontologies and data standards) and a methodology for service-oriented development processes to redefine the product development process and information architecture to enable collaboration between service oriented Competence Centres in Distributed Development Teams

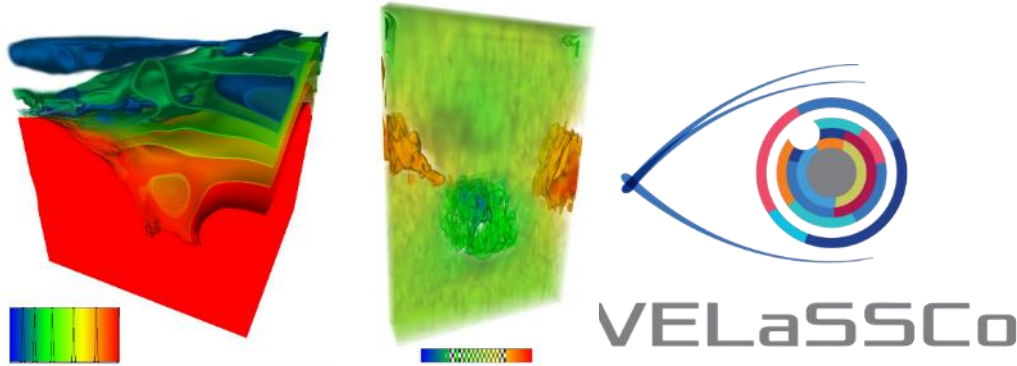




AP209

**CloudFlow** – ([www.eu-cloudflow.eu](http://www.eu-cloudflow.eu)):

Jotne is responsible for the experiment “PLM/SDM in the Cloud”, which was successfully completed in autumn 2015. Based on the new Cloud capabilities, Jotne is developing business models for software-as-a-service for their commercial products. Jotne supports CloudFlow partners to apply ISO 10303 STEP standards to improve engineering data interoperability.



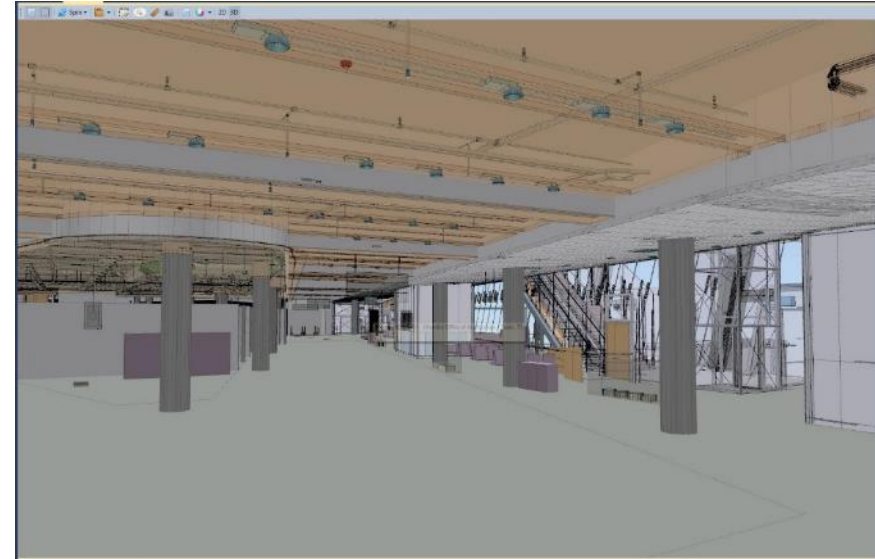
AP209



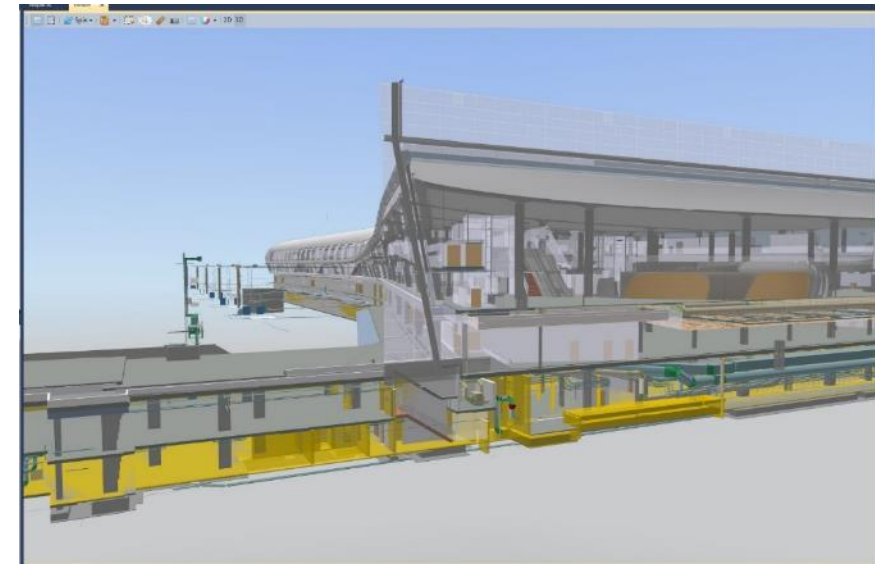
**VELaSSCo** – Visualization For Extremely Large-Scale Scientific Computing ([www.velassco.eu](http://www.velassco.eu)):

Jotne provides a database solutions in the project for big simulation data. The Jotne database is integrated into an architecture for fast retrieval of simulation result data for visualization. Jotne supports VELA S S C o partners to apply ISO 10303 STEP standards to improve engineering data interoperability. Here is also a data model for DEM being developed.

# Examples from OPEN BIM data (OSL)



Examples from one project:  
Typical Models: 15 GB  
Typical Database instance: 250 GB



# VELaSSCo basic information

Proposal number: **619439**  
Project Officer: **Mr. Pierre-Paul SONDAG**  
Name of the coordinating person: **Dr. Abel COLL (& Mr. Miguel PASENAU)**

Participant organisation name	Short name	Country
International Center for Numerical Methods in Engineering	<b>CIMNE</b>	ES
School of Engineering. The University of Edinburgh	<b>UNEDIN</b>	UK
STIFTELSEN SINTEF	<b>SINTEF</b>	NO
Institut national de recherche en informatique et en automatique	<b>INRIA</b>	FR
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. Fraunhofer-Institut für Graphische Datenverarbeitung	<b>FRAUNHOFER</b>	DE
Jotne EPM Technology	<b>JOTNE</b>	NO
Atos Spain S.A.	<b>ATOS</b>	ES

**3 years project** (2014 –2016)

**393 persons x month**

The total costs of VELaSSCo are **4.441.603 €**, and total funding is **3.294.000 €** (original 3.294.425 €)

# Brief introduction to numerical simulations

*“from ~140 GB ( 8 M elements, 2,300 steps) to 50 TB ( 240 M elements, 25,000 steps)”*

VELaSSCo

Pre-processing

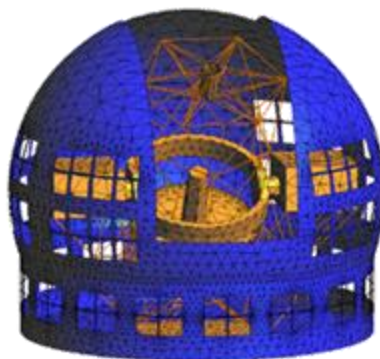
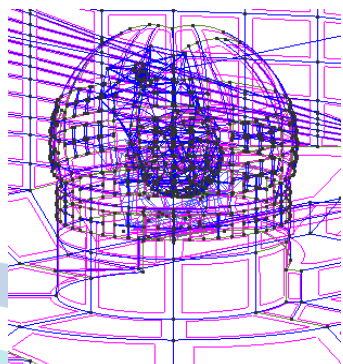
Calculation

Post-processing

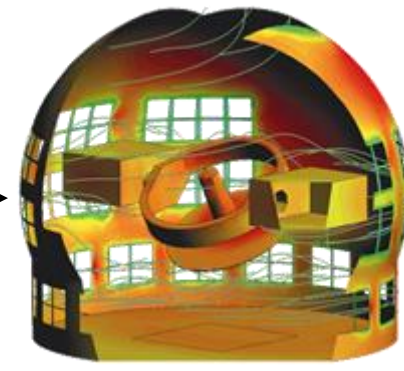
Geometry description

Preparation of analysis data

Visualization of results



Computer Analysis



Pre and post-processor

# LR-spline approximation of simulation data

Approximation of the vertical velocity field in a fluidized bed, used for mixing or coating particles.

- We currently handle data sizes of ~20 GB locally
- Focus have been on scalability and implementation in Cloud infrastructures
- Tiling and stitching in 2D and 3D -> highly parallelizable

Why use LR-spline models?

- Compact
- Well-suited for hardware-accelerated visualization
- On-the-fly visualization of, e.g.,
  - Cut planes
  - Iso-surfaces
  - Derived properties such as Von Mises stress

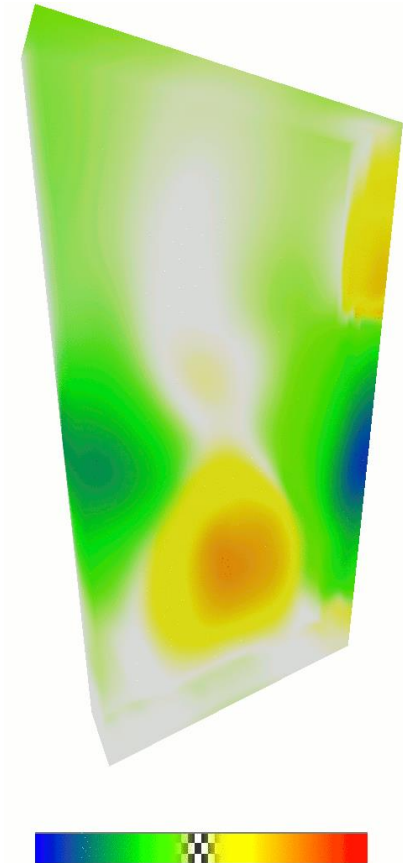


Real-time interaction  
with the model



<http://www.velassco.eu/>

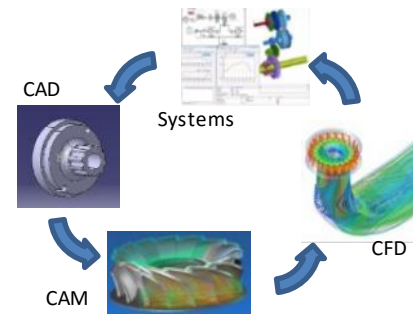
Fluidized bed, vertical  
velocity field  
*University of Edinburgh*







- Motivation
  - Manufacturing industry requires ICT for competitiveness
  
  - Engineering workflows are complex
    - Different types of software involved
    - Compute intense
  
  - Open up the power of Cloud and HPC computing to SMEs

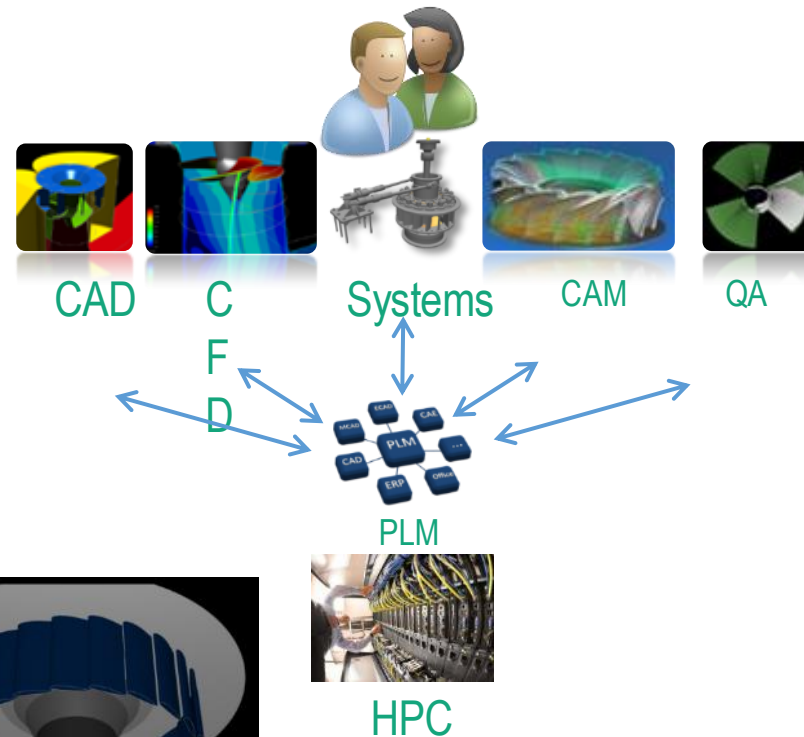


# What is CloudFlow?

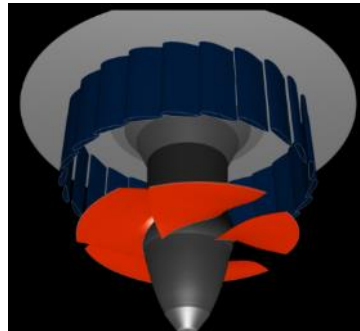


## Computational Cloud Services and Workflows for Agile Engineering

- CAD on the Cloud
- CAM on the Cloud
- CFD on the Cloud
- PLM on the Cloud
- Systems simulation on the Cloud
- Point clouds vs CAD comparison on the Cloud (QA)



The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7-2013-NMP-ICT-FoF) under grant agreement n° 609100. <http://www.eu-cloudflow.eu/>

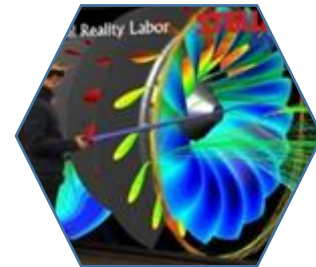
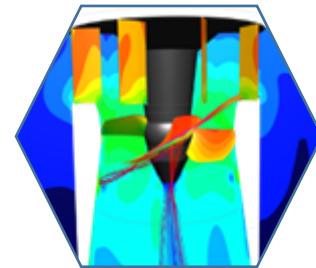


# WHAT WE ACHIEVED

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## 1. IMPACTS from CloudFlow (selected)

Process	SME User Impact	SME Partner Impact
Design	From 8 hours to 20 min.	New "Plug-in" software
PLM	25% improvements	Growth in software sales
Efficiency optimization	Factor of 30 times	New CFD software
Machine Simulation	Almost 70% reduction	New employments
Safety Analysis	Reduce 10k€ per project	New Workflow software
QA 3D Scanning	Factor of 5 times	New employments



# ITEA call 8 – IDEaliSM project



- 14 Partners, 5 Countries, 3 yr program
- Use cases from Aerospace and Automotive
- Integrated & Distributed Engineering Services Framework

**IDEALISM**  
*Integrated & Distributed Engineering Services Framework for MDO*



# IDEaliSM features 3 main deliverables

## An **advanced integration framework**

for distributed multidisciplinary design and optimization, enabling companies to offer and share engineering services

## An **engineering language workbench**

to enable flexible configuration of engineering workflows and services and straightforward integration into the advanced integration framework

## A **methodology for service-oriented development processes**

to redefine the product development process and information architecture enabling collaboration between service-oriented Competence Centres in Distributed Development Teams

# Use case 1B

## Aircraft design challenge

A: Accelerated aircraft MDO concept design study

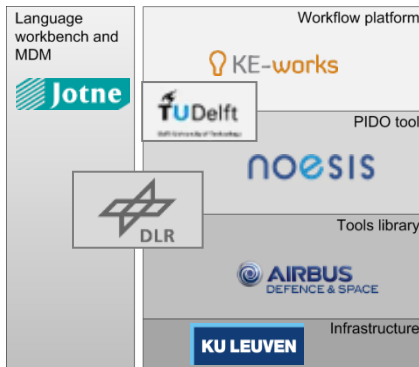
B: Accelerated development of an aircraft rudder

## 10-day harness

Aerospace: wire harness layout in 10 days

## Cockpit in 3 weeks

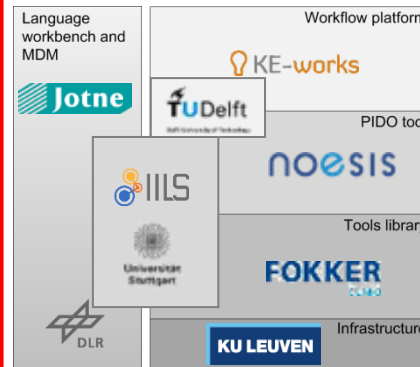
Automotive: cockpit wire harness design in 3 weeks



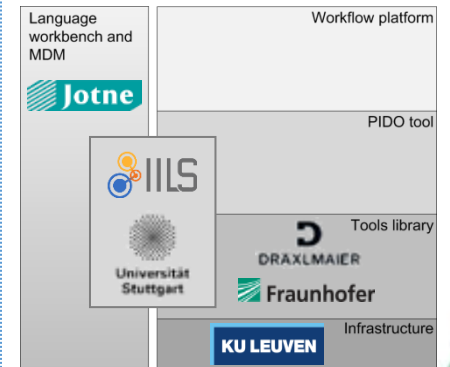
1A



1B



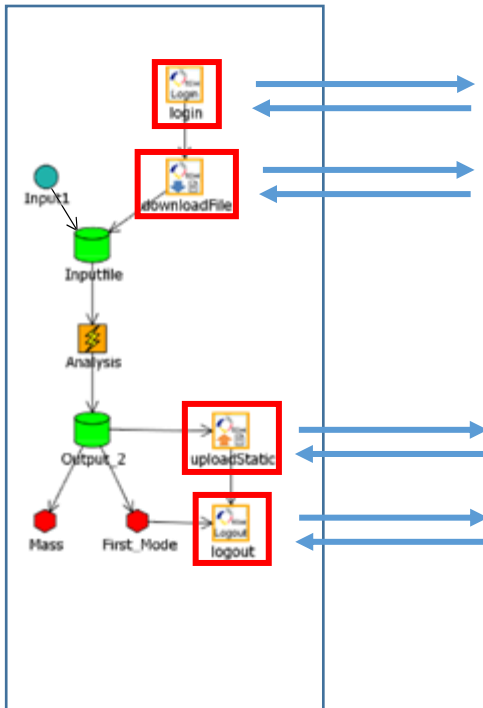
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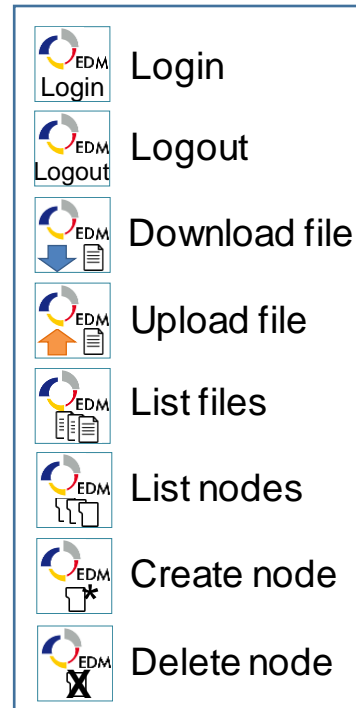
3

# Integration PIDO – PLM

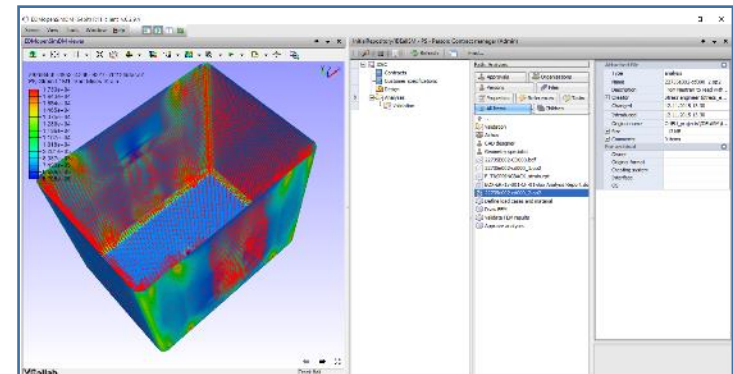
## Noesis Optimus workflow



## Optimus – EDM server interface



## ISO 10303 (STEP) Open SimDM



## Video

**Automatic interaction between simulation workflows and  
ISO 10303 (STEP) – Open SimDM**



Video showing how the various tools has been integrated to the ISO 10303 (STEP) repository using the Jotne OpenSimDM application

# All data in ISO 10303-209 - Open SimDM



EDMOpenSimDM (64bit) R11, client v.0.2.9.4

Server View Tools Window Help

EDMOpenSimDM viewer

InitialRepository/IDEalISM - PS - Person: Contract manager (Admin)

292b84c0-39a3-4236-9227-7bf15ddaca7  
Ply Strain L1M1 :Von Mises Strain

1.733e-04  
1.643e-04  
1.554e-04  
1.465e-04  
1.375e-04  
1.286e-04  
1.196e-04  
1.107e-04  
1.018e-04  
9.281e-05  
8.387e-05  
7.493e-05  
6.599e-05  
5.705e-05

Path: Analyses

- Approvals
- Persons
- Organizations
- Files
- Properties
- References
- Tasks
- All Items
- Children

Validation

- Arbus
- CAD designer
- Geometry specialist
- 22735e002-cd000.bdf
- 22735e002-cd000\_1.op2
- F\_T&SPRINGBACK\_strain.rpt
- BOX-ER-15-001-CF-01-Box Analysis Report.do
- 22735e002-cd000\_2.op2
- Define load cases and material
- Draw FEM
- Validate FEM results
- Approve analyses

Attached file

Type	analysis
Name	22735e002-cd000_2.op2
Description	From Nastran to read with...
Creator	Stress engineer (stress_e...
Changed	12.11.2015 13.30
Introduced	12.11.2015 13.30
Original name	C:\EU_projects\IDEalISM\t...
Size	13 MB
Comments	0 items

For archival

Owner	
Original format	
Creating system	
Interface	
OS	

VCollab

Track Ball

18.11.2015 10.25.06

10.25  
18.11.2015

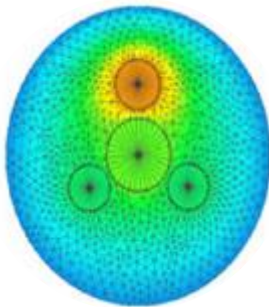
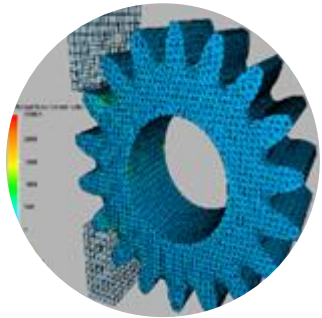




Tor Dokken, SINTEF IKT, Anvendt Matematikk,  
Kjell Bengtson, JOTNE EPM Technology

computer aided technologies  
for additive manufacturing

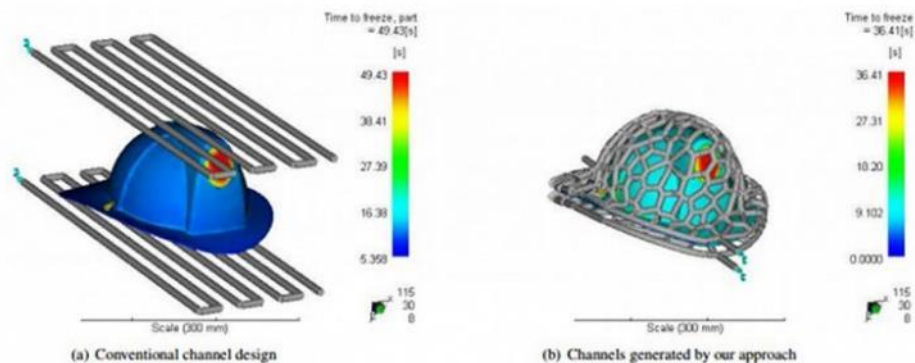
*The Additive Manufacturing (AM) market is expected reach 16.2 billion USD by 2018. As a result, there will be increasing demand for a software ecosystem that enables Computer Aided Technologies (CAx) support of AM processes and machines. However, to move from prototypes and demonstration 3D-models to real industrial use one needs to document and certify the quality of the outcomes of AM processes, such as product strength, surface quality, material behaviour and shape constraints.*



# Adressed by CAxMan



Use case 1:  
NuGear



Use case 2:  
Injection mould



# Extend the AP 242 ed1 model to support Additive Manufacturing design information interoperability

Whitepaper

Development of STEP AP 242 ed2  
“Managed Model Based 3D Engineering”

Version 1.0  
2014-03-30



## **4.4.3.2 Enhancements for design information for 3D additive manufacturing parts**

The aerospace and automotive industries are assessing the use of the new “3D additive manufacturing” technology. This new technology will result in a new integrated process, similar to the composite structure process. Specific CAx functionalities and information will be developed to cover design, simulation, manufacturing and inspection of 3D additive manufacturing parts and assemblies. AP 242 ed2 will be extended to support design information interoperability for the “3D additive manufacturing” technology.

Example of new entities to add:

- \* “Organic” shapes,
- \* Multiple materials,
- \* Variable densities,
- \* Microstructures,
- \* Graded materials enabling a progressive evolution of material properties according to the geometry.

Additive manufacturing systems can use voxels to represent the production result. The objective is to add a voxel representation into the appropriate STEP Integrated Resource, for example, Part 42. Target use case: exchange and long term archiving of additive manufacturing result (see also: enhancements for design information for 3D additive manufacturing parts).



# Technologies being used

- HPC systems
  - University of Edinburgh
  - CIMNE, Co-located at University of Barcelona
  - Arctur, hosting services in Slovenia
  - In house systems
- Software systems
  - Database – EXPRESS Data Manager and its Query Language, using ISO standards
  - Web services, Soap, Rest etc.
  - XML (P28), Text formats (P21), CGNS, HDF5 etc.
  - Any programming language, C, C++, C#, VB, Java, Python etc.

Workshop at  
World Manufacturing Forum 2016  
May 2, Barcelona

NAFEMS NORDIC Conference 2016  
Engineering Simulation: Best Practices,  
New Developments, Future Trends  
May 10-11, Gothenburg, Sweden

**Computer Aided Technologies for Additive Manufacturing (CAxMan)**

The objectives of Computer Aided Technologies for Additive Manufacturing (CAxMan) are to establish Cloud based Toolboxes, Workflows and a One Stop-Shop for CAx-technologies supporting the design, simulation and process planning for Additive Manufacturing.

**Let's meet to discuss at the ...**



**.. pre-workshop**  
**May 2, 2016**



**NAFEMS NORDIC CONFERENCE 2016**  
May 10-11  
Göteborg

[roger.oswald@nafems.org](mailto:roger.oswald@nafems.org)



The EU project CAxMan will conduct a seminar, presenting what CAxMan and other EU projects are doing to support your future plans for innovations and to extend your network of new opportunities.

The pre-workshop is an informal event to meet the people in EU projects, understanding the objectives and learn more about their capabilities and results.



**os!o**  
**innovation**  
**week**

2016: 17 – 21 October