



# **Towards a Center of Excellence for Engineering Applications**

Bastian Koller, 28.02.2017  
IDC HPC User Forum, Stuttgart

# Why a Centre of Excellence for Engineering Applications?

## EU engineering industry

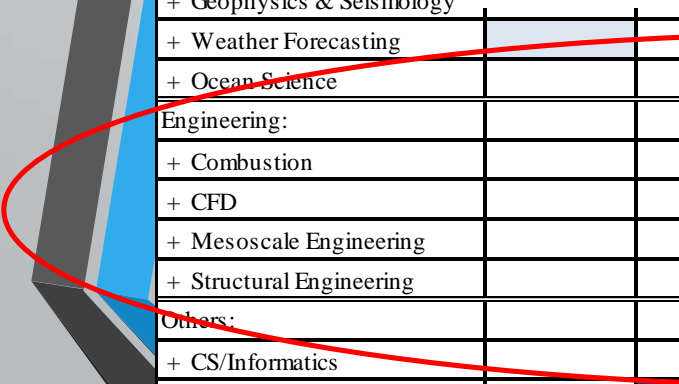
- consists of 130 000 companies,
- employing >10.3m people with high qualification and skill level,
- generating an annual output of some EUR 1 840 bn and about 1/3 of all exports of the EU

In 2015 the EC funded 8(9) Centres of Excellences, but if you look closer:

Applications Areas	Centres of Excellence							
	EoCoE	BioExcel	NoMaD	MaX	ESiWACE	E-CAM	POP	COEGSS
Biosciences:								
+ Biomolecular Modelling		Dark Blue						
+ Bioinformatics		Light Blue						
+ Systems Biology								
+ Medical Science		Light Blue						Light Blue
Chemical Sciences:								
+ Chemistry				Light Blue		Dark Blue		
+ Materials Science	Dark Blue		Dark Blue	Dark Blue		Dark Blue		
+ Surface Science				Light Blue				
Physics and Astronomy:								
+ Astrophysics & Cosmology								
+ Nuclear Physics								
+ Particle Physics								
+ Plasma Physics	Dark Blue							
+ Soft Matter Physics	Light Blue							
+ Solid State Physics								
Environmental Sciences:								
+ Climate Science								
+ Geophysics & Seismology								
+ Weather Forecasting	Light Blue							
+ Ocean Science								
Engineering:								
+ Combustion								
+ CFD								
+ Mesoscale Engineering								
+ Structural Engineering								
Others:								
+ CS/Informatics								Light Blue
+ Data Analytics		Dark Blue	Dark Blue	Light Blue				Dark Blue
+ Economics/Finance								Light Blue
+ HPC Research						Dark Blue		
+ Mathematics								
+ Humanities								
+ Social Science								Dark Blue

or Engineering

None of them addresses engineering

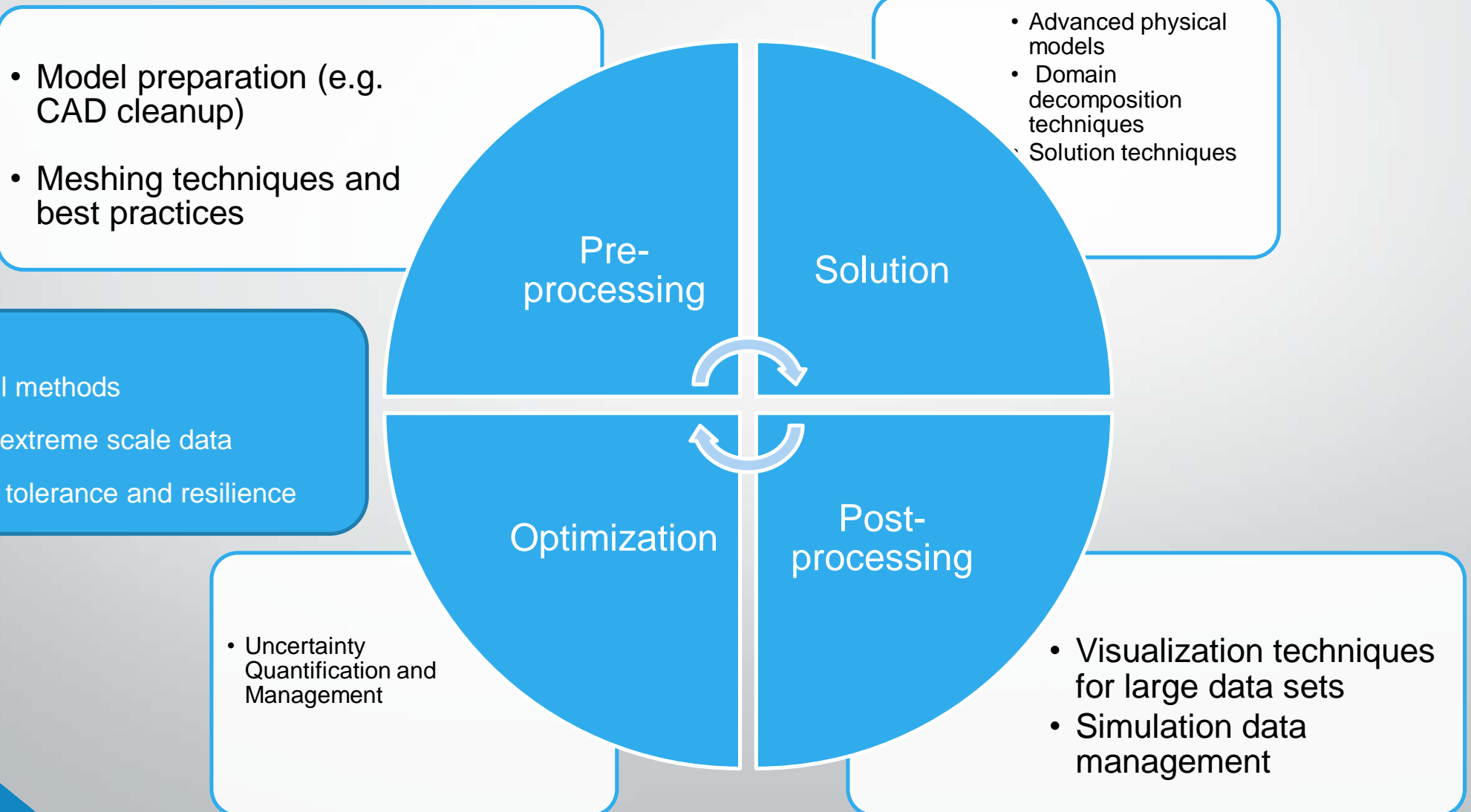


# Why a Centre of Excellence for Engineering Applications?

Meanwhile in the USA:

- DOE awards LBNL a 5-year-grant to establish a Center for Exascale Simulation of Combustion in Turbulence (ExaCT) (2011)
- IBM, NVIDIA and Oak Ridge HPC centre form CAAR: a CoE whose goal is to enable advanced, large-scale scientific and engineering applications (July 2015)
- Exascale Computing Project announces \$48 million to establish four exascale co-design centres (November 2016)

# Addressing the engineering workflow



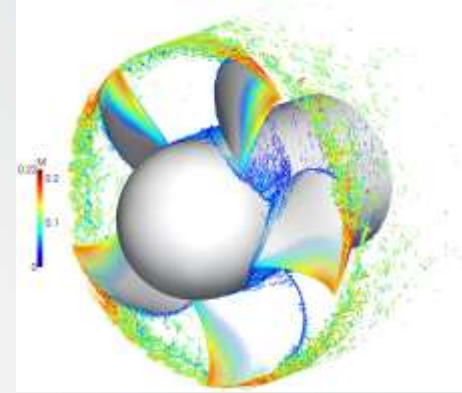
# Can engineering scale?

- ANSYS, HLRS and Cray partnership achieves to set a new supercomputing record after working together for a year (2015-2016)
- ANSYS Fluent is scaled to over 172,000 cores on the HLRS supercomputer Hazel Hen, a Cray XC40 system
- 5x increase over the record set two years ago when Fluent was scaled to 36,000 cores

*"With the state-of-the-art resources and support from Cray, as well as access to government, industry and academia, we can use HPC to solve even more complex and challenging problems across any industry."*

Wim Slagter, director of HPC and cloud marketing at ANSYS

# Can engineering scale?



- User Project of the Aerodynamic institute of RWTH Aachen University (AIA)
- Tests and evaluation within the frame of a German AIF research project with EBM Pabst

## Target:

- Development of a reliable prediction tool for noise development of ducted fans
- Development of turbulence models to make the problem Cluster Scale

Executed with AIA Zonal Flow Solver

- Large Eddy Simulation
- 92,000 compute cores
- 110 h walltime
- 80 TB result data
- 1 Billion grid points
- 320,000 timesteps for 4 rounds



# Vision of a Centre of Excellence on Engineering

The CoE will **boost the competitiveness** of European engineering through **excellent research** that addresses grand challenges of **complex applications** using **cutting-edge HPC technologies**.

The aim of the CoE is to support the engineering community at a level that no single HPC provider can.



# Principle elements



# So...what should be done?

- Develop, scale and optimise **engineering applications**
- Support advanced users/existing communities and new user groups with **access to (niche) expertise**
- Facilitate **technology transfer**: knowledge base on topics of interest + repository of developed software and tools
- Deliver specialised **training** and **industry validation** workshops
- Help pave path towards **Exascale**
- **Support** the evaluation of new upcoming technology in alignment with the European HPC Strategy
  - **Co-Design** with vendors
  - **Support** the Exascale Demonstrator Activities (e.g. by testing new Hardware)

# Approach to selecting applications

- Start with a selection of codes per discipline
  - Enhance during lifetime with emerging applications
- Implement special mechanisms to integrate ISV (such as NUMECA, ANSYS, Siemens/Altair) in the workflow, taking into account their special requirement
- Address the open source community (e.g. OpenFOAM, NEK5000, Netkar++) with appropriate community building tools and support mechanisms

# Synergies with related HPC-focused projects

## EU competitiveness in HPC driven advances



Target: advanced users/ existing communities, industry, new users during exploitation stage  
Main service: address Grand Challenges in engineering HPC applications; achieve limits in both optimisation and hardware use



Target: manufacturing SMEs, new-users  
Main service: access to simulation and modelling resources (software and hardware) through cloud for prototyping; amplify use of cloud-HPC



Target: SMEs, academia, new users  
Main service: access to HPC infrastructure for prototyping; amplify use of established technology

# EXCELLERAT and its sustainability path

- Grow initial team: HLRS, KTH, EPCC, CERFACS (new)
- Form industrial partnerships
- Apply for funding during next EC CoE call
- Diversify revenue streams
- Collaborate with other CoEs, FET-HPC projects and the Extreme Scale Demonstrators
- Interact with EXDCI, PRACE and ETP<sub>4</sub>HPC

# Stay tuned - visit our website

The screenshot shows the homepage of the EXCELLERAT website. At the top, there is a browser address bar with the URL <http://www.excellerat.eu/wp/> and a search icon. The main header features the EXCELLERAT logo, which consists of a stylized 'e' made of blue squares and the word 'EXCELLERAT' in a bold, blue, sans-serif font. Below the logo is the tagline 'The European Centre of Excellence for Engineering Applications'. A dark teal navigation bar contains the following menu items: ABOUT, TRAINING, EVENTS, JOBS, RELATED ACTIVITIES, NEWS, and CONTACT. On the right side of this bar are social media icons for LinkedIn and Twitter. The main content area is divided into two columns. The left column is titled 'ABOUT' and features three circular images connected by a horizontal line. The first image shows a server rack with the 'EPCC' logo and the word 'ancher' below it. The second image shows a woman in a blue dress standing next to a large brown bear in a forest. The third image shows a server rack with the 'HLRS' logo. Below these images are the labels 'EPCC', 'KTH', and 'HLRS' respectively. The right column contains a search bar with the text 'Search ...' and a 'RECENT POSTS' section. The first post is titled 'New supercomputing record set by ANSYS, HLRS and Cray 17/02/2017'. The second post is titled 'EPCC develops new modelling techniques for the chemical and oil and gas industry 13/02/2017'. At the bottom of the page, there is a paragraph of text: 'EXCELLERAT is a European Centre of Excellence for Engineering Applications. The Centre is an initiative of three European High Performance Computing Centres, the High Performance Computing Centre in Stuttgart (HLRS), the Edinburgh Parallel Computing



*Thank you*

# Addressing the engineering workflow

