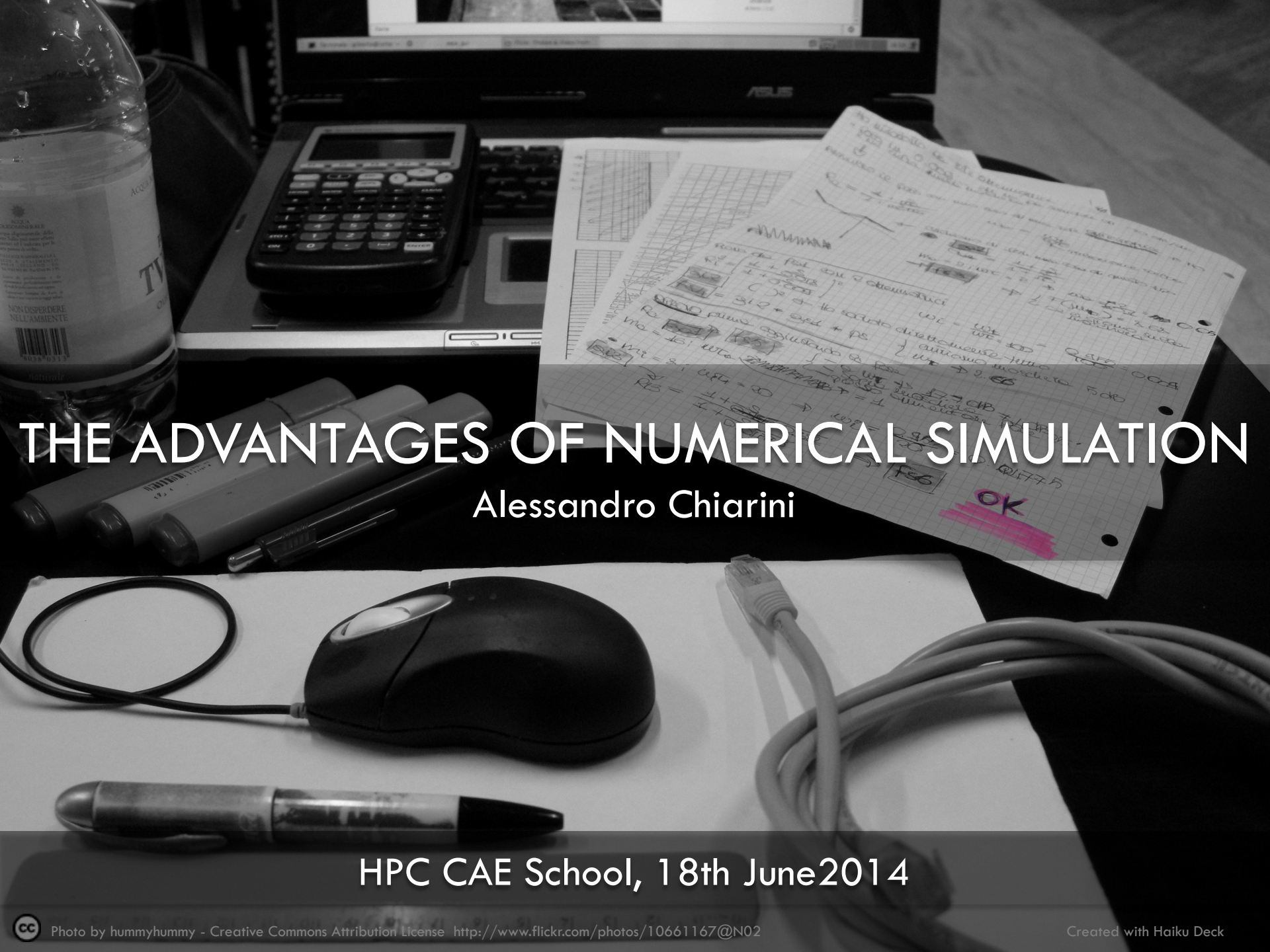


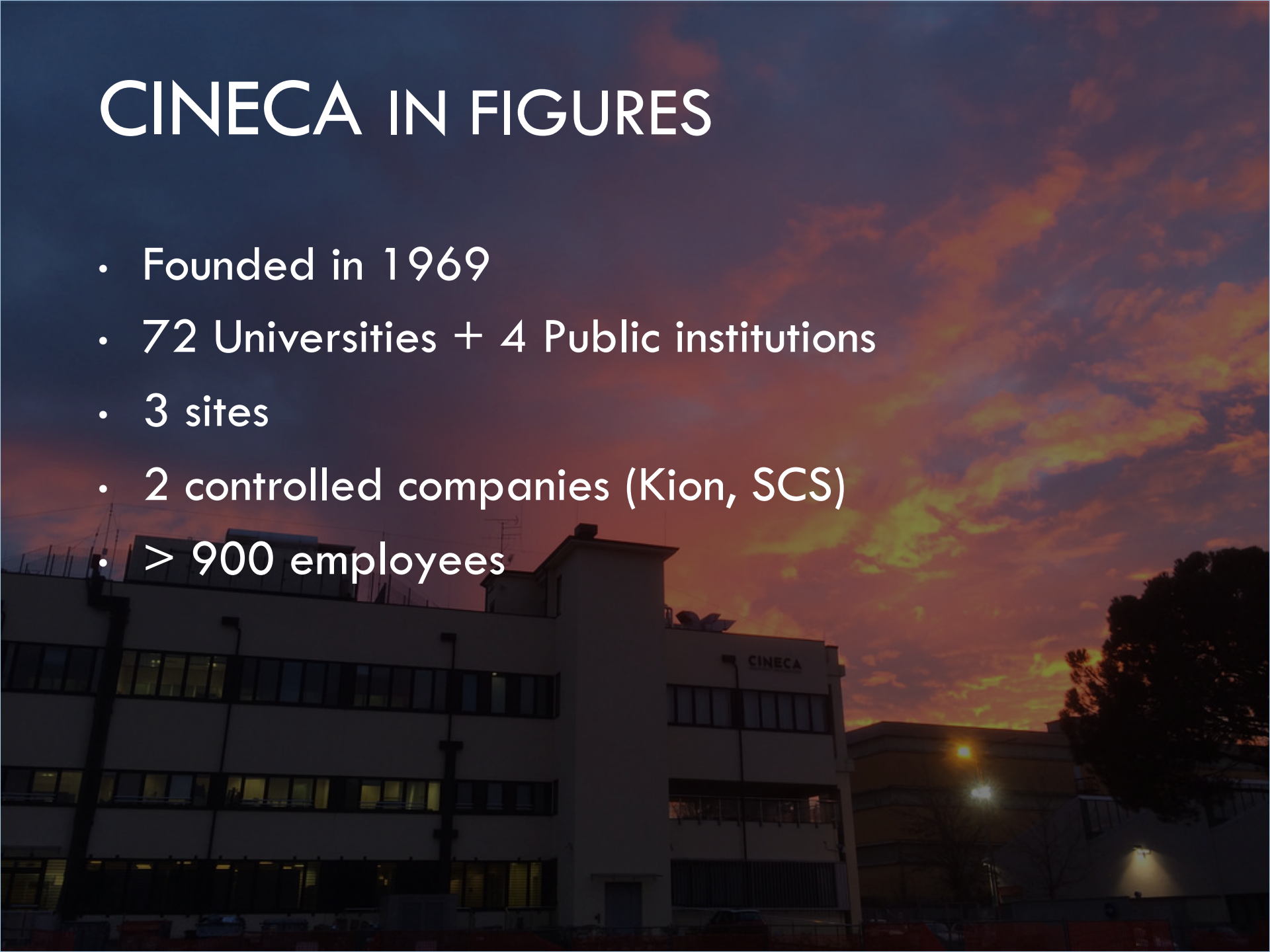
THE ADVANTAGES OF NUMERICAL SIMULATION

Alessandro Chiarini

HPC CAE School, 18th June2014

CINECA IN FIGURES

- Founded in 1969
- 72 Universities + 4 Public institutions
- 3 sites
- 2 controlled companies (Kion, SCS)
- > 900 employees



CINECA - SCAI

- 1 Tier 0 system(Fermi) e 2 Tier 1 (PLX, Eurora)
- Best placement in Top500: #7 (Fermi)
- Best placement in GreenTop500: #1 (Eurora)
- Total storage capacity: 3PB -(->8PB in June)
- HPC services to support public research
  - International: PRACE
  - Italian: ISCRA
- Technological transfer towards industry

SCS SUPERCOMPUTING SOLUTIONS

- Funded in 2003
- HPC services marketing and sales
- Consultancy services (CAE, HPDA)
- Development of integrated solutions (HPC+CAE+HPDA)

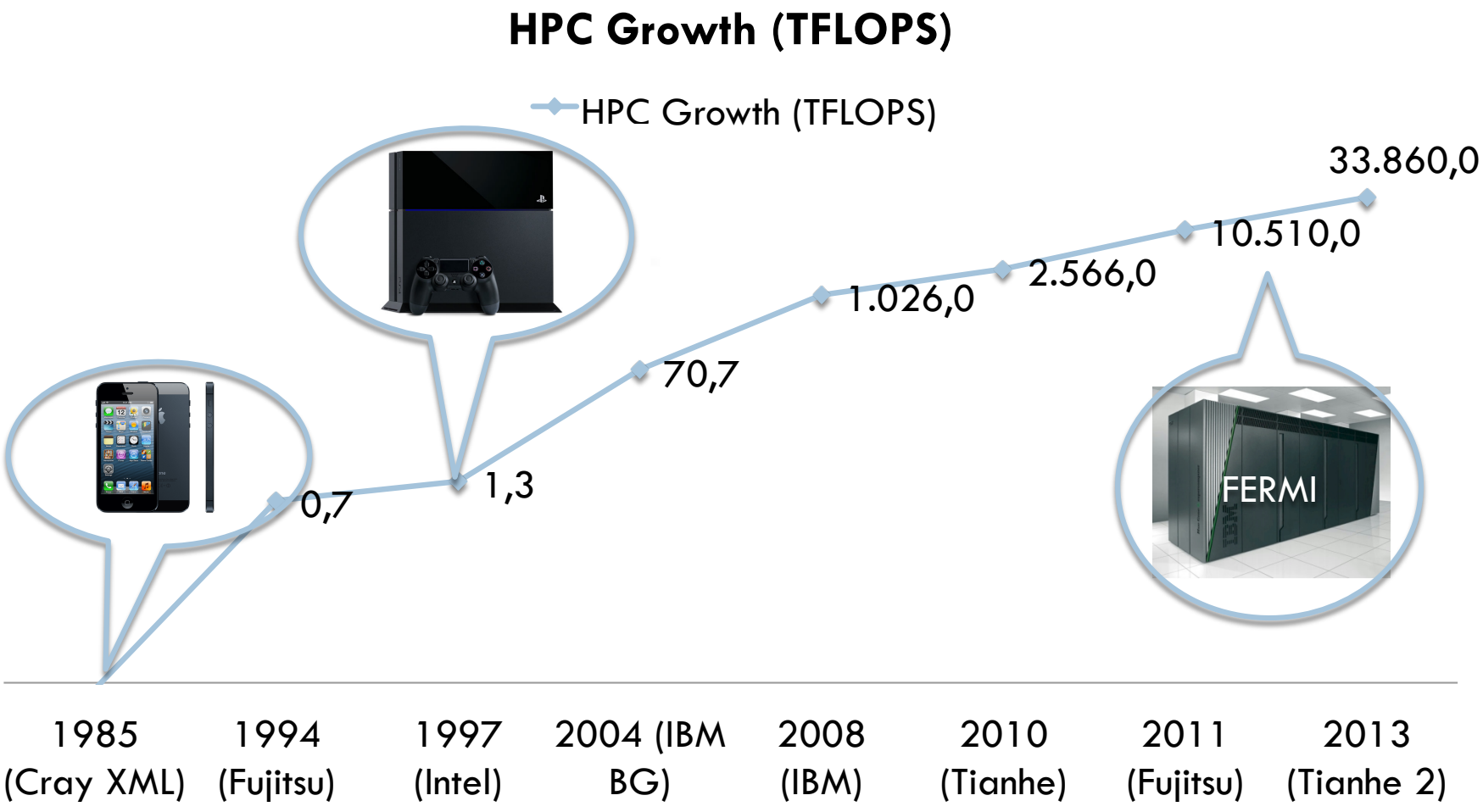
NUMERICAL SIMULATION

*"For **simulation** of a physical process we mean the representation by solving equations of a mathematical model with the computer. The numerical method is a tool that allows you to achieve results **not achievable by other means. The use of numerical simulation is becoming increasingly important with the increase in computing power available**."* (fonte: Enc. Treccani)

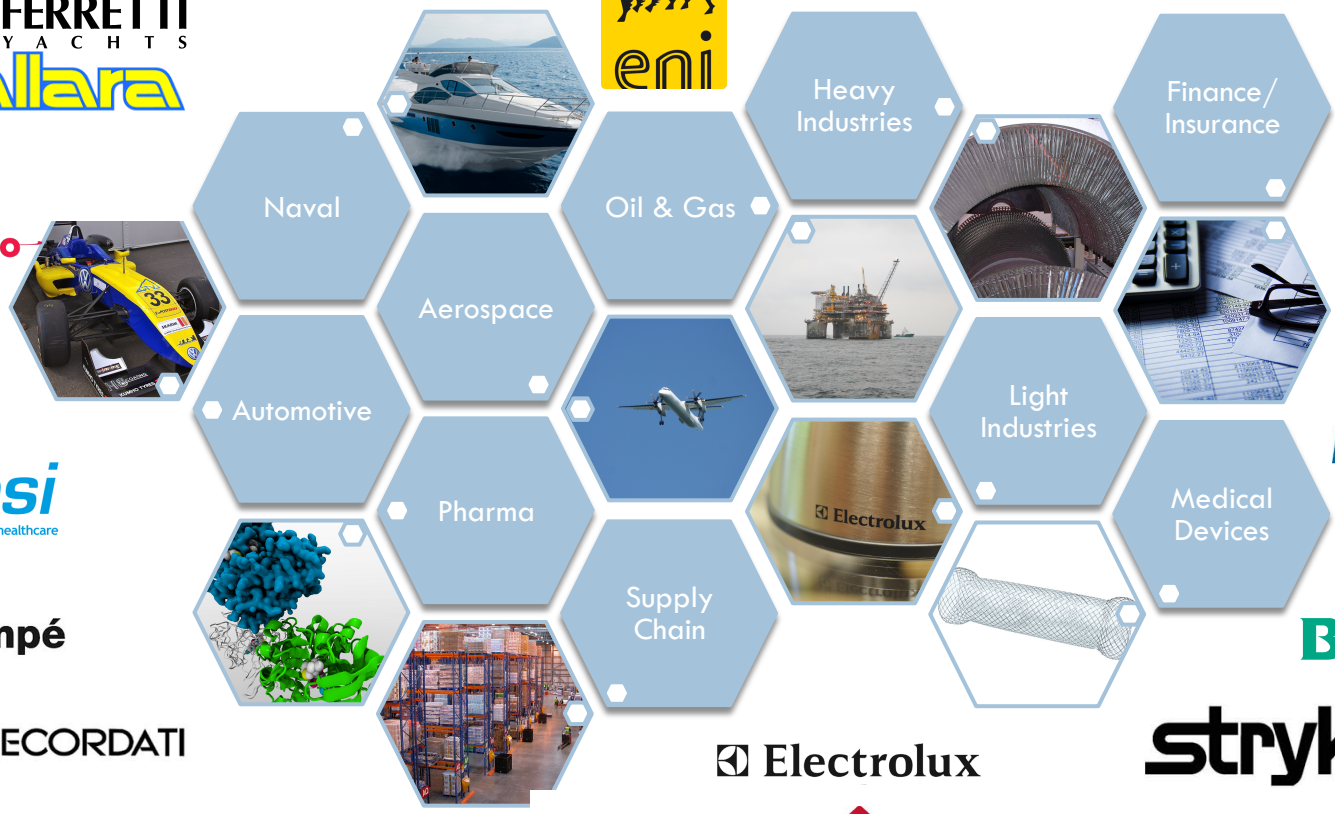
HIGH PERFORMANCE COMPUTING

"Centralize a computing capacity in a single system to provide much higher performance than those of a workstation or a desktop computer. This capability is used to solve problems in chemistry, physics, engineering or finance." (source: HPC Inside)

EVOLUTION

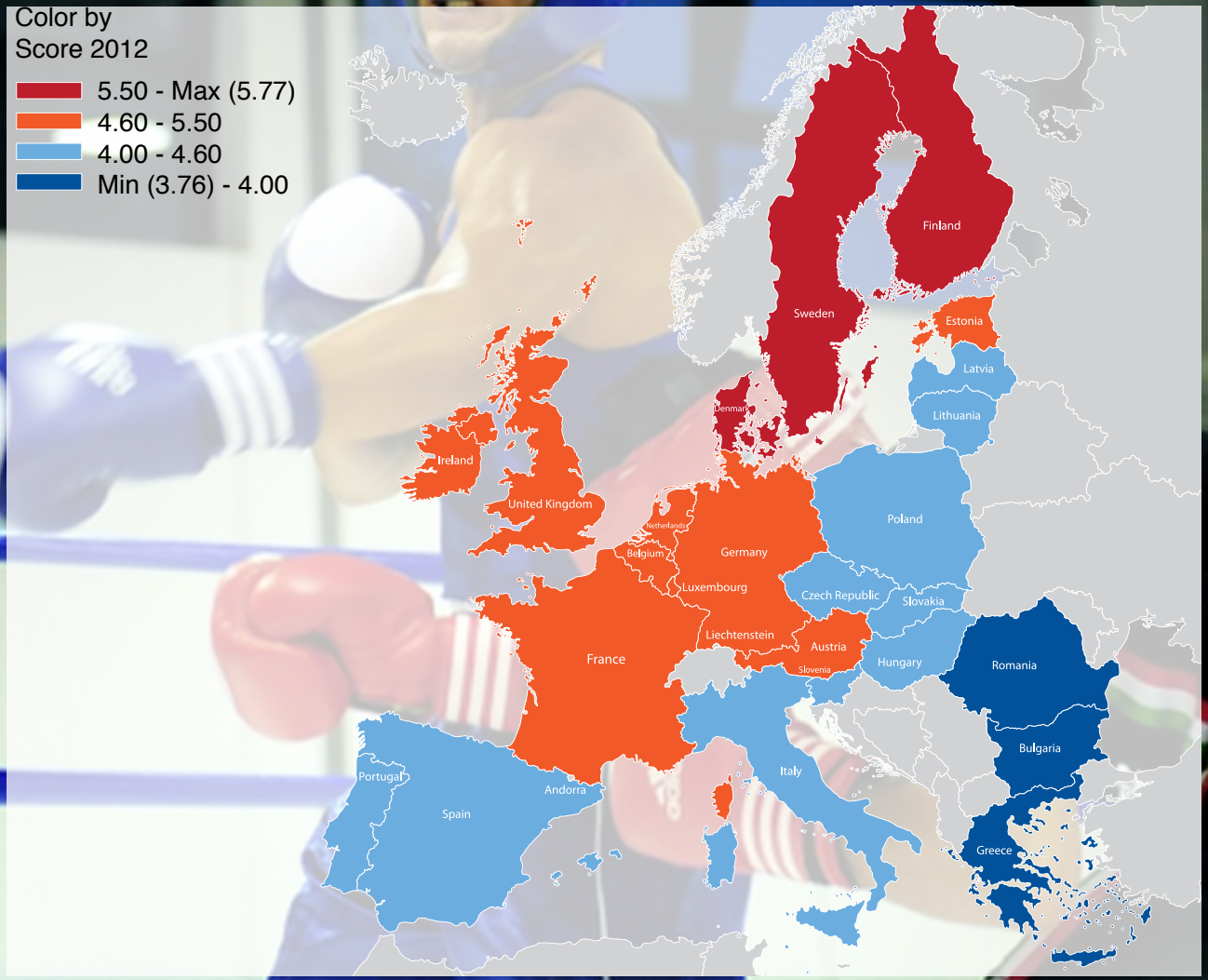

HPC Growth (TFLOPS)
HPC Growth (TFLOPS)
0,7
1,3
70,7
1.026,0
2.566,0
10.510,0
33.860,0
FERMI
1985 (Cray XML)
1994 (Fujitsu)
1997 (Intel)
2004 (IBM BG)
2008 (IBM)
2010 (Tianhe)
2011 (Fujitsu)
2013 (Tianhe 2)

APPLICATIONS



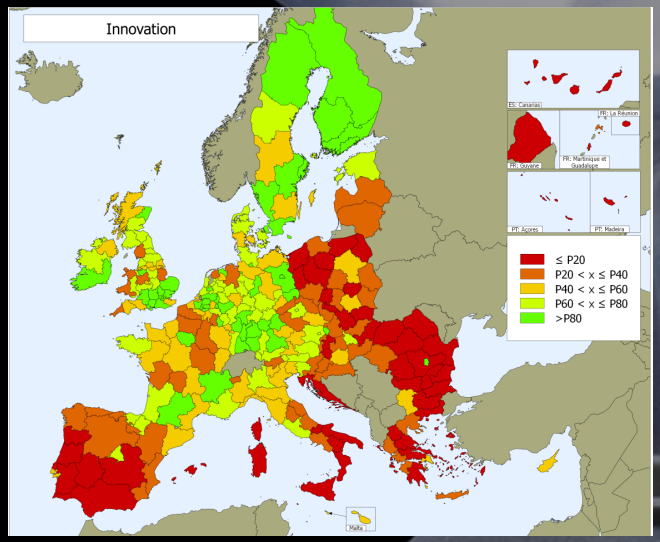
LUNA ROSSA CHALLENGE 2013
AZIMUT YACHTS
FERRETTI YACHTS
dallara
Ferrari
eni
BOMBARDIER
ALSTOM
SACMI
cefla
Unipol GRUPPO
SCUDERIA Toro Rosso
CRF CENTRO RICERCHE FIAT
Chiesi People and ideas for innovation in healthcare
Medtronic
WRIGHT.
Dompé
B BRAUN SHARING EXPERTISE
RECORDATI
Electrolux
stryker
ToolsGroup POWERFULLY SIMPLE
elica aria nuova
ARISTON THERMO GROUP

THE CHALLENGE



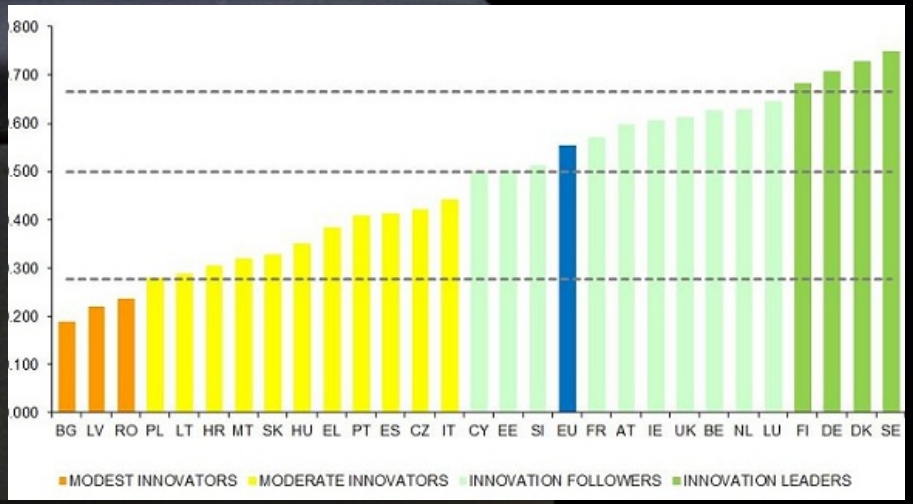
Fonte: EU COMPETITIVENESS REPORT 2012

TO INNOVATE TO COMPETE

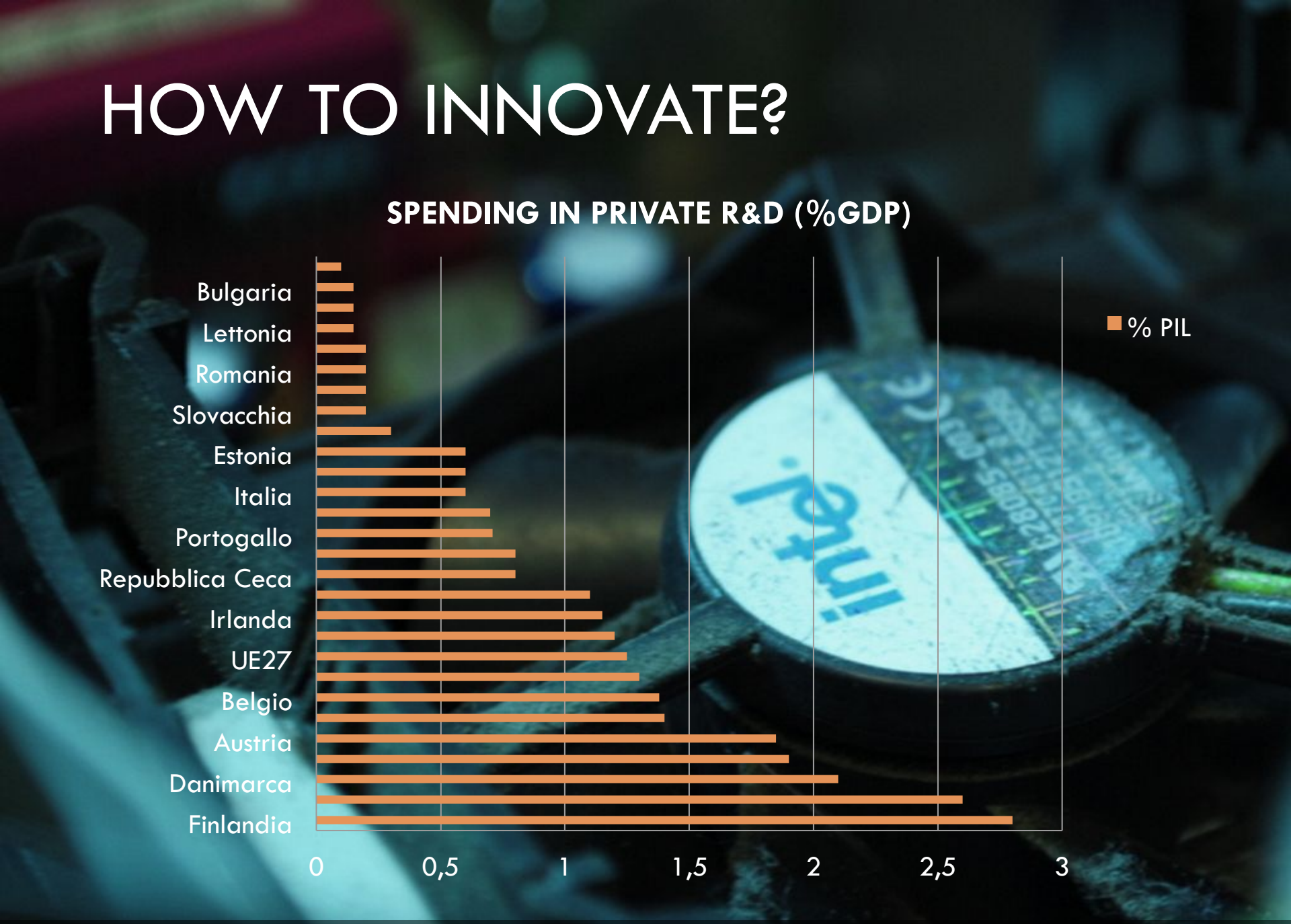


SRC: REGIONAL COMPETITIVENESS REPORT EU 2013

SRC: INNOVATION UNION SCOREBOARD 2014

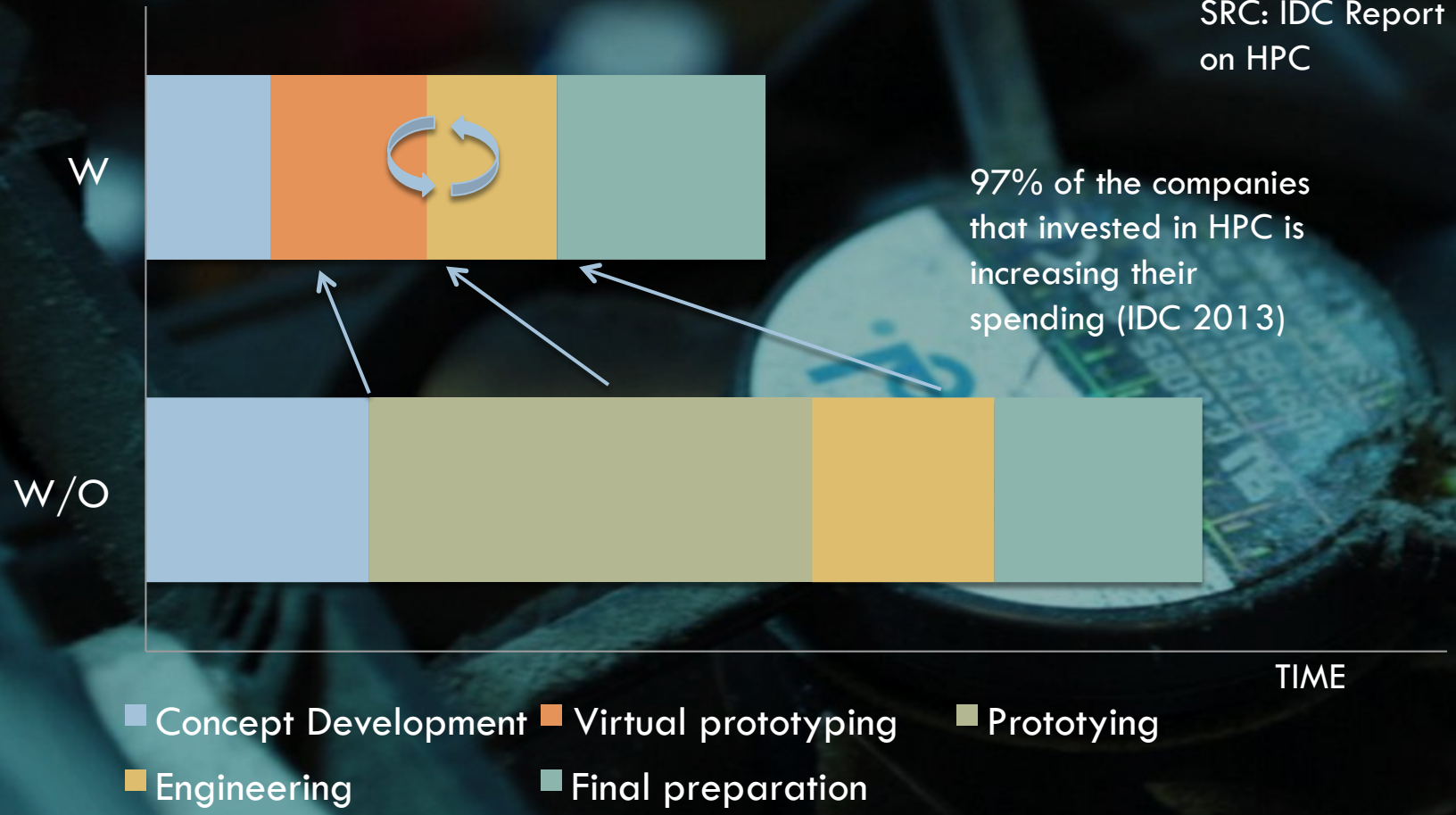


HOW TO INNOVATE?



THE HPC IN THE PRODUCT CYCLE

SRC: IDC Report on HPC

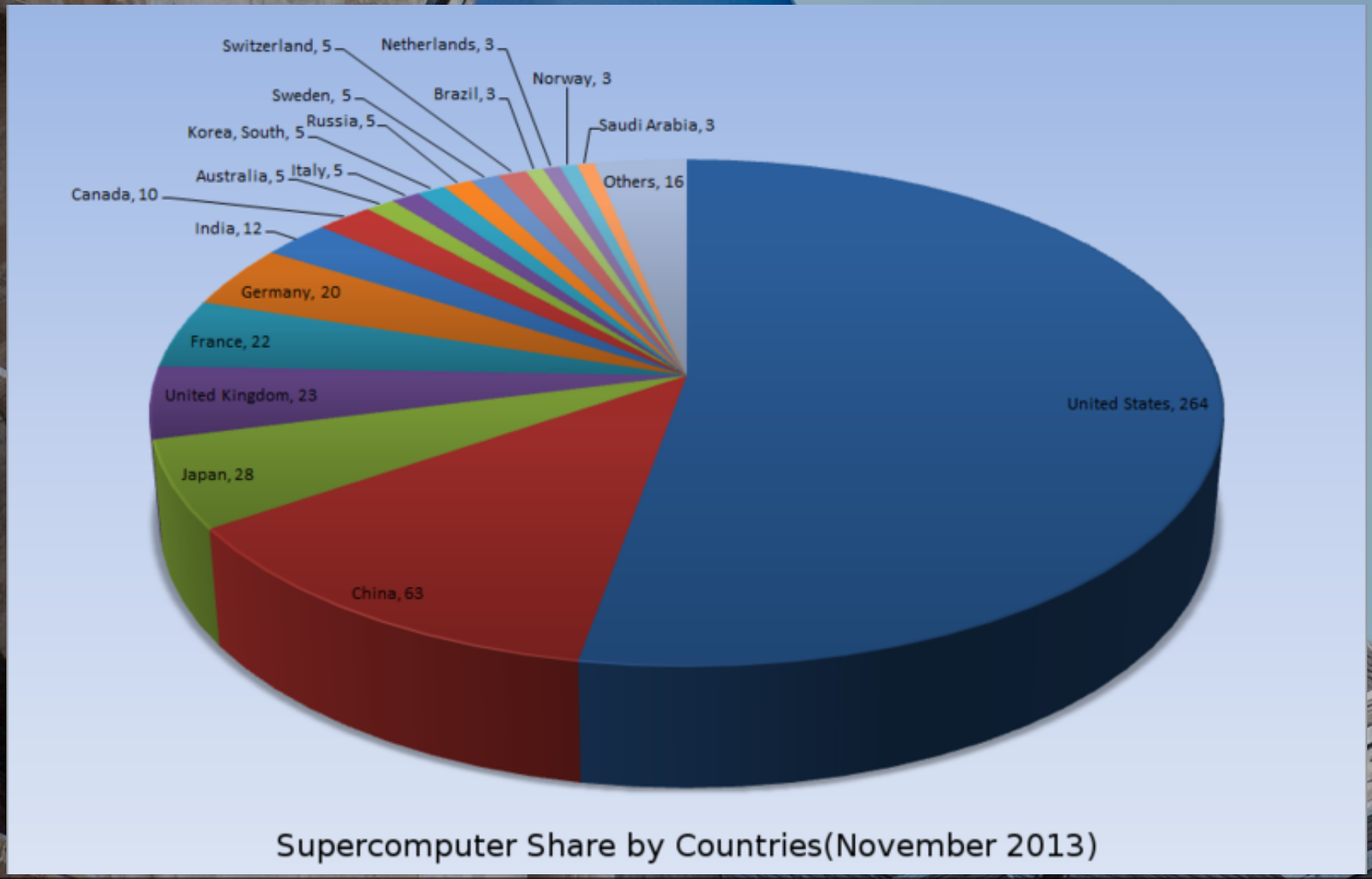


97% of the companies that invested in HPC is increasing their spending (IDC 2013)

EU PRIORITIES

- EC increased its HPC investment to 1.2B€
- To reach 1ExaFlops within 2020
- Make more relevant the EU HPC ecosystem
- Make more fair the HPC market for EU operators

THE EU CHALLENGE



EC ACTIONS

- Strengthen e-infrastructure programs (PRACE)
- Creating PPP to promote the adoption of HPC technologies (ETP4HPC, FoF)
- To develop centre of excellence for application domains
- To promote specific actions to improve applications scalability to exascale class.
- To promote specific actions in order to improve productive technologies (aka power consumption, e.g. DEEP)
- To promote actions to standardize the access services (Cloud, PaaS, IaaS, HPCaaS -> **Fortissimo**).

THE HPC MARKET

- HPC market is foreseen in constant growth for the next three years (ave. 7,6%, IDC data)
- China, US, Korea, Russia leaders claimed that HPC is the key to competitiveness of their industry.
- Among segments, storage will grow the most.
- Big data, particularly HPDA will be trending.

THE CHALLENGES-1

To keep low operational costs (that can reach 20% of the total cost of a HPC system, 20M€/y)

- Cooling
- Partnership CINECA-Eurotech
- Sustainable, eco-friendly datacentre

THE CHALLENGES-2

HPC as a commodity? WTH?

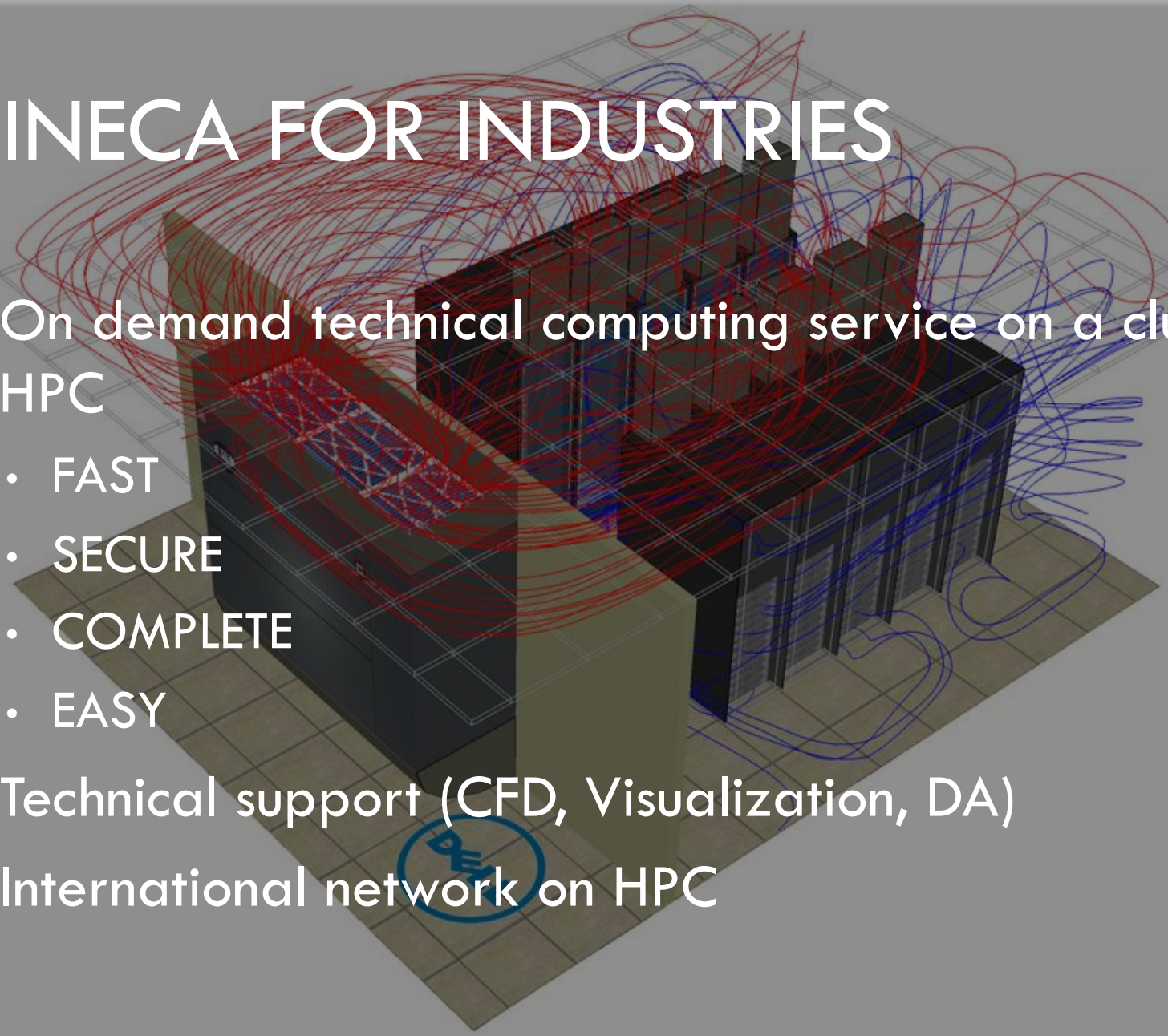
- Iaas vs PaaS
- Security models
- SLA e QoS

THE CHALLENGES-3

To train people in HPC adequately is a priority for EC.

- HPCEUROPA Program
- CINECA Schools
- International master in HPC (SISSA+ICTP)

CINECA FOR INDUSTRIES



- On demand technical computing service on a cluster HPC
  - FAST
  - SECURE
  - COMPLETE
  - EASY
- Technical support (CFD, Visualization, DA)
- International network on HPC

- CFD
  - ANSYS Fluent
    - Remote User
    - Local User
  - [redacted]6
  - [redacted] v7
  - [redacted]
- Structural Analysis
  - Abaqus
  - NASTRAN
  - DYTRAN
- Interactive
  - Utilities
  - ANSYS CFD
    - Fluent 13
    - ANSYS WorkBench
    - ICEM
    - CFX
  - NEXUS
    - [redacted]
    - [redacted]
    - [redacted]
    - Gocad
    - ParaView
    - MSC-PATRAN
    - ABAQUS CAE
    - Pointwise
    - VisIt

Remote User

Welcome to the Fluent page for Remote test! You must use this page if your input files are on your remote cluster.

Please insert:

Journal File
A file with the command lines for your Fluent test.

Input Files
*Input Files: *cas and/or *.dat and all the additional files you need*

Version
You must select one of these versions: 2d, 3d, 2ddp, 3ddp

Number of CPUs
How many CPUs do you want to use ?

Other Parameters
If you are an expert user, you should use some usefull other parameters.
Please type "-help" in the box in order to get some information.

Queue
name of the queue your job will be submitted to
PRIVATE USERS MUST USE the queue "reserved"!!

Journal File [Select..]

Input Files [Select..] [Clear]

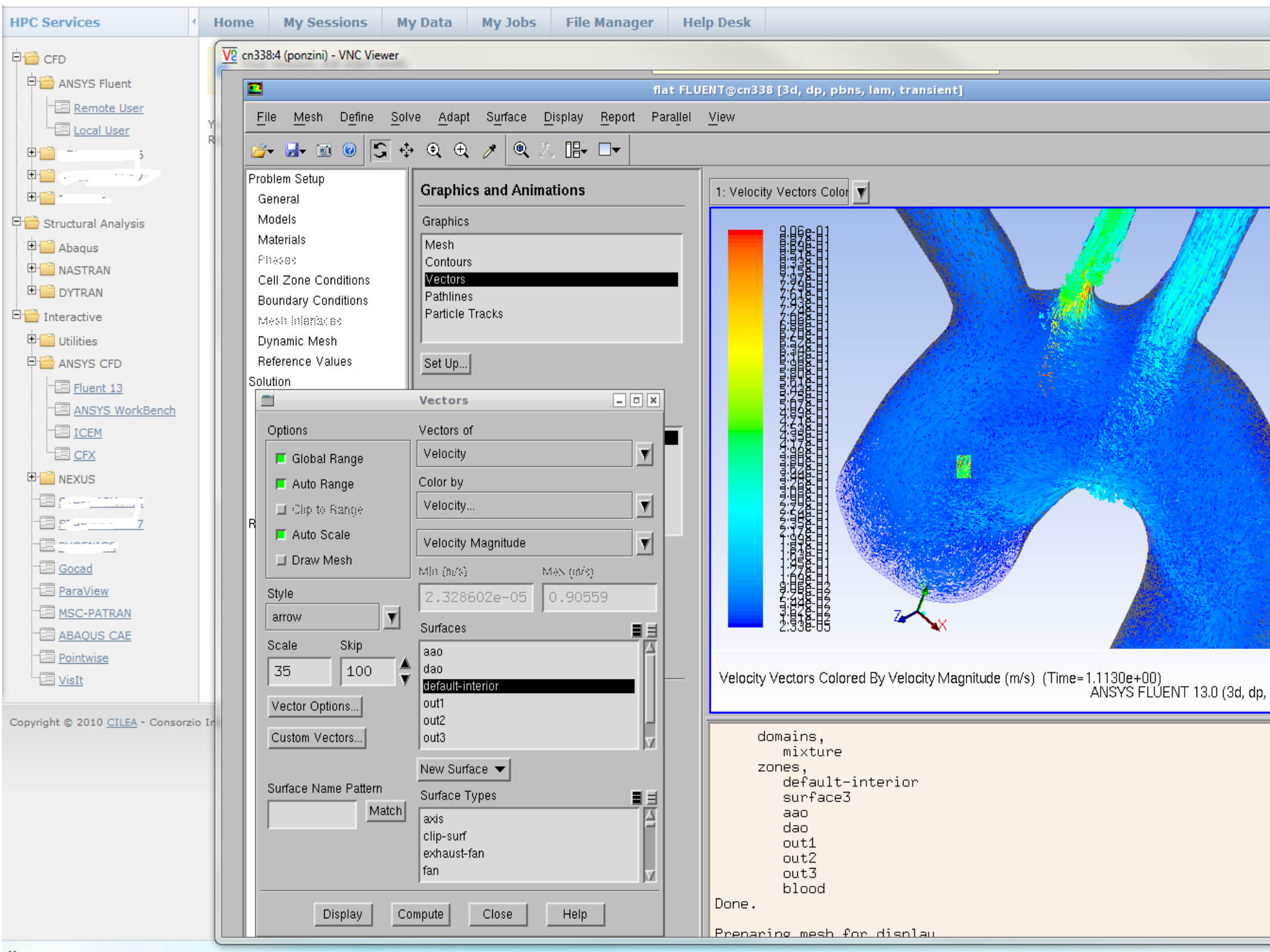
Version
- 2d
- 3d
- 2ddp
- 3ddp

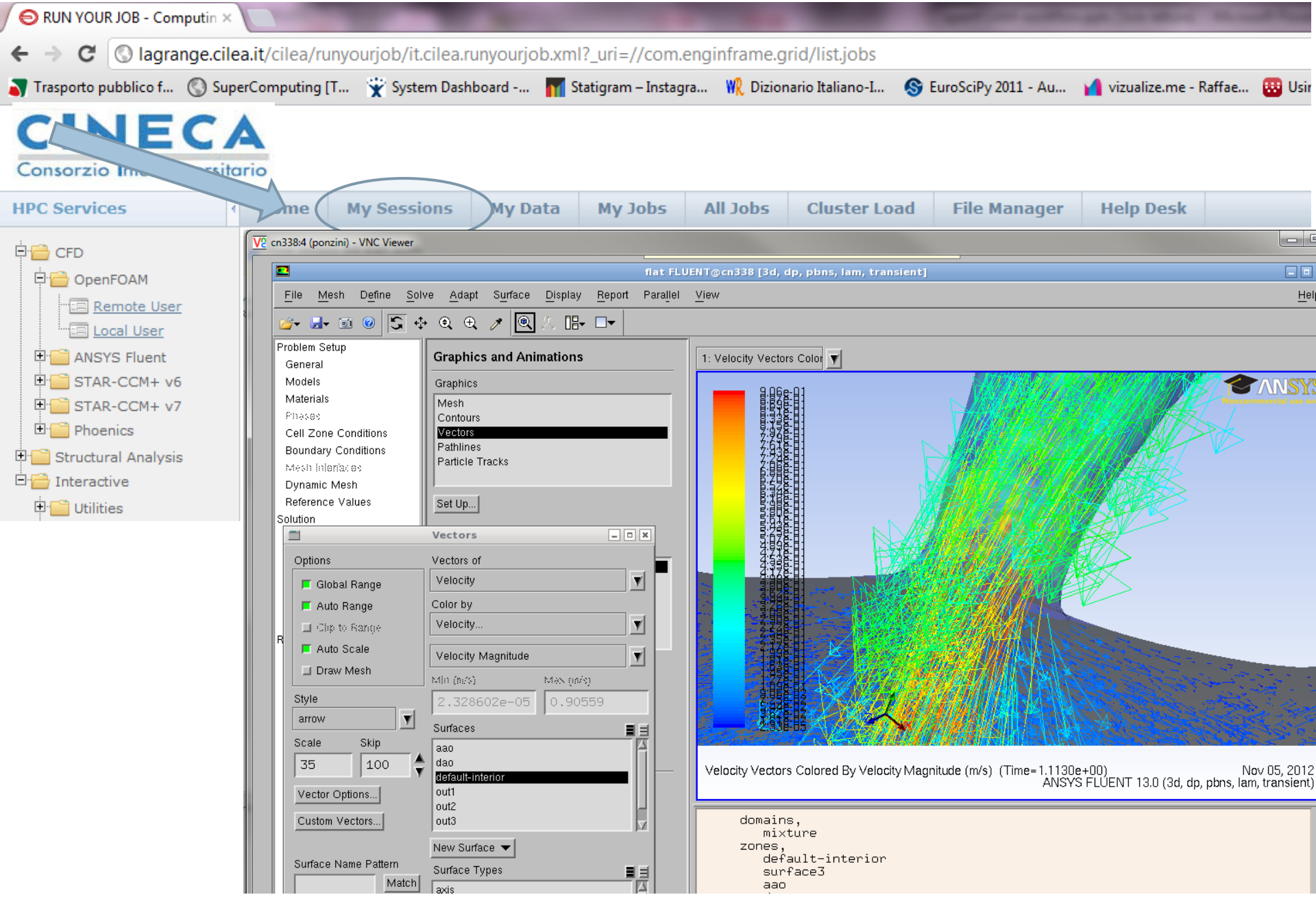
Number of CPUs 1

Other Parameters

queue reserved

Submit job


HPC Services
Home
My Sessions
My Data
My Jobs
File Manager
Help Desk
CFD
ANSYS Fluent
Remote User
Local User
Structural Analysis
Abaqus
NASTRAN
DYTRAN
Interactive
Utilities
ANSYS CFD
Fluent 13
ANSYS WorkBench
ICEM
CFX
NEXUS
Gocad
ParaView
MSC-PATRAN
ABAQUS CAE
Pointwise
VisIt
Copyright © 2010 CILEA - Consorzio In
cn338:4 (ponzini) - VNC Viewer
flat FLUENT@cn338 [3d, dp, pbns, lam, transient]
File
Mesh
Define
Solve
Adapt
Surface
Display
Report
Parallel
View
Problem Setup
General
Models
Materials
Phases
Cell Zone Conditions
Boundary Conditions
Mesh Interfaces
Dynamic Mesh
Reference Values
Solution
Graphics and Animations
Graphics
Mesh
Contours
Vectors
Pathlines
Particle Tracks
Set Up...
1: Velocity Vectors Color
Vectors
Options
Global Range
Auto Range
Clip to Range
Auto Scale
Draw Mesh
Vectors of
Velocity
Color by
Velocity...
Velocity Magnitude
Min (m/s)
Max (m/s)
2.328602e-05
0.90559
Style
arrow
Scale
35
Skip
100
Vector Options...
Custom Vectors...
Surfaces
aao
dao
default-interior
out1
out2
out3
New Surface
Surface Name Pattern
Match
Surface Types
axis
clip-surf
exhaust-fan
fan
Display
Compute
Close
Help
Velocity Vectors Colored By Velocity Magnitude (m/s) (Time=1.1130e+00)
ANSYS FLUENT 13.0 (3d, dp,
domains,
mixture
zones,
default-interior
surface3
aao
dao
out1
out2
out3
blood
Done.
Preparing mesh for display


RUN YOUR JOB - Computin
lagrange.cilea.it/cilea/runyourjob/it.cilea.runyourjob.xml?_uri=//com.enginframe.grid/list.jobs
Trasporto pubblico f...
SuperComputing [T...
System Dashboard -...
Statigram – Instagra...
Dizionario Italiano-I...
EuroSciPy 2011 - Au...
vizualize.me - Raffae...
CINECA
Consorzio Interuniversitario
HPC Services
My Sessions
My Data
My Jobs
All Jobs
Cluster Load
File Manager
Help Desk
CFD
OpenFOAM
Remote User
Local User
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cn338:4 (ponzini) - VNC Viewer
flat FLUENT@cn338 [3d, dp, pbns, lam, transient]
File Mesh Define Solve Adapt Surface Display Report Parallel View
Problem Setup
General
Models
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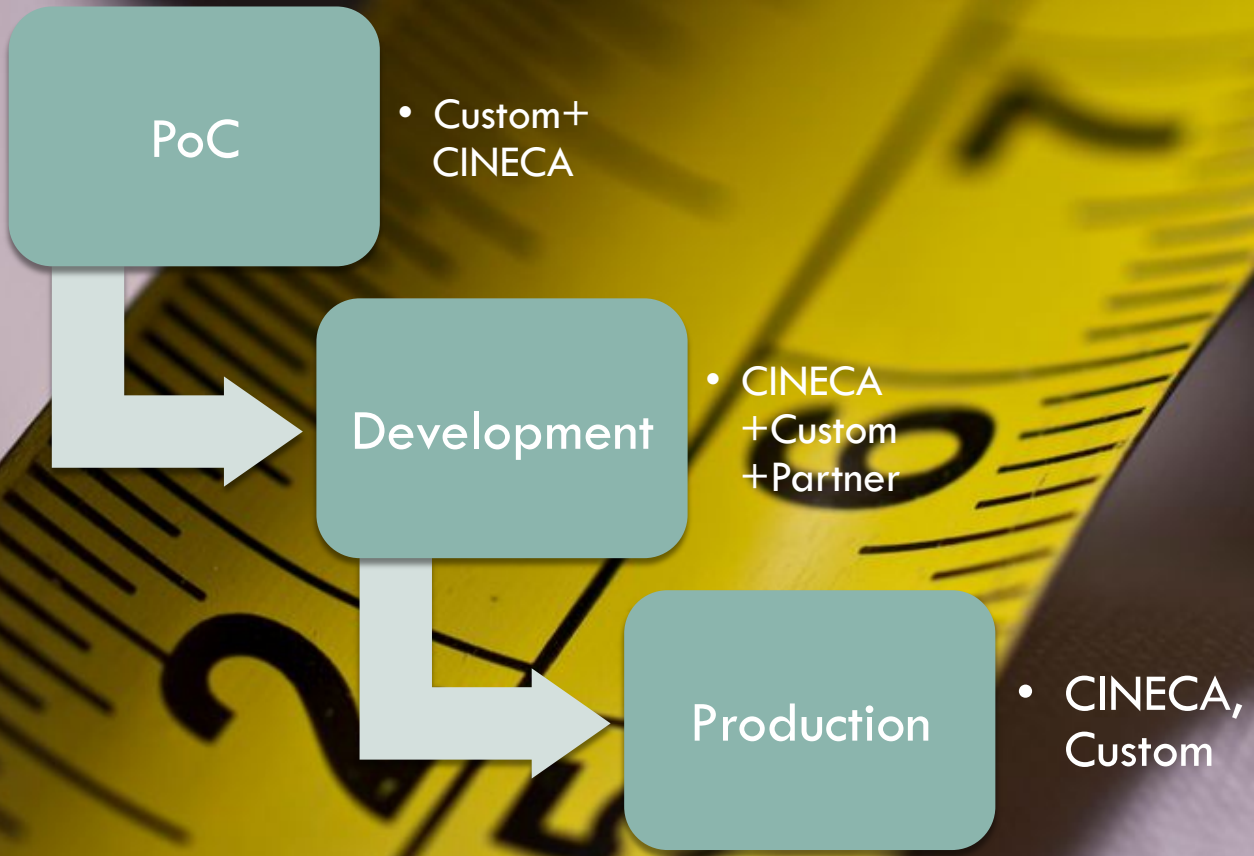
Cell Zone Conditions
Boundary Conditions
Dynamic Mesh
Reference Values
Solution
Graphics and Animations
Graphics
Mesh
Contours
Vectors
Pathlines
Particle Tracks
Set Up...
1: Velocity Vectors Color
Vectors
Options
Global Range
Auto Range
Auto Scale
Draw Mesh
Vectors of
Velocity
Color by
Velocity...
Velocity Magnitude
Min (m/s)
Max (m/s)
2.328602e-05
0.90559
Style
arrow
Scale
Skip
35
100
Vector Options...
Custom Vectors...
Surfaces
aao
dao
default-interior
out1
out2
out3
New Surface
Surface Name Pattern
Match
Surface Types
axis
Velocity Vectors Colored By Velocity Magnitude (m/s) (Time=1.1130e+00)
Nov 05, 2012
ANSYS FLUENT 13.0 (3d, dp, pbns, lam, transient)
domains,
mixture
zones,
default-interior
surface3
aao

Data security

- System access (ISO 27001)
- Cyphred connection
- Access policy on local file system
- Differentiated access policies for *industry users*
- Access policy on scheduler
- *Data Backup*
- *Disaster recovery*

SCALING-UP

The CINECA “method” :



ARE YOU READY FOR HPC?

- NS and HPC are a key factor to improve competitiveness of a manufacturing company
- HPC is an enabling technology part of innovation strategy for EU G20 countries.
- CINECA is the reference partner for HPC
- We are ready to speed up your innovation.