FORTISSIMO

Fortissimo Success Stories

Fortissimo Manufacturing SMEs to benefit from High Performance Computing Cloud-Based Simulations

4th Edition

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www.ec.europa.eu

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FORTISSIMO

The Fortissimo Marketplace

Fortissimo is funded by the European Commission within the I4MS initiative (ICT Innovation for Manufacturing SMEs) framework. It consists of two phases: the first phase began in July 2013 and ended in December 2016; the second phase began in November 2015 and will end in October 2018.

THE AIM OF FORTISSIMO

The aim of Fortissimo is to strengthen the global competitiveness of European industry. To do this, Fortissimo offers companies easy, cloud-based access to computationally intensive simulations.

THE CHALLENGE

In the past, gaining access to the resources required for digital simulation has often posed serious technical and financial challenges to SMEs. Through the use of High Performance Computing (HPC) simulations available via a cloud-based infrastructure, opportunities for business benefits can be identified and applied across the complete value chain, thus saving companies time and money and improving their competitive position.

THE MARKETPLACE

The Fortissimo Marketplace – launched in October 2016 – provides all European businesses, in particular Small & Medium Enterprises (SMEs), with permanent, simple and cost-effective

access to the hardware, software, and expertise required for computationally intensive simulations, via an on-demand, pay-per-use, "one-stop-shop" model.

Improvements resulting from the Fortissimo Marketplace approach are manifold, including: better and more precise design of complex components and systems; acceleration of time-to-market; and cost savings in development, production and operation.

SME PARTICIPATION

Fortissimo collaborates with SMEs, experts, ISVs and HPC-Computer centres to demonstrate the business benefits of Cloud-based-HPC simulations. SMEs can propose potential experiments through "open calls". During the 18-month duration of an experiment, the Fortissimo partners provide the participating SMEs with free access to HPC-resources via a cloud-infrastructure and support them in the planning, implementation and realisation of their experiment.

CLOUD-BASED HPC

The cloud-based Fortissimo Marketplace offers fast and convenient access to supercomputing services:

- The Fortissimo platform simplifies access to high-performance computer simulations for small and medium sized enterprises;
- Sign-up is free for users;
- Fortissimo match service providers to users' requirements, handling set up, project management and billing.

For further information, please visit: www.fortissimo-project.eu

Joint review of I4MS project in Edinburgh, September 2014.

Core Partners

THE UNIVERSITY OF EDINBURGH

EPCC is a leading European centre of excellence in advanced research, technology transfer, and the provision of high-performance computing services to academia and industry.
www.epcc.ed.ac.uk

ARCTUR

Arctur prides itself in being 'not just another HPC infrastructure provider'. Rather, they always provide personal support to users, ensuring that every HPC project achieves or even surpasses expectations.
www.hpc.arctur.net

ATOS

Atos is a leader in digital services, with 93,000 employees in 72 countries. Their deep technology expertise and industry knowledge has allowed them to build global client base across many different business sectors.
www.atos.net/en-us/home.html

Bull SAS

The only truly European IT company capable of designing, integrating and implementing supercomputers, Bull has made Extreme Computing one of its key strategic priorities.
www.bull.com/extreme-computing

FUNDACION CENTRO TECNOLOGICO DE SUPERCOMPUTACION DE GALICIA

CESGA is a public foundation committed to the advancement of Science and Technical Knowledge, by means of research and application of HPC, communications and other IT resources for the benefit of society.
www.cesga.es/en/cesga

CONSORZIO INTERUNIVERSITARIO

CINECA, the Italian supercomputing centre, is equipped with the most advanced hardware resources. Its mission is to provide computational resources for present and future academic and industrial research.
www.cineca.it

GRAND EQUIPEMENT NATIONAL DE CALCUL INTENSIF

GENCI was created with the aim of placing France on the international stage in terms of HPC. Its role is to help implement the national strategy for HPC in support of scientific research within France.
www.genci.fr

GOMPUTE

Gompute is a leading HPC and HPC Cloud company, which offers HPC services to a large number of users worldwide. It delivers comprehensive solutions for HPC, both in-house and as a service.
www.gompute.com

HLRS – UNIVERSITY OF STUTTGART

The High Performance Computing Centre (HLRS) is one of three national computing centres affiliated to the University of Stuttgart. It operates and provides compute resources to research groups and industry.
www.hlrs.de

INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

Over the last 40 years, Inria's researchers have been working at the crossroads of computer sciences and mathematics. Inria is France's only public research body fully dedicated to computational sciences.
www.inria.fr/en

INTEL DEUTSCHLAND GMBH

Intel (NASDAQ: INTC) is a world leader in computing innovation. The company designs and builds the essential technologies that serve as the foundation for the world's computing devices.
www.intel.com

SCAPOS AG

Scapos was founded in 2009 for the sales, marketing and support of technical computing software and of advanced software solutions. Its customers range from large research institutes and industrial corporations to SMEs.
www.scapos.com

SICOS BW GmbH

SICOS BW has been founded to support SMEs in the usage of HPC. Its tasks are to support industrial users who want to use HPC systems, and to support computing centres to provide suitable services.
www.sicos-bw.de

SURFSARA BV

SURFsara supports research, education and industry in the Netherlands in the areas of HPC and big data, through the development and provisioning of advanced ICT infrastructure, services and expertise.
www.surfsara.nl

XLAB D.O.O.

XLAB Research is recognized in Slovenia as one of the strongest computer science research teams outside the academic world. Their expertise is in security and distributed systems.
www.xlab.si

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FORTISSIMO

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www.fortissimo-project.eu

FORTISSIMO

HPC Cloud-based simulation of light-aircraft aerodynamics

ORGANIZATIONS INVOLVED

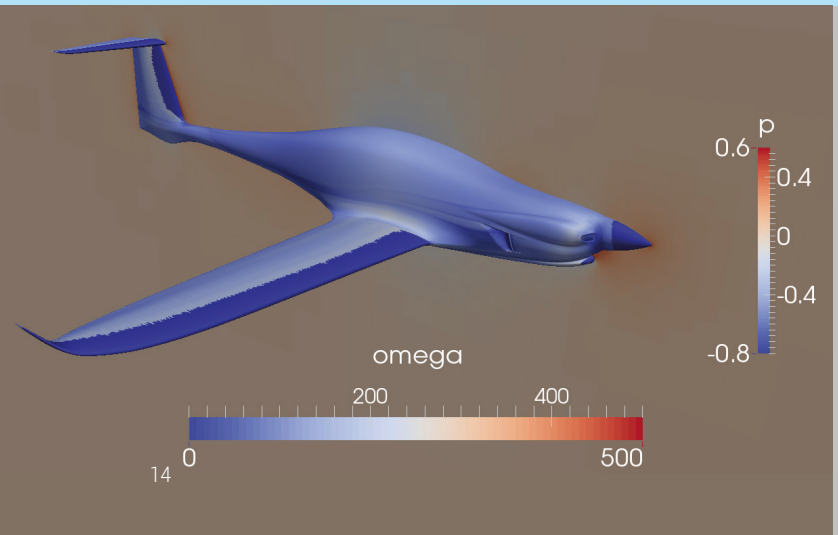
Pipistrel is a Slovenian SME. It was established in 1989 and is a leading designer and manufacturer of light aircraft. In order to develop its product line, Pipistrel needs to understand how air flows over its aircraft.

For an SME, it is virtually impossible to use wind tunnel tests during the design phase, because such tests are simply too expensive. The only option an SME has is to simulate the flow of air as accurately as possible using a high-performance computer. To replace wind-tunnel tests satisfactorily, aerodynamic models, which accurately simulate real airflows, need to be deployed. Such models require significant compute cycles and memory.

End User	HPC Expert	HPC Provider
PIPISTREL	XLAB NOT IDLE	ARCTUR
www.pipistrel.si	www.xlab.si	www.arctur.si

THE CHALLENGE

The challenge facing Pipistrel was to perform simulations of the flow over its aircraft in sufficient detail to model real physical effects accurately. Such simulations require expensive computer resources which are normally beyond the means of an SME. However, the use of Cloud-based HPC offers the possibility of running such simulations on a pay-per-use basis which is financially viable for an SME.



The challenge facing Pipistrel was to perform simulations of the flow over its aircraft which are sufficiently detailed to model real physical effects accurately.

This experiment allowed Pipistrel to use HPC for the first time and to learn about its capabilities. Pipistrel ran more demanding, higher fidelity simulations. It gained considerable experience in the use of HPCbased simulation.

THE SOLUTION

The use of Cloud-based HPC allowed Pipistrel to run simulations which accurately predicted how an aircraft would behave in flight. To simulate the air flow around the aircraft with the required degree of accuracy, a large computer model was used. Such a model ran in approximately 2 to 3 days on a Cloud-based HPC system. This enabled Pipistrel to perform complex simulations in a reasonable time and at an affordable cost.

EXPERIMENT #401 HIGHLIGHTS

Industry Sector:
Aerospace

Country: **Slovenia**

Software used:
OpenFOAM

End Date:
December 2014

BUSINESS IMPACT

Pipistrel needs to simulate the flow of air over the body of an aircraft only occasionally during the design process. It estimates that it is 10 times cheaper to use Cloud-based HPC simulations than have a suitably powerful in-house system which is only used for part of the time. The indicative annual costs of using Cloud-based HPC simulations are approximately €30k compared with an in-house costs of €300,000, which shows that this saving is considerable.

This case study allowed Pipistrel to use HPC for the first time and to learn about its capabilities. Pipistrel ran more demanding, higher fidelity simulations. It gained considerable experience in the use of HPC-based simulation. This experience will help Pipistrel to estimate the time and the cost of such simulations better. This will help them to decide if the use of HPC is justified or not in future projects.

Pipistrel learned that the use of HPC will be very valuable during a design phase of future aircraft. HPC can be used to run much more demanding simulations that improve the fidelity of results. The time needed for such simulations running on an HPC system is roughly the same as the coarser simulations currently run on Pipistrel's in-house cluster. The higher-resolution simulations give more and better data that can be incorporated into each design phase. This both accelerates the design phase and reduces the number of the design cycles.

Pipistrel
Slovenia

FORTISSIMO

HPC Cloud-based simulation of steel casting

ORGANIZATIONS INVOLVED

Ergolines is an Italian SME. They are world leaders in manufacturing products used in the production of speciality steels, including special instruments used in continuous casting. Ergolines' goal is to develop equipment which supports production of flawless steel alloys with properties that satisfy an increasingly quality-oriented market. Ergolines routinely uses in-house computational resources during development to simulate the flow of liquid steel as it solidifies. This case study addresses the problem of slag carry-over from the ladle to the tundish, which can lead impurities in steel or poor ladle yield. This is a complex phenomenon which cannot be observed directly, and simulating it requires the use of HPC, which Ergolines has not previously used.

End User

ergolines INNOVATION PARTNER

www.ergolines.it

HPC Expert and Centre

ARCTUR

www.arctur.si

THE CHALLENGE

In continuous steel casting it is crucial to prevent slag – a by-product – from transferring to the tundish. This causes breakouts, resulting in hot liquid steel spraying out – with serious safety and economic implications. An automated system for ladle-slag monitoring is thus in high demand, one which matches the vibration of the slag with the fluid dynamics of the system. This requires detailed simulation, which can only be done using HPC.

Dedicated HPC-based simulations followed by case experimental validation have provided Ergolines with key insights into the physics of the system and into different ladle-emptying mechanisms. As a result, it has been possible to establish a correlation between the shroud vibrational signal and the fluid dynamics of the system.

THE SOLUTION

HPC simulations gave new insights into the physics of the problem and different ladle-emptying mechanisms. The discovered link between the shroud vibrational signal and the fluid dynamics of the system forms the basis of an innovative monitoring technology, which will significantly improve occupational safety and productivity in steel plants. Ergolines had previously used simulation in its design process, but this was their first experience of using full-scale HPC and seeing its potential benefits.

EXPERIMENT #402 HIGHLIGHTS

Industry Sector:
Casting

Country: **Italy**

Software used:
OpenFOAM

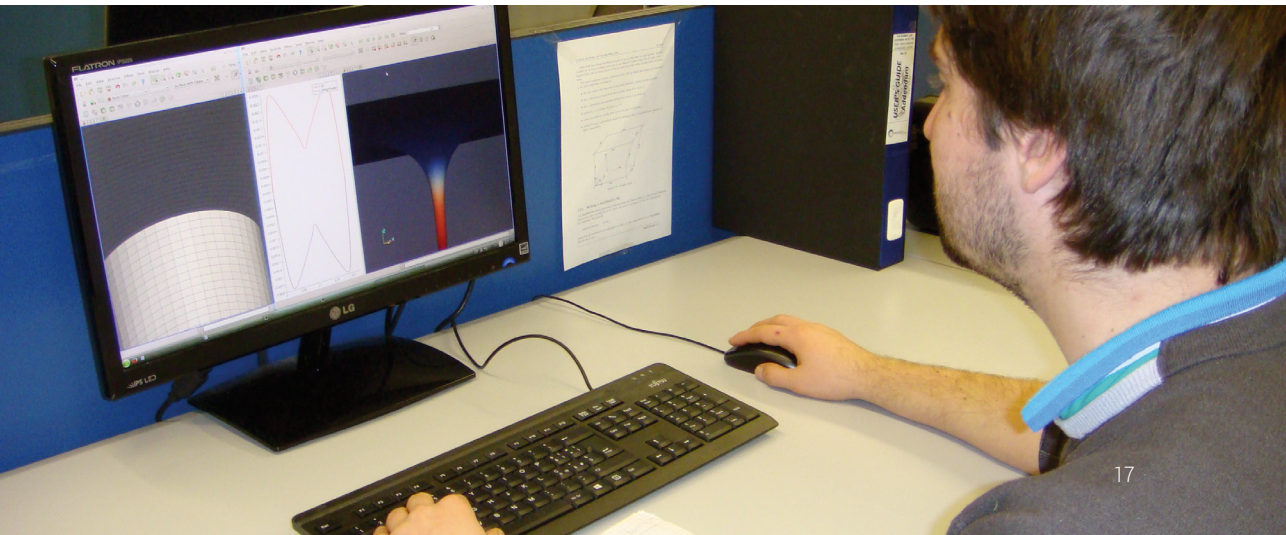
End Date:
December 2014

BUSINESS IMPACT

To get accurate results in complex slag carry-over simulations, it was necessary to use very fine-grained simulations for both geometry and time. This required powerful computing resources that Ergolines did not have. Access to a cloud-based HPC system thus allowed Ergolines to reduce computational times without incurring the high costs HPC ownership. The results from the fluid-dynamic analysis enabled development of a new automatic slag detection technology for steel continuous casting, which could bring significant improvements to occupational safety and productivity of steelworks.

Ergolines
Italy

The ability to detect slag while it is passing through the shroud enables a steel plant to control the closing of the ladle more finely. For an average ladle size of 100 tons, 0.5 - 1% of steel usually remains in the ladle. With the new monitoring technology, 60% of the lost steel can be saved. On an average production of 1 million tonnes of per year, a medium-size factory could avoid re-melting 6,000 tonnes of steel. Re-melting 6,000 tonnes of steel at approximately €70 to €100 per tonne represents a saving of €420,000 to €600,000. The loss of a further 300 tonnes of steel could be also avoided, saving 70,000€, for total savings of up to €670,000 per year, per medium-sized plant. Casting is a high-energy process, so on top of the monetary savings, energy savings for steel plants equipped with the monitoring technology would be significant.



FORTISSIMO

HPC Cloud-based design of high-pressure vessels

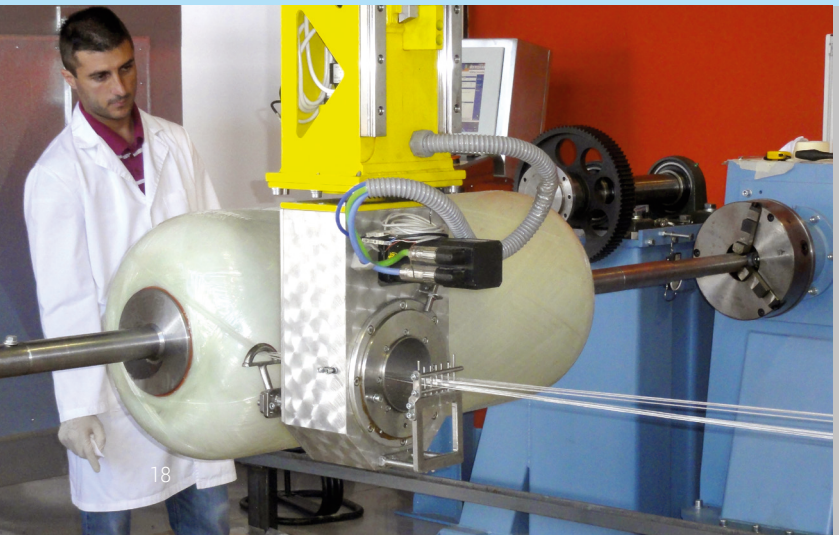
ORGANIZATIONS INVOLVED

Founded in 1991, Mikrosam is an SME, which manufactures winding machines for the construction of composite pressure vessels such as natural gas containers in automobiles. It is involved in the design of pressure vessels and the development and adjustment of its machines to produce such designs. The biggest advantage of modern composite materials is that they are many times lighter than and yet as strong or stronger than widely used metals. Composite materials have the potential to replace widely used steel and aluminium, often with better performance. Composite components can lead to weight savings of between 60% to 80% by replacing steel components and between 20% to 50% by replacing aluminium components.

End User	HPC Expert	HPC Provider
MIKROSAM CONTROL • AUTOMATION • ROBOTICS	XLAB NOT IDLE	ARCTUR
www.mikrosam.com	www.xlab.si	www.arctur.si

THE CHALLENGE

Previously for Mikrosam, design involved physical tests. To replace physical tests with numerical simulation requires significant computing resources. An HPC-based system is necessary to get results in a reasonable time frame. The challenge was to develop a model for the simulation of composite materials and to implement it on an HPC system which would enable accurate results to be obtained within an acceptable development time.



The challenge was to develop a model for the simulation of composite materials and to implement it on an HPC system which would enable accurate results to be obtained in a time frame allowing an acceptable development time.

THE SOLUTION

A HPC-based computer model was developed to simulate the behaviour of composite materials using an open-source software package. This model needed significant computing resources and ran on an HPC system. Such simulations reduce the amount of physical testing needed in the design of composite materials. Previously Mikrosam was using simulation in its design process. However this case study was their first experience of HPC and the benefits it could bring.

EXPERIMENT #403 HIGHLIGHTS

Industry Sector:
Composites

Country:
FYR Macedonia

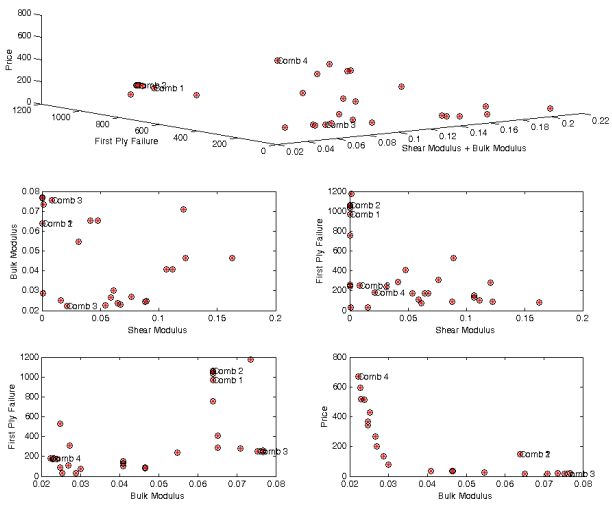
Software used:
OpenFOAM

End Date:
December 2014

BUSINESS IMPACT

For each filament winding machine used in the production of high-pressure vessels, different combinations of materials and winding angles for the composite, need to be considered. With the simulation code developed in this case study it is possible to shorten the design time and to reduce the number of physical tests and prototyping costs. The case study has shown that using simulation on an HPC system can reduce time for composite design by about 30% and reduce the cost of design and testing by 10%. As a result of the Fortissimo experiment, Mikrosam will be able reduce its production costs by about €30,000 per year for the next 5 years. More importantly its product offer (production machines for high-pressure vessels) will give each of its customers an advantage in production costs of around €300,000 per year per machine for machines that are currently on the market. The considerable advantage of Mikrosam's products over those of its competitors will, as a conservative estimate, lead to an increased revenue for the company of around €400,000 per year for the next 5 years. This is a significant amount for this SME. The experience gained in this experiment together with reduced production costs for both Mikrosam and its customers constitutes a base for further growth of the company and the resultant creation of new jobs.

Mikrosam
FYR Macedonia



FORTISSIMO

HPC Cloud-based simulation of flange tightening

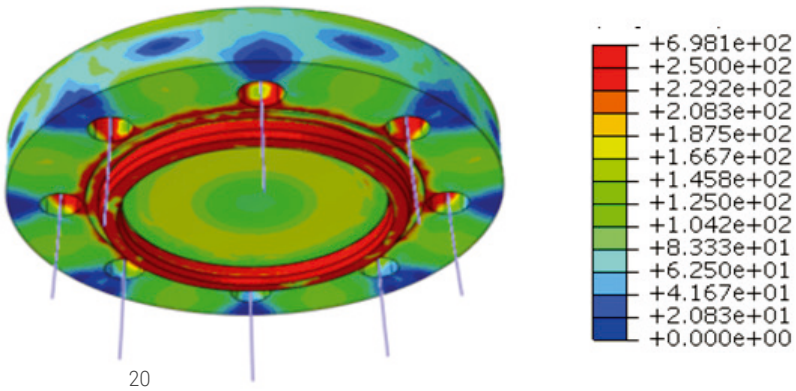
ORGANIZATIONS INVOLVED

Texas Controls is a Spanish SME offering tightening and sealing solutions to large industrial facilities in a number of sectors. These are especially important to customers in the oil and gas industry, where it is imperative to avoid leaks in pipes, pressure vessels, or reactors that are under extreme pressures and temperatures. In these situations, preventing leaks is much less costly than dealing with consequences of one. It is crucial to be able to predict the behaviour of flanged joints, and to understand elastic interactions between them. Texas Controls has used computer simulations previously, however, the computational demands of modelling the behaviour of flanges were high, and so an HPC-based solution was necessary. This was the first time they had used such technology.

End User	Domain Expert	HPC Centre and HPC Expert
TexasControls	aimen TECHNOLOGY CENTRE	CESGA
www.texascontrols.com	www.aimen.es	www.cesga.es

THE CHALLENGE

To seal a joint properly, a gasket is placed inside a groove located on both flanges. The challenge here was to simulate and optimise tightening of the flanges - during the closing and tightening process, the gasket and the flanges may be damaged through deformations and high levels of stress. If the joint is damaged, it could fail, which could seriously harm workers, the surrounding community, and the environment.



The challenge of this case study was to simulate and optimise the tightening of flanges. This required the development of a computer model for simulating the tightening process and a front-end application to control the simulations in order to improve the design of the tightening process. The mechanical division of Texas Controls is the only engineering company in Spain specialising in tightening and sealing.

THE SOLUTION

A computer model was developed which represented all the functional parts of a flange, including the gasket and the tightening bolts. This model was driven by a user interface, which enabled different tightening scenarios to be evaluated. Using the model, Texas Controls could accurately simulate and improve the design of the tightening process. The model was implemented using both open-source and proprietary simulation codes. Several sizes of case studies were run.

EXPERIMENT #404 HIGHLIGHTS

Industry Sector:
Mechanical Engineering

Country: **Spain**

Software used:
code_aster

End Date:
December 2014

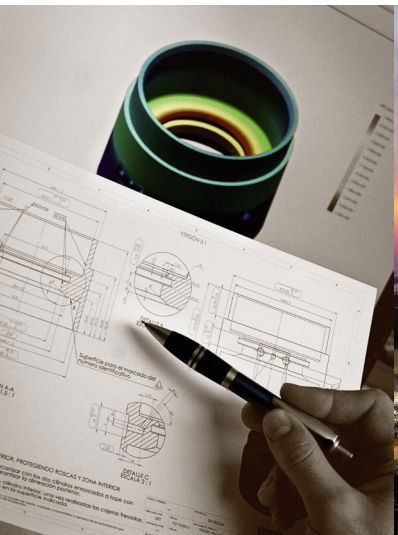
BUSINESS IMPACT

Based on previous experience in the field (when no simulations were carried out), a non-optimised tightening of a 24 stud bolt flange took 108 man-hours; using simulation, Texas Controls reduced the process to 72 man-hours - a 33% time saving per flange. Whilst this represents considerable savings in labour costs, the most important outcome is the reduction in downtime of industrial installations such as refineries.

The cost of "down time" for a medium-sized hydrocracker is about €21k per hour (€500k per day). Using advanced simulation, flange tightening can be reduced from 27 hours to 18 hours. This means a saving to the end-user of ~€180k, because the shutdown path is shortened by the same amount that the tightening process is optimized. HPC-based simulation also allows technicians to avoid damage to flanges during the tightening, which is not possible using the usual experience-based method. This can also have significant cost implications.

Texas Controls
Spain

These benefits give Texas Controls a significant competitive advantage in a highly technical industrial sector, which should result in winning major, international commissioning contracts. This is expected to result in an increase in revenue of €2 million over the next 3 years, and a related 15% increase in staff employed. Texas Controls has a range of other services where the use of cloud-based HPC tools have the potential to similarly enhance Texas Controls' competitive advantage.



FORTISSIMO

HPC Cloud-based design of high-voltage cables

ORGANIZATIONS INVOLVED

Prysmian Group is a world leader in the development and supply of energy and telecom cables and associated systems. Prysmian Group develops underground and submarine power cables in the energy sector, and medium- and low-voltage cables for the construction and infrastructure industry, and so need to model the physical behaviour of high-voltage power-transmission cables. Prysmian has a clear business requirement to scale-up its current simulations of energy cables and systems to a larger refinement and size, which exceeds the computing power available in-house. Prysmian would also like to undertake more ambitious simulations, requiring new competencies and tools. The demonstration of a successful, cost-effective cloud-based HPC simulation would be a breakthrough for Prysmian.

End User

Prysmian Group

www.prysmiangroup.com

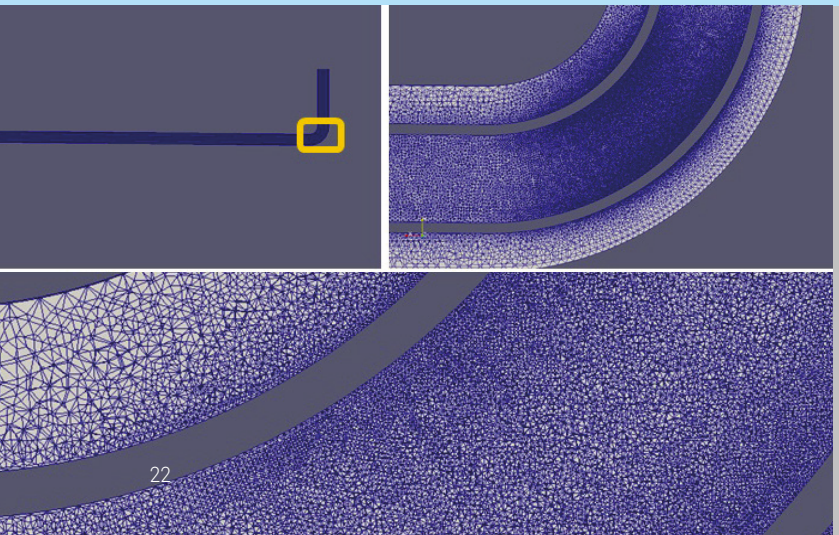
HPC Expert and HPC Service Provider

CINECA

www.cineca.it

THE CHALLENGE

Prysmian has used a standard modelling package for several years as its main tool for electromagnetic simulations, using 2D models on a few high-end workstations. However, finer simulations were needed, which were achieved using Cloud-based HPC to create a 3D model, and addressing how improved simulations could be exploited in a future business model. Another goal was to use open-source software in these simulations, to avoid expensive licences.



Both the third-party and open-source simulation packages have been ported to a Cloud-based HPC system. The resultant simulations have enabled Prysmian to improve the calculation of losses inside an energy cable, especially those induced by the magnetic field from the load current. They are also able to model better the heat transfer from the cable to the surrounding environment.

THE SOLUTION

Both the third-party and open-source simulation packages were ported to a Cloud-based HPC system. The resultant simulations enabled Prysmian to improve calculation of losses inside energy cables, especially those induced by the magnetic field due to the load current. Prysmian is also able to better model the heat transfer from the cable to the environment. This has improved their design capability significantly – 2D simulations have been replaced by much more realistic 3D simulations on the HPC system.

EXPERIMENT #405 HIGHLIGHTS

Industry Sector:
Electrical Engineering

Country: **Italy**

Software used:
COMSOL

End Date:
December 2014

BUSINESS IMPACT

The business benefits from the use of a Cloud-based HPC system arise from several sources. The move from the previous 2-D model to an advanced 3-D model enables much better cables to be designed. This allows Prysmian to retain the competitive edge needed to remain market leader with a time to market independent of the increase in complexity of the design process. The need for Cloud-based HPC simulation is of the utmost importance in this case study. Cloud-based HPC modelling has enabled better, more detailed simulations to be made in a shorter time. Running such simulations would not be feasible on a network of workstations, so previously Prysmian did not have this capability.

Prysmian Group
Italy

Prysmian estimates that the use of a Cloud-based HPC system instead of investing in an in-house system can provide savings of around 30% per annum in costs for cycles alone. This is based on the costs of the cycles needed to run the simulations in the HPC-Cloud compared with the costs of a suitable HPC computer system which would cost €150K, amortised over 3 years with additional annual operational costs of €40K. Further savings were also identified through the use of expertise on-demand at the computer centre rather than through the employment of a member of staff with the necessary expertise in simulation.

FORTISSIMO

HPC Cloud-based urban planning

ORGANIZATIONS INVOLVED

Founded in 1994, IES is an SME based in Scotland. IES develops the world's leading integrated building-performance modelling software system, designed to enhance building performance and create more sustainable buildings. The IES's Virtual Environment (VE) is a suite of tools based around a single integrated data model. IES provides leading-edge support for the design, construction and operation of some of the largest, most challenging buildings in the world. Based on its VE, IES has developed a planning tool for cities, which will enable stakeholders to assess the energy efficiency of a city, quality of living, etc. The tool can be used in cities just beginning the journey towards a 'smart' city, or those that are well on their way towards integration with 'smart' technologies.

End User, Application Expert and ISV

INTEGRATED ENVIRONMENTAL SOLUTIONS

www.iesve.com

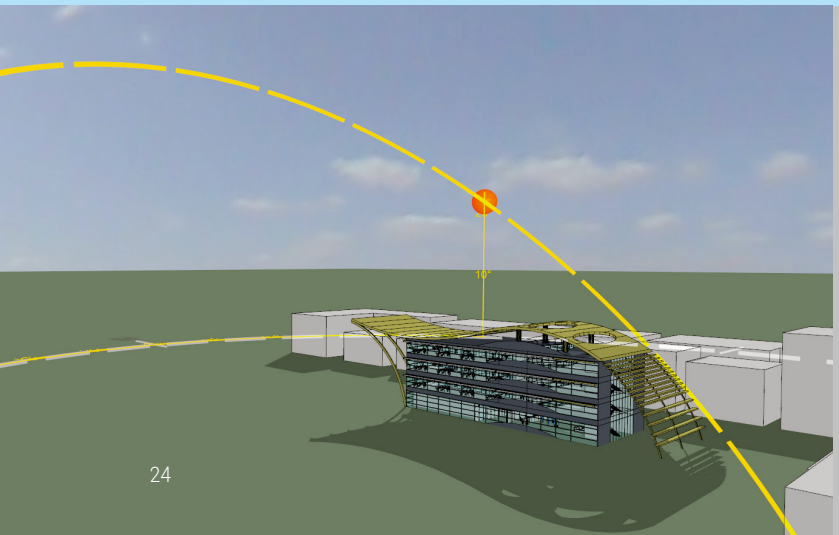
HPC Provicer and HPC Expert

epcc

www.epcc.ed.ac.uk

THE CHALLENGE

The purpose of IES's VE is to provide the information required to design, build and operate better performing, more sustainable communities. The planning tool based on the VE relies heavily on HPC cloud-based simulation, because of the amount of data generated by multiple buildings. A major objective here was to enable VE desktop installs and web-based interfaces to access calculation resources hosted on an HPC-cloud infrastructure.



Based on its VE, IES has developed a planning tool for cities, which will enable relevant stakeholders to assess, for example, the energy efficiency of a city, quality of living etc.

This tool relies heavily on the availability of HPC cloud-based simulation because of the very large amounts of data associated with multiple buildings and their interaction within the urban context.

THE SOLUTION

IES's planning tool addresses large simulations quickly and effectively through Cloud-based HPC, but uses a familiar workstation for data display. This case study has proved to be very significant for IES. Simulations run from personal workstations or company servers were often long and tedious, with the consultant having to wait for results to be available. A cloud-based HPC approach significantly decreased the run-time of simulations whilst substantially increasing the number of buildings per simulation.

EXPERIMENT #406 HIGHLIGHTS

Industry Sector:
Urban Planning

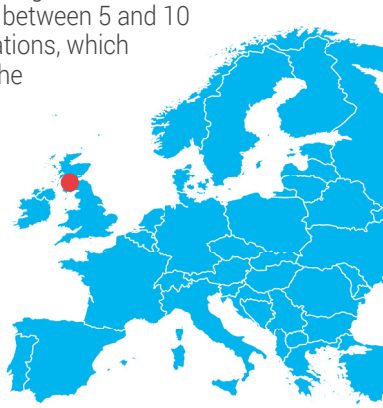
Country:
United Kingdom

Software used:
In-house code

End Date:
December 2014

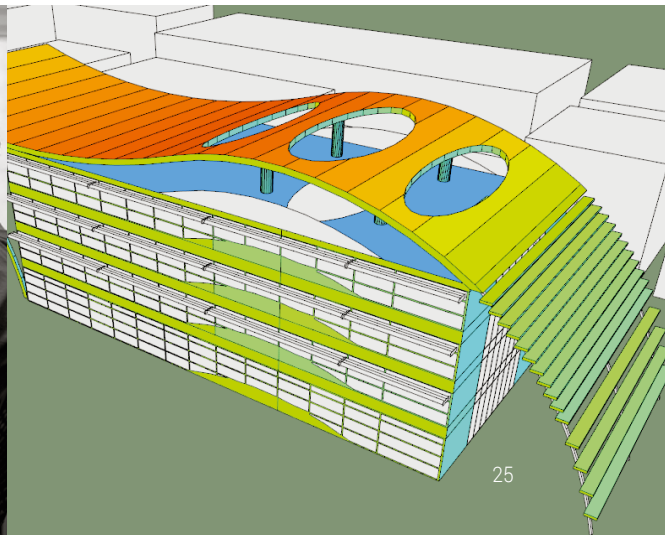
BUSINESS IMPACT

In this case study, model simulations ranging from the small to the very large were tested. Typical speedups (comparing the workstation to the HPC system) were between 5 and 10 times faster for the HPC system. The major benefit of this is that simulations, which previously had unrealistically long compute times of days or weeks on the workstation, could be run in a few hours or days using the Cloud-based HPC system. As IES's VE is used today by many of the world's leading architectural and engineering practices, this has clear commercial benefits. Indeed, based on the successful experiment, IES is now offering an HPC-based service to its customers. This service embodies a pay-as-you-go approach which is underpinned by HPC-systems available from EPCC, the HPC centre of the University of Edinburgh.



IES
United Kingdom

A 64-core in-house system costing £33k would have an annual running cost of around £22k (support, maintenance, electricity, housing, etc.). Amortised over three years, this gives a total cost per core hour of £0.10, compared with a cost of £0.05 for Cloud-based HPC cycles – already a 50% saving. Cloud-based HPC looks even more cost effective when it is considered that an in-house system would never be used continuously, and so would be even less competitively priced than this calculation indicates.



FORTISSIMO

HPC Cloud-based optimisation of aircraft wiring

ORGANIZATIONS INVOLVED

KEW, an SME founded in 2008, specialises in the optimisation of engineering-intensive projects in the manufacturing industry. In particular, KEW is active in the aerospace sector and has developed an application to optimise the routing of wiring within an aeroplane. This is an important issue in the design of aircraft, which traditionally has been addressed by trial and error. Although this problem can be tackled using computer models, applications to do this are very computationally intensive. SMEs generally do not have the available resources to buy and maintain the large computer systems needed to perform the necessary optimisations, nor do they have the required expertise to use such systems.

End User	Domain Expert	HPC Expert	HPC Centre
KE-works	noesis	CINECA	GOMPUTE
www.ke-works.com	www.noesissolutions.com	www.cineca.it	www.gompute.com

THE CHALLENGE

The challenge addressed by this case study was to adapt a wiring optimisation application from KEW to run on a Cloud-based HPC system, so that wiring layouts could be optimised in a feasible length of time, at an acceptable cost. This solution would involve computationally intensive simulations that could be run on a pay-per use basis, with significant savings over owning a system, and would offer sufficient resources to satisfy demand.

In particular KEW is active in the aerospace sector and has developed an application to optimise the routing of wiring within an aeroplane. This is an important issue in the design of aircraft which traditionally has been addressed by trial and error. This case study showed that an advanced wiring optimisation application would run 20 times faster on an HPC system compared to the current suboptimal simulation running on a workstation.

THE SOLUTION

The solution has involved porting the KEW optimization software to run on an HPC system and developing the necessary "glue" software to bring all the necessary software components together taking account of any software licensing issues. The successful implementation of this solution has enabled typical optimisations to be run on an HPC system much more quickly and effectively. It should be noted that this case study was the first time that KEW had used HPC in its wiring optimization.

EXPERIMENT #408 HIGHLIGHTS

Industry Sector:
Electrical Wiring

Country: **Netherlands**

Software used: **MORE**

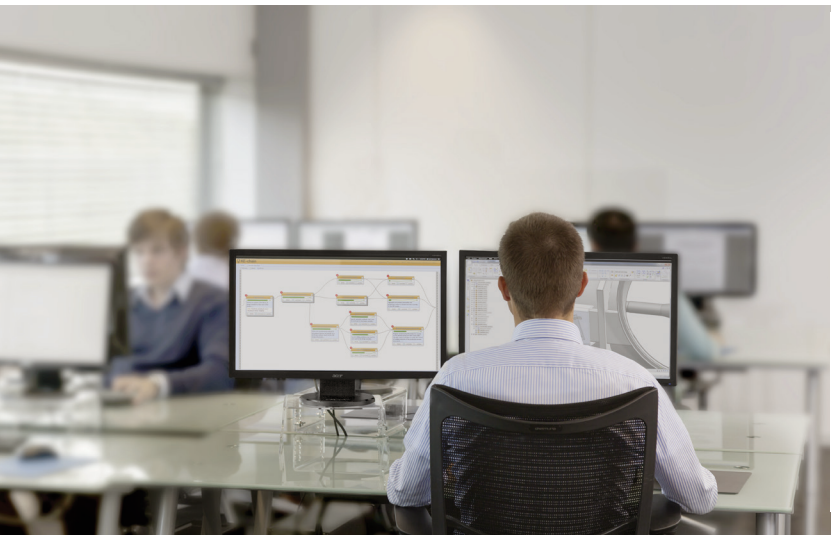
End Date:
December 2014

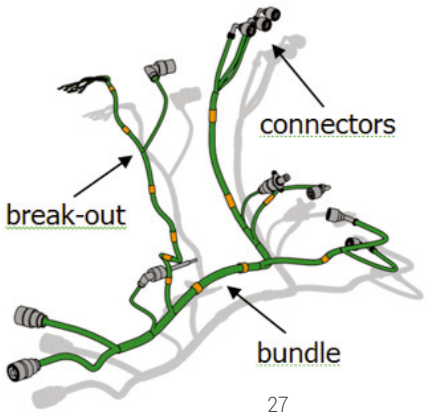
BUSINESS IMPACT

By using advanced simulations, KEW improved the quality of its designs, and reduced costs by 2.5% per design. Using Cloud-based HPC instead of in-house resources contributed to a reduction of 90% in the lead-time for the design of a single Electrical Wiring and Interconnection System, and an eight- to ten-fold reduction in computational costs. The impact of a single simulation may be very significant, as a single optimised wiring design may be used in hundreds of aircraft. The automated, optimised process running on a Cloud-based HPC system gave a 2.5% reduction in cost and weight of the wiring system. This is a recurring benefit, as all aircraft of the same type will utilise the same wiring design. As the aerospace industry has very fine margins, a 2.5% saving may increase profit margins by 50%. Saving one kilogram in the wiring may enable a 20kg reduction in overall aircraft weight, which will reduce fuel consumption over the aircraft's life.

KE-Works
Netherlands

The cost of computation on a Cloud-based HPC system is about €660 for a single design run, compared to an annual cost of an in-house HPC system of about €61K. Furthermore, a Cloud-based HPC system is much more flexible if more computational power is required. This demonstrates the feasibility and cost-effectiveness of using Cloud-based HPC for engineering simulations. SMEs are much more able to afford to use Cloud-based HPC, allowing them to compete better with larger organisations.





FORTISSIMO

HPC Cloud-based prediction of air quality

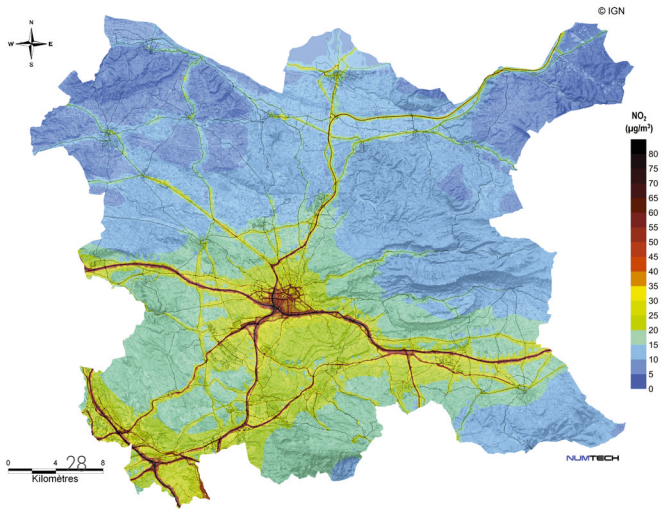
ORGANIZATIONS INVOLVED

Numtech is a French SME specialised in the development and use of innovative digital tools for air-quality and meteorological simulations. They are the market leader in France for modelling the weather and atmospheric dispersion. Its customers are mainly large companies, local and regional authorities, and research institutes. Numtech makes substantial use of the ADMS code from CERC in its business. European regulations on air-quality now require more and more testing and evaluation of pollution adaptation and reduction scenarios. Rather than evaluating 2 to 3 scenarios, consulting companies and regional air-quality agencies now need to evaluate tens of scenarios. This requires an increase in their capacity for computing, beyond what they can manage with in-house resources.

End User	Software and Domain Expertise Provider	HPC Providers and HPC Experts
NUMTECH	CERC	Bull atos technologies
www.numtech.fr	www.cerc.co.uk	www.bull.com

THE CHALLENGE

The challenge here was to demonstrate the use of Cloud-based-HPC services to investigate air-quality at city-scale. Running simulations using Cloud-based HPC would help to increase the numbers of scenarios which could be feasibly simulated in a given time, and reduce the computational time needed for simulations. The outcomes of using this system include shorter times for simulations and cost reductions, with resultant competitive advantages.



The challenge of this case study was to demonstrate the use of Cloud-based-HPC services to investigate air-quality at the scale of cities. This case study used the ADMS-Urban software from CERC running on the Extreme Factory HPC offering from BULL.

THE SOLUTION

This case study used the ADMS-Urban software from CERC running on the Extreme Factory HPC offering from BULL. ADMS-Urban was adapted to run on a Cloud-based HPC system. The results of the simulations were then made available via a familiar workstation environment. In doing this, an evaluation of the viability of this service on commercial HPC clouds has been carried out and possible business models for such a service have been proposed.

EXPERIMENT #410 HIGHLIGHTS

Industry Sector:
Urban Planning

Country: **France**

Software used:
ADMS Urban

End Date:
December 2014

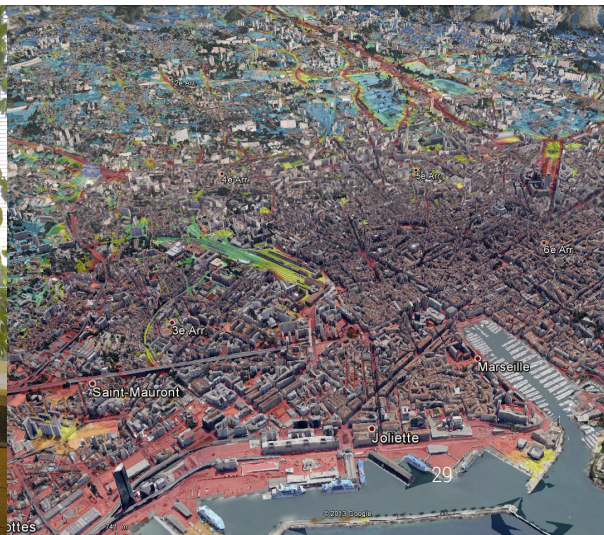
BUSINESS IMPACT

To offer a simulation service, CERC needs to source computer cycles, which means it either needs to own and maintain a sufficiently powerful HPC system, or it needs to buy cycles from an HPC centre. In the former case, a powerful enough in-house server would need to be purchased. Investigation shows that if the average time a server is in use falls below 40%, a pay-on-demand cloud service becomes a more economically viable option, compared with the costs to acquire and maintain that server. This depends on the mode of use, but buying cycles on demand offers considerable flexibility to SMEs looking to set up a service.

Numtech
France

As a result of this study, CERC can now offer the ADMS-Urban software as a cloud service on a pay-for-use basis, rather than requiring a customer to purchase an annual licence and run the software locally on workstations. This allows for an attractive pricing option for customers needing an infrequent use of the model.

Using Cloud-based HPC services, Numtech can save production costs of €125k over 5 years, which allows them to offer more competitive services. By recruiting new customers, Numtech's turnover is expected to increase by a total of €750k over the same time. Finally, the new capacity to launch multiple scenarios at reasonable cost using SaaS constitutes a new business model that will further increase NUMTECH's turnover by €150k up to 2020.



FORTISSIMO

HPC Cloud-based reduction of vehicle emissions

ORGANIZATIONS INVOLVED

AVL is the world's largest independent company in the development of powertrain systems for internal combustion engines and associated instrumentation and test systems, and has been working in partnership with companies all over the world for more than 60 years. The need for CO2 reduction, the increasing complexity of new powertrain systems, and a requirement to achieve the highest possible level of process efficiency are some of the key challenges facing the automotive industry now and for the foreseeable future. AVL provides its customers, many of which are SMEs, with a set of comprehensive simulation tools in a flexible and open environment enabling multi-disciplinary solutions as an integral part of the powertrain development process.

End User and Code Owner

AVL

www.avl.com

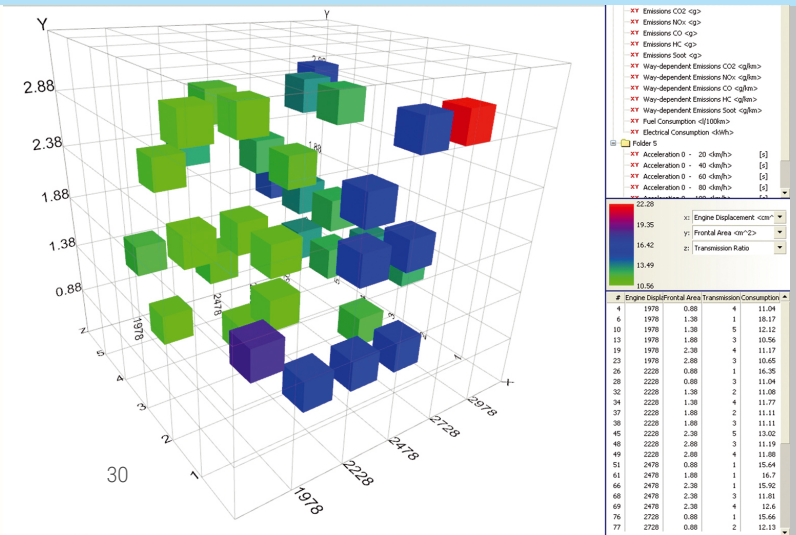
HPC Centre and HPC Expert

HLRS

www.hlrs.de/home/

THE CHALLENGE

This case study addresses the use of on-demand, Cloud-based HPC resources to tackle the important requirement for the reduction of CO2 emissions in the design of vehicles. The majority of projects in the area of vehicle optimization involve studies with large-scale variations in parameter and components on a limited palette of base vehicle models. These studies require high levels of CPU cycles on-demand.



#	Engine Displ	Frontal Area	Transmission	Consumption
4	1978	0.88	4	11.04
6	1978	1.38	1	18.17
10	1978	1.38	5	12.12
13	1978	1.88	3	10.56
19	1978	2.38	4	11.17
23	1978	2.88	3	10.65
26	2228	0.88	1	16.35
28	2228	0.88	3	11.04
32	2228	1.38	2	11.08
34	2228	1.38	4	11.77
37	2228	1.88	2	11.11
38	2228	1.88	3	11.11
45	2228	2.38	5	13.02
48	2228	2.88	3	11.19
49	2228	2.88	4	11.88
51	2478	0.88	1	15.64
61	2478	1.88	1	16.7
66	2478	2.38	1	15.92
68	2478	2.38	3	11.81
69	2478	2.38	4	12.6
76	2728	0.88	1	15.66
77	2728	0.88	2	12.13

The outcome of this case study has been to demonstrate the viability of on-demand computing resources in the design of powerchains with specific emphasis on the reduction of CO2 emissions.

THE SOLUTION

Providing sufficient computational resources to accomplish optimization tasks in an acceptable time-frame is a struggle faced not only by SMEs, but even by larger companies. The outcome of this case study has been to demonstrate the viability of on-demand computing resources in the design of powertrains with specific emphasis on the reduction of CO2 emissions. This solution involves the running of AVLs simulation codes on a Cloud-based HPC system where computer resources are made available on-demand.

EXPERIMENT #412 HIGHLIGHTS

Industry Sector:
Automotive

Country: **Austria**

Software used:
AVL CRUISE

End Date:
December 2014

BUSINESS IMPACT

The most clear cost benefit of using HPC-cloud resources is the possibility to lease a powerful computing cluster for single projects, instead of acquiring and maintaining in-house computational resources. These would likely be underutilized for most of the time, and may even not be sufficiently utilised to justify their cost when in use. Using a Cloud-based solution, taking into account all additional cloud overheads, short-term projects running millions of simulations on 400 cloud CPU cores for a period of a couple of weeks, several times a year, would run with costs reduced by up to 90% when compared to the total cost of ownership of a dedicated in-house system. This is the cost range where it becomes attractive for SMEs to participate in projects which require high CPU power for only a short time.

AVL
Austria

The results of using a cloud-based approach mean AVL are better able to offer their powerful simulation platforms to its clients. Given the breadth of the product space AVL and its clients occupy – among them diesel engines, electric drives, alternative fuels, control software, transmissions, and batteries - this should have significant economic and competitive advantages for AVL. AVL is now better able to go about its business, tackling the development of highly creative, mature and application-specific solutions for its customers in order to meet their market challenges.

FORTISSIMO

HPC Cloud-based simulation of hazardous chemicals

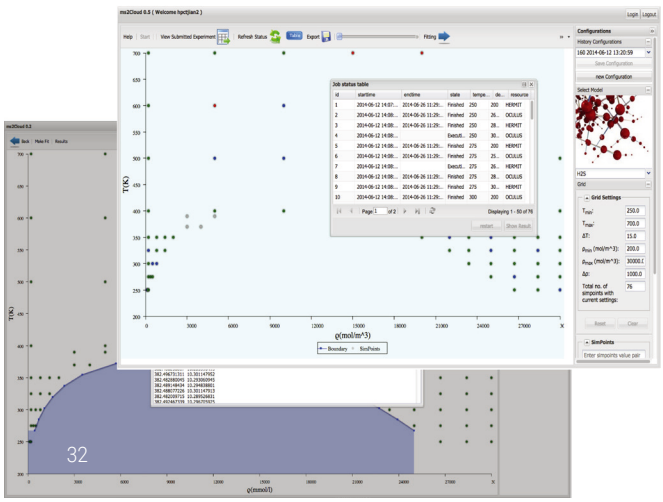
ORGANIZATIONS INVOLVED

Founded in 1897 in Switzerland, Lonza is one of the world's leading and most trusted suppliers to the Pharma & Biotech and Specialty Ingredients markets. A key part of Lonza's business is in distillation columns, whose operation requires a detailed knowledge of the thermodynamic properties of the target compounds. The chemical industry usually measures the required data experimentally, and this was previously how Lonza operated as well. However, when determining the properties of hazardous substances (explosive, toxic or mutagenic), computer-based simulations are a very attractive alternative to dangerous and expensive physical tests. Powerful predictive methods now exist that calculate the properties of compounds using simulation, but these require significant computing power.

End User	Domain Expert	HPC Centre and HPC Expert
Lonza	ThEt Universität Paderborn Die Universität der Informationsgesellschaft	HLRS
www.lonza.com	www.uni-paderborn.de	www.hlrs.de/home

THE CHALLENGE

In this case, the goal was to demonstrate the benefits of porting an existing third-party code to an HPC system. To determine a full set of physical properties for one compound, around 200 state points need to be calculated. Currently, a single state point calculation takes 20 hours on a 16-core workstation, so the total calculation would take up to 4000 hours - almost six months. Access to an HPC system would decrease this to a reasonable level.



Access to an HPC system decreased state point calculation time to a reasonable level.

Shortening the time needed to determine a compound's properties brings clear benefits to the design process.

THE SOLUTION

A detailed molecular-simulation code has been implemented on an HPC system driven by a simple, web-based user interface. Multiple simulations of state points can be initiated through this interface enabling the complete thermodynamic properties of a compound to be determined in a reasonable length of time. For example, whilst the calculation of a complete set of physical properties would take ~6 months on a 16-core cluster, the calculation time can be reduced to below 20 hours on an HPC system.

EXPERIMENT #414 HIGHLIGHTS

Industry Sector:
Chemical Engineering

Country: **Switzerland**

Software used: **ms2**

End Date:
December 2014

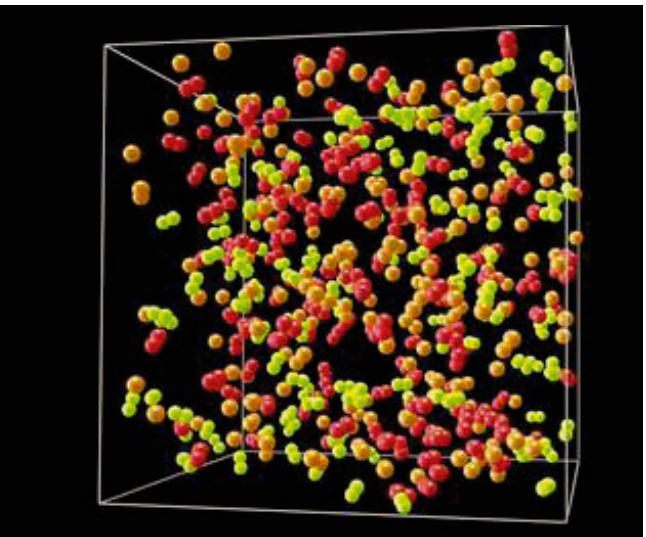
BUSINESS IMPACT

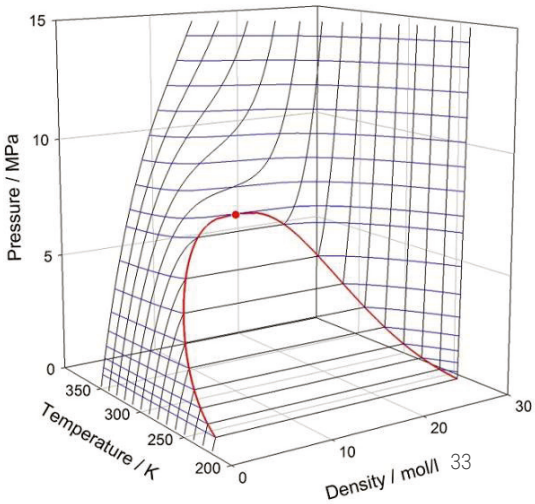
The use of simulation can bring massive savings to Lonza's production process. Shortening the time needed to determine a compound's properties brings clear benefits to the design process. It is also clear that the cost of cycles is much less than that of owning and maintaining a large HPC system in-house.

The cost to determine a single property of a single compound experimentally is approximately €2700. For a mixture of compounds, this cost increases significantly - 60 gas solubility data points of a binary mixture can cost up to €50,000. Compared to that, 60 molecular simulations covering the entire fluid region up to arbitrary high pressures will cost around €1,600, while for the mixture the cost usually doubles compared to a pure component, so €3,200. Not only does this represent a huge reduction in costs for Lonza, this also covers conditions that are difficult or impossible to test experimentally.

Lonza
Switzerland

A typical distillation column designed by Lonza costs around €1.5 million. This includes the design of a system to obtain all required physical properties through experimental measurements, costing €100,000 (100 staff days at €1,000). Using a modelling simulation, this cost would be only €13,600, saving €86,400 for a single distillation process, of which Lonza designs in excess of five per year. Given these figures, it is clear that HPC cloud-based simulation has considerable benefits for Lonza.





FORTISSIMO

HPC Cloud-based design of copper-alloy moulds

ORGANIZATIONS INVOLVED

Founded in 1959, IMR is an SME which designs and manufactures foundry equipment for brass alloys and bronze; the company also dedicated consulting services for designing moulds and other manufacturing processes. It is essential to ensure a laminar flow of liquid metal through the mould and a uniform cooling gradient, in order to avoid cracks and defects in the final piece. The success of this depends on the design of the mould; the quality of which usually depends on the experience of mould makers. Currently, the mould is often modified several times before committing to production. There are several commercial packages for the simulation of casting processes, but they have not been widely used in this sector.

End User

IMR E&T S.p.a. ENGINEERING & TECHNOLOGIES

www.imr.it

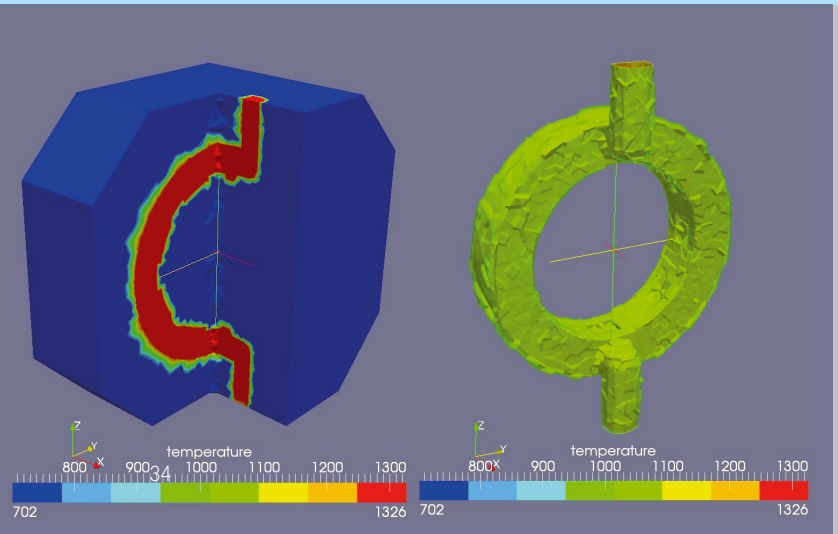
HPC Provider and HPC Expert

ARCTUR

www.arctur.si

THE CHALLENGE

In the past, IMR has tried to conduct simulations with commercial software, but never with HPC. The costs associated with purchasing dedicated casting software, the necessary hardware, and the training required are not viable for SMEs like IMR, whose normal activities do not require such an investment. They therefore wanted investigate how cloud-based simulations could improve the time to market and productivity.



The challenge of this case study was to demonstrate the benefits of simulation, in order to support the business decisions of the SME. A computer model to simulate the flow of copper alloys was developed based on an open-source software package. This model produces a reliable simulation, in a simple geometry, of the filling of a mould by the molten copper alloy at low pressure that keeps track of both the filling velocity and the thermal exchange between the mould and liquid metal.

THE SOLUTION

A computer model was developed, based on an open-source software package, which would simulate the flow of copper alloys. This model produces a simulation of the filling of a mould by the molten copper alloy at low pressure, and the reliability of the results were validated by comparison with physical tests. Using a Cloud-based HPC system, the time for simulations could be reduced from one day to 3 hours, which is a more acceptable time frame.

EXPERIMENT #415 HIGHLIGHTS

Industry Sector:
Casting

Country: **Italy**

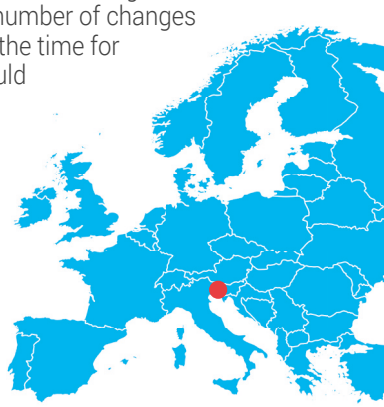
Software used:
Elmer FEM

End Date:
December 2014

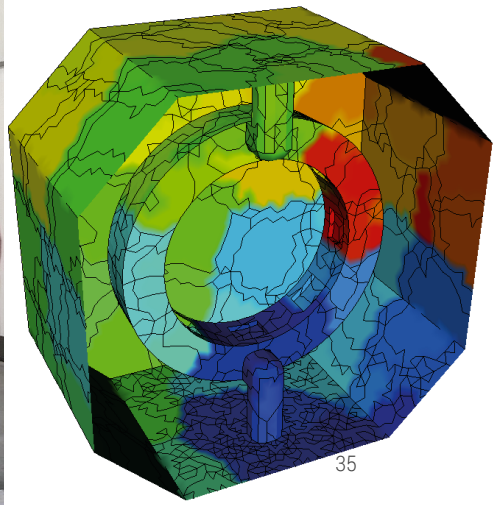
BUSINESS IMPACT

Although IMR had used simulation in the past, this was their first experience of using an HPC cloud-based system for simulations. The use of HPC reduced the number of changes required to the mould prototype during its design. This reduced by 20% the time for development of the mould and saved 20% of the cost of testing the mould before mass production can begin.

The average cost for the design and testing of a set of moulds for a new product based on the traditional, experience-based, trial-and-error method is currently about €41,000. The use of a Cloud-based HPC simulation method saves about € 8,000 per set and 3 weeks of testing and modifications. This includes all costs, such as set-up times and computing costs, not just design and testing. IMR has about 8 sets of moulds per year to develop, so this represents a total annual saving of €64,000. It aslo reduces the time to market of the moulds, so IMR may be able to produce more moulds per year, increasing their profitability. The ability to quickly and accurately design a mould, without the wastage of materials inherent in the trial-and-error method, will further increase their competitiveness in their business sector. Furthermore these simulations create the opportunity for IMR to offer its customers a new, HPC-based design service.



IMR
Italy



FORTISSIMO

HPC Cloud-based simulation of sports-car aerodynamics

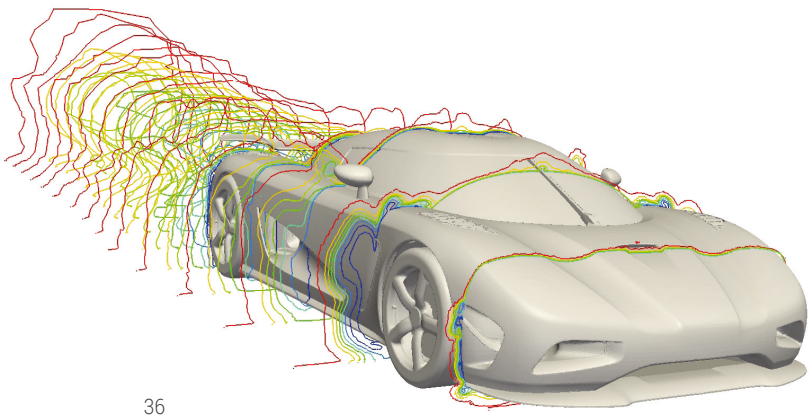
ORGANIZATIONS INVOLVED

Koenigsegg is a Swedish SME. Established in 1994, they are a leading designer and manufacturer of high-performance sports cars. In the development of these cars, intensive CFD simulations are carried out to reduce the cost of wind tunnel testing. Models are created which accurately replicate real-life cars, including all geometric details - such as rotating wheels and integrated components (including heat exchangers, fans and condensers). These models can be very large and complex, so the use of HPC can make a significant difference in how accurately a simulation can be conducted and how long it takes to complete. This case study was the first time that Koenigsegg had used HPC in the design of a hypercar, the One:1.

End User	ISV	HPC Expert	HPC Provider
Koenigsegg	icon		CINECA
www.koenigsegg.com	www.iconcfd.com	www.dit.hua.gr	www.cineca.it

THE CHALLENGE

There are two ways to determine how air flows over a car: wind tunnel testing and simulating air flow using Computational Fluid Dynamics (CFD). Wind tunnel tests are expensive and time-consuming, so are only used infrequently, but simulations can be used throughout the design phase. The challenge here was to show how cloud-based HPC resources can reduce the amount of required wind tunnel testing and show the cost-effectiveness of this approach.



The challenge facing Koenigsegg was to perform simulations of the flow over its hypercars which were sufficiently detailed to model real physical effects accurately.

Such simulations require suitable simulation codes and expensive computer resources, which are normally beyond the means of an SME.

THE SOLUTION

Before the start of this case study, Koenigsegg had only limited in-house computing resources and no experience in HPC-based CFD. Access to Cloud-based HPC allows simulations to run on a pay-per-use basis, which makes access to powerful computing resources financially viable for an SME, as well as reducing hardware and maintenance costs. The use of ICON simulation software on a Cloud-based-HPC system has enabled Koenigsegg to reduce or even, in some circumstances, avoid wind tunnel testing.

EXPERIMENT #417 HIGHLIGHTS

Industry Sector:
Automotive

Country: **Sweden**

Software used:
iconCFD

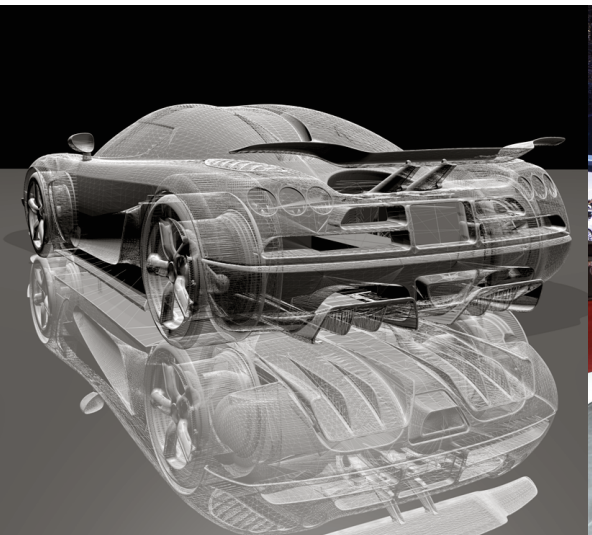
End Date:
December 2014

BUSINESS IMPACT

In this case study, 100% of the aerodynamic development of the Koenigsegg One:1 has been conducted using HPC-based CFD simulations. Koenigsegg were able to completely eliminate expensive wind tunnel tests thanks to the high fidelity of HPC simulations, allowing them to have confidence that the simulation results would transfer into real-world gains. In less than eight months, hundreds of simulations to test various configurations have been carried out. The results were an impressive 250% increase in down-force with only a 15% increase in drag at 250km/h and with a 50% higher down-force at 440km/h, the vehicle's maximum speed. Tests have shown that HPC-based simulation, supported by external software and expertise, led to a return on investment in less than three months for the production of a new car configuration. Significant costs can be saved and transferred to other critical parts of the development and production process.

Koenigsegg
Sweden

The benefits obtainable by the use of the Fortissimo HPC-Cloud can be quantified as a 5% saving in operational costs, a 30% saving in design costs, a reduction of 50% in wind tunnel and physical testing, a 60% saving in prototyping costs, and a 30% shortening of the time to market. Furthermore, savings in development were about €90K per year on the design process, a 1.5% reduction in overall development costs. These calculations take account of a computing cost on the Cloud-based HPC system of around €100K.



FORTISSIMO

HPC Cloud-based design of centrifugal pumps

ORGANIZATIONS INVOLVED

Founded in 1984, EnginSoft is a consulting SME operating in the field of computer-aided engineering, virtual prototyping and advanced simulation, including computational mechanics and fluid dynamics, numerical crash testing, and environmental engineering. EnginSoft has around 160 employees, 6 sites in Italy and 5 branch offices in Europe. In this case study, Enginsoft addressed the design of centrifugal pumps using advanced HPC-based simulation. Centrifugal pumps are widely used in many industrial applications, from oil & gas to water treatment, automotive and home appliances. Such devices may be required to operate over a wide flow range and the prediction of operating characteristic curves is essential for a designer.

End User

ENGIN SOFT

www.enginsoft.com

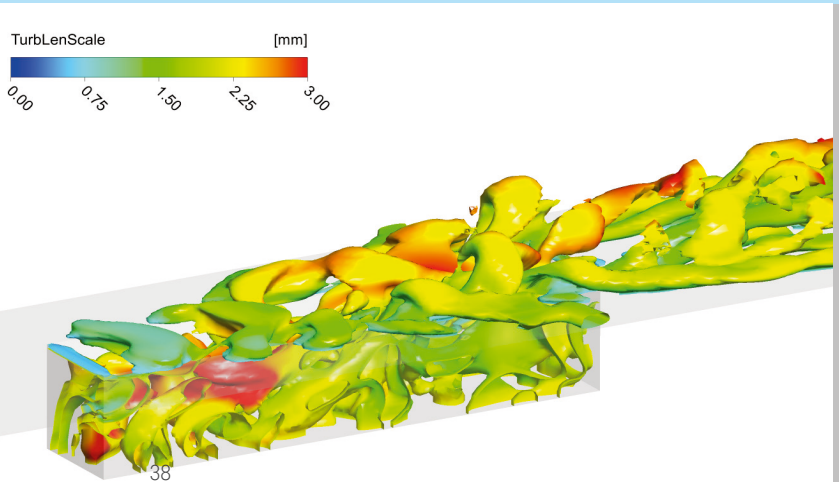
Computer Centre and HPC Expert

CINECA

www.cineca.it

THE CHALLENGE

Numerical simulation has become an important and common tool for pump designers. Many tasks can be solved faster and cheaper numerically than by means of experiments and, most important, the complex internal flows in water pump impellers can be predicted well. Performing the numerical simulations required would not be possible for a typical SME, which has neither the technical expertise nor the computing resources to carry out such a simulation.



The numerical simulation of centrifugal pumps is not easy due to a number of challenges: complex geometries, unsteady flows, turbulence, secondary flows, flow separation, boundary layers and so on. These aspects require a high-fidelity CFD model, very fine computational grids and the analysis of transient flows.

THE SOLUTION

A simulation model has been implemented on a Cloud-based HPC system for a centrifugal pump using a commercially available software package. This represents an attractive solution in terms of cost, effectiveness and relevance for those SMEs which do not have the resources to perform the necessary simulations on their own. The benefits of simulation using Cloud-based HPC system has been demonstrated through a series of experimental runs.

EXPERIMENT #418 HIGHLIGHTS

Industry Sector:
Turbomachinery

Country: **Italy**

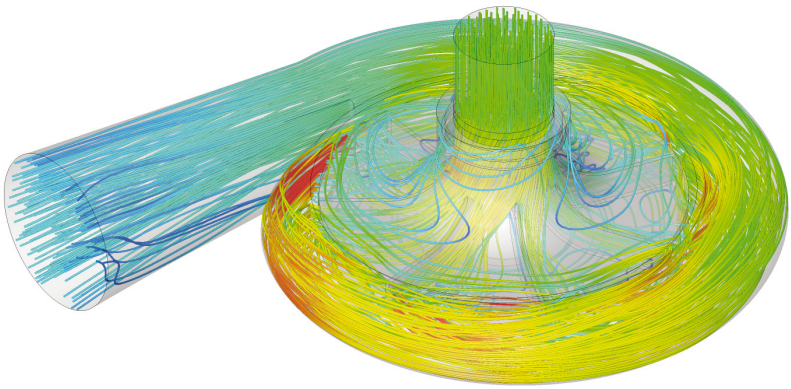
Software used:
ANSYS CFD

End Date:
December 2014

BUSINESS IMPACT

The test runs have shown that the use of HPC-based simulation using a combination of Cloud infrastructure and external expertise results in a return on investment in less than six months. The simulation of centrifugal pumps is not easy due to a number of challenges: complex geometries, unsteady flows, turbulence, secondary flows, flow separation, boundary layers and so on. Simulating these requires a high-fidelity CFD model, very fine computational grids and the analysis of transient flows. The design and optimisation of a single pump can thus take 2 to 3 years to complete. With the advantage of access to cloud-based HPC, this can be reduced to 6 months. The improved design process using simulations can give Enginsoft a significant commercial advantage, allowing them to design and test up to six different pump designs in the time it would take a competitor to perfect a single design. It can also offer these pumps at an extremely competitive cost thanks to the money saved: not only do EnginSoft not need to purchase and maintain costly dedicated computational resources, the increased efficiency of HPC-based simulations saves time, and therefore money, throughout the design process.. Due to this improvement in the design process, Enginsoft expects to increase its market share by at least 1% with a resultant profit of €100,000 per year.

Enginsoft
Italy



FORTISSIMO

HPC Cloud-based simulation of drifting snow

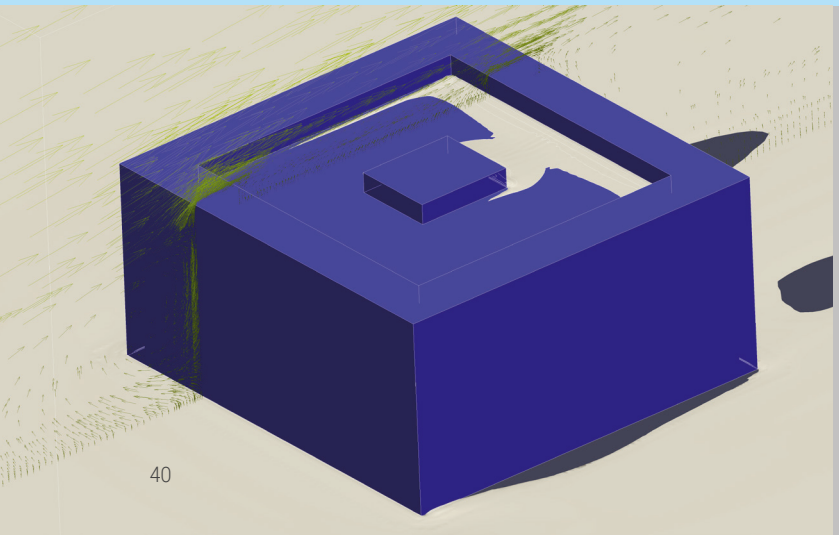
ORGANIZATIONS INVOLVED

Founded in 2005, Binkz is an SME whose business is consultancy, specialising in single and multiphase flows. Binkz provides state-of-the-art consultancy services using computational fluid dynamics (CFD) for applications such as wind engineering, process technology and aircraft icing. Binkz has developed the CFD program snowFoam. This program allows an accurate assessment of snow loads on buildings. The maximum snow load that may be accumulated on a building rooftop is an essential parameter in assessing the safety and stability of a building. When compared to existing alternatives, snowFoam is more accurate, more reliable and more versatile, but it requires the computational resources that only an HPC system can provide.

End User and Code Developer	HPC Expert	HPC Provider
BinkZ Inc.	VORTECH BV	SURF SARA
www.binkz.ca	www.vortech.nl	www.surfsara.nl

THE CHALLENGE

The overall challenge was to study the commercial feasibility of a CFD consultation service for assessing snow loads on buildings, employing snowFoam, to civil engineering firms on the Fortissimo HPC-cloud infrastructure. For the viability of such a consultancy service, it is essential that both the simulation time and the cost of the computation are acceptable within the framework of a typical CFD consultation project.



Every year, roof collapses due to accumulated and drifting snow are responsible for losses in the order of hundreds of millions of Euros as well as bodily injuries and loss of life. Binkz has developed the CFD program snowFoam. This program allows an accurate assessment of snow loads on buildings. When compared to existing alternatives, snowFoam is more accurate, more reliable and more versatile, but it requires the computational resources that only an HPC system can provide.

THE SOLUTION

This case study has shown that the simulation of drifting snow using snowFoam is feasible using a Cloud-based HPC system. Analysis can be completed within a few weeks, which fits well with the timescales for the design of buildings. In the solution developed here, the user has access to computing resources, storage, and visualization facilities from a desktop environment. The required computational resources needed and their costs are appropriate considering those for the overall design of a building.

EXPERIMENT #419 HIGHLIGHTS

Industry Sector:
Civil Engineering

Country: **Canada**

Software used:
OpenFOAM

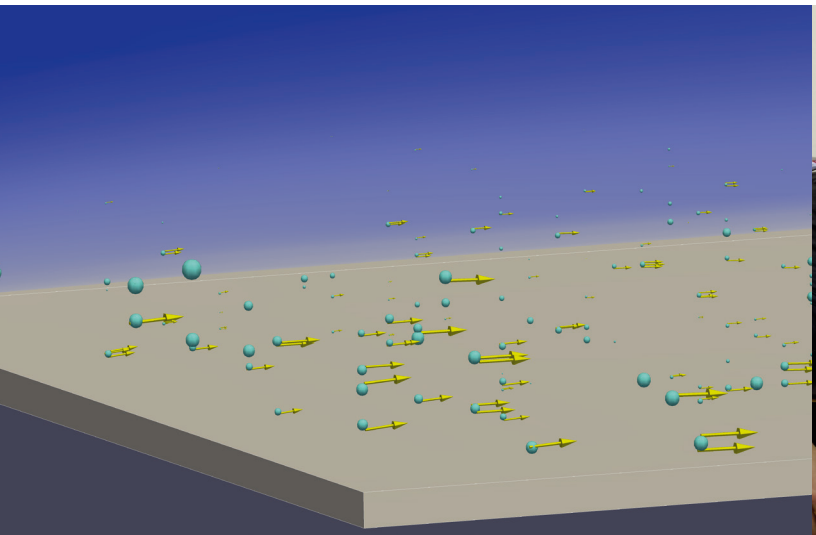
End Date:
December 2014

BUSINESS IMPACT

Every year, roof collapses due to accumulated and drifting snow are responsible for losses of hundreds of millions of Euros as well as bodily injuries and loss of life. This is a problem for all countries in Northern Europe and more generally in the Northern hemisphere. The maximum snow load that may be accumulated on a building rooftop is an essential parameter in assessing the safety and stability of a building. It is, however, hard to predict the maximum snow load when designing a new building. This leads to a costly over-design of the structure, which could be avoided if the snow load could be predicted with sufficient accuracy.

Binkz
Canada

The simulation of drifting snow requires significant compute resources, which can only be provided by a large HPC system. A typical simulation of drifting snow takes 50,000 CPU hours. This equates to 150 CPUs for 14 days. Furthermore, at a cost of €0.2 per CPU hour, this represents a cost of €10,000. A small consultancy at Binkz would not be able to afford the capital cost of a system containing 150 CPUs, neither could it use a smaller system in-house because the computation time would be much longer than the target two weeks. Even if Binkz were to buy a suitable system, then it would only be used for a fraction of the time and its overall costs would be much greater than the use of a Cloud-based system. Consequently, there is a clear benefit for Binkz in the use of a Cloud-based HPC system.



FORTISSIMO

HPC Cloud-based molecular modelling

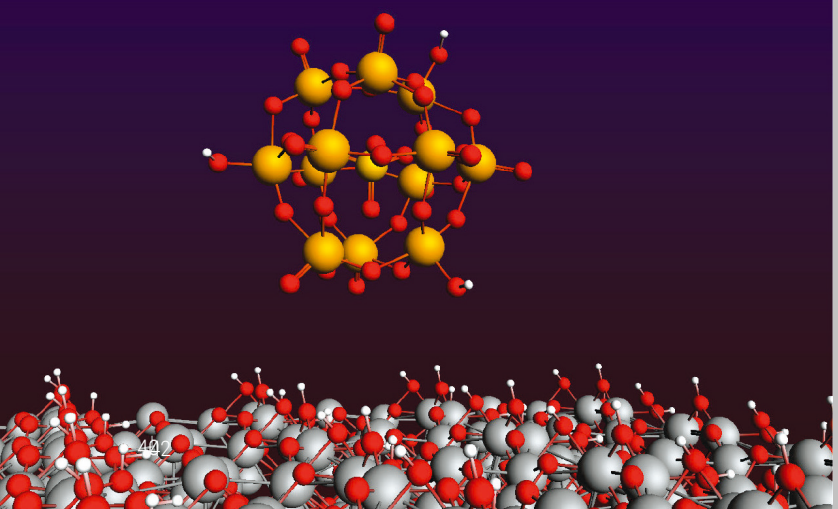
ORGANIZATIONS INVOLVED

The Albemarle Corporation is a global leader in the development, manufacture, and distribution of highly engineered speciality chemicals. It serves customers in approximately 100 countries in a wide range of sectors, including petroleum refining, automotive, transportation, pharmaceuticals, and food safety. Albemarle already uses HPC in the development of its products, however, it wants to improve its capability in this area through the use of CPU-GPU hybrid HPC platforms which offer significant benefits in terms of price-performance and power-performance. In order to take advantage of this, the simulation codes in use by Albemarle need some reprogramming.

End User	ISV	HPC Expert and Service Provider
ALBEMARLE®	SCM Scientific Computing & Modelling	SURF SARA
www.albemarle.com	www.scm.com	www.surfsara.nl

THE CHALLENGE

The challenge in this case was to port an existing simulation code for molecular modelling so that it would run on a hybrid HPC platform. To demonstrate the successful porting of this code and the benefits of using a hybrid HPC system, a test case was chosen from the petroleum refining sector which involved the use of catalysts in the removal of sulphur from vehicle fuels.



Molecular modelling is a proven powerful tool, providing key information for the design of new chemicals and materials.

THE SOLUTION

Molecular modelling is a proven powerful tool, providing key information for the design of new chemicals and materials. However, accurate molecular modelling requires significant computing power that even an SME with experience in HPC, such as Albemarle, would not have access to. The solution involved not only the porting of the simulation code for the target computer system, but also the development of a simple user interface to prepare the models and their submission to the HPC system.

EXPERIMENT #420 HIGHLIGHTS

Industry Sector:
Chemical Engineering

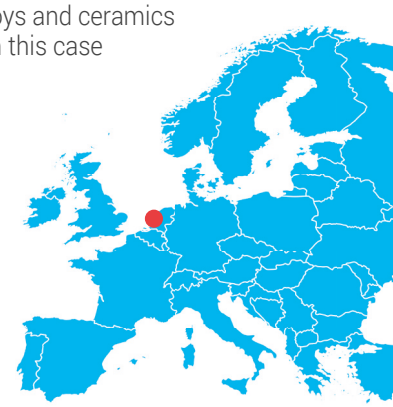
Country: **Netherlands**

Software used: **ReaxFF**

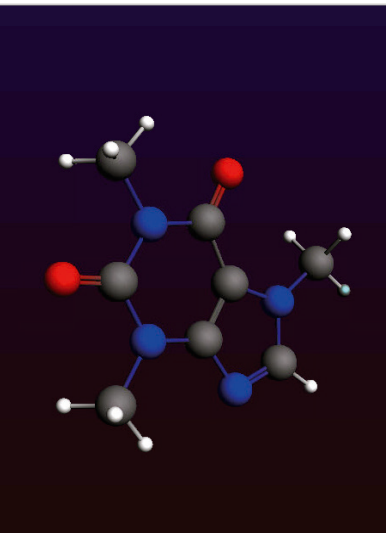
End Date:
December 2014

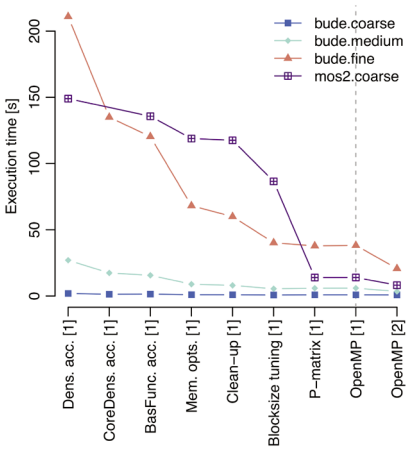
BUSINESS IMPACT

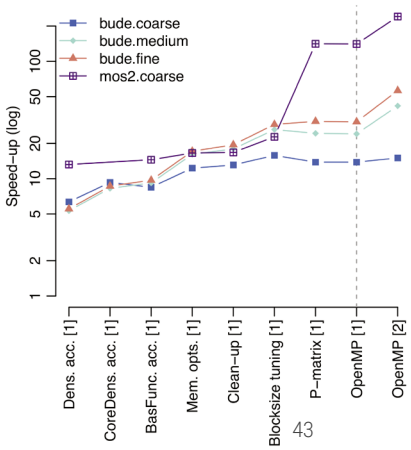
The software for modelling large-scale molecular systems has applications in sectors such as electronics, organic chemistry, food, paints, dyes, adhesives and alloys and ceramics for the aerospace industry. Modelling these systems is complex, and in this case required the use of a CPU-GPU hybrid system to provide the necessary computational power. This case study demonstrated a successful port of a molecular modelling software package to a hybrid HPC system, with resultant cost benefits. It was determined that, in this case, the annual costs for the use of a Cloud-based HPC system on a pay-per-use basis were approximately half that of owning and maintaining a sufficiently powerful in-house system, representing a yearly saving of €38,000. The ability to access powerful computing resources on a pay-per-use basis offers significant flexibility to SMEs who would not be able to access HPC in other ways. This allows them to develop and refine their product lines more efficiently, giving them a competitive advantage in their sectors. The results of this case study will benefit many SMEs, not just Albemarle, as the code developed in this case study can be offered to other companies wishing to perform detailed molecular simulations. As a result of this case study, Albemarle has allocated a significant budget for Cloud-based HPC computing for its next business year.



Albemarle Corporation
Netherlands







FORTISSIMO

Cloud-based map interpolation for civil engineering

ORGANIZATIONS INVOLVED

Sisener Ingenieros, a Spanish SME, is an engineering company whose main market is in energy projects, especially in the field of renewables. Projects undertaken by Sisener need accurate topographical information not only to determine the earthworks to be performed (which depends on intrinsic information, such as levels, slopes and volumes) but also for the overall design of the installation.. Ingeniería y Control Electrónico (Ingecon), a Spanish SME, develops and sells software for managing cartographic data. The objective of this experiment is to demonstrate how Cloud-based HPC can be used to convert and manage cartographic data across a range of formats and resolutions in order to improve the design process of wind farms and to reduce overall costs.

End User	HPC Expert	HPC Provider
SISENER INGENIEROS S.L.	Ingeniería y Control Electrónico, S.A.	CESGA
www.sisener.com	www.ingenieriaycontrol.es	www.cesga.es

THE CHALLENGE

Civil engineering projects need accurate cartographic data, requiring a map resolution of 1 metre or finer. Maps at this resolution are often unavailable, but can be created by applying a Kriging interpolation to existing maps. However, this is numerically intensive and typically requires HPC resources which are unavailable to SMEs. The challenge here was to create a solution using Ingecon's existing software that would be viable for Sisener.

Civil engineering projects need accurate cartographic data, requiring a map resolution of 1 metre or finer.

The use of HPC has reduced the processing times for wind farms to a few minutes and for other projects requiring greater resolution to a few hours.

THE SOLUTION

Ingecon has ported its software to run on an HPC system via a PC-based GUI. The use of HPC has reduced the processing times for wind farms to a few minutes and for other projects requiring greater resolution to a few hours. For the software vendor this is a scalable way to offer a new service to customers. Civil engineering companies save time and money because data acquisition times are reduced and expensive data gathering can be replaced by cheaper, quicker numerical interpolation.

EXPERIMENT #501 HIGHLIGHTS

Industry Sector: **Renewable Energies**

Country: **Spain**

Software used: **In-house code**

End Date: **March 2016**

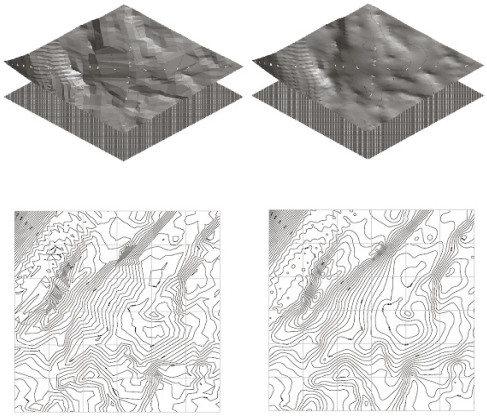
BUSINESS IMPACT

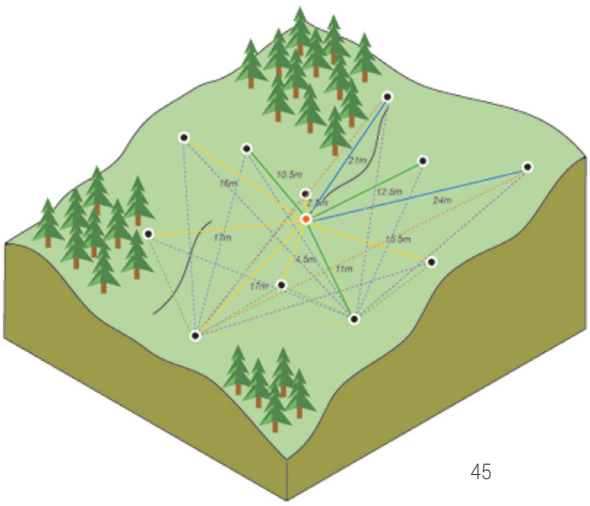
Ingecon sees this as a major opportunity to provide a new service not only in the design of wind farms, but also in other application areas where cartographic data is used. For a company like Sisener, the costs of a yearly software licence and a powerful enough computer to perform the necessary computations are prohibitive. However, a pay-per-use service where computing costs and software licensing are available, would be a very attractive proposition for all parties.

Sisener Ingenieros
Spain

The major benefit for Sisener is a reduction in the cost of map data. Through the use of interpolation, as opposed to buying raw data, the cost of a typical design can be reduced from €4k to €2k taking staff effort and computing costs into account. A company like Sisener will be involved in around 25 such projects per year, so annual savings amount to €50k.

Ingecon already has two further companies testing this solution and expects to engage 10 companies by the end of 2016. Based on data from Eurostat, there are over 350,000 potential customers across the EU for the proposed service from Ingecon of which 40,000 are based in Spain. Ingecon estimates a yearly income from this service at €200 per customer with 200 customers by 2018 and a 1% share of the European market (3,500 customers and a revenue of €700,000) by 2020.





FORTISSIMO

Advanced simulation of electromagnetic effects

ORGANIZATIONS INVOLVED

SEEMI is a French SME which develops solutions for product packaging and transport. The devices it builds are often found in environments with significant electromagnetic fields, which can lead to serious malfunctions in equipment. Electrical devices play a major role in all types of automated and embedded systems. Cables, both shielded and non-shielded, have become a major issue in terms of safety, weight, performance, power consumption, cost and reliability. It is essential to verify during the design stage that cables are not susceptible to external electromagnetic effects, and to shield from any potential interference. Simulation has become mandatory in making such decisions. The customers for products designed by SEEMI are major national and international groups.

End User	HPC Expert	ISV	HPC Provider
www.seemi.com	www.inria.fr	www.algotech-informatique.com	www.bull.com

THE CHALLENGE

Algo'Tech has developed an electromagnetic simulator running on a PC to simulate small and medium-sized problems for customers. This approach allows SMEs, such as SEEMI, to reduce the design time and costs of electrical networks used in the packaging and other sectors. For larger installations, computing on a PC becomes too time-consuming to meet user requirements, as thousands of calculations are needed to cover a range of common frequencies.

An HPC Cloud-based electromagnetic simulator running on a PC reduced the design time and costs of simulations of small and medium-sized problems for customers.

Algo'Tech now offers a pay-per-use electromagnetic-design service to its customers which enables them to carry out large-scale simulations as needed.

THE SOLUTION

The solution developed here provides seamless access to their code, running on an HPC machine, from a PC. Cloud-based High Performance Computing (HPC) has dramatically reduced the computation time for complex electromagnetic simulations from hours to seconds, and is now an essential tool for simulating the complex electromagnetic behaviour of equipment. Algo'Tech now offers a pay-per-use electromagnetic-design service to its customers which enables them to carry out large-scale simulations as needed.

EXPERIMENT #502 HIGHLIGHTS

Industry Sector: **Electrical Engineering**

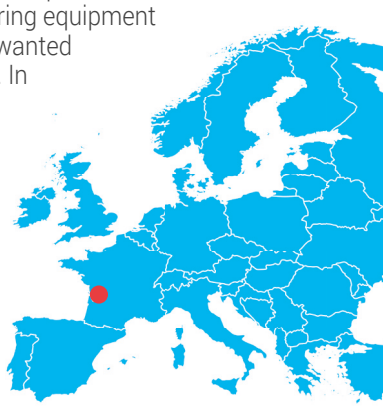
Country: **France**

Software used: **Gramat**

End Date: **March 2016**

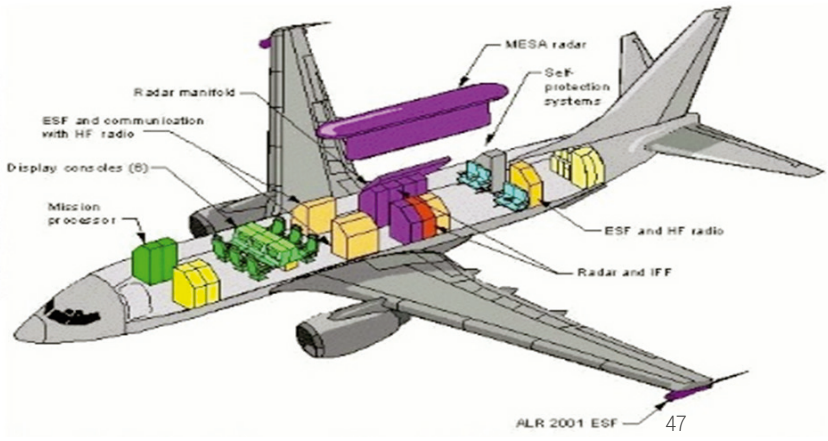
BUSINESS IMPACT

The cost-benefits of simulating the electromagnetic behaviour of devices depends on where they are deployed. For example, an electromagnetic issue in manufacturing equipment has cost implications, but may present no danger to life. In contrast, unwanted electromagnetic effects in a vehicle may constitute a significant danger. In the former case, the value of a simulation can be estimated at 1% of the cost of the risk. In the latter case, the value of a simulation can be much greater because the cost of the risk is much higher. The market price for a small-scale simulation of the electromagnetic behaviour of a device is around €240. This cost can be broken down as follows: €200 for Algo'Tech to cover licence fees; and €40 to the computer centre for the cost of cycles. For a larger simulation the market price is €1,750: €1,500 in licence fees; and €250 for the cost of cycles.



Seemi
France

For the end users, the cost of electromagnetic issues, detected during the installation phase on customer premises, would be between tens to hundreds of K€. This compares favourably with the corresponding costs and benefits of simulation. As a result of the new service it can offer, Algo'Tech expects to see an increase of 10% in licence revenue and for HPC-based simulations to constitute 20% of its overall business. Overall, it expects an annual growth in its revenue of around 8% as a result of its new HPC-based, electromagnetic-simulation.



FORTISSIMO

Advanced simulation of metal casting

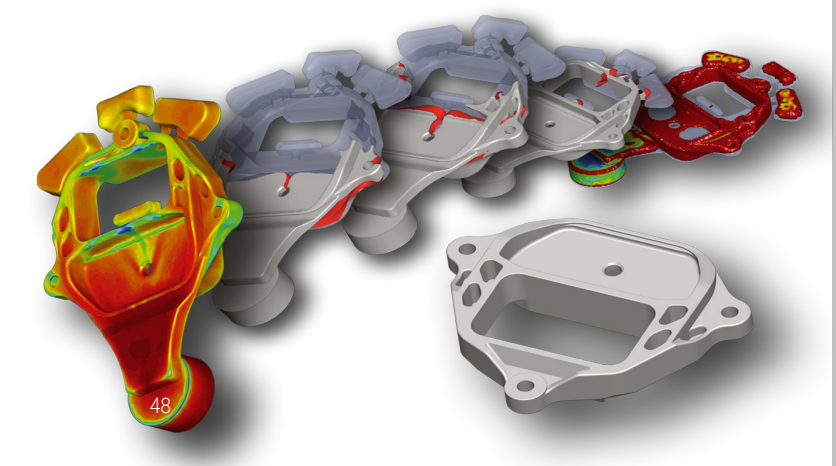
ORGANIZATIONS INVOLVED

Fundiciones de Roda is a Spanish SME specialising in the casting of grey and ductile cast iron. To save time and money, foundries need advanced simulation to detect metal casting defects as soon as possible, but, like many other SMEs in this sector, Fundiciones de Roda finds the advanced simulation of its casting process prohibitively expensive because of the costs of software licences and of computer hardware. Quantech is an ISV which develops and markets the software package Click2Cast, which simulates the casting of a range of metals including aluminium, steel, brass and copper. The software is able to simulate a range of components such as automobile and aerospace components, hydraulic valves, turbine disks, impellers and flanges.

End User	HPC Expert	ISV	HPC Provider
Fundiciones de Roda	CIMNE	QUANTECH ATZ	CESGA
www.fundicionesderoda.es	www.cimne.com	www.quantech.es	www.cesga.es

THE CHALLENGE

Many SMEs in the casting industry are reluctant to use advanced simulation software because of the high costs of software licences and of access high-performance hardware. Here, a service was developed based on Quantech's Click2Cast package which offers SMEs such as Fundiciones de Roda an affordable, pay-per-use option for simulating casting processes accurately and quickly and without the need for detailed specialist knowledge.



To save time and money, foundries need advanced simulation to detect metal casting defects as soon as possible.

A service was developed which offers SMEs such as Fundiciones de Roda an affordable, pay-per-use option for simulating casting processes accurately and quickly and without the need for detailed specialist knowledge.

THE SOLUTION

Click2Cast has been ported to a High Performance Computer system available via a Cloud infrastructure. Access to this application has been made available as a pay-per-use service which enables even inexperienced users access to advanced simulation via a simple click-based interface. Click2Cast tackles 90% of all casting techniques including High Pressure Die Casting, Gravity Casting, Low pressure Die Casting and Tilt Pouring.

EXPERIMENT #503 HIGHLIGHTS

Industry Sector: **Casting**

Country: **Spain**

Software used: **Click2Cast**

End Date: **March 2016**

BUSINESS IMPACT

The use of Click2Cast simulation service supported by an HPC-Cloud enables a foundry to determine the most efficient casting technique quickly and optimise its configuration. In this way, the weight of casting systems can be reduced as much as possible. In particular, the use of a service that simulates the completed metal casting processes can significantly save time and money in the development of new types of moulds, because defects in the casting process can be detected at design time and before expensive prototyping.

A pay-per-use service such as that now offered is a very attractive option for SMEs in this sector. Through the use of an HPC Cloud-based service, design times can be significantly reduced by up to 60% - from a week to a couple of days. Through the use of the Click2Cast service Fundiciones de Roda can reduce its annual design costs by €3,200. Furthermore, because of an increase in productivity, it expects to increase its annual revenue by €20,000.

Fundiciones de Roda
Spain

Quantech now offers the only casting design and simulation pay-per-use service in the market. Over the next 5 years, the growth in its business is estimated to be 40%, with a total of approximately 500 new customers by the third year. The additional profit for Quantech per customer is estimated to be €1,000 per annum.

FORTISSIMO

Simulation of airflow in concentric chimneys

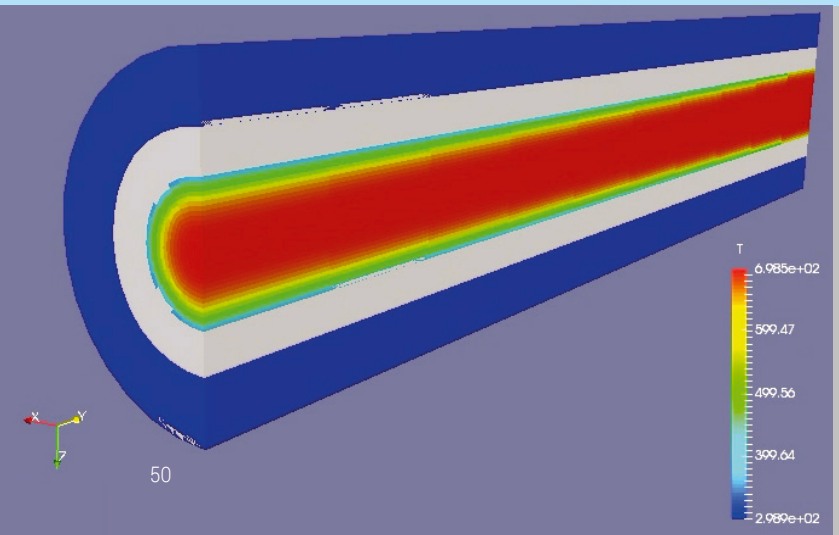
ORGANIZATIONS INVOLVED

DINAK is a Spanish SME that specialises in designing, manufacturing and installing domestic and industrial chimneys and ventilation systems. In order to improve its capabilities and be competitive in a global market, DINAK needs to optimize its chimney designs to reduce CO2 emissions and be more energy efficient. The design process involves many variables, so physical testing is not feasible on the grounds of cost and time. DINAK thus needs a simple and powerful tool to analyse and test the design of exhaust chimneys, help them to improve the design of concentric chimneys, and gain understanding of the exhaust processes. To reduce design times to reasonable levels, High Performance Computing (HPC) has become an essential component in the development of such a design tool.

End User	HPC Expert	Application Expert	HPC Provider
DINAK	UNIVERSIDADE DA CORUÑA	aimen TECHNOLOGY CENTRE	CESGA
www.dinak.com	www.gac.udc.es	www.aimen.es	www.cesga.es

THE CHALLENGE

In a building with stoves, chimneys need to be installed to ensure proper ventilation, and poorly designed chimneys can cause incomplete combustion. Reducing emissions requires designing new, optimised chimneys, and simulation plays an important role in the design process. There are many complex variables involved in the optimization of the design of a chimney, and physical tests are generally too expensive and time-consuming to conduct.



There are many complex variables involved in the optimization of the design of a chimney, and physical tests are generally too expensive and time-consuming to conduct.

A reliable HPC-based simulation was implemented to allow DINAK to shorten the design process down to a single week.

THE SOLUTION

A reliable HPC-based simulation, based around the open-source Open Foam package, was implemented to allow DINAK to shorten the design process down to a single week. A user interface provides the ability to explore the design space in a systematic way, improving the quality of the resulting designs. This experiment, successfully validated against commercial software and experimental data, has demonstrated that the design of concentric chimneys using HPC-based simulation resources is feasible and accurate.

EXPERIMENT #505 HIGHLIGHTS

Industry Sector: **Energy**

Country: **Spain**

Software used: **OpenFOAM**

End Date: **October 2016**

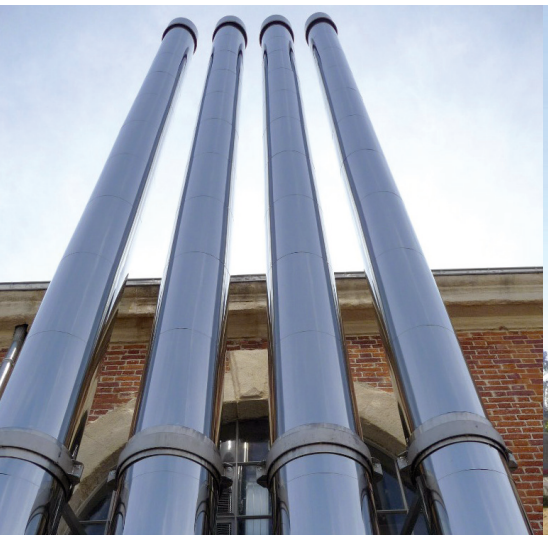
BUSINESS IMPACT

HPC simulation has enabled DINAK to accelerate and optimise the design of concentric chimneys, allowing them to increase their competitiveness and enter new markets. In the past, the first company to market with a new chimney design could expect to increase their market share by up to 10%. Currently, DINAK develops around 3 to 4 new products per year, and this advantage would increase its turnover by approximately €100K.

Before this experiment, DINAK required approximately a month for the design and testing of a new chimney. The cost of a single chimney design was €13,400 - 3 specialist engineers for 1 month (€9,300), 1 craftsman for 1 month (€2,100) and prototype costs of €2,000. HPC simulation reduced this time to 1 week, and costs reduce to €1,140 - 1 week of an engineer's time (€900) and computing costs of €240. This gives DINAK a saving of over €12,250 per design, and the optimised design enables DINAK products to pass CE Mark tests with a zero failure rate. Previously there were 1 to 2 failures per year resulting in additional operating costs of around €6,000.

DINAK
Spain

Based on experience gained in this experiment, UDC is planning to offer, via the Fortissimo marketplace, a consultancy service to develop web interfaces for cloud-based applications. AIMEN will be able to offer consultancy services in the Marketplace based on OpenSource modelling. CESGA will increase its sales of computer cycles by around 10,000 CPU hours per year.



FORTISSIMO

High-Performance gear analyzer

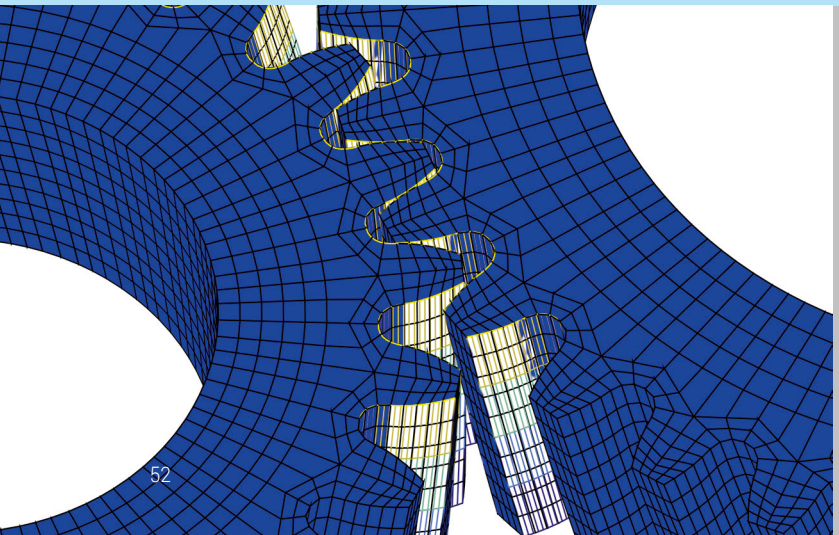
ORGANIZATIONS INVOLVED

VE&D is an SME which has been working in the field of automotive engineering for over 50 years, providing design services to its industrial partners. In particular, it has been involved in designing gearboxes for large companies such as Piaggio. Italy has a large number of gear manufacturers, many of whom are SMEs, operating in the areas of gear production, gear design and gearbox manufacture. The objective of this experiment was to develop an HPC-Cloud-based High Performance Gear Analyzer (HPGA) using advanced software and high-performance computing resources which would allow SMEs such as VE&D to benefit from the most advanced methods for gear analysis and design.

End User	HPC Expert and Provider	Application Expert and ISV
Vehicle Engineering & Design	CINECA	UNIMORE Università degli Studi di Modena e Reggio Emilia
www.veandd.eu	www.cineca.it	www.unimore.it

THE CHALLENGE

A typical SME gear designer is generally an expert in gears and traditional design tools. They usually have only a basic knowledge of software for structural analysis, and limited awareness of specialized applications. The challenge here was to support the design of reliable and efficient gears using cloud-based advanced simulation, without the need for significant investments in computational resources, expensive software licences and training.



The challenge here was to support the design of reliable and efficient gears using cloud-based advanced simulation, without the need for significant investments.

The HPGA software was developed, that appears as a simple user interface with standard gear datasheets, menus for the creation of gear geometry and checking for data coherence, performance analysis and optimization, and the presentation of results.

THE SOLUTION

The research group of UNIMORE, the ISV partner in this experiment, developed several computational tools for gear analysis and optimization. It became clear that HPC Cloud technologies would be needed to create a tool for design engineers with an appropriate time to solution. The HPGA software appears as a simple user interface with standard gear datasheets, menus for the creation of gear geometry and checking for data coherence, performance analysis and optimization, and the presentation of results.

EXPERIMENT #506 HIGHLIGHTS

Industry Sector: **Automotive**

Country: **Italy**

Software used: **MSC Marc**

End Date: **October 2016**

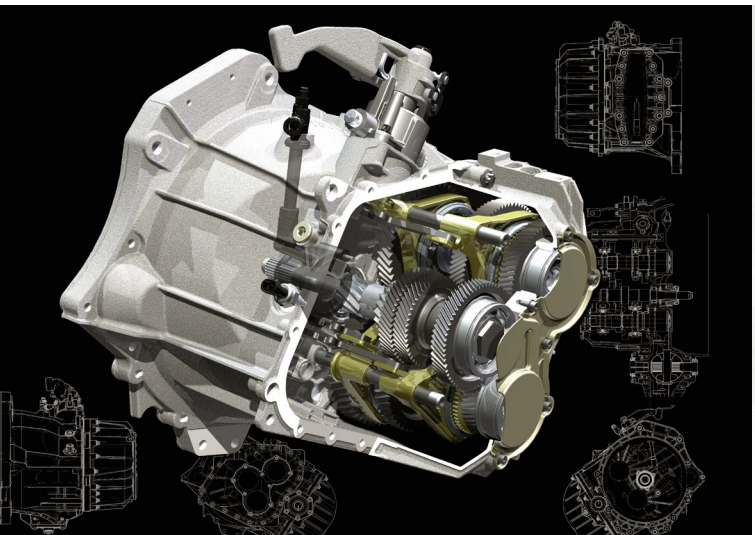
BUSINESS IMPACT

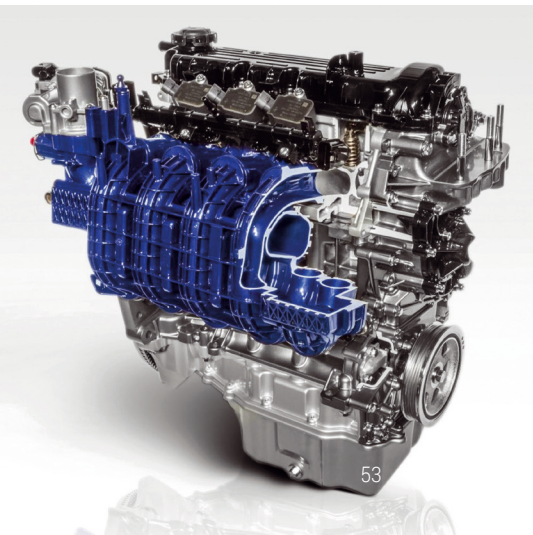
The current yearly costs for VE&D to simulate gears in-house are approximately €160K: €10K for software licences; €88K for staff costs, computer hardware costs of between €20K to €40K and other costs (administration, personnel and security) of €32K. The yearly costs for VE&D to simulate gears using HPGA via Cloud-based HPC are approximately €143K: €10K for the use of HPGA (licence and computing costs included); €25K for computer hardware, €79K for staff costs and other costs of €28K. VE&D will see an annual saving of €17K as a result of using HPGA via cloud-based HPC. Given that there are a significant number of SMEs, which design gears, this represents a substantial saving across this sector.

VE&D
Italy

A further benefit is that HPGA enables tooth contact analysis, which is more refined than that currently performed by VE&D. The market is going to increasingly require this kind of analysis. Having this capability is expected to increase VE&D's market share.

For the ISV UNIMORE the benefits of HPGA will be twofold. Firstly, there will be a direct increase of contracts related to the design of mechanical transmissions, starting from the actual turnover of about €20K per annum in 2017 rising to €100k per annum after 5 years. Secondly, the reputation of UNIMORE will rise leading to a subsequent increase in collaborative research projects.





FORTISSIMO

Simulation of laser-based welding in the automobile and machine tool sectors

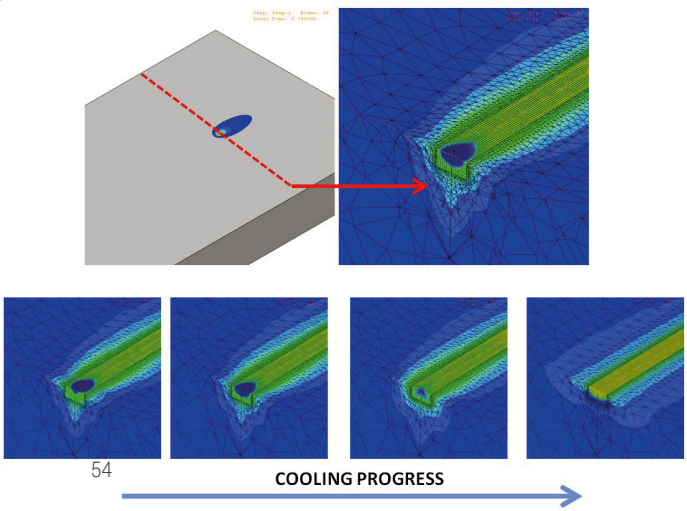
ORGANIZATIONS INVOLVED

Lasersystemtechnik Bollinger & Ohr (LBO) is an SME founded in 1999, specialising in laser-welding technology. Many of the components of automobiles and machine tools are welded, and these welds can suffer thermally-induced stress during manufacture. This can result in flaws which may affect the durability of components. Traditionally, testing of welds involves the cutting, polishing and sanding of samples to obtain micro-sections, but this is expensive and destroys the piece being inspected. Simulation of the welding process on an HPC system would dramatically reduce the time to assess and optimise a particular weld, thus avoiding expensive prototypes.

End User	HPC and Application Expert, ISV	HPC Provider, Expert and Host Centre
LASERSYSTEMTECHNIK Bollinger & Ohr	Lauer & Weiss Engineering	HLRS
www.lasersystemtechnik.de	www.lauer-weiss.de	www.hlrs.de

THE CHALLENGE

Simulations allow companies avoid costly physical prototypes and the speed-up of the development cycle. However, there are few, if any, simulation tools to model welding processes, because they are highly complex and difficult to observe. Accurate simulations require significant computing power due to the non-linear behaviour of materials and the highly transient conditions, and SMEs cannot afford the necessary computer hardware.



Welding processes are highly complex and difficult to observe.

A simulation of laser-welding processes has been developed. The accuracy of this methodology has been positively assessed through the physical inspection of welding samples. This confirms that simulated welds accurately model real-world cases and that expensive physical prototypes can be eliminated.

THE SOLUTION

Lauer & Weiss (L&W), an expert in the development of software solutions for the automobile and machine tool industry, has developed a simulation of laser-welding processes based on the commercially available ABAQUS package. The accuracy of this methodology has been positively assessed through the physical inspection of welding samples in cooperation with LBO. This confirms that simulated welds accurately model real-world cases and that expensive physical prototypes can be eliminated.

EXPERIMENT #507 HIGHLIGHTS

Industry Sector: **Laser Welding**

Country: **Germany**

Software used: **Abaqus**

End Date: **October 2016**

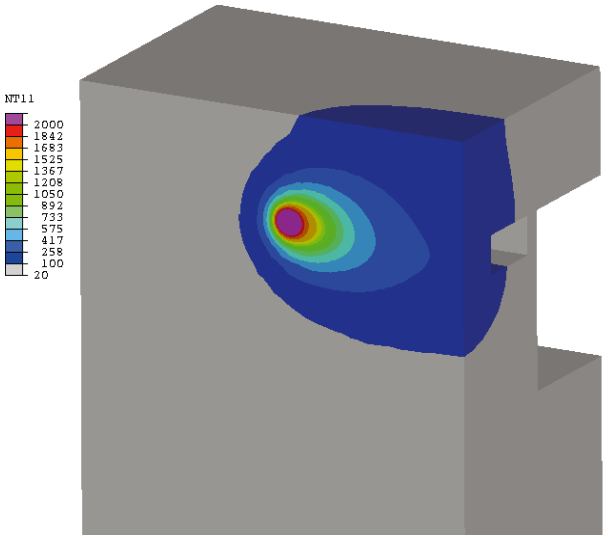
BUSINESS IMPACT

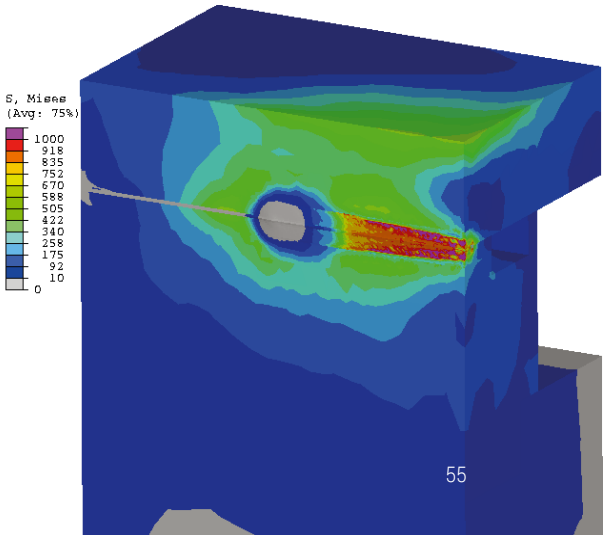
The cost of a physical prototype at LBO is approximately €3.3K, and testing takes around one week. In physical prototyping, multiple trials are usually needed, costing in total €13K and 3 weeks of time.

In comparison, a computer-based analysis costs L&W €6K. Results are available within two weeks. Once a running FEM model has been created, modifications to certain parameters are made very quickly, thus a second simulation loop is less expensive. The in-house cycle and licence fees remains at €2K, but the staff cost reduces to ~€500. Assuming that three simulations runs are necessary to find suitable welding parameters, the costs for the evaluation of a weld at L&W using HPC-based simulation are about €11K, which is almost the same as the physical weld trials at LBO with roughly the same development time. However, a complex calculation of a welding process would block all licences at L&W for seven days. This means that no other projects could be processed during this time, which is not acceptable.

LBO
Germany

In recent years, LBO has conducted four to five expensive welding trials per year. Using Cloud-based-HPC simulations, L&W can generate a significant cost reduction of ~40k EUR per year for these trials. For each new client like LBO, L&W sees a further benefit of €20K to €30K. In Germany alone there are several tens of such companies which gives L&W a significant potential for new business.





FORTISSIMO

Cloud-based simulation of target drug compounds

ORGANIZATIONS INVOLVED

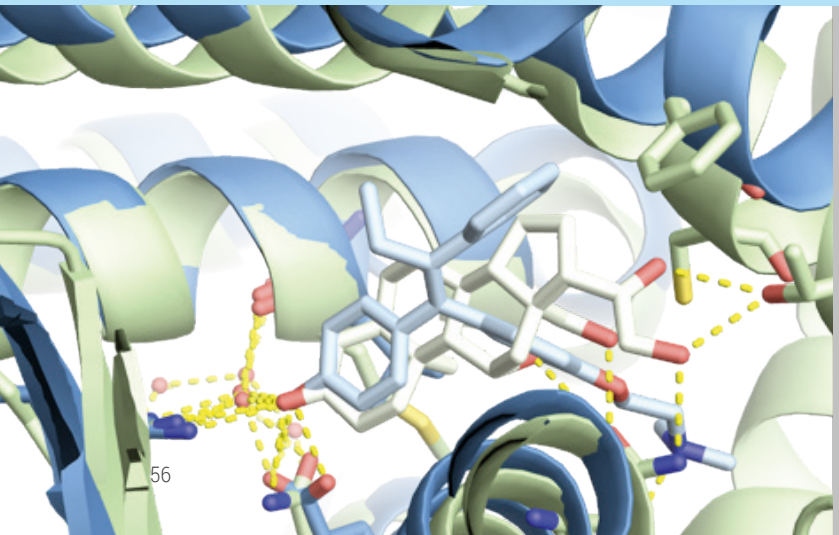
Transinsight is a German SME which develops software products in the area of bioinformatics where it analyses high-throughput data. This case study addresses the identification of existing drugs to treat illnesses other than those for which they are currently prescribed. This has the potential to make a significant impact in drug discovery where the costs of developing new treatments are becoming prohibitive.

The assessment of target compounds requires the use of Cloud-based HPC because the search space is so large and complex. A new Cloud-based-HPC service will be offered by Transinsight to support drug discovery both by SMEs and by larger organisations.

End User	Domain Expert	HPC Expert	HPC Provider
TRANSINSIGHT	biotec		epcc
www.transinsight.com	www.biotec.tu-dresden.de	www.dit.hua.gr	www.epcc.ed.ac.uk

THE CHALLENGE

In the field of drug discovery, there is great interest in investigating unknown drug-target relationships of existing compounds. Investigating these requires significant computational resources. The use of Cloud-based computing can speed up drug development and reduce its costs by uncovering off-target effects, and thus causes of adverse drug reactions, early in the development pipeline.



Investigating unknown drug-target relationships of existing compounds requires significant computational resources.

The use of Cloud-based computing speed up drug development and reduced the costs of the evaluation of a single compound.

THE SOLUTION

The use of an HPC-Cloud infrastructure combined with algorithmic improvements enabled substantially better computational performance. This was achieved through the parallelisation of the algorithms used combined with the more efficient use of memory. This resulted in a significant reduction in the time and cost of the evaluation of a single compound. The Cloud-based approach enabled significant computational resources to be deployed without the need to purchase and maintain expensive hardware.

EXPERIMENT #508 HIGHLIGHTS

Industry Sector:
Pharma Industry

Country: **Germany**

Software used:
In-house code

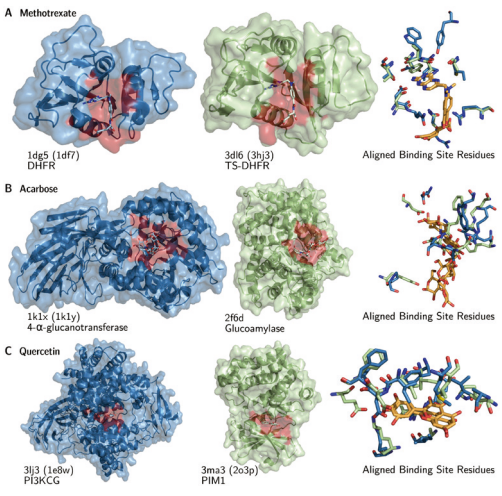
End Date: **August 2016**

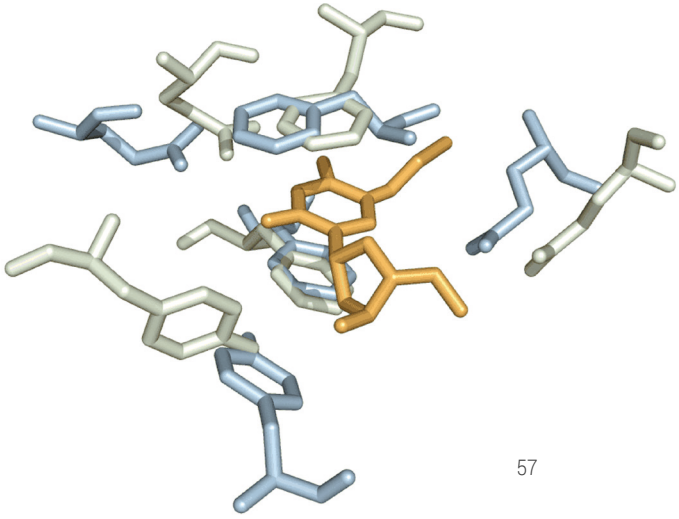
BUSINESS IMPACT

The journey for a drug from invention to market is a long one. There are many challenges to overcome, and many reasons that development of a promising compound may fail. The time required to develop a new drug de novo ranges between 10 and 17 years; that is, if it ever makes it. The chance for a new drug to actually make it to market is only 1:5,000. These slim chances are accompanied by the high cost for developing a new drug, which may reach an average of US$ 403 million. These rising costs threaten to make the development of new drugs increasingly unaffordable for both companies and patients. Repositioning existing drugs for new diseases could deliver the productivity increases that the industry needs. A prerequisite for drug repurposing is drug promiscuity, a drug's ability to bind to several targets. Here, a HPC-Cloud infrastructure demonstrates the viability of a system for investigating previously unknown binding capabilities of existing compounds. Because existing drugs have already undergone extensive safety and bioavailability studies, the cost and time to market of one of these compounds may be significantly reduced.

Transisight
Germany

Transinsight estimates that there are hundreds of potential users of its proposed service. Each user represents a potential profit of €2,000 per annum comprising around 4,000 queries regarding protein matching. For Transinsight this represents a potential increase in profits of around 3% per annum.





FORTISSIMO

HPC Cloud-based analysis for optical control in manufacturing processes

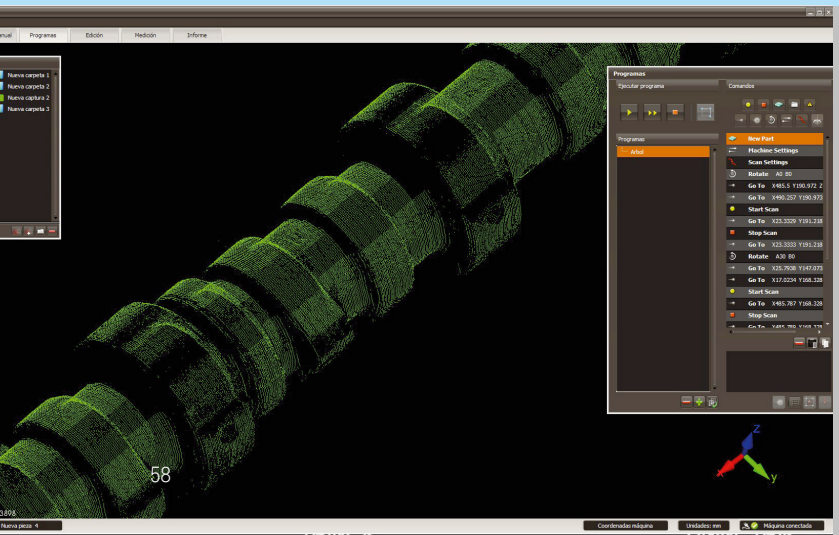
ORGANIZATIONS INVOLVED

EPC is a Spanish SME specialising in the manufacture of camshafts. These are critical components in high power engines, where tolerances are very small. For this reason, EPC is always working to improve its quality-control process, integrating the latest innovations in hardware and software. The integration and exploitation of 3D optical scanning systems for dimensional quality control in manufacture results in significant benefits in terms of time and dimensional information generated compared to traditional tactile technologies. The use of Cloud-based HPC has the potential to provide a detailed and quick analysis of manufacturing processes enabling significant improvements in the control of quality in production processes.

End User	Domain Expert	ISV	HPC Provider
epc Engine Power Components	UNIMETRIK METROLOGY AND CALIBRATION	DATAPIXEL QUALITY CONTROL ENGINEERING	CESGA
www.engpwr.com	www.unimetrik.es	www.datapixel.com	www.cesga.es

THE CHALLENGE

The challenge of this case study was to develop a service which enables companies, particularly SMEs, to control manufacturing processes with very high accuracy using optical scanning techniques. This requires intensive analysis of the parts to be manufactured using 3D digital information. The combination of scanning, measurement and analysis can identify any problems in the manufacturing process early enough for necessary corrections to be made.



The combination of scanning, measurement and analysis can identify any problems in the manufacturing process early enough for necessary corrections to be made.

Cloud-based-HPC resources enabled new methods of analysis such as large-scale geometry extraction and temporal analysis of the dimensional quality of large batches.

THE SOLUTION

Cloud-based-HPC resources were used, enabling new methods of analysis such as large-scale geometry extraction and temporal analysis of the dimensional quality of large batches. Moreover, traditional tasks such as reverse engineering are now optimised enabling the much faster generation of control data for the production line. This allows the generation of additional information concerning the manufacturing quality at both the part and system levels.

EXPERIMENT #509 HIGHLIGHTS

Industry Sector: **Camshaft Production**

Country: **Spain**

Software used: **M3**

End Date: **May 2016**

BUSINESS IMPACT

A typical file size for manufacturing data is around 300 Megabytes, representing 15 million points. This means that a single company generates several Terabytes of information in short periods of time to be processed by a service provider such as Unimetrik. At the same time, software developers such as Datapixel have to work on the optimisation of their processing algorithms to enable quicker access to the information contained in the data collected. The use of the HPC-cloud-based service enables a reduction in the time needed to extract dimensional information from 5 minutes to 1 minute. Due to this time reduction:

EPC
Spain

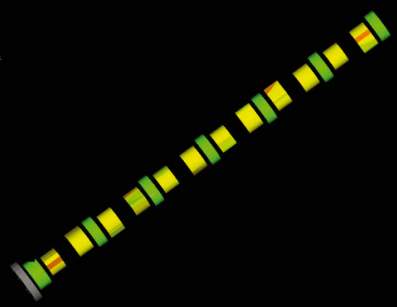
- Unimetrik will increase its service business by 30% and its portfolio of international customers by 20%. This is expected to lead to an increased turnover of €400K over the next five years due to the commercialisation of these advanced services and the creation of two new positions within the company.

- Datapixel, expects an increase of 25% in new licences, representing an additional turnover of €750K over the next five years, due to the commercialisation of the optimized data-processing software developed in this case study.

- The end-user, EPC, expects to improve the quality of its manufacturing process reducing the production of defective parts down to 0%. This would result in a cost reduction of €1.5M over the next five years.

Real part

Virtual part



Quality and Manufacturing Knowledge

FORTISSIMO

Cloud-based processing of seismic data

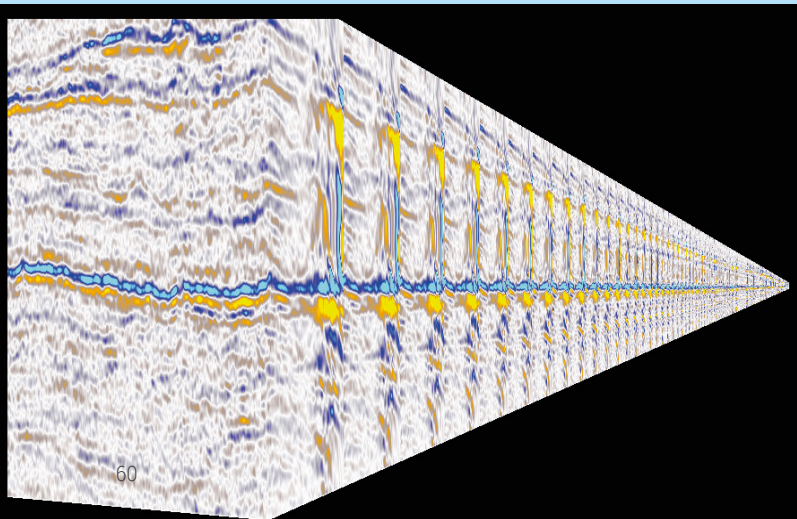
ORGANIZATIONS INVOLVED

Seismic Image Processing (SIP) and Sharp Reflections are premiere suppliers of geological and geophysical services, with a strong reputation for integrated processing, depth imaging, and rock physics. SIP and Sharp Reflections offer a wealth of experience and proprietary technologies which provide clients with unique and innovative solutions. SIP is the end user of the Pre-StackPRO software tool, developed by Sharp Reflections. Sharp Reflections is an innovative software company bringing fast, full-survey pre-stack computing to the interpreter's desktop. The application Pre-StackPRO harnesses the power of many-core CPUs to deliver visual, real-time affordable processing via the Cloud. Sharp Reflections defines a leading edge in seismic data analysis.

End User	ISV	HPC Expert	HPC Provider
SEISMIC IMAGE PROCESSING / sharpreflections	sharpreflections	Fraunhofer ITWM	Bull atos technologies
www.seismicimageprocessing.com www.sharpreflections.com	www.sharpreflections.com	www.itwm.fraunhofer.de	www.bull.com

THE CHALLENGE

As the Oil & Gas industry has had to deal with more and more complex geological targets, high-resolution processing of seismic data and interpretation of results has become strategically important. Pre-StackPRO addresses this need by taking advantage of innovative and powerful computation and visualization capacities. Oil & Gas SMEs cannot afford HPC clusters, and therefore do not benefit from the software's full scaling capabilities.



High-resolution processing of seismic data and interpretation of results has become strategically important for the Oil & Gas SMEs, that cannot afford HPC clusters, and therefore do not benefit from the software's full scaling capabilities.

With the implementation of software Pre-StackPRO in the HPC cloud it is now available from any remote location through remote desktop connections.

THE SOLUTION

Significant changes to the underlying software architecture of Pre-StackPRO have been made, including fully decoupling it from a specific hardware infrastructure, so end-users can choose the datacentre and hardware that best fits their needs. With the implementation of Pre-StackPRO in the HPC cloud it is now available from any remote location through remote desktop connections, which enables new business models and opportunities for collaboration on seismic datasets.

EXPERIMENT #511 HIGHLIGHTS

Industry Sector: **Oil and Gas**

Country: **United Kingdom and Norway**

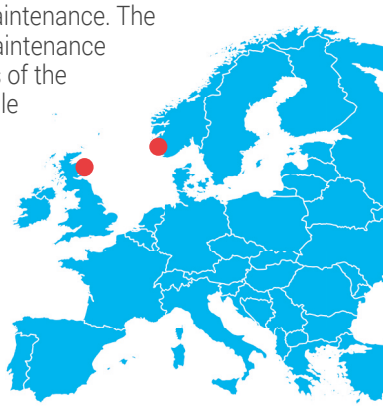
Software used: **Pre-StackPro**

End Date: **October 2016**

BUSINESS IMPACT

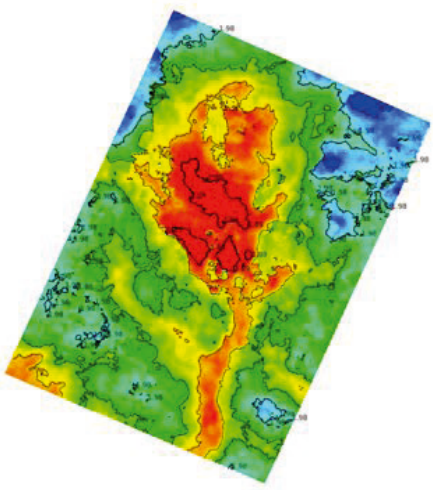
A common configuration for in-house seismic processing by SMEs using Pre-StackPRO comprises a perpetual software licence costing €87k plus 20% annual maintenance. The software runs on a 2-node in-house system costing €40K, with annual maintenance costs of €4K. Over 4 years, this gives an annual cost of ~€55K, regardless of the number of hours of processing on the system. These costs are an obstacle to SMEs, and this setup has obvious limitations - when the processing requirements are high, they cannot be met by the in-house system, and when they are low, expensive hardware and software are not being used.

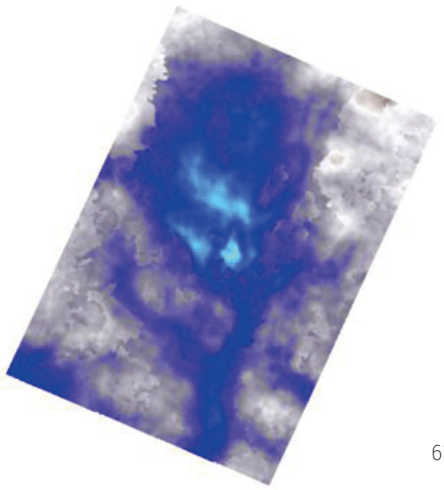
Based on the outcomes of this experiment, Bull is offering a compute node with Pre-StackPRO installed and licensed as a Cloud-based service. Such nodes can be purchased on a pay-per-use basis ranging from 1 week to 3 years. Clearly the advantage of such an offering is that variable workloads can be easily and cost effectively accommodated. Savings, over the in-house solution, of between €20K to €30K for each SME can be expected. Furthermore, the flexible pay-per-use approach enables much larger data-sets to be processed by scaling up the hardware as needed. It is expected that the provision of such a service will increase Sharp Reflection's total revenues significantly - about 1 M€, equivalent to 10% of total revenues in 2017, gradually increasing to 4 M€ and 23% of total revenues in 2022.



Seismic Image Processing
United Kingdom

Sharp Reflections
Norway





FORTISSIMO

Cloud-based simulation of pipeline components for the oil & gas industry

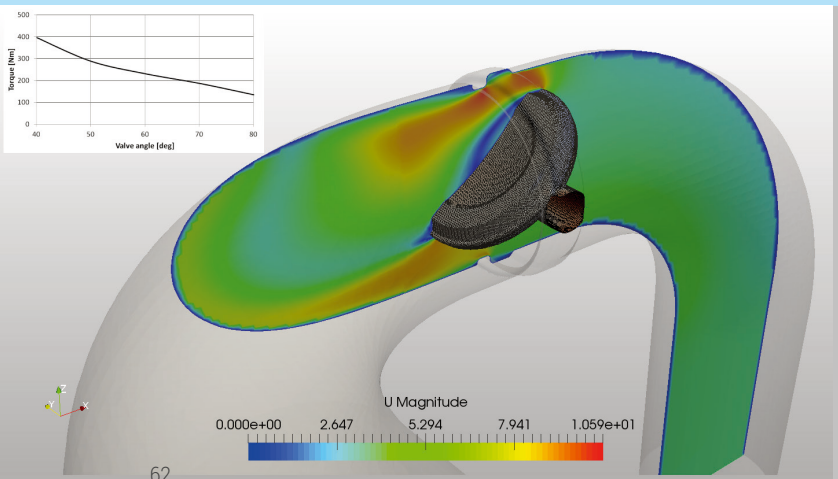
ORGANIZATIONS INVOLVED

The Dynaflow Research Group (DRG) is an SME that has provided engineering consultancy services to globally leading oil & gas companies since 1983. This work often requires multidisciplinary simulations encompassing static and dynamic analysis of fluids and mechanical components. To satisfy their advanced modelling requirements, DRG relies on the open-source based CFD software solution HELYX® developed by the ISV ENGYS®. In the past, such simulations were mainly performed on DRG's local systems with a small-scale parallel capability. The objective of this experiment was to enable DRG to run CFD simulations using HELYX® on a cloud infrastructure, via a familiar desktop environment, which would significantly enhance DRG's simulation capabilities in this area.

End User	HPC Expert	Domain Expert	HPC Provider
DRG Dynaflow Research Group	engys	nag Results Matter. Trust NAG.	epcc
www.dynaflow.com	www.engys.com	www.nag.co.uk	www.epcc.ed.ac.uk

THE CHALLENGE

For many SMEs in the engineering and manufacturing sectors, including DRG, in-house computing hardware is usually insufficient for solving large problems. On-demand cloud-based HPC solutions, combined with open-source software, can offer a more cost-effective alternative. The main challenge faced by DRG and its partner ENGYS was to create a new methodology to perform oil & gas CFD simulations using on-demand cloud-based HPC solutions.



The main challenge faced by DRG and its partner ENGYS was to create a new methodology to perform oil & gas CFD simulations using on-demand cloud-based HPC solutions.

The new client-server framework allows end-users to perform CFD simulations on remote HPC hardware directly from a desktop Graphical User Interface.

THE SOLUTION

ENGYS developed and tested a novel client-server framework for their CFD software HELYX® with the help of NAG and DRG. The new client-server framework allows end-users to perform CFD simulations on remote HPC hardware directly from a desktop Graphical User Interface. The new technology facilitates access to and effective use of remote HPC resources from a local desktop, such as those employed by DRG. ENGYS could also offer this product on a short-term licence as an on-demand service.

EXPERIMENT #512 HIGHLIGHTS

Industry Sector: **Oil and Gas**

Country: **Netherlands**

Software used: **HELYX**

End Date: **October 2016**

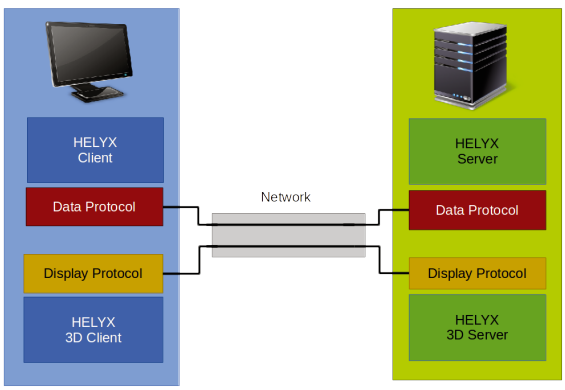
BUSINESS IMPACT

A simple calculation based on the work in this experiment showed that the costs to DRG of buying and maintaining a computer cluster in-house for performing these CFD simulations could be up to 5x the costs of an equivalent cloud-based HPC solution. There are also clear benefits in turn-around times for simulations, as well as the opportunity to perform much larger computations using a cloud-based HPC platform. The simulations are up to 10 times faster, with potential savings of €2,000 per simulation per day (based on standard industry rates).

Dynaflow Research Group
Netherlands

The new client-server approach in HELYX® is also expected to increase sale opportunities for ENGYS by as much as 20%, thanks to the introduction of short-terms licenses for on-demand usage of the software in the cloud. Furthermore, the possibility of providing these resources via the Fortissimo Marketplace should lead to increased revenue by exposure to a wider market.

EPCC will see an increase in its commercial activities through extended use of its commercial supercomputer platforms. NAG will create case studies based on this experiment to showcase its capability in software engineering and high-performance computing. Such marketing materials will be distributed to potential customers to attract new HPC consulting business. Current estimates are that this would result in an additional revenue for NAG in excess of €150K over the next three years.



FORTISSIMO

Cloud-based environmental modelling

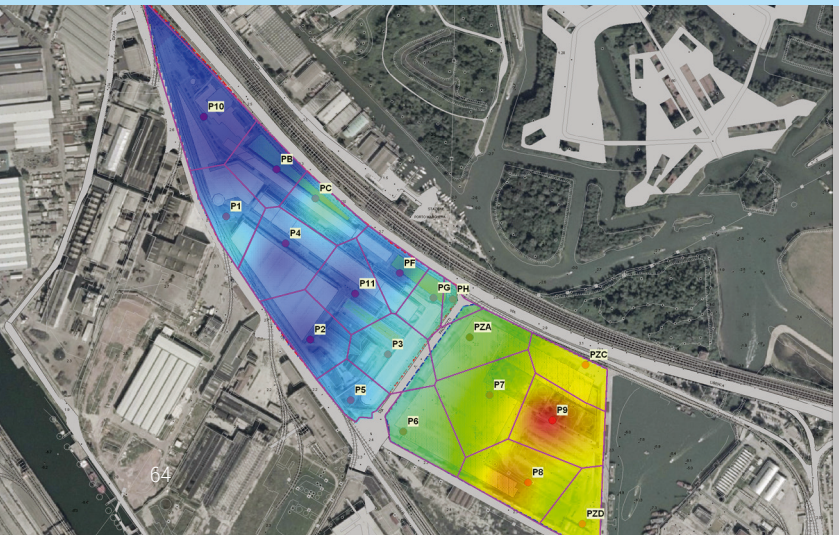
ORGANIZATIONS INVOLVED

eAmbiente is an SME operating in the area of environmental consulting. It provides its services to architects and designers involved in the design of large factories and industrial plants, characterized by significant environmental impacts. eAmbiente's mission is to reduce these impacts to acceptable levels. Since 2002, eAmbiente has used computer simulation to model emissions and water flow to predict the risk to soil and groundwater. During this period, environmental modelling has become an important tool during the planning phase of buildings, factories and public infrastructures. Although the required simulations are well understood, their performance and ease of use are limited. In particular, models may take prohibitively long run-times on conventional computing resources.

End User	HPC Expert	Domain Expert	HPC Provider
eAmbiente IMPROVE THE GREEN FUTURE	progesi gruppo BV TECH	t2i trasferimento tecnologico e innovazione	CINECA
www.eambiente.it	www.progesi.eu	www.t2i.it	www.cineca.it

THE CHALLENGE

The challenge of this Case Study is to overcome the current limitations of environmental modelling tools. The main aim is to set up and test an innovative service for SMEs, public sector and private stakeholders through a single access point. This includes a cloud-based service that will launch and aggregate the results of different models in parallel and an offline service used to evaluate and interact with the results of the simulations.



The challenge of this Case Study is to overcome the current limitations of environmental modelling tools.

This issue has been addressed through the development of a customized platform to integrate environmental software including a single easy-to-use GUI available to potential end-users.

THE SOLUTION

This issue has been addressed through the development of a customized platform to integrate environmental software including a single easy-to-use GUI available to potential end-users. This GUI gives one-stop access to cloud-based HPC resources for the end-user. The use of this solution enables an 80% reduction in both simulation time and time to result with consequent cost benefits. Furthermore, the use of open-source software for the simulations has resulted in a significant reduction in costs.

EXPERIMENT #514 HIGHLIGHTS

Industry Sector: **Environmental Assessment**

Country: **Italy**

Software used: **Aermod**

End Date: **June 2016**

BUSINESS IMPACT

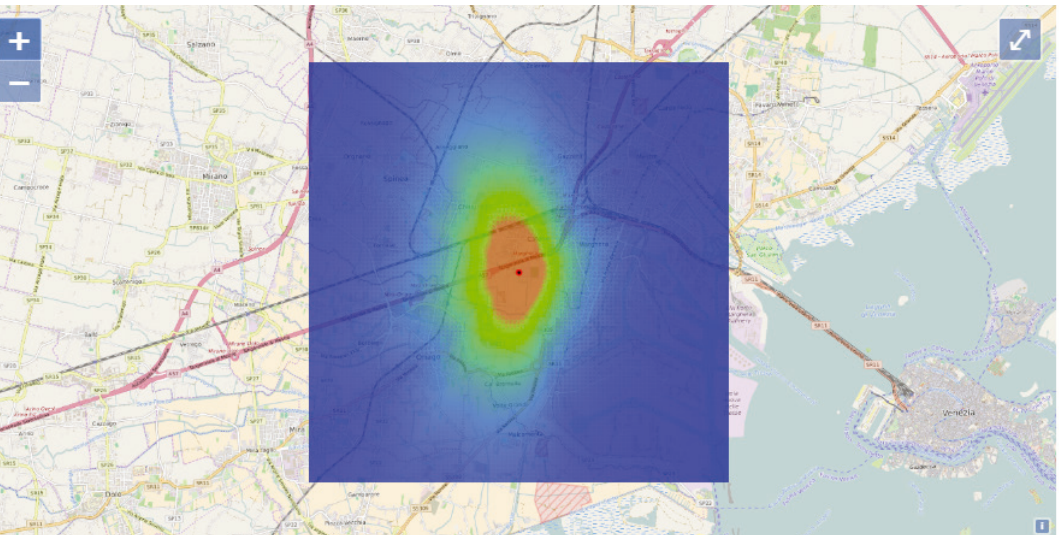
The total cost of running a single traditional Environmental Impact Assessment (EIA) on a powerful in-house system is ~€30.5K. The same assessment, using open-source software, Cloud-based HPC resources and reduced staff effort is ~€6.5K, a saving of ~€24K per EIA. eAmbiente expects to carry out an additional 4 EIAs yearly over each of the next five years resulting in an overall cost saving of ~€64K per year.

Furthermore, eAmbiente expects to increase its revenue with around €374 K of additional business over the next five years, corresponding to about €75K per year. eAmbiente has a revenue of about €270K per year for the EIA sector. The experiment can generate an increase of +28% in that yearly revenue. As a result of the experiment, two new employees over the next five years is expected. Finally an increase in competitiveness at the European level is anticipated since the workflow is easily customizable to European environmental legislation.

eAmbiente
Italy

T2i will develop a brand new EIA-related service starting from scratch. There is no such (digital) service in T2i's portfolio. T2i estimates a 5% increase in commercial revenues in the next two years corresponding to an expected increase in sales of €5K to €10K euros per annum.

Finally, this experiment offers a success story for CINECA. It is estimated that this will bring at least one new customer per year, with an approximate 5% increase in revenues from commercial services.



FORTISSIMO

HPC Cloud-based additive manufacture

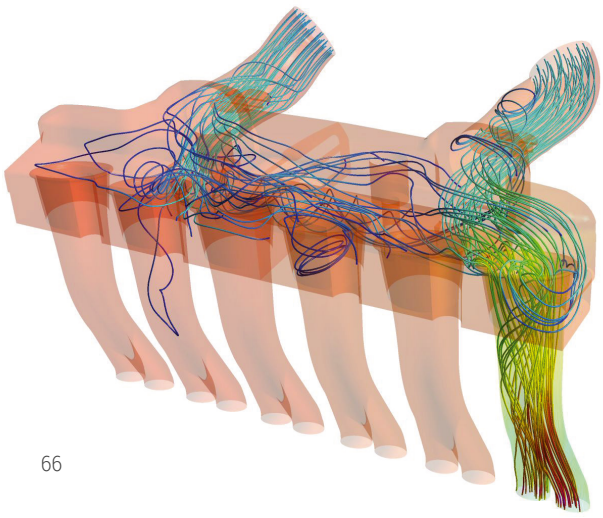
ORGANIZATIONS INVOLVED

HSL is an SME and a market leader in both Additive Manufacturing and the rapid production of prototypes. In recent years Additive Manufacturing has emerged as a viable mainstream production technology. Overcoming technical and bureaucratic obstacles has allowed 3D printing to grow as a cost-effective option for small and medium scale production together with the ability to produce complex shapes not achievable by standard manufacturing processes. This flexibility in design enables the optimisation of components, a reduction in manufacturing time by almost a third and a halving of production costs by reducing the waste of materials and energy.

End User	Domain Expert	ISV	HPC Provider
www.hsl-italia.it	www.web.uniroma2.it	www.rbf-morph.com	www.cineca.it

THE CHALLENGE

Computer-aided engineering (CAE) tools are able to suggest new shapes and accurately predict the behaviour of components, making them a natural choice in the design chain, but can be prohibitively expensive for SMEs. This is especially true when dealing with complex Computational Fluid Dynamic (CFD) simulations. The goal is to demonstrate the validity of an optimisation service using CAE by optimising a Lamborghini 12-cylinder airbox.



Numerical grid parameterisation using a mesh morpher avoids the time consuming task of mesh generation. Access to CFD simulation through the Fortissimo HPC Cloud allows a speed-up in calculation times reducing the time to market and to return on investment.

THE SOLUTION

Numerical grid parameterisation using a mesh morpher avoids the time consuming task of mesh generation (that can take up to 70% of the total analysis cost). Access to CFD simulation through the Fortissimo HPC Cloud allows a speed-up in calculation times reducing the time to market and to return on investment. Using a collaborative, interactive, cloud interface helps analysts and clients to work together, increasing customer satisfaction and building better products more effectively.

EXPERIMENT #515 HIGHLIGHTS

Industry Sector: **Automotive**

Country: **Italy**

Software used: **RBF Morph**

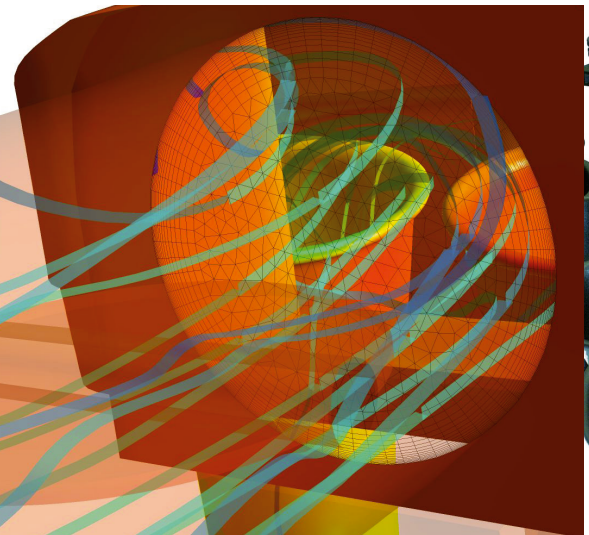
End Date: **June 2016**

BUSINESS IMPACT

HSL expects that the new service will see the development of a business department with two to three staff, potentially growing to five to six staff after three to four years. For UTV it is estimated that thanks to the new know-how acquired the relevant department will increase its industrial research services. The economic benefit is estimated to be between 40k and 70k € per year in a five-year plan. Finally, this case study comprises a success story for CINECA, in the application field of high fidelity CFD, that is estimated to bring in at least two new SME customers per year, with an approximate 5% increase in revenue for commercial services.

HSL
Italy

Having access to the RBF Morph morphing tool combined with CFD analysis powered by HPC opens a wide range of business opportunities. In parallel with existing rapid prototyping services, HSL can now propose to its clients alternative component designs corresponding to appropriate performance indicators. For HSL, offering a shape optimisation service in parallel with its existing core business of rapid prototyping activities, represents an opportunity to establish customer activity over a range of key R&D areas. HSL is ready to offer the developed tool to a range of existing clients in the automotive industry, anticipating for the next two years, a total revenue growth of 16% per year in that sector.



FORTISSIMO

Advanced simulation for metal forming

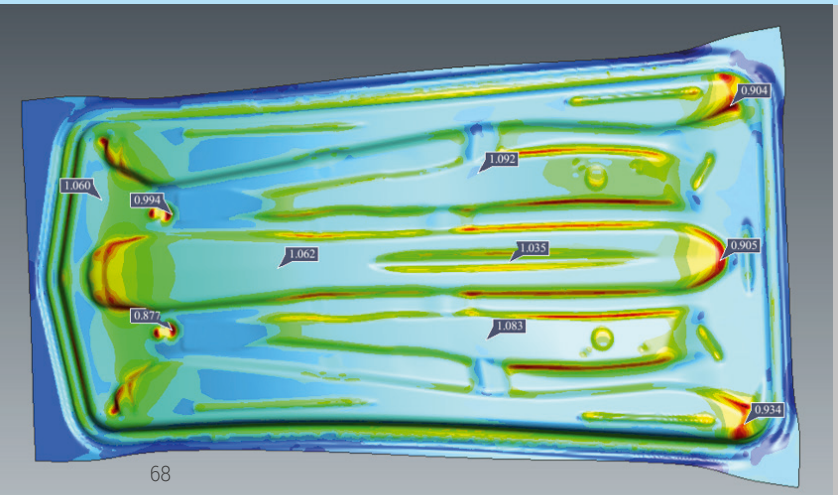
ORGANIZATIONS INVOLVED

MATRICI is a Spanish SME founded in 1964, specialising in the production and design of complex metal panels in the automobile and aerospace industries. The sheet metal forming industry is important in the development of the world's economy. The use of HPC-based simulation can have a significant financial impact on the manufacturers of such panels. However, despite recent significant advances in computing hardware and software, high-end computer simulation and engineering design tools are often unaffordable for small companies because of the large capital investment in computing power required. This experiment demonstrates the benefits of advanced Cloud-based HPC tools in design and how these can be delivered as a pay-per-use service, affordable by small companies.

End User	Technology Expert	ISV	HPC Provider, Expert and Host Centre
MATRICI	Fraunhofer SCAI	QUANTECH ATZ	CESGA
www.matrici.com	www.scai.fraunhofer.de	www.quantech.es	www.cesga.es

THE CHALLENGE

The challenge here was to develop a software solution that allows industry to simulate metal forming with higher efficiency and ease of use than possible using today's state-of-the-art commercial codes. Stampack, a simulation code available from QUANTECH, models the forming of sheet metal panels. However, the application would need to be modified to be able to run effectively in a Cloud of HPC resource on a pay-per-use basis.



The challenge here was to develop a software solution that allows industry to simulate metal forming with higher efficiency and ease of use than possible using today's state-of-the-art commercial codes.

A Cloud-based version of Stampack (StamHPC) has been adapted, developed and validated, and its performance and usability evaluated in an industrial setting.

THE SOLUTION

A Cloud-based version of Stampack (StamHPC) has been adapted, developed and validated, and its performance and usability evaluated in an industrial setting. A graphical interface offers easy and intuitive use in the metal forming industry. This allows any end-user, even without HPC expertise, to launch a calculation and get results with an appropriate response time. Furthermore, an appropriate licensing server has been developed which supports the availability of StamHPC on a pay-per-use basis.

EXPERIMENT #516 HIGHLIGHTS

Industry Sector: **Automotive**

Country: **Spain**

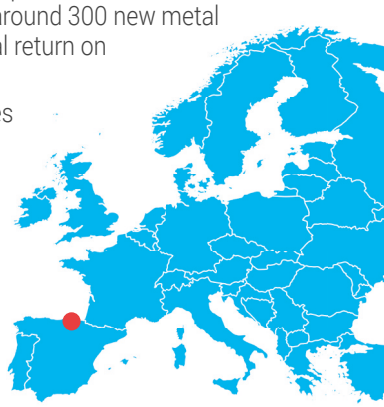
Software used: **Stampack**

End Date: **August 2016**

BUSINESS IMPACT

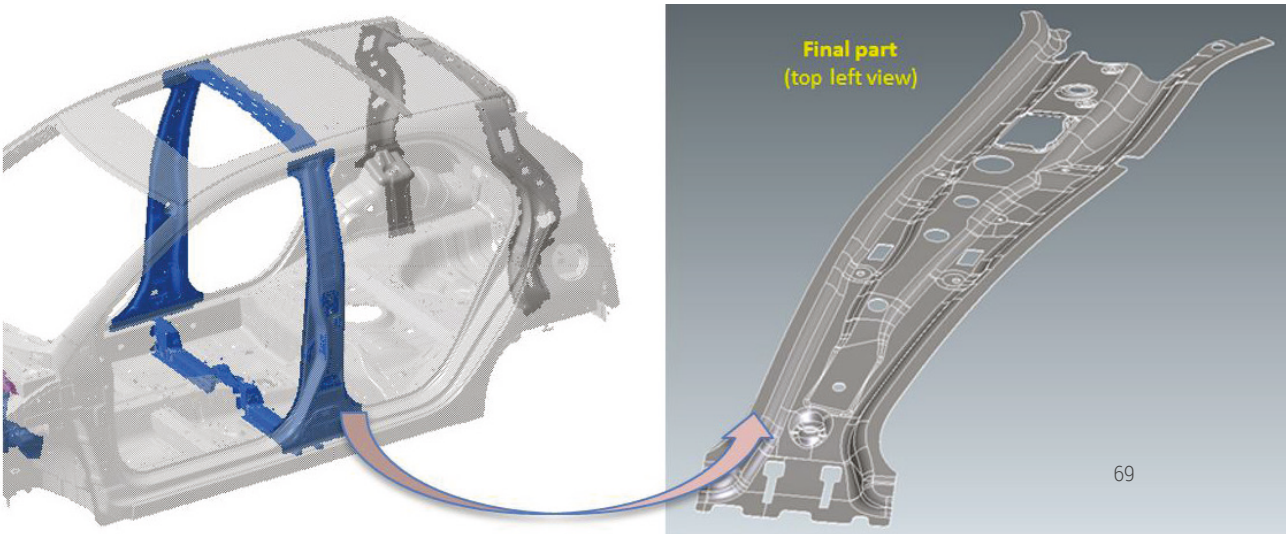
MATRICI estimates that the use of the Cloud-based StamHPC in its design processes is worth an additional €200k in revenues per year. QUANTECH and CESGA expect around 300 new metal forming SMEs to use StamHPC over the next 5 years, leading to a potential return on investment of €60M.

A typical simulation to support the design of a metal forming process takes around 120 iterations, each of which needs 20 computing hours on a standard workstation (8 cores, 32 GB of memory). Such a simulation represents 10 weeks of work involving a workstation and an engineer. Using the StamHPC solution within an HPC-Cloud it is possible to run, at the same time, several options of the feasibility design concepts, reducing the time required to design a prototype. The reduction of time to solution is about 50%, with similar cost reductions. A company like MATRICI performs 200 Feasibility design studies per year in order to make offers to customers, the reduction of design costs, plus the accuracy of the new StamHPC software would represent savings around 1.5 M€/year (2.5% of current company turnover for MATRICI).



Matrici
Spain

CESGA estimates that it will see, due to the sale of computer cycles as a result of the Cloud-based StamHPC, an additional annual revenue of €45K in 2017 growing to €365K in 2021. SCAI will use the success of this experiment as a reference to support the sales of its software products, particularly those relevant to HPC-based Clouds.



FORTISSIMO

Optimised cutting and bending of steel reinforcement bars using Cloud-based HPC

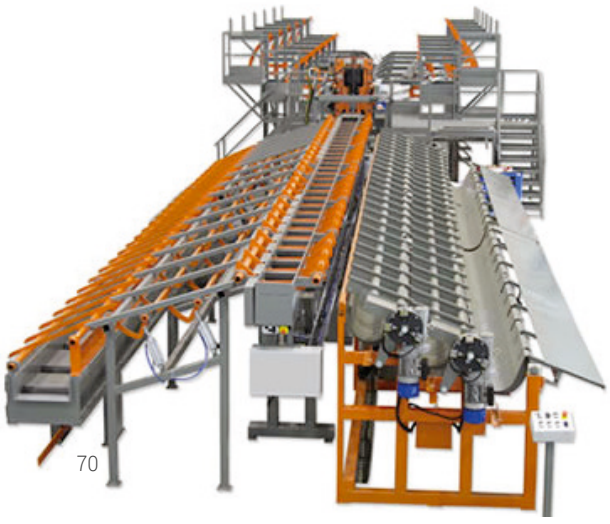
ORGANIZATIONS INVOLVED

Schnell Software, a Spanish SME, designs specialized CAD-CAM software for companies which cut and bend steel, particularly the cutting of iron bars for reinforced concrete. SCHNELL already has optimisation software running on a PC; however, execution take several hours if high levels of optimization are required, which is impractical in a production environment.The optimisation of cutting and bending of iron bars is based on complex algorithms which are numerically intensive. Better optimisation would enable SCHNELL's customers to plan their schedules to obtain the best possible combination of orders, minimising wastage in the cutting and bending process, and saving time in the analysis of production orders and raw material requirements.

End User and ISV	HPC and Application Expert	HPC Provider, Expert and Host Centre
SCHNELL SOFTWARE	Instituto Universitario de Investigación Biocomputación y Física de Sistemas Complejos Universidad Zaragoza	CESGA
www.schnellsoftware.com	www.bifi.es	www.cesga.es

THE CHALLENGE

The challenge facing SCHNELL was to modify its software to run on a Cloud-based HPC system rather than a local PC. The objective was to reduce the compute time from hours down to minutes for even large-scale optimisations, and develop a graphical user interface for users. The modified software would serve as a database portal and clients would be able to carry out a real simulation of a cutting process with minimal cost and effort.



The challenge facing SCHNELL was to modify its software to run on a Cloud-based HPC system rather than a local PC.

The optimization software has been adapted to run in a distributed Cloud-based HPC infrastructure. Through the use of a graphical user interface it is easy to setup and optimise bar cutting and bending optimisations.

THE SOLUTION

The optimization software has been adapted to run in a distributed Cloud-based HPC infrastructure. Through the use of a graphical user interface it is easy to setup and optimise bar cutting and bending optimisations. This hides all the complexity of the Cloud. Launching optimisations is as simple as sending some input files, with appropriate parameters and receiving the results after a manageable processing time.

EXPERIMENT #517 HIGHLIGHTS

Industry Sector: **Building Industry**

Country: **Spain**

Software used: **Optimo**

End Date: **August 2016**

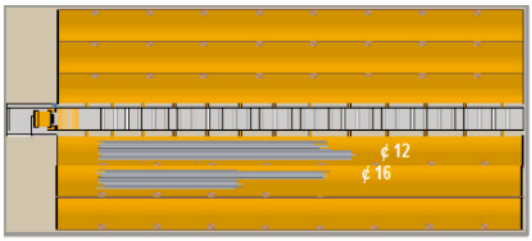
BUSINESS IMPACT

A large foundry produces 2,000 tonnes of steel bars per month. Through the use of Cloud-based high-level optimisation, it can reduce waste steel by 2% (480 tonnes per annum). The average price of steel is €500 per tonne, so this represents a saving of €240K per annum. A lower-level optimisation offers savings of only around €60K per annum. The higher-level optimisation also results in a €30K reduction in staff costs.

For small companies, acquiring an in-house optimization system that guarantees a reliable cut of high quality requires significant investment in hardware and software. Not all small and even large companies are willing to do this because they are not sure of the benefits. This barrier can be overcome using a cloud-based, pay-per-use approach as companies can test and evaluate the service without a large capital investment. A simple analysis of the costs of performing the high-level optimisation in-house on a sufficiently powerful system results in a yearly expenditure of €80K. The corresponding computing costs of performing the same optimisation in the Cloud are only €7.5K per annum.

Schnell
Spain

Over 5 years SCHNELL estimates a total income of ~€480K from the provision of its Cloud-based optimisation service to steel foundries, including Cloud-computing and SCHNELL licence costs, resulting in a total profit of ~€440K. In addition to this, CESGA will increase sales of computer cycles by around 175,000 CPU hours per year.



FORTISSIMO

Cloud-based optimisation of water turbines for power generation

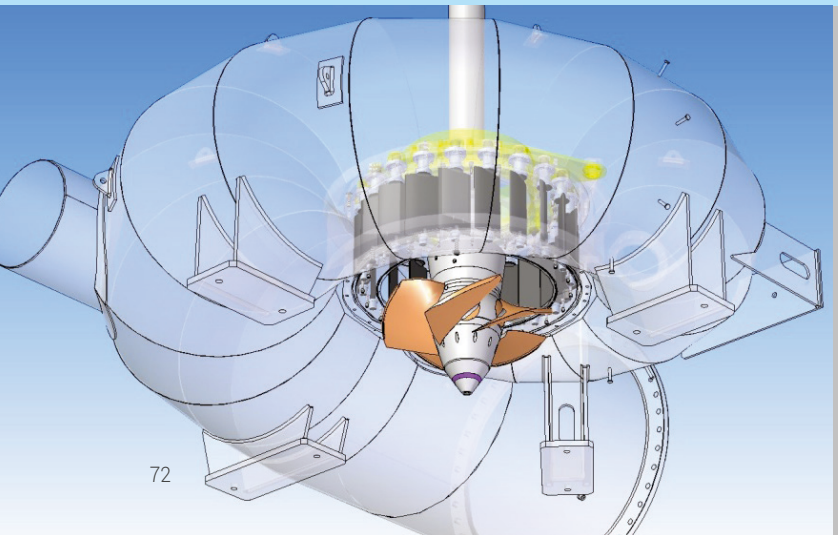
ORGANIZATIONS INVOLVED

Zeco is an Italian SME in the renewable energy sector. It specialises in the production of different types of water turbine. SMEs like Zeco must develop and innovate their products to remain competitive. High-fidelity simulation using Computational Fluid Dynamics (CFD) has become an essential tool for turbine designers because it results in better designs for less effort and lower cost. However, for Zeco and, in general for SMEs, full exploitation of CFD tools is often not possible as they lack the necessary computing power, and the skills to exploit it effectively. The objective here is to demonstrate how all the necessary resources can be assembled to give ZECO a one-stop-shop for the simulation of turbines leading to business benefits across the whole value chain.

End User	HPC Expert	ISV	HPC Provider
www.zeco.it	www.enginsoft.com	www.ansys.com	www.cineca.it

THE CHALLENGE

Current practice in the design of hydro-power plants is to determine the most suitable design in a series of time-consuming experiments. However, SMEs in this sector face stiff completion and tight deadlines to sell their turbines in both national and global markets. The challenge facing Zeco is to improve its design processes by the use of HPC-based high-fidelity simulations of flow in its turbines through the use of CFD-based tools.



Current practice in the design of hydro-power plants is to determine the most suitable design in a series of time-consuming experiments.

High-fidelity simulations and the availability of HPC significantly reduced the development costs of prototypes, so the time to market is significantly lower.

THE SOLUTION

A CFD-based HPC application has been developed which enables the design of a small hydro power plant in a very fast and reliable way, compared to current practices. The use of this application can contribute significantly to savings in time and money in the development of new water-turbine systems. High-fidelity simulations and the availability of HPC significantly reduce the development costs of prototypes, so the time to market is also significantly lower.

EXPERIMENT #519 HIGHLIGHTS

Industry Sector: **Hydraulic Turbines**

Country: **Italy**

Software used: **ANSYS CFD**

End Date: **March 2016**

BUSINESS IMPACT

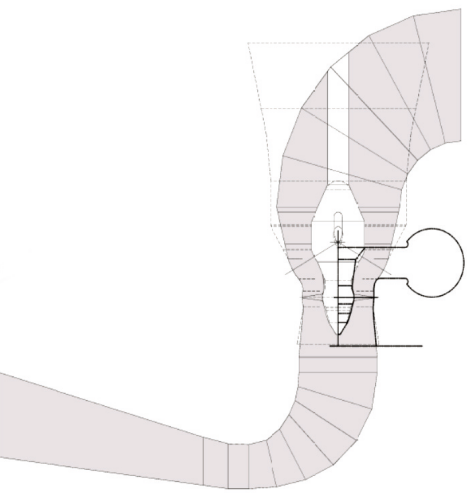
HPC-based CFD calculations have reduced the design time of a turbine from 1 year to 3 months. As manufacturing the turbine takes 8 months, the time to market can be reduced from 20 to 11 months. Without the use of HPC, the development process could take up to two years, which is no longer a competitive time frame in this sector.

Using such turbines, a medium-sized hydropower plant costing 1.5M€ can reduce operational costs by 350k € per installation over two years. Furthermore, the optimization through HPC leads to a 1% increase in plant efficiency, with a 50% reduction in the total number of days required for maintenance. This means an increase of the revenue related to energy production of up to 40 k€ per year per installation. Due to these improvements, Zeco expects to increase its market share by at least 5% with an additional profit of 50 k€ per year.

Zeco
Italy

As a result of the increased market for advanced simulation using HPC, EnginSoft expects a growth of 10% in business related to the turbo-machinery market sector, which means an additional profit of around 50 k€ per year.

CINECA estimate potential revenues for the HPC service of 100 k€ per year. The workflow developed here is applicable to other sectors as well, so there is a large potential market. CINECA's target is to acquire two customers for this service per year for the next three years, with an estimated increased revenue of 900 k€ and a profit of around 100 k€.



FORTISSIMO

HPC-based prediction of the optical properties of dyes

ORGANIZATIONS INVOLVED

Scriba Nanotechnologie is an SME active in the fields of smart packaging, health, and machine vision. In particular, Scriba is involved in the development of time temperature integrators (TTIs), which are devices that record the thermal history of products. Placed close to perishable products, they can be used to monitor the thermal history of packaging and storage conditions. TTIs form an important part of cold chain logistics in a world where production is global. TTIs use dyes which may change if there is a change in temperature. This experiment uses molecular dynamics to simulate dyes used in the manufacture of new and innovative TTIs. Simulations reduce the time to customise these devices, thus lowering the overall cost.

End User

SCRIBA NANOTECNOLOGIE

www.scriba-nanotec.com

HPC Expert and Provider

CINECA

www.cineca.it

Domain Experts

Welcome to the TCPC GROUP

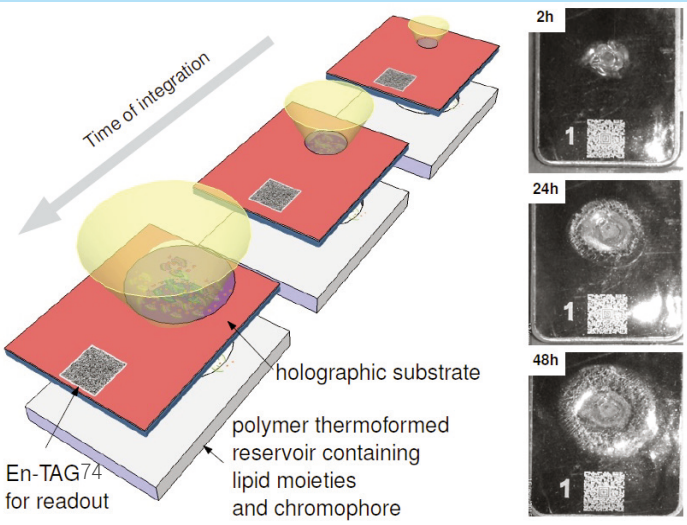
www.tcpc.univaq.it

UNIMORE
UNIVERSITÀ DEGLI STUDI DI MODENA E REGGIO EMILIA

www.unimore.it

THE CHALLENGE

The challenge faced by this experiment is to use HPC to simulate candidate dyes, based on molecular dynamics, to be used in the fabrication of innovative TTIs. This requires a multidisciplinary approach using molecular dynamics-based simulations of dyes. The aim is to reduce the time required for customisation of TTIs, lowering the overall cost of these products. The goal is to develop a new tool in cold chain logistics.



The challenge faced by this experiment is to use HPC to simulate candidate dyes, based on molecular dynamics, to be used in the fabrication of innovative TTIs.

A computational pipeline for the simulation of optical properties of dyes in different environments has been set up and a cloud-based web portal has been developed to manage the simulations.

THE SOLUTION

A computational pipeline for the simulation of optical properties of dyes in different environments has been set up and a cloud-based web portal has been developed to manage the simulations. This portal has been specifically designed for users with no expertise in simulation - the user only needs to select the material of interest and the experimental conditions to be simulated, and default options are presented to help the user proceed through the steps.

EXPERIMENT #520 HIGHLIGHTS

Industry Sector: **Pharmaceutical Engineering**

Country: **Italy**

Software used: **Perturbed Matrix Method (PMM)**

End Date: **October 2016**

BUSINESS IMPACT

Through the use of the advanced simulation package, Scriba expects to see a saving of €90K per simulation in the first year of use, with further savings of €70K in subsequent years. This can be broken down as savings in personnel costs of €45K, in infrastructure costs of €10K, in material costs (including computing costs) of €25K, and optical readout and further development of €15K in the first year. Scriba estimates that it will be involved in approx. 6 simulations per year resulting in an annual saving of around €400K.

Scriba Nanotechnologie
Italy

CINECA plans to use the success of this experiment to target SMEs in the European market who have the need for high-fidelity chemical and molecular dynamics simulations. The target is to acquire two customers of this type per year in each of the following three years. UNIMORE and UNIVAQ expect to see an increase in their consultancy business as a result of this successful experiment. Both partners will be further involved in the enhancement of the software, operating as external consultants. The value of the external consultancy to the two domain experts is estimated to be ~€10K per year each. The number of potential users to run simulations explicitly for the development of temperature sensors is about 5 and for the design of optical (bio)sensors about 100.

Scriba will make available the developed virtual tool in the Fortissimo marketplace, subject to appropriate terms and conditions.

FORTISSIMO

Multi-physics simulation of high-temperature superconducting devices

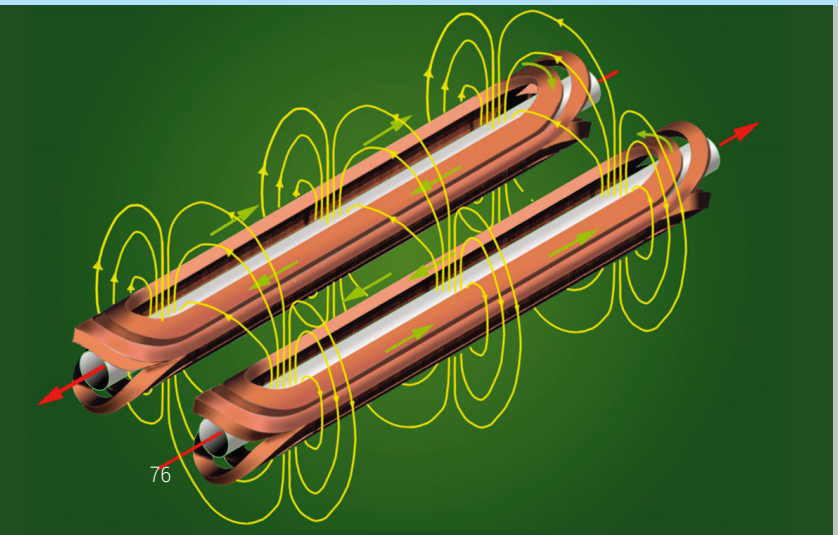
ORGANIZATIONS INVOLVED

Oxolutia is a technology-based Spanish SME specialising in thin-film oxide architectures. These are deposited by industrial inkjet printers using special inks. Oxolutia has investigated the high-temperature superconductor (HTS) space as a potential new market for them to move into. These materials can be used to construct generators, motors and superconducting magnets, for applications such as power cables, energy storage and magnetic resonance imaging (MRI) devices. However, they are complex and difficult to work with, exhibiting strongly non-linear hysteretic behaviour and time-dependence. This requires a robust, fast and powerful computing environment to obtain solutions consistent with a productive design cycle.

End User	HPC Expert	ISV	HPC Provider
OXOLUTIA	ICMAB CSIC	CIMNE	CESGA
www.oxolutia.com	www.icmab.es	www.cimne.com	www.cesga.es

THE CHALLENGE

The challenge was to develop a design tool that could calculate the required properties of HTSs - magnetic, electric and current density fields, and mechanical and thermal properties including temperature, stress and strain fields – in a reasonable time frame. This was done using FEMPAR, an electromagnetic software package from the ISV CIMNE. The results of the modified FEMPAR package were verified by comparison with other commercial solvers.



The challenge was to develop a design tool that could calculate the required properties of HTSs - magnetic, electric and current density fields, and mechanical and thermal properties including temperature, stress and strain fields – in a reasonable time frame.

In order to reduce computation times to reasonable levels, a multiphysics-based HPC application has been developed which enables the behaviour of HTS devices to be simulated.

THE SOLUTION

In order to reduce computation times to reasonable levels, a multiphysics-based HPC application has been developed which enables the behaviour of HTS devices to be simulated. The use of this application can contribute significantly to savings in time and money in the development of devices adapted to meet customer demands. It enables Oxolutia to understand the performance and characteristics of its products, and to increase their competitiveness by allowing them to enter a new business area.

EXPERIMENT #521 HIGHLIGHTS

Industry Sector: **Electromagnetic Components Industry**

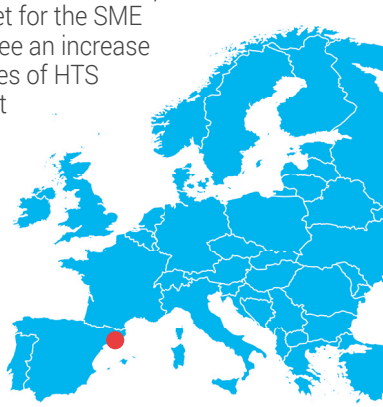
Country: **Spain**

Software used: **FEMPAR**

End Date: **October 2016**

BUSINESS IMPACT

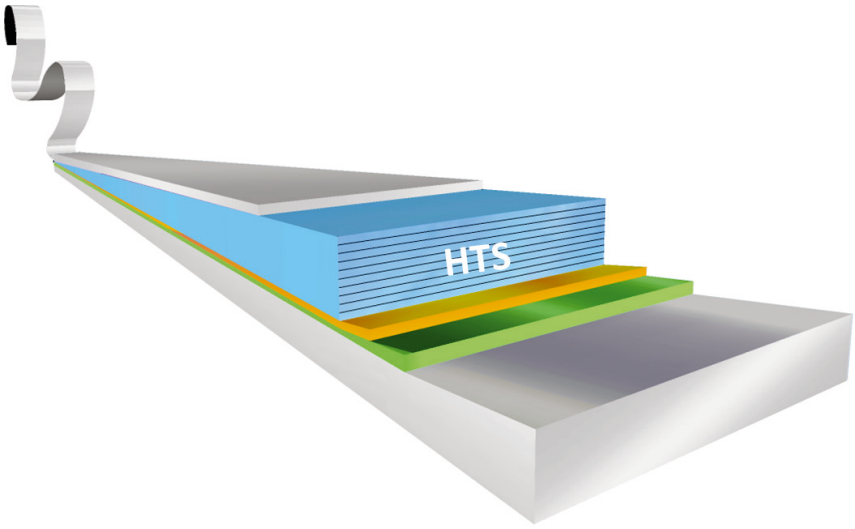
High-fidelity simulations and the availability of HPC can significantly reduce the development costs of prototypes. In this experiment, this has opened up a new market for the SME involved, Oxolutia. Through the use of this service, Oxolutia expects to see an increase in business turnover of €25k over the next year. This is based on the sales of HTS devices - production costs, licence fees and computer cycles would cost €12k, giving Oxolutia a net profit of €13k in the first year. Looking over the next 3 years, Oxolutia expects to see an increase in business turnover of €500k, spending €150k on production costs, licence fees and computer cycles - a net profit of €350k.



Oxolutia
Spain

CESGA and CIMNE plan to offer a service enabling SMEs to simulate the electromagnetic and physical behaviour of HTS devices. This service will be offered on a pay-per-use basis including licence fees and the costs of computing cycles. CIMNE anticipates a net profit of €54k from related new business over the next 3 years due to the provision of service. Over this period CESGA expects to increase its provision of CPU cycles to CIMNE by 32k core hours.

ICMAB, the HPC application expert, expects a profit over this period of €45k based on increasing of consultancy and research contracts using the pay-per-use service.



FORTISSIMO

HPC-Cloud-based monitoring of crowds

ORGANIZATIONS INVOLVED

DFRC is a leading centre for knowledge, research, and development of geospatial data. Its expertise lies in crowd monitoring and smart cities. DFRC delivers powerful end-to-end solutions using data about the location and the movement of people using a suite of tools, software platforms and applications. DFRC operates LBASense, a service which anonymously measures crowd behaviour on a city-wide scale. This information is highly valuable for services such as transportation planning, the promotion of tourism and public safety applications. LBASense, which currently operates in Bern, Zug, Skelefteå, Barcelona, Prague, and Singapore, requires an extensive "fingerprinting" of the cellular network radio signals in order to calculate the location of mobile phones.

End User

DFRC from data to knowledge

www.dfrc.ch

HPC Provider

HLRS

www.hlrs.de

THE CHALLENGE

The challenge of this experiment was to improve the process of "fingerprinting" a city, by offering a near-real-time simulation to determine the best locations at which to take measurements. Doing this was expected to reduce the time to map a city from weeks to days. To respond to this challenge, the mapping algorithm, which determines the best locations for measurement points, would need to be ported to a Cloud-based HPC system.

The challenge of this experiment was to improve the process of "fingerprinting" a city, by offering a near-real-time simulation to determine the best locations at which to take measurements.

Existing simulation tools have been ported to enable them to run on an HPC system with many processors.

THE SOLUTION

Existing simulation tools have been ported to enable them to run on an HPC system with many processors. Detailed tests have been made to verify the correctness, accuracy and stability of the ported algorithm and to determine the speed up of the implementation. The outcome of the experiment has been a high-performance combined simulation tool that reduces the deployment time of LBASense. This allows DFRC to finish a single iteration of the simulation within hours as opposed to days.

EXPERIMENT #522 HIGHLIGHTS

Industry Sector: **Smart Cities**

Country: **Switzerland**

Software used: **LBASense**

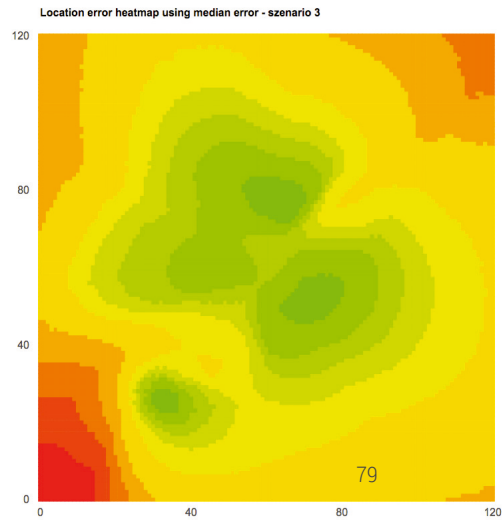
End Date: **October 2016**

BUSINESS IMPACT

The ability to access a cost-effective, one stop-shop, cloud-based HPC service has enabled DFRC to significantly reduce the deployment costs of LBASense. This saving is as a result of the reduction in time to deployment, allowing DFRC to save the costs of two weeks each for two engineers per deployment, which is approximately €25K. The results show that DFRC is able to speed up the whole process of mapping a city (i.e. 1000 base stations – 10x10 km) by a factor close to the number of processing units available. That is, with 32 processing units it is possible to speed up the computation process by a factor of almost 32. This allows DFRC to offer a cheaper, faster and more focused service, and hence to be more competitive with respect to cellular operators. DFRC expects to gain new market share, especially by being able to reduce time to market. Based on the overall costs of installing LBASense in a city, and the speed with which it can be done, DFRC expects to see a growth in its business from 20 installations in 2017 to 200 in 2021 with an overall cost saving of ~€8M.

DFRC AG
Switzerland

HLRS, the HPC provider in this experiment, benefits from the experiment through an increased knowledge about commercially relevant scenarios leading to improved offerings for a wider range of customers, which will increase its competitiveness.



FORTISSIMO

Cloud-based design of motorcycle helmets

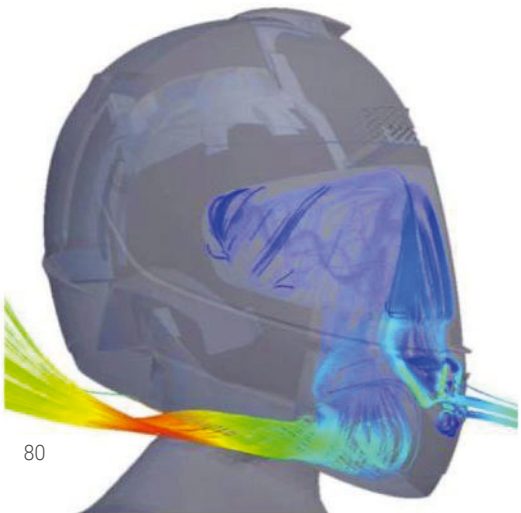
ORGANIZATIONS INVOLVED

The NolanGroup is a Mid-Cap Italian company that are one of the leading manufacturers of motorcycle helmets worldwide. Nolan produces helmets for professional, leisure and racing activities, participating in the main international motorcycle competitions. Nolan wants to enhance its helmet design capabilities to reduce costs and time to market through the use of advanced HPC-based simulation. Moxoff is an Italian SME developing mathematical modelling software, and has been in partnership with Nolan since 2010. Moxoff's projects cover a wide range of applications, including multiphysics modelling, numerical simulations, statistics and big data analytics. CASCo is a dedicated multiphysics platform developed by Moxoff to support the simulation of Nolan's motorcycle helmets.

End User	Technology and Domain Expert	HPC Expert and Provider
Nolangroup	MOX-OFF MATHEMATICS FOR INNOVATION	CINECA
www.nolan.it	www.moxoff.com	www.cineca.it

THE CHALLENGE

Nolan have only recently introduced a simulation-based approach using CASCo to simulate external aerodynamics, thermal effects, acoustics, and impacts of its helmet designs. The choice of computational platform here is critical, as the right choice can reduce compute times by orders of magnitude. The aim of this experiment is to enable advanced and fine detail simulations with feasible runtimes through the use of HPC via the CASCo platform.



The aim of this experiment is to enable advanced and fine detail simulations with feasible runtimes through the use of HPC.

In this experiment, a powerful simulation platform has been developed, which can be easily configured to provide Simulation-as-a-Service using massive HPC computing resources.

THE SOLUTION

The CASCo Multiphysics platform has been ported to an HPC system. This enables detailed models to be simulated in a simple way by those not expert in the underlying physics. This has involved the enhancement and customisation of GUIs, workflows and file formats, and the development of the interface with an HPC scheduler system. These enhancements have achieved the aim of allowing non-experts to perform detailed simulations and to make their results easily accessible and in a much shorter timescale.

EXPERIMENT #601 HIGHLIGHTS

Industry Sector:
Automotive

Country: **Italy**

Software used:
In house code

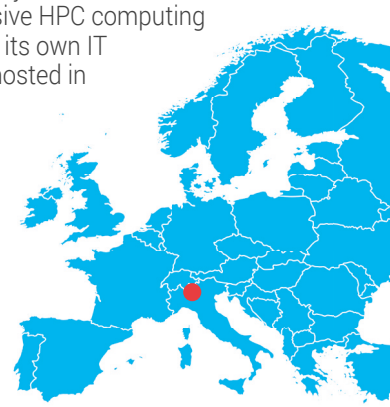
End Date:
December 2016

BUSINESS IMPACT

In this experiment, a powerful simulation platform has been developed by Moxoff which can be easily configured to provide Simulation-as-a-Service using massive HPC computing resources, even across totally different industries. Nolan can either use its own IT resources or, for time sensitive simulations, use a pay-per-use service hosted in the CINECA HPC facilities.

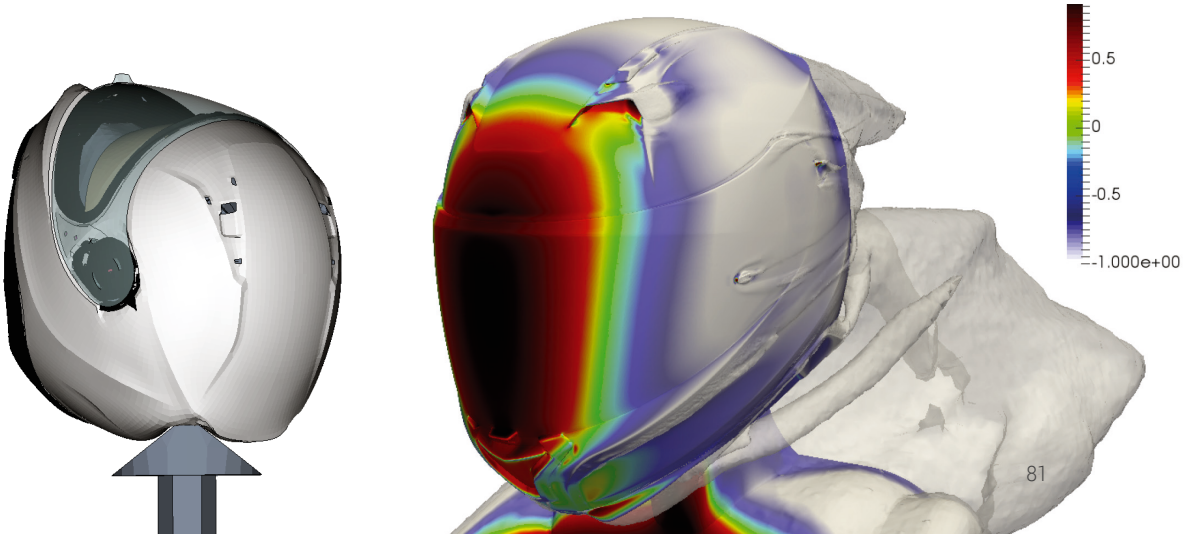
Moxoff estimates that its exploitation of the SaaS and the platform will increase its turnover by 10% and will significantly contribute to its planned growth for the coming 3 years. Furthermore, through the wider development of this platform, Moxoff will reduce its software development costs by €50K per year.

Nolan estimates that, for each new helmet developed, the use of HPC simulations will save money in physical prototype testing and final product tuning. This new approach will provide a net saving of €52K per helmet once the cost of compute cycles and software licences are deducted. Furthermore, advanced simulations will lead to a 3-month reduction in the current 15-month development cycle which can have important implications for Nolan's market impact.



NolanGroup
Italy

Finally, this experiment comprises a success story for CINECA, in the application field of integrated multiphysics workflows, that is estimated to bring at least two new SME customers per year, creating an approximate 5% increase in commercial revenues.



FORTISSIMO

Simulation of High-Performance composite materials in the automobile industry

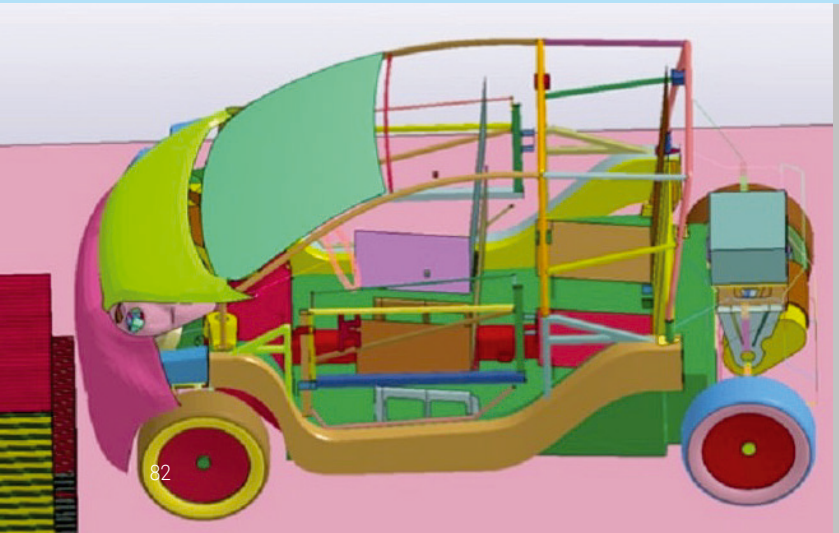
ORGANIZATIONS INVOLVED

Formtech Composites specialises in the design, engineering and manufacture of lightweight composite structures and components, using carbon, glass, aramid, and other high-performance fibres. It collaborates with leading automotive, motorsport, military and aerospace partners to take forward composite research, engineering, prototyping and serialised manufacture. The industrial use of carbon-fibre-reinforced plastic (CFRP) is being driven by the increasing use of composites to reduce weight in the automotive industry, where cost and performance are major factors. With world-wide tooling budgets running into hundreds of millions of Euros, simulating processes and manufacturing times are central to delivering high-quality products at an affordable price.

End User	ISV	Domain Expert	HPC Provider
FORMTECH COMPOSITES	Fraunhofer SCAI	KIT Karlsruhe Institute of Technology	GOMPUTE A GRIDCORE COMPANY
www.formtech-composites.co.uk	www.scai.fraunhofer.de	www.fast.kit.edu/lbt	www.gompute.com

THE CHALLENGE

To make high performance CFRP economically viable for large scale production, it is essential to reduce overall development and production costs. The big advantage of a continuous virtual CAE chain would be the acceleration of the development loops. The objective of this experiment was to develop a CAE chain which could reduce the overall development and production costs through the implementation of the associated development loops.



The platform developed increases the quality of design of composite materials, adds functionality, and reduces the engineer's work load. It shortens simulation times from days to hours whilst offering more detailed simulations.Using simulation leads to less material usage, due to the reduced need for physical prototyping and mechanical testing.

THE SOLUTION

KIT, the domain expert, working with Fraunhofer SCAI, has developed a prototype simulation platform which allows the user to plan manufacturing processes and predict the final structural performance of a material. An integrated workflow to optimise the design of CFRP components has been developed, which uses the prototype from KIT and Fraunhofer SCAI. It is accessible through a web based interface and runs on a Cloud-based-HPC system at Gompute, which can easily satisfy the necessary compute requirements.

EXPERIMENT #602 HIGHLIGHTS

Industry Sector: **Manufacturing**

Country: **United Kingdom**

Software used: **In house code**

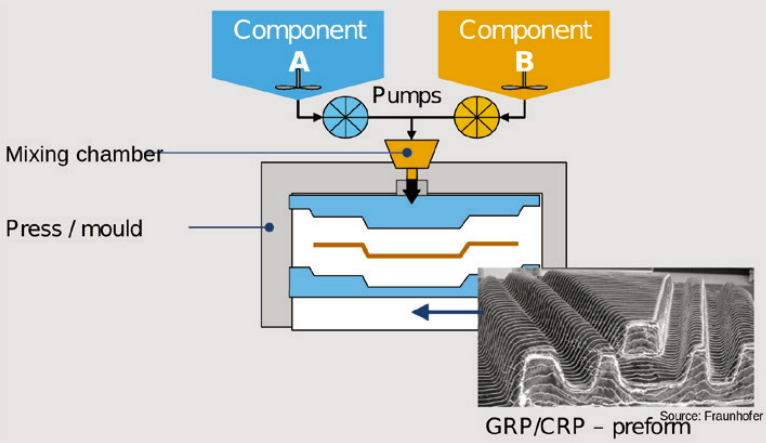
End Date: **December 2016**

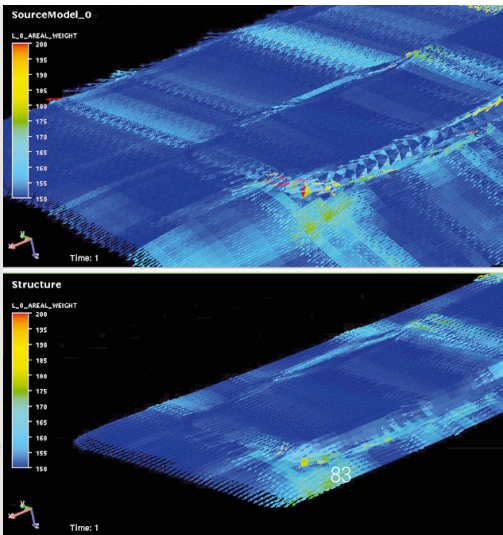
BUSINESS IMPACT

The platform developed here increases the quality of design of composite materials, adds functionality, and reduces the engineer's work load. It shortens simulation times from days to hours whilst offering more detailed simulations. Using simulation leads to less material usage, due to the reduced need for physical prototyping and mechanical testing. Formtech has already exploited the HPC capacity of Gompute to meet a project deadline where a 50% reduction in compute time was imperative, so using advanced simulation has enabled Formtech to maintain a competitive edge over other companies world-wide. As a result of using advanced simulation, Formtech anticipates an increase in revenue per annum of ~€100K. KIT estimates that, due to time saving through using HPC systems, it will increase its annual revenues by around €30K. Additionally, annual personnel costs will be reduced by €10K. Fraunhofer SCAI expects a strongly growing demand for customised and integrated CAE development. Fraunhofer SCAI estimates that, during the next 2 to 3 years, it can increase its regular annual licence revenues by ~€60K.

Formtech Composites
United Kingdom

The outcome of this experiment has given valuable feedback to Gompute. The success of this CAE chain implementation has already brought new business with annual turnovers of over €2K for the sale of compute cycles. KIT and Fraunhofer SCAI plan to offer a CFRP simulation service via the Fortissimo Marketplace starting in Q3 2017.





FORTISSIMO

Cerebral blood-flow simulations

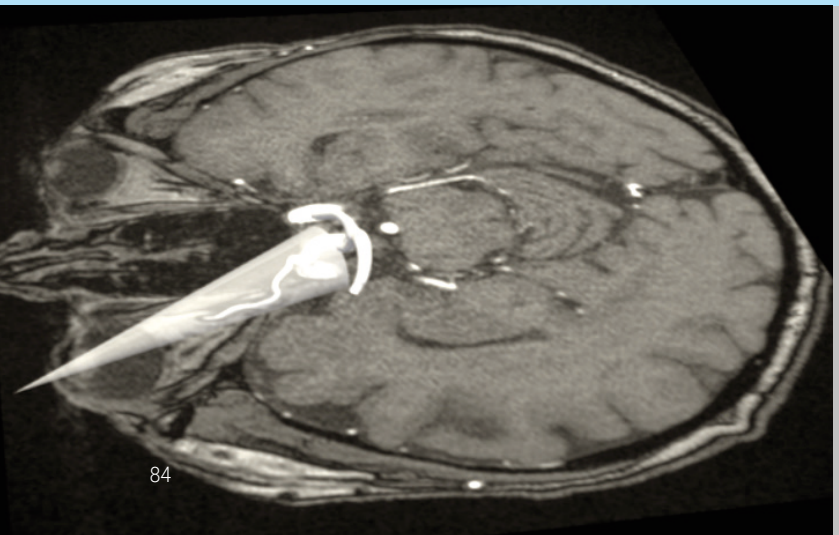
ORGANIZATIONS INVOLVED

The non-invasive accurate and quick measurement of the intracranial pressure (ICP) is of paramount importance for the diagnosis and treatment of neurological diseases, brain injuries and other neuro-pathologies. The world's first accurate, non-invasive ICP measurement device, based on two-depth ultrasound Doppler technology, has been developed by a Lithuanian SME, Vittamed. The Simula Research Laboratory was founded in Norway in 2001. Its main objective is to create knowledge about fundamental scientific challenges of genuine value for society. Simula has developed leading-edge blood flow models. The use of these models in the simulation of ICP requires the use of HPC. The implementation of these models on a Cloud-base-HPC system is the objective of this experiment.

End User	HPC and Application Expert	Provider and Host Centre
VITTAMED	simula	CINECA
www.vittamed.com	www.simula.no	www.cineca.it

THE CHALLENGE

The challenge facing the partners in this experiment was to create mathematical models and develop the necessary software tools to enable simulations of cerebral blood flow in the ophthalmic artery. The computational requirements of this made it necessary to adapt the software tools to run on an HPC system. The goal was to demonstrate the feasibility and benefits of such simulations via a pay-per-use Cloud-based-HPC solution.



The challenge facing the partners in this experiment was to create mathematical models and develop the necessary software tools to enable simulations of cerebral blood flow in the ophthalmic artery.

An internal Carotid/Opthalmic Artery model has been developed, based on MRI imaging, and used to simulate blood flow. This model has been tested and optimised to run on a multi-processor HPC system.

THE SOLUTION

An internal Carotid/Opthalmic Artery model has been developed, based on MRI imaging, and used to simulate blood flow. This model has been tested and optimised to run on a multi-processor HPC system. It will be used by Vittamed in the future development of its non-invasive ICP measurement technology. Simula has written and tested the necessary software tools needed to implement the required simulations. These tools enable the efficient implementation of the model on an HPC-system.

EXPERIMENT #603 HIGHLIGHTS

Industry Sector: **Health**

Country: **Lithuania**

Software used: **In house code**

End Date: **December 2016**

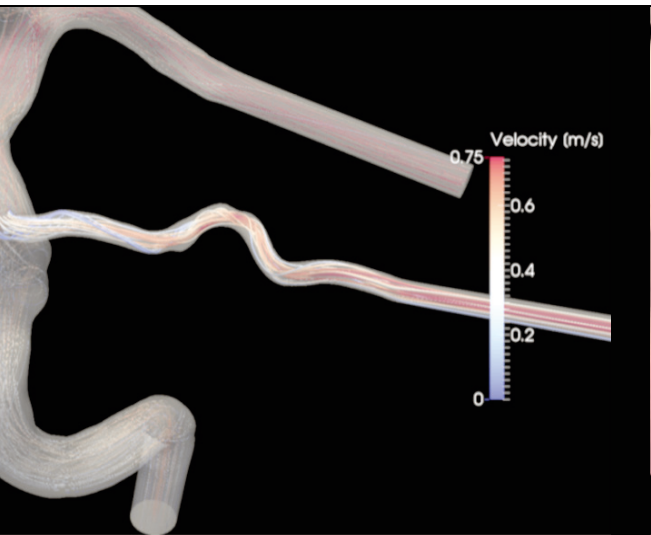
BUSINESS IMPACT

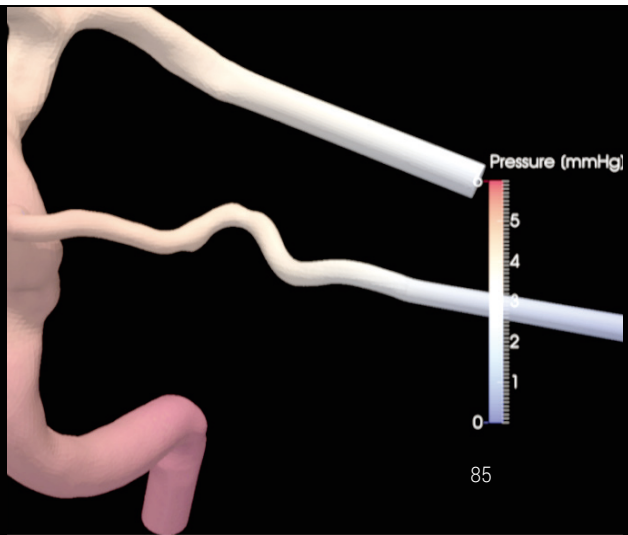
Vittamed can now reduce their time to market due to shorter simulation times. This will also allow them to design more accurate products based on blood flow simulations - Vittamed is targeting entry to the ophthalmological market for glaucoma diagnostics, where more precise and accurate ICP measurements are needed. In glaucoma management, improved measurements of intraocular and intracranial pressure would enable the development of innovative screening technologies and treatment methods. Vittamed can gain a significant commercial benefit resulting from the global expansion of the market for ICP diagnostic devices in ophthalmology. The global market for ophthalmic diagnostic equipment is estimated to reach $947M in 2017. The new market niche for SME in ophthalmology will create a commercial opportunity with an estimated potential of more than €100M per year.

Vittamed
Lithuania

Simula Research Laboratory will exploit the results of this experiment by developing research projects with industrial, clinical, and scientific communities across Europe and beyond. The open-source solver developed is an attractive alternative to commercial solvers because there are no associated licence fees.

The results of the experiment will support the HPC cloud provider, CINECA, in offering its services to the biomedical market, enabling SMEs to benefit from HPC-based simulation.





FORTISSIMO

Cloud-based simulation of complex fluids

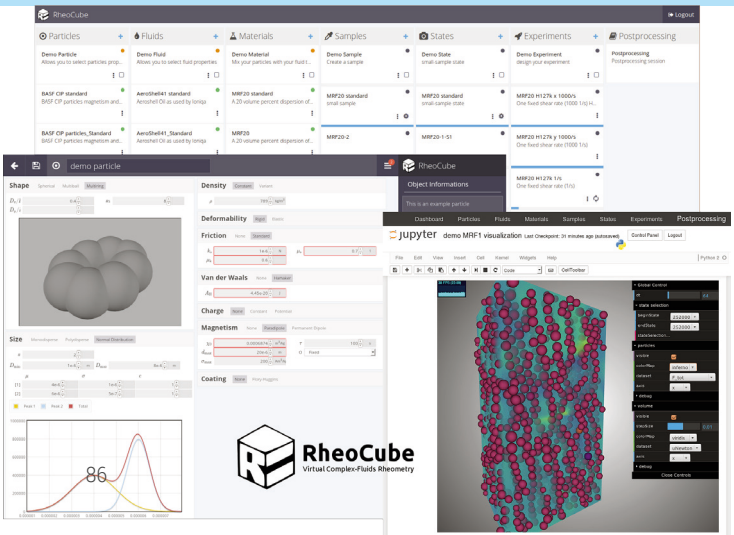
ORGANIZATIONS INVOLVED

Ioniqa, a Dutch SME, specialises in the development of MSMs (Magnetic Smart Materials) used in various mechanical, chemical processes and a range of applications including automotive and seismic shock absorbers. Ioniqa has developed a PET-recycling process involving MSMs to degrade coloured PET waste into 'virgin quality' raw materials, competing with oil-based PET in both quality and costs. With this game changing technology Ioniqa has found a profitable solution for almost a quarter of all plastic waste in the world. The modelling of Magnetic Smart Materials and Processes is very demanding involving the simulation of the microstructure of complex fluids and its effect on transport and rheology. Electric Ant Lab, a Dutch SME, has developed a software package called SuSi which allows to perform such simulations.

End User	ISV	HPC Expert and Provider
Ioniqa Technologies	Electric Ant Lab Scientific Modeling & Simulations	SURF SARA
www.ioniqa.com	www.electricant.com	www.surfsara.nl

THE CHALLENGE

Electric Ant Lab (EAL) has developed HPC software for the detailed simulation of complex fluids. The high-fidelity simulation of an MSM, as needed by Ioniqa, requires a resolution of smaller than 1µm in space and 0.1µs in time. Simulations of a material sample of 1mm3 and a physical time span of 1 second with this resolution would take around 10 years on a single CPU-core. State-of-the-art HPC resources with high-end GPGPU accelerators are required to bring the total runtime of complex-fluid simulations down to an acceptable timescale of 1 or 2 days.



Part of the difficulty of this experiment was that materials scientists need access to high-performance resources to carry out complex-fluids simulations. RheoCube as a virtual material lab solution was developed with experimental scientists as users in mind. As a result of this experiment, RheoCube can be offered as a SaaS, making HPC simulations of complex fluids accessible to SMEs in an affordable way, thus giving them a valuable tool for innovation.

THE SOLUTION

A user interface has been developed within the RheoCube environment, which emulates a "wet lab" familiar to material scientists. It provides a workflow that enables the user to design materials and run experiments on the HPC-cloud backend. Objects such as materials, samples, states and experiments can be intuitively managed and shared with other project members. Data analysis and visualisation tools have been integrated in the cloud-based post-processing supporting the interpretation of simulation results by the user.

EXPERIMENT #604 HIGHLIGHTS

Industry Sector:
Manufacturing

Country: **Netherlands**

Software used:
RheoCube and SuSi

End Date:
December 2016

BUSINESS IMPACT

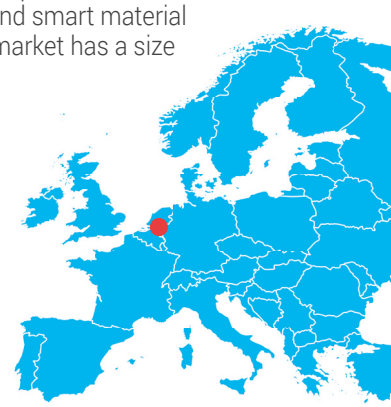
RheoCube as a virtual complex-fluids rheometry solution has the proven potential to significantly reduce R&D costs and time-to-market for complex-fluids and smart material products. With lab researchers as users in mind the total addressable market has a size of €2B.

As a result of this experiment, RheoCube can be offered as a SaaS (Software-as-a-Service), making high-fidelity simulations of complex fluids available to SMEs in an affordable way, thus giving them a valuable tool for material innovation. Using RheoCube, Ioniqa is able to reduce the costs of their MSM development by up to 90%.

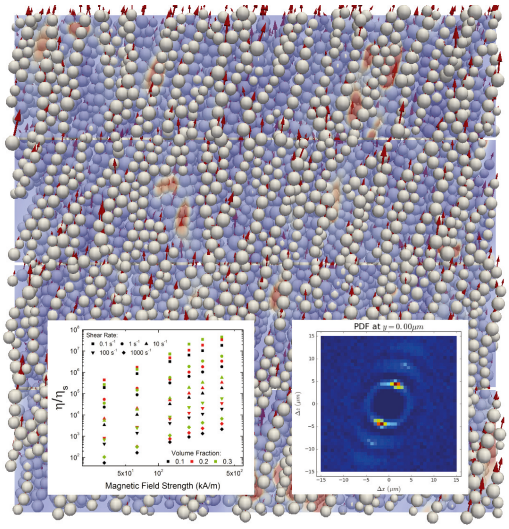
EAL estimates a total net profit of ~€400K over the next five years based on income from consulting and providing RheoCube as an SaaS, leading to a yearly profit of ~€550K from 2022 onwards.

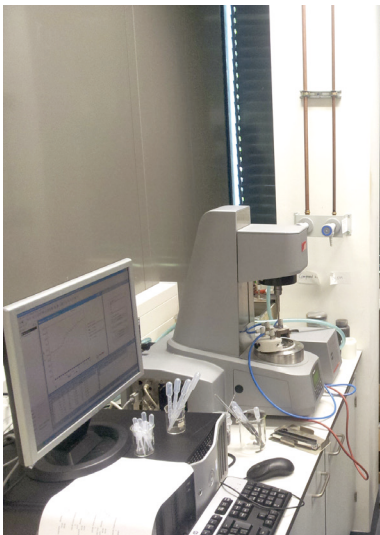
As resource provider for RheoCube, SURFsara has a projected revenue stream of ~€13K in 2017 with a doubling of revenue each year for the following 4 years.

Both, RheoCube and EAL's consultancy on HPC simulations of complex fluids and smart materials will be offered through the Fortissimo Marketplace.



Ioniqa Technologies
Netherlands





FORTISSIMO

HPC-Cloud-based seakeeping design

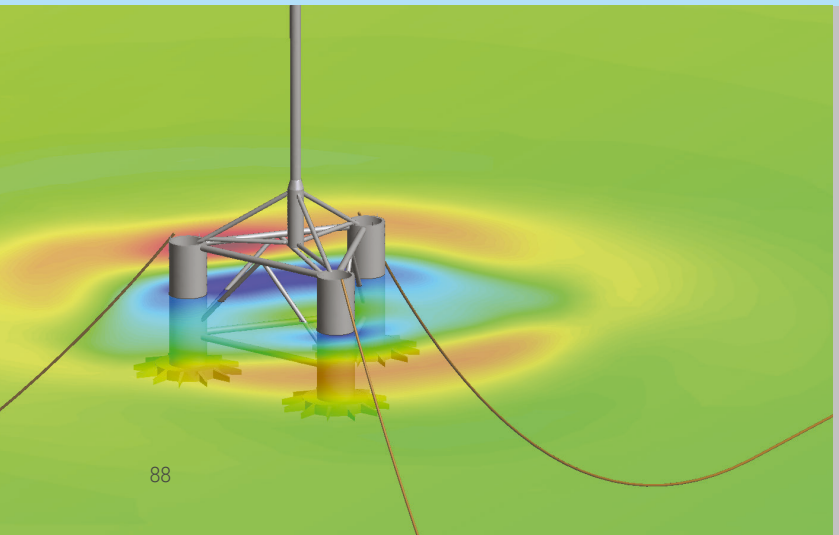
ORGANIZATIONS INVOLVED

Seakeeping is the study of a ship or marine structure that is subject to the action of waves. WAVEC is a private non-profit association active in applied research and consulting. VICUSDT operates in the shipbuilding and shipping industries, providing hydrodynamic engineering services. It also provides hydrodynamic analysis capabilities to the offshore and marine energy sector, carrying out advanced simulations of structures for the oil and gas industry. COMPASSIS is an SME ISV which provides simulation software for a variety of different engineering fields including multiphysics simulations and structural and seakeeping analysis. In this experiment COMPASSIS will enable and evaluate simulations that require intense computational and data storage resources. CIMNE, a research organisation, will also provide some of the software components required for this simulation.

End User		ISV	Domain Expert	HPC Provider
WavEC Offshore Renewables	VICUSdt DESARROLLOS TECNOLOGICOS	COMPASS www.compassis.com	CIMNE	CESGA
www.wavec.org	www.vicusdt.com	www.compassis.com	www.cimne.com	www.cesga.es

THE CHALLENGE

The challenge addressed in this experiment was demonstrate how advanced computing can optimise seakeeping design. Seakeeping simulations are large and complex, and so require significant compute power to be completed in a reasonable time. To achieve this, existing seakeeping software would need to be adapted to run on remote HPC resources. This would give WAVEC and VICUSDT a powerful design tool and a significant competitive advantage.



The challenge addressed in this experiment was demonstrate how advanced computing can optimise seakeeping design.

The use of Cloud-based-HPC simulations enables cases to be analysed far more quickly than was previously possible. Due to the speed up in calculation time, it also allows previously infeasible cases to be analysed, and solutions devised.

THE SOLUTION

The relevant software packages have been ported to the HPC-Cloud-based system and integrated into an overall simulation package. An interface between the end-user and the HPC resources has been implemented, so simulations can be run from a familiar desktop system whilst using the full capabilities of the HPC system. The simulations have been benchmarked using a model of an off-shore floating wind platform and a model of a stern trawler, which showed a speed-up by a factor of 45 on the HPC system.

EXPERIMENT #605 HIGHLIGHTS

Industry Sector:
Maritime

Country: **Portugal and Spain**

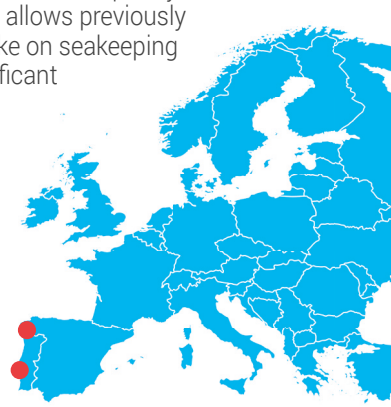
Software used:
SeaFEM and in house code XFire

End Date:
December 2016

BUSINESS IMPACT

The use of Cloud-based-HPC simulations enables cases to be analysed far more quickly than was previously possible. Due to the speed up in calculation time, it also allows previously infeasible cases to be analysed, and solutions devised. The ability to take on seakeeping cases that other companies cannot gives WAVEC and VICUSDT a significant competitive advantage in the sector.

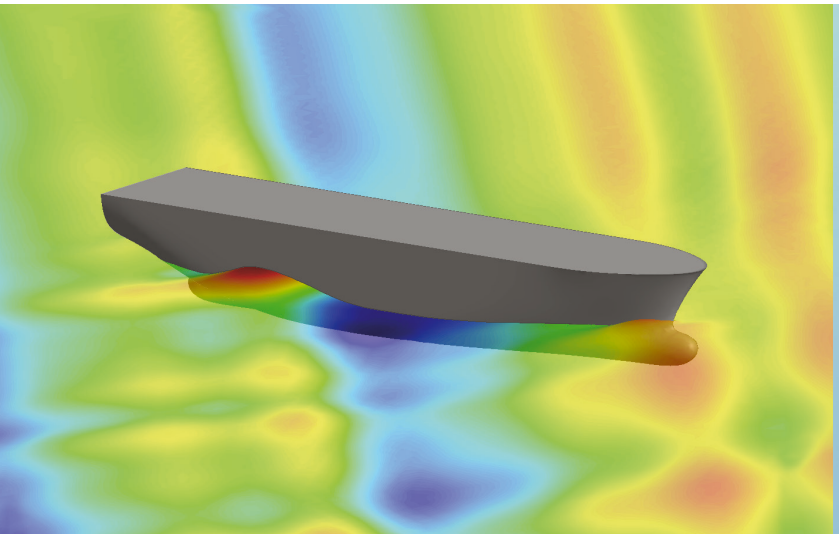
HPC-Cloud-based simulation of marine structures has the potential to expand WAVEC's activities as a consulting company specialized in services for the offshore renewable industry and other related industries (aquaculture, oil and gas). Over the next four years, from 2017 to 2020, WAVEC expects an increase in its total profit of ~€550K, based on a revenue of €1.8M, due to an increase in its consultancy activities. Over the same four-year period, VICUSDT expects an increase in its total profit of €480K, based on a revenue of €1.4M, due to an increase in its consultancy activities. Over the same four year period, COMPASSIS expects an increase in profit of €2M based on an increase in its licence sales of €4.5M.

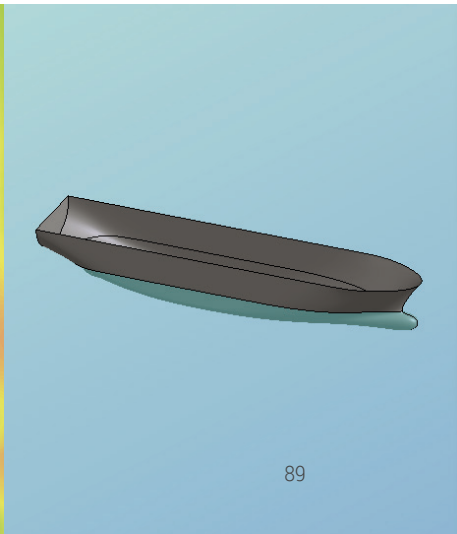


Wavec
Portugal

Vicusdt
Spain

A service for seakeeping assessments based on the results of this experiment is planned to be available in the Fortissimo Marketplace. Furthermore, CESGA proposes to offer a service in the Marketplace bases on the benchmarking of key applications and their performance and scalability.





FORTISSIMO

HPC-Cloud-based standard strength assessment of commercial ships

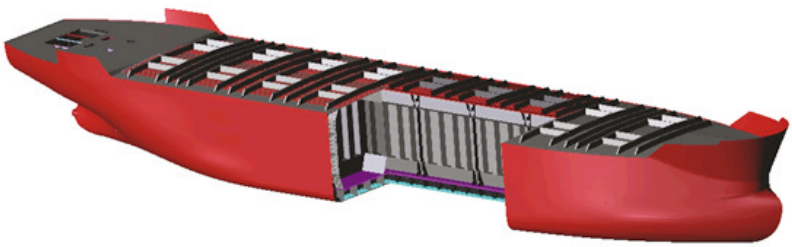
ORGANIZATIONS INVOLVED

ISONAVAL, an SME working in the areas of naval architecture and marine engineering services, is specialized in the generation of analysis and production information for ships, yachts and naval artefacts. Merchant ships (such as tankers and container ships) must undergo a standard strength assessment as a statutory requirement, and advanced simulation could be useful in standard strength assessment calculations. COMPASSIS is an SME ISV which markets simulation software, RamSeries, in different engineering fields including multiphysics simulations and structural analysis. In this experiment the expertise and software of COMPASSIS will be complemented by FNB-UPC, a University research centre developing innovative simulation tools and implementing them on HPC systems.

End User	ISV	Domain Expert	HPC Provider
ISONAVAL	COMPASS www.compassis.com	UPC	CESGA
www.isonaval.net	www.compassis.com	www.upc.edu	www.cesga.es

THE CHALLENGE

The challenge addressed in this experiment was to demonstrate the use of advanced simulation in standard strength assessments of merchant ships. Large amounts of computing power are required to complete these simulations in a reasonable time. The objective here was to adapt standard strength assessment software, RamSeries, to run on remote HPC resources, and demonstrate the benefits of advanced simulation using Cloud-based HPC for this purpose.



Large amounts of computing power are required to complete the simulation in standard strength assessments of merchant ships in a reasonable time.

The relevant software packages have been ported to an HPC-Cloud-based system and integrated into an overall simulation package.

THE SOLUTION

The relevant software packages, including RamSeries, have been ported to an HPC-Cloud-based system and integrated into an overall simulation package. An effective interface between the end-user and the HPC resources has been implemented which integrates the various software components and the HPC system. The simulations have been benchmarked using a model of the full 3D hull structure of a merchant ship. These demonstrated a significant speed-up by a factor of 42 through the use of an HPC system.

EXPERIMENT #606 HIGHLIGHTS

Industry Sector:
Maritime

Country: **Spain**

Software used:
RamSeries

End Date:
December 2016

BUSINESS IMPACT

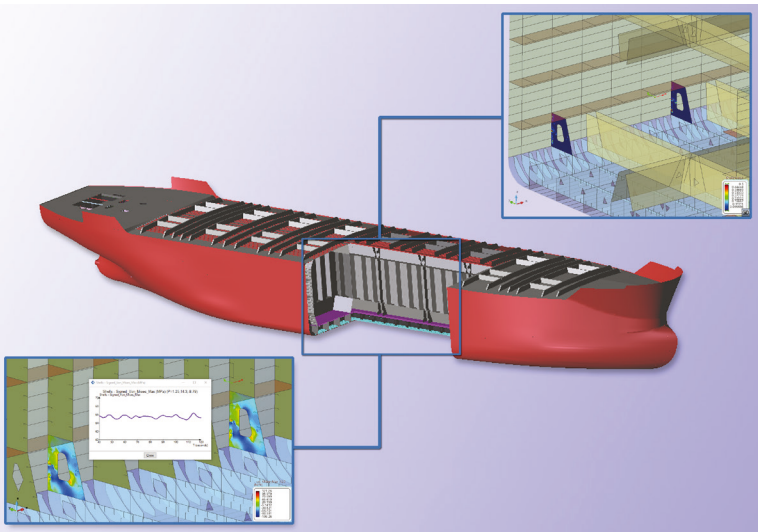
A standard strength assessment study of a tanker requires more than a week on a desktop system. Using RamSeries with HPC resources reduces this time to less than 6 hours. This significantly reduced compute time fits much better to the design cycle of companies.

COMPASSIS will increase its market by introducing the use of the RamSeries software for the direct strength assessment of a complete ship structure. This assessment requires large computational and data storage resources. COMPASSIS estimates an additional annual revenue of €24K in 2017 growing to €120K in 2020, due to the sale of direct strength assessment of complete ship structures using RamSeries integrated with a Fortissimo HPC infrastructure.

ISONAVAL estimates an additional annual revenue of €15K in 2017 growing to €60K in 2020, also due to the sale of direct strength assessment of complete ship structures.

CESGA will offer new HPC added-value services for SMEs such as benchmarking to analyse performance of HPC applications, including multi-core scalability and its dependency on different parameters such as size of the problem and processor frequency. It expects a consequent increase in its HPC services and customers. New alliances with ISV and application experts have been formed during this experiment. Revenues based on 3 benchmarking studies and an annual fee for hosting the ISV software and for infrastructure maintenance will be around €35K over a 4-year period.

Isonaval
Spain



FORTISSIMO

Cloud-based shape optimisation in manufacturing

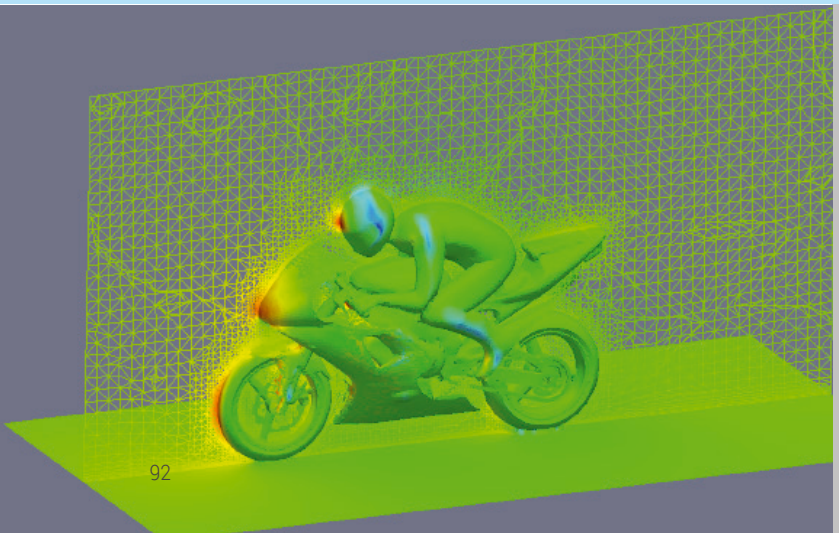
ORGANIZATIONS INVOLVED

Automobili Lamborghini is an Italian manufacturer of luxury sports cars and SUVs. Founded in 2006, OPTIMAD is an Italian SME active in shape and topology optimisation in the engineering sector. The objective of this experiment was to demonstrate that by combining High-Performance Computing (HPC) and optimisation software, there is an opportunity to change current design practices and bring automatic shape optimisation (ASO) to a wider audience of manufacturing SMEs. The goal was to develop and implement an HPC-cloud-based platform that gave the inexperienced user the possibility to optimise automatically the shape of a particular mechanical system. The aim was to text this solution using practical test cases from the end-user Lamborghini.

End User	ISV	Application Expert	HPC Provider
www.lamborghini.com	www.optimad.it	www.strath.ac.uk	www.cineca.it

THE CHALLENGE

There are several issues associated to the use of automatic shape optimization. It takes significant computational power, because many simulations need to be evaluated, and only specialised engineers can set up a viable ASO procedure. The challenge facing this experiment was therefore to develop a platform which combined Cloud-based HPC resources with in-house computing capabilities, and develop an intuitive user interface for non-expert users.



The challenge facing this experiment was to develop a platform which combined Cloud-based HPC resources with in-house computing capabilities, and develop an intuitive user interface for non-expert users.

This is an innovative and cost-effective approach to making shape-optimisation software available to SMEs.

THE SOLUTION

The SOUTH platform has been developed. This provides an integrated environment with access to optimization software and both in-house and cloud-based HPC computing resources. There is a high degree of automation, but users can interact with the optimisation process and investigate partial solutions. Users experienced in simulation but inexperienced in optimization can easily set up runs. This is an innovative and cost-effective approach to making shape-optimisation software available to SMEs.

EXPERIMENT #607 HIGHLIGHTS

Industry Sector:
Automotive

Country: **Italy**

Software used:
Camilo

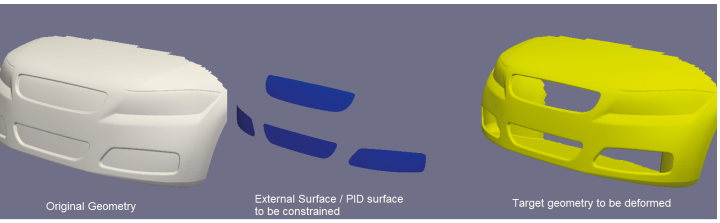
End Date:
December 2016

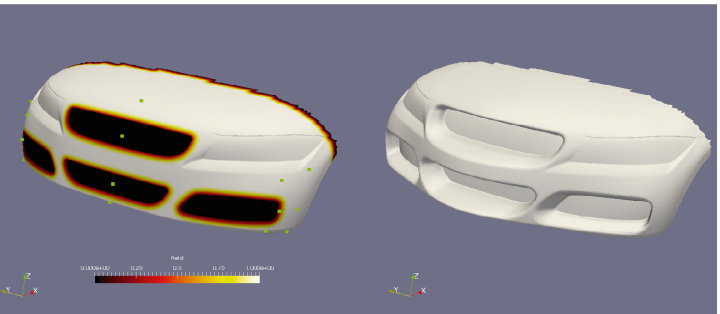
BUSINESS IMPACT

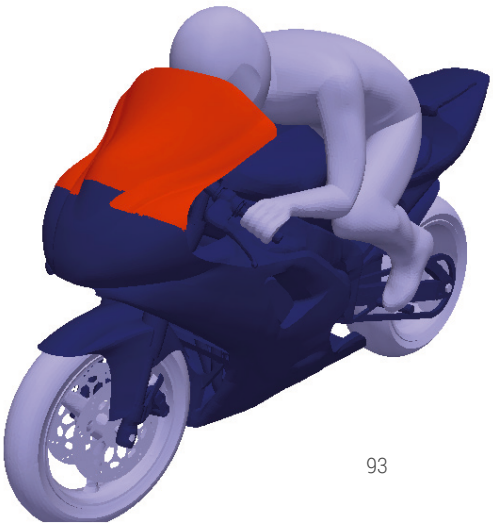
Lamborghini has its own HPC resources, but having its environment duplicated by a supercomputing-class HPC centre has several benefits. These include a reduction in development time of 40%, and the ability to dealing with peaks in the demand for computer resources by using Cloud-based HPC. The use of SOUTH reduces the effort for a typical optimisation from 2.25 person months to 2.0 days and the simulation time from 3 months to less than 10 days. Although the number of CPU hours required rises from 120K to 160K, the overall reduction in cost is ~ €18K. Generally, considering the average design activity in the company, yearly cost savings are expected to range from €140K to €200K.

Automobili Lamborghini
Italy

Until now, OPTIMAD has provided automatic shape optimization mainly as a consultancy service with typical cost to the end-user of ~ €20K to €40K per optimisation. Through the SOUTH platform, the same service may be delivered with typical costs of ~ €8K to €12K whilst keeping the same profit margins. This will permit OPTIMAD to offer a more competitive and attractive service to the market. It is estimated that in the first year through the use of SOUTH in its consultancy service, the increase in revenue for OPTIMAD will be ~ €75K with a net profit of ~ €22K. By deploying SOUTH as a scalable SaaS using Cloud-based HPC resources, OPTIMAD expects further revenues in the first year of operation to be €150K with a net profit of €37K.







FORTISSIMO

HPC-Cloud-based microscopy

ORGANIZATIONS INVOLVED

MicroscopeIT is a Polish technology-based SME company, founded in 2012, which has introduced an internet service called VIRTUM. VIRTUM provides computations in a Software-as-a-Service (SaaS) model for use in microscopy. Before this experiment, VIRTUM comprised a client-server architecture using in-house computer resources. UZH is a University laboratory making significant use of microscopic data. In this experiment UZH provided a test case in the area of fluorescent microscopy. OpTecBB, founded in 2000, is the competence network for optical technologies and micro-system technology in the region of Berlin-Brandenburg. Currently, this association has approximately 100 employees.

End User	ISV	HPC Provider and Expert	Hardware Vendor
University of Zurich[UZH] OpTecBB Nikon	MICROSCOPEIT	ARCTUR	OPTA-TECH z pasją do innowacji
www.interfacegroup.ch	www.microscopeit.com	www.arctur.si	www.opta-tech.com
www.optecbb.de www.nikon.com			

THE CHALLENGE

The challenge here was to adapt the VIRTUM service to an HPC-Cloud-based infrastructure and to test the new service on four numerically intensive test cases. The test cases were: analysis of images from remotely controlled fluorescence microscopy; processing data from super-resolution microscopy; management and visualization of spectroscopic data; and whole slide imaging and analysis in digital pathology and high-throughput screening.

Clinical laboratories and R&D departments produce and analyse huge amounts of microscopic image data. In many cases the analysis of this data can be computationally intensive requiring the use of powerful computers.

Through the use of HPC, the time taken to process test cases has been reduced from one day to a few hours, a typical reduction of 5 times.

THE SOLUTION

The VIRTUM service has been adapted to work on an external Cloud-based HPC infrastructure. Through the use of HPC, the time taken to process test cases has been reduced from one day to a few hours, a typical reduction of 5 times. A cross-platform, simple user-interface has also been developed. This supports the visualisation of data and its management from almost any device. Furthermore, the VIRTUM service provides flexible licensing models allowing end-users to optimize their costs.

EXPERIMENT #608 HIGHLIGHTS

Industry Sector: **Health**

Country: **Poland, Switzerland and Germany**

Software used: **In house code**

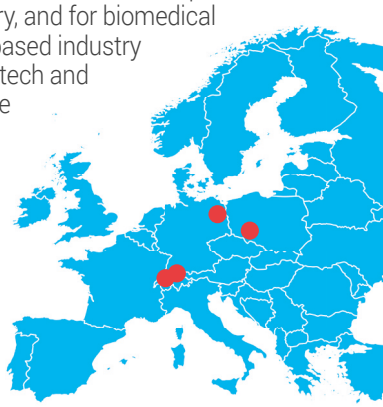
End Date: **December 2016**

BUSINESS IMPACT

Clinical laboratories and R&D departments produce and analyse huge amounts of microscopic image data. This is used in medical diagnosis, to accelerate drug discovery, and for biomedical research. To support the analysis of this data, there is a significant SME-based industry for the manufacturing of microscopes and spectroscopes serving the biotech and material science industries. In many cases the analysis of this data can be computationally intensive requiring the use of powerful computers. In this experiment, the expertise and software of MicroscopeIT has been complemented by the end-user requirements of UZH and OpTecBB and the HPC expertise of ARCTUR. This has greatly enhanced VIRTUM's availability, capabilities and affordability, particularly to SMEs.

VIRTUM-DP has the potential to remove obstacles and bottlenecks in current oncological diagnostics. Its main benefit is a significant improvement in clinical diagnosis. This is due to the increased speed and quality of diagnosis, an increased throughput of diagnoses, and more accessible storage of samples. VIRTUM-DP can result in a reduction in staff costs by 50% through increased efficiency, which in the USA alone results in an overall saving per annum of $1.7 billion.

Furthermore, there is a significant cost saving in IT infrastructure through the use of Cloud-based processing as in most cases, computer resources available via the Cloud are more cost-effective.

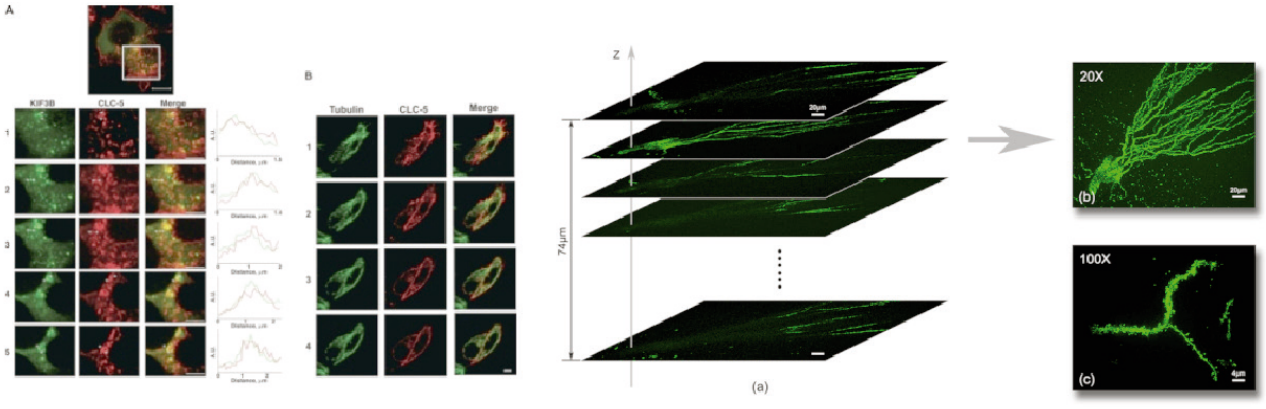


MicroscopeIT
Poland

UZH
Switzerland

OpTecBB
Germany

Nikon
Switzerland



FORTISSIMO

HPC based Delft3D service for modelling flooding, morphology, and water quality

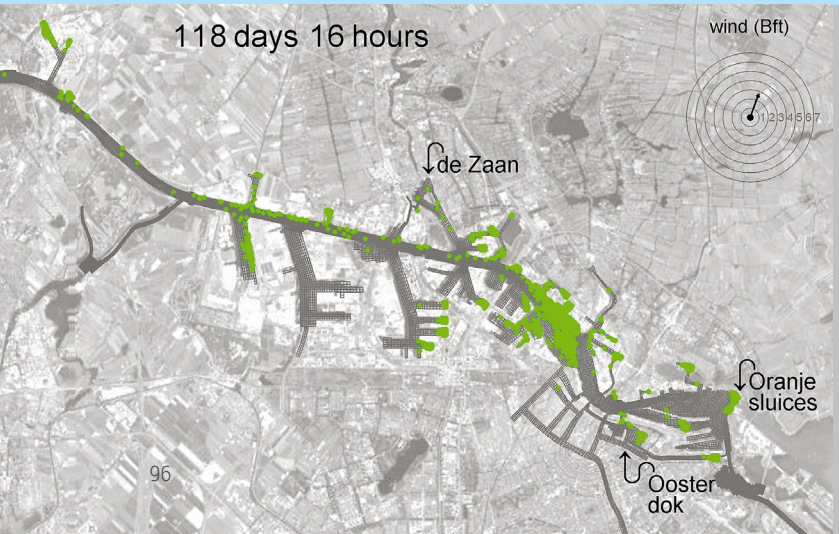
ORGANIZATIONS INVOLVED

Deltares is an independent non-profit institute for applied research in the field of water and subsurface. They have five areas of expertise: flood risk, environment, water and subsoil resources, delta infrastructure, and adaptive delta planning. They have developed a modelling suite, Delft3D, to tackle their challenges. One of the SMEs that use Delft3D is HKV Consultants. They provide consultancy services and conduct research in the fields of safety, drought and flood risk analyses for rivers, coasts, estuaries and urban water systems. Its clients include private businesses, governments, research institutes, and regional water authorities worldwide. For their consultancy services and research, at the moment, HKV runs Delft3D on local desktop machines and clusters.

End User	Domain Expert and ISV	HPC Expert and Provider
HKV CONSULTANTS	Deltares Enabling Delta Life	SURF SARA
www.hkvconsultants.com	www.deltares.nl	www.surfsara.nl

THE CHALLENGE

Delft3D has been open source since 2011 and is used worldwide. It consists of modules for modelling hydrodynamics, waves, morphology, water quality, and ecology. However, to improve the quality of its work, HKV needed easy access to a version of Delft3D that could scale to available hardware resources in a flexible way. The objective was to develop a pilot version of Delft3D-as-a-Service (DaaS) that could run for remote use by HKV.



The objective was to develop a pilot version of Delft3D-as-a-Service (DaaS) that could run for remote use by HKV.

Delft3D has been optimized for large-scale HPC, which is necessary for the coupled modelling involving different Delft3D modules, and for the highly detailed modelling increasingly required by SMEs.

THE SOLUTION

The official Deltares version of Delft3D has been installed and certified at the HPC systems of SURFsara. A portal for DaaS has been developed, with a command-line interface with extended options and flexibility available for experienced users, and a simpler, web-based interface available for newer users. Delft3D has been optimized for large-scale HPC, which is necessary for the coupled modelling involving different Delft3D modules, and for the highly detailed modelling increasingly required by SMEs.

EXPERIMENT #610 HIGHLIGHTS

Industry Sector: **Civil Engineering**

Country: **Netherlands**

Software used: **Delft3D**

End Date: **December 2016**

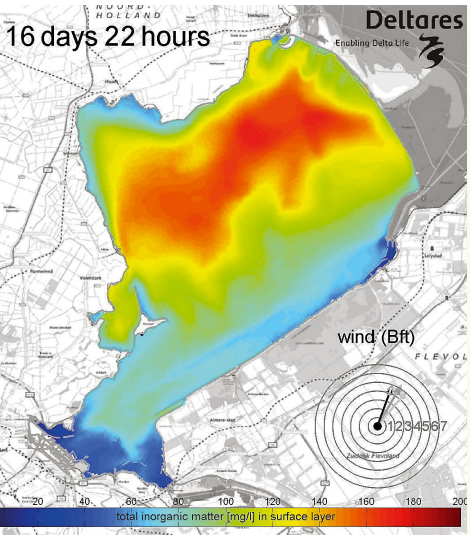
BUSINESS IMPACT

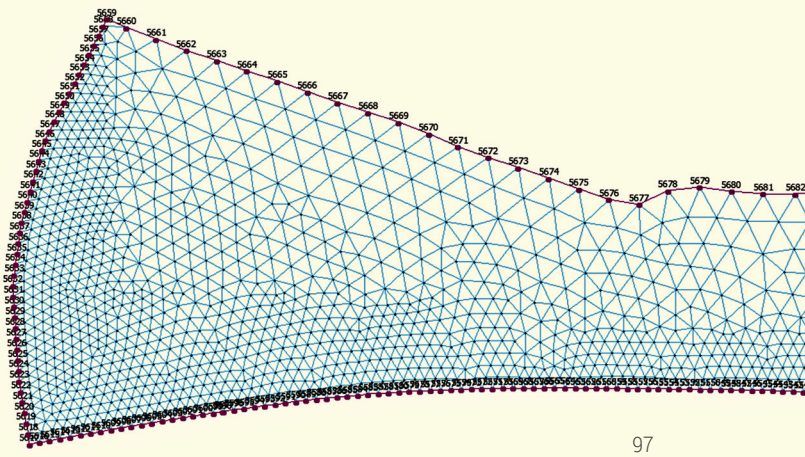
DaaS opens new possibilities for SMEs such as HKV, because it offers quick, efficient, and flexible access to HPC hardware resources for modelling and simulation using Delft3D. This Fortissimo experiment served as a starting point for gradual transition for current Delft3D users and growth model for new Delft3D users worldwide. Deltares and HKV themselves are already involved in further projects using Delft3D running on remote HPC systems.

HKV
Netherlands

Deltares expects additional revenues of about €70K per annum due to an increase in the use of (certified) Delft3D and of about €500K per annum due to an increase in Delft3D-related advisory and research projects by Deltares itself. With DaaS, Deltares expects an increase of business opportunities in data and forecasting services based on Delft3D and projects related to large scale computing with Delft3D, for example for dike safety assessments.

Due to the new possibilities of DaaS for large ensemble modelling and highly detailed modeling, HKV expects additional revenues of about €100K and €30K per annum, respectively. With DaaS, HKV expects an increase of business opportunities in add-on services based on Delft3D. Furthermore, DaaS will reduce risks in projects with a lot of Delft3D modelling, with the opportunity to spend more project time on creating added value for the client.





FORTISSIMO

Cloud-based simulation of marine communication buoys

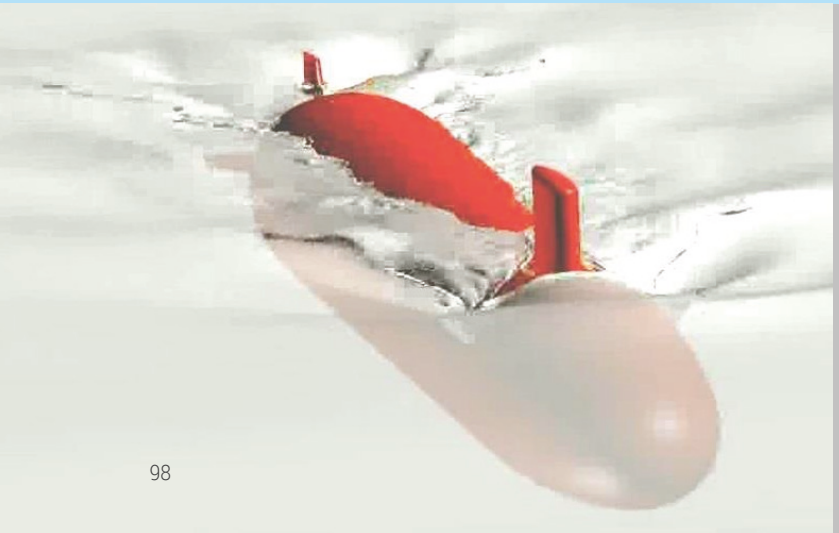
ORGANIZATIONS INVOLVED

ALSEAMAR is a French SME, specialised in the design and manufacturing of radio communication systems for both surface ships and submarines. ALSEAMAR wanted to develop a releasable, communication buoy for submarines. This experiment aimed to design such a device using HPC-based CFD. K-Epsilon is a French SME which offers CFD consulting and the development of customised software. In particular K-Epsilon develops and markets the software package K-FSI which formed the basis for the simulation model used in this experiment. In addition to this, the role of K-Epsilon in this experiment was to support the partners in the simulation of a releasable communication buoy, using Cloud-based HPC, and to demonstrate the benefits of advanced CFD simulations.

End User	Application Expert and ISV	HPC Expert and Provider
ALSEAMAR ALCEN	K-EPSILON HYDRODYNAMICS & AERODYNAMICS	Bull atos technologies
www.alseamar-alcen.com	www.k-epsilon.com	www.bull.com

THE CHALLENGE

ALSEAMAR needs to investigate the behaviour of a radio communication buoy released from a submarine. Numerical simulation is the only way to do this, because tests involving real submarines are almost impossible. This type of simulation involves a strong fluid structure interaction coupling and the use of large and fine overset meshes. Computations are required to run for multiple days to converge. To compute these cases in a reasonable timeframe, simulation software must necessarily be run on an HPC system.



Numerical simulation involves large and fine meshes. Computations are required to run for multiple days to converge. To compute these cases in a reasonable timeframe, simulation software must necessarily be run on an HPC system.

THE SOLUTION

K-FSI and FINE™/Marine (Numeca) software has been ported to the BULL eXtreme factory HPC-as-a-Service, to create an appropriate simulation model. An online solution monitor has been integrated with the eXtreme factory web interface. Because end-users such as ALSEAMAR do not possess the skills to perform simulations of such complex cases, K-Epsilon makes use of the pay-per-use HPC cloud on their behalf. Specific workflows have been developed to reduce engineering time and to feed into the ALSEAMAR design cycle.

EXPERIMENT #611 HIGHLIGHTS

Industry Sector:
Maritime

Country: **France**

Software used: **K-FSI**

End Date:
December 2016

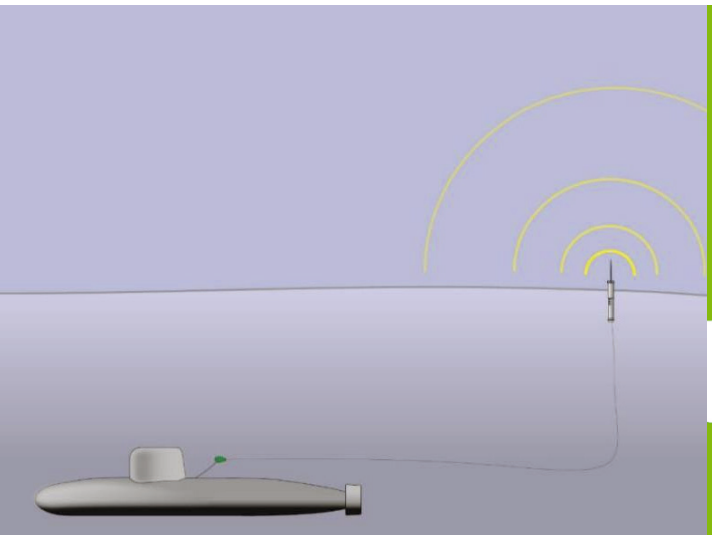
BUSINESS IMPACT

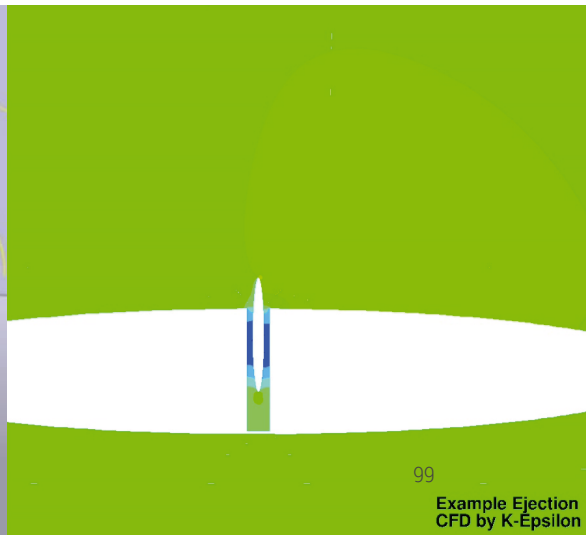
Computational Fluid Dynamics (CFD) has demonstrated its ability to model detailed scenarios with great robustness. However, some complex applications are still challenging. For such applications, High Performance Computing (HPC) is required to perform the required computations in a reasonable timeframe.

In this experiment, ALSEAMAR has developed a releasable communication buoy for submarines. The resultant revenue is estimated to be €500K in 2017 and €1M in 2018. ALSEAMAR estimates that 3 jobs will result and its turnover will increase by 20%. These figures are based on the sale of 125 units in 2017 and 250 in 2018. Through this experiment, ALSEAMAR has gained confidence in using CFD simulations to improve their design process, offering an alternative to physical tests.

Alseamar
France

This experiment enabled K-Epsilon to integrate its in-house tool K-FSI on a HPC cloud, with a pay-per-use service. The results have demonstrated the capabilities of K-Epsilon to address very complex cases with K-FSI. 2 jobs were created during the Fortissimo project, and K-Epsilon expects to create another 3 positions in a five-year plan. K-Epsilon's annual turnover is expected to increase by 8% in 2017, and by 65% over the next five years. For Bull, this experiment has been an opportunity to reach new potential customers in the maritime market. Bull will earn 20% of the turnover from simulations by K-Epsilon, through the provision of cycles via eXtreme Factory.

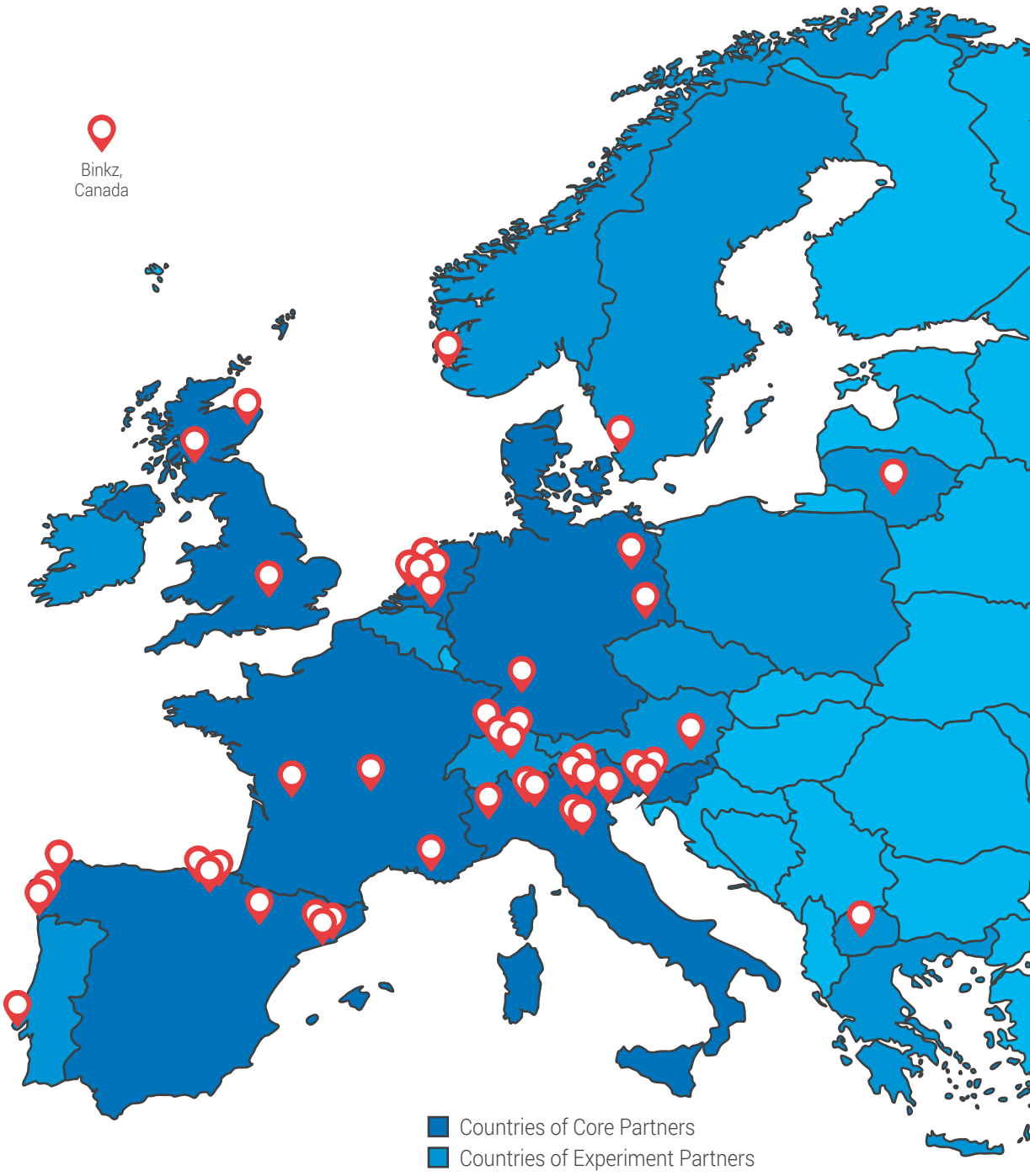




Example Ejection
CFD by K-Epsilon

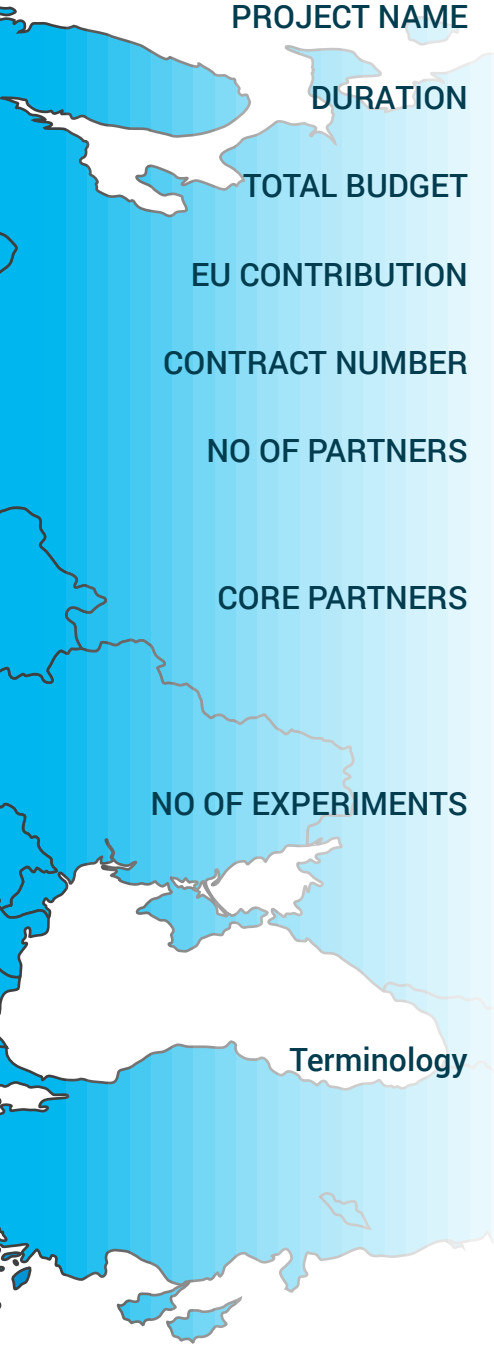
FORTISSIMO

Map of Success Stories



Projects at a Glance

FORTISSIMO



PROJECT NAME

Fortissimo - Factories of the Future Resources, Technology, Infrastructure and Services for Simulation and Modelling

DURATION

Fortissimo: July 1st 2013 - December 31th 2016

Fortissimo 2: November 1st 2015 - October 31st 2018

TOTAL BUDGET

Fortissimo: 21.7 M€

Fortissimo 2: 11.1 M€

EU CONTRIBUTION

Fortissimo: 16.0 M€

Fortissimo 2: 10.0 M€

CONTRACT NUMBER

Fortissimo: 609029 under the 7th Framework Programme

Fortissimo 2: 680481 under the H2020 Framework Programme

NO OF PARTNERS

Fortissimo: 122 in total (14 Core Partners and 108 Partners in Experiments)

Fortissimo 2: 38 in total (13 core Partners and currently 25 Partners involved in Experiments)

CORE PARTNERS

Fortissimo: The University of Edinburgh (EPCC), Arctur, Bull, CESGA, CINECA, GENCI, Gompute, University of Stuttgart (HLRS), INRIA, Intel, Scapos, Sicos BW, SURFsara and Xlab.

Fortissimo 2: The University of Edinburgh (EPCC), Arctur, Atos, Bull, CESGA, CINECA, Gompute, University of Stuttgart (HLRS), Intel, Scapos, Sicos BW, SURFsara and Xlab.

NO OF EXPERIMENTS

Both phases comprise in total 77 experiments, of which 53 have already finished and 24 are currently running. The first phase included 53 experiments in total, 33 of which were added as the result of two open calls. The second phase (Fortissimo 2) includes currently 24 experiments, 10 of which have been added through the first open call from early 2016. It is expected that the second open call (from late 2016) will add at least another 10 experiments to Fortissimo 2.

Terminology

Experiment: A end-user-relevant case study demonstrating the use of Cloud-based HPC and the benefits it brings to the value chain from the end-user to the HPC-infrastructure provider.

Open Call: Is a call for proposals made by the Fortissimo project for new experiments to add to the current portfolio. The call is aimed at involving additional end-user partners and their business relevant experiments.

Success Story: Is a resumé of an experiment that has been conducted within the Fortissimo project. This resumé focuses on the business benefits resulting from the experiment.

ICT Innovation for Manufacturing SMEs
www.i4ms.eu

Seventh Framework Programme
www.cordis.europa.eu/fp7

Horizon 2020
www.ec.europa.eu/programmes/horizon2020/

European Commission
www.ec.europa.eu

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For further information, please visit:

www.fortissimo-project.eu

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