HPC-Cloud-based design of centrifugal pumps

Fortissimo Experiment Facts:
- Segment: Industrial Machinery
- Application Domain: CFD
- Application: ANSYS CFD

The Company

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. Numerical simulation has become an important and common tool for pump designers. Many tasks can be solved much faster and cheaper numerically than by means of experiments and, most important, the complex internal flows in water pump impellers can be predicted well.

The Challenge

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. This approach is quite prohibitive for a typical SME which has neither the technical expertise nor the computing resources to carry out such a simulation. The challenge is to demonstrate 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 Solution

A simulation model has been implemented for a centrifugal pump using a commercially available software package. This model has been developed to run on a Cloud-based HPC system. Through a series of experimental runs the benefits of simulation using Cloud-based HPC system have been demonstrated.
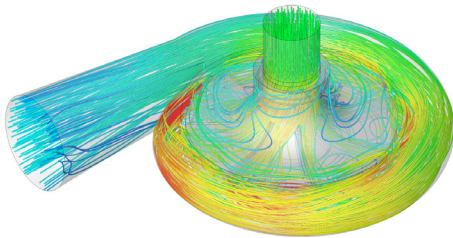
The Benefits

The test runs have shown that the use of HPC-based simulation using a Cloud and external expertise results in a return on investment in less than six months. That is the design and optimisation of a single pump can be completed in 6 months rather than in the usual 2 to 3 years. This improved design process using simulations can give Enginsoft a significant commercial advantage. 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.

The Fortissimo Project

Fortissimo is a collaborative project that enables European SMEs to be more competitive globally through the use of simulation services running on a High Performance Computing cloud infrastructure. The project is coordinated by the University of Edinburgh and involves 123 partners including Manufacturing Companies, Application Developers, Domain Experts, IT Solution Providers and HPC Cloud Service Providers from 14 countries. These partners are engaged in 53 experiments (case studies) where business relevant simulations of industrial processes are implemented and evaluated. The project is funded by the European Commission within the 7th Framework Programme and is part of the I4MS Initiative.