Cloud-based simulation of pipeline components for the oil & gas industry
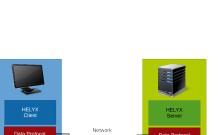
Fortissimo Experiment Facts:
- Segment: Oil and Gas
- Application Domain: CFD
- Application: HELYX

The Company

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 both fluids and mechanical components. To satisfy this 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 of oil & gas pipeline components using HELYX® on remote supercomputing facilities via a familiar desktop environment. This represents a significant enhancement for DRG's simulation capabilities in this area of application. The feasibility of the proposed solution was demonstrated by means of two simulations of oil & gas pipeline components.
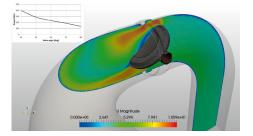
The Challenge

For many SMEs in the engineering and manufacturing sectors, in-house computing hardware is usually insufficient for solving large problems. This is the case for the CFD simulations required by DRG for oil & gas applications. Furthermore, the initial investment required to acquire in-house HPC resources is often prohibitive, in particular for businesses with occasional CFD usage. On-demand cloud-based HPC solutions, combined with software based on open-source technologies, 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 in a similar fashion as computations perform using in-house hardware resources.

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. The introduction of the client-server module in HELYX® also opens the possibility of providing this product on a short-term licence as an on-demand service, which could be promoted and delivered via the Fortissimo Marketplace and other similar platforms.

The Benefits

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 can be as much as 5 times higher than the costs associated with the equivalent cloud-based HPC solution. In addition, there is a clear benefit of faster turn-round times for the simulations, as well as the opportunity to perform much larger computations using a cloud-based HPC platform. The simulations can be as much as 10 times faster with potential savings of €2,000 per simulation per day, based on standard industry consultancy rates for relevant consultancy projects.
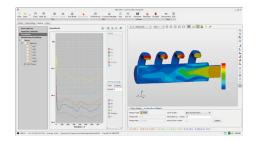
The new client-server approach in HELYX® is also expected to increase sale opportunities for ENGYS by as much as 20%, thanks to the introduction of short-terms licenses for on-demand usage of the software in the cloud. Furthermore, the possibility of providing these resources via the Fortissimo Marketplace 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.

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.