FF4EuroHPC Success Story

Cloud-Based CFD Optimization of Magnetic Drive Pumps using HPC

Organizations

CDR Pompe s.r. is an Italian manufacturing SME, a leading developer and producer of pumps for hazardous, corrosive, and highly pure liquids in the chemical, pharmaceutical, and other process industries.

EnginSoft is a consulting SME specialized in the field of Computer-Aided-Engineering with offices worldwide and partnerships with companies, R&D centres, and universities.

CINECA is the largest Italian HPC centre and cooperates with academia and industrial partners.

End User

Domain Expert

HPC Provider

CINECA is part of the Italian NCC.

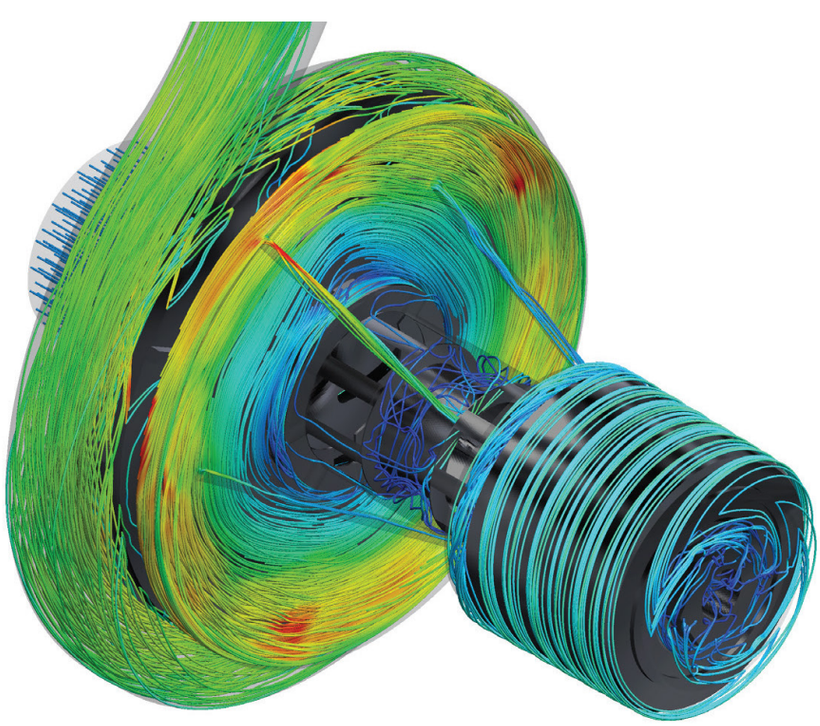
The Challenge

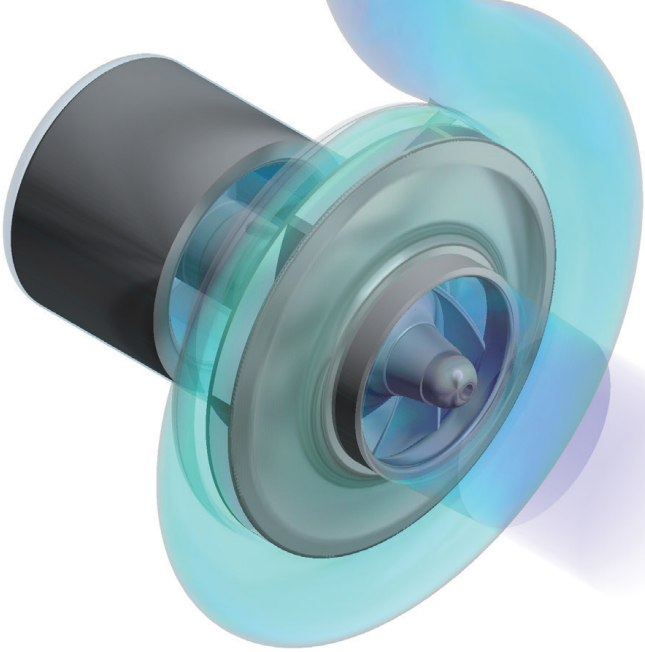
Magnetic drive chemical-process pumps eliminate the need for shaft sealing, which reduces costs while improving safety. These pumps are used to avoid leakage of aggressive fluids such as those found in the chemical, pharmaceutical, or nuclear industries.

CDR desired to re-design four sizes of this kind of pump in order to improve product performance and reduce engineering and manufacturing costs, and to comply with regulations in markets outside of Europe. The following improvements were seen as most pressing:

- Minimising axial force to avoid too much thrust against the delicate internal components, which could lead to early failure of the pump;
- Minimising cavitation and thereby decreasing the Net Positive Suction Head required (NPSH), or increasing the operating range and flexibility of use by decreasing the suction pressure necessary to ensure proper pump operation;
- Reducing energy consumption;
- Finding a compromise between the previous targets and higher efficiency.

However, the simulation tools, know-how, and HPC infrastructure required were not available to CDR.





Industry Sector
Manufacturing

Technology used:
HPC,
CFD Simulation

The Solution

CDR teamed up with EnginSoft to optimise the four pump sizes using CFD. The CFD models use a mesh with 30-70M elements and a steady-state approach. The subsequent geometry-based optimisation process (based on the Design of Experiment and Response Surface methodology) provided optimised performance maps in terms of head, efficiency, power and axial thrust (reduced by 5-20%, permitting longer pump lifetime). In total 130,000 core hours were used to investigate more than 80 design points for each pump size.

The Impact

Besides making CDR more competitive in the European market, the improved models will help to access the US market (being compliant with the local standards), with expected growth in the company's annual turnover of €1.5M after five years. The reduced maintenance need is a game changer for an SME with no maintenance support force in the US and a competitive asset in such a complex market. The HPC-based design process cuts down time-to-market by 50%. To strengthen the contribution of these tools to future business, the SME doubled the number of simulation and product design experts in the R&D team.

EnginSoft built relevant know-how regarding services, software sales, HPC consultancy, and training courses related to the pump market and to complementary market sectors.

Reduced energy consumption also leads to reduced CO_2 emissions. A better design for a magnetic drive pump prevents fluid dispersion, reducing noise and vibration, and increasing the versatility, reliability, and durability of the pump, while requiring less planned and unplanned downtime and maintenance.

Benefits

- Substantially improved energy efficiency, lifetime, and robustness of CDR's magnetic pump models.
- Improvements enable access to the US market (USD 12 Billion in 2021 in total) for CDR.
- €1.5M additional annual turnover expected after 5 years for CDR.
- €1.5M additional turnover in the pump design sector expected for EnginSoft in the next 3 years.