

The Commonwealth Scientific and Industrial Research Organisation (CSIRO)  
Financial & Business Services Case Study



## Challenge

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) needed to improve the energy efficiency of electricity-intensive industries through the design of better electrical connections using realistic simulation.

## Solution

CSIRO offered new modelling techniques with Dassault Systèmes' 3DEXPERIENCE technology including SIMULIA, the realistic simulation application, running on a high-performance computing (HPC) platform.

## Benefits

Realistic simulation has allowed CSIRO's industry partners to assess and test new electrical connection systems to significantly reduce energy consumption and greenhouse gas emissions.

## Reducing the electricity footprint

Large factories and smelters in electricity-intensive industries can use as much power as a medium-sized town, so finding ways to reduce their energy requirement is a high priority. As well as decreasing operational costs, cutting power consumption also helps to reduce the strain on electricity transmission grids and the volume of greenhouse gases emitted by generators.

Significant power savings are possible through the design and implementation of more efficient high-amperage electrical connections. However, because it is impractical to test new configurations in a functioning facility, engineers must use simulation tools to determine whether new designs will work and to calculate the power savings they will deliver to the operator.

To help industry partners in the design and testing process, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia's leading science agency, needed a way to examine the sophisticated physics involved in the electrical supply infrastructures of large-scale facilities and assess the impact of possible changes. Required features included the ability to assess fully coupled thermal-mechanical connections for the assembly of large electrical systems and fully coupled thermal-electrical-mechanical constraints that would occur during operation.

Realistic simulation plays a key role in this task, so CSIRO needed to ensure it had the tools and systems in place that would enable it to become a world leader in this specialist area of research.

"Modeling and simulation are key tools for future process and design improvement to help our industry partners increase energy efficiency," CSIRO Research Consultant David Molenaar said. "An opportunity existed to harness the infrastructure of CSIRO to develop a new, more advanced modelling solution."

## CSIRO - a national research organization

Molenaar is one of the more than 6,500 CSIRO staff housed in 55 locations in Australia and around the world. Established in 1926, the organization conducts a diverse range of research projects in a wide range of areas, including information technology, natural resources, manufacturing, agriculture, mining, and health. CSIRO works closely with industry partners to overcome real-world challenges through the application of science and technology.

The CSIRO team spent 12 months conducting a comprehensive benchmark study that examined all suitable tools available on the market. Performed in partnership with Swinburne University (Melbourne, Australia), the benchmarking process incorporated a simple contact problem and a more complex real-world problem. After assessing three potential providers, CSIRO decided to adopt Dassault Systèmes' 3DEXPERIENCE technology including SIMULIA's Abaqus finite element analysis (FEA) application for realistic simulation through its partner Simuserv, a leading provider of simulation consulting services.

"The decision to adopt SIMULIA was based on its ability to solve the fully coupled thermal-electrical-mechanical equations and to achieve convergence in highly nonlinear problems, including complex contact scenarios," Molenaar said. "We also liked its ability to scale and run on our high-performance computing platform." Other advantages included the ability of the application to support subroutines, which can be used by CSIRO clients in their own installations of the SIMULIA code. This would allow the team to develop sophisticated modules that clients could then "bolt on" to their existing, in-house systems for future testing.

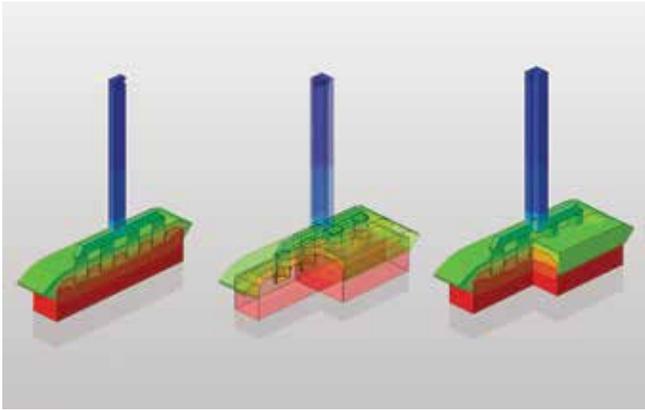
Once the decision to proceed was made, the CSIRO team focused on installing the code on the organization's high-performance computing (HPC) architecture. This architecture is a 96 compute node CPU cluster that sits within CSIRO's state-of-the-art HPC facility. The facility also incorporates a GPU cluster with 128 16-core compute nodes and 384 GPUs, which is ranked 212th in the world in terms of performance.

Work is under way to migrate the SIMULIA computations to this new GPU cluster. This vast computing capability, together with the efficient parallel performance of SIMULIA, allows CSIRO to deliver solutions to clients in short timeframes even when computationally intensive work is required.

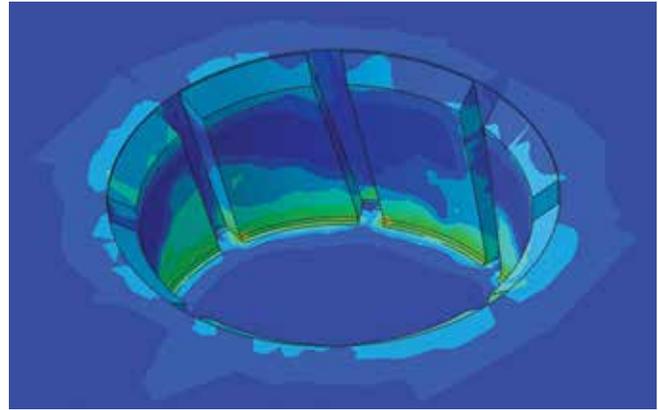


*"Australia is both a lucky country and a smart country. By harnessing tools such as SIMULIA Abaqus, we are able to compete on a world stage."*

**David Molenaar, Research Consultant, CSIRO**



Temperature distribution in the anode assembly at half rota THERMAL PHYSICS



Electrical current density in the stubhole showing sub-optimal distribution - highlighting opportunities for improvements. ELECTRICAL PHYSICS

## Helping industry become more efficient

With its 3DEXPERIENCE technology now in place, the CSIRO team is able to undertake detailed studies of industrial electrical systems and infrastructures. Indeed, the team has evolved from having no capability in this area to being recognized as a world leader in a period of just two years.

“We are now receiving calls from clients around the world who are keen to work with us to find more energy-efficient solutions for their operations,” Molenaar said. “With Abaqus as a spine on our HPC architecture, we can deliver very accurate results to our clients in commercially relevant timeframes that we simply could not have achieved before.”

The new capabilities meet the overall objectives of CSIRO. While it increases the efficiency of the Australian industry, the application also allows the research organization to play an important and valuable part in minimizing the environmental impact of energy-intensive industrial activity.

For CSIRO’s clients, the benefits of the new SIMULIA-based infrastructure are significant. They are able to gain a much clearer view of their power infrastructure’s performance and make more informed decisions about potential changes. The CSIRO team works to calculate possible performance improvements and cost reductions for each project. The end result is improved energy efficiency and a reduced environmental footprint.

Energy generators and distributors also benefit from CSIRO’s new solutions. A reduction in energy consumption by a smelter, for example, reduces the amount of power delivered over high-voltage transmission lines. As a result, the longevity of the lines can be increased, saving money and prolonging existing capital investments.

Based on its success with SIMULIA to date, the CSIRO team is planning to extend its usage during the next few years. The networked nature of the application will allow it to be utilized more broadly within the organization to run a variety of computationally intensive simulations. As client demand for its services continues to grow, CSIRO anticipates the size of the team will also increase.

“Australia is both a lucky country and a smart country,” Molenaar said. “By harnessing tools such as SIMULIA Abaqus, we are able to compete on a world stage. The support of Dassault Systèmes has been integral to the success of the implementation project and the value that is now being delivered to our clients.”

### Focus on CSIRO

Established in 1926, CSIRO is Australia’s national science agency and one of the largest and most diverse research agencies in the world.

**Products:** Scientific Research Services

**Employees:** 6500

**Headquarters:** Canberra, ACT, Australia

#### For more information

[www.csiro.au](http://www.csiro.au)

### Focus on SIMUSERV

Simuserv, a leading provider of simulation consulting services and a strategic technology partner of Dassault Systèmes, was established in 2002 to provide high-quality simulation consulting services to a range of industries, and has been involved in work ranging from small one-off consulting projects to the technical management of large onsite programs.

#### For more information

[www.simuserv.com](http://www.simuserv.com)





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