Norwegian university boosts international reputation when it teams with IBM for a new supercomputing environment

The Norwegian University of Science and Technology (NTNU), one of Norway's leading academic institutions, works with IBM to deliver world-class research.

Overview

- ***Business challenge***
  Elevate the profile of the university as a top-tier international research institution by leveraging a high performance computing (HPC) environment to improve the speed and efficiency of complex calculations
- ***Solution***
  High performance computing system built on IBM System p5™ and IBM Tivoli® software and designed, implemented and maintained by IBM Global Technology Services
- ***Key Benefits***
  Increased user satisfaction with reliable and predictable operations and improved responsiveness to increasingly complex challenges, with a capacity increase of 700 percent

Like the ancient seafarers before them, Norway's brightest are embarking on a journey to conquer new frontiers. This generation, though, is using supercomputers, not sailing vessels, to make its mark on history.

Technology is at the heart of a grand vision for Norway's future. The Research Council of Norway (RCN) launched a decade-long initiative, "Notur," to provide and operate the national infrastructure for computational science.

The ambitious agenda, designed to help the Norway researchers compete more effectively at the international level, would meet the growing demand for faster, more powerful supercomputers to tackle complex scientific problems. Large-scale, realistic and accurate modeling and simulations on this order require substantial resources, including the kind of investment in IT infrastructure many public sector institutions do not readily have available.

The RCN's plan: leverage the funding and compute resources of Norway's four key universities, allowing each to capture high-profile, prestigious research projects within its unique specialty. For the CIOs of these higher education institutions, the opportunity to participate and be recognized on a global scale is both a blessing and a curse. With fierce competition for compute resources, all eyes would be on the research projects that won the available slots, putting a university's reputation squarely on the line.

Research on a mission

At the Norwegian University of Science and Technology (NTNU) in Trondheim, CIO Roar Aspli sees his role as both a supporter of the school's mission and a change agent.

"The university wants to be considered among the most excellent institutions in its specialized area. That's why it has invested in HPC [high performance computing] infrastructure and in this project. The highest opportunity I have as CIO is in enabling the university to progress toward its goals," he says.

NTNU already had a reputation as an early adopter of technological advances, hosting Norway's first supercomputer back in 1986. Hosting the operational weather forecasting for the Norwegian Meteorological Institute (met.no), the university leveraged its capabilities to develop a strong focus on weather forecasting, thermodynamics and oceanographic modeling, which require heavy compute power. In recent years, however, as the scale of data-intensive research grew, NTNU's legacy system proved woefully inadequate to meet the demands. In order to play in the big-stakes Notur project, the infrastructure would need a massive infusion.

"I used to make a pyramid diagram, with basic IT services like e-mail and storage at the bottom, and a fully networked university at the top. I'd ask NTNU leadership, 'How high up the pyramid do you want to go? How ambitious should we be?' The answer would always depend on who we were talking to, since everyone had a different perspective," Aspli says.

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Support from leadership sets the tone, he notes. Although the Notur program draws external attention to the university, projects of this scope rarely occur in a vacuum inside an organization. Managing the expectations of internal stakeholders can be the most important role the CIO plays in an initiative's success. Part leader, part liaison, part mediator, the CIO becomes the face of the project to both the executives who fund it and the IT staff who deliver it.

"One of the biggest challenges in this environment is to prioritize competing needs. You can never please everyone 100 percent. Every professor wants to decide what to buy and how to make it work. The IT experts in HPC can't know all of the requirements of the university. Having an IT governance process in place is critical, since it allows us to centralize investment, focus on portfolio management and base our decisions on the big picture."

Looking for a partner

To move quickly on the Notur project, NTNU needed help designing, implementing and supporting the new infrastructure. For nearly two years, IBM Public Sector executives in Norway had established a friendly working relationship with the university that allowed them to gain a deeper understanding of its business objectives. Between speaking engagements at national conferences, meetings with the Research Council and regular contact with the leading universities, IBM had become a familiar face not only within NTNU, but throughout academic and industry circles.

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Still, when NTNU issued the request-for-proposal to replace its high performance computing environment, the stringent public sector process meant IBM would be strictly on an even playing field with other companies vying to help the university.

"Financial stability, experience and the ability to deliver a world-class system were very important considerations," says Aspli. "We needed to reduce our risk. But more than that, we were looking for a trusted partner to work closely with us."

Boosting HPC performance

Ultimately, only one company could meet the demands imposed by the supercomputing project. IBM was able to provide a comprehensive range of hardware, software and services to design, project-manage and install the supercomputing environment. And to help reduce operational risk, NTNU engaged IBM to provide remote hardware and software support and maintenance. Research of this magnitude is notoriously intolerant of downtime, which can affect the outcome of calculations. The IBM maintenance contract helps sustain high levels of availability and deliver service levels that had faltered with the previous system.

Although the footprint of the new system would be smaller (seven racks instead of twenty-one), NTNU planned a new data center as a concurrent project—which presented its own set of challenges because of unanticipated construction delays.

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"We couldn't let that affect the delivery of our systems," says IBM's Pia Bjernemose. "It took some careful fine tuning on our part to keep the project on track when we didn't have control of all the elements."

Aspli says, "If we were to do this all again, I think we would have an IBM project manager on the data center instead of the local vendor—someone with deeper experience in this kind of installation."

To tackle the supercomputing project, IBM assembled a worldwide team drawn from various locations and disciplines. For example, the IBM Montpellier test center conducted benchmark tests with different applications to measure the system's performance, and high-performance computing experts from other IBM labs consulted on the system's architecture.

The IBM team collaborated closely with the university's IT staff throughout the project. "Having so many smart people in a room can be challenging," Aspli points out. "You can't always foresee all the twists and turns the project will take, so it's good to have a wide range of opinions and experience. Sometimes, though, we just had to find middle ground when decisions had to be made."

Delivering on the promise

And they found it quickly. The project was delivered on time—an astonishing six weeks, followed by a four-week stability test—and on budget. In the tradition of associating names from Norse mythology with supercomputers, this one was appropriately named "Njord," after the protector of seafarers and fishermen who sends favorable winds and calm seas.

In the end, the university got a stable, efficient environment that runs, with systems that don't break down. With a 700 percent increase in computing capacity, the solution is allowing the met.no researchers to run daily weather forecasts with higher resolutions in atmospheric and oceanographic models, enabling more accurate predictions for the maritime and oil and gas industries so vital to Norway's economy.

That team, which uses nearly a quarter of the system's capacity, has reported "stable and predictable runtimes of our operational model, in accordance with the benchmarks" and availability has been deemed "excellent." Researchers also use the system for a variety of other scientific disciplines, including computational fluid dynamics, computational chemistry, applied geophysics, petroleum engineering and simulations of characteristics of superconducting materials.

"Njord" has been a hands-down hit with researchers. On any given day—and the project's resources are tracked literally by the minute—utilization of the NTNU system is very high compared to the other partner universities' installations, with lots of researchers' jobs running or in the queue.

In some cases, NTNU researchers have reduced computation time from one day to one hour. One group[1] working on molecular modeling of soft condensed matter has noted, “We have used Njord extensively during the last year .... It has certainly improved the productivity of the group.”

For another research team[2] simulating climate effects, the project encouraged a move from another Notur resource to NTNU’s system. Their requirements for high spatial resolution and long simulation time place heavy demands on the computer system. “Upgrading of the parallel computer made it possible to increase the computational speed a factor of nearly four,” they reported.

From an organizational perspective, the response has also been positive. Aspli suggests that CIOs engaged in similar projects pay attention to the impact of change on users.

“When switching over from the old system, our users experienced a lot of process changes, and they had to act in a different way. In hindsight, we should have done even more user support up front than we did to keep them informed every step of the way.”

Forging a valued relationship

More than enhancing IT performance, the project reinforced the partnership between NTNU and IBM. “They are not seen as just a technology vendor,” says Aspli, ”but an active and willing participant in our business.“ Whether it’s participating in monthly operations meetings, providing an extra resource when it’s needed or bringing in specialists in research, higher education or the oil industry, the IBM team has stayed close by.

With plenty of bright, talented resources at the university, IBM continues to bring added value, Aspli says. “We’re interested in working with someone who can talk about the next evolution, the next way of applying HPC here,” he says. “Not being a salesman, but a listener. The perspective of IBM’s other customers also helps us with our roadmap to the future. We’re looking ahead now three to five years to see where we need to be to maintain our position.”

For IBM, the value of the relationship extends like ripples on the North Sea.

“Our close cooperation with the university enhances our understanding of how the technology works in the real world,” says Frode Tveit, IBM. “And the research that happens at NTNU as a result of the technology creates the inventions we need and produces the talent that supports innovation in society. That’s something we can feel good about.”

Solution Components

Hardware

- High performance computing system with IBM System p5™

Software

- IBM Tivoli® Workload Scheduler LoadLeveler

Services

- IBM Server Services for System p
- IBM Hardware Maintenance Services

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[1,2] UNINETT Sigma AS, May 2008. Scientific Progress Report, 2006-2007; pp. 53-54, 112-113.

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