

Korea Meteorological Administration Implements Cost-saving Innovations for Electricity Usage with PBS Professional and AcuSolve



Key Highlights

Industry
Weather

Challenge
Discovering Ways to Reduce Energy Consumption While Maintaining Performance

Altair Solution
PBS Professional, Altair AcuSolve

Benefits

- Around 3% reduction in energy
- Cost savings of max \$61,000 each year
- Energy-efficient supercomputing
- Optimized A/C operations

Customer Profile:

The Korea Meteorological Administration (KMA) is an organization of Korea's Ministry of Environment with a mission to protect citizens' lives and properties from natural disasters and improve the public commonwealth in ways that support economic activities. KMA observes and analyzes meteorological phenomena on the ground, in the ocean, and in the atmosphere, while providing weather forecasts and warnings, and presents climate statistics and industrial-meteorological data. KMA exchanges meteorological data and information with domestic and foreign organizations, conducts research and technology development activities, and prompts international cooperation. With 1313 civil servants, KMA operates a total of 97 weather stations including 11 radar, 5 upper-air observation stations, and 477 automatic weather stations.

The Challenge: Cost-Effective and Energy-Efficient Supercomputing

KMA recently undertook a project to install its new Supercomputer Unit 4, a Cray® XC40™ system which, while introduced and operated at a similar budget, is expected to deliver approximately 30 times the computing speed (based on actual performance) as the previous system – an increase which is vital to KMA's supercomputing leadership.

Equipped with over a hundred thousand computing cores, Supercomputer Unit 4 runs quadrillions of computing jobs every second, which consumes a great deal of energy and causes high heat. For balanced operations, it is essential to keep the National Center for Meteorological Supercomputer (NCMS) at a cool and constant temperature; however, the increased energy consumption required

Korea Meteorological Administration

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Ha-young Oh,

Assistant Director of National Center for Meteorological Supercomputer

for Supercomputer Unit 4 puts a significant burden on A/C system operations.

To address this challenge, KMA collaborated with Cray and Altair to simulate the expected working conditions of A/C systems in its NCMS, in order to determine requirements for dealing with the additional energy consumption and cooling needs.

The Solution: Advanced Simulation Techniques Applied to A/C System Analysis

KMA selected Altair as its solution partner for this challenging and sophisticated simulation, because KMA was confident in Altair's proven know-how in both computer-aided engineering (CAE) and high-performance computing (HPC).

To ensure the highest levels of performance and reliability, KMA selected Altair's PBS Professional for its workload manager. PBS Professional is used in many Top 500 supercomputers around the world (including NASA); it is already running on 140,000 cores of KMA's Supercomputer Unit 4, as well as 90,000 cores of KMA's Supercomputer Unit 3.

“PBS Professional has been a very reliable workload manager for our large, complex supercomputing systems,” said Ha-young Oh, Assistant Director of KMA Supercomputer Center.

KMA and Altair Korea analyzed the A/C system using Altair's AcuSolve, a Computational Fluid Dynamics (CFD) solver with greater robustness and scalability than other CFD products, which can deliver more accurate results in a shorter timeframe.

The approach started with modeling a dual structure of the KMA computing room floor using AcuSolve; this analysis focused on air flow conditions and hot spot phenomenon in KMA's computing rooms, as well as the possible influence of operating a thermo-hygrostat, which can cool down room temperature.

Conventional simulations used in computer centers have been limited to applying the center's area and the positions of A/C systems to compute universal energy efficiency. However, the new simulation approach conducted by KMA in collaboration with Altair Korea is unique and innovative in that it makes a precise analysis of the A/C system case by case (for example, studying the flexibility of tiling [open/close] on the floor of computing rooms, or power input [power on/off] for components of A/C system, and more) to locate optimal positions for energy efficiency.

Ha-young Oh originally proposed the simulation approach, explaining that “Supercomputing systems are designed to simulate and forecast uncertain future conditions, for instance in

automobile or aircraft aerodynamics and geological analysis for oil drilling, as well as weather prediction. The effectiveness of such uses is well documented – therefore, I thought if we were able to get more sophisticated results from each scenario than with conventional computing rooms, KMA could forecast the minimum energy required for operating our supercomputers and could thus save energy costs.”

Dr. Kyeong Han, a manager from Altair Korea and the simulation director of this project, said: “Flow analysis is one of the advanced technologies that are widely used for CAE, especially in the aerospace and auto industries. Historically, it is the first time a computer center has adopted such an advanced simulation to analyze their own operations, so this project was very interesting to me. It is extremely innovative of KMA to propose this simulation approach.”

Structurally, KMA's Supercomputer Center consists of an upper space with computing equipment installed and a lower passage space for actively circulating air flow. For Supercomputer Unit 4, KMA had planned to set open, flexible tiles to circulate a higher rate of air flow between the upper and lower spaces. Based on this plan, Altair Korea conducted a simulation project to compare simulation results with actual measurements and thus decided to set open, flexible tiles on the floor, based on the results.

Project Summary

The Korea Meteorological Administration partnered with Altair to perform a working simulation of air conditioning systems for its Cray XC40 system, which runs PBS Professional workload managers. Based on the study, which was performed using Altair's AcuSolve CFD solver, KMA expects to save up to max \$61,000 of energy costs (reduction of around 3% of energy consumption) on a yearly basis.

“Owing to the results of Altair's sophisticated simulations with AcuSolve running on PBS Professional, KMA can now run a green IT center in a more predictable and efficient way.”

Su-hong Lee,
Deputy Director of KMA Supercomputer Center

“We measured actual room temperature and humidity in comparison with the simulation of our A/C system based on tiling in the computing rooms,” explained Ha-young Oh. “We found that the simulation results are very accurate; we also outsourced some additional simulations to Altair Korea regarding the operation of our A/C system. Ultimately, we aimed to achieve more cost-effective energy consumption and minimize spending of the governmental budget, and thanks to the AcuSolve project we can now move forward with confidence that our plan will meet these goals.”

KMA then proceeded with the next step of this project: KMA and Altair Korea set several scenarios around turning off a certain number of thermo-hygrostats to reduce energy consumption in each computing room.

Based on the prior results, KMA and Altair analyzed positions of KMA's thermo-hygrostats depending upon possible influence on cooling, so both teams could screen the thermo-hygrostats' positions with relatively low influence. They conducted a simulation of operating and shutting down the thermo-hygrostats (as screened). As a result, they determined the minimum number of thermo-hygrostats that should work in each computing room, and also discovered that even if a minimum number of thermo-hygrostats are operated, the A/C system can

work without any serious adverse effect on running the supercomputers, although the temperature rose by a small amount.

Furthermore, the teams were able to identify optimal positions of thermo-hygrostats in case it ever becomes necessary to further reduce air temperature across several computing systems. Based on a simulation of a decreased number of thermo-hygrostats with Supercomputer Unit 3 shut down, it was found that the temperature remained in the proper range. Thus, KMA was able to determine optimal settings as a reliable reference for future cost-effective operations of A/C system in its supercomputer center.

The Results: Energy and Cost Savings

Dr. Kyeong Han said, “KMA's admirable pursuit of energy savings in its supercomputing operations led to successful results, thanks to our trial. Altair has now extended its market into system consulting for computer centers to analyze operations and pinpoint opportunities to reduce energy consumption and costs.”

Hee-sik Kim, Cray APAC Presales Team Leader, said, “KMA's fourth supercomputer, a Cray XC40 system with Cray® Sonexion® storage, will provide the highest level of energy efficiency with the combination of

Cray's supercomputer and Altair's PBS Pro Work Load Manager. In addition to the success of the Cray® XE6™ as KMA's third supercomputer, we expect KMA will be even more satisfied with this new system. Cray and Altair are supercomputing leaders in the weather and climate modeling industry, and we are more than happy to have collaborated with KMA for this groundbreaking HPC simulation project.”

Su-hong Lee, deputy director of KMA Supercomputer Center, said, “Unit 4 has significantly higher energy efficiency than Unit 3, so we expect it will require less energy for the same computing workload, with energy savings at least 7 times greater than Unit 3. Moreover, if we apply the results of these A/C system simulations, we expect to save about 70 million won (around USD \$61,000) in energy consumption every year, equivalent to a reduction of about 3% of electric energy required for running our supercomputers.”

“Owing to the results of Altair's sophisticated simulations with AcuSolve running on PBS Pro, KMA can now run a green IT center in a more predictable and efficient way.”

KMA's Supercomputer Unit 4 will be installed within the next 6-8 months, based on the new specifications as a result of this project.

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About PBS Works

Altair PBS Works™ allows enterprises to maximize ROI on existing infrastructure assets. PBS Works is the most widely implemented software suite for managing grid, cloud, and cluster computing resources worldwide, voted "#1 HPC Software Product" by HPCwire readers in 2014. With products for fast, powerful scheduling, portal-based submission, analytics and data management, PBS Works is a comprehensive solution for optimizing HPC environments.

About HyperWorks

Altair HyperWorks(R) is a computer-aided engineering (CAE) simulation software platform that allows businesses to create superior, market-leading products efficiently and cost effectively. HyperWorks provides the most comprehensive, open-architecture CAE solution in the industry, including best-in-class modeling, analysis, visualization and data management solutions for linear, nonlinear, structural optimization, fluid-structure interaction, and multi-body dynamics applications.



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