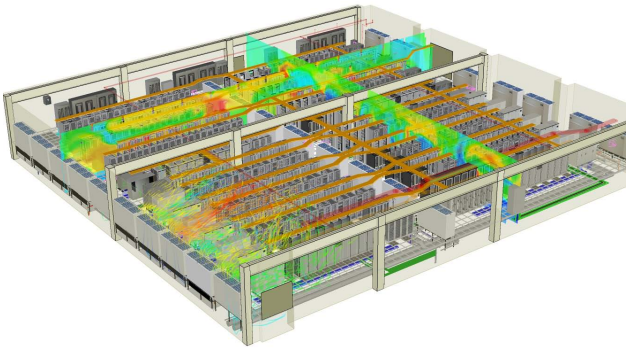
Energy Efficiency Case Study: The Dell Computer Data Center

"The power density of IT equipment increases rapidly, but modifying the supporting infrastructure of the data center is expensive and complex. Before you rearrange your data center, you had better know what you are doing. ***6SigmaDC*** allows you to test your ideas without expensive data center downtime."

Adam Greene
Dell Computer Corporation

6SigmaDC

6SigmaDC provides a fully detailed, 3D representation of an actual facility and is the basis for a holistic methodology to address design, and load growth management of the facility. 6SigmaDC is unique in its ability to predict the impact of operational changes at any time within the facility. Throughout the life cycle, from initial design, construction, commissioning, to day-to-day operations, 6SigmaDC can replace inadequate rules-of-thumb with scientific precision to manage resilience and efficiency of the mission critical facility.



- Can simulation accurately predict the benefits of cold-aisle containment and reveal areas for improvement before a new high-density computing zone is added?

- 15,480 square feet
- 4 MW of total power available
- 2.7 MW of cooling capacity
- 4,777 units of IT equipment drawing 1.5 MW
- Total energy bill: $2.3M per year
- $960k per year in cooling energy costs
- $1.3M per year in IT equipment energy costs

How Direct is Your Cooling Path?

The most efficient cooling path in a data center is direct and well-defined. Unfortunately, cooling-path considerations made during initial data-center design often involve overly simplistic assumptions, because IT equipment layout and composition are usually unknown at design time. Upon implementation, cooling paths will differ from design intent. The challenge is managing the unintended consequences of changing thermal dynamics as IT equipment and load evolve.

The Energy Efficiency Challenge

Dell's management was hoping to add a new high-density computing zone to Dell's 15,480 square-foot data center in Austin, Texas. The data center housed 577 2-post cabinets containing nearly 5,000 networking and storage equipment elements. The data center had non-uniform distribution of IT loading with high-density equipment concentrated on one side. Despite the presence of 25 Leibert 740C scooped CRAC units (capable of cooling 2.7 MW of waste heat), a handful of servers were overheating as determined by their manufacturers' specifications. The site's power usage effectiveness (PUE) of 1.86 was reasonable, but higher than the commonly-accepted ideal value of 1.6. Could simulation lead the way to eliminating hotspots, reducing inlet temperatures, improving efficiency and increasing computing capacity in Dell's data center?

future facilities

Dell Computer Case Study, cont'd

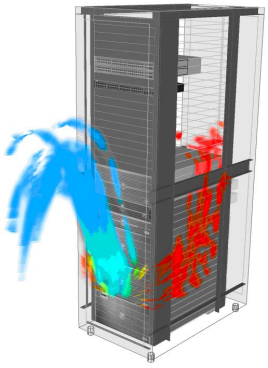
Dell Computer Corporation

Dell computer, founded in 1984 and headquartered in Round Rock, Texas, designs and manufactures computer equipment including desktop PCs, notebook computers, servers, storage devices and smartphones. With nearly 100,000 employees, annual revenue of over $50B and a best-of-breed worldwide sales and consulting presence, Dell places extraordinary demands on its internal IT operations. It is therefore not surprising that Dell never ceases to investigate new ways to make its IT operations more efficient and responsive.

Future Facilities

Future Facilities is a global, full-service organization for thermal design, optimization, troubleshooting and management of Mission Critical Facilities.

Future Facilities supplies the popular 6SigmaDC suite of data center software tools for 3D space, power and cooling design, optimization and management.



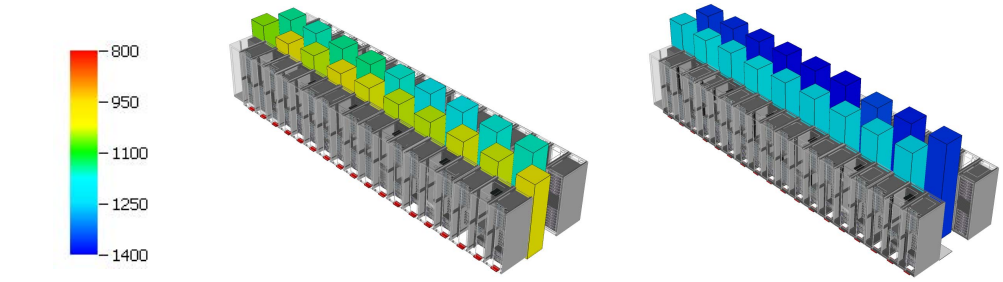
Cabinet hot spots from recirculation

The Solution Options

Dell decided to use Future Facilities' ***6SigmaDC*** data center simulation software to model the thermal properties of the data center under three different conditions: the current "baseline" configuration, the baseline configuration with proposed low-risk/low-cost "tactical" modifications, and the tactical configuration with cold-aisle containment. For each simulation, all aspects of the data center were modeled, including the nature and configuration of internal cabinets, floor tiles, structured cabling, and water-plumbing troughs below the slab. The detailed modeling produced a consistent and impressive 85-90% accuracy level across the entire data center space.

The performance of the baseline configuration was found to have deteriorated over time due to cooling-path breakdowns that resulted from prior IT equipment adds, moves and changes. 56% of the cold air from the CRACs bypassed the equipment inlets, and 54% of waste heat re-entered equipment inlets.

A number of tactical improvements were proposed and modeled, including adding skirts to the power distribution units, sealing holes behind the CRACs, and installing high-capacity floor grills. The containment simulation revealed that reducing gaps between cabinets and installing strip curtains around the cold aisles would reduce harmful recirculation.



Simulated Flow (cfm) *Before* *After*

CFD simulation enabled Dell engineers to visualize bypass airflow and redirect the air to the cold aisles.

The simulations indicated that tactical modifications would reduce recirculation from 54% to 51%, increase cabinet capacity from 2.7 kW to 3.2 kW, and increase airflow 17%. Cold-aisle containment would reduce bypass from 56% to 46% and reduce recirculation to 40%. The combined tactical and containment changes would improve PUE from 1.86 to 1.77, reducing overall power consumption by 5%. Furthermore, the simulation indicated that greater improvements could be possible if airflow capacity were increased.

The Results

- Chiller power consumption reduction of 12%, and total data-center power consumption reduction of 5% - a potential $100k annual savings.
- Capacity per cabinet increase from 2.7 kW to 3.2 kW, aiding expansion.
- Conclusions based on simulation pave the way for introduction of new high-density computing zone in the data center.

Services Available

- Software and methodology training
- Technical Support
- Software Maintenance
- Design consulting services
- Management consulting services

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