CASE STUDY

Accelerating Computer Aided Engineering (CAE) Workflows with Silicon Graphics Prism™

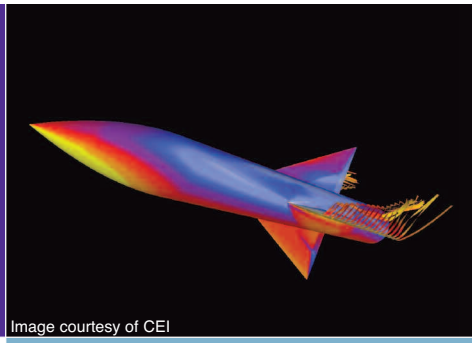

Image courtesy of CEI

Increase Team Productivity

Silicon Graphics Prism visualization systems deliver real-world benefits to your CAE department across the spectrum of CAE disciplines. This document highlights four examples to help you consider the range of similar opportunities available to you. Learn how users:

- Accelerate computational fluid dynamics workflows, saving over $1.25M, delivering a final product months earlier than anticipated and achieving a return on investment (ROI) of more than 300%
- Reduce cycle time for Radar Signature Analysis by increasing computation speed by 300%, improving the design by 10%, saving over $6M in reduced personnel, prototyping, and testing costs, and achieving more than 225% ROI
- Improve building survivability analysis and visualization and increase team productivity tenfold with a single high-performance computing, visualization, and storage system
- Optimize performance and improve bridge design while reducing overall construction costs and accelerating project completion by three months

F16 plane screen shot image courtesy of Intelligent Light

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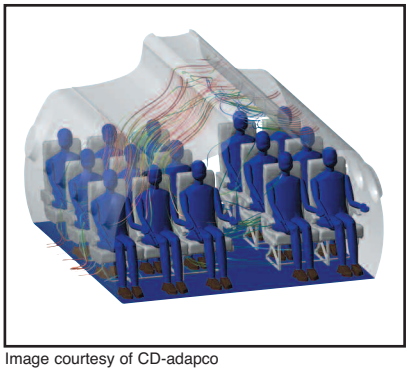

Image courtesy of CD-adapco

Example #1: An aerospace company increases its competitiveness by accelerating computational fluid dynamics workflows and reducing development costs with a datacentric solution from SGI, thus accelerating new business wins.

Challenge: A major aerospace company is under contract to deliver a new generation of cabin ventilation for an airliner that will increase air filtration, reduce weight, and cut operational costs. The new ventilation design must be delivered at a fixed price and on a given date two years in the future.

The successful completion of the design requires new global optimization of the fluid flow around the sub-assembly and through the cabin as well as the exchange of air with the external environment. To meet stringent goals laid down by the aircraft manufacturer, 100% of the design must be simulated prior to fabrication, and failure will eliminate the company from future multi-billion-dollar-per-year opportunities.

To succeed, the company must:

- Increase the complexity of flow simulation from 5M cells to over 20M cells for internal operations and over 200M cells for several different cabin configurations
- Optimize designs to reduce weight and maximize filtration
- Analyze time-varying results that range from 50GB up to 4TB in size
- Enable multiple remote teams (including the aircraft manufacturer and launch customers) to collaborate on the design and analysis
- Minimize capital investments while accelerating schedules

Solution: The solution for this large data analysis challenge is adoption of a datacentric approach to computing and visualization that gives all team members access to the data and visual results but does not move the raw data itself.

This is accomplished with:

- An SGI® Altix® 1350 cluster with a total of 128 Itanium 2 CPUs and 512GB of memory for running Star-CD from CD-adapco
- A Silicon Graphics Prism system with 16 Itanium 2 CPUs, 4 graphics pipes, and 96GB of shared memory for analyzing results with FIELDVIEW eXtreme from Intelligent Light
- SGI® Storage Area Network with 20TB of on-line storage for sharing results between HPC and visualization systems
- SGI® Visual Area Networking (VAN) for delivering the high-end results generated on the Silicon Graphics Prism to local and remote end-users or distributed collaborative teams in an interactive, on-demand manner

Results: Overall, the subsystem developer accelerates project delivery and revenue by eight months, saves over $1.25M in operational costs over a three year period, and achieves a 300% ROI. This is the result of a variety of improvements in the workflow:

- Critical path development stays on track, even as model sizes expand
- HPC results are immediately available for visualization, thus eliminating data copying and accelerating design and analysis cycles by up to 50%
- Visualization of dynamic computational fluid dynamics (CFD) results enables engineers to optimize multiple cabin configurations with a single basic design, reducing development time by six months and development cost by $500,000
- VAN based collaboration with the aircraft developer uncovers potential design conflicts before prototype fabrication, saving another two months and $150,000 and accelerating $1M in profit from the initial contract

The level of capability and collaboration shown by the subsystem developer increases the confidence of the aircraft manufacturer which offers them more business that results in $5M pre-tax profit in year three. The developer's simplified IT environment with powerful HPC and visual servers and thin-client desktops saves over $200,000 per year in operational expenses.

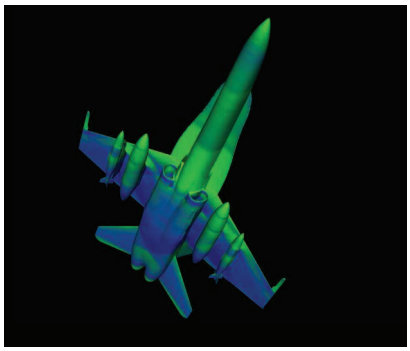

Image courtesy of CEI

Example #2: A large defense system integrator drastically reduces cycle time for Radar Signature Analysis on airplane prototypes that can elude radar detection with an integrated SGI solution for compute, visualization, and storage.

Challenge: The system integrator (SI) is in a competitive fly-off where the performance of the aircraft and its radar signature are critical evaluation criteria. In this competitive environment, the schedule for the design of this next-generation aircraft is highly compressed.

The engineering team must optimize the aircraft geometry, develop new radar-absorptive coatings, and then simulate the radar cross section for all weapons configurations and operating conditions as well as current and future radar technologies. The existing UNIX® based systems employed for this task are functional but do not allow the team enough computer simulation time within project deadlines for adequate design optimization.

Solution: Integrating visualization, large shared memory, and cluster capabilities into a single solution that is tied together by a single, shared-file system maximizes computational throughput and enables the engineering team to understand the effects of various design and process changes.

This is accomplished with:

- An SGI® Altix® 1350 cluster system with a total of 96 CPUs and 192GB of memory to simulate a large number of different Xpatch scenarios
- An SGI® Altix® 3700 with 64 Itanium 2 CPUs and 128GB of memory for producing high-resolution simulations of promising design candidates using MM3D
- Two Silicon Graphics Prism systems, each with 8 CPUs, two graphics pipes, and 32GB of memory for visualization with Tecplot. At night and on weekends, these systems are used to simulate additional Xpatch scenarios
- A shared 50TB storage infrastructure with 2GB/second of peak performance using SGI® InfiniteStorage Shared Filesystem CXFS™ to give all compute and visualization systems equal access to high-performance storage, further reducing wait times and increasing productivity
- Visual Area Networking that allows engineers throughout the organization to use normal desktop systems to access the total power of the Silicon Graphics Prism

Results: Computation time for equivalent problem sizes is accelerated 300%. A full aircraft scattering simulation at 2GHz is conducted in hours rather than days. Using accelerated computational electromagnetics simulation with SGI, the customer improves aircraft geometries and coating materials without having to perform experimentation on costly physical prototypes.

Compute acceleration allows the team to try more scenarios before arriving at a final design that hides the true size, shape, and speed of the aircraft. Using Silicon Graphics Prism and Tecplot to interactively visualize simulation results allows the team to look at larger data which provides better context for design optimization decisions. This accelerates the design process even further. The use of VAN for remote collaboration allows offsite specialists in Radar Signature Analysis to communicate proposed design changes quickly and accurately back to the development team for incorporation into the final design.

By allowing radar cross section analysts to construct, simulate, and analyze more than three times as many scenarios in a given period of time, the system integrator was able to improve the design by 10%, reduce staffing on the project by 20%, and eliminate over $4M in physical testing, resulting in a 220% ROI — independent of whether the SI wins the contract.

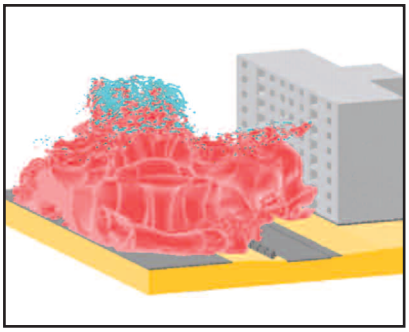

Image courtesy of ERDC

Example #3: A government agency dramatically increases its productivity when conducting advanced building survivability studies with a single cost-effective Silicon Graphics Prism system.

Challenge: A government agency is looking to conduct coupled CFD and computational structural dynamics (CSD) analysis of the blast resistance of a large number of structures from a variety of threats.

The agency is currently forced to share a remote computational resource, creating wait periods for the delivery of results from a single simulation. This makes the asking of “what if” scenarios difficult and the visualization of results virtually impossible. The quality of the numerical analysis is paramount and the agency must maximize the number of simulations, evaluations, and presentation of results that can be completed in the next 12 months.

Solution: Because the agency has a limited systems management staff, the best solution is to deploy a single high-performance solution that can simulate coupled CFD and CSD models as well as visualize the results.

This is accomplished with:

- A Silicon Graphics Prism with 128 Itanium 2 CPUs, four graphics pipes, and 512GB of main memory for running a wide range of computational software

Applications like FEFLO, LS-DYNA, and CTH take advantage of the system’s scalable CPUs and large shared memory. EnSight Gold leverages the multiple CPUs of the Silicon Graphics Prism to accelerate the extraction of key attributes from 100GB datasets that maximize understanding.

- Creation of a team room environment where the multiple graphics pipes are used in conjunction with the multi-discipline visualization capabilities of CEI EnSight Gold to understand the coupled model results. These are presented in a team room where multiple specialists gather to share their insights and come to a single conclusion faster than if they viewed the data separately
- 20TB of high-performance SGI® InfiniteStorage disk arrays attached to the Silicon Graphics Prism to maximize data access rates and data security

Results: The government agency is able to analyze four times the number of scenarios per building, accelerate the generation of individual results by 150%, and improve understanding by visualizing scenarios in a group environment. The end result is more than a tenfold improvement in the productivity and impact of the team.

The shared-memory architecture of the Silicon Graphics Prism means that analysis of even the most detailed simulations is extremely rapid because all processors have direct access to system memory.

Advanced visualization capabilities integrated into the high-performance computing system delivers maximum value to the team by using a single compute, memory, and I/O infrastructure to support both computational and visualization needs.

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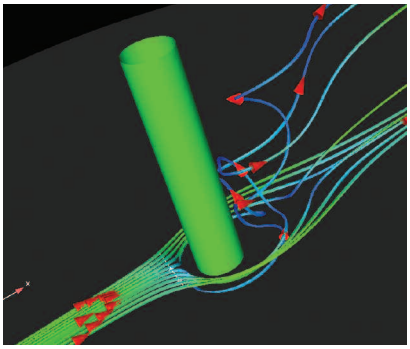

Example #4: A large building and bridge manufacturer saves time and money by using a Silicon Graphics Prism system to optimize performance for its CFD and finite element analysis (FEA) codes.

Challenge: An engineering team is challenged by accelerated schedules for the design of a second span for a popular bridge. The existing UNIX systems do not allow enough computer simulation time within the tight project deadlines to optimize the design. Of particular concern is the effect of the existing bridge pylons on the new pylons that are immediately downstream.

In order to maximize safety and avoid penalties for late construction, the design and construction firm must simulate up to fifty design options, each with twenty to thirty environmental scenarios, and then optimize the best three or four candidates.

CFD is used to calculate the hydrodynamic force of the river on the existing and new pylons. With these forces as input, a structural analysis of the new bridge pylon is then performed with structural analysis code in order to optimize the location and orientation of the new bridge pylons.

Solution: The solution is to replace the existing set of UNIX servers with a high-performance solution for simulation, several deskside visualization systems, and a SAN to provide high-performance access to shared storage.

This is accomplished with:

- An SGI Altix with 16 Itanium 2 CPUs and 64GB of memory for running the primary compute applications

The shared-memory architecture of the Silicon Graphics Prism allows FEA applications like ANSYS to run efficiently on the system. The high-bandwidth, low-latency shared memory architecture means that message-passing CFD applications like Fluent also run efficiently. Dynamic software partitioning of the Altix system allows coupled code to run concurrently while not interfering with the memory, CPU, or I/O requirements of the other application.

- Five Silicon Graphics Prism deskside systems are installed for the key CAE analysts at the firm

Each system has two Itanium 2 CPUs, 24GB of memory, two graphics pipes, and a 4Gbit/second fibre channel connection to the SAN. The CAE analysts use CEI Ensight Gold on the deskside systems with their large memory capacity to analyze the many medium-sized linked models generated by the simulations. Each Silicon Graphics Prism deskside system is also used to run small non-coupled CFD and structural simulation models at night and on weekends.

- 10TB of SGI InfinitePerformance storage is deployed with direct connections to the Altix and each of the Silicon Graphics Prism systems. This direct connection delivers up to 400MB/second of I/O to each user to accelerate the storage and reloading of results

- One of the Silicon Graphics Prism systems is also connected to two projectors in a small team room where CFD experts, structural analysis experts, architects, and traffic engineers gather to visualize cross-functional results and jointly reach decisions about next steps in their design.

The team room is also used to brief civic leaders, state environmental teams, and transportation authorities on the progress of the design and environmental impacts.

Results: The optimized configuration cuts the compute time required for the CFD analysis by over 40% and the FEA analysis by over 60%. The new systems provide an excellent platform for the required CFD analysis, which runs in a distributed-memory mode and the FEA analysis which runs in a large shared-memory mode. The individual Silicon Graphics Prism deskside systems allow CAE analysts to understand the hydrodynamic/structural interaction for specific scenarios while the link to a team room allows everyone to work together to formulate goals for the next design iteration. The combined results allow the team to quickly zero in on the optimal design and position of the second pylon. The optimized design minimizes forces on the pylon, reduces the material costs for the pylon by 30%, lowers the cost of the entire bridge by 5%, and shortens the construction time by three months.

For more information about Silicon Graphics Prism, see *www.sgi.com/products/visualization/prism/*.

To learn how Silicon Graphics Prism visualization systems can deliver real-world benefits to your CAE department, contact SGI at one of the sales offices listed below.

sgi

Corporate Office
1500 Crittenden Lane
Mountain View, CA 94043
(650) 960-1980
www.sgi.com

North America +1 800.800.7441
Latin America +55 11.5509.1455
Europe +44 118.912.7500
Japan +81 3.5488.1811
Asia Pacific +1 650.933.3000

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