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Global Headquarters: 5 Speen Street Framingham, MA 01701 USA P.508.872.8200 F.508.935.4015 www.idc.com

## WHITE PAPER

# SGI's Strategic Markets: Technical and Creative Computing

Sponsored by: SGI

Christopher G. Willard, Ph.D.

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> "Because SGI is exclusively focused on the technical computing marketplace, our systems are specifically designed to solve the world's most challenging problems." — from the SGI Annual Report for 2003

SGI is unique among major computer systems vendors in that the company's strategy is focused on meeting the needs of a well-defined set of computer users in high-performance markets. From its inception, SGI has worked closely with the scientific, engineering, and creative user communities and has been a major supplier of computer, visualization, and storage technology within these markets. The company believes that several fundamental characteristics of research and development environments lead to specialized requirements for technical and creative computing systems. These characteristics include:

- **Strategic capabilities.** Discovering new scientific principles, developing new products and processes, and managing and analyzing ever expanding environmental and security data sets are fundamental competitive assets for academic, industrial, and governmental organizations. Knowledge and intellectual property have become major factors in the generation of new wealth and the maintenance of national security. Industrial and national organizations simply cannot compete now or in the future without high-performance computational capabilities.

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- **Inherent complexity growth.** It is in the nature of scientific discovery that the solution to one problem generates a new set of questions that are generally more complicated than the initial problem. (*Once the problem is solved, it is no longer interesting.* — Ancient Cybernetic Proverb) For example, having defined a genome, scientists can begin to ask questions about which specific part of the genome code accounts for a particular trait, which protein sequences are produced by different parts of a genome, how those protein sequences behave and interact with other proteins, and so on. Similarly, when companies compete to continually develop and bring to market new products and services, the creation of one product leads to more complex requirements for a more capable follow-on product.

*Once the problem is solved, it is no longer interesting.* — Ancient Cybernetic Proverb

- **Data-intensive environments.** There has always been a close relationship between the speed of a technical computer and the size of the data sets it works on — the more data that must be processed, the faster computers must be to do

the work in a reasonable amount of time. Several factors combine to drive continual nonlinear growth in data-set size for technical applications:

- The multidimensional nature of computer models (e.g., spatial dimensions, time, temperature, pressure, velocity)
- Increasing requirements for simulation fidelity
- Multiphysics simulations

- **Expanding sources and increased precision**. As new analysis and data gathering technologies mature, they generate new and more complex data sets. Examples of this tendency toward data expansion include:

  - Medical scanning technologies that enable such devices as CAT and NMR scanners (It should be noted that these technologies have also found their way into industrial applications.)
  - Satellite imaging technology data, which is generated by visible light cameras, infrared cameras, and imaging radar
  - Digital product development, which includes solid modeling, computer-aided engineering, conceptual and large-assembly design, manufacturing process simulation, and visually collaborative design reviews
  - Environmental and weather monitoring data, which is captured by a growing array of ground-based and satellite sensors

As technical computing becomes evermore data intensive, the performance of computing environments will depend on data management capabilities. Thus, high-performance computing systems require large physical memories, fast access to memory, strong I/O performance, result visualization capabilities, and high-performance communications between all components.

SGI strongly believes that these characteristics combine to create a unique technical computing market that requires specialized solutions at virtually all levels of the technical IT infrastructure. Bob Bishop, chairman and CEO of SGI, summarized SGI's challenge as follows:

> "High-performance computing (HPC) is an ecosystem of multiple technologies, each with its own set of issues and challenges: fast processors, complex memory hierarchies, interconnect fabrics, massive storage facilities, high-fidelity visualization, networking, and multilayered software, to name but a few. A single weak factor will likely reduce the overall effectiveness of any HPC installation dramatically."

By building products designed to meet the requirements of technical computing customers, SGI has tied its success to the size, requirements, growth, and staying power of the markets that these customers populate. Therefore, it is important to

 

identify SGI's scientific, engineering, and creative users and the opportunities and challenges these users present for the company.

This paper provides a brief overview of SGI's overall strategy, examines the company's major technical and creative markets, identifies SGI's basic competencies, and examines SGI's near-term technology plans. Customer examples from SGI illustrate typical workloads in different market segments. IDC provides an analysis of market growth, key drivers in different market segments, and a review of SGI's opportunities and challenges.

## Three Ways to Look at a Strategy

SGI's strategy is best examined along three interrelated dimensions: their customers, competencies, and products.

### *Customers*

Overall, SGI is designing, developing, and fielding computer solutions to address the needs of scientists, engineers, and creatives. These strategic customer groups are briefly defined in the following:

- Scientists are people who work to expand our knowledge of the physical universe. Scientific efforts range from developing theories that describe the basic constructs of matter and evolution of the universe, to a better understanding of the genetic and biochemical nature of disease, to analysis of environmental change.

- Engineers are people who work to develop and manufacture new or better products. Engineering activities range from discovering and producing petroleum products, to improving the safety and comfort of automobiles, to developing more efficient and less environmentally costly production methods for chemicals and manufactured goods.

- Creatives are people who work to develop and manage content for entertainment, broadcast networks, and education. Creative activities range from developing animations and specific effects, to managing large digital media libraries, to acquiring and editing real-time content for distribution and broadcast.

An important intersection of these three groups can be found in the national security sector. Scientific applications range from material science, to nuclear physics, to biosciences. Engineering applications range from aircraft design, to signal processing, to medical device design. Visualization applications range from flight simulators, to command and control systems, to real-time, higher resolution image analysis.

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### *Core Competencies*

In order to provide products and solutions that are tailored to the needs of technical and creative users, SGI's strategy is based on maintaining core competencies in three major areas: high-performance computing, visualization, and high-performance storage systems.

### High-Performance Computing

The nature of technical and creative computing is to continually address the next most difficult problems. Thus, technical and creative communities are among the few groups that can easily identify problems that exceed the capabilities of current computing systems. Users regularly report that they can identify applications that would require from one to three orders of magnitude (10x to 1,000x) more computing power than what is currently available. In this case, high performance can be defined as "whatever it takes to solve the next class of problems."

The nature of technical and creative computing is to continually address the next most difficult problems.

SGI has structured its R&D and product development efforts to address the next class of problems and regularly spends about 13% of its annual revenue on research and development. In doing so, SGI is taking a philosophically different approach than the "leveraged product strategies" (i.e., using the same computer products for both technical and commercial markets, thus leveraging market volumes, and single R&D budgets) that predominate in the overall computer system market. These one-architecture-fits-all strategies assume that a single, scalable system architecture can effectively address a very broad range of markets; that is, the same fundamental system design used to run back-office operations will also work as well in the design of aircraft engines. The risk for technical users is that requirements for commercial computing will overwhelm requirements for technical computing over the long term. SGI is addressing this issue by designing systems with the sole intent of meeting the needs of technical and creative users.

SGI is taking a philosophically different approach than the "leveraged product strategies" …

At the heart of SGI's system is the SGI Numa architecture. Numa is a memory system architecture that SGI developed to build highly scalable systems with support for a single view of memory across all processor nodes (i.e., a single system image at the memory level). This global shared memory (i.e., logically shared, physically distributed memory) provides a number of advantages:

Numa is a memory system architecture that SGI developed to build highly scalable systems with support for a single view of memory across all processor nodes.

- Users can implement parallel applications using either a message-passing interface (MPI) or a shared-memory (i.e., OpenMP) programming model.
- Systems are highly scalable with servers currently configurable up to 1024 processors. SGI continues to work to extend the up limit of scalability.
- System components scale independently. That is, processors, memory, and I/O components can be expanded separately from one another.
- Programmers have a unified view of all system resources and can directly reference those resources. Similarly, systems managers view the system as one logical computer, as opposed to multiple interrelated nodes.

At a higher level, the Numa architecture can be viewed as a memory network that provides the ability to configure and reconfigure computational resources (i.e., processing, memory, I/O) to meet the specific requirements of an organization, while maintaining a single view of the resources for programming and management purposes.

 

## Visualization

*You can't give a MHz upgrade to the brain.* — Ancient Cybernetic Proverb

While computer performance is increasing nonlinearly, driven by both Moore's Law and system scalability, the performance of the human central nervous system has remained flat for the past hundreds of thousands of years *(You can't give a MHz upgrade to the brain.* — Ancient Cybernetic Proverb*)*. Technical and creative users have leveraged the increased power of computer systems by developing large and increasingly complex models for analysis. Without a tool to bridge the gap between the speed of the computer systems and the speed of the human mind, the ever-growing power of high-performance computer systems would be largely worthless. Visualization — the ability to present results of computational analysis as multidimensional images — is that tool.

In addition to visualization workstations the company provides "immersive" visualization environments …

One of SGI's greatest assets is its 3D graphics heritage, particularly in its understanding of how graphics are used to present complex multidimensional data sets in a visual and thus easily understood form. In addition to visualization workstations, the company provides "immersive" visualization environments, such as visualization walls, rooms, and caves. Visualization walls are systems large enough to allow multiple investigators to work together viewing the same visualized data at the same locations and at the same time. Rooms provide a wraparound screen providing a convenient arena for immersion, much like experienced in an IMAX theatre. Visualization caves project visualization data on all surfaces of a room, allowing users to "walk into the middle" of their data. In all three visualization environments, immersion allows closer collaboration among groups of users. Problems are more easily solved when all parties are able to view and discuss the data in real time.

The company sees collaborative visualization as a natural extension to the SGI Reality Center facilities, by bringing the same insight to distributed groups and teams. Geographically dispersed scientists and engineers, using a variety of computers, will be able to work together in real time using the same visual model. The company's visual area network (VAN) strategy addresses collaboration by generating images at a central server and dispatching these images in real time to different types of client devices at different locations. In addition to managing the visualization, the central system helps manage interaction among users.

## High-Performance Storage Systems

A supercomputer is a system that turns a compute-bound problem into an I/O-bound problem.

All user and vendor organizations that enter the high-performance computing arena eventually learn its darkest secret: A supercomputer is a system that turns a compute-bound problem into an I/O-bound problem. If you are running systems that perform billions of calculations per second, then you must manage billions of bytes of data per second — getting it in and out of the computer, storing it, backing it up, and so on. SGI has consistently worked to develop data storage solutions that keep pace with the visualization and computational capabilities of its workstations and servers.

Technical data management environments are typified by requirements to move large files from storage systems to any of several heterogeneous compute or visualization servers. Once at the server, data is streamed at high speed into the system with large result files created at the same time and written at roughly the same rate as data is read in. Files containing original data, intermediate, and final results have a very long shelf life. These files must be assigned to different levels of a storage hierarchy based

on the likelihood of next access and the importance of the data. Although result files can usually be regenerated if lost, original experimental or survey data files are generally difficult or impossible to reproduce and must therefore be carefully backed up and archived. In the creative industries, large-scale storage systems manage data that is broadly accessed by a community of users. In industries such as broadcast and media, for example, the shelf life for digital video news content can range from hours to years. Journalists access a common source of digital video content both "as it happens" from new feeds and from archival repositories, configure that information for different markets and audiences, and dispatch replicates of the data to a web of broadcast points. The process repeats as new information arrives and old information is shifted to archival systems. A major driver for such efforts is to minimize time-to-air for new stories.

### *Product Strategy*

At a product level, SGI has developed a solutions-oriented strategy designed to allow the company to address a broad set of market requirements. The company's overall strategy for supporting technical and creative users includes the following major tactics:

- **Leverage component-level technology growth curves.** SGI dedicates its R&D efforts to system-level architectures utilizing industry standard processors, memory chips, and I/O devices. It provides a full line of computer products, including workstations, servers, storage, and visualization systems.

- **Offer the SGI Altix family of high-performance servers.** These systems are based on the SGI Numa global shared-memory architecture and uses 64-bit Linux and Intel Itanium processors. Altix systems scale from two processors to a 512-processor configuration. Planned future products will scale to a 1024-processor system.

- **Develop high-performance graphics and visualization systems.** SGI develops advanced graphics systems based on Linux, Itanium 2 processors, and Silicon Graphics Prism graphics technology. SGI extends graphics access through visual area networking. In the visualization domain, SGI offers its Reality Center facilities.

- **Provide SGI InfiniteStorage integrated storage products** to meet the capacity, performance, and workflow requirements of the high-performance communities. The InfiniteStorage product line offers SAN and NAS consolidation, data life-cycle management software, and data protection software integrated with storage hardware to offer turnkey storage solutions. SGI InfiniteStorage products provide file services for multiple operating systems, and they scale up to multipetabyte configurations.

- **Provide a comprehensive suite of professional services.** SGI provides services ranging from consulting and education to systems design and support.

 

## Technology Directions

In considering technology strategies to meet the future computing requirements of scientists and engineers, SGI has chosen a strategy for future systems development that will extend processing capability into the memory controller and specialty components. Under the code name "Project Ultraviolet," SGI is working to develop a multiparadigm computing architecture. Multiparadigm computing is based on three design principles:

- Use powerful standard processors for general-purpose or scalar processing.
- Extend data-processing capabilities into the memory subsystem to support some fine-grained parallel operations.
- Provide the ability to integrate specialty-processing components into the system.

This strategy should allow future systems to support four different modes (i.e., paradigms) of computing:

- **Scalar operations.** Scalar operations process sets of calculations that are not "parallelizable" because, for example, they are only processed once in a program or because there are dependencies among intermediate results in a calculation. Scalar operations also include program flow control, file management, and data management. SGI intends to use Intel Itanium series of processors for scalar operations.
- **Vector processing.** Vector processing is a form of fine-grained parallelism that involves accessing sets of data (i.e., vectors) in memory as a unit and performing the same set of calculations or operation on each element in the data set. SGI's approach to vector computing is to add capabilities to the memory subsystem that allows it to assemble vectors from memory, preprocess them, and present them to the Itanium processors in such a way as to maximize the efficiency of the CPU's pipelined functional units. Essentially, vector processing allows the CPU to perform operations at a high percentage of the processor's peak theoretical speed.
- **Processor in memory (PIM).** Processor-in-memory strategies involve performing fine-grained parallel operations on data in memory at the memory level. That is, calculations are made without moving the data through the memory system to the processor cache, then to the processor registers and functional units, and then back along the same path to memory. PIM calculations make sense for simple operations that are to be performed on a large set of data in memory, such as setting all elements of an array to the same initial value. SGI's approach to PIM is to add capability to the memory controller to allow it to perform a small set of operations directly on memory. Although this approach is a variant on the traditional PIM model, it has the advantage of allowing the system to make use of industry-standard memory chips.
- **Specialty processing.** Specialty processing includes the use of components such as field programmable gate arrays (FPGA) and digital signal processors (DSPs). FPGAs are semiconductor devices that can be configured by the

programmer to execute application-specific processing tasks. These components essentially allow the program to create a single functional unit to execute a specific algorithm. DSPs operate on analog data (i.e., signal) in such areas as medical imaging, satellite imaging, radar analysis, and communications. SGI plans to add a port to the memory controller that will provide high-speed access to a specialty processor module.

SGI will introduce elements of the Project Ultraviolet paradigms progressively, beginning with initial specialty processing functionality. SGI next plans to field its initial PIM functionality and then add vector processing, thus completing the basic multiparadigm framework. Additional functionality will be added to the framework over the years to come.

SGI's multiparadigm architecture is a blueprint for building additional performance around the Intel Itanium processor. Multiparadigm computing is intended to extend processing capability more deeply into the computer architecture. It is also important to note that the various computing modes are all targeted to technical applications requirements.

## SGI Target Markets: Size, Potential, and Analysis

IDC estimates that the total available market for computer systems sold into technical and creative markets was about $14.1 billion in 2003. We expect this figure to grow to about $15.7 billion by 2005. The market includes revenue accrued through sales of servers, workstations, additional storage, and services. Table 1 presents these market estimates based on major product categories: servers, storage, services, traditional workstations, personal workstations, and visualization.

**TABLE 1**

SGI Total Available Market by Product Type ($000)

| | 2003 | 2004 | 2005 |
|---|---|---|---|
| Servers | 5,565,799 | 6,091,573 | 6,556,883 |
| Storage | 2,040,262 | 2,352,651 | 2,584,941 |
| Services | 1,939,563 | 1,948,062 | 2,073,479 |
| Traditional workstations | 1,151,406 | 948,422 | 826,647 |
| Personal workstations | 3,198,558 | 3,335,723 | 3,486,352 |
| Visualization | 181,762 | 198,162 | 210,439 |
| Total | 14,077,350 | 14,874,592 | 15,738,740 |

Source: IDC, 2004

SGI defines its market in terms of five major industry segments. These segments are government and defense industries; manufacturing; science, including biosciences; energy; and media. Table 2 presents the total available technical market estimates in terms of these industry segments.

 

**TABLE 2**

SGI Total Available Market by Industry ($000)

| | 2003 | 2004 | 2005 |
|---|---|---|---|
| Government and defense | 2,636,145 | 2,781,292 | 2,895,750 |
| Digital media management | 606,690 | 634,720 | 677,015 |
| Manufacturing | 3,283,862 | 3,460,813 | 3,681,541 |
| Energy | 1,212,216 | 1,262,453 | 1,317,252 |
| Scientific | 6,338,437 | 6,735,314 | 7,167,182 |
| Total | 14,077,350 | 14,874,592 | 15,738,740 |

Source: IDC, 2004

**Methodology**

Data for the analyses shown in Tables 1 and 2 is based on IDC Workstations and High-Performance Computer Census Databases and Forecasts.

- In Table 1, data on high-performance server sales anchored our model. Revenue for storage and services was developed based on a model of the relationship between server sales and additional storage sales for various industry segments and for services by price bands. Revenue estimates represent sales by all vendors and for all price points. Storage revenue represents add-on sales of storage systems and components that were not bundled as part of initial system sales; sales from both computer systems vendors and storage systems vendors were included. Services include integration and support revenue accrued by systems vendors.

- In Table 2, IDC research established the proportional size of each of SGI's industry segments, and total revenue for each of the three years was divided among industries using these proportions.

This section further examines these five market segments in terms of growth opportunities and their relationship to SGI's product and service offerings.

### *Government and Defense Industries*

The government and defense industries market segment supports national defense and security efforts. This market includes a broad range of players, such as weapons laboratories, military organizations, national security agencies, and defense contractors. Applications include weapons design, nuclear stockpile stewardship, basic research, war gaming, training simulations, security analysis, cryptanalysis, and signal and imagery processing. Visualization-based applications in this segment range from real-time simulation output, to imagery interpretation, to decision support. Government defense industries accounted for approximately 40% of SGI's annual revenue.

Government markets are driven by requirements for security organizations to respond quickly, flexibly, and in a cost-effective manner to ever-changing political realities and security conditions. These requirements, in turn, drive the market for computer systems that can provide more innovative, less costly, and more quickly implemented solutions in such areas as data acquisition and management, training, equipment/weapon systems design and development, criminal investigations, and home defense operations. It is important to note that government buyers often shift spending to computer systems in times of stable or decreasing budgets, using simulation and modeling to replace physical training systems and to increase design-cycle efficiency. In addition, government users have increasingly looked to computer technology to provide a competitive advantage based on more advanced technical solutions.

SGI's strength in government markets is based on its ability to provide solutions sales. The company has a long history of working with government clients and thus has a good understanding of basic government requirements and operations procedures. Its highly scalable line-of-server, storage, and visualization systems are oriented toward technical applications and allow the company to sell into virtually all of the government market space. Finally, SGI's service offering allows the company to work with system integrators to help implement solutions in an increasingly tight technical labor market.

SGI's government customers include the Los Alamos National Laboratory along with the U.S. Army, Navy, and Air Force. In support of its Stockpile Stewardship Program, Los Alamos uses an 80-processor, 34-pipe Silicon Graphics Onyx4 Ultimate Vision system to meet its needs for virtual testing. The Onyx4 Ultimate Vision in conjunction with other SGI systems enables the design of U.S. Army ground vehicles, such as tanks, trucks, and personnel carriers. The U.S. Navy creates immersive visualizations of new ship designs with an SGI Onyx 3800 system. Finally, customers at Wright-Patterson Air Force Base, use an SGI Origin 3000 supercomputer with 2048 processors and 2TB of memory for a multitude of simulations, such as the complex behavior of combustion in a jet engine.

In addition to continuing to provide advanced technology solutions, success in government markets is based on a vendor's ability to work closely with customers and to partner with system integrators to develop more sophisticated and competitive solutions. We believe that SGI's Reality Center visualization systems position the company to bring to market new solutions that can address the growing size and complexity of next-generation government applications.

### *Scientific*

Scientific computing supports national research facilities, universities, and commercial organizations involved in all levels of scientific inquiry. Applications in this category range from quantum chemistry, to climate modeling, to genomics and proteomics, to support for planetariums and museums. The scientific community pioneered the field of computational visualization, and virtually all scientific fields make use of this technology. Overall, scientific research applications are typically compute- or data-intensive and often require high-performance graphics or visualization capabilities.

A major segment of the science market is biosciences. This subsegment represents a significant growth opportunity for technical computing that IDC considers separately in market analyses. The biosciences market segment includes national, private, and commercial organizations in the pharmaceutical, chemical, and biotechnology industries. Computational applications range from genomic sequencing and search, to proteomic analysis, to molecular modeling. Visualization-based applications include diagnostic imaging, surgical planning and support, and digital image management and communications.

IDC believes that biosciences, including related medical and healthcare industries, are on the verge of a technology revolution that could match the electronics and computer revolutions of the past 50 years. Moreover, IDC believes that computing is a fundamental driver for advances in the biosciences. This market represents a significant opportunity for growth in the server, storage, and services markets.

SGI consolidates academic, government, and life sciences under the scientific heading. Cambridge University is an academic customer, and the pharmaceutical company, Merck, is a life sciences customer. The COSMOS consortium led by Professor Steven Hawking at Cambridge, England, uses an SGI Altix 3000 to model the history of the universe. Finally, Merck uses SGI Origin 3000 servers in support of informatics and molecular profiling workloads. Merck's high-performance computing systems support several projects in sequence informatics, molecular profiling, proteomics, research genetics, and toxicology for research programs in the areas of metabolic disorders, neuroscience, infectious diseases, and oncology.

These markets, which constitute approximately 25% of SGI's revenue, have differing drivers and potential. The classical research and education market is largely government funded and subject to changing economic and political fortunes. However, at its heart is a basic principle that scientific research serves in large part as a primary generator of physical, economic, and societal advancements. As such, this research should continue to receive significant support.

The various segments of the scientific market have a number of features in common: requirements for high-performance computing, storage, and visualization systems, which play to SGI strengths; requirements to manage very large and rapidly expanding databases, which provide an opportunity for SGI; and the ability to incorporate new technologies — most recently, clusters — into its computing environments, which poses a competitive challenge for SGI.

To move forward in this market, SGI must maintain a technology leadership position in servers, emphasize next-generation visualization technologies, capitalize on new storage system opportunities, and maintain the flexibility to compete with clustered technology.

### *Manufacturing*

The manufacturing market includes computing technology used to support the design, development, and production of manufactured goods, ranging from civilian and military aircraft and satellites, to automobiles, to electronics components and systems, to consumer products, to industrial machinery/equipment. Applications include modeling of product characteristics and behavior, virtual prototyping,

automotive crash analysis, modeling fluid flow (e.g., air, gasoline) around and through a product, and analysis of structures. Visualization-based activities include product styling, development of digital mock-ups, and design reviews.

The manufacturing market, which accounts for about 15% of SGI's FY04 revenue, is driven by requirements to bring more sophisticated, efficient, and compelling products to market in as short a time frame as possible. New product designs must combine innovative concepts, use of advanced technologies and materials, and efficiency in manufacturing. Manufacturers are competing at not only a product design level but also against time, in terms of both speeding new products to market and creating products that can succeed with shortened life spans. We believe the key driver for computer technology is the increasing movement toward a simulation-based design strategy, where physical modeling is being replaced by computer-based techniques.

SGI has worked with the manufacturing community since the company's inception; thus SGI's strengths are derived in significant measure from its experience in this market segment. SGI's strengths include the ability to support new product development practices, as well as the performance and ease of use of its servers. SGI products receive good customer reviews. Third-party application software is available. SGI's strong visualization offerings are important to the manufacturing community.

SGI customers in the manufacturing segment include Skoda Automotive, Tata Motors, and Volvo. Skoda, a Czech manufacturing company that is part of VW Group, uses SGI supercomputing and storage technologies to solve computer-aided engineering (CAE) computation challenges associated with modern car development and design. Tata Motors, an Indian auto manufacturer, uses SGI visual area networking and storage area networking (SAN) technologies along with SGI Altix 3000 compute servers and SGI Onyx 3900 visualization systems to accelerate the design of models. Volvo, a division of Ford Motor Company, partnered with SGI to develop a multidisciplinary design optimization (MDO) methodology to address vehicle safety, noise, vibration, harshness (NVH), and weight.

To move forward in this market, SGI must continue to provide technically competitive product offerings, work to establish itself as the leader in next-generation tools for visualization and engineering collaboration, and expand its offering to address a greater proportion of the overall technical computing environment in such areas as product life-cycle management and organizationwide storage solutions.

### *Energy*

Energy computing supports the petroleum exploration and production activities of national oil companies, multinational oil companies, and oilfield service companies. Applications range from seismic analysis, to reservoir modeling, to management of exploration and production data. The energy market segment has a strong visualization component driven by requirements to interpret a vast amount of seismic and reservoir data and to support collaborative decision-making activities.

Petroleum industry computer systems support two quite different workloads. One workload is managing the return on investment for existing petroleum reserves, which has relatively low requirements for high-performance computing capability. The other

workload is in support exploring for new reserves, which, in contrast, has relatively high requirements for advanced computing systems. It is also important to note that petroleum exploration and reserve management is a global enterprise that requires onsite systems and support. We believe that recent price fluctuation and political uncertainty will lead to renewed efforts to identify and fully exploit petroleum reserves, thus increasing requirements for computer systems sales.

SGI notes that more than 100 SGI Reality Center visualization systems are currently installed in the energy segment. SGI customers in this market include Statoil and Marathon Oil. Statoil, the largest petroleum operator on the Norwegian continental shelf, uses SGI Onyx 3000 visualization supercomputers in its first onshore support center (OSC). The Reservoir Description and Management group at Houston-based Marathon Oil Company depends upon an SGI Altix 3000 system driven by 12 Intel Itanium 2 processors for the modeling tasks needed to describe the subsurface and predict fluid flow at Marathon fields around the world.

Applications in the energy market tend to be highly parallel and data intensive. Seismic analysis was one of the first commercial applications for parallel-processing computers, with experience in parallelism dating back at least to the early 1990s. A combination of improved algorithms and more capable standard interconnect technology has positioned the industry to leverage cluster technology to extend seismic analysis capabilities.

Data from petroleum exploration surveys does not expire. A combination of advances in both data analysis and drilling and extraction technologies allows the industry to revisit historical survey data in order to reevaluate areas for exploitable resources. Thus, the long-term value of survey data creates requirements for both capabilities to manage very large data archives and to support a variety of data storage formats, particularly tape.

Finally, energy applications tend to produce large, complex result data sets. In addition, these results are often interpreted in a collaborative manner by a team of geoengineers. This approach to analysis creates requirements for high-end, networked visualization systems.

SGI's visualization and data management capabilities help position the company to work with system integration partners to develop solutions-based products for the energy market, which is approximately 10% of SGI's FY04 annual revenue. To succeed, SGI must support the global nature of the business, providing scaled-down systems for local use and international support.

### *Media*

The media market, which consists primarily of the broadcast, film, and television production market segments, contributes about 10% of SGI's revenue. Media computing supports the creation, management, and distribution of digital content. Much of this content was previously created and stored in an analog form (e.g., video tape, acetate film) but is or in the process of being digitized. SGI has developed products for the major segments of this industry.

The broadcast segment includes cable and television companies that create and distribute content. For 50 years, the broadcast industry has used analog media for storage. Mandated by government policy, the transition to digital encoding, processing, and storage is now underway. European broadcasters are moving to digital media more rapidly than those in North America, and the rest of the world will migrate to digital technology over time.

The film and television production segment includes episodic television, television commercials, film studios and the services organizations that serve the film and television industries. Creation of digital content requires tools for ingesting (i.e., transforming video into a digital form), editing, and compositing real-time graphics. Moreover, production companies need an infrastructure for processing, storing, and managing the digital product workflows.

The computational requirements of broadcast and other creative media applications are similar to those of high-performance computing applications. Both communities require the ability to manage and move large amounts of data at high speed and to perform large numbers of calculations on this data as it is streamed between processors, memory, and I/O devices. SGI has designed its system architectures to meet these requirements.

SGI broadcast and production customers include BBC Broadcasting, Danish Broadcasting Corporation (DR), and EFILM. BBC Broadcasting uses SGI InfiniteStorage NAS 3000 and SGI CXFS shared file system as a foundation for a tapeless environment with 50TB of storage and high-bandwidth capacity. The system will eventually ingest, archive, and play out all BBC content. DR, Denmark's oldest and largest public service radio and television company, is converting its entire operations from an analog to digital workflow. The DR Sports and News Production System uses SGI Media Server for Broadcast systems that ingest and playout. DR also has a centralized storage system with SGI Origin 3000 and Origin 300 servers and SGI InfiniteStorage Total Performance 9400 storage with SGI Data Migration Facility for archiving. EFILM, a leading digital film laboratory in Hollywood uses SGI Onyx 3000 visualization systems and hundreds of terabytes of SGI InfiniteStorage TP9300 and TP9500 systems in an SGI CXFS SAN, to create digital intermediates, which include high-resolution scanning, color correction, editing, compositing, laser film recording and film and video mastering. EFILM creates one high-resolution digital distribution master that can be used for film output, digital cinema releases, and home video, all designed to meet national and international theatrical and video delivery requirements.

SGI's goal is to provide "IT for the media industry." Digital data processing has long been a mainstay in other industries. For example, in the paper-based world of the past, a financial services company shuffled paper through narrow workflow channels. Modern information systems allow multiple individuals to access the same digital information and enable nearly instantaneous transmission of information to where it is needed. Over the last decade, computer capabilities have reached a point where they can effectively and affordably address media data and provide many of the same benefits that are common in general technical and business environments. SGI is aggressively pursuing media markets as a growth opportunity for the company.

 

## IDC Analysis: Opportunities and Challenges

IDC believes that the drivers for technical and creative markets — strategic necessity, growth in problem complexity, and expansion of data set sizes — lead to strong, long-term growth in both system requirements and market size. SGI is well positioned to take advantage of these underlying growth drivers; however, at the same time, the company must fight for share in a very competitive market.

### *Opportunities*

SGI's opportunities center on the company's ability to leverage its business strategy to capitalize on market growth and expand its position within the overall technical and creative market. These opportunities include:

- **Riding the market growth curve.** SGI has the opportunity to expand its business in conjunction with the growth of technical computing. In addition, the company has the potential to leverage its exclusive focus on technical and creative users to establish a leadership position in the market. Such a position could allow SGI to outgrow the market through early access to new applications areas and provide it with the ability to price products and services based on their technological advantages.

- **Capitalizing on technical innovation.** Technical innovation is a viable strategy for increasing share in the high-performance technical computing market. With forward-looking processing initiatives, such as Project Ultraviolet, and storage capabilities, such as those demonstrated in the InfiniteStorage product line, SGI is moving to reinforce and extend its positions as a provider of innovative products.

- **Extending sales through partnerships.** In addition to SGI's current offerings, the company also has potential long-term opportunities to expand the markets for its technology through partnerships, reseller, or license agreements. That said, IDC strongly agrees with SGI's long-term strategy of targeting technical and creative markets. Therefore, technology resale activities are expected to be a profitable but small business for the company.

### *Challenges*

SGI's challenges center on doing business in the highly competitive technical and creative markets. This competition is driven by both economic and noneconomic factors. In addition to ordinary competition for revenue and share, technical computing is attractive to established players as a proving ground for new technology development. New companies view the market as a viable entry point. Specific challenges for SGI include:

- **Walking the pricing tightrope.** In the last few years, the technical computing market has seen a strong growth in cluster solutions based on a combination of absolute performance at the processor and node levels, as well as highly competitive price/performance ratios. While SGI must work to maintain technology differentiation of its products, it must also respond to new pricing realities.

- **Walking the technology tightrope.** The company aims to build products with commodity and industry-standard componentry while adding value with architectural features aimed at the requirements of technical and creative users. The company must find the right balance to avoid becoming a commodity player, on the one hand, and not limit its market opportunity through over-specialization, on the other.

- **Identifying the supercomputing-hungry organizations.** SGI must identify and build strong relationships with those customers who have demanding applications and strategic objectives that are immediately satisfied by SGI's products. These are the organizations that cannot afford to lose time or expend researcher effort on adapting workloads to general-purpose technologies.

## Conclusion

### *Meeting the Challenges*

SGI's overall strategy targets five closely related market segments. Its choice of segments allows the company to concentrate on delivering leading visual and scalable computing solutions for technical and creative users. In addition, these markets represent significant current opportunities for the company and hold strong future growth potential. We see SGI's long track record for working in these industries and in bringing high-performance computing solutions to these markets as a major competitive strength for the company. We believe that by maintaining its focus on technical and creative markets, SGI has an opportunity to distinguish itself as providing unique products and services that are customized to meet the highly demanding and specialized requirements of its core customers.

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