Albert-Battaglin Consulting Group TAGITT/CATIA 4.2.0 r1 Evaluation

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TAGITT/CATIA
4.2.0 r1 Evaluation

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Notices

Results are shown as either times in which smaller numbers represent the faster performance, or in terms of the Price/Performance Index (PPI) in which case larger numbers indicate better price/performance. PPI values are dependent on list prices. Changes in list prices may render comparisons of PPIs invalid. All prices used to calculate PPIs are provided and are U.S. list prices. No consideration is given to discounting due to discounting’s variable nature and its dependence on multiple parameters. The sources for the pricing information are D. H. Brown as of April 27, 1999 and IBM U.S. list prices as of April 27, 1999.

Executive Summary

Seven engineering workstations from Hewlett-Packard, IBM, Silicon Graphics, Inc., and Sun Microsystems, Inc. were evaluated by the Albert-Battaglin Consulting Group using a new version of TAGITT: The Albert Group Interactive Throughput Test. TAGITT/CATIA measures workstation performance from a user perspective by simulating interactive work sessions using the 4.2.0 refresh 01 version of this CAD/CAM application software package. Key results were as follows:

- The IBM 43P 260/2way GXT3000P was the overall performance leader in the TAGITT/CATIA 4.2.0 r1 test followed by the IBM 43P 260/1way GXT3000P and IBM 43P 260/1way GXT2000P machines. The IBM 43P 260/2way GXT3000P was 4% faster than the IBM 43P 260/1way GXT3000P and 7% faster than the IBM 43P 260/1way GXT2000P overall. The IBM 43P 260/2way GXT3000P was about 16% faster than the fastest competitive machine, the HP C360 FX6.
- In terms of overall price/performance (PPI), the IBM 43P 150/375 GXT2000P and SUN ULTRA 60-360 ELITE 3DM6 were the clear leaders. The PPI for the IBM 43P 150/375 GXT2000P was less than 1% better than that of the SUN ULTRA 60-360 ELITE 3DM6. These machines offered 15% better PPI than the IBM 43P 260/1way GXT2000P.
- For graphics performance, IBM 43P 260/2way GXT3000P graphics was significantly (more than 20%) faster than other machines tested. The HP C360 FX6 was the second fastest machine followed by the IBM 43P 260/1way GXT3000P.
- The HP C360 FX6 and IBM 43P 260/2way GXT3000P were nearly identical in price performance for most tests.
- The SGI OCTANE 250MHZ MXE was consistently the worst price/performance machine in the tested set.
- Machine performance was not the same across all tested applications. Although the IBM 260 machines were the fastest in nearly all of tests, HP, Sun, and SGI machines each won individual tests.

Summary of Top Three Winners in Each Test:

Throughput Summary Results

Task/Test	First	Second	Third
Overall Throughput	**IBM 43P 260/2way GXT3000P**	**IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P**	HP C360 FX6
Application Throughput	**IBM 43P 260/2way GXT3000P** **IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P**	HP C360 FX6	**IBM 43P 150/375 GXT2000P** SUN ULTRA 60-360 ELITE 3DM6
Graphics Throughput	**IBM 43P 260/2way GXT3000P**	HP C360 FX6	**IBM 43P 260/1way GXT3000P**
System Quickness	**IBM 43P 260/1way GXT3000P** **IBM 43P 260/2way GXT3000P** **IBM 43P 260/1way GXT2000P**	HP C360 FX6	**IBM 43P 150/375 GXT2000P**
CPU Throughput	**IBM 43P 260/1way GXT2000P** **IBM 43P 260/1way GXT3000P** **IBM 43P 260/2way GXT3000P**	HP C360 FX6	SUN ULTRA 60-360 ELITE 3DM6 **IBM 43P 150/375 GXT2000P**
Dynamic Graphics Throughput	HP C360 FX6 **IBM 43P 260/2way GXT3000P**	**IBM 43P 260/1way GXT3000P**	SGI OCTANE 250MHZ MXE **IBM 43P 260/1way GXT2000P**

Throughput Summary Results			
Task/Test	**First**	**Second**	**Third**
Read/Write Throughput	SGI OCTANE 250MHZ MXE	**IBM 43P 260/2way GXT3000P** **IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P**	HP C360 FX6 SUN ULTRA 60-360 ELITE 3DM6 IBM 43P 150/375 GXT2000P
4D Navigator	SGI OCTANE 250MHZ MXE	**IBM 43P 260/1way GXT3000P** **IBM 43P 260/2way GXT3000P**	**IBM 43P 150/375 GXT2000P**

Summary of Price/Performance Index Results:

PPI (Price/Performance Index) Summary Results			
Task/Test	**First**	**Second**	**Third**
Overall PPI	**IBM 43P 150/375 GXT2000P** SUN ULTRA 60-360 ELITE 3DM6	**IBM 43P 260/1way GXT2000P**	**IBM 43P 260/1way GXT3000P**
Application PPI	SUN ULTRA 60-360 ELITE 3DM6 **IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT2000P**	**IBM 43P 260/1way GXT3000P**
Graphics PPI	**IBM 43P 150/375 GXT2000P**	SUN ULTRA 60-360 ELITE 3DM6	**IBM 43P 260/1way GXT2000P** **IBM 43P 260/1way GXT3000P**
CPU PPI	SUN ULTRA 60-360 ELITE 3DM6	**IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT2000P**
Dynamic Graphics PPI	SUN ULTRA 60-360 ELITE 3DM6 **IBM 43P 150/375 GXT2000P**	HP C360 FX6	**IBM 43P 260/1way GXT2000P**
Read/Write PPI	SUN ULTRA 60-360 ELITE 3DM6 **IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT2000P**	**IBM 43P 260/1way GXT3000P**
4D Navigator PPI	**IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P**	SGI OCTANE 250MHZ MXE **IBM 43P 260/2way GXT3000P**

Individual Application Test Throughput Results:

Primary Application Test Throughput Results			
Task/Test	**First**	**Second**	**Third**
Modeling	**IBM 43P 260/2way GXT3000P** **IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P** HP C360 FX6	**IBM 43P 150/375 GXT2000P** SUN ULTRA 60-360 ELITE 3DM6	SGI OCTANE 250MHZ MXE
Finite Element	**IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P** **IBM 43P 260/2way GXT3000P**	HP C360 FX6 SGI OCTANE 250MHZ MXE	SUN ULTRA 60-360 ELITE 3DM6
NC	**IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P** **IBM 43P 260/2way GXT3000P**	**IBM 43P 260/1way GXT2000P**	HP C360 FX6
Detailing	**IBM 43P 260/1way GXT2000P**	HP C360 FX6 **IBM 43P 260/2way GXT3000P** **IBM 43P 260/1way GXT3000P**	SUN ULTRA 60-360 ELITE 3DM6 **IBM 43P 150/375 GXT2000P**

Secondary Application Test Throughput Results			
Task/Test	**First**	**Second**	**Third**
Analysis	HP C360 FX6	**IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT2000P** **IBM 43P 260/1way GXT3000P** **IBM 43P 260/2way GXT3000P**
Read/Write	SGI OCTANE 250MHZ MXE	**IBM 43P 260/2way GXT3000P** **IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P**	HP C360 FX6 SUN ULTRA 60-360 ELITE 3DM6 **IBM 43P 150/375 GXT2000P**
Walk Through	**IBM 43P 260/2way GXT3000P**	**IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P**	HP C360 FX6
Sheet Metal	**IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P** **IBM 43P 260/2way GXT3000P**	HP C360 FX6 **IBM 43P 150/375 GXT2000P**	SGI OCTANE 250MHZ MXE

Secondary Application Test Throughput Results (continued)			
Task/Test	**First**	**Second**	**Third**
Fitting Simulation	HP C360 FX6 **IBM 43P 260/2way GXT3000P**	**IBM 43P 260/1way GXT3000P**	**IBM 43P 260/1way GXT2000P**
Kinematics	HP C360 FX6 **IBM 43P 260/2way GXT3000P**	**IBM 43P 260/1way GXT3000P**	**IBM 43P 260/1way GXT2000P**
Studio	SUN ULTRA 60-360 ELITE 3DM6	HP C360 FX6	**IBM 43P 260/2way GXT3000P** **IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P**
Viewer	SUN ULTRA 60-360 ELITE 3DM6	HP C360 FX6	**IBM 43P 260/2way GXT3000P** **IBM 43P 260/1way GXT3000P** **IBM 43P 260/1way GXT2000P**

Individual Test PPI (Price/Performance Index) Results

Primary Application Test PPI Results			
Task/Test	**First**	**Second**	**Third**
Modeling PPI	SUN ULTRA 60-360 ELITE 3DM6 **IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT2000P**	**IBM 43P 260/1way GXT3000P**
Finite Element PPI	**IBM 43P 260/1way GXT2000P**	**IBM 43P 260/1way GXT3000P**	SUN ULTRA 60-360 ELITE 3DM6
NC PPI	**IBM 43P 260/1way GXT2000P**	**IBM 43P 150/375 GXT2000P**	SUN ULTRA 60-360 ELITE 3DM6 **IBM 43P 260/1way GXT3000P**
Detailing PPI	SUN ULTRA 60-360 ELITE 3DM6	**IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT2000P**

Secondary Application Test PPI Results			
Task/Test	**First**	**Second**	**Third**
Analysis PPI	**IBM 43P 150/375 GXT2000P**	SUN ULTRA 60-360 ELITE 3DM6	**IBM 43P 150/375 GXT2000P**
Read/Write PPI	SUN ULTRA 60-360 ELITE 3DM6 **IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT2000P**	**IBM 43P 260/1way GXT3000P**
Walk Through PPI	**IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT2000P**	**IBM 43P 260/1way GXT3000P**
Sheet Metal PPI	**IBM 43P 260/1way GXT2000P**	**IBM 43P 150/375 GXT2000P**	SUN ULTRA 60-360 ELITE 3DM6 **IBM 43P 260/1way GXT3000P**

Secondary Application Test PPI Results (continued)			
Task/Test	**First**	**Second**	**Third**
Fitting Simulation PPI	**IBM 43P 150/375 GXT2000P**	SUN ULTRA 60-360 ELITE 3DM6	**IBM 43P 260/1way GXT2000P** HP C360 FX6 **IBM 43P 260/1way GXT3000P**
Kinematics PPI	**IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT2000P** HP C360 FX6	**IBM 43P 260/1way GXT3000P**
Studio PPI	SUN ULTRA 60-360 ELITE 3DM6	**IBM 43P 150/375 GXT2000P**	**IBM 43P 260/1way GXT2000P** HP C360 FX6 **IBM 43P 260/1way GXT3000P**
Viewer PPI	SUN ULTRA 60-360 ELITE 3DM6	**IBM 43P 150/375 GXT2000P**	HP C360 FX6 **IBM 43P 260/1way GXT2000P** **IBM 43P 260/1way GXT3000P**

Why TAGITT?

The Need for Application-Level Testing

When mechanical engineers select and use workstations, performance considerations should be based on the ability of the machine to rapidly complete the users' design task. Users are concerned with throughput: how much faster (or better) could I design my next product if I upgraded to a faster graphics card or a faster CPU? In the workstation industry, MIPS, MFLOPS, SPECmarks, etc. have become the standards for performance comparison of CPUs. For graphics, 3D vector drawing speed and polygon drawing speed (polygons per second) are often used for comparison. In selecting a workstation for a mechanical design application, the user is faced with a choice between many competitive machines — some with higher MIPS ratings, others with higher vector and/or polygon rates. Without running an actual application benchmark, it is difficult to predict which of the two machines will provide the better performance level for its application.

MIPS, megaflops, vectors per second, GPC, XPC, OPC and polygons per second all allow users to compare machines, but those specs may be misleading as predictors of engineering task efficiency. Today's CAD/CAM applications are typically very large, complicated programs. The way in which these programs perform in the context of different hardware architectures and with different operating system services and graphic libraries is generally not predictable from the previously mentioned specifications. Although software vendors are striving to make their code highly "portable" so that it runs on a wide variety of machines, the fact is that all applications must be ported and tuned to obtain optimal performance. Each workstation vendor offers unique performance-enhancing capability. Without tuning, application software may or may not take full advantage of the target hardware/operating system platform. Since software developers cannot possibly take advantage of every function in every workstation and/or operating system, performance compromises occur. The user has no way of knowing to what extent his/her application software has been ported and tuned to match capabilities offered by any particular workstation vendor without application level testing.

Test Description

TAGITT, The Albert Group Interactive Throughput Test, was designed to directly measure performance in completing typical engineering design tasks, especially related to solid modeling. For users of solid modeling software, the results provide a comparison of workstations that is more relevant than the typical manufacturer's published specifications of MIPS, megaflops, vectors per second and polygons per second.

TAGITT testing is typically accomplished by recording and playing back user interaction scenarios. Most CAD/CAM applications include functions to accomplish this task although some are undocumented. Record and playback mechanisms are the preferred method of testing for a number of reasons, including repeatability, accuracy, and user relevance. Although it is often easier to measure times for individual operations or functions, this can be a misleading measure of performance from a user perspective. Users constantly switch between functions and/or modules, which can result in significant performance variation as portions of the software are loaded, unloaded, and accessed from memory. The use of interaction scenarios provides a more realistic measurement of overall system performance. TAGITT tests use built-in timing and data capture mechanisms in order to obtain accurate measurements over a relatively large number of functional tests.

In addition to overall time measurements, TAGITT scenarios normally include interim times for specific functions or operations. These can provide specific performance data for individual functions such as adding a solid feature, shading a model or generating a NC tool path. These times are also used by Albert-Battaglin Consulting Group as a rough method for isolating performance which is compute intensive, graphic intensive or I/O intensive. While it is clear that the interplay between these system aspects is too complicated to be accurately measured at the application level, the measurements can sometimes point to areas for in-depth performance profiling using specialized tools.

TAGITT interaction scenarios consist of a variety of operations, with an emphasis on parametric/variational solid modeling and associated tasks such as part visualization, kinematic and “walk through” analysis, drawing view creation from 3D models, NC tool path generation, geometric/FE analysis and high quality image rendering and display. Regardless of the task, special emphasis is placed on tasks that are not by nature “interactive.” For example, the creation of a line segment in most systems takes place in well under a half a second so that performance differences will most likely be unnoticed by users. These times are not considered in TAGITT results. In contrast, updating a solid model or regenerating a drawing layout following a dimensional change can take from many seconds to several minutes and therefore has an impact on a user’s productivity. TAGITT evaluations also measure ancillary tasks such as changing functions (through menu picks) or selecting geometry. The time taken for these operations generally range between 0.5 and 5 seconds. Albert-Battaglin Consulting Group feels that the overall responsiveness of the system is reflected in these interaction times. This “responsiveness” is the difference between systems that seem heavy and slow, compared to those that “feel” quick and light. The TAGITT measurements gather data from both of these interaction types and combine them together to create an overall throughput measurement.

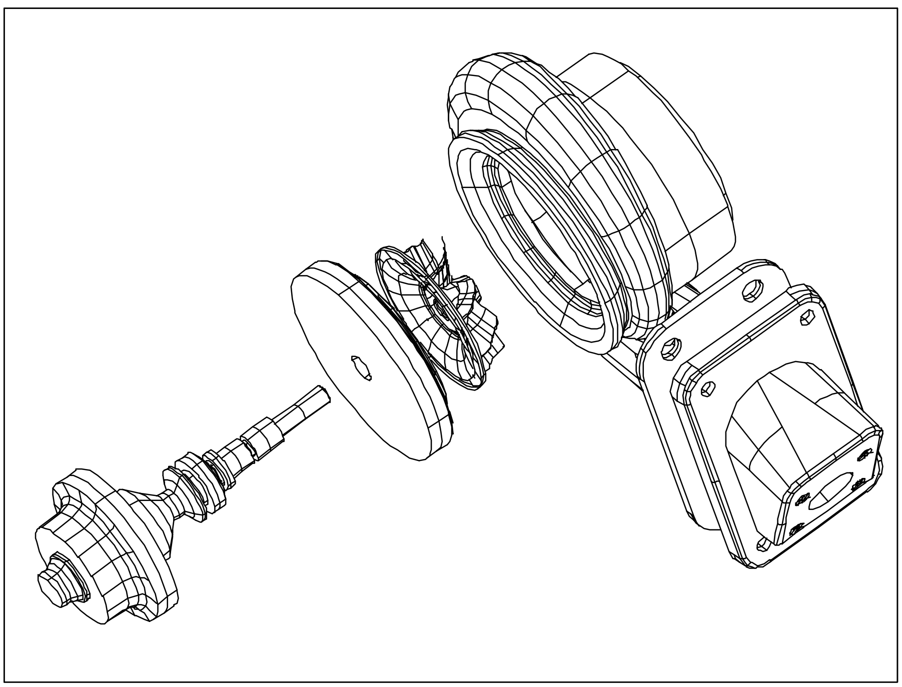

Figure 1 – Albert-Battaglin Consulting Group Turbo Charger Assembly

Models used for TAGITT evaluations consist mostly of real models taken from customer data. In order to provide some level of cross-application comparison, a subset of each TAGITT evaluation consists of one or more parts from the Albert-Battaglin Consulting Group Turbo charger assembly depicted in Figure 1. Although conceptually simple, the assembly's geometries still require enough computation so as to make performance differentiation possible. In addition, the simplicity of the models forces operations to be undertaken in a similar fashion on various applications thus providing better comparative data.

TAGITT/CATIA

TAGITT/CATIA consists almost entirely of a series of CATIA "record files" which are capable of recording and playing back a series of user interactions. The record files capture a majority of user interaction including some simulations of dynamic graphic manipulations performed via the GRAPER utility function. Sixty program files are used in the 4.2.0 refresh 01 version of TAGITT/CATIA. About one-fifth were created by Albert-Battaglin Consulting Group to construct, modify and manipulate the Compressor Wheel and Test Fixture parts in a fashion which as closely as possible matches the method used for other TAGITT testing with other leading CAD/CAM systems. The remaining program files were either adapted from standard CATIA Operator Exchange test files or were developed around Dassault demo part models. Some of the models used are shown in Figure 2. These files cover many areas of the CATIA 4.2.0 r1 product including part modeling, surface intersection, drawing layout, parametric modification and updates, finite element analysis, fitting simulation, kinematics simulation, walk through analysis, NC tool path generation, sheet metal part modeling, studio image rendering and viewing and model storage and retrieval from disk. Combined, these files represent thousands of user interactions and many hours of operator seat time.

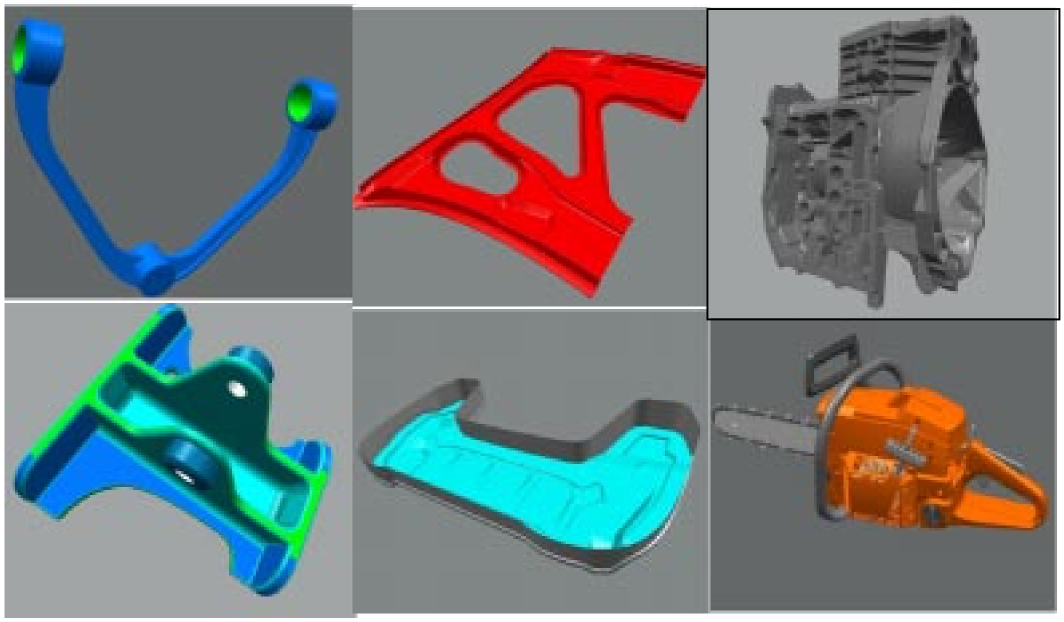

Figure 2 – Some of the CATIA models used for TAGITT/CATIA

The latest version of TAGITT/CATIA also includes CATIA Image Viewer and 4D Navigator tests. For the CATIA Image Viewer test, the time for displaying an image generated by the Studio function as recorded by the Image Information function is used. In contrast to common measurements of 4D Navigator using a "frame counter" utility, Albert-Battaglin Consulting Group has developed what it feels to be a more representative measurement method. In TAGITT/CATIA, five different CATIA models are rendered in single light, dual light, neon and neon with edges modes. These models are each rotated through 360 degrees in 30 degree steps and times are recorded from the 4D Navigators' performance monitor. Models used for the testing of both of these functions are large and complicated enough such that the operations are generally not interactive (i.e. less that 0.5 seconds). The models used for the 4D Navigator test are shown in Figure 3.

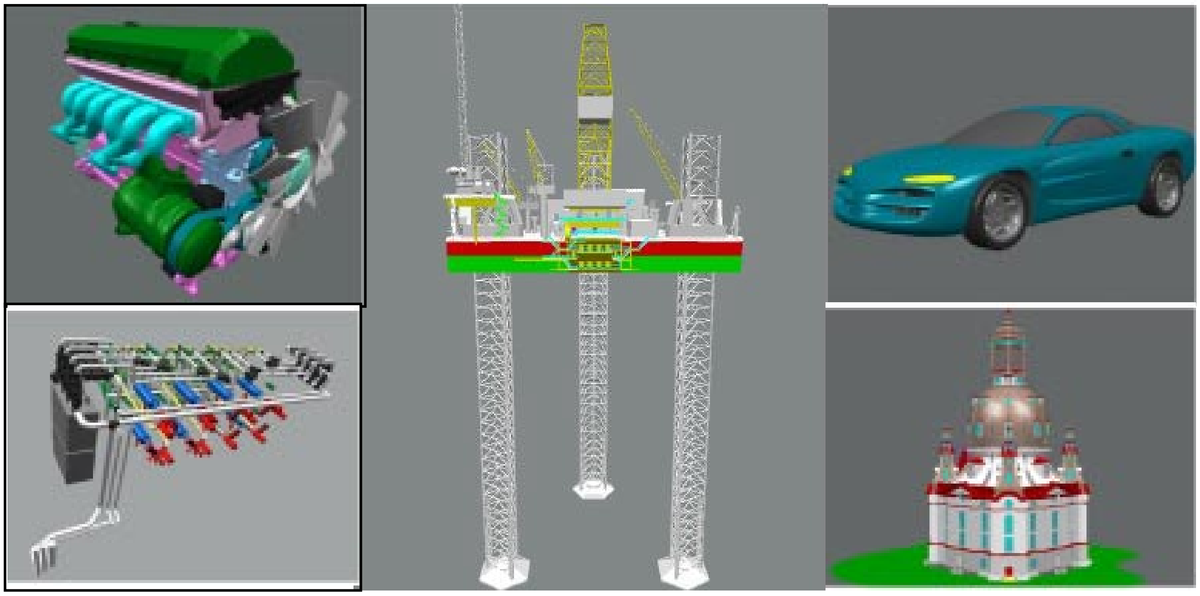

Figure 3 – CATIA 4D Navigator Test Modules

Results

Machines Evaluated

The following table shows the machines tested and their configurations. All machines are priced configured with 256 MB main memory, 500 MB swap, 20/21" color monitor, CD ROM drive, ethernet interface, mouse, keyboard and 4 GB or larger hard disk, operating system, and 3D API. Note: throughout the report, references to the HP, SGI and Sun machines include the graphics accelerators listed below.

Vendor	Model	Graphics	CPU	L2 Cache Mb	Clock MHz	OS	U.S. List Price as of 4/27/99
IBM	43P 260/2way	GXT3000P	Power3	4	200	AIX4.3.2	$ 36,020
IBM	43P 260/1way	GXT3000P	Power3	4	200	AIX4.3.2	$ 28,020
IBM	43P 260/1way	GXT2000P	Power3	4	200	AIX4.3.2	$ 24,515
IBM	43P 150/375	GXT2000P	604E	1	375	AIX4.3.2	$ 16,406
HP	C360	FX6	PA-RISC 8200	1	360	HPUX10.20A	$ 31,505
SGI	Octane 250	Maximum Impact (E)	R10000	2	250	IRIX64 6.5	$ 41,876
Sun	Ultra 60-360	Elite3D-m6	UltraSPARC-II	2	360	SunOS 5.6	$ 16,085

TAGITT/CATIA 4.2.0 r1 Results

Test Weighting

While running the TAGITT/CATIA 4.2.0 r1 benchmark, the times for individual operations and scenarios are recorded. To produce application, graphics and overall throughput results, weighted sums of appropriate individual test results are used. Albert-Battaglin Consulting

Group sets the weighting factors for each type of operation based on its judgment of the relative importance of each operation. The weighting is Albert-Battaglin Consulting Group's best judgment for a "typical" CATIA user, whether from aerospace, automotive or any other industry. The weights are applied to actual times by averaging the results measured across the various workstations and applying the appropriate factor.

Overall throughput numbers consist of the weighted sum of the Applications, Graphics and Responsiveness portions of the test. Application tests measure the times required to complete application related tasks such as changing a solid model, generating a tool path or running a FEM analysis. Graphics portions of the test measure exclusively viewing-related functions such as generating a shaded image or dynamically rotating that image. Responsiveness tests include the times needed to change CATIA functions, select options or pick geometry. The weighting used is shown in Figure 4.

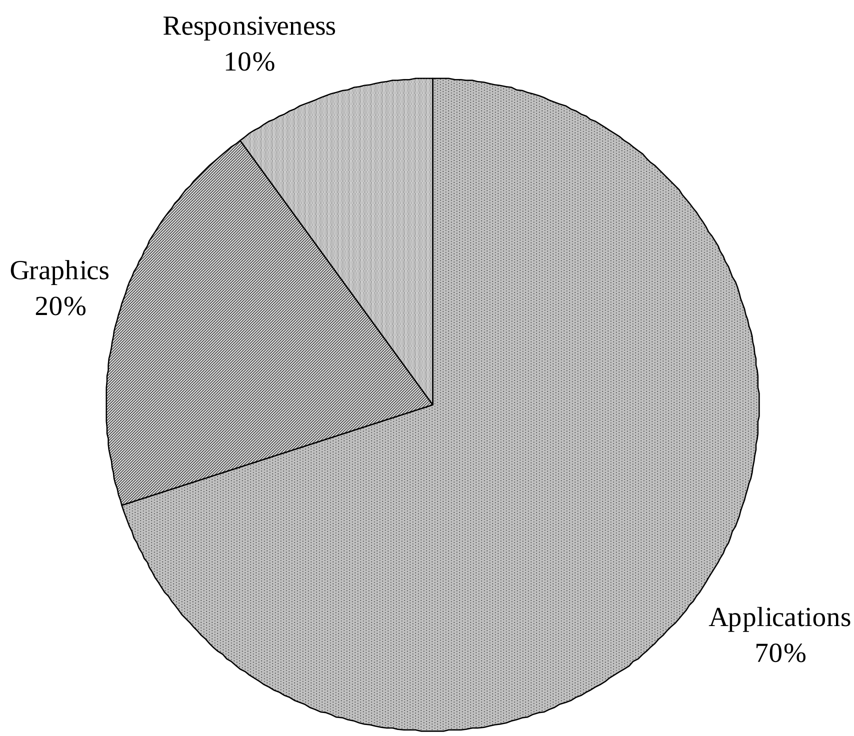

Figure 4 – Overall Throughput Weighting

The Application time for this TAGITT test is the weighted sum of the Analysis, Bend (Sheet Metal), Detailing, Finite Element, Fitting Simulation, Kinematics, Modeling, NC, Studio, Image Viewer, Walk Through, and Read/Write portions of the test. The weightings used are shown in Figure 5.

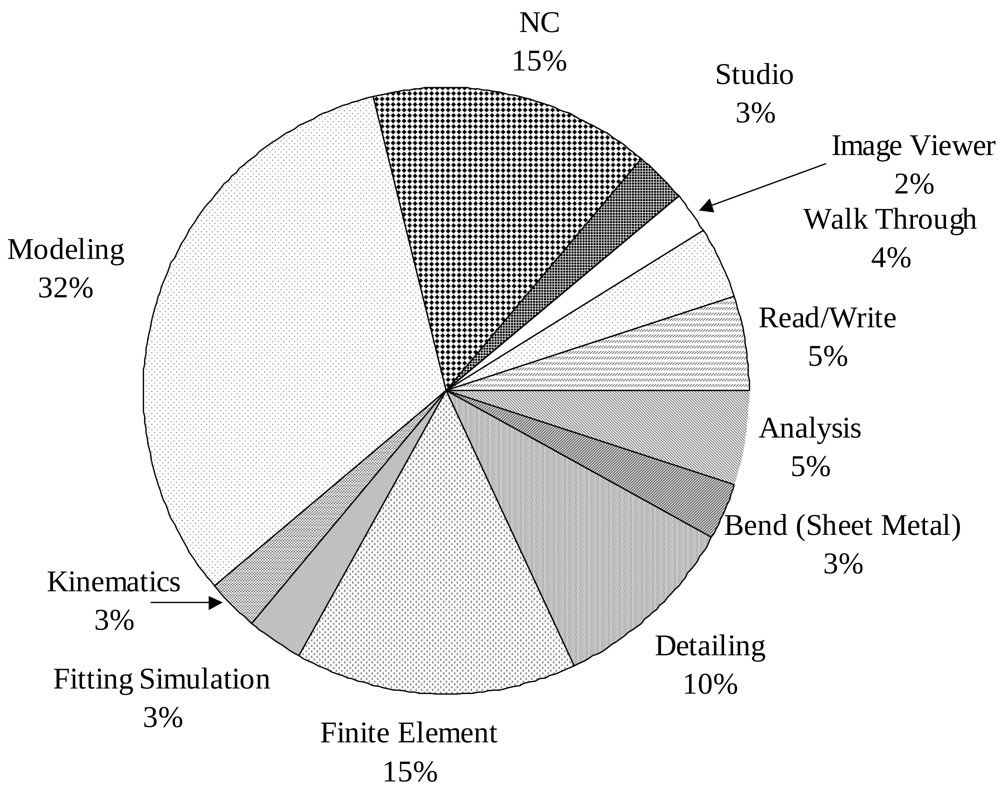

Figure 5 – Application Weighting Factors

4D Navigator throughput is calculated based on the weighted sum for the single light, dual light, neon and neon with edges rendering tests for the five models tested. The weighting factors are shown in Figure 6.

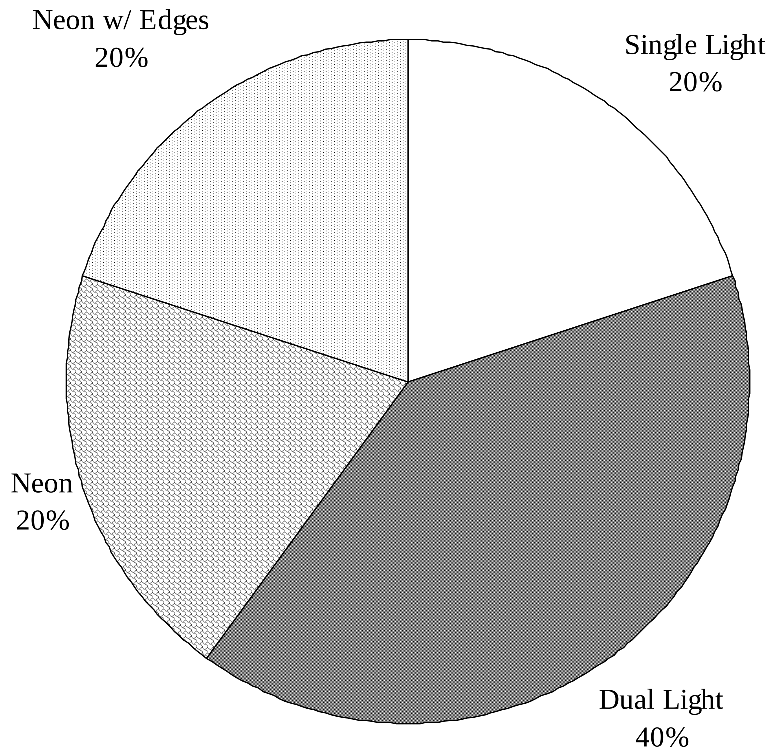

Figure 6 – 4D Navigator Weighting Factors

Graphics throughput is calculated based on the weighted times for the various graphics tests (refer to Figure 7) so as to present one representative number for this aspect of each workstation. These operations include not only the often measured dynamic graphic manipulation (dial turning) functions, but also the “graphics compute” functions which often occur the first time one accesses these operations on a given part. This version of TAGITT also includes 4D Navigator results in the overall Graphics throughput. This combined measurement gives a better overall picture of graphic performance during typical work sessions from a user perspective. Isolated evaluations of dynamic shading or hidden line processing may be good for tuning tasks, but they do not adequately take into account the mix of operations encountered by a user. These graphic compute operations are always much longer than the dynamic manipulations themselves and are also dependent on CPU performance and its interactions with the graphics processor. The Graphics Throughput Time for this TAGITT test is the weighted sum of the 4D Navigator, Graphics Compute, Hidden Line, Shaded Image and Wireframe portions of the test which are each sums from the various (15) models used throughout the testing.

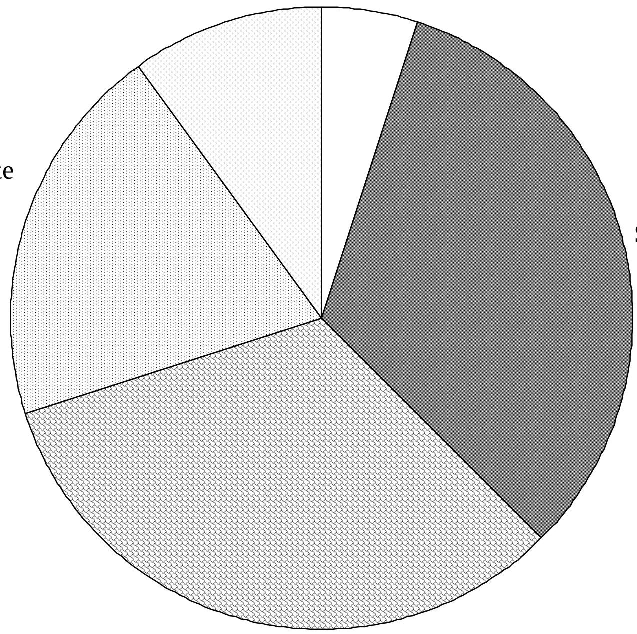

Figure 7 – Graphics Weighting Factors

It should be noted that user perceptible differences in display performance will in general only be found when processing large complex models. Overall workstation and graphic performance across the industry has progressed to where "simpler" models can be easily transformed interactively. Unfortunately, we found no easy method for defining a "simple" model. Model size and the number of geometric elements (surfaces, planes, lines, etc.) did not correlate with graphic performance. The performance is based on the complexity of the various geometric components, which is not easy for the user to determine. It is difficult to determine what class of workstation offers "sufficient" performance without examining explicitly the types of models and displays commonly used.

The results presented in this report represent a cross section of different types and sizes of models that can act as a guide for overall graphic performance.

Overall Throughput

Chart 1 shows the overall weighted elapsed time to complete the TAGITT/CATIA 4.2.0 r1 interactive scenarios including the graphics tests. Albert-Battaglin Consulting Group feels that this number gives the best overall rating of workstation performance. The chart shows the IBM 43P 260/2way GXT3000P machine to be the fastest overall. The IBM 43P 260/1way GXT3000P and IBM 43P 260/1way GXT2000P machines were nearly as fast, only 4% and 7% slower than the leader respectively. In third place, 16% behind the leader, was the HP C360 FX6.

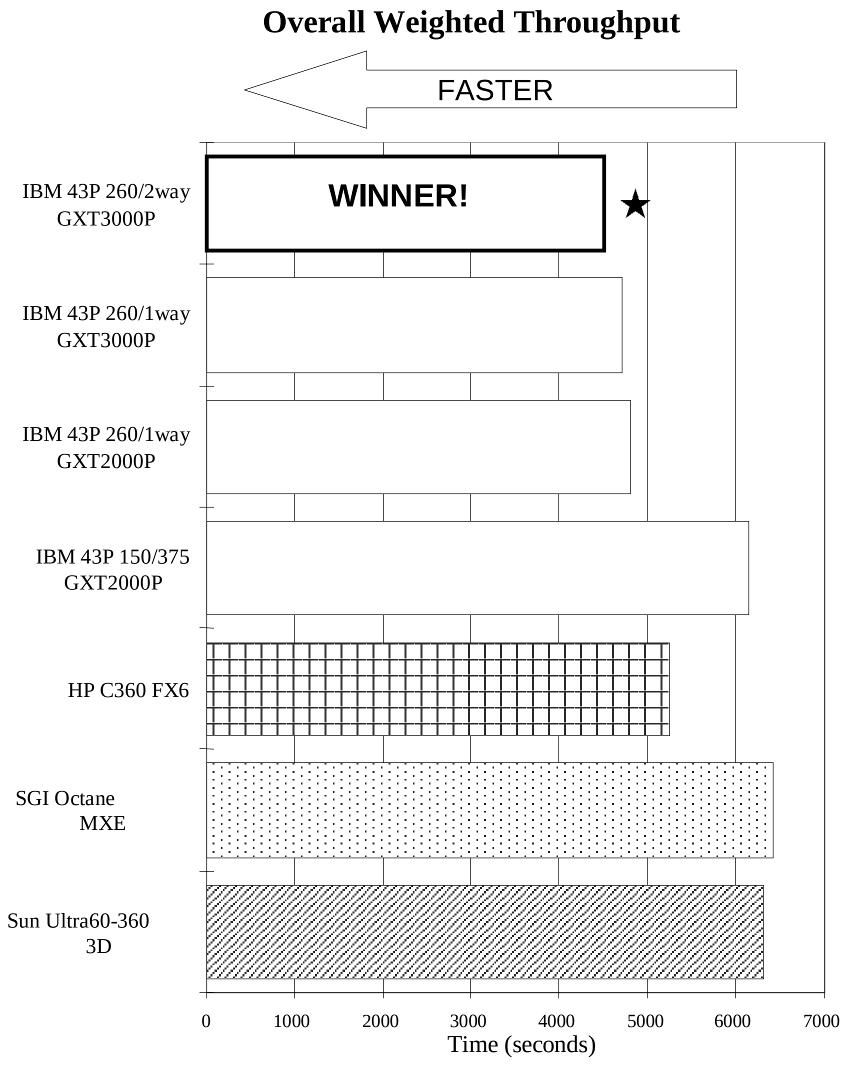

Chart 1 – Overall Weighted Throughput Times CATIA 4.2.0 r1
Lowest time wins! (★)

Graphics Throughput

Chart 2 shows the weighted cumulative time to complete graphic view manipulation operations of parts and assemblies. As described earlier, the Albert-Battaglin Consulting Group Graphics Throughput time includes both initial "loading" of graphics as well as dynamic manipulation times. The IBM 43P 260/2way GXT3000P was the fastest machine in this test. The second fastest machine, the HP C360 FX6, was 16% slower than the leader. In third place, the IBM 43P 260/1way GXT3000P machine was 21% slower than the leader.

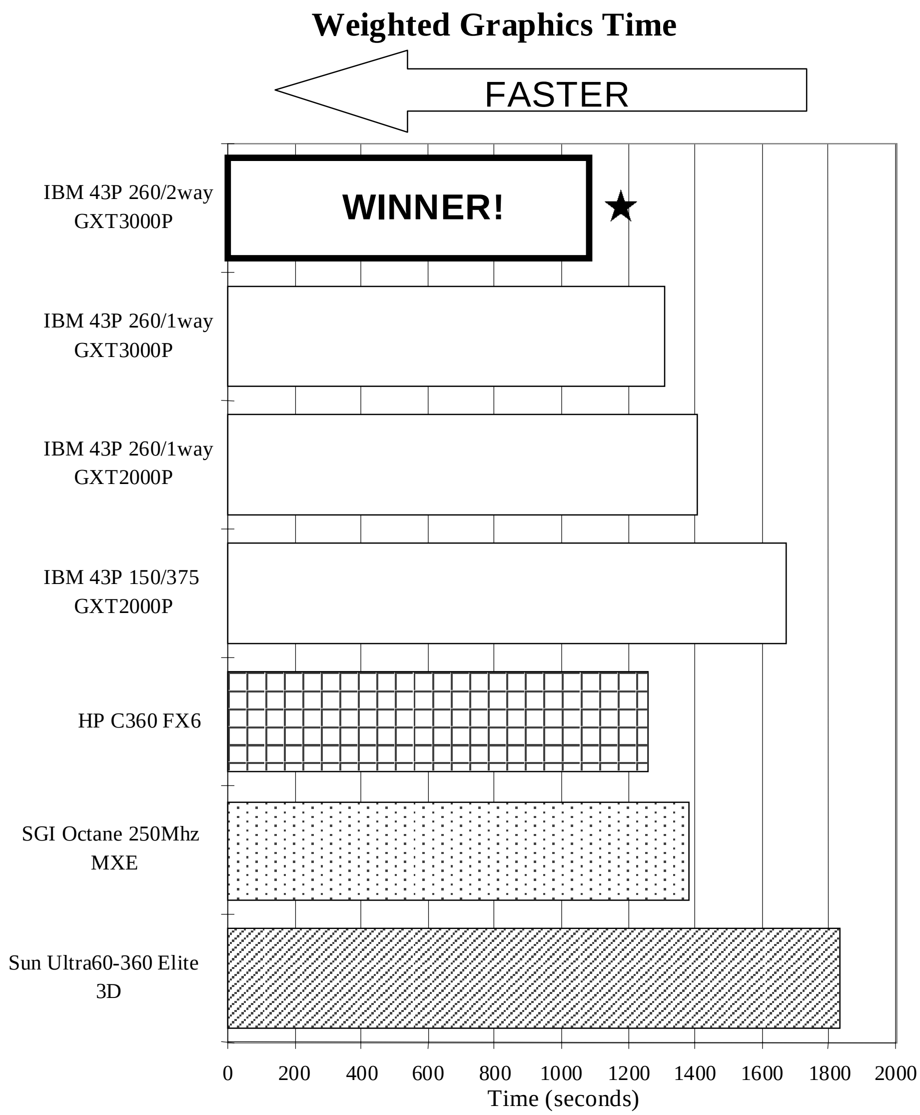

Chart 2 – Weighted Graphic Throughput Values
Lowest time wins! (★)

Application Throughput

Chart 3 shows the weighted cumulative time to complete all of the application-specific tasks in the benchmark. There was a three way tie of overall winners in this test between the IBM 43P 260/2way GXT3000P, IBM 43P 260/1way GXT3000P and IBM 43P 260/1way GXT2000P machines. In second place, the HP C360 FX6 was 16% slower than the leaders. The third place IBM 43P 150/375 GXT2000P and SUN ULTRA 60-360 ELITE 3DM6 machines finished 33% and 35% slower than the leaders respectively.

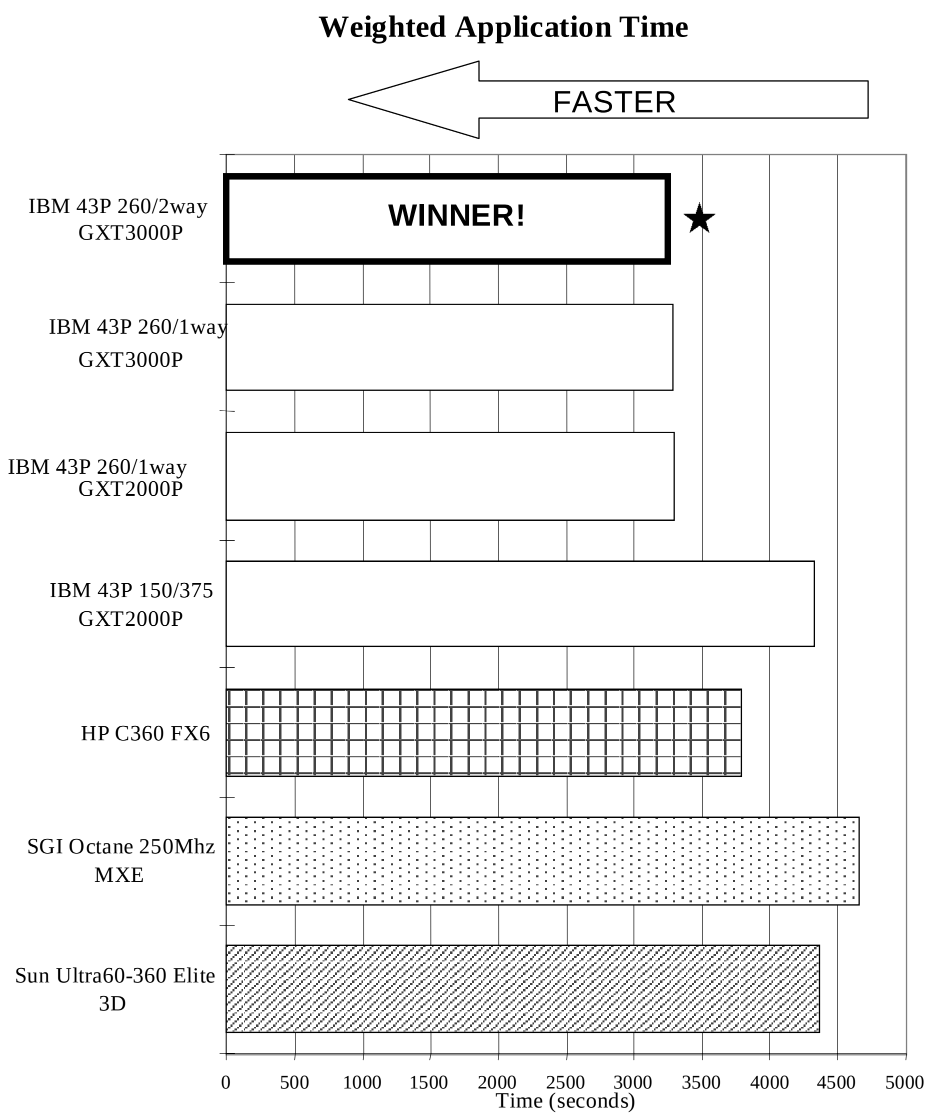

Chart 3 – Weighted Application Throughput Values
Lowest time wins! (★)

System Responsiveness

Chart 4 shows the cumulative time to complete all of the system responsiveness tests in the benchmark. The overall winners of this test were the IBM 43P 260/1way GXT3000P, IBM 43P 260/2way GXT3000P and IBM 43P 260/1way GXT2000P machines. In second place, the HP C360 FX6 was 18% slower than the leading machines. In third place the IBM 43P 150/375 GXT2000P was 25% slower than the fastest machines.

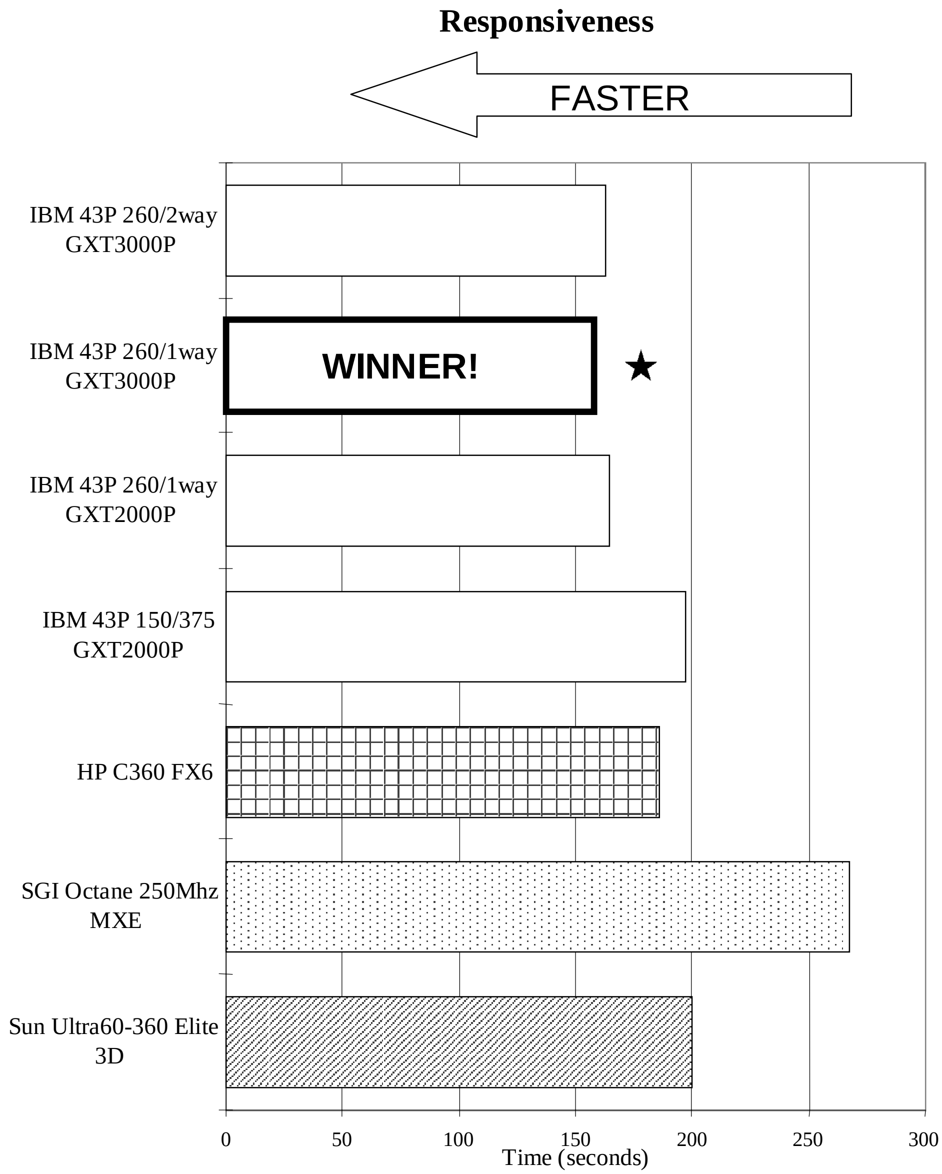

Chart 4 – System responsiveness
Lowest time wins! (★)

CPU Throughput

Chart 5 shows the cumulative time to complete all of the CPU intensive tasks in the benchmark. The overall winners of this test were again a three way tie with the IBM 43P 260/1way GXT2000P, IBM 43P 260/1way GXT3000P and IBM 43P 260/2way GXT3000P machines. In second place, the HP C360 FX6 was 14% slower than the leaders. For third place the SUN ULTRA 60-360 ELITE 3DM6 and IBM 43P 150/375 GXT2000P machines finished 26% and 29% slower than the leaders respectively.

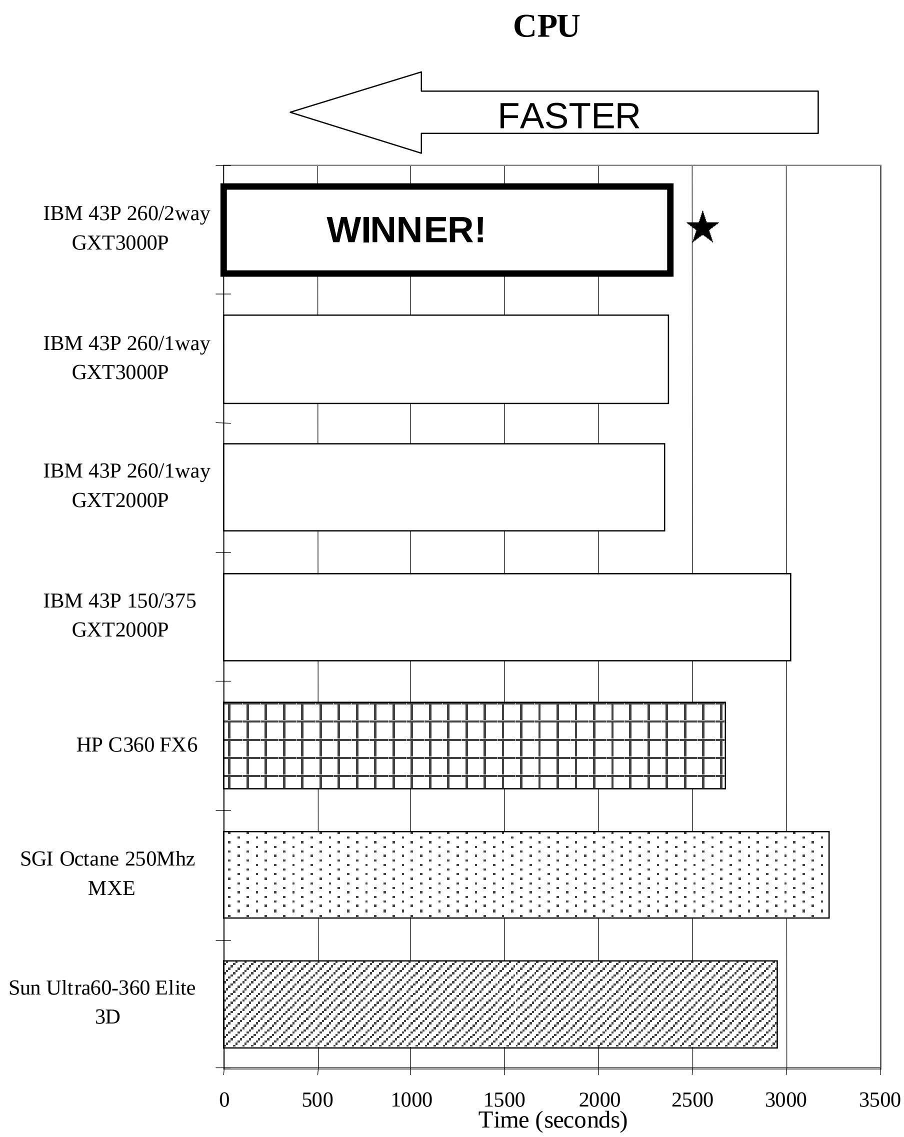

Chart 5 – CPU Throughput Values
Lowest time wins! (★)

Dynamic Graphic Throughput

Chart 6 shows the cumulative time to complete all of the dynamic graphics tasks in the benchmark including wire-frame, shaded and hidden line dynamic graphic operations. This test does not include the longer graphic computation times. The overall winners of this test were the HP C360 FX6 and IBM 43P 260/2way GXT3000P machines. In second place, the single processor IBM 43P 260/1way GXT3000P machine was 30% slower than the leaders. Nearly tied for third place, the SGI OCTANE 250MHZ MXE and IBM 43P 260/1way GXT2000P machines finished about 35% slower than the leaders.

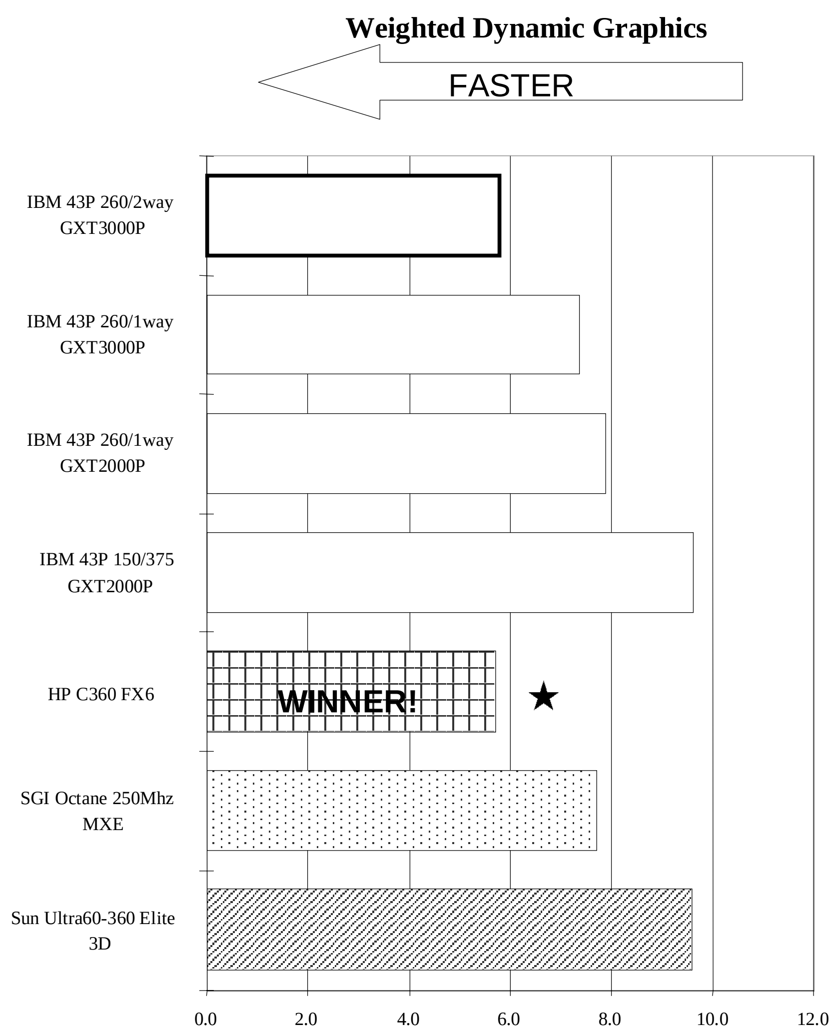

Chart 6 – Dynamic Graphic Throughput Values
Lowest time wins! (★)

Read/Write (Input/Output) Throughput

Chart 7 shows the cumulative time to complete all of the Read/Write intensive tasks in the benchmark including application starts and model reads and writes. The overall winner of this test was the SGI OCTANE 250MHZ MXE. In second place, the IBM 43P 260/2way GXT3000P, IBM 43P 260/1way GXT3000P and IBM 43P 260/1way GXT2000P machines were between 10% and 14% slower than the leader. Nearly tied for third place, the HP C360 FX6, SUN ULTRA 60-360 ELITE 3DM6 and IBM 43P 150/375 GXT2000P machines finished about 20% slower than the leader.

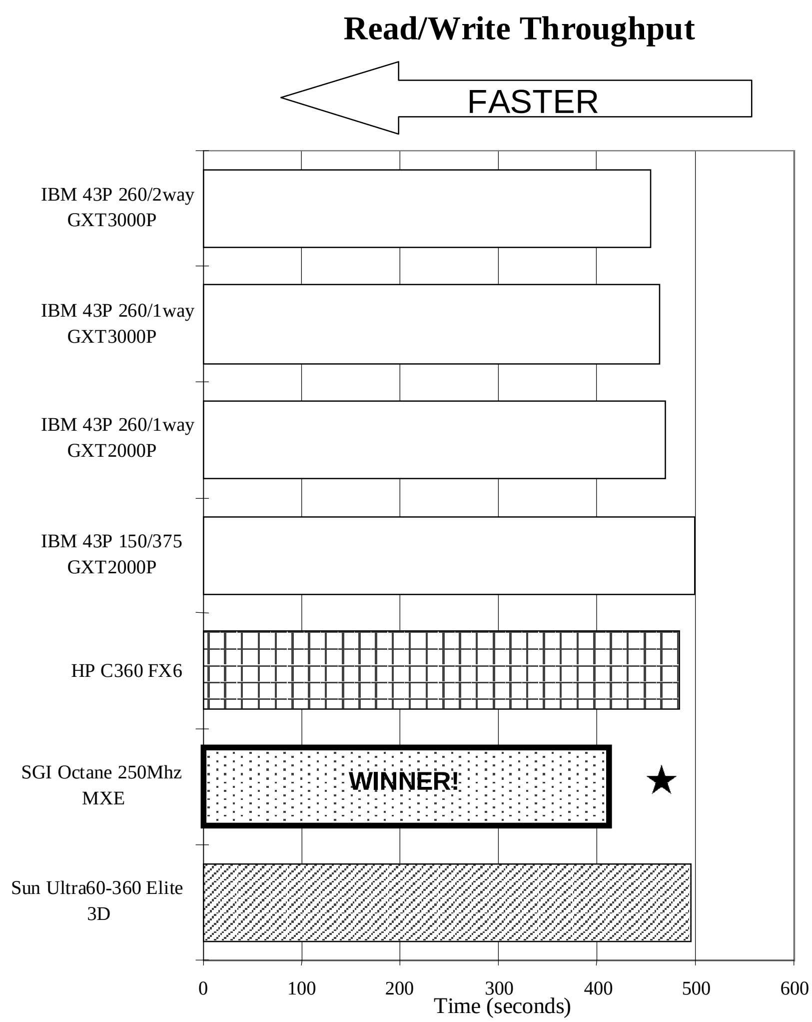

Chart 7 – Input/Output Throughput Values
Lowest time wins! (★)

4D Navigator Throughput

Chart 8 shows the weighted cumulative time to complete all of the 4D Navigator tests in the benchmark including single light, dual light, neon and neon with edge rendering modes. The overall winner of this test was the SGI OCTANE 250MHZ MXE by a substantial margin. In second place, the IBM 43P 260/1way GXT3000P and IBM 43P 260/2way GXT3000P machines were 28% slower than the leader. The third place machine finished about 43% slower than the leader. It must be noted that the SUN ULTRA 60-360 ELITE 3DM6 was unable to complete many of the exercises in this test and estimated values, based on the tests which were completed were used. Note also that the HP C360 FX6 machine was not equipped with the texture mapping option. This substantially affected its speed on the neon and neon edge portions of this test and consequently on the overall throughput.

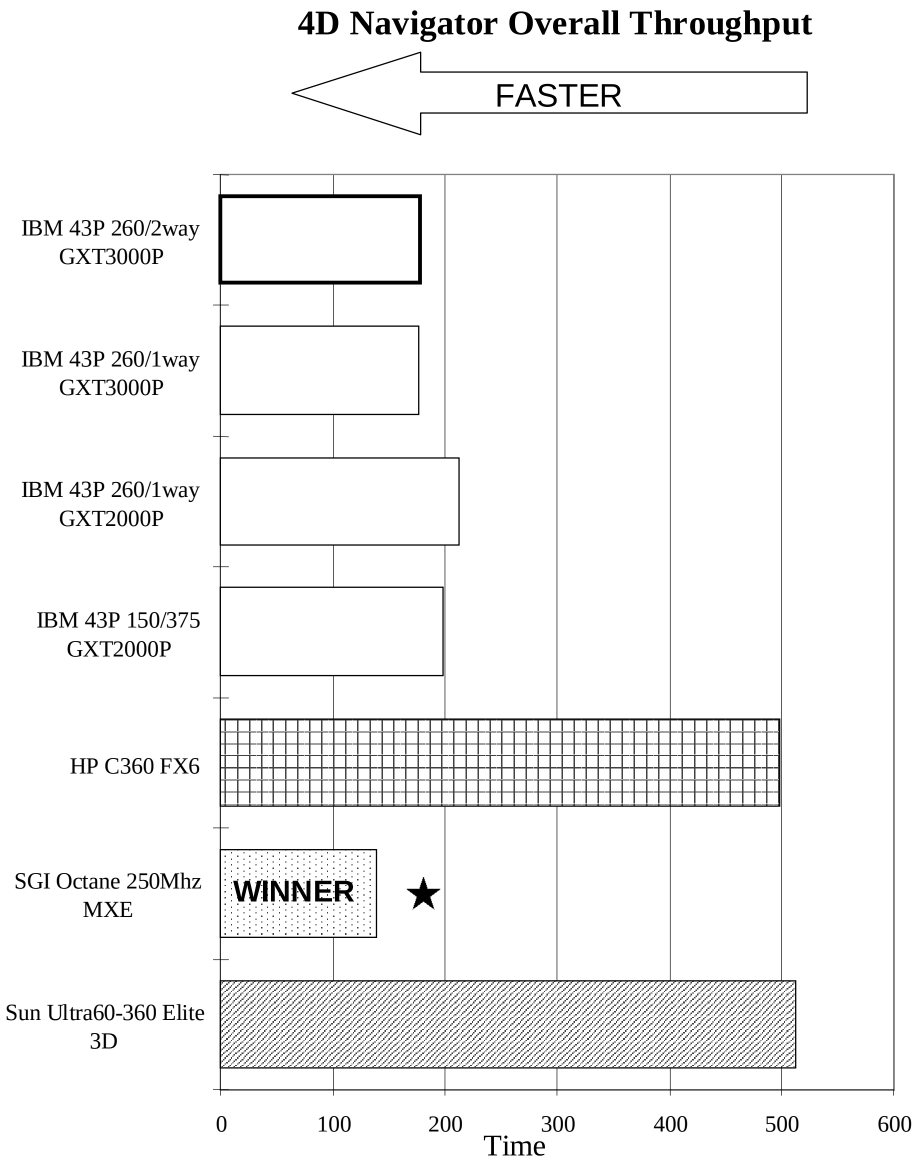

Chart 8 – 4D Navigator Throughput Times
Lowest time wins! (★)

TAGITT Price/Performance Index Comparisons

Charts 9 through 14 compare the workstations using the same tests as on Charts 1 through 7 while factoring in workstation list price. This Price/Performance Index or PPI value increases with increasing performance or decreasing price such that higher numbers represent better performance for less money. The actual numeric value of a PPI score is not significant, rather only relative values pertaining to the same test.

Overall PPI

Chart 9 shows the IBM 43P 150/375 GXT2000P and SUN ULTRA 60-360 ELITE 3DM6 tied as clear leaders in TAGITT/CATIA 4.2.0 r1 overall PPI evaluation. The IBM 43P 260/1way GXT2000P rated second with 85% of the leading machine's PPI. In third place, the IBM 43P 260/1way GXT3000P delivered 76% of the leading machine's PPI. Scoring worst in overall PPI was the SGI OCTANE 250MHZ MXE machine. This machine offered only 37% of the Price/Performance of the leading machines.

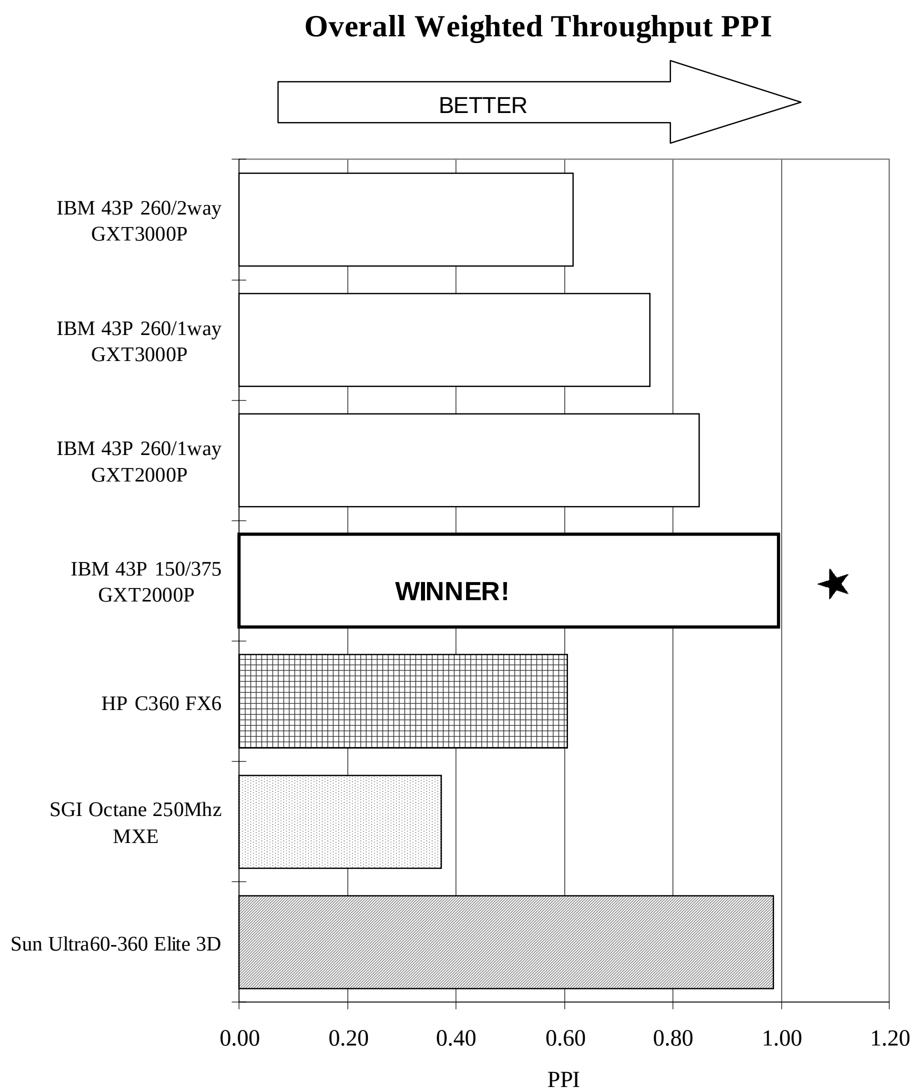

Chart 9 – Overall PPI CATIA 4.2.0 r1
Highest PPI wins! (★)

Graphics PPI

Chart 10 shows the IBM 43P 150/375 GXT2000P to be the leader in graphics operation PPI. In second place, the SUN ULTRA 60-360 ELITE 3DM6 obtained just over 93% of the leader's PPI. Tied for third, the IBM 43P 260/1way GXT2000P and IBM 43P 260/1way GXT3000P machines obtained about 75% of the leader's PPI.

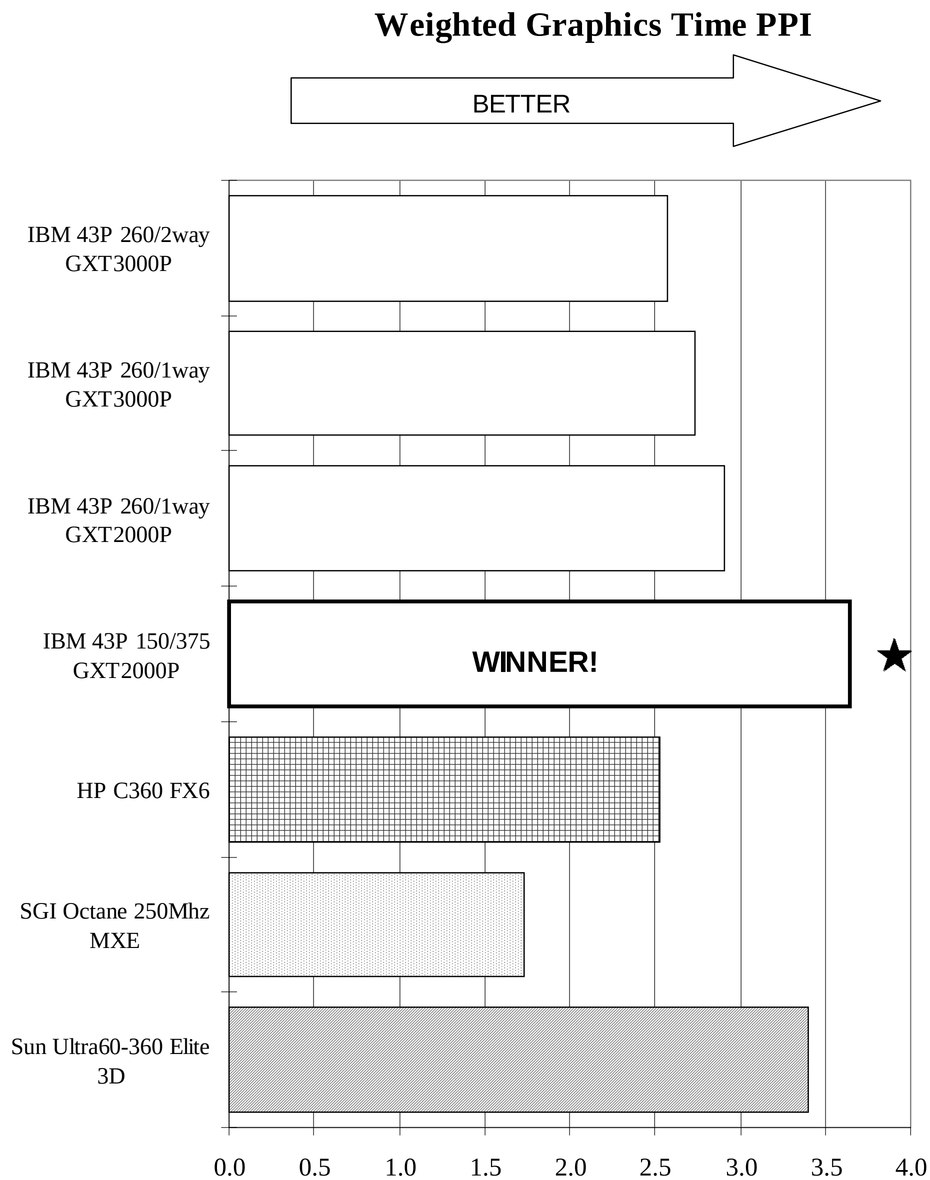

Chart 10 – Overall Graphics PPI CATIA 4.2.0 r1
Highest PPI wins! (★)

Application Tasks PPI

Chart 11 shows the SUN ULTRA 60-360 ELITE 3DM6 and IBM 43P 150/375 GXT2000P machines to be almost exactly tied for the leading position in application task PPI. These machines had scores which were less than 1% different from one another. Following 13% behind in second place was the IBM 43P 260/1way GXT2000P. Behind this machine with about 76% of the leader's PPI was the IBM 43P 260/1way GXT3000P machine. The SGI OCTANE 250MHZ MXE machine with only 36% of the leader's score delivered the worst PPI for this test.

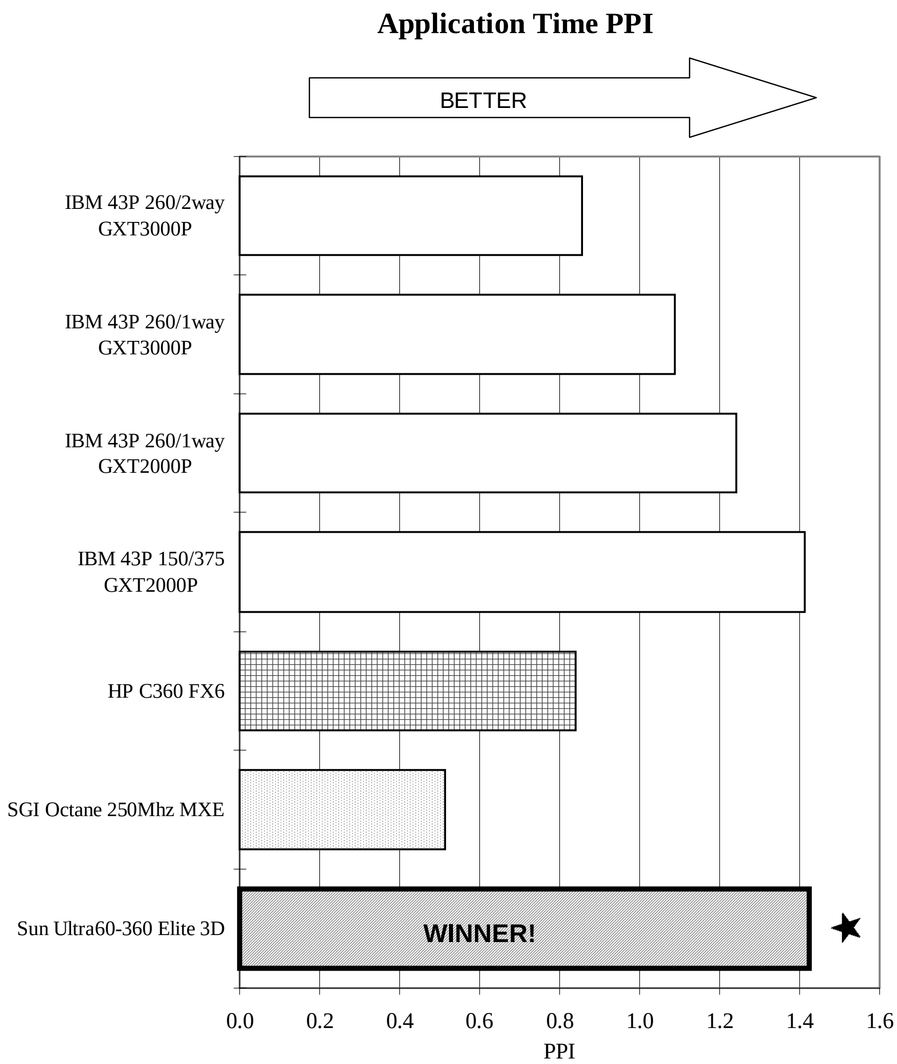

Chart 11 – Applications PPI CATIA 4.2.0 r1
Highest PPI wins! (★)

CPU PPI

Chart 12 shows the SUN ULTRA 60-360 ELITE 3DM6 to be the narrow leader in CPU PPI. Only 4% behind in second place was the IBM 43P 150/375 GXT2000P. The third place IBM 43P 260/1way GXT2000P machine delivered 82% of the leading machine's PPI. The worst PPI for this test was again delivered by the SGI OCTANE 250MHZ MXE machine with only 35% of the leader's score.

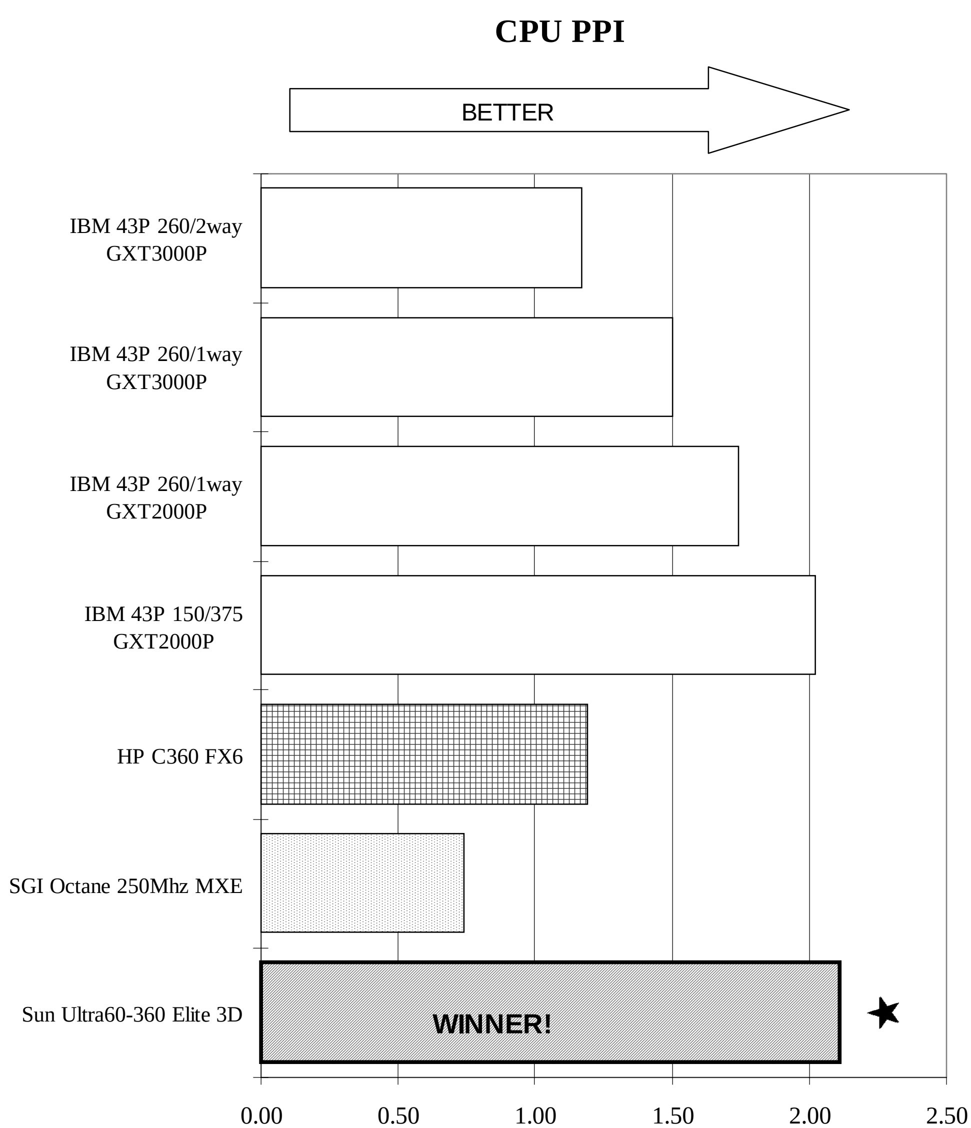

Chart 12 – CPU PPI CATIA 4.2.0 r1
Highest PPI wins! (★)

Dynamic Graphics PPI

Chart 13 shows the SUN ULTRA 60-360 ELITE 3DM6 and IBM 43P 150/375 GXT2000P machines to be the clear leaders in Dynamic Graphics PPI. The second place HP C360 FX6 machine delivered only 86% of the leaders' scores. Close behind this machine with 80% of the leaders' PPI was the IBM 43P 260/1way GXT2000P. The SGI OCTANE 250MHZ MXE managed 48% of the leaders' scores in this test.

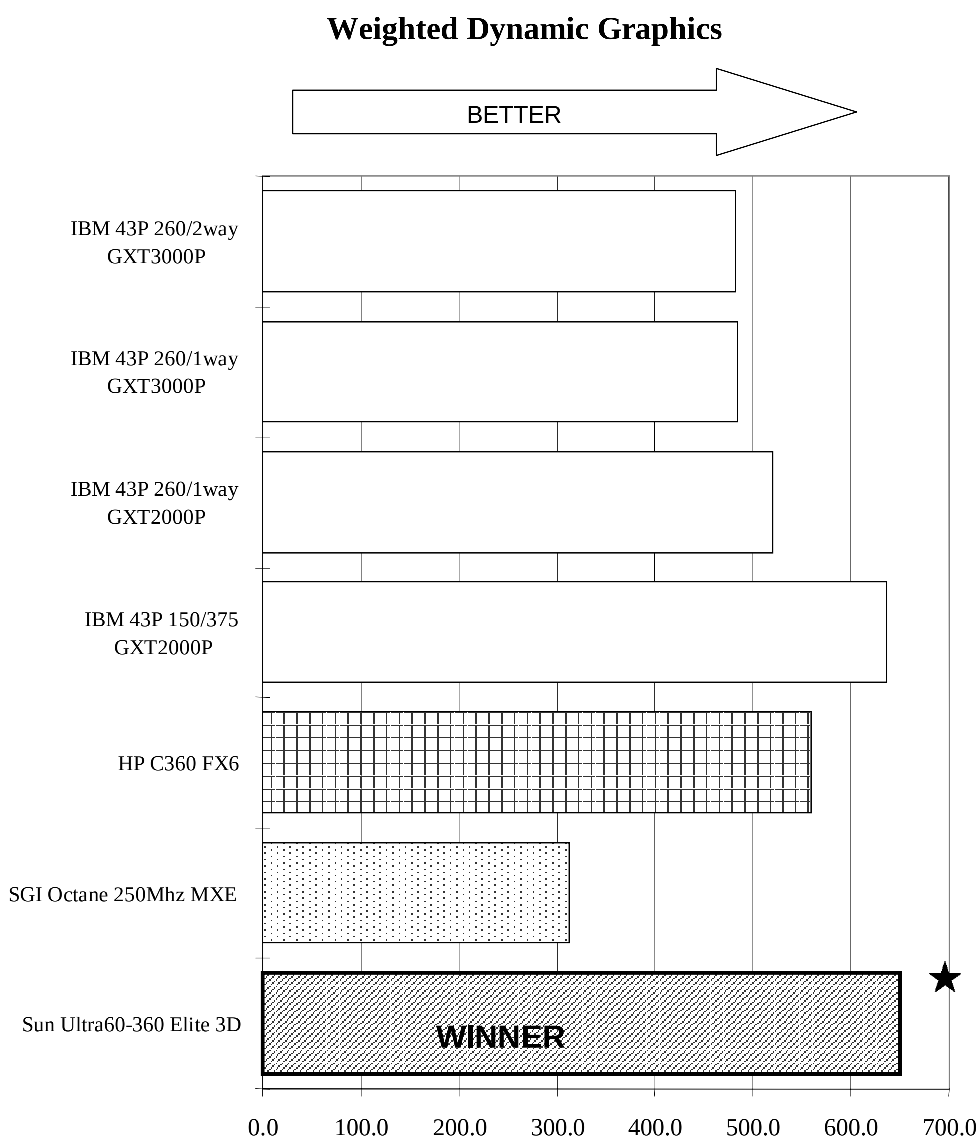

Chart 13 – Dynamic Graphics PPI CATIA 4.2.0 r1
Highest PPI wins! (★)

Read/Write (Input/Output) PPI

Chart 14 shows the SUN ULTRA 60-360 ELITE 3DM6 and IBM 43P 150/375 GXT2000P machines to be the clear leaders in I/O PPI. The second place IBM 43P 260/1way GXT2000P machine delivered only 69% of the leaders' scores. Close behind this machine with 62% of the leaders' PPI was the IBM 43P 260/1way GXT3000P. The worst PPI's for this test were delivered by the IBM 43P 260/2way GXT3000P and SGI OCTANE 250MHZ MXE machines with between 46% and 49% of the leaders' scores.

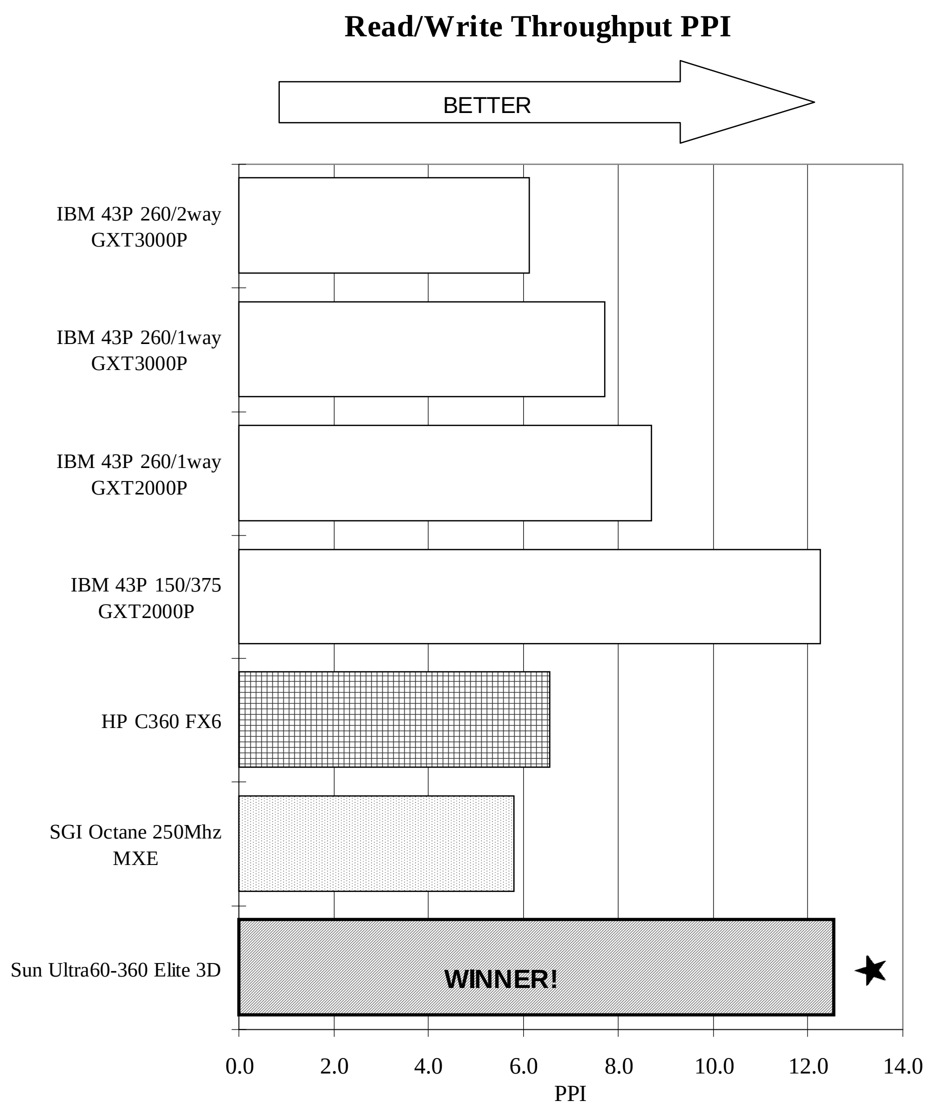

Chart 14 – I/O PPI CATIA 4.2.0 r1
Highest PPI wins! (★)

4D Navigator PPI

Chart 15 shows the IBM 43P 150/375 GXT2000P to be the clear leader in PPI when running CATIA 4D Navigator. The second place IBM 43P 260/1way GXT3000P and IBM 43P 260/1way GXT2000P machines delivered only 66% of the leader's score. Close behind this machine with 56% of the leader's PPI was the SGI OCTANE 250MHZ MXE. The worst PPI's for this test were delivered by the SUN ULTRA 60-360 ELITE 3DM6 and HP C360 FX6 machines with between 39% and 21% of the leader's score respectively.

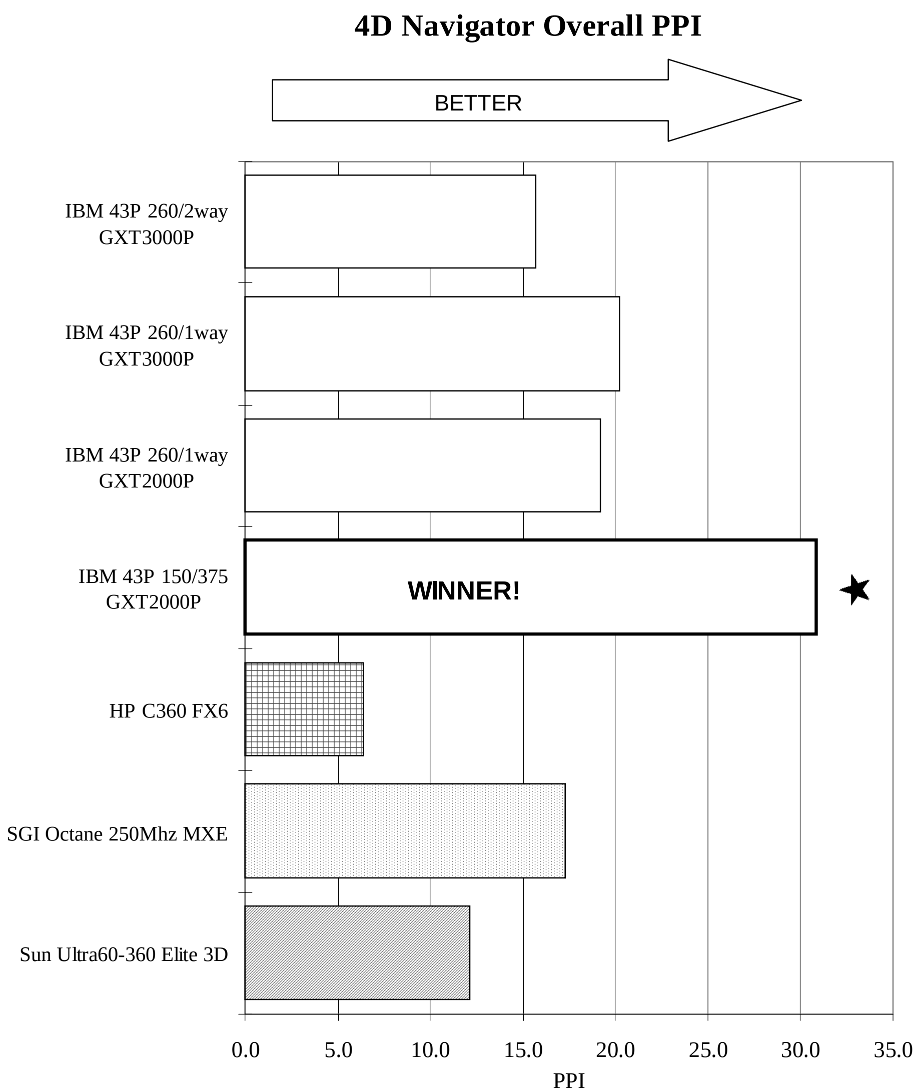

Chart 15 – 4D Navigator CATIA 4.2.0 r1 PPI
Highest PPI wins! (★)

Conclusions

The results of the TAGITT/CATIA 4.2.0 refresh 01 evaluation show IBM to have the overall performance lead with its IBM 43P 260 based machines. The IBM 43P 260/2way GXT3000P was 16% faster overall than the nearest competitive machine, the HP C360 FX6. In addition, the single processor versions of the machine were often as fast as the dual processor machine at a significantly lower price. The HP C360 FX6 was shown to be a strong competitor and would likely have done somewhat better in the test with the texture mapping option to the FX6 graphics. The HP C360 FX6's performance on the neon portion of the 4D Navigator test was especially poor. The SUN ULTRA 60-360 ELITE 3DM6 and the IBM 43P 150/375 GXT2000P demonstrated very similar performance in this round of TAGITT testing with the SGI OCTANE 250MHZ MXE machine performing generally slower than both.

In the important price/performance ratings the IBM 43P 150/375 GXT2000P and SUN ULTRA 60-360 ELITE 3DM6 should be considered equal and were the current leaders by a good margin (~15%) over second place IBM 43P 260/1way machines. The IBM 43P 260/2way GXT3000P and HP C360 FX6 were also roughly equal in price performance, some 40% behind the two leading machines. The SGI Octane 250 MHz MXE's price is likely too high for most CAD/CAM users, and yielded the worst PPI numbers in the test.

In terms of graphic performance, the IBM 43P 260/2way GXT3000P machine was again the clear leader in overall performance. This was the only area where dual processors showed clear benefit. The excellent performance of the new GXT3000P graphic adapter remains well matched with the Power3 CPU for excellent overall results. The HP C360 FX6 delivered the best dynamic graphic performance, beating the IBM 43P 260/2way GXT3000P by a narrow 2% margin. In the dynamic graphic performance test, using the GXT3000P graphics adapter, the dual processor IBM 43P 260 outperformed the single processor configuration by 28%.

In the new TAGITT 4D Navigator test, the SGI OCTANE 250MHZ MXE was the fastest machine by a substantial 28% margin. The lack of texture mapping on the HP C360 FX6 apparently hurt the machine in the neon rendered portions of the test where the machine was more than 30 times slower than the fastest machine. The HP was the fastest machine in the single and dual light portions of the test by a substantial (20+%) margin. The Sun machine was unable to complete substantial portions of the 4D Navigator test which used large models. For price/performance, the IBM 43P 150/375 GXT2000P had a substantially (>40%) better score than any competitive machine.

The wider range of application testing in TAGITT/CATIA 4.2.0 r1 showed performance differences between various CATIA functions. It is impossible to tell from the TAGITT evaluation the reasons for these differences. Although the IBM 43P 260/2way GXT3000P or IBM 43P 260/1way GXT3000P machines won nearly all of the individual application tests, there were some notable exceptions. In particular, the SUN ULTRA 60-360 ELITE 3DM6 was fastest in the Studio and Image Viewer tests by a substantial margin. The SGI OCTANE 250MHZ MXE showed the best I/O performance by winning the Read/Write test. The HP C360 FX6 was 8% faster than the surprise second place IBM 43P 150/375 GXT2000P machine in the surface/solid analysis test, and it tied for first place in the Modeling, Fitting Simulation and Kinematics tests.

IBM has made significant strides in both overall performance and price/performance with the addition of the Power3 and 604E architectures and the new GXT 3000P, and GXT 2000P 3D graphics accelerators for its 43P workstations. The GXT 2000P graphics adapter and Sun’s Elite 3D graphics adapter were very similar in performance but could not keep up with the other graphic adapters tested for raw speed. In terms of price/performance however, both the IBM 43P 150/375 GXT2000P and SUN ULTRA 60-360 ELITE 3DM6 lead the pack by a comfortable (+16%) margin. The relatively low 200 MHz clock speed of the IBM 43P 260 indicates some room to grow with this workstation architecture. In addition the excellent performance of the IBM 43P 150/375 indicates that the enhancements to the 604 architecture have paid off for CAD/CAM users. Performance gains with the 375MHz 604E were far above what would be expected from an increase in clock-speed alone.

The TAGITT/CATIA 4.2.0 r1 test shows the IBM 43P 260 machines to be excellent in raw performance while the IBM 43P 150/375 GXT2000P matches the best price/performance workstation tested. The combination of raw speed and excellent price performance in the IBM 43P workstation line, make them good choices in engineering environments.

Methodology

All tests were conducted by Albert-Battaglin Consulting Group personnel. Test conditions were set up to minimize any platform differences with the various systems. Systems were tested in "lab" environments so that they were isolated from network interference. Albert-Battaglin Consulting Group saw no evidence to suggest that performance was impacted by extraneous network activity. All timing data was automatically recorded and transferred directly into spreadsheets for analysis. All tests were run three times and the average times were used for comparison. For the overall test, the time difference between runs were typically less than 1.5% and in some cases as low as 0.1%.

All TAGITT/CATIA 4.2.0 r1 tests were completed using released CATIA 4.2.0 refresh 01 software. In all cases the software and data were loaded locally on each workstation.

Appendix

The following charts show the results for individual application tests that were combined to form the overall application and overall throughput times for TAGITT/CATIA 4.2.0 r1.

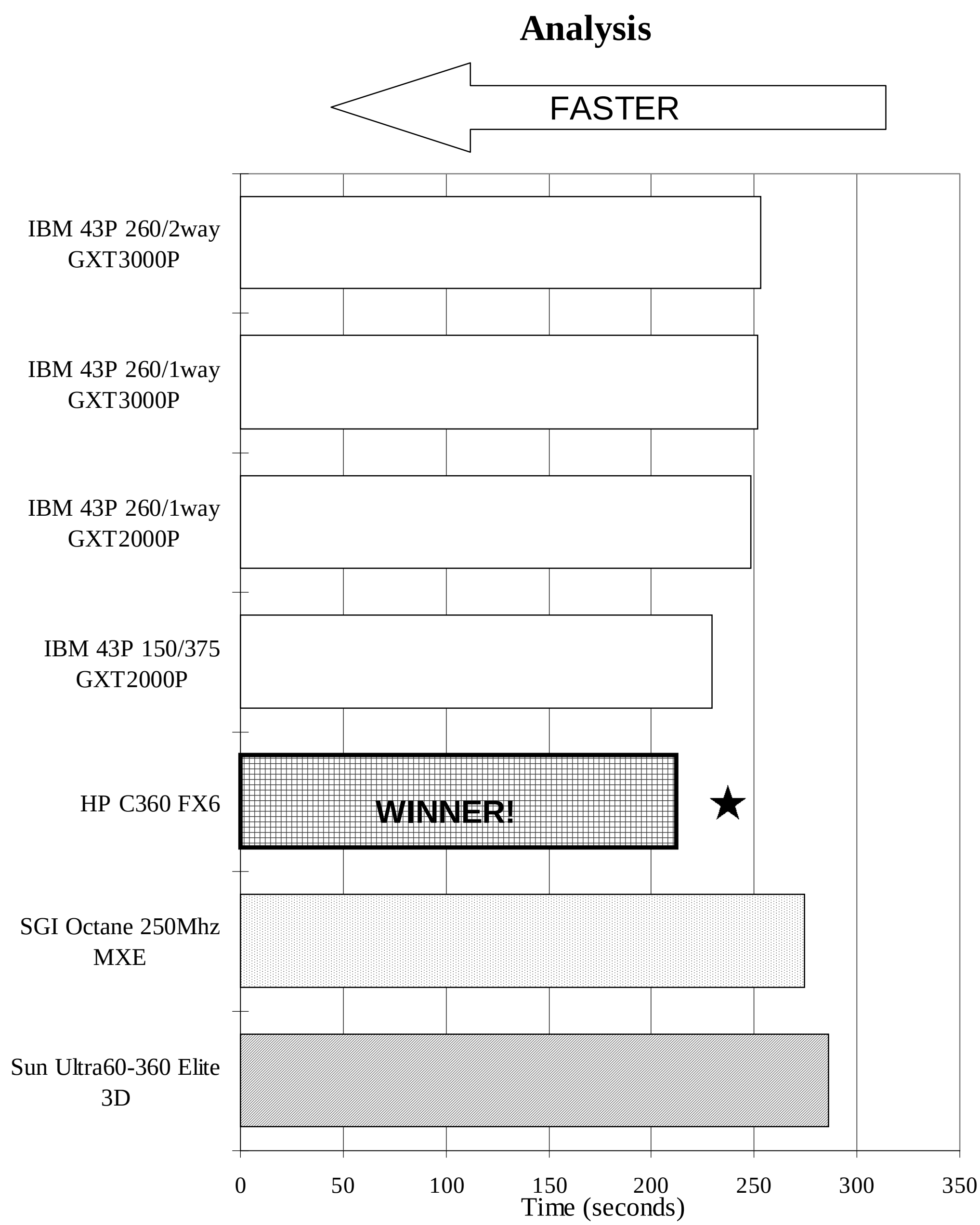

Chart 16 – Solid and Surface Analysis Function Throughput Values
Lowest time wins! (★)

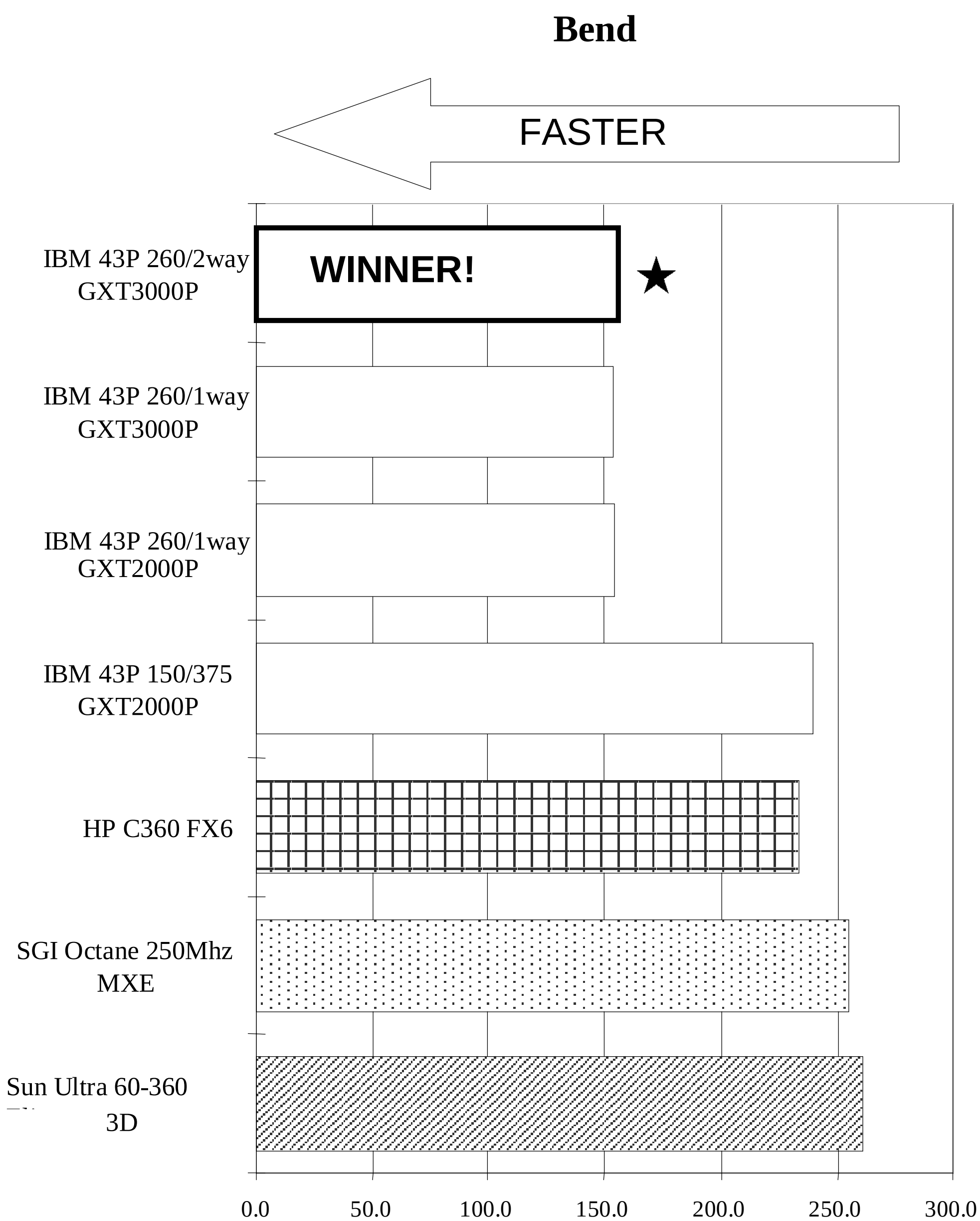

Chart 17 – Bend (Sheet Metal Part Development and Modification) Throughput Values
Lowest time wins! (★)

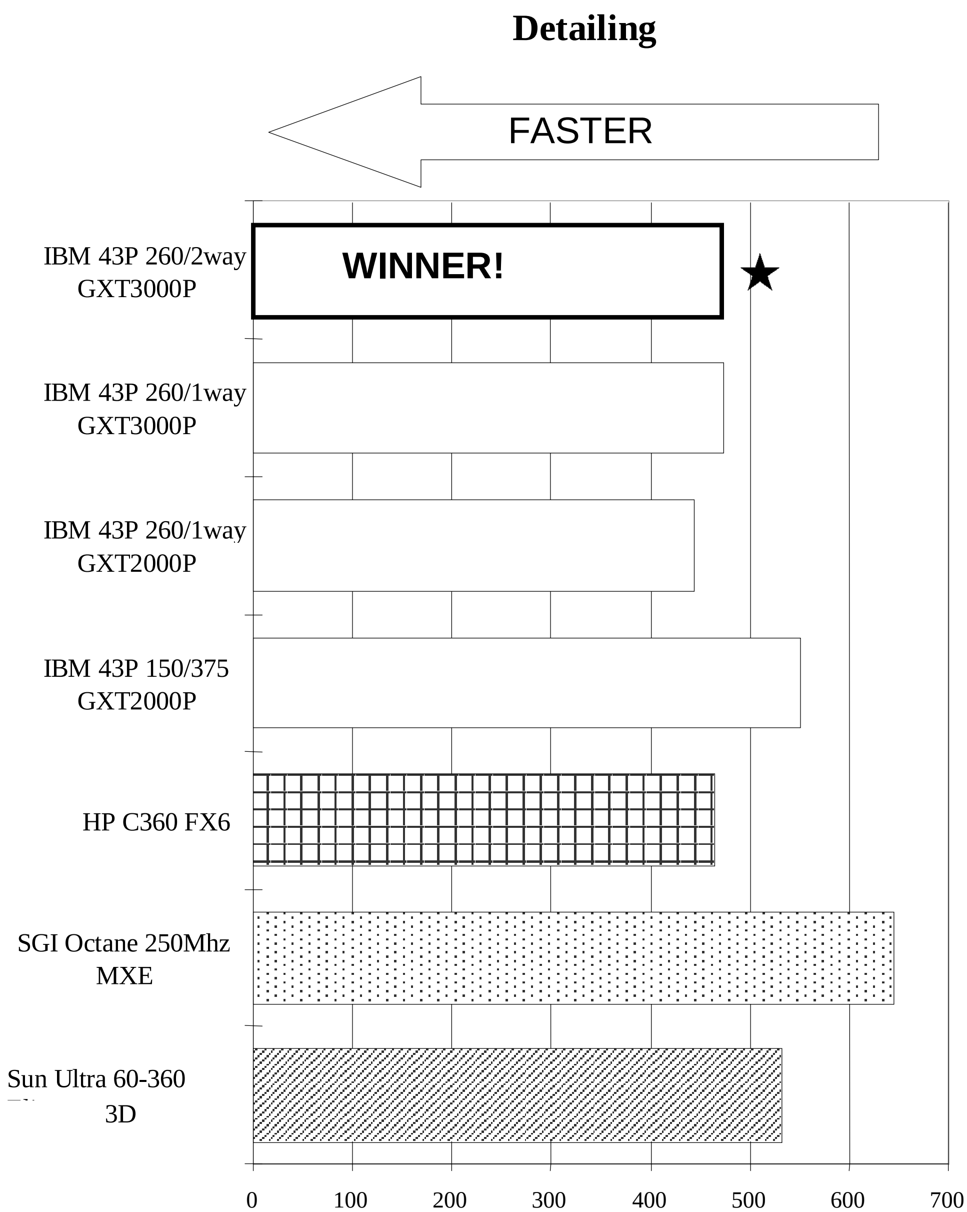

Chart 18 – Detail Drawing Creation Throughput Values
Lowest time wins! (★)

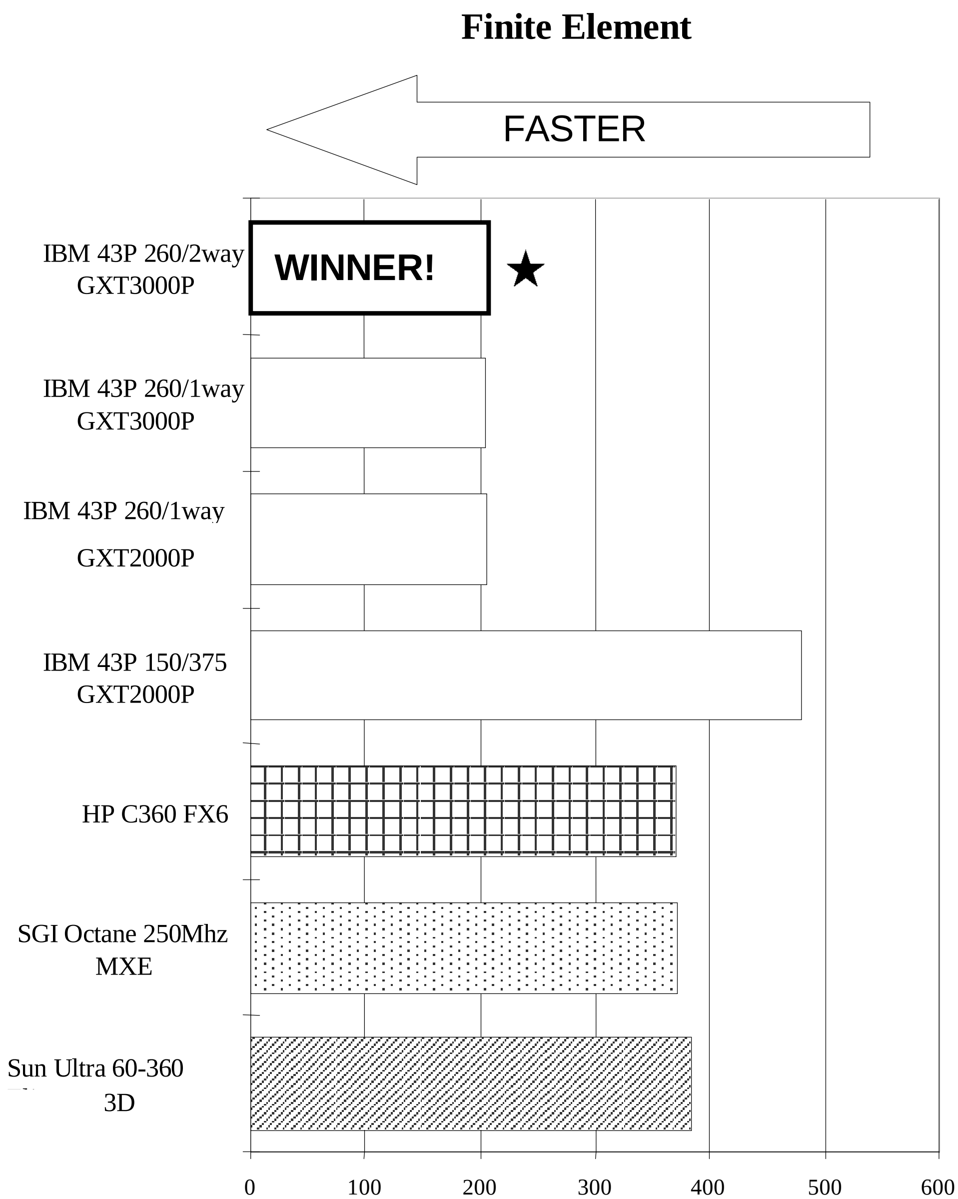

Chart 19 – Finite Element Analysis (ANSOLID) Throughput Values
Lowest time wins! (★)

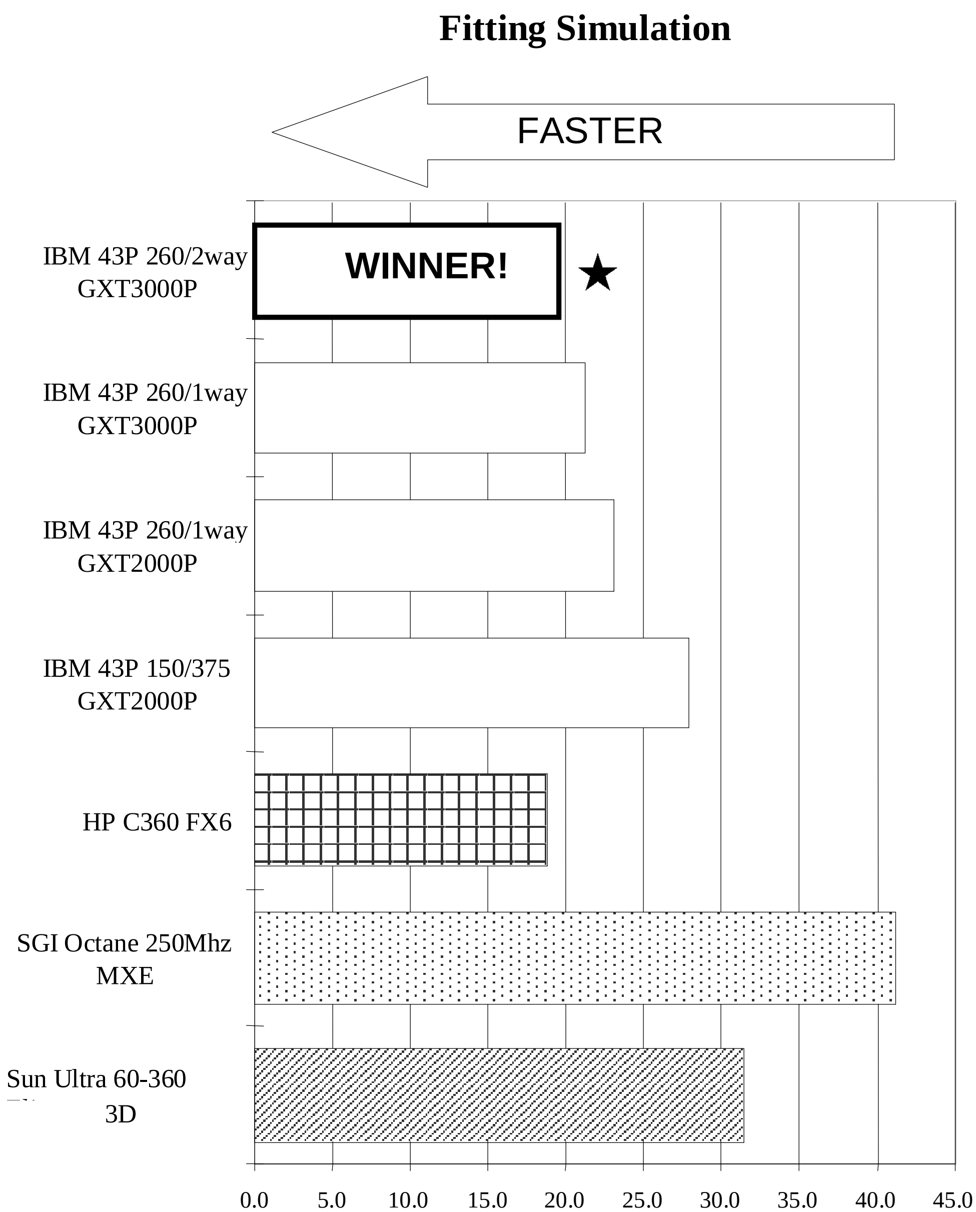

Chart 20 – Fitting Simulation Throughput Values
Lowest time wins! (★)

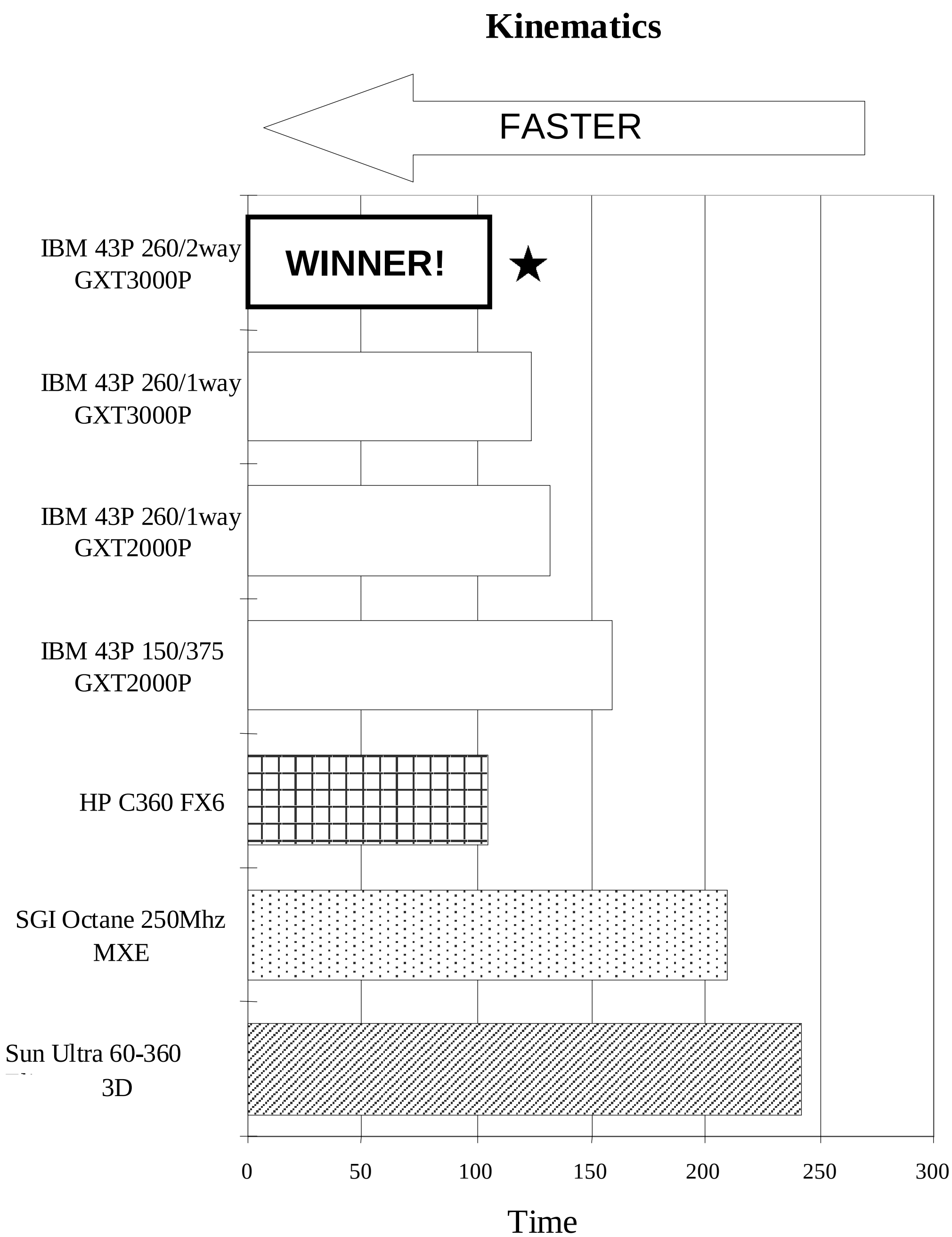

Chart 21 – Kinematic Simulation Throughput Values
Lowest time wins! (★)

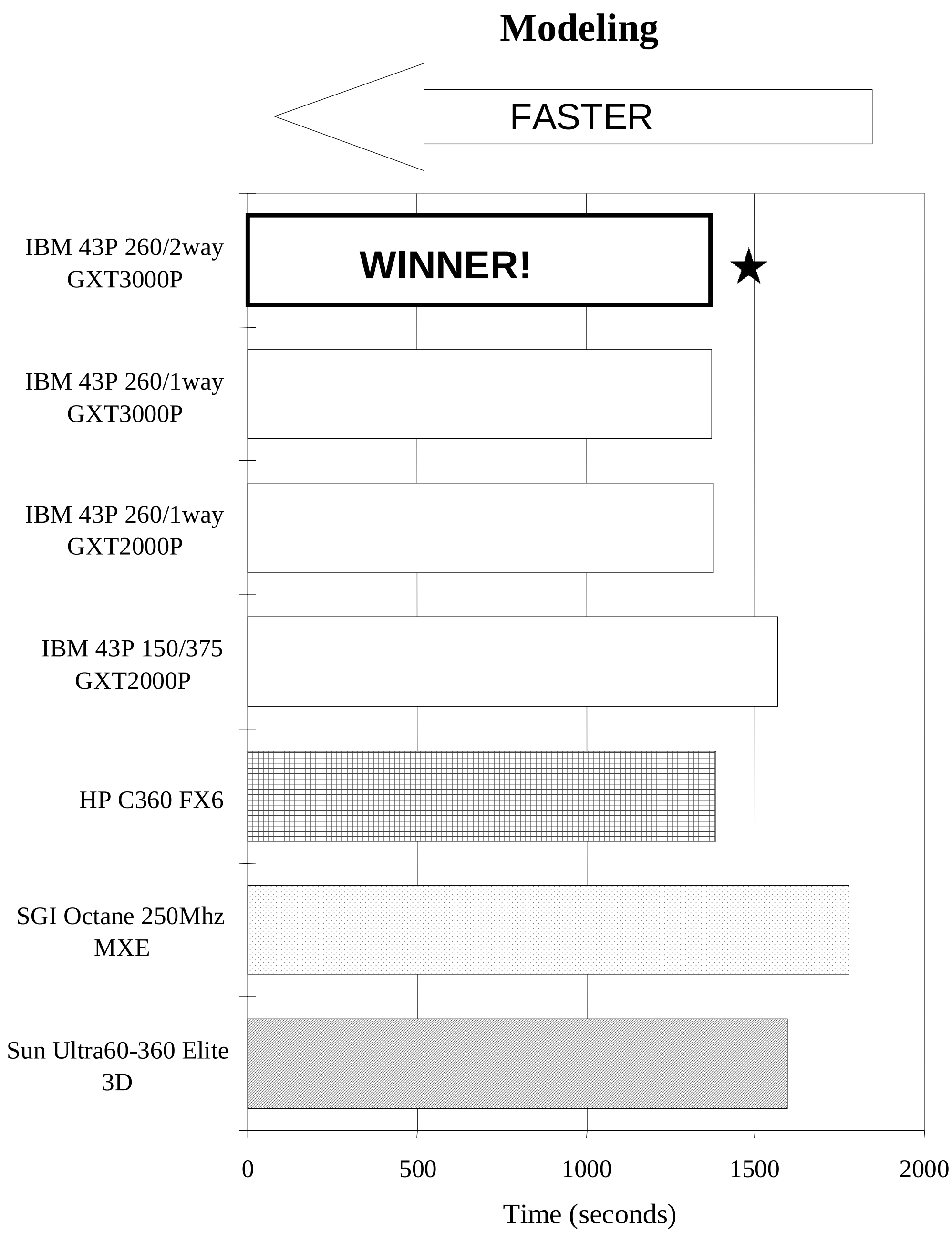

Chart 22 – Solid Model Creation and Modification Throughput Values
Lowest time wins! (★)

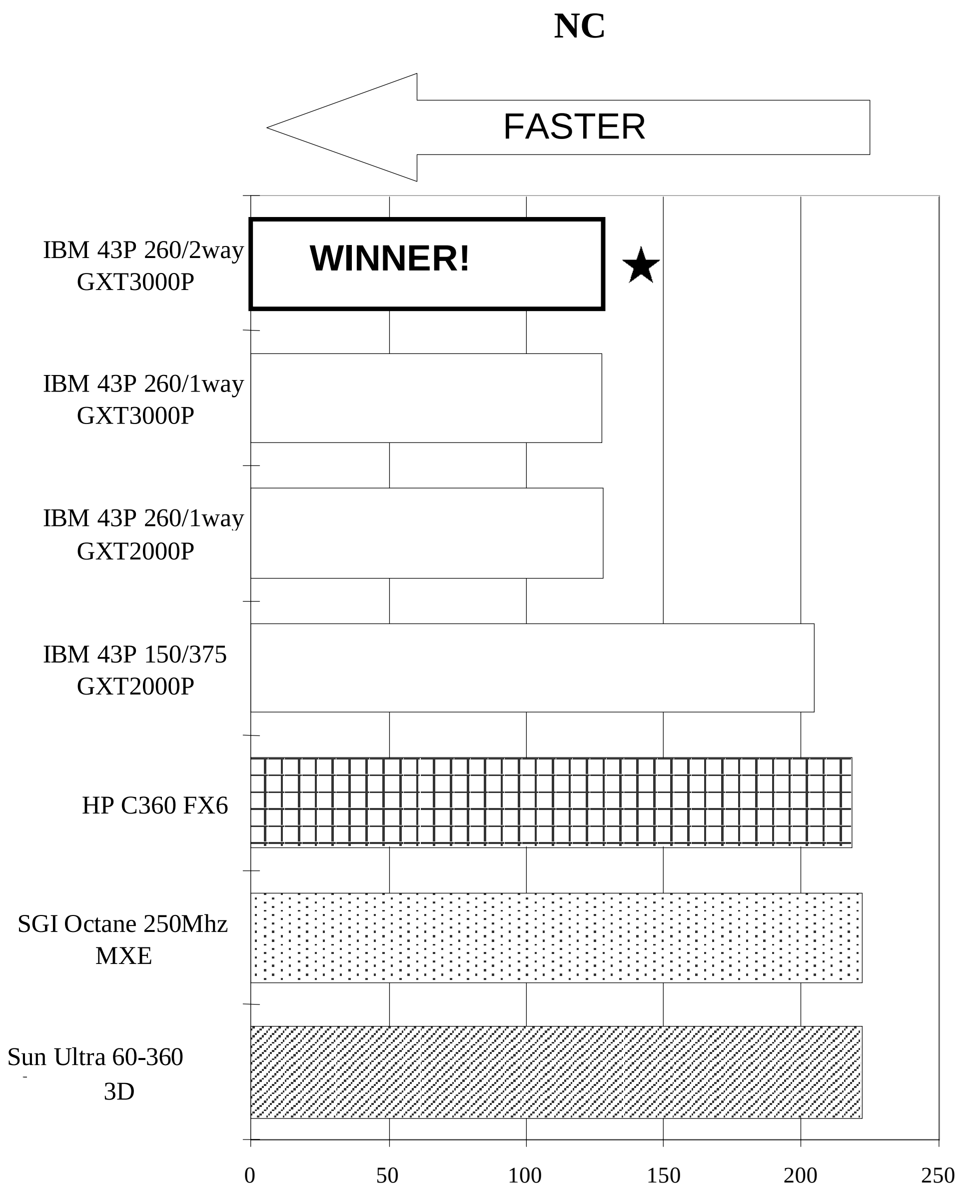

Chart 23 – NC Tool Path Generation Throughput Values
Lowest time wins! (★)

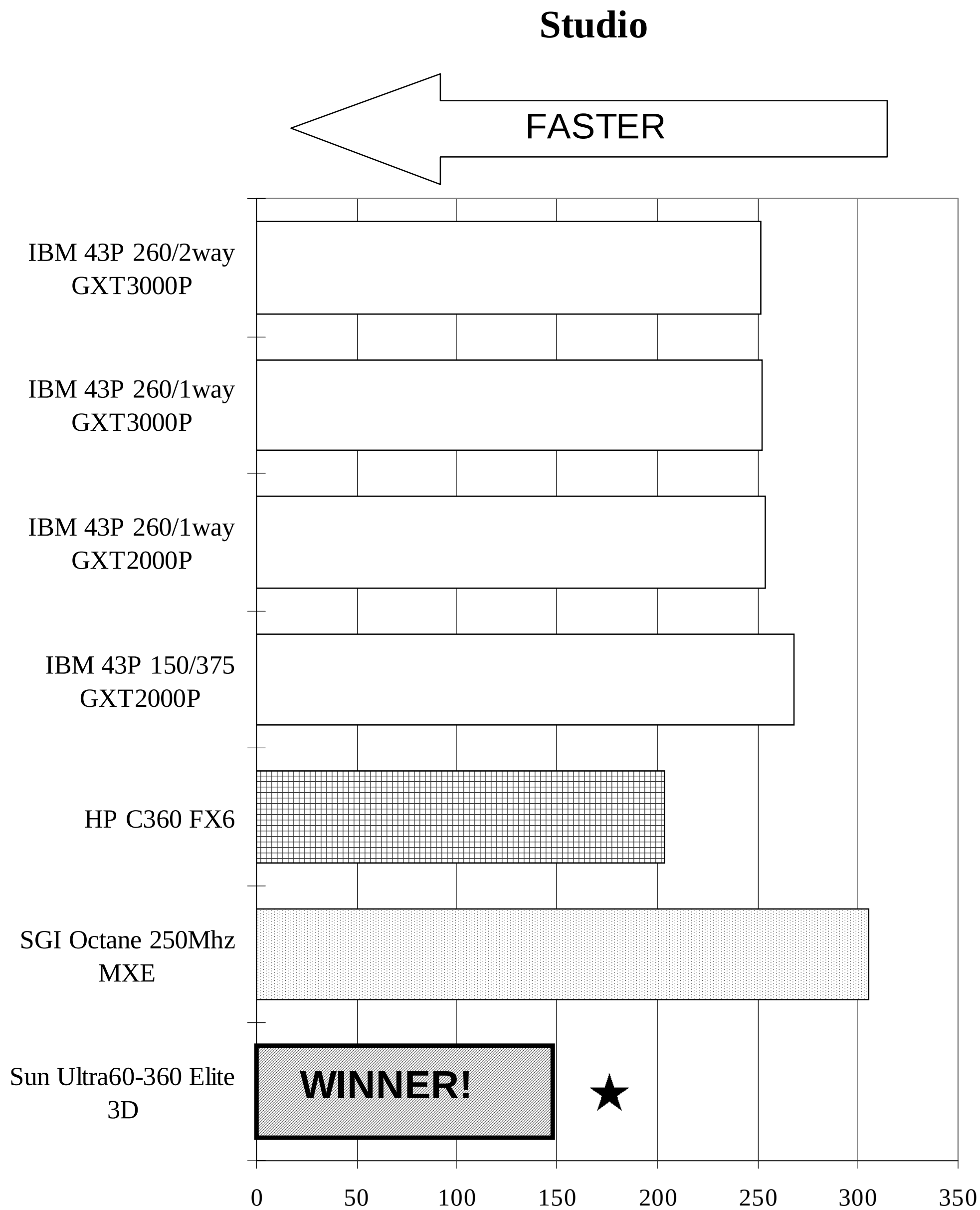

Chart 24 – Studio Throughput Values
Lowest time wins! (★)

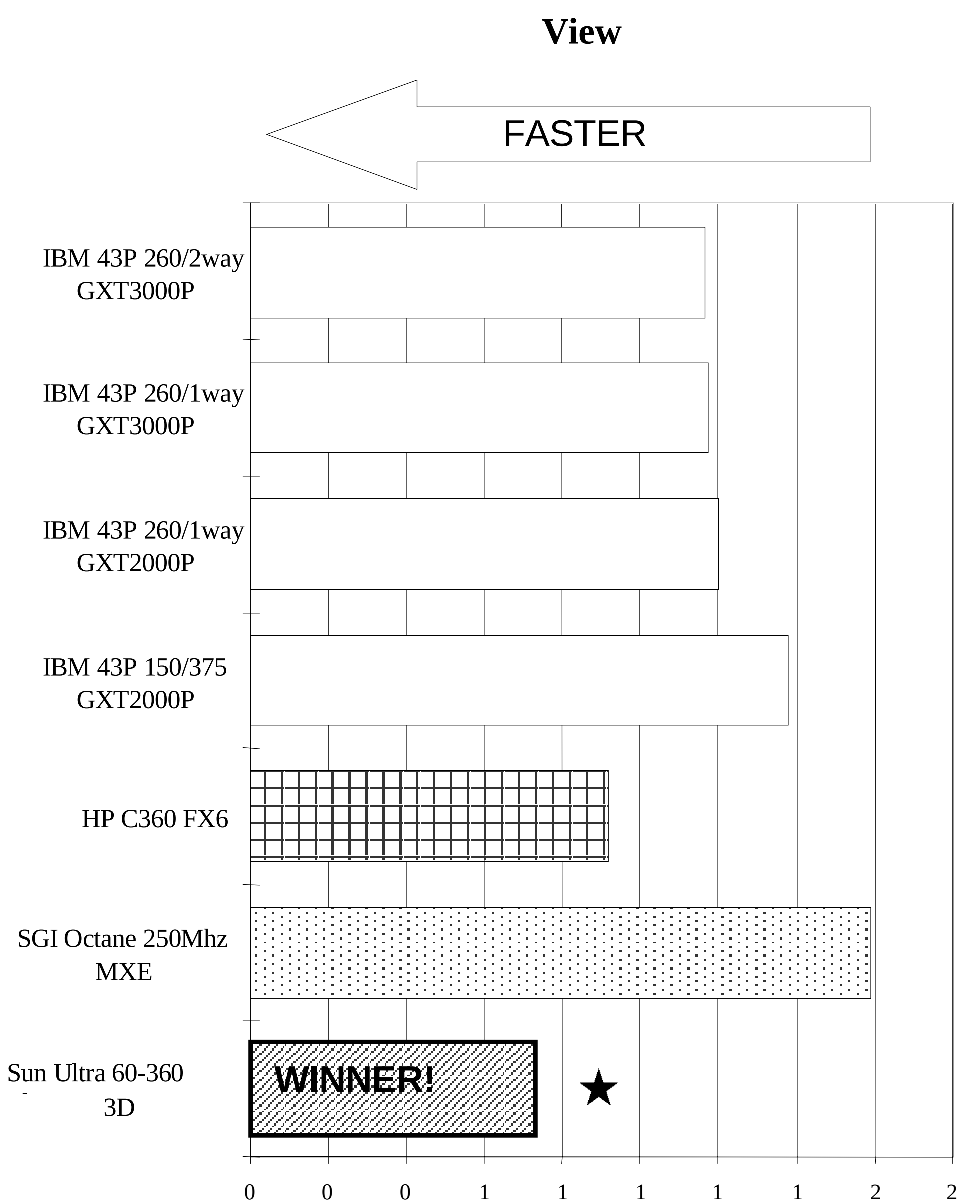

Chart 25 – Image Viewer Throughput Values
Lowest time wins! (★)

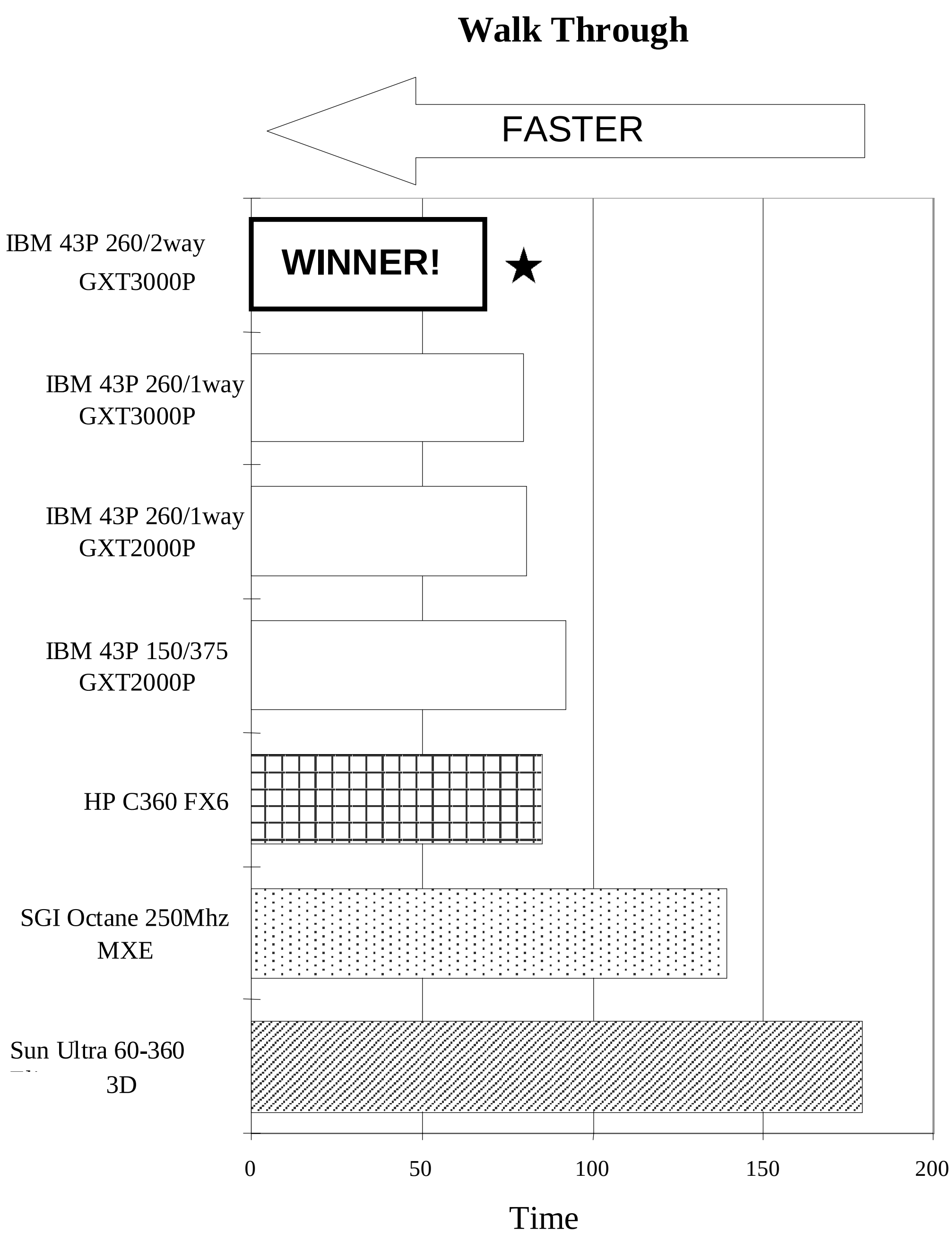

Chart 26 – Walk Through Throughput Values
Lowest time wins! (★)