
White Paper

**Multi-core Intel®Xeon® processors**

# Innovate More, Iterate Faster

## Siemens PLM Software, HP, and Intel deliver technologies to revolutionize your business.

# Introduction

Siemens PLM Software, HP, and Intel deliver technologies to revolutionize your business, enabling you to work differently and move from serial to simultaneous workflows.

New technology allows engineers and designers to work in ways that were not possible a few years ago. Move from serial to simultaneous workflows and realize exceptional performance and productivity gains that help you get higher quality, competitive products to the marketplace faster.

Intel, HP, and Siemens PLM Software have a long history of creating innovative, high-performing, and cost-effective solutions for the manufacturing market. In this study, HP and Intel investigated parallelized manufacturing workflows for users of NX* software from Siemens PLM Software. Multi-core processors were tested to determine how they can help fundamentally change the way engineers work.

## Workflow Parallelization

Engineering productivity can be significantly improved by applying concurrent workflow techniques. Parallelization of workflows can take on two forms:

- *Speeding up individual applications.* Software vendors hardcode application improvements, which take advantage of SMP (Symmetric Multi-Processing).
- *Running multiple applications at once.* With good system interactivity, end users can run applications simultaneously.

A good example of the first type of parallelization is the Teamcenter Visualization Batch-Mode Clearance Prototype, which detects and analyzes clearance violations within a digital product mockup. Teamcenter Visualization was reworked for multi-core architectures, realizing up to 3x performance gains over single-core processor systems.[1] Because a complete analysis of a complex digital product assembly can take several days to complete, performance gains are significant.

This paper focuses on the second type of parallelization—using multiple cores to run more of your workload simultaneously. To determine how multi-core processors can help fundamentally change the way engineers work, HP and Intel tested multi-core processors with NX manufacturing benchmarks and standard productivity tools. The application for this study is NX, but the results can be applied to the broader manufacturing marketplace.

[1] Tests conducted on an HP xw6400 Workstation:

- Two Dual-Core Intel® Xeon® Processors 5150/ 2.66 GHz, 4 MB L2, 1333 MHz FSB
- Genuine Windows XP Professional x64 Edition*
- 4 GB of RAM

Additional configuration available at the end of this document.

## Design Flows of the 1990s

To help understand the demands of the current engineering environment, examining the design flows and workarounds of the past is important. Often due to a lack of compute resources, designers took shortcuts in the 1990s to fit their designs into workable pieces. To avoid system interactivity issues, other techniques emerged such as allocating two computers per engineer and running toolpaths overnight. Table 1 summarizes some of the workarounds of the 1990s. Even though recent technology renders these behaviors obsolete, the workarounds became habit and many engineers still use them.

## Working Differently—Design Flows of the 2000s

Engineering in the twenty-first century is extremely complex. Designers must work with increasingly difficult designs, larger data sets, and tight timelines. They are doing more and more product verification with software, which requires multiple applications to get the job done. Running the required jobs takes an enormous amount of compute resources, and businesses cannot afford to rely on workarounds or let talented engineers sit idle.

The technology constraints of the past no longer exist. HP's newest workstation, the HP xw8600, is powered by dual-core and quad-core Intel technology. With up to 8 cores, 128 GB of memory, 5 TB of storage, and high-end graphics in a single system, HP xw8600 Workstations are built to meet the demands of challenging environments.

However, manufacturers aren't necessarily taking advantage of this power. Many organizations have yet to recognize that workflows of the past are irrelevant. In today's competitive climate, business as usual is not acceptable. To gain and maintain an edge, you must do more and do it faster. You have to enhance innovation and slash time-to-decision. A shift has occurred from serial to simultaneous workflows. You have to work differently. Table 2 summarizes how today's technology can help fundamentally change the way you work.

**Table 1: Engineering workarounds due to lack of compute resources**

| Behavior | Result | Detriment |
|---|---|---|
| Breaking designs into smaller parts | Possible interferences or ill-fitting parts when manufactured that need correcting late in the process | Inferior products |
| Starting analyses at the end of the workday to run overnight | Possible set-up or parameter errors, resulting in a re-run the next evening | Longer design time |
| Supplying two computers per engineer (one for design, one for office tasks) | Crowded office space and excess energy use | Non-ideal environment |
| Walking away during a compute-intensive job because the system is not interactive | Frustration and wasted time | Decreased productivity |
| Working with designs that are less detailed; reducing tolerances | Less accurate results | Inferior products |

**Table 2: Today's technology allows you to work differently**

| Behavior | Result | Benefit |
|---|---|---|
| Working with the entire design | More accurate data | Better products |
| Running analyses concurrently with day-to-day activities | Find set-up errors more easily and monitor results | More efficient workflows |
| Supplying one computer per engineer | Less crowded office space and improved energy use | More productive environment; lower energy bills |
| Continuing work during a compute-intensive job because the system is interactive | Less frustration and wasted time | Increased productivity |
| Working with designs that are more detailed; using appropriate tolerances | More accurate results | Better products |

**Tables 1 and 2** shows engineering workarounds of the past that are no longer required due to improved technology. Multi-core processor-based workstations help improve workflows, productivity, and products.

**Figure 1: HP NX Multi-Program Benchmark launch sequence**

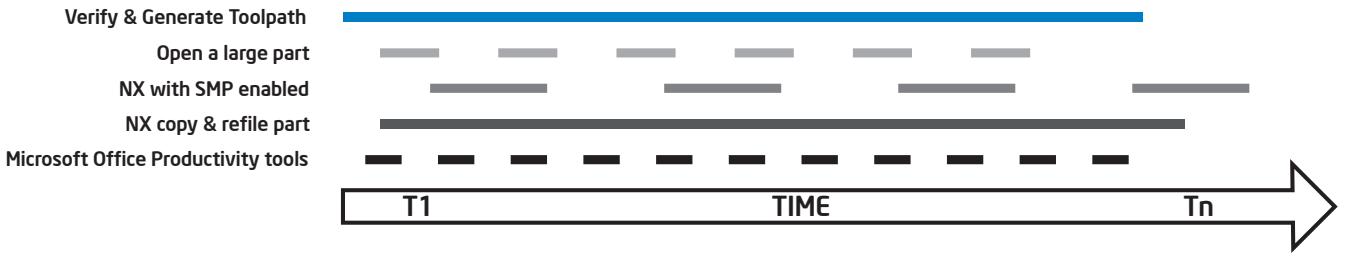



**Figure 1:** In this benchmark, simultaneous workflows mimic individual multi-tasking. Performance results will be measured on 1-core, 2-core, and 4-core systems.

## Moving from Serial to Simultaneous Workflows

To measure the impact of moving from serial to simultaneous workflows, HP created a tool called the HP NX Multi-Program Benchmark. It measures system performance when running multiple compute-intensive applications and office productivity tools simultaneously.

The HP NX Multi-Program Benchmark simulates complex environments and illustrates the possibilities of working differently. Note that it may or may not be typical of your workflow. The benchmark includes the following compute tasks:

1. NX manufacturing benchmark
   - NX: Generate several tool paths for an assembly in manufacturing (CAM)
   - NX: Open a large part (3 times)
   - NX with SMP enabled: Open mass properties and silhouettes (3 times)
   - NX: Copy and re-file a part in a large directory
2. Microsoft® Office* productivity tools: Microsoft Internet Explorer*, Microsoft Word*, Microsoft PowerPoint*, and Microsoft Excel*

To mimic a realistic engineering environment, the NX manufacturing benchmark is interspersed with common interactive user demands from Microsoft Office suite applications during a time span of 40 minutes. Figure 1 shows how the different tools launch over time.

**Figure 2: Relative performance benefits of running on multiple cores vs. a single core**

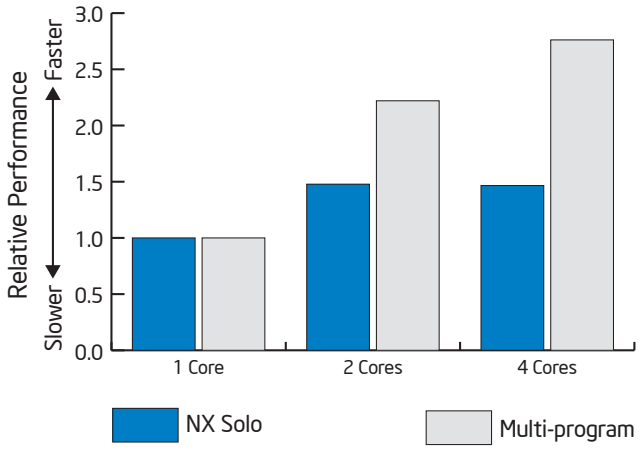



**Figure 2:** Moving from 1 to 4 processor cores improves NX performance nearly 1.5x and improves Multi-program performance over 2.5x. Innovative Intel technology allows you to work differently and increase your productivity.

## Accelerating NX with Multi-core Processors

Benchmark testing began with the NX manufacturing benchmark running without additional tasks (see NX solo in Figure 2). The NX solo results show the following:

- Performance was 1.5 times faster on multiple cores than on 1 core.
- 2-core and 4-core systems showed similar results.

To simulate a more realistic engineering environment, the NX manufacturing benchmark and the productivity tools were run simultaneously (see Multi-program in Figure 2). This testing shows more dramatic results:

- Significant productivity benefits in complex environments are possible with 4-core systems.
- The HP NX Multi-Program Benchmark running multiple tasks was more than 2.5 times faster on a 4-core workstation compared to a 1-core workstation.
- Interactivity was much faster on the 4-core system (see Figures 3-5).

## Improved Interactivity with Microsoft Office Tools During NX Benchmark

Figures 3-5 show interactivity with various Microsoft productivity tools while running the NX manufacturing benchmark. To determine if response time is sufficient for multi-tasking, the benchmark measured user interactivity while the system ran CAD functions. Research shows that 10 seconds is the approximate limit for keeping users focused (see the Response Times sidebar).

**Figure 3: Microsoft Word interactivity during the NX manufacturing benchmark**

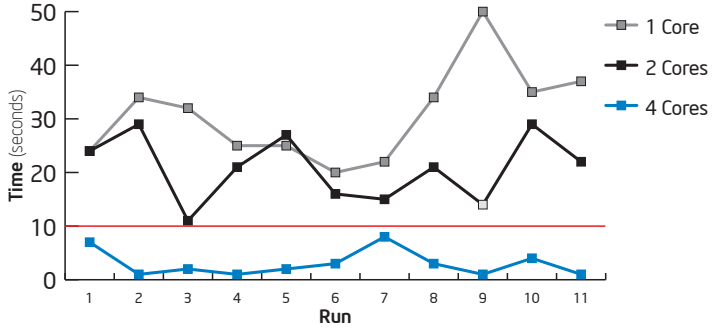



**Figure 4: Microsoft PowerPoint interactivity during the NX manufacturing benchmark**

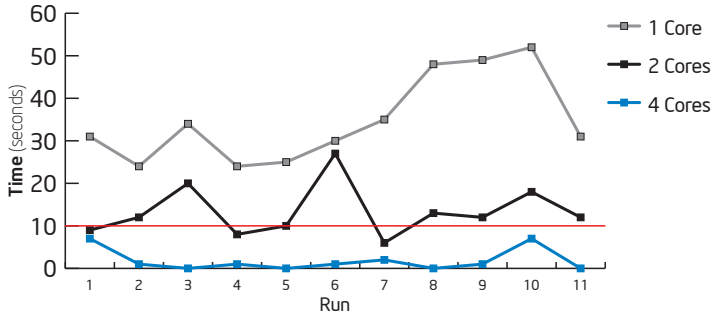
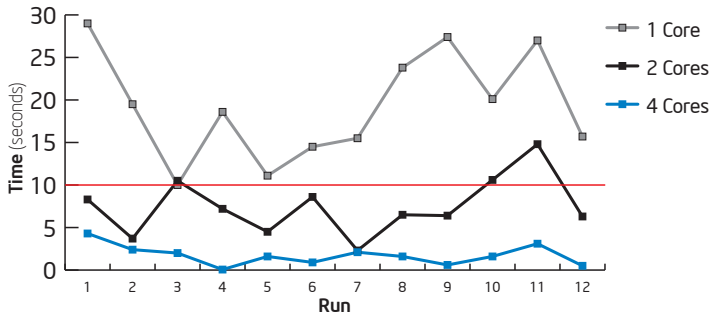



**Figure 5: Microsoft Internet Explorer interactivity during the NX manufacturing benchmark**




**Figures 3-5:** Since 10 seconds is the limit for keeping user's attention focused on a task (see Response Times below), any response greater than that is detrimental to productivity. Systems with 4 or more cores deliver the compute capacity to multi-task and keep innovation at the forefront.

### Response Times

The basic advice regarding response times has been about the same for thirty years [Miller 1968; Card et al. 1991]:

- **0.1 second** is about the limit for having the user feel that the system is reacting instantaneously.
- **1.0 second** is about the limit for the user's flow of thought to stay uninterrupted, even though the user will notice the delay.
- **10 seconds** is about the limit for keeping the user's attention focused on the dialogue. For longer delays, users will want to perform other tasks while waiting for the computer to finish.

—Jakob Nielsen; "Usability Engineering", Morgan Kaufmann, San Francisco, 1994

Using the response time standards for the NX manufacturing benchmark:

- A 1-core system is not interactive.
- A 2-core system is better than a 1-core system, but it does not meet the 10-second response goal.
- A 4-core system shows very good interactive performance.

## Imagine the Possibilities

From the results shown, it is clear that you can maximize productivity by running NX on HP Workstations with multi-core Intel processors. Gain a competitive edge by working differently. When you rapidly iterate ideas and alternatives while remaining productive, your designs can improve dramatically.

See if you can increase the productivity of your engineers by moving from serial to simultaneous workflows. Imagine your business when productivity improvements help you:

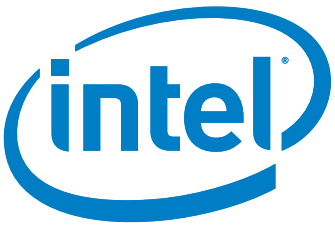
- Accelerate the release of complex product designs
- Reduce risk and rework
- Improve collaboration
- Increase innovation
- Improve the productivity of highly skilled workers

Think about how much more you can do—and how much faster—by putting the power of Dual-Core and Quad-Core Intel® Xeon® processors to work for you!

## Learn More

For more information about HP Workstations with Dual-Core Intel Xeon processors and NX, visit www.hp.com/go/ugs.

For information about Intel processors, visit www.intel.com.



**www.intel.com**

## System Configurations Referenced in Benchmarks:

1-core system

- HP xw8200 Workstation: Intel® Xeon® Processor/ 3.4 GHz, 1 MB L2, 800 MHz FSB, Genuine Windows XP Professional x64 Edition; 5 GB memory, NVIDIA Quadro FX3400

2-core system

- HP xw8400 Workstation: Dual-Core Intel Xeon Processor 5150/ 2.66 GHz, 4 MB L2, 1333 MHz FSB, Genuine Windows XP Professional x64 Edition, 5 GB memory, NVIDIA Quadro FX3500

4-core system

- HP xw8400 Workstation: Two Dual-Core Intel Xeon Processors 5150/ 2.66 GHz, 4 MB L2, 1333 MHz FSB, Genuine Windows XP Professional x64 Edition, 5 GB memory, NVIDIA Quadro FX3500