Pfeiffer Report

Lenovo Workstations and Laptops: Performance for Creative Industries

About this Benchmark Project

This report presents the findings of a market-specific research project conducted by Pfeiffer Consulting for Lenovo and Intel. The main aim of the research was to **document the efficiency and productivity gains of recent versions of hardware platforms for creative industries**, compared to performing the same operations on older hardware.

Benchmarks were executed using *Pfeiffer Consulting's Methodology for Productivity Benchmarking*, which has been fine-tuned over more than a decade, and measures the time experienced operators take to execute specific tasks. Please refer to the Methodology section on the last page of this document for detailed information.

Benchmark Details

Two different hardware platforms were benchmarked: On the laptop side, the **ThinkPad P1 Gen 3** was measured against the recent **ThinkPad P1 Gen 7**; on the workstation side, our benchmarks compared the **ThinkStation P520** with the more recent **ThinkStation P5**. (For technical details, please see page 2.).

On the software side, we performed a wide selection of productivity measures with **four key applications for creative industries**: Adobe Premiere Pro and Adobe After Effects for video workflows, as well as Autodesk Maya and Blender for 3D workflows. For each software package, the most recent release has been used.

Key Benchmark Results: Average of 67 Workflow Benchmarks

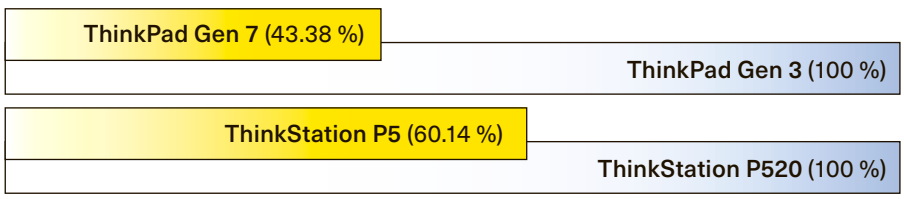


Chart based on the average of 67 different workflow benchmarks per platform.
A total of 954 individual benchmark measures were taken.
Reference value: Average time when working with the older hardware. **Shorter is better.**

Executive Summary

- This benchmark project was conceived to **measure the performance and productivity gains** that recent hardware platforms can bring to creative industries.
- On the laptop side, benchmarks compared the **ThinkPad P1 Gen 3** with the more recent **ThinkPad P1 Gen 7.** The two workstations that were compared were the **ThinkStation P520** and the recent **ThinkStation P5.**
- Benchmarks covered **3D modelling rendering and animation**, **video editing** and **motion graphics,** using very widely used software for these fields.
- The average of all workflow benchmarks showed that the **ThinkPad P1 Gen 7 provided a 130.54% performance increase** over the older model. On average, **the ThinkStation P5 provided 66.29% performance increase** over the older ThinkStation P5.
- Due to hardware advances in recent years, **the mobile workstation has become a reality**, and can efficiently complement office-bound tower workstations in creative workflows.

The Impact of Hardware Improvements

The Evolution of Hardware Platforms

As software applications become increasingly sophisticated and data-intensive, this may put a strain on the available computing resources. **This report documents the performance differentials between older and more recent laptops and workstations used in the creative industries.**

Over the past five to seven years, significant advancements have reshaped the landscape of high-performance computing. In mobile workstations, such as the Lenovo ThinkPad P1 series, this evolution is evident in several critical components. **Processor architectures have evolved significantly**, yielding increased core counts and more efficient processor designs. This can be seen in the shift from Intel's 10th generation Core i7/i9 processors to the newer Intel Core Ultra chip architecture; this directly impacts multi-threaded application performance on the more recent ThinkPad P1 used in our benchmarks. **Memory technology for laptops has also progressed over the last years** from DDR4 to LPDDR5x, providing significantly higher bandwidth, which is crucial for memory-intensive applications.

Major Points

- Hardware architectures have **evolved significantly** over the past few years.
- Memory technology has progressed considerably, providing **significantly higher bandwidth, crucial for memory-intensive applications** such as video, motion graphics and 3D modelling, rendering and animation.
- Thanks to hardware advances, **the mobile creative workstation has become a reality**, and complements tower workstations even for complex assignments.

Benchmark Hardware Comparison Table

	ThinkPad P1 Gen 3	ThinkPad P1 Gen 7	ThinkStation P520	ThinkStation P5
Processor	Intel Core i7-10850H	Intel Core Ultra 7 155H	Intel Xeon W-2155	Intel Xeon W5-2545
Cores	6 cores	16 cores	10 Cores	12 Cores
Clock Speed	2.70 GHz 5.10 GHz Max Turbo	1.4 GHz (Performance cores) 4.8 GHz Max Turbo	3.30 GHz Up to 4.5 GHz Turbo	3.50 GHz Up to 4.7 GHz Turbo
RAM	32 GB	32 GB	128 GB	128 GB
RAM Type	DDR4	LPDDR5x	DDR4 ECC RDIMM	DDR5 ECC RDIMM
Video	NVIDIA T1000 (4 GB)	NVIDIA RTX 1000 Ada (6 GB)	NVIDIA RTX A4000 (16 GB)	NVIDIA RTX A4000 (16 GB)
Storage	1TB M2 SSD	1TB M2 SSD	1TB M2 SSD	1TB M2 SSD

Hardware Evolution of Workstations

Comparable developments have occurred in tower workstations: while the older Lenovo ThinkStation P520 relied Intel Xeon W-2100 series, the ThinkStation P5 used for these benchmarks uses the **12-core Intel Xeon W5-2545 processor**.

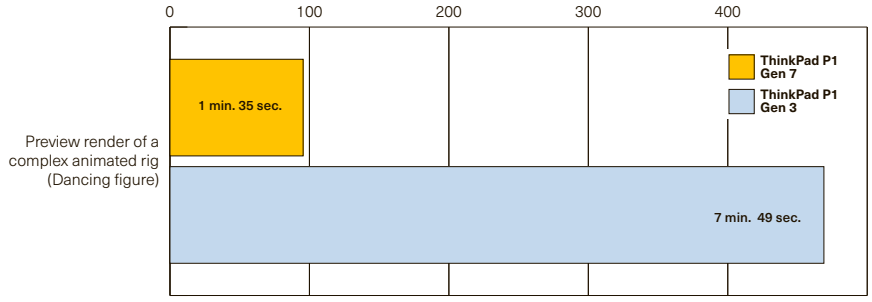
Also, **workstation memory has evolved from DDR4 ECC to DDR5 ECC**, providing a considerable increase in memory bandwidth: For the ThinkStation P520, which uses DDR4 memory, the typical memory bus speed is 2666 MHz; the ThinkStation P5, on the other hand, uses DDR5 ECC RDIMM. The typical memory bus speed for this configuration is 4800 MHz.

Hardware Configurations for the Benchmarks

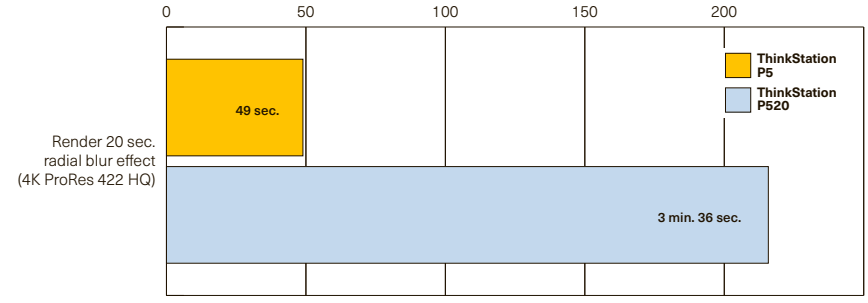
The aim of this benchmark project was to provide users of older hardware platforms in creative industries **with a realistic perspective on the productivity increases** that can be expected from upgrading their computing hardware.

However, for this goal to be achieved, **the benchmark configurations also needed to take into account the most likely upgrades** users of the older system might have installed in their computers, specifically concerning storage and video cards. Therefore, we decided to use **the same NVIDIA cards for both workstations**. Also, **all benchmark systems were equipped with the same 1TB M2 SSD.**

ThinkPad 3D Benchmarks: Maya
Time-scale in seconds. **Shorter is better.**



ThinkStation Video Benchmarks: After Effects
Time-scale in seconds. **Shorter is better.**



*These charts show the **top benchmark result** for each hardware group. **The ThinkPad PI Gen 7 was almost four times faster** rendering a dancing figure in Maya. (Top Chart). **The ThinkStation P5 outperformed the older model by 341%** applying Radial Blur to a short clip in After Effects. (Bottom charts.)*

The Rise of the Mobile Workstation

The last five to ten years have seen a remarkable evolution in computing hardware: **the rise of the mobile creative workstation**.

Indeed, it used to be that for most complex tasks such as 3D animation, video editing and effects production, **if efficiency was at stake, only a powerful tower workstation would be able to handle the processing requirements**.

The benchmarks for this project show that this is no longer the case. The recent ThinkPad P1 Gen 7 was significantly faster than the older model: as the chart on the left shows, **it was up to four times faster than the older model in some benchmarks.**

Several technical aspects contributed to this remarkable trend: **not only processors have become significantly more efficient,** memory and storage has also reached new heights in speed and throughput; in addition **recent advances in video cards also contribute significantly** to make the mobile creative workstation a reality.

This doesn't mean the end of the tower workstation as we know it, since it offers, among other things, **considerable expansion potential**, both in terms of memory and storage, and it can also be upgraded with high-end video cards that are impossible to include in a laptop.

However, **the rise of the mobile workstation provides a significant expansion of the creative workflow:** the capacity to take even very complex projects on the road and continue the work while away from the office.

Key Productivity Gains in 3D Production

The Complexities of 3D Software

Autodesk Maya and Blender have become key applications in creative domains such as animation, product design, visual effects, and architectural visualization. They are also extremely deep programs that cover aspects as diverse as character rigging and animation, physical simulations and photorealistic rendering, among many others. They also require considerable computing power. **Our aim for these benchmarks was to cover a representative array of these features,** covering dozens of real-world usage scenarios.

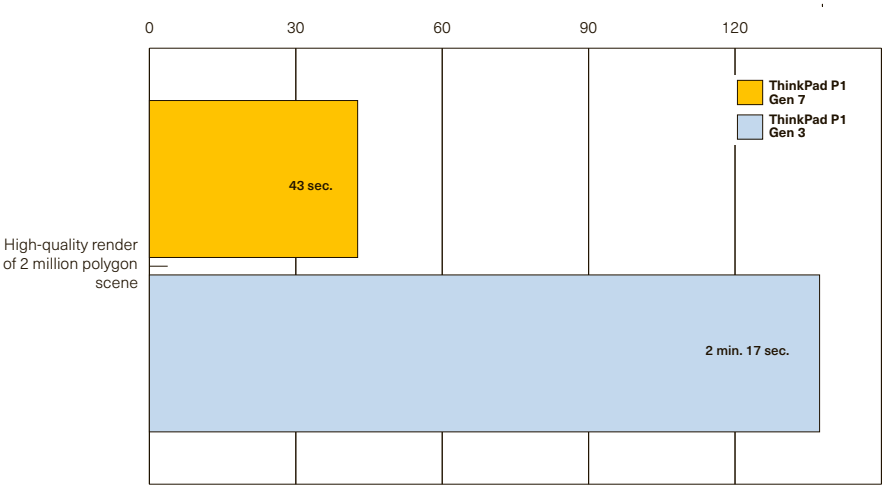
Overview of Results: ThinkPad

The collected data indicates performance improvements across both system types, with the extent of these gains varying by application and hardware category. In our Maya benchmarks, **the recent ThinkPad P1 Gen 7 showed an average workflow performance increase of 158.74%** compared to the ThinkPad P1 Gen 3. This corresponds to an over 2.5x increase in productivity. **In some Maya benchmarks, the recent ThinkPad was almost four times faster than the previous model,** and could efficiently handle scenes with 2 million polygons. (See chart below.)

Major Points

- Using Maya, the recent ThinkPad P1 Gen 7 showed **an average workflow performance increase of 158.74%** compared to the ThinkPad P1 Gen 3.
- In some Maya benchmarks, **the ThinkPad P1 Gen 7 was almost four times faster** than the older model.
- The average of all Blender workflow benchmarks showed a **73% performance gain of the ThinkStation P5** over the older model, while **some operations were twice as fast** as on the ThinkStation P520.

ThinkPad 3D Benchmarks: Maya
Time-scale in seconds. **Shorter is better.**



One of the most important aspects in creative 3D work is the capacity of dealing with complex models. In our Maya benchmarks, ***the ThinkPad P1 Gen 7 managed to render a complex, 2 million polygon model in just 43 seconds****, compared to well over two minutes on the ThinkPad P1 Gen 3.*

The ThinkPad P1 Gen 7 also achieved an average GPU+CPU performance increase of 476.57% in benchmark measures conducted with BlenderBench.

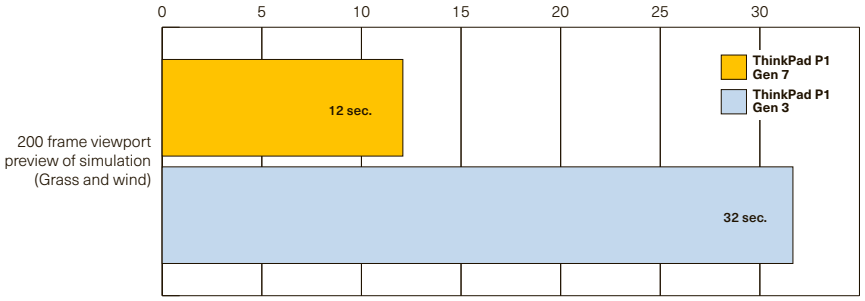
Overview of Results: ThinkStation

Maya benchmarks with the ThinkStation P5 **showed a 31.19% performance increase** relative to the P520, while the average of all Blender workflow benchmarks showed **a 73% performance gain of the recent workstation**; some operations were two times faster than on the older model. (See chart below.)

Interestingly, despite fact that both the ThinkStation P520 and the recent ThinkStation P5 were equipped with exactly the same video card (an NVIDIA RTX A4000 with 16 GB of VRAM), **the ThinkStation P5 was 50% faster on the BlenderBench GPU benchmarks**. This tends to underline the impact of the improved system architecture of the ThinkStation P5.

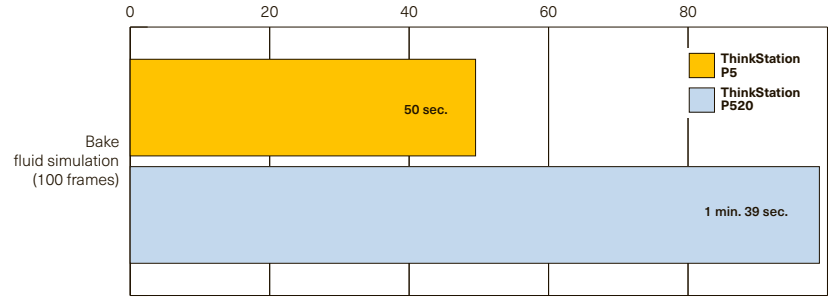
Maya Viewport Performance on ThinkPad P1: The capacity to smoothly preview animations in the viewport is a crucial aspect for creative work. For this benchmark, we measured the time necessary to play a 200 frame animation showing wind blowing over thousands of blades of grass. **The ThinkPad P1 Gen 7 managed to play the animation almost in real time**, while the third generation model took almost three times longer.

ThinkPad 3D Benchmarks: Maya
Time-scale in seconds. **Shorter is better.**



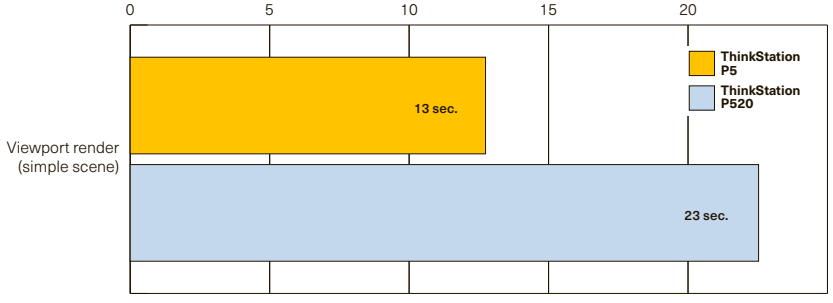
Blender Performance on ThinkStation: Over the years, the open source 3d modelling and animation program Blender has become a strong contender in 3D video and effects production. **In our Blender benchmarks, the ThinkStation P5 was two times faster than the ThinkStation P520** when baking a 100 frame fluid simulation.

ThinkStation 3D Benchmarks: Blender
Time-scale in seconds. **Shorter is better.**



ThinkStation Maya Rendering Performance: While in professional 3D, video and effects production, final rendering is usually outsourced to a render farm, being able to render single frames efficiently is very important during the creative process. **The ThinkStation P5 was almost 77% faster than the P520** producing a preview render using Maya's Arnold render engine.

ThinkStation 3D Benchmarks: Maya
Time-scale in seconds. **Shorter is better.**



Key Productivity Gains in Video Production

Benchmarking Video Editing and Motion Graphics

We used two key applications for benchmarking video and motion graphics workflows: Adobe Premiere Pro and Adobe After Effects. Both applications are widely used by professionals in the creative industries, and require powerful hardware to work efficiently. Our benchmarks covered a representative selection of processing-intensive workflow operations, using real-world assets to conduct the benchmarks.

Video and Motion Graphics Performance: ThinkPad P1

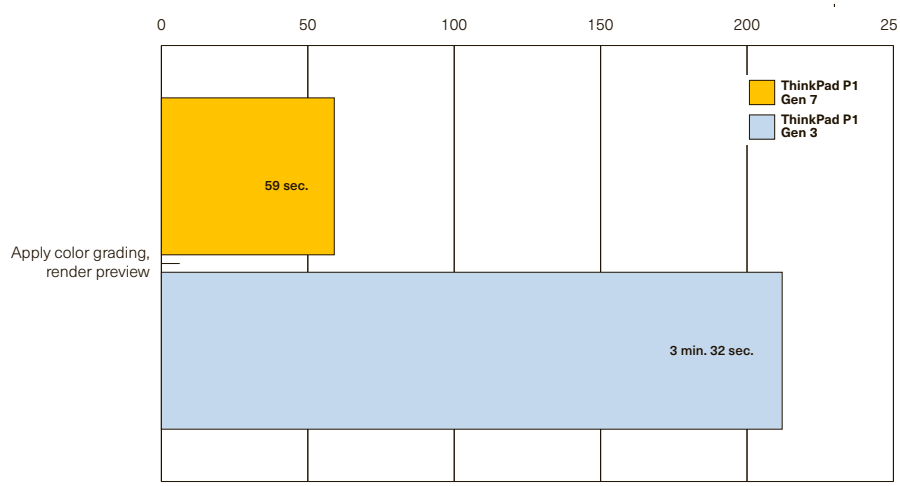
Based on 21 individual After Effects benchmarks, **the ThinkPad P1 Gen 7 showed an average workflow performance increase of 159.12%** over the ThinkPad P1 Gen 3. On specific benchmarks, such as exporting multiple concurrent video streams with multiple applied effects, **the recent ThinkPad P1 Gen 7 was 2.5 times faster.** (See chart next page.)

In Premiere Pro benchmarks, similar performance increases could be observed. Based on 17 individual workflow benchmarks, **the ThinkPad P1 Gen 7 achieved an average Premiere Pro workflow performance increase of 130.26%** over the ThinkPad P1 Gen 3.

Major Points

- Video and motion graphics benchmarks for this research **showed strong performance gains for both the ThinkPad P1 Gen 7 and the ThinkStation P5** over the older model.
- In After Effects benchmarks, the **ThinkPad P1 Gen 7 showed an average workflow performance increase of 159.12%**. Premiere Pro workflow performance **increased on average by 130.26%.**
- Compared to the older model, the ThinkStation P5 showed **an average workflow performance increase of 71.13% with After Effects** and of **54% with Premiere Pro.**

ThinkPad Video Benchmarks: Premiere Pro
Time-scale in seconds. **Shorter is better.**



*Sophisticated color grading is essential in video production, but can require significant computing resources, notably an efficient GPU. In our benchmarks of color grading performance, **the ThinkPad P1 Gen 7 was over three times faster than the older model**, underlining the fact that the mobile video workstation has become a reality.*

Video and Motion Graphics Performance: ThinkStation

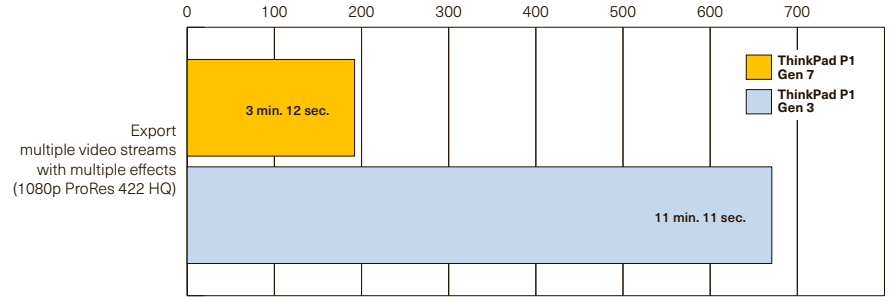
In After Effects benchmarks, **the ThinkStation P5 showed an average workflow performance increase of 71.13%** compared to the ThinkStation P520. In some operations, such as applying a radial blur to a clip, **the recent workstation was almost 3.5 times faster.** (See chart page 2.). Other operations showed a 2x Performance increase over the older workstation. (See chart below.)

Based on 17 individual workflow benchmarks conducted with the two workstations, **Premiere Pro running on the ThinkStation P5 showed an average performance increase of 54% over the P520,** with individual operations being 60% to 80% percent faster.

Taking into account that both systems used the same video card and SSD storage, **this underlines the higher efficiency of the ThinkStation P5's system architecture**.

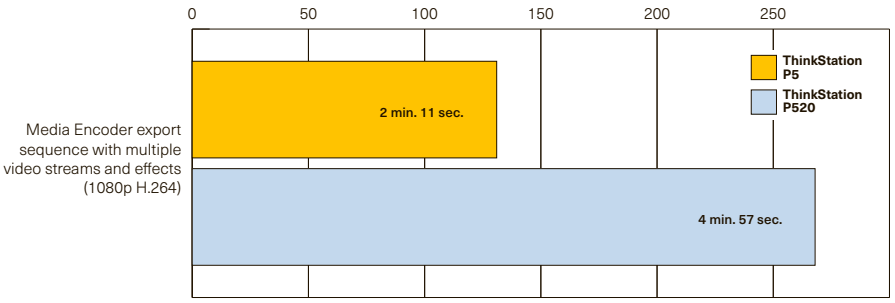
After Effects Performance on ThinkPad:
After Effect allows the creation of extremely complex motion graphics, that can include several video streams in parallel and multiple effects in a single sequence. In our benchmarks, the **ThinkPad P1 Gen 7 was 249% faster than the older model** when exporting a sequence containing three parallel 1080p video streams, effects and an animated text overlay.

ThinkPad Video Benchmarks: After Effects
Time-scale in seconds. **Shorter is better.**



After Effects Performance on ThinkStation:
We benchmarked After Effect's Media Encoder export of a sequence containing multiple 1080p video streams, multiple effects and animated text on both models of the ThinkStation. **The ThinkStation P5 was over two times faster** in this benchmark, despite the fact that both computers were equipped with the same GPU and storage medium.

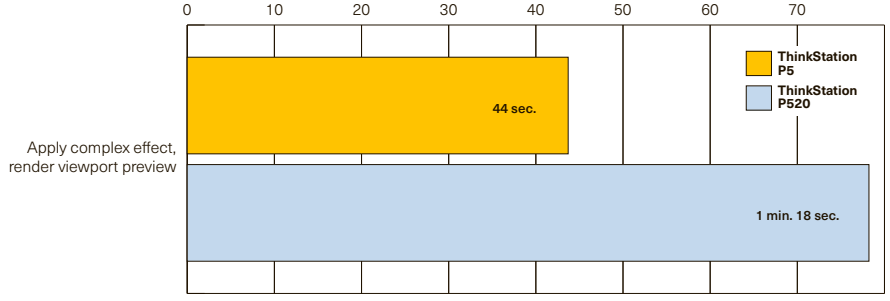
ThinkStation Video Benchmarks: After Effects
Time-scale in seconds. **Shorter is better.**



Premiere Pro Performance on ThinkStation:

Premier Pro offers a wide array of effects and treatments that can be applied to a clip; however, previewing complex effects in the viewport can require significant computing resources. Using a 20 second 4K clip, we measured the time necessary to apply a distortion effect and to render the viewport preview. **The ThinkStation P5 was almost 80% faster** than the P520 in this benchmark.

ThinkStation Video Benchmarks: Premiere Pro
Time-scale in seconds. **Shorter is better.**



How Performance Gains Impact ROI

The Overlooked Importance of Small Performance Gains

It is a common mistake to overlook the impact of small, but frequently occurring productivity gains. That's quite normal: unless one is consciously waiting for the workstation to compute a complex operation, one tends not to pay attention to the seconds and minutes one spends for some simple operation to be completed.

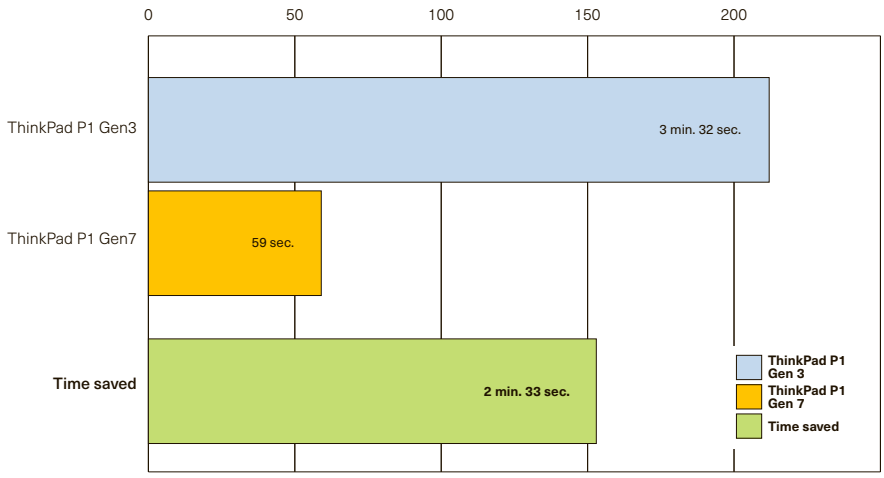
Yet if such a seemingly minor wait occurs over and over again, dozens of times in a work day, the time one loses adds up without the user noticing it. This means that seemingly small performance gains can significantly add up over time. Take one simple example: **according to our Maya benchmarks, playing a 200 frame/8 second animation in the viewport on the recent ThinkPad P1 just once saves 24 seconds** over the same operation on the older model.

While that may not seem like much, it all depends on the frequency of the operation, and the length of the animation that is previewed. Let`s look at the math: **repeated thirty times in a workday, a 24 second time saving would have saved 11 minutes and 47 seconds at the end of the day.** And almost 24 minutes if the clip was 16 seconds long... The crux of the matter is that **these small time savings necessarily go unnoticed, yet their effect is nevertheless real.**

Major Points

- The **cumulative effect** of small, but frequently occurring time savings **are often overlooked.**
- While impossible to notice first-hand, **these seemingly small performance gains of a newer system add up significantly over time** when upgrading a computer**.**
- As an example, 24 seconds saved on a single viewport preview operation of an 8 second animation **will save almost 12 minutes** if repeated 30 times.

Time Savings of Frequent Operations: Color Grading and Preview (Premiere Pro)
Time-scale in seconds.



This chart shows the performance of both ThinkPad models applying sophisticated color-grading to a 20 second 4K clip and previewing the result, ***saving 2 minutes and 33 seconds on the ThinkPad P1 Gen 7*** *over the older model.*
How this single time saving can result in hours of saved work hours is explored in the table on the next page.

How Productivity Gains Scale with the Number of Operations

		Number of Occurrences (Time Saved)			
Operation	**Clip**	**1**	**10**	**20**	**30**
Cumulated time savings of a simple, frequently occurring operation (ThinkPad P1 Gen 7) (Color grading and preview of a 20 second 4K clip. See chart previous page for details.)	**20 sec.**	**2 min. 33 sec.**	25 min. 30 sec.	50 min.	1 hours 16 min.
	40 sec.	5 min. 06 sec.	50 min.	1 hours 41 min.	2 hours 32 min.
	60 sec.	7 min. 39 sec.	1 hours 16 min.	2 hours 32 min.	3 hours 49 min.
	80 sec.	10 min. 12 sec.	1 hours 41 min.	3 hours 23 min.	**5 hours 05 min.**

The cumulative effect of relatively small productivity gains is often underestimated. This table shows how relatively insignificant time savings of frequently occurring tasks can scale as the number of occurrences increases.

Let's now look at a more extreme example: color grading in Premiere Pro. In our benchmarks, **applying and previewing a Lumetri color grade on a single 20 second clip on the ThinkPad P1 Gen 7 saves 2 minutes and 33 seconds over the same operation on the older model.**

Let's now assume a video editor does this just six times a day, thirty times a week: in that case just that one little time saving would have saved time an hour and sixteen minutes in a week. Let's now assume the clip he or she worked on was not 20 seconds but 40, 60 or 80 seconds... In that last case, **the single two-and-a-half minute time saving of a single operation would have saved over 5 hours, more than half a day of work, in a week.**

Never Underestimate the Impact of Small Performance Gains

The examples we just presented could be applied to a majority of the benchmarks we conducted for this research project. While it is true that some not very frequently used operations can show spectacular performance gains, **the real benefit of a more powerful computer platform are the cumulated small productivity gains that go mostly unnoticed.**

This is definitely worth keeping in mind when thinking about upgrading or improving the computer systems one uses: it's the small productivity gains on everyday operations that really make a difference at the end of the day. **You may not be able to measure them; but once you do the math you can see what is happening.**

And there is an added benefit to this: saving time is not about going home earlier at the end of the week, **it`s about having more time to think about the important stuff. More efficiency very often also means more energy for creative work.**

Methodology

This benchmark project was commissioned by Lenovo and Intel, and independently executed by Pfeiffer Consulting.

All the productivity measures presented in this document are based on real-world workflow examples, designed and executed by professionals with many years of experience with the programs and workflows involved.

Core Methodology

The basic approach is simple. In order to assess productivity gains that a program or solution may (or may not) bring, we start by analyzing the minimum number of steps necessary to achieve a given result in each of the applications or workflows that have to be compared.

Once this list of actions has been clearly established, we start to execute the operation or workflow in each solution, with the help of seasoned professionals who have long-standing experience in the field and with the solutions that are tested.

Hardware

Benchmarks were executed on four systems, two laptops and two workstations, aiming to document performance differences between an approximately five year old and a recent model in each class. For laptops, we compared the **ThinkPad P1 Gen 3** with the more recent **ThinkPad P1 Gen 7**; on the workstation side, the **ThinkStation P520** was put up against the **ThinkStation P5**. (See table page 2 for detailed tech specs of benchmark systems.)

To account for components users of the older systems might have upgraded over the years, **all computers were equipped with the same internal storage, a 1TB M2 SSD; both workstations used the same amount of RAM (128 GB) and the same NVIDIA RTX A4000 video card with 16 GB of VRAM.**

Software

All systems were equipped with standard installations of Adobe Premiere Pro, Adobe AfterEffects, Autodesk Maya and Blender. **Default settings were used for all benchmarks.** The same benchmark files were used on all benchmark systems

Benchmark Execution

In order to provide stabilized results, **every benchmark sequence was executed three times in an identical fashion.** The same benchmark sequences were executed first on both laptops, then on both workstations. **After each individual benchmark, the system was restarted.** In order to provide reliable performance data, **disk or memory cache was deleted after each benchmark** for applications that use such a mechanism.

A total of **954 individual benchmark measures** were taken.

About Pfeiffer Consulting

Pfeiffer Consulting is an independent technology research and benchmarking operation focused on the needs of publishing, digital content production, and new media professionals.

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