Research

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Replacing Enterprise PCs: The Fallacy of the 3-4 Year Upgrade Cycle

A J.Gold Associates Research Report

"Common industry practice says that enterprise PCs should be replaced on a 3-4 year cycle, when the costs of maintaining the PC outweigh the cost of replacing it. Indeed, this has been commonplace for many years, and companies simply accept this as fact. However, is this model still valid in the modern age? Does it still make sense for companies to wait for an extended period of time in an era of rapid chip technology improvement, cloud based systems and consumer-driven technology upgrade cycles? Our analysis indicates a significant ROI can be achieved by upgrading more often, despite the costs involved in migrating users to new systems…."

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Introduction

Common industry practice says that enterprise PCs should be replaced on a 3-4 year cycle, when the costs of maintaining the PC outweigh the cost of replacing it. Indeed, this has been commonplace for many years, and companies simply accept this as fact. However, is this model still valid in the modern age? Does it still make sense for companies to wait for an extended period of time in an era of rapid chip technology improvement, cloud based systems and consumer-driven technology upgrade cycles? We have investigated the benefits enterprises can achieve by upgrading user PCs more frequently. Our analysis indicates a significant ROI can be achieved by upgrading more often, despite the costs involved in migrating users to new systems. We are confident that organizations that deploy new systems on a 2 year upgrade cycle will achieve a substantial positive benefit, and recommend that all organizations implement this strategy as soon as possible. While we expect any PC to benefit, the greatest benefits are likely to occur in mobile-class devices where most companies are now focused, and therefore this research and analysis has centered on notebook computers. Below we describe our research and quantify its results.

> ***TREND**: Most enterprises look at the 3-4 year upgrade cycle for their PCs as optimum. However, we believe this is outdated legacy thinking. Given the rapid advance of chip technology, the lower cost of new devices relative to the cost of employing typical knowledge workers, and the potential for substantially improved productivity, we recommend a 2 year upgrade cycle be instituted. The ROI is substantial, and the upgrade investment can be recovered in a matter of a few weeks of use by most knowledge workers*
> *J.Gold Associates LLC.*

Upgrading More Often?

In order to evaluate the benefits of a “more-often” approach to machine upgrades, we tested an approximately 2 year old enterprise-class notebook (“older generation”) and a newly released machine (“current generation”). This provided quantitative data for our analysis. We compared the typical productivity gains achieved by the increase in performance available from the current generation device in roll-based work scenarios for several typical job functions within enterprises. By evaluating the potential gains in productivity improvements, and by calculating an ROI based on these improvements, we are able to determine whether a shorter or longer refresh cycle is most appropriate for the majority of companies.

Machine Tests

We analyzed the user productivity improvement benefits by running benchmark tests and comparing the results for the “older generation” and “current generation” machines. The older machine is an HP EliteBook 8570P, which was released in 2012. The current machine tested for comparison purposes is an HP ProBook 650, which was selected as the closest equivalent to the older generation machine. The biggest difference between the devices is the generation of Intel Core processors powering them (3rd generation Core i5 vs. 4th generation Core i5). Both test machines had an identical amount of memory and the same SSD. They both had Windows 7 installed. The chip in the newer machine had a slightly

higher clock rate, but this was compensated for, with test scores "equalized" to reflect this disparity. A more complete specification for each machine can be found in Appendix 1

Testing User Productivity

To evaluate users productivity, we conducted tests on each machine utilizing a real-world application benchmark (BAPCo's SYSMark 2012). We consider this benchmark to be a realistic suite of actual applications that is similar to work being done in a typical business setting. While no test suite is perfect, we believe application-based tests run under a script moving data into and out of programs and executing program operations produce a more realistic outcome than synthetic tests that do not use actual productivity applications. As a result, this standardized test suite provides a fair representation of real world operations for comparative purposes, and our findings are based on these tests.

Test Scenarios

SYSmark 2012 utilizes 6 "test scenarios" that perform specific routine operations, based on an analysis by BAPco of typical "roles" in business settings. While individual usage will vary by user role, responsibility, industry, etc., we believe these scenarios to be a fair representation of a typical work scenario. The test scenarios in SYSmark 2012 include:

- Office Productivity
- Media Creation
- Web Development
- Data/Financial Analysis
- 3D Modeling
- System Management

Detailed analysis of the applications and scenarios for each test are provided in Appendix 2, as described in the SYSmark 2012 documentation.

Each machine was re-imaged with a clean, fresh version of Windows 7, and then machine-specific drivers were added. The SYSmark test suite was then installed on each machine. The complete SYSmark 2012 test suite was then run on each machine, with each test run taking multiple hours to complete. The automated tests were run 3 times on each machine and an average result was then calculated.

Compensating for the differences in Clock Frequency

As stated earlier, the newer machine had a faster clock rate (2.8GHz) than the older machine (2.6GHz). To compensate, we corrected all tests scores obtained on the faster machine by multiplying them by .94 to reflect a correction factor for the differing clock rates (determined by the ratio of the clock frequencies with a slight additional correction factor applied).

Figure 1: Test Results: Productivity Improvement for Current Generation Machine vs. 2 Year Old Machine.

Test Scenario	Office Productivity	Media Creation	Web Development	Data/Financial Analysis	3D Modeling	System Management	Overall Score
Improvement	7.9%	5.1%	13.9%	3.6%	20.1%	8.5%	9.7%

Figure 1 indicates the average individual scenario test score improvement on a percentage basis for each of the SYSMark scenario tests of the newer machine versus the older machine. The improvements varied widely based on the test scenario, and is likely due to variations created by CPU enhancements, and particularly for some tests in improved GPU capabilities of the 4th generation chip. It is important to note that in the real world, while the actual numbers may change based on varied usage factors, we believe the increases shown in the tests are valid representations of real work loads and improvements that can be achieved.

Scenario Compensation

Any test suite creates its scripts based on some normalized concept of what users will likely do on their machine, and it's unlikely that a single role represents the only workload that user will encounter. To compensate for this as much as is possible, we have created our own worker-based scenarios. They include a sampling of each of the scripted SYSmark scenario tests, but based on work we estimate each role would perform within each of the scenarios as a percentage of the user's total work time. We believe this blended approach to the test results is a more accurate representation of the varying types of work done by most professionals. It is possible to come up with a virtually endless number of scenarios, but for this report, we created 6 role-based worker scenarios that reflect common business roles within most organizations.

The six role-based worker scenarios we created are:

- *Office Worker* – general office worker such as a manager, sales person, etc.
- *Engineering* – a generic engineering professional engaged in design work
- *Admin* - a general purpose administrative assistant in an office setting
- *Business Analyst* – someone who performs data-centric analysis tasks
- *Web Programmer* – someone engaged in software and/or web page creation
- *IT Staff* – general tasks associated with managing and supporting users

Once the above roles were defined, we determined an activity "blending" by building a scenario for each worker type. This assumed that a worker would utilize different components of the SYSmark test scenarios for various portions of the work day, and that the various roles would, to varying degrees, utilize test scenarios not often associated with their direct roles (e.g., a web designer using office productivity tools). This "Weighted Task Matrix"

reflecting the six worker scenarios described above and the percentage of time spent in each SYSmark defined scenario is described below:

Figure 2: Six Roll-Based Work Scenarios and Their Relationship to Benchmark Test Scenarios

	Office Worker	Engineering	Admin	Bus Analyst	Web Programmer	IT Staff
Weighted Task Share						
Office Productivity	65%	20%	30%	30%	25%	20%
Media Creation		10%	10%	5%	10%	5%
Web Development					40%	5%
Data/Financial Analysis	10%	10%	5%	40%		
3D Modeling		40%				
Systems Management	10%	5%	30%	5%	15%	50%
Total PC Time	85%	85%	75%	80%	90%	80%

**Weighted Task Share is the amount of time the roll-based worker spends in efforts tested by the particular benchmarks within the SYSMark tests.*
**Total PC time is the amount of time in a typical work day that the roll-based worker spends in doing various PC tasks*

It is important to note that none of the total PC times for the various blended scenarios add up to 100%. This is because we assumed various workers would have additional tasks to perform that were not completed on the computer (e.g., filing, telephone calls, attending meetings). Since this calculation will be used to determine the productivity improvements, we felt a more representative basis was necessary. As such the scenario results presented reflect this less than 100% time allotment.

Scenario Results

The weighted tasks were used to compute a productivity improvement value for each role. The results of the calculations for the determined roles are presented below:

Figure 3: Average Productivity Improvement by Roll-Based Function

Roll-Based Scenario	Office Worker	Engineering	Admin	Business Analyst	Web Programmer	IT Staff
Productivity Improvement	6.35%	10.92%	11.57%	4.49%	9.29%	6.78%

The results show a significant difference in productivity improvement across the various roles. Even the lowest improvement at approximately 5% is still a very significant productivity enhancement, while the highest at approximately 12% indicates a substantial return on investment potential.

Average Yearly Savings Calculations

From the results obtained showing the amount of productivity improvement for the various roles, we determined an actual dollar amount for each. This was determined by creating a representative "fully burdened" cost for each worker type. Each is detailed in Figure 4.

Figure 4: Average Yearly Saving Per Worker Role Through "Newer Machine" Productivity Improvement

Roll Based Scenario	Office Worker	Engineering	Admin	Business Analyst	Web Programmer	IT Staff
Average Burdened Salary	$80,000	$120,000	$70,000	$120,000	$120,000	$75,000
Average Yearly Benefit	$5,077	$13,103	$8,096	$5,385	$11,151	$5,085

Once the salary and percentage of productivity improvement was determined, we calculated the amount of yearly productivity improvement benefit per employee. As expected, this amount varies by employee type/role based on percentage improvement and total compensation, but is nevertheless quite significant, ranging from $5,077 to $13,103.

To better reflect on our assertion that the two-year lifecycle for a typical corporate PC is optimum, we calculated the amount of benefit realized for two years by simply doubling the yearly gains indicated above.

Figure 5: Two Year Productivity Gains Benefit

Roll Based Scenario	Office Worker	Engineering	Admin	Business Analyst	Web Programmer	IT Staff
Two Year Benefit	$10,153	$26,207	$16,193	$10,770	$22,303	$10,170

ROI

Many organizations include a Return on Investment (ROI) calculation as part of their planning process, as well as using it to determine whether a particular expenditure is worthwhile. To that end, we have calculated the ROI, detailed below.

Figure 6: 1 Year and 2 Year Return on Investment

Roll Based Scenario	Office Worker	Engineering	Admin	Business Analyst	Web Programmer	IT Staff
1 Year ROI	249%	642%	397%	264%	547%	249%
2 Year ROI	498%	1285%	794%	528%	1093%	499%

The above calculations represent 1 year and 2 year ROI based on the productivity improvements per worker role obtained by deploying the newer, higher productivity machine. The ROI calculations are based on a typical enterprise-class notebook PC cost estimate of $1,000 and the cost of migrating and deploying the machines (calculated from our models/research) at $1,040 per device.

Equivalent Work Days Gained

Through the productivity benefits determined above, we calculated that the organization can actually gain a significant number of “equivalent work days” from each employee. This can be used to supplement and/or offset hiring and worker rolls. Below we indicate the number of “equivalent work days” gained per worker within each of the specific roll-based scenarios. Multiplying each amount by the number of workers in that role within the organization provides a large “hidden workforce” that can be leveraged by the corporation.

Figure 7: Number of “Equivalent Work Days” Gained per Worker per Year

Roll Based Scenario	Office Worker	Engineering	Admin	Business Analyst	Web Programmer	IT Staff
Days Gained per Year	15.86	27.30	28.92	11.12	23.23	16.95

PC Upgrade costs as a Percentage of Employee Costs

We have calculated the cost of a two year upgrade cycle and compared it to the fully burdened cost of the role based workers. As can be seen from the results in Figure 8, the PC costs, including purchase of the device and related device migration costs, are a tiny portion of the overall burdened employee cost. This is an indication of the device cost to employee salary ratio that has been steadily declining over the past several years. It reinforces the need to move away from the longer lifecycle times implemented when the PC investments were a higher portion of the employee cost burden, and into a model where shorter life cycles make way for increasingly productive workers.

Figure 8: Upgrade Costs Compared to Employee Cost

Roll Based Scenario	Office Worker	Engineering	Admin	Business Analyst	Web Programmer	IT Staff
Upgrade Cost as % of Employee Cost	1.28%	.85%	1.46%	.85%	.85%	1.36%

Recommendations

Based upon our testing and the results obtained, we recommend that organizations take the following actions:

- We strongly recommend companies immediately move to a refresh cycle for their corporate PCs of 2 years for most users. The increased levels of productivity offer both a substantial ROI, as well as provide for a more efficient workforce, allowing organizations to do more with the resources they currently have, or to delay adding staff as productivity is improved.
- Enterprises should establish a refresh program that is not based on “old thinking” industry practices established many years ago. The cost of a new machine is considerably less today on a device to employee expense ratio than it was a decade ago when many of the recommendations were established. Organizations must look at the negative cost implications of keeping older devices past their prime.
- With more data and apps being accessed from the cloud, the impact (and cost) associated with upgrading machines will continue to decline, as little IT effort and/or user down time will be involved in upgrades. As a result, the effort and cost to update more frequently will decline as well.

- Companies that do not deploy upgraded PCs on a regular basis will face lower overall user productivity that can lead to being uncompetitive in the marketplace, as well as user frustration leading to higher turnover rates.
- Finally, based on our analysis presented above, there is no reason why organizations should delay switching over to a more aggressive upgrade cycle.

Many organizations have unique requirements and/or different assumptions than represented here. This model is easily modified to reflect the unique characteristics of individual companies. We encourage any organization that wishes to have a more customized model reflecting its own costs and rates to contact us.

Appendix

Appendix 1: PC Test Machine Configurations as Reported by SYSmark Test Suite

Older Machine

- Model: **HP EliteBook 8570P**

Hardware

- BIOS Hewlett-Packard 68ICF Ver. F.04 66.26 06/12/2012
- Motherboard type 17A7
- CPU type Intel(R) Core(TM) i5-3320M CPU @ 2.60GHz
- CPU frequency 2600 MHz
- Memory size 4096 MB
- Screen Resolution 1024 x 768 @ 60 Hz
- Disk 0 180.0 GB INTEL SSDSC2BW180A3H
- Policies Write caching: Default; Power protected: Default
- GPU 0 Intel(R) HD Graphics 4000

Software

- OS type Windows 7 Professional x64 Service Pack 1
- OS version 6.1.7601.17514
- Virtual Memory 7922 MB Total, 6478 MB Free
- Visual Effects Let Windows choose what's best for my computer
- Desktop Composition Enabled
- Power policy BAPCo SYSmark 2012

Newer Machine:

- Model: **HP ProBook 650**

Hardware

- BIOS Hewlett-Packard L78 Ver. 01.05 22.56 04/29/2014
- Motherboard type 2101
- CPU type Intel(R) Core(TM) i5-4330M CPU @ 2.80GHz
- CPU frequency 2800 MHz
- Memory size 4096 MB
- Screen Resolution 1366 x 768 @ 59 Hz
- Disk 0 179 GB INTEL SSDSC2BW180A3H
- Policies Write caching: Default; Power protected: Default
- GPU 0 Intel(R) HD Graphics 4600
- Driver version 10.18.10.3540
- Network 0 Loopback Pseudo-Interface 1
- IP 127.0.0.1

Software

- OS type Windows 7Professional x64 Service Pack 1
- OS version 6.1.7601.17514
- Virtual Memory 7793 MB Total, 6802 MB Free
- Visual Effects Let Windows choose what's best for my computer
- Desktop Composition Enabled
- Power policy BAPCo SYSmark 2012

Appendix 2: PC Test Scenarios

The test suite utilized in this project was BAPCo SYSmark 2012. In an effort to define exactly what test scenarios were included during the test, below are the Usage Model/Scenario Selection, Scenario Workload Descriptions and Application Selection descriptions. This information is copied directly from the BAPCo whitepaper "An Overview of SYSmark 2012", July 2011 Revision 1.10. The full whitepaper is available at www.bapco.com . The information provided should only be considered in the context of the full whitepaper and benchmark disclaimer. J.Gold Associates makes no claim to ownership of this content and it is inserted here for informational purposes.

2.2 Usage Model/Scenario Selection

For SYSmark 2012, BAPCo chose a wide variety of usage models in which the user experience is influenced by system performance. BAPCo then grouped related usage models into these six scenarios:

Office Productivity

The Office Productivity scenario models productivity usage including word processing, spreadsheet data manipulation, email creation/management and web browsing.

Media Creation

The Media Creation scenario models using digital photos and digital video to create, preview, and render a video advertisement for a fictional business.

Web Development

The Web Development scenario models the creation of a website for a fictional company.

Data/Financial Analysis

The Data/Financial Analysis scenario creates financial models to review, evaluate and forecast business expenses. In addition, the performance and viability of financial investments is analyzed using past and projected performance data.

3D Modeling

The 3D Modeling scenario focuses on creating, rendering, and previewing 3D objects and/or environments suitable for use in still imagery. The creation of 3D architectural models/landscapes and rendering of 2D images and video of models are also included.

System Management
The System Management scenario models the creation of data backup sets and the compression, and decompression of various file types. Updates to installed software are also performed.

2.6 Scenario Workload Descriptions

The scenario workloads created at the workload development sessions for SYSmark 2012 are described below:

Office Productivity
Read, create and search for emails. Create and execute a rule on email inbox. Use multiple browsers to browse a blog, online shopping site, wiki site and social networking site. Check web mail in a private browser session. Combine multiple scanned pages from a complex document into an encrypted PDF document using optical character recognition (OCR). Create a PDF with fillable form fields from scanned pages. Archive a diverse set of files into a single encrypted file. Use an advanced OCR program to convert scanned pages of complex and simple documents into editable word documents. Create a blog post and do a mail merge. Use a spreadsheet program to do data analysis. Create and view complex presentations that include clip art and video. Some of these activities are performed concurrently to model typical multitasking behavior.

Media Creation
Create a panoramic image using an image editing application, combine a set of photos into one high dynamic range (HDR) image, and adjust and prepare both images for print. Preview and encode a complex video project using a video compositing application. Here, OpenGL is used for all video previews and a software render is used for maximum video quality upon final output as recommended by software vendor documentation. Transcode the video to a format suitable for web publishing using a video editing application.

Web Development
Combine images, video clips, and audio into a video using a video editing application, then encode the video to a web-ready format. Layout the graphics and create the icons for a website using an image editing application. Use batch processing to manipulate a set of photos for use in a web-based photo gallery. Assemble the graphics, gallery, and video into a functional website using a web development application, fixing links and moving documents as needed. Preview the pages in multiple web browsers.

Data/Financial Analysis
Generate sales forecasts by region and currency based on historical data, and produce summary graphs and pivot tables using a spreadsheet application.

3D Modeling
Create components for a 3D scene, including a panoramic image and texture images, using an image editing application. Create and render views of an architectural model using realistic materials in an architectural modeling application. Add visual features to an existing architectural model, and render "sketch" style views using an architectural modeling application. Create a 3D scene, rendering views and a fly-through animation of the scene's progression through development, using a 3D modeling application.

System Management
Install and then upgrade an application using a complete application installer and patch installers. Perform a (simulated) full system backup using encryption, then after making changes to the initial backup dataset, perform two encrypted incremental backups. Restore both backups. Create an encrypted archive of various sensitive files for transfer across unsecured communications, and another unencrypted archive of various files. Decompress the initial backup and two incremental backups. Decompress the encrypted and unencrypted archive files.

2.3 Application Selection

For SYSmark 2012, BAPCo has identified the following representative applications for the six usage scenarios:

Table 1: Office Productivity Applications
ABBYY® FineReader Pro 10.0 Image files, word processing documents
Adobe® Acrobat® Pro 9 Portable document files, image files
Adobe® Flash® Player 10.1 Flash animations
Microsoft® Excel® 2010 Spreadsheets
Microsoft® Internet Explorer® 8 (or newer version, if already installed) Web pages
Microsoft® Outlook® 2010 E-mails
Microsoft® PowerPoint® 2010 Presentation files, image files, video files
Microsoft® Word 2010 Word processing documents
Mozilla® Firefox® 3.6.8 Web pages
WinZip® Pro 14.5 Zip files, assorted document files

Table 2: Media Creation Applications
Adobe® After Effects® CS5 Video files, image files, audio files
Adobe® Photoshop® CS5 Extended Image files
Adobe® Premiere® Pro CS5 Video files

Table 3: Web Development Applications
Adobe® Photoshop® CS5 Extended Image files
Adobe® Premiere® Pro CS5 Video files, image files, audio files
Adobe® Dreamweaver® CS5 Web pages, image files, video files
Microsoft® Internet Explorer® 8 (or newer version, if already installed) Web pages

Mozilla® Firefox® 3.6.8 Web pages

Table 4: Data/Financial Analysis Applications Application Version Document Type
Microsoft® Excel® 2010 Spreadsheets

Table 5: 3D Modeling Applications Application Version Document Type
Adobe® Photoshop® CS5 Extended Image files
Autodesk® 3ds Max® 2011 CAD files, image files, video files
Autodesk® AutoCAD® 2011 CAD files
Google SketchUp™ Pro 8 CAD files, image files

Table 6: System Management Applications
Mozilla® Firefox® Installers for versions 2.0.0.20, 3.6.2, 3.6.3, 3.6.4, 3.6.6, 3.6.7
Application installer WinZip® Pro 14.5 Zip files, assorted media and document files
WinZip® Command Line 3.2 Zip files, assorted media and document files.

About J.Gold Associates

J.Gold Associates provides insightful, meaningful and actionable analysis of trends and opportunities in the computer and technology industries. We offer a broad based knowledge of the technology landscape, and bring that expertise to bear in our work. J.Gold Associates provides strategic consulting, syndicated research and advisory services, and in-context analysis to help its clients make important technology choices and to enable improved product deployment decisions and go to market strategies.

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