



SYSmark[®] 2012

An Overview of SYSmark 2012

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July 2011—Initial publication
August 2011— corrected the application list for the Office Productivity scenario (section 2.3)
April 2013 – addendums 1 and 2 added



About BAPCo

Business Applications Performance Corporation (BAPCo) is a non-profit consortium with a charter to develop and distribute a set of objective performance benchmarks for personal computers based on popular computer applications and industry standard operating systems.

For more information about BAPCo or a complete list of the current membership, see our website at <http://www.bapco.com/>.

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1 Introduction

SYSmark® 2012 is the latest revision of the premier system performance benchmark that measures and compares PC performance using real world applications, featuring all-new workloads, support for Microsoft Windows 7* 64-bit, and a new integrated system configuration manager.

SYSmark 2012 gives commercial and government IT decision makers, media, channel buyers, consultants, and system and component designers and manufacturers an objective, easy-to-use tool to evaluate PC performance across the wide range of activities that a desktop worker may encounter.

SYSmark 2012 is designed for those who want to:

- Evaluate and compare desktop and notebook computers for purchase consideration based on system performance and application responsiveness.
- Provide useful information to their audiences to assist in the evaluation and purchase of desktop and notebook computers.
- Evaluate desktop and notebook computers to better optimize the performance of the system.

Unlike synthetic benchmarks, which artificially drive components to peak capacity or attempt to deduce performance using a static simulation of application behavior, SYSmark 2012 uses real applications, real user workloads, and real data sets to accurately measure how overall system performance impacts user experience.

SYSmark 2012 builds upon BAPCo's 20-year history of building benchmarks to evaluate platform technologies. Benchmarks designed by BAPCo are the result of cooperative development between companies representing the breadth of the computing industry. They harness a consortium of knowledge to better reflect today's and tomorrow's emerging business trends.

This document describes the methodologies employed in the development of SYSmark 2012. For detailed instructions on how to install and run SYSmark 2012 products, please refer to the documentation provided on the installation media and/or the BAPCo web site (www.bapco.com).

Since the original release of this document, BAPCo has released SYSmark 2012 v1.5 and SYSmark 2012 Lite. This document has been updated with technical information on these new SYSmark 2012 products.

SYSmark 2012 v1.5 added additional support for Microsoft Windows 8 64-bit Operating System, bug fixes and application refreshes.

SYSmark 2012 Lite added support for Microsoft Windows 7 32-bit and Windows 8 32-bit operating systems, and bug fixes. This release uses 32-bit applications, and includes workload compatibility updates required for 32-bit operating system support.

Refer to the BAPCo 2012 product versions FAQ located in the SYSmark 2012 support section at www.bapco.com for more information.

2 BAPCo Development Process

BAPCo creates benchmarks in accordance with the BAPCo Development Process, a set of milestones and checkpoints collaboratively developed and agreed upon by the BAPCo membership.

Early in the process, prevailing business personal computer usage models are identified and grouped into scenarios according to their fit within a workflow. Applications are selected for each usage model on the basis of market research and technical feasibility.

BAPCo members then join together with expert application users in development sessions to collaboratively develop a workload specification for each scenario, defining each user/PC interaction which is to be simulated by the benchmark.

The goal of the development sessions is to produce representative business application workloads for the benchmark. Each application workload consists of three elements: the input data set, the tasks performed on the input data set, and the generated output. An example of generated output would be an image generated through an iterative process of steps to create a desired appearance. These three elements of the workload are chosen to represent the workflow of a user skilled in each given application.

After the workload specifications are created at the development sessions, BAPCo developers implement the workloads according to those specifications while satisfying benchmarking constraints to ensure the stability of the benchmark, the consistency of results, and the feasibility of implementation and distribution of the benchmark.

2.1 Milestone Overview

The BAPCo development process is divided into six major phases (Initialization, Design and Planning, Implementation, Validation, Characterization and Launch). Each phase consists of a series of milestones, some of which may be worked on concurrently.

The membership must vote to close each milestone. Once all the milestones within a phase are complete, the membership must vote to exit the phase and enter the next phase. BAPCo members work in a collaborative process where decisions regarding products are sometimes made by majority vote rather than unanimously.

The following is the list of the development phases and the corresponding milestones. Some of these milestones are explained in greater detail in the following sections, as noted in this list.

1. Initialization Phase

- a. Milestone 0 – Committee kickoff
- b. Milestone 1 – Benchmark market and customer analysis
- c. Milestone 2 – Product positioning and customer value proposition
- d. Milestone 3 – Preliminary marketing requirements document
- e. Milestone 4 – Final marketing requirements document

2. Design and Planning Phase

- a. Milestone 5 – Preliminary engineering requirements document
- b. Milestone 6 – Usage model selection (*see section 2.2*)
- c. Milestone 7 – Application selection (*see section 2.3*)
- d. Milestone 8 – Define member resource commitments
- e. Milestone 9 – Define development infrastructure
- f. Milestone 10 – Define scoring methodology (*see section 2.4*)
- g. Milestone 11 – Define application licensing requirements
- h. Milestone 12 – Plan and execute workload development sessions (*see section 2.5, 2.6*)
- i. Milestone 13 – Define product release criteria
- j. Milestone 14 – Select product name

3. Implementation Phase

- a. Milestone 15 – Create implementation schedule
- b. Milestone 16 – Determine calibration system (*see section 2.7*)
- c. Milestone 17 – Software development (*see section 2.8*)

4. Validation Phase

- a. Milestone 18 – Validation testing
- b. Milestone 19 – Define risk management plan

5. Characterization Phase

- a. Milestone 20 – Characterization testing
- b. Milestone 21 – Beta testing

6. Launch Phase

- a. Milestone 22 – Product pricing
- b. Milestone 23 – Pre-launch materials
- c. Milestone 24 – Release to manufacture vote and sign-off
- d. Milestone 25 – Duplicate and distribute media
- e. Milestone 26 – Post-launch materials

2.2 Usage Model/Scenario Selection

In milestone 6 of the BAPCo Development Process, PC usage models are chosen for inclusion in a benchmark. 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.

Note: The Media Creation scenario is not included in SYSmark 2012 Lite

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.

Note: The 3D Modeling scenario is not included in SYSmark 2012 Lite

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.

2.3 Application Selection

In milestone 7, after the usage models have been collected into scenarios, applications are chosen for the scenarios on the basis of market research and technical feasibility.

Sufficient lead time is needed after the applications are selected for BAPCo to develop workloads, integrate the applications into the benchmark, and perform validation of the benchmark. Therefore, some of the application versions are not the newest available at the time of the launch of SYSmark 2012.

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

A summary of the application versions installed and used by SYSmark 2012 and SYSmark 2012 Lite is included in Appendix A.

Application	Version	Document Type
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 1: Office Productivity Applications

Application	Version	Document Type
Adobe® After Effects®	CS5	Video files, image files, audio files
Adobe® Photoshop®	CS5 Extended	Image files
Adobe® Premiere®	Pro CS5	Video files

Table 2: Media Creation Applications

Application	Version	Document Type
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 3: Web Development Applications

Application	Version	Document Type
Microsoft® Excel®	2010	Spreadsheets

Table 4: Data/Financial Analysis 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 5: 3D Modeling Applications

Application	Version	Document Type
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

Table 6: System Management Applications

2.4 Scoring Methodology

In milestone 10, BAPCo decides the types of results that will be produced by a benchmark and the scoring methodology that determines how those results are calculated.

Importantly, BAPCo determines the scoring methodology before determining the content of the workloads, which helps ensure that a methodology is chosen for its ability to generate results that correspond to user experience, not for the results it produces on a pre-determined set of workloads.

For SYSmark 2012, BAPCo evaluated the merits of a variety of scoring methodologies and chose a methodology on the basis of how it met the following criteria:

- The scoring methodology should give expected results:
 - The resulting score should differentiate between systems with different performance.
 - The resulting score should be repeatable and not have high variation.
 - The resulting score should not be affected by benchmark artifacts, such as the number of tasks within a scenario.
- The relative performance between any two systems should not be affected by the selection of the calibration system.
- The resulting score should reflect the performance of user initiated multitasking operations.
- The scoring methodology should be easy to understand.

SYSmark 2012 measures system performance by measuring the response time of tasks on a PC using real applications and simulated user input. In the SYSmark 2012 scoring methodology, task response times are used to generate a performance rating that reflects the user experience. The faster a PC responds to the application workloads in SYSmark 2012, the higher its SYSmark 2012 performance ratings will be.

For more information on how task response times are measured, see section 2.8.

A complete SYSmark 2012 run will output six scenario performance ratings (one for each scenario) and an overall performance rating.

Scenario Rating

Each scenario has a rating calculated by taking the sum of the response times of tasks in that scenario as performed on the test system and then comparing it with the sum of those same task response times as performed on the calibration system (see section 2.7). The calibration sum is divided by the measured sum on the test system and multiplied by 100. The result is then rounded to the nearest integer.

Overall Rating

The SYSmark Overall Rating is calculated by taking the geometric mean of all the scenario ratings (prior to rounding). The result is then rounded to the nearest integer. To obtain an overall rating, you must run all scenarios.

2.5 Workload Development Sessions

Once the usage models, scenarios, applications, and scoring methodology for the benchmark are decided, BAPCo members and application experts meet to create the application workloads that will be used in the benchmark.

For SYSmark 2012, the workload development sessions consisted of two weeks of face-to-face meetings that included representatives from BAPCo member companies and expert application users who had professional experience with the applications chosen for the benchmark. The application experts included professionals in the fields of small business marketing, financial forecasting, graphic design, video editing, web development, 3D modeling, and enterprise IT deployment.

In the workload development sessions, the experts take the lead, weaving the usage models supplied by BAPCo into a storyboard of user interactions with a series of applications. Each user/PC interaction is written down in a workload specification, the specification used to automate the workloads later.

At the end of the workload development sessions, BAPCo comes away with a detailed workload specification for each of the benchmark scenarios and all of the input data sets needed to reproduce the workloads created at the sessions.

Additional Workload Considerations

The following additional factors come into consideration at the workload development sessions:

Input Data Set

Frequently in the sessions, the experts need raw digital content to serve as a input data set for a workload. Examples of such content might include a video to transcode, a presentation to modify, or documents to compress. When experts need such content, care is taken to ensure that they use something that is functionally representative of content they might use or encounter professionally.

For instance, if pictures are needed in order to create a web photo gallery, an expert might walk outside and take pictures using the same equipment he/she uses professionally. If a 3D model of a building is needed for a landscape workload, an expert might purchase a stock model from his/her usual online resource. Like the user interactions, all of these source materials are captured at the development session and used later in the development of automated workloads.

Task Switching and Concurrent Execution

In some cases, experts are encouraged to switch between open applications (e.g., as a user might between an e-mail program, word processor, and spreadsheet) or to leave activities running in the background as they perform work in another application (e.g., as a user might leave a compression task to run in the background while browsing the web).

In SYSmark 2012, the Office Productivity scenario makes extensive use of task switching and concurrent execution.

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.

Note: Media Creation scenario is not part of SYSmark 2012 Lite

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.

Note: The 3D Modeling scenario is not part of SYSmark 2012 Lite

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.

2.7 Calibration System

The calibration system is a system chosen in milestone 16 as a reference point for all other SYSmark 2012 results. BAPCo chose the configuration below for its wide availability and its representation of a typical mainstream PC at the time of release of SYSmark 2012.

SYSmark 2012 has been calibrated in such a way that a PC with performance equivalent to this calibration system for a given workload will have a performance rating of 100. A system twice as fast as the calibration system on a given workload (or, equivalently, that responds in half the time on average) will have a performance rating of 200. This is true for both overall ratings and scenario ratings.

The calibration system for all SYSmark 2012 products has the following configuration:

- Lenovo m90 Series Tower
- Intel Core i3-540 Processor (3.06GHz, 4MB Cache)
- 4GB PC3-10600 (DDR3-1333) SDRAM (2 DIMMs)
- Integrated Video
- Integrated High Definition Audio
- Seagate ST3250318AS 250GB Hard Drive (8M Cache, 7200RPM SATA 3Gb/s)
- DVD Recordable
- Integrated Gigabit Ethernet
- Windows 7 Professional 64-bit
- 1920x1080 Display Resolution

A fresh operating system installation is performed on the system.

For more details about the configuration of the calibration system, please contact support@bapco.com.

Please note that the minimum requirements to run SYSmark 2012 products are listed in Appendix B and are not equivalent to the calibration system.

2.8 Benchmark Implementation

Once the workload specifications have been created, BAPCo begins the important work of translating the workload specifications into an automated benchmark in milestone 17.

SYSmark 2012 is built upon scripts that do things much the way a user would, using controls like buttons, text input boxes, and menus to navigate applications. See Appendix C for screenshots of the benchmark in action.

To ensure that SYSmark 2012 has deterministic behavior, BAPCo uses a framework to install applications, collect system information, run the scenario scripts, record performance measurements, calculate performance ratings, and display test results. The framework is kept lightweight, consuming a minimal amount of memory and compute resources, in order to ensure that performance measurements reflect the workload performance and do not include overhead from the framework.

The fundamental performance unit in SYSmark 2012 is *response time*. Response time is defined as the time it takes the computer to complete a task that has been initiated by the automated script. A task can be initiated by a mouse click or a keystroke. The duration of each task is measured by the framework. Examples of tasks include launching an application, finding text in a document, copying a file, encoding a video, and performing an image manipulation.

The framework has several methods of detecting task completion, depending upon the method the application uses to signal task completion to the user. For example, the framework may wait for the application to show a completion message in the form of a pop-up window, or may wait for a progress dialog to disappear and for control of the application to be returned to the user.

3 Workload Characteristics

This section provides data illustrating the performance characteristics of the 64-bit version of SYSmark 2012.

3.1 Sensitivity Analysis

The series of tables below shows the sensitivity of SYSmark 2012 to different system characteristics, including the amount of system RAM, CPU frequency, number of CPU cores, graphics adapter, I/O technology, operating system and display resolution.

Within each study only one system component (e.g. memory) is varied. All the other system components are held constant. To best illustrate the sensitivity, one configuration is chosen as a baseline and the ratings for the other configurations are shown as the percentage difference relative to the baseline.

In order to give better control over system configuration, not all sensitivity charts use the same baseline configuration. Note the configuration details below each table and be aware that component sensitivities will vary from one configuration to the next.

Refer to Addendum I for SYSmark 2012 Windows 8 sensitivity analysis data and Addendum II for SYSmark 2012 Lite sensitivity analysis data.

3.1.1 Sensitivity to System Memory

The total system memory is changed from 2 GB to 4 GB to 8 GB. In all configurations, two sticks of memory were used in dual-channel mode.

System Memory Sensitivity	2 GB (2x1 GB)	4 GB (2x2 GB)	8 GB (2x4 GB)
Office Productivity	0%	+7.5%	+9.7%
Media Creation	0%	+233.3%	+250.0%
Web Development	0%	+8.8%	+11.0%
Data/Financial Analysis	0%	+6.3%	+4.2%
3D Modeling	0%	+2.0%	+2.0%
System Management	0%	+9.8%	+12.0%
SYSmark® 2012 Overall Rating	0%	+28.2%	+30.8%

Table 7: System Memory Sensitivity

Intel Core i3-540 processor @ 3.06 GHz, DH57DD-based motherboard,
Seagate ST3250318AS 250 GB 7200 RPM hard disk drive, DDR3-1333
dual channel SDRAM, Intel HD Graphics, Microsoft Windows 7 64-bit

3.1.2 Sensitivity to CPU Frequency

The CPU frequency of a system is changed from 2.93 GHz to 3.33 GHz in steps of 133 MHz. For these tests, Intel Turbo Boost Technology* is disabled to ensure the CPU is running at the specified speed.

CPU Frequency Sensitivity	2.93 GHz	3.06 GHz	3.20 GHz	3.33 GHz
Office Productivity	0%	+3.8%	+7.6%	+10.7%
Media Creation	0%	+2.8%	+6.2%	+9.0%
Web Development	0%	+0.6%	+4.0%	+9.0%
Data/Financial Analysis	0%	+2.6%	+5.2%	+7.8%
3D Modeling	0%	+3.6%	+7.7%	+11.3%
System Management	0%	+3.1%	+6.2%	+11.6%
SYSMark® 2012 Overall Rating	0%	+3.0%	+6.6%	+10.2%

Table 8: CPU Frequency Sensitivity

Intel Core i7-980X processor with Turbo Boost Technology disabled,
Intel DX58SO2 motherboard, Seagate ST31000528AS 1 TB 7200 RPM
hard disk drive, 4 GB DDR3-1066 dual channel SDRAM, 1920x1080
video resolution, ATI Radeon HD 6970 2 GB video card, Microsoft
Windows 7 SP1 64-bit

3.1.3 Sensitivity to CPU Cores/Threads

The number of CPU cores is controlled by changing system BIOS settings to enable 2 cores, then 4 cores, and finally all 6 cores of a 6-core processor. Because the CPU used in this study has two logical threads per core, the number of threads is always two times the number of cores. In this table, “2c/4t” represents “2 cores, 4 threads”.

CPU Core/Thread Sensitivity	2c/4t	4c/8t	6c/12t
Office Productivity	0%	+6.8%	+13.6%
Media Creation	0%	+14.3%	+28.6%
Web Development	0%	+36.9%	+61.5%
Data/Financial Analysis	0%	+34.9%	+67.8%
3D Modeling	0%	+57.4%	+109.8%
System Management	0%	-0.7%	+2.1%
SYSMark® 2012 Overall Rating	0%	+23.5%	+43.2%

Table 9: CPU Core/Thread Sensitivity

Intel Core i7-980X processor @ 3.33 GHz, Intel DX58SO2 motherboard,
Seagate ST31000528AS 1 TB 7200 RPM hard disk drive, 4 GB DDR3-
1066 dual channel SDRAM, 1920x1080 video resolution, ATI Radeon HD
6970 2 GB video card, Microsoft Windows 7 SP1 64-bit

3.1.4 Sensitivity to Graphics Subsystem

The graphics adapter is changed according to the table below. For the integrated graphics test, the on-CPU graphics subsystem is used. For the discrete graphics tests, PCI Express cards are plugged into the same motherboard and the integrated graphics subsystem is disabled.

Graphics Sensitivity	i3-550 Integrated	6450 512 MB	6970 2 GB
Office Productivity	0%	-0.9%	+0.9%
Media Creation	0%	+1.0%	+1.0%
Web Development	0%	-2.8%	+0.9%
Data/Financial Analysis	0%	+7.0%	+7.0%
3D Modeling	0%	+0.9%	+1.9%
System Management	0%	+1.9%	+0.9%
SYSmark® 2012 Overall Rating	0%	+0.9%	+1.9%

Table 10: Graphics Sensitivity

Intel Core i3-550 processor @ 3.20 GHz, DH57DD-based motherboard,
Seagate ST31000528AS 1 TB 7200 RPM hard disk drive, 4 GB DDR3-
1333 dual channel SDRAM, 1920x1080 video resolution, Microsoft
Windows 7 SP1 64-bit

3.1.5 Sensitivity to I/O Subsystem

The primary storage device is changed according to the table below.

I/O Sensitivity	160 GB 5400 RPM HDD ST9160314AS	1 TB 7200 RPM HDD ST31000528AS	256 GB SSD MV-5PA256/US
Office Productivity	0%	+15.4%	+25.4%
Media Creation	0%	+3.8%	+7.7%
Web Development	0%	+19.4%	+39.4%
Data/Financial Analysis	0%	+7.3%	+13.7%
3D Modeling	0%	+4.9%	+7.4%
System Management	0%	+21.5%	+43.8%
SYSmark® 2012 Overall Rating	0%	+11.8%	+21.9%

Table 11: I/O Sensitivity

Intel Core i7-980X processor @ 3.33 GHz, Intel DX58SO2 motherboard,
4 GB DDR3-1066 dual channel SDRAM, 1920x1080 video resolution, ATI
Radeon HD 6970 2 GB video card, Microsoft Windows 7 SP1 64-bit

3.1.6 Sensitivity to Operating System

The operating system is changed according to the table below.

Operating System Sensitivity	Windows Vista SP2 64-bit	Windows 7 SP1 64-bit
Office Productivity	0%	+14.5%
Media Creation	0%	-0.6%
Web Development	0%	+8.2%
Data/Financial Analysis	0%	-1.2%
3D Modeling	0%	-1.2%
System Management	0%	+40.0%
SYSmark® 2012 Overall Rating	0%	+9.2%

Table 12: Operating System Sensitivity

Intel Core i7-980X processor @ 3.33 GHz, Intel DX58SO2 motherboard,
Seagate ST31000528AS 1 TB 7200 RPM hard disk drive, 4 GB DDR3-
1066 dual channel SDRAM, 1920x1080 video resolution, ATI Radeon HD
6970 2 GB video card

3.1.7 Sensitivity to Display Resolution

The system display resolution is changed according to the table below.

Display Resolution Sensitivity	1024x768 4:3 ratio 0.79 M pixels	1600x900 16:9 ratio 1.44 M pixels	1920x1080 16:9 ratio 2.07 M pixels
Office Productivity	0%	-0.6%	-2.6%
Media Creation	0%	-0.6%	-3.6%
Web Development	0%	-1.9%	-6.6%
Data/Financial Analysis	0%	-1.1%	-6.7%
3D Modeling	0%	+0.4%	+0.0%
System Management	0%	-0.7%	+1.4%
SYSmark® 2012 Overall Rating	0%	-1.0%	-3.1%

Table 13: Display Resolution Sensitivity

Intel Core i7-980X processor @ 3.33 GHz, Intel DX58SO2 motherboard,
Seagate ST31000528AS 1 TB 7200 RPM hard disk drive, 4 GB DDR3-
1066 dual channel SDRAM, ATI Radeon HD 6970 2 GB video card,
Microsoft Windows 7 SP1 64-bit

3.2 Application Contribution Analysis

The following chart shows the approximate contribution of each application to the SYSmark 2012 overall rating on the calibration system.

Due to system implementation differences, this chart is accurate for the calibration system only. These contributions will vary from one system to the next.

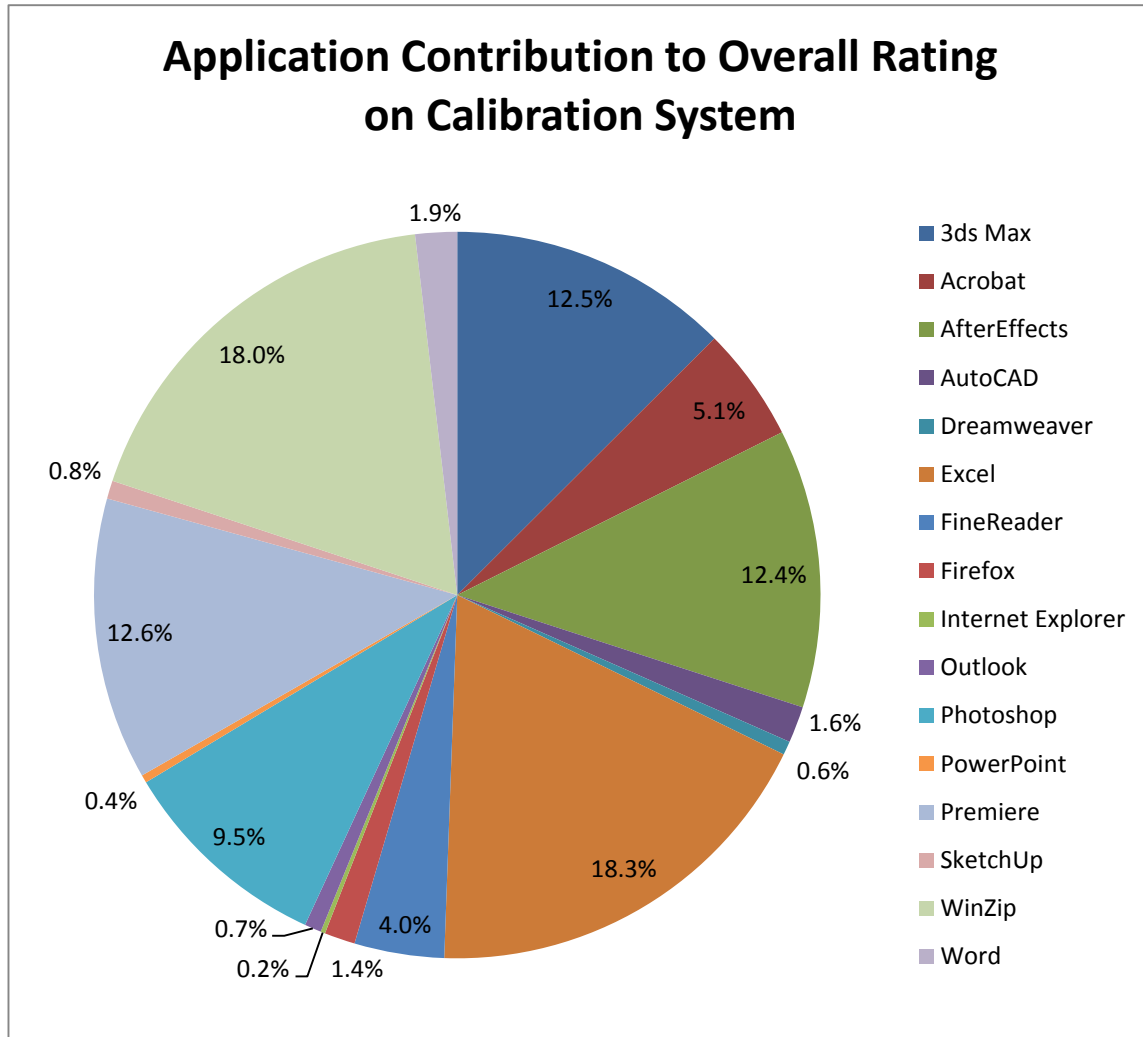


Figure 1: Application Contribution to Overall Rating

Intel Core i3-540 processor @ 3.06 GHz, DH57DD-based motherboard,
Seagate ST3250318AS 250 GB 7200 RPM hard disk drive, 4 GB DDR3-
1333 dual channel SDRAM, Intel HD Graphics, Microsoft Windows 7 64-
bit

APPENDIX A: Application Program Versions

The following applications are installed and used by SYSmark 2012:

- ABBYY® FineReader Pro 10.0
- Adobe® Acrobat® Pro 9
- Adobe® After Effects® CS5
- Adobe® Dreamweaver® CS5
- Adobe® Flash® Player 10.1
- Adobe® Photoshop® CS5 Extended
- Adobe® Premiere® Pro CS5
- Autodesk® 3ds Max® 2011
- Autodesk® AutoCAD® 2011
- Google SketchUp™ Pro 8
- Microsoft® Excel® 2010 64-bit
- Microsoft® Internet Explorer® 8 (or newer version, if already installed)
- Microsoft® Outlook® 2010 64-bit
- Microsoft® PowerPoint® 2010 64-bit
- Microsoft® Word 2010 64-bit
- Mozilla® Firefox® Installer (several versions)
- Mozilla® Firefox® 3.6.8
- WinZip® Pro 14.5
- WinZip® Command Line 3.2

The following applications are installed and used by SYSmark 2012 Lite:

- ABBYY® FineReader Pro 10.0
- Adobe® Acrobat® Pro 9
- Adobe® Dreamweaver® CS4
- Adobe® Flash® Player 10.1
- Adobe® Photoshop® CS5 32-bit
- Adobe® Premiere® Pro CS4
- Microsoft® Excel® 2010 32-bit
- Microsoft® Internet Explorer® 8 (or newer version, if already installed)
- Microsoft® Outlook® 2010 32-bit
- Microsoft® PowerPoint® 2010 32-bit
- Microsoft® Word 2010 32-bit
- Mozilla® Firefox® Installer (several versions)
- Mozilla® Firefox® 3.6.8
- WinZip® Pro 14.5
- WinZip® Command Line 3.2

APPENDIX B: System Requirements

SYSmark 2012 has the following requirements:

- Windows® 7 64-bit or Windows® 8 64-bit
- 1.8 GHz dual core processor
- 2 GB system RAM
- DirectX 9-compatible graphics adapter
- At least 50 GB free space on the primary storage device
- 1024x768 display resolution (or higher)

SYSmark 2012 Lite has the following requirements:

- Windows® 7 (32-bit or 64-bit) or Windows® 8 (32-bit or 64-bit)
- 1.8 GHz dual core processor
- 2 GB system RAM
- DirectX 9-compatible graphics adapter
- At least 50 GB free space on the primary storage device
- 1024x768 display resolution (or higher)

APPENDIX C: Screenshots

The screenshots below are included to illustrate the user interface and workloads included in SYSmark 2012. These screenshots may not accurately depict future releases of SYSmark 2012.

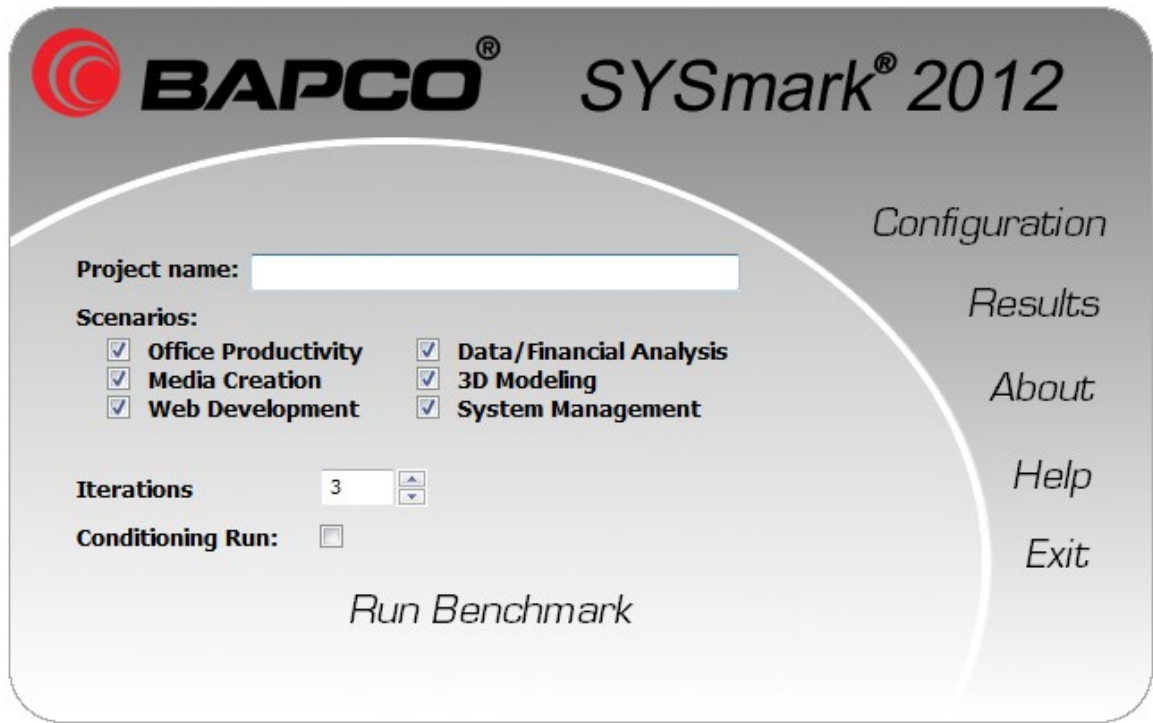


Figure 2: Test Setup

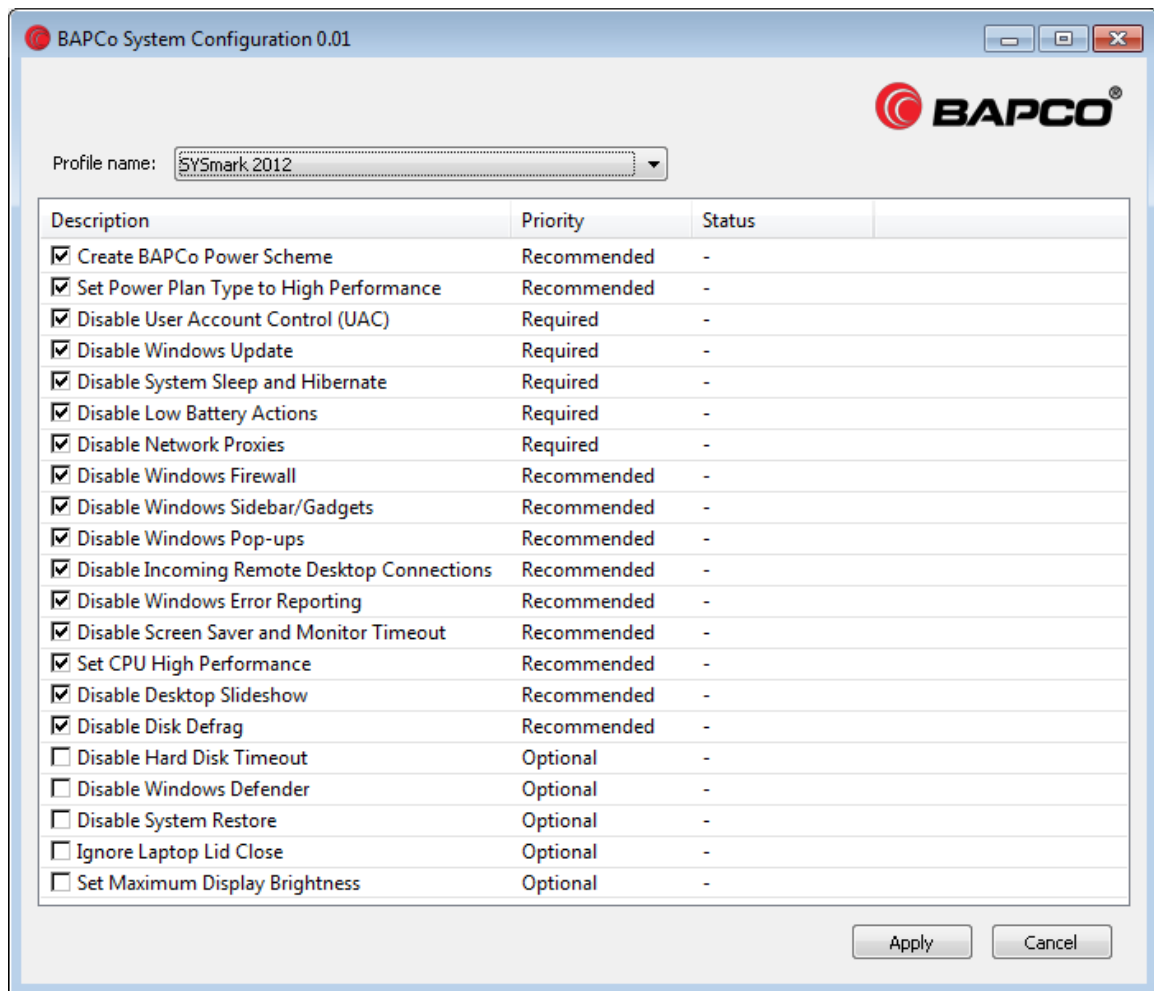


Figure 3: System Configuration

New built-in tool simplifies management of system configuration



Figure 4: Heads-Up Display

Displayed atop other windows on the top-right of the desktop during testing

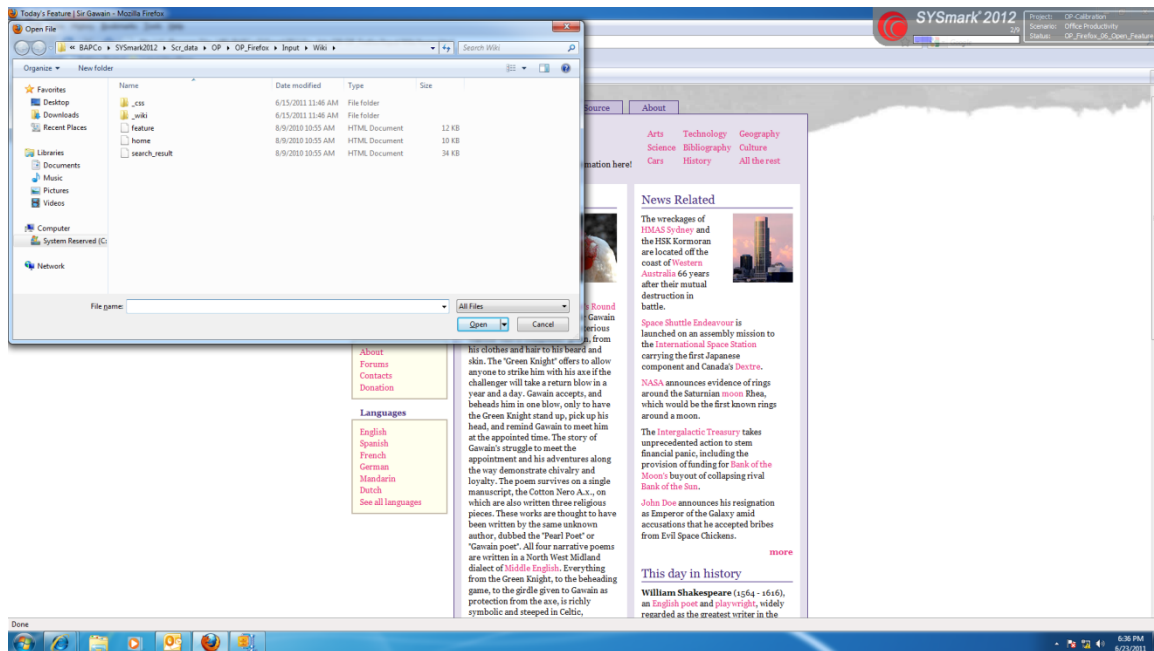


Figure 5: Office Productivity Scenario

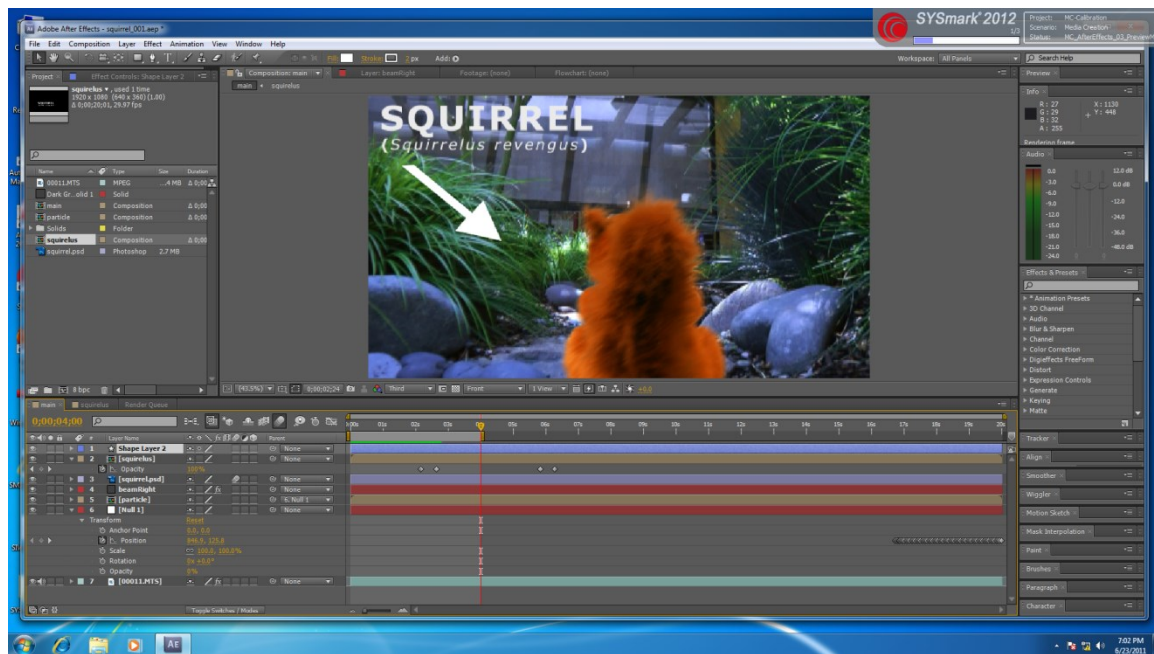


Figure 6: Media Creation Scenario

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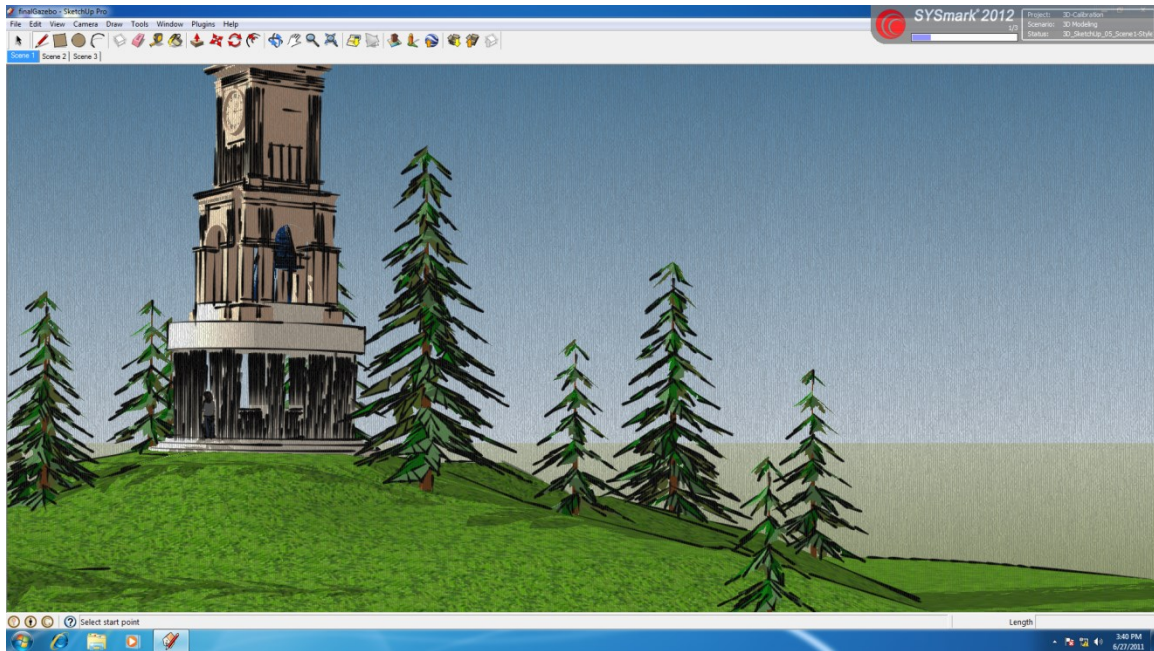


Figure 9: 3D Modeling Scenario

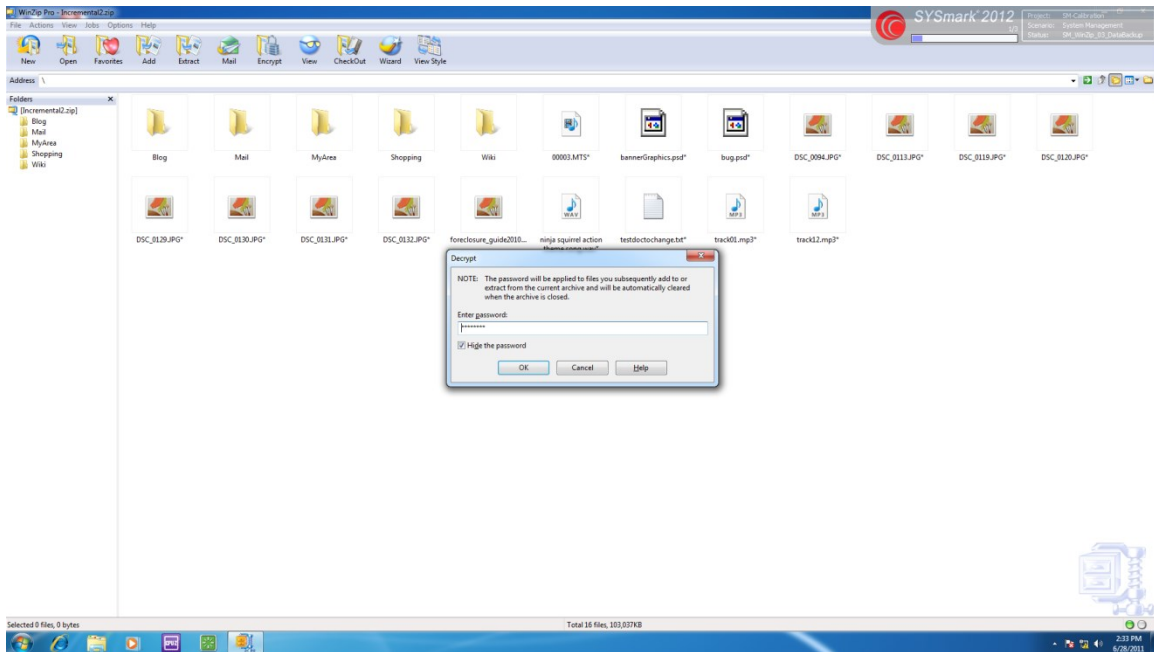


Figure 10: System Management Scenario

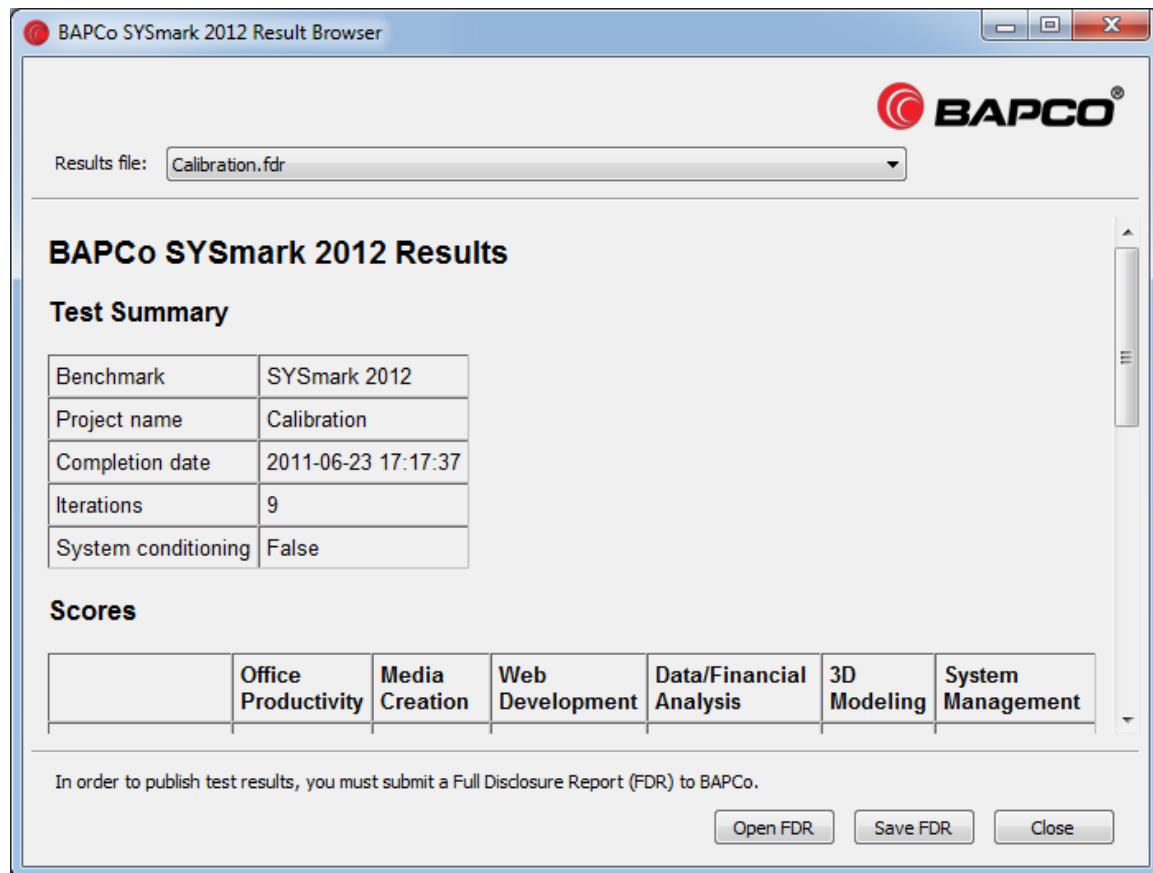


Figure 11: Results Browser

ADDENDUM I: SYSmark 2012 Sensitivity on Windows 8

The series of tables below shows the sensitivity of SYSmark 2012 to different system characteristics, including the amount of system RAM, CPU frequency, number of CPU cores, graphics adapter, I/O technology, operating system and display resolution.

Within each study only one system component (e.g. memory) is varied. All the other system components are held constant. To best illustrate the sensitivity, one configuration is chosen as a baseline and the ratings for the other configurations are shown as the percentage difference relative to the baseline.

In order to give better control over system configuration, not all sensitivity charts use the same baseline configuration. Note the configuration details below each table and be aware that component sensitivities will vary from one configuration to the next.

Sensitivity to System Memory

The total system memory is changed from 2 GB to 4 GB to 8 GB. In all configurations, two sticks of memory were used in dual-channel mode.

System Memory Sensitivity (normalized to 2GB baseline)	2 GB (2x1 GB)	4 GB (2x2 GB)	8 GB (2x4 GB)
Office Productivity	0%	+19.4%	+27.3%
Media Creation	0%	+150.6%	+167.5%
Web Development	0%	+41.3%	+52.4%
Data/Financial Analysis	0%	+2.8%	+8.1%
3D Modeling	0%	+10.4%	+13.1%
System Management	0%	+17.3%	+23.7%
SYSmark® 2012 Overall Rating	0%	+34.0%	+41.3%

Table A: System Memory Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz, DZ77GA-based motherboard,
Seagate ST31000528AS 1TB GB 7200 RPM hard disk drive, DDR3-1600
dual channel SDRAM, Intel HD Graphics, Microsoft Windows 8 64-bit

Sensitivity to CPU Frequency

The CPU frequency of a system is changed from 2.90 GHz to 3.50 GHz in steps of 133 MHz. For these tests, Intel Turbo Boost Technology* is disabled to ensure the CPU is running at the specified speed.

CPU Frequency Sensitivity (normalized to 2.90 GHZ baseline)	2.90 GHZ	3.0GHZ	3.20GHZ	3.5GHZ
Office Productivity	0%	+3.8%	+12.1%	+25.8%
Media Creation	0%	+3.0%	+9.1%	+18.2%
Web Development	0%	+3.0%	+8.4%	+24.1%
Data/Financial Analysis	0%	+7.3%	+16.8%	+31.4%
3D Modeling	0%	+4.2%	+9.5%	+24.2%
System Management	0%	+3.9%	+11.6%	+22.5%
SYSmark® 2012 Overall Rating	0%	+4.4%	+11.3%	+24.4%

Table B: CPU Frequency Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz with Turbo Boost Technology disabled; DZ77GA-based motherboard, Seagate ST31000528AS 1TB GB 7200 RPM hard disk drive, 8GB DDR3-1600 dual channel SDRAM, Intel HD 4000 Graphics, Microsoft Windows 8 64-bit

Sensitivity to CPU Cores/Threads

The number of CPU cores is controlled by changing system BIOS settings to enable additional cores/threads as indicated in the table below. The column headers indicate the number of cores/threads active for each test. For example: “1c/2t” represents a test run on one core and one thread. The results in the table are normalized to the 1c/1t configuration.

CPU Cores/Threads Sensitivity (normalized to 1c/1t baseline)	1c/1t	1c/2t	2c/2t	2c/4t	4c/4t	4c/8t
Office Productivity	0%	+12.6%	+32.4%	+40.5%	+48.6%	+59.5%
Media Creation	0%	+10.1%	+51.5%	+67.7%	+93.9%	+108.1%
Web Development	0%	+25.4%	+78.9%	+107.0%	+163.4%	+207.0%
Data/Financial Analysis	0%	+34.5%	+64.3%	+115.5%	+144.0%	+217.9%
3D Modeling	0%	+24.2%	+90.9%	+130.3%	+215.2%	+278.8%
System Management	0%	+0.0%	+1.8%	+0.6%	+1.8%	+3.0%
SYSmark® 2012 Overall Rating	0%	+16.8%	+50.5%	+69.5%	+96.8%	+123.2%

Table C: CPU Core/Thread Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz; DZ77GA-based motherboard,
Seagate ST31000528AS 1TB GB 7200 RPM hard disk drive, 8GB DDR3-
1600 dual channel SDRAM, Intel HD 4000 Graphics, Microsoft Windows
8 64-bit

Sensitivity to Graphics Subsystem

The graphics adapter is changed according to the table below. For the integrated graphics test, the on-CPU graphics subsystem is used. For the discrete graphics tests, PCI Express cards are plugged into the same motherboard and the integrated graphics subsystem is disabled. The results are normalized to the integrated graphics HD 4000 configuration.

Graphics Adapter Sensitivity (normalized to HD 4000 baseline)	HD 4000 Integrated	Nvidia GTX630	Nvidia GTX680
Office Productivity	0%	+0.6%	+0.6%
Media Creation	0%	+0.5%	+0.5%
Web Development	0%	+0.0%	+1.8%
Data/Financial Analysis	0%	+10.9%	+11.6%
3D Modeling	0%	-0.8%	-0.4%
System Management	0%	+0.0%	+0.0%
SYSmark® 2012 Overall Rating	0%	+1.9%	+2.4%

Table D: Graphics Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz; DZ77GA-based motherboard,
Seagate ST31000528AS 1TB GB 7200 RPM hard disk drive, 8GB DDR3-
1600 dual channel SDRAM, 1920x1080 resolution, Microsoft Windows 8
64-bit

Sensitivity to I/O Subsystem

The primary storage device is changed according to the table below. The results are normalized to the 5400rpm drive configuration.

I/O Sensitivity (normalized to 5400rpm HDD baseline)	1TB 5400rpm WDC WD10EARS- 003BB1	1TB 7200rpm ST31000528A S	180GB SSD SSDSC2CW180A 3
Office Productivity	0%	+6.0%	+17.4%
Media Creation	0%	+1.0%	+2.9%
Web Development	0%	+5.8%	+15.0%
Data/Financial Analysis	0%	+1.5%	+3.4%
3D Modeling	0%	+2.5%	+2.9%
System Management	0%	+8.2%	+27.7%
SYSmark® 2012 Lite Overall Rating	0%	+3.9%	+11.3%

Table E: I/O Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz; DZ77GA-based motherboard,
8GB DDR3-1600 dual channel SDRAM, Intel HD 4000 Graphics,
Microsoft Windows 8 64-bit

Sensitivity to Display Resolution

The system display resolution is changed according to the table below. The results are normalized to the 1024x768 configuration.

Display Resolution Sensitivity (normalized to 1024x768 baseline)	1024x768 4:3 ratio 0.79 M pixels	1600x900 16:9 ratio 1.44 M pixels	1920x1080 16:9 ratio 2.07 M pixels
Office Productivity	0%	-0.5%	-5.9%
Media Creation	0%	-1.4%	-3.3%
Web Development	0%	-1.3%	-5.6%
Data/Financial Analysis	0%	-1.0%	-12.2%
3D Modeling	0%	-0.8%	-2.0%
System Management	0%	+0.0%	+0.6%
SYSMark® 2012 Overall Rating	0%	-0.9%	-4.9%

Table F: Display Resolution Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz; DZ77GA-based motherboard,
Seagate ST31000528AS 1TB GB 7200 RPM hard disk drive, 8GB DDR3-
1600 dual channel SDRAM, NVIDIA GTX680 Graphics, Microsoft
Windows 8 64-bit

ADDENDUM II: SYSmark 2012 Lite Sensitivity Analysis

The series of tables below shows the sensitivity of SYSmark 2012 Lite to different system characteristics, including the amount of system RAM, CPU frequency, number of CPU cores, graphics adapter, I/O technology, operating system and display resolution.

Within each study only one system component (e.g. memory) is varied. All the other system components are held constant. To best illustrate the sensitivity, one configuration is chosen as a baseline and the ratings for the other configurations are shown as the percentage difference relative to the baseline.

In order to give better control over system configuration, not all sensitivity charts use the same baseline configuration. Note the configuration details below each table and be aware that component sensitivities will vary from one configuration to the next.

Sensitivity to System Memory

The total system memory is changed from 2 GB to 4 GB to 8 GB. In all configurations, two sticks of memory were used in dual-channel mode. The results data is normalized to the 2GB configuration.

System Memory Sensitivity (normalized to 2 GB baseline)	2 GB (2x1 GB)	4 GB (2x2 GB)	8 GB (2x4 GB)
Office Productivity	0%	+12.4%	+13.1%
Web Development	0%	+14.8%	+13.9%
Data/Financial Analysis	0%	+4.3%	+2.4%
System Management	0%	+9.3%	+7.9%
SYSmark® 2012 Lite Overall Rating	0%	+10.0%	+9.4%

Table G: System Memory Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz, DZ77GA-based motherboard,
Seagate ST31000528AS 1TB GB 7200 RPM hard disk drive, DDR3-1600
dual channel SDRAM, Intel HD Graphics, Microsoft Windows 8 32-bit

Sensitivity to CPU Frequency

The CPU frequency of a system is changed from 2.90 GHz to 3.50 GHz in steps of 133 MHz. For these tests, Intel Turbo Boost Technology* is disabled to ensure the CPU is running at the specified speed. The results data is normalized to the 2.90GHz configuration

CPU Frequency Sensitivity (normalized to 2.90 GHz baseline)	2.90 GHz	3.0GHZ	3.20GHZ	3.5GHZ
Office Productivity	0%	+2.9%	+7.2%	+15.8%
Web Development	0%	+2.7%	+7.2%	+18.0%
Data/Financial Analysis	0%	+2.9%	+8.7%	+17.4%
System Management	0%	+3.1%	+8.7%	+13.4%
SYSMark® 2012 Lite Overall Rating	0%	+2.8%	+7.7%	+16.2%

Table H: CPU Frequency Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz with Turbo Boost Technology disabled; DZ77GA-based motherboard, Seagate ST31000528AS 1TB GB 7200 RPM hard disk drive, 8GB DDR3-1600 dual channel SDRAM, Intel HD 4000 Graphics, Microsoft Windows 8 32-bit

Sensitivity to CPU Cores/Threads

The number of CPU cores is controlled by changing system BIOS settings to enable additional cores/threads as indicated in the table below. The column headers indicate the number of cores/threads active for each test. For example: "1c/2t" represents a test run on one core and one thread. The results in the table are normalized to the 1c/1t configuration.

CPU Cores/Threads Sensitivity (normalized to 1c/1t baseline)	1c/1t	1c/2t	2c/2t	2c/4t	4c/4t	4c/8t
Office Productivity	0%	+9.8%	+28.6%	+41.1%	+48.2%	+54.5%
Web Development	0%	+19.6%	+84.8%	+110.9%	+197.8%	+202.2%
Data/Financial Analysis	0%	+32.1%	+61.7%	+112.3%	+108.9%	+219.8%
System Management	0%	-0.6%	-1.3%	-0.6%	-1.9%	-3.8%
SYSMark® 2012 Lite Overall Rating	0%	+14.4%	+40.0%	+57.8%	+73.3%	+94.4%

Table I: CPU Core/Thread Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz; DZ77GA-based motherboard, Seagate ST31000528AS 1TB GB 7200 RPM hard disk drive, 8GB DDR3-1600 dual channel SDRAM, Intel HD 4000 Graphics, Microsoft Windows 8 32-bit

Sensitivity to Graphics Subsystem

The graphics adapter is changed according to the table below. For the integrated graphics test, the on-CPU graphics subsystem is used. For the discrete graphics tests, PCI Express cards are plugged into the same motherboard and the integrated graphics subsystem is disabled. The results are normalized to the integrated graphics HD 4000 configuration.

Graphics Adapter Sensitivity (normalized to HD 4000 baseline)	HD 4000 Integrated	Nvidia GTX630	Nvidia GTX680
Office Productivity	0%	-0.6%	-2.9%
Web Development	0%	0.0%	-0.7%
Data/Financial Analysis	0%	+11.2%	+7.3%
System Management	0%	+5.3%	+5.3%
SYSMark® 2012 Lite Overall Rating	0%	+4.0%	+2.3%

Table J: Graphics Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz; DZ77GA-based motherboard,
Seagate ST31000528AS 1TB GB 7200 RPM hard disk drive, 8GB DDR3-
1600 dual channel SDRAM, 1920x1080 resolution, Microsoft Windows 8
32-bit

Sensitivity to I/O Subsystem

The primary storage device is changed according to the table below. The results are normalized to the 5400rpm drive configuration.

I/O Sensitivity (normalized to 5400 HDD baseline)	1TB 5400rpm WDC WD10EARS- 003BB1	1TB 7200rpm ST31000528A S	180GB SSD SSDSC2CW180A 3
Office Productivity	0%	+11.6%	+21.9%
Web Development	0%	+11.2%	+21.6%
Data/Financial Analysis	0%	+5.7%	+6.5%
System Management	0%	+25.8%	+65.8%
SYSMark® 2012 Lite Overall Rating	0%	+13.6%	+27.3%

Table K: I/O Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz; DZ77GA-based motherboard,
8GB DDR3-1600 dual channel SDRAM, Intel HD 4000 Graphics,
Microsoft Windows 8 32-bit

Sensitivity to Display Resolution

The system display resolution is changed according to the table below. The results are normalized to the 1024x768 configuration.

Display Resolution Sensitivity (normalized to 1024x768 baseline)	1024x768 4:3 ratio 0.79 M pixels	1600x900 16:9 ratio 1.44 M pixels	1920x1080 16:9 ratio 2.07 M pixels
Office Productivity	0%	+1.2%	+2.4%
Web Development	0%	-1.4%	0.0%
Data/Financial Analysis	0%	-2.5%	-6.8%
System Management	0%	-0.6%	-3.8%
SYSmark® 2012 Lite Overall Rating	0%	+1.1%	-2.2%

Table L: Display Resolution Sensitivity

Intel Core i7-3770K processor @ 3.5 GHz; DZ77GA-based motherboard,
Seagate ST31000528AS 1TB GB 7200 RPM hard disk drive, 8GB DDR3-
1600 dual channel SDRAM, NVIDIA GTX680 graphics, Microsoft
Windows 8 32-bit