

## WHITE PAPER

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# Quantifying the Economic Value of Chromebooks for K–12 Education

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## EXECUTIVE SUMMARY

Technology and the Web have given educators new learning models — blended learning, flipped classrooms, and the ability to do remote or "distance" teaching. Students, especially at the K–12 level, use online tools such as Wikipedia, Google Search, OpenClass, GeoGebra, Khan Academy, and Blogger for coursework, projects, and homework. Teachers keep current with online lesson plans and class syllabi.

The Web is clearly a value-added learning platform, enhancing knowledge acquisition and sharing for students, teachers, and administrators. The challenge is to manage and scale the use of Internet access technology in classrooms and institutions in order to turn these potential benefits into realities within budget and resource constraints.

## IDC OPINION

Chromebooks are computers designed specifically to access the rich educational and collaborative resources of the Internet, and to do so at a lower overall cost than traditional PCs. This makes Chromebooks excellent candidates for schools looking at options to enable productive and effective learning on the Web for students.

IDC conducted detailed research with 12 K–12 school systems that implemented Chromebooks for student access to the Internet and to educational resources and tools. This research, conducted in Q4 2011, led to the following conclusions:

- ☑ Chromebooks reduced the need for additional IT staff to support their deployments, requiring approximately 69% less labor to deploy and 92% less labor to support than desktop PCs, laptop PCs, or netbooks.
- ☑ Chromebooks' high reliability increased actual teaching and educational administration time by reducing the time lost in managing desktop PCs, laptop PCs, or netbooks by 82%.
- ☑ Deployment of Chromebooks eliminated the need for system reimaging and lost file recovery in these school systems. Multiple respondents in the interviews reported zero help desk calls or support tickets for their installed Chromebooks.

- ☒ The comparative lower overall cost of deploying, using, and supporting Chromebooks allowed for an increase in one-to-one learning.
- ☒ At the time of the research, Chromebooks cost \$747, and compared with alternative devices, Chromebooks reduced the per-device cost of ownership for these schools by \$590 over three years. With the new Chromebook launched in October 2012, the cost for the device and management combined was reduced to \$279, resulting in the monthly per-device cost for hardware/software dropping from \$20.75 to \$7.75 and improving the three-year cost of ownership savings to \$1,135.

## METHODOLOGY

IDC employed a standard methodology for this assessment project, as noted in this section.

All financial quantification is based on interviews with administrators, educators, and IT staff in 12 disparate school systems that have deployed Google's Chromebooks for education. The information gathered in these interviews was aggregated to quantify the economic value of Google Chromebooks for education.

Calculations are based on the following assumptions:

- ☒ Time values are multiplied by burdened salary to quantify efficiency and productivity savings.
- ☒ Classroom downtime values are a product of the reduction in downtime hours per device multiplied by teachers' burdened salary.
- ☒ Because not every hour of downtime equates to a lost hour of productivity, IDC specifically asks about the percentage impact of an hour of downtime and attributes a fraction of the hourly result to the dollar savings.
- ☒ As noted previously, new Chromebook devices were launched after IDC conducted these interviews with the educational institutions. Where appropriate, this document highlights where the new pricing affects the comparative advantage of Chromebooks.

*Note: All numbers in this document may not be exact due to rounding.*

## **IN THIS WHITE PAPER**

This white paper examines the business case for Chromebooks in the educational market — specifically, the K–12 segment. We present research drawn from interviews in a dozen typical learning environments, and we compare the costs associated with Chromebooks to those of alternative devices, including standard PCs.

Additional factors in the calculations include the impact of educator support for these devices because time spent fixing classroom computer problems directly affects available classroom teaching time.

## **SITUATION OVERVIEW**

The Internet has changed many aspects of modern society, but the field of education has the potential to be altered more profoundly than most. The Web provides access to information at a scale that librarians and educators could have scarcely imagined less than a generation ago. Not surprisingly, schools are very interested in finding effective and cost-efficient ways to access and leverage this information in an easy, straightforward manner.

Personal computers have played a critical role in providing this access, but they can also introduce challenges of their own — particularly when it comes to managing the operating systems (OSs) and applications on those devices. A more direct approach is to use a device whose sole focus is to provide access to Internet information and applications through a simple Web browser–based interface. That is the essential concept of a new class of devices developed by Google called Chromebooks — low-cost, notebook form factor computers that offer access to the vast knowledge stores of the Internet and leverage a cloud computing–based model for collaboration, online storage, and the rich application capabilities of the Web.

An important advantage of Chromebooks over traditional PCs is that because Chromebooks lack the "overhead" of legacy components found in many PCs, Chromebooks boot rapidly (in under 10 seconds) and connect immediately to the Internet. As a result, users quickly begin their productive work with Web-based tools and applications. Students and teachers benefit from the increased control of applications and content and the increased security that Chromebooks offer out of the box. With their small footprint, secure OS, and cloud (meaning Web-based) storage and management capability, Chromebooks are designed to enable IT administrators in school environments to easily provide students and faculty with the benefits of educational Internet access. In addition, Chromebooks can be maintained, managed, and updated at a lower cost and in less time than traditional PCs.

## DISCUSSION OF CHROMEBOOKS

Chromebooks are purposely built to provide a level of functionality similar to that of a typical PC — running Web applications, creating and editing documents, using email and Web browsing — through Google's Chrome browser. Chromebooks do not require traditional (and expensive) desktop productivity applications that are purchased in addition to PCs. Instead, they use the cloud computing model, where all applications — such as Google Apps for Education that offers email, calendar, documents, data, and more — are stored in the cloud and can be accessed anywhere, regardless of device.

Chromebooks use commonly available WiFi wireless networks to make their connections. They are also available, for an additional cost, with 3G radios that allow students to access the Internet over cellular broadband connections if WiFi is not available.

This simplified architecture means that Chromebooks are significantly easier to manage than traditional PCs. Operating system patches are quickly and automatically applied whenever the Chromebook is started. When Web-based applications are updated (Google Docs, for example), these software updates are often immediately and transparently available to all devices that access them, and typically for free. In addition, a Chromebook comes with standard security features, such as browser and application sandboxing and verified operating system boot to block or avoid attacks. Bringing a PC to a comparable level of security requires a significant investment in the purchase, installation, and ongoing management of aftermarket software products.

Documents and data created by Chromebook users exist primarily in the cloud. "Offline" versions of some applications can store data locally, but the preferred model relies on an Internet connection. This eliminates the need for IT administrators in educational institutions to back up (and to be prepared to restore) the Chromebooks within their schools in the event that a device is lost, broken, or stolen. Students know exactly where their data resides, and they can access their data from anywhere and at any time — whether from any Chromebook in the school or at home using any connected computing device. Students at schools that have already adopted Google Apps have their own online data storage account, and each time they use their account — regardless of whether they use a Chromebook or another device to log in — they have easy access to all their saved data, reports, or other coursework.

The net result is that the maintenance effort for Chromebooks can be significantly lower than the maintenance effort for traditional PCs, allowing educational IT administrators to focus less of their time on repetitive PC maintenance tasks and more of their time on productive work. As the next section illustrates, a standard PC-based environment requires 69% more labor to deploy the PC and set up a user than a Chromebook-based environment. A standard PC-based environment requires 92% more labor for ongoing maintenance than a Chromebook-based environment.

## Business Value

### *Study Demographics*

In the winter of 2011, IDC interviewed 12 U.S. K–12 organizations that had deployed Chromebooks. These school systems ranged in size from 135 students (for K–8) to 26,000 students and included public, private, and charter schools. The interviews were designed to elicit both quantifiable information and anecdotal experiences so that IDC could interpret the full impact of Chromebooks on the organizations. Table 1 presents the respondent demographics.

**TABLE 1**

#### Respondent Demographics

Category	Average
12 schools	
Staff	438
Faculty	267
Students	3,528
Locations (classrooms labs, etc.)	288
Campuses	5
<b>Devices</b>	
Total	2,110
Desktops	38%
Laptops	26%
Tablets	5%
Netbooks (excluding Chromebooks)	6%
Chromebooks	25%
<b>Operating System (OS)</b>	
Windows 7	37%
Windows Vista	1%
Windows XP	19%
Mac OS	14%
iOS	3%
Chrome OS	26%

Source: IDC, 2013

### ***Financial Benefits Analysis***

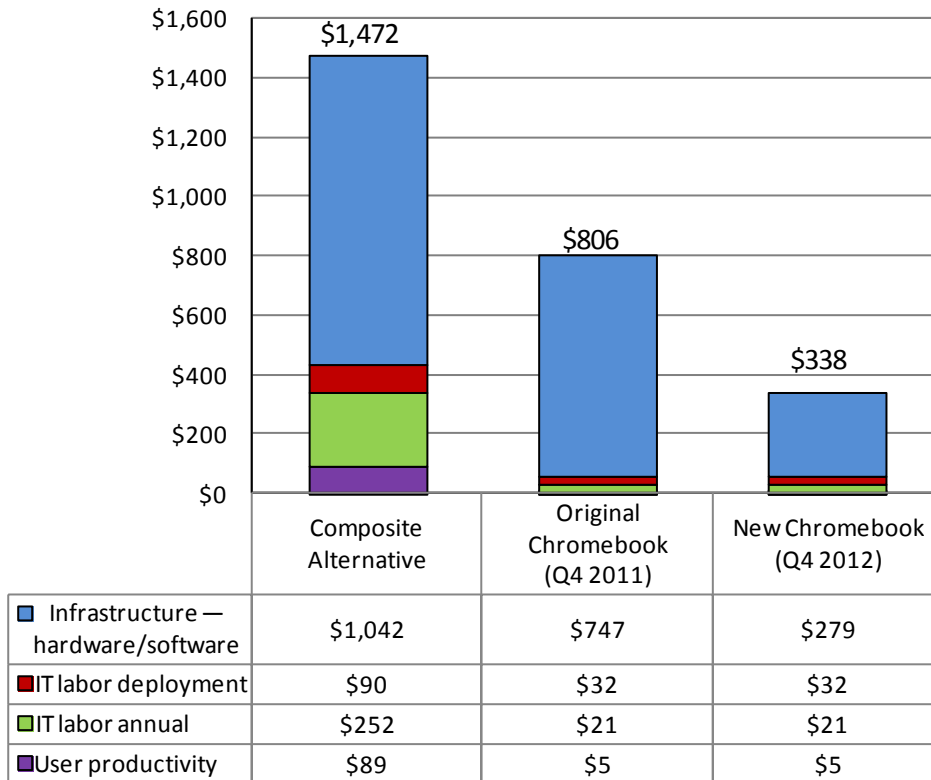
The school systems in this study had been using Google Apps on standard PCs for an average of 20 months. Many schools were evaluating the potential for Chromebooks to enable a desired migration to "one-to-one computing," in which all students have their own computing device connected to the Internet. Such one-to-one environments have proven more effective for learning than environments in which multiple students share a single device.

In aggregate, the school systems realized the following benefits from their sets of Chromebooks (see Figure 1):

- ☒ **Reduced total cost of infrastructure.** At an all-inclusive price of \$747, the original Chromebook (at the time of the interviews) cost these school systems \$295 (28%) less over three years than what the schools were spending on their alternative devices. However, the newer Chromebooks (introduced in October 2012) are priced at \$279 for the device and management console, thereby extending the Chromebook cost advantage to \$763 per device were the schools to migrate to Chromebooks today.
- ☒ **Reduced costs to deploy and manage devices.** The most noticeable benefit was that Chromebooks required 69% fewer hours to deploy and 92% fewer hours to manage, thus saving \$289 in support labor over three years.
- ☒ **Increased useful time.** Chromebooks' more reliable operation reduced time lost in the classroom due to PC downtime, help desk calls, reboots, and operating system maintenance by 94%, saving an average of \$84 per device in teacher productivity.

**FIGURE 1**

Three-Year Total Costs per System



Source: IDC, 2013

***Changing the Infrastructure Model***

Computer purchasing strategies among the school systems in the study are typical of K–12 organizations today. Most schools started with a base of desktop PC systems, each with multiple users. In recent years, schools have moved to mobile devices such as laptop PCs, tablets, and netbooks. For comparison purposes, IDC derived a weighted average that reflected the mix of alternative devices in use at the schools. This is referred to as the "composite alternative" and reflects the data in Table 1. Of the non-Chromebook devices, desktop PCs were 50.7%, laptop PCs were 34.8%, netbooks were 8.1%, and tablets were 6.4% of the total.

Regardless of the platform, though, the current infrastructure model (as shown in Figure 2) has the following elements:

**Computing Device**

- ☒ **Composite alternative:** IDC derived a weighted average device cost from the mix of desktop PCs, laptop PCs, tablets, and netbooks — \$540 (including OS license).

- ☒ **Chromebooks:** The original Chromebook in Q4 2011 cost \$747. With the launch of the new Samsung Chromebook in October 2012, the pricing dropped to \$249 for the device and Chrome OS software (included) and a one-time \$30 fee for the management console system.

**Software**

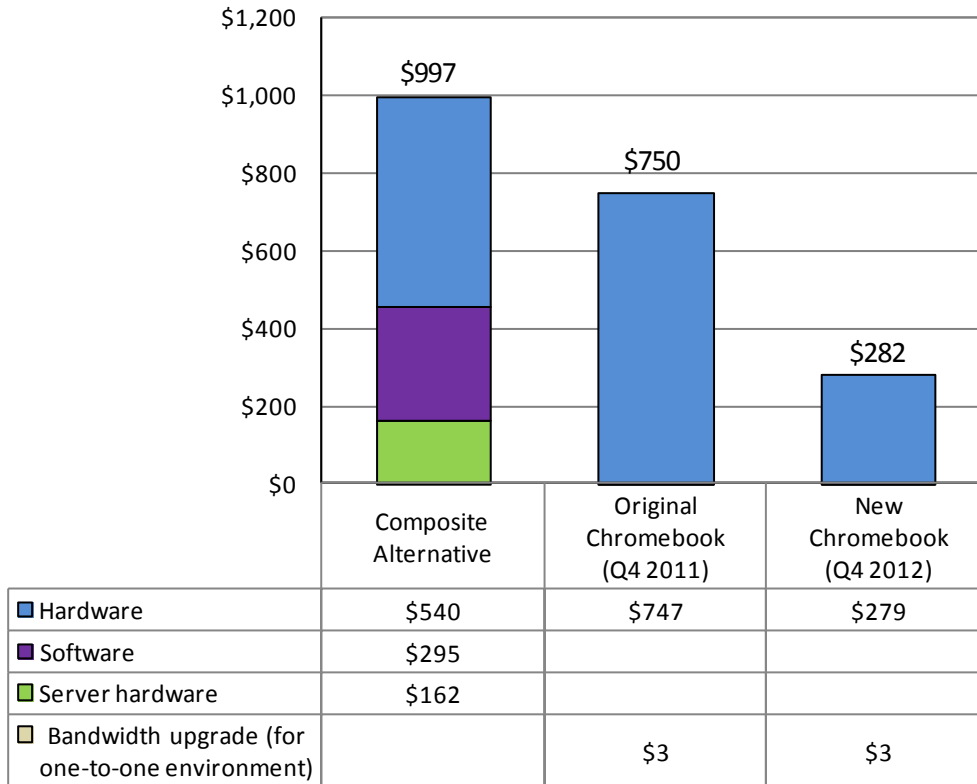
- ☒ **Composite alternative:** IDC considered the initial and annual license fees for OS, education, and productivity applications as well as antivirus — \$295.
- ☒ **Chromebooks:** Google Apps, including Gmail, Google Calendar, and Google Docs, are free to schools and available on all devices, and virus protection is built in.

**Server Hardware**

- ☒ **Composite alternative:** IDC allocated the cost to purchase servers (\$4,250) for each device using the applications (email, IM, productivity tools) running on the servers — \$162.
- ☒ **Chromebooks:** Google Apps are "cloud based" and do not require the schools to purchase servers.

**FIGURE 2**

Three-Year Infrastructure Cost



Source: IDC, 2013



The total cost for Chromebooks was 28% less than the total cost of the composite alternative. However, most schools were comparing Chromebooks with laptop PCs, and for that comparison, the advantage rose to 37%. In fact, the low cost of the Chromebook enabled one school to move to its desired one-to-one environment:

Yes, [Chromebooks are] our platform of choice for one-to-one computing. We couldn't have done it with the alternatives because of the cost and overhead. We have an evaluation going on right now. It's going fine so far; we've seen radically increased levels of student engagement.

With the new Samsung Chromebook device launched in October 2012, the three-year infrastructure cost drops to \$279 per device, 73% less than the cost of the composite alternative. As more Chromebook devices are produced by different OEMs, the price of devices is expected to drop.

### ***Transforming the Operational Cost Structure***

In our study, the schools migrated from a PC environment to Chromebooks, which required time and effort.

Some of the schools had only recently adopted Google Apps, so they conducted normal application usage testing and training in conjunction with their Chromebook deployment. Additional training associated with operating the management console was also included in this analysis.

The most significant financial impact the schools experienced with their Chromebooks was the reduction of labor costs associated with deploying and maintaining computing devices.

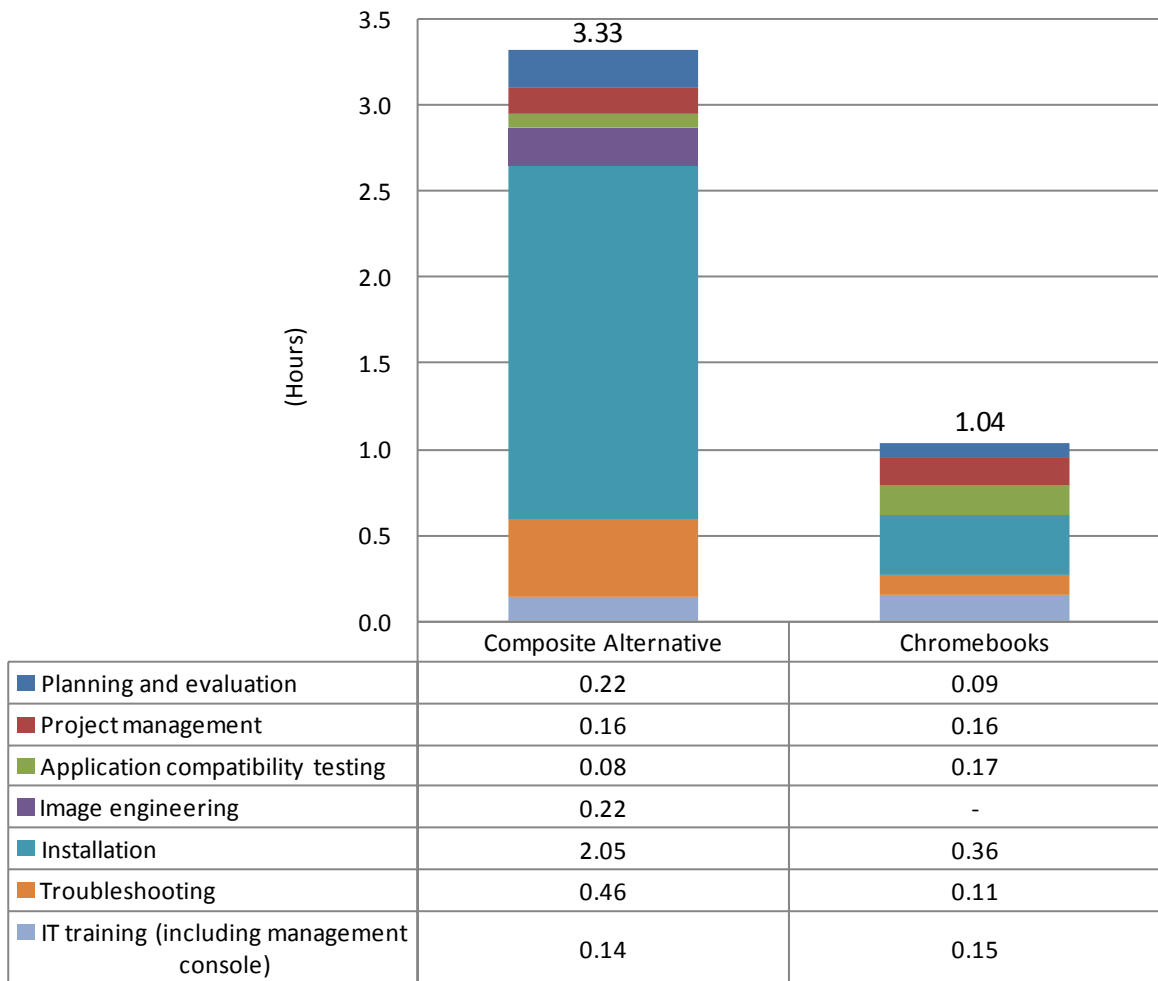
Deployment savings were driven by the nature of a cloud-based device being far less complex than that of the typical PC. This accounted for 84% of the total time saved, as the deployment staff set up each Chromebook in 30 minutes — far less than the 2.5 hours required for alternative devices.

Another major factor was the use of the Web-based management console to enable centralized configuration and deployment. Because the time and costs associated with hard disk image management were eliminated, the schools realized significant time savings in deploying and loading applications and updates. After the changeover from alternative devices, Chromebooks experienced far fewer ongoing issues, reducing device troubleshooting time by 76%.

Overall, the schools were able to reduce their deployment time by 2.29 hours (69%) per device (see Figure 3). Another way of describing the benefit is to say that these schools were able to deploy three Chromebooks with the same IT staff resources required to deploy a single alternative device.

**FIGURE 3**

IT Labor Hours per System — Deployment

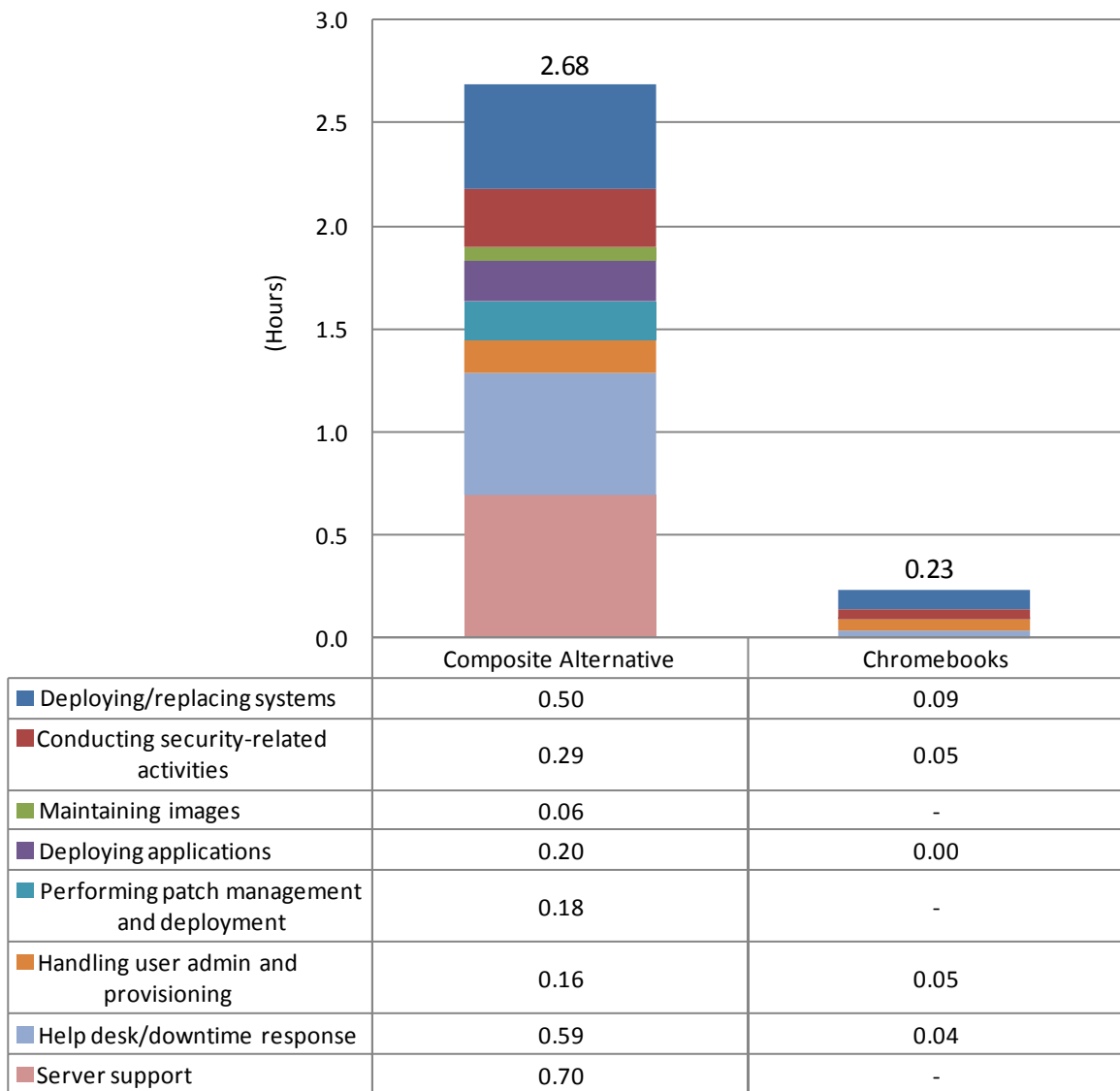


Source: IDC, 2013

Once the Chromebooks are deployed, annual operational support requirements are 2.45 hours (91%) less for each Chromebook (see Figure 4). Over half of the time savings are related to not having to manage imaging or manage and patch applications. Another 22% stems from Chromebooks' experiencing 98% less downtime and generating 78% fewer help desk utilization hours. In addition, another 26% is the result of the IT staff not having to manage and support servers with the cloud devices.

**FIGURE 4**

IT Labor Hours per System — Annual Support



Source: IDC, 2013

**Reducing the Technology Barriers to Learning**

One of the unexpected benefits that schools experienced was the reduction in the operational issues that disrupt a class using PCs, including hardware and application failures that lead to downtime where students are unable to use the affected PCs. In addition, they had to deal with various security attacks that then required reimaging devices; and the most common problem — the amount of time required to boot the device (see Table 2). Each of these problems can disrupt the flow of learning or derail the class entirely. As one of the interviewees explained:

With our classroom teachers, instructional time is paramount, obviously. The Chromebooks start up whenever we want them to, pretty much instantaneously — a matter of seconds. With our older systems, it could take anywhere between 30 to 45 seconds and 5 to 6 minutes. So it ruins the flow, and the teachers were less likely to pull them out in the middle of the class ... if they didn't start class with them. With the Chromebooks, they can pull them out and put them away at any moment.

**TABLE 2**

User Productivity KPIs

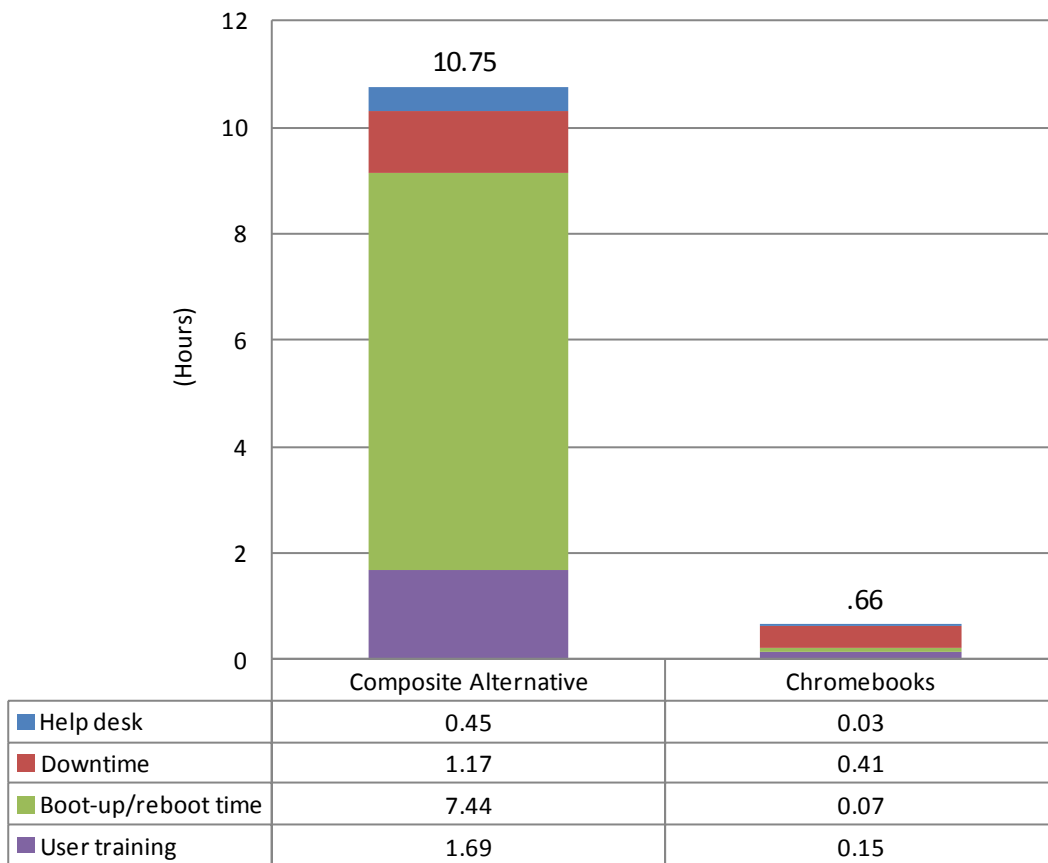
	Composite Alternative	Chromebooks	% Improvement
Percentage of clients that have a hardware failure each year	7%	2%	60%
Files that are lost due to application failures (per week)	1.58	0	100%
Reboots per week (per user)	3.15	0.37	88%
Average reboot time in minutes	3.55	0.27	92%
Number of machines that have to be reimaged due to spyware/malware	31.67	0	100%

Source: IDC, 2013

To assign a financial value to lost productivity in a K–12 organization, IDC chose to multiply the number of lost hours for faculty and administration by the average weighted salary. This value accounts for only a portion of the lost productive hours because we do not have a hard-cost value on students' time. Figure 5 shows that each user saves more than 10 hours per year, or an average of 3,000 to 3,500 total hours for each school system. We are assigning value only to the portion affecting the faculty and staff, which is an average savings of \$84 per device.

**FIGURE 5**

User Productivity Costs (Hours per User per Year)



Note: Teacher and admin systems were used to measure the value of lost productivity.

Source: IDC, 2013

***Mapping the Route to a One-to-One Environment***

Prior to the deployment of Chromebooks, the school systems in this study had a number of students sharing each PC — from as few as 1.3 students per device to as many as seven. All of the schools improved their student-to-device ratio with Chromebooks.

More than half of the schools, though, have the explicit goal of achieving a one-to-one student-to-device ratio over time, and they have selected Chromebooks as the computing platform to enable them to accomplish that goal. One of the schools has already achieved that objective:

One-on-one programs are possible now because of our Chromebooks. The kids are able to do online testing .... This allows ... a ton of kids to be able to do it at once. If we were to use PCs, we wouldn't have had the physical facilities to do that.

This year is phase 2 of our one-to-one initiative, which is ... really capacity building in our staff — the capacity of our staff to use these as instructional tools. While many districts go ahead and just buy every kid a laptop, we decided to trickle them in, to a degree, and build some lateral capacity in our staff so that when every student does have a laptop, there are some people that are real experts. So this year, all of our language arts and all of our social studies teachers at the high schools, ... a little over 60 classrooms, have classroom sets of Chromebooks, with the idea that these language and social studies teachers will become our content area experts as we ... next fall, give a Chromebook to every kid.

We chose Chromebooks to leverage the fact that they are near-zero maintenance and support on the end point. Our experience with other portable devices has been the polar opposite — increased management and overhead.

Table 3 shows the path that the average school in the study would follow to migrate from where it is today with its mixed environment to a one-to-one environment with all students using Chromebooks.

In its current state, each school has an average of 2,110 computing devices. Of these, 260 devices support the staff and faculty and run standard office and education applications. The remaining 1,850 devices (1,390 PCs plus 460 Chromebooks) are shared by the 3,500 students, meaning each device is shared by roughly two students. The average cost per student is \$826, which includes \$554 for labor and \$272 for infrastructure.

Moving to one-to-one computing would mean replacing the 1,390 student PCs with Chromebooks and adding an additional 1,650 Chromebooks so that each student has his or her own device. For value calculations, we assume those PCs are at the midpoint of their life span and therefore have a residual value of \$236. Even with the residual, the replacement with Chromebooks reduces the infrastructure costs by \$87 per student. One may add to those savings an additional \$57 per student in IT labor savings. Because of the labor and hardware savings, the average school in our study can add 1,100 Chromebooks without incurring additional costs.

A school system in the study can implement a one-to-one program, which involves moving from 1,850 student devices to 3,500 student devices, at a cost of \$46 per student for the device and reduce the costs to support the devices by \$26 per student over three years for a net cost of \$20 per student, including all infrastructure and labor costs.

**TABLE 3****Migration to a One-to-One Environment (Three-Year Costs per Student)**

	Current Environment	Add Chromebooks to One-to-One Environment
<b>Students</b>	3,500	3,500
<b>Devices</b>		
Student devices — PCs	1,390	0
Chromebooks	460	3,500
<b>Total devices</b>	<b>1,850</b>	<b>3,500</b>
Net-new devices	0	1,650
Ratio of students per device	1.89	1.00
<b>Costs</b>		
Three-year infrastructure cost per student	\$473	\$518
Three-year IT labor cost per student	\$190	\$164
Three-year cost per student	\$662	\$682
Net infrastructure cost per student		\$46
Net IT labor cost per student		-\$26
<b>Total net cost per student</b>		<b>\$20</b>

Source: IDC, 2013

## FUTURE OUTLOOK

IDC believes that the future of personal computing for many people looks similar to what Chromebooks offer today: a thin, lightweight client device that provides quick access to the Internet and the growing world of Web-based applications and services.

New learning models and techniques supported by the Internet are now available to educators, and they will be improved over time. The Web will be more important as an educational tool, and those without access to it will be left behind. Chromebooks and cloud computing are an enabling platform to access these resources.

The educational vision of one-to-one environments — all students, connected, with their own device — requires a low initial cost, low ongoing maintenance, and an easily scalable and highly manageable solution.

The Chromebook, with its Web-centric operating system, secure computing capability, simple deployment and management, Chrome browser-based applications, and cloud data storage, is one device that meets those requirements. Because it is a low-cost solution and because it places very few ongoing demands on an IT staff, the Chromebook is well positioned to be a preferred educational connected computing solution.

## **CHALLENGES/OPPORTUNITIES**

Chromebooks offer important advantages over traditional PCs, but they present several challenges to the educational K–12 environment.

Chromebooks do not run the Windows operating system, so they do not run Windows-based productivity applications. Schools with large investments in specific Windows applications will need a way to address this limitation. Fortunately, they have an option — Google offers a free virtualization solution with its Chrome Remote Desktop (RDP) application, which allows remote access to other computers that can host Windows applications remotely for access on Chromebooks. Additionally, alternative application virtualization services are available from third-party vendors.

Many applications are available as Web-based browser applications, but many proven educational applications are available only on PCs. In most instances, there are functional equivalents to important applications — such as Google Docs in place of Microsoft Office — but some specific educational products and legacy applications may not have alternatives. Here, too, though, the virtualization and DaaS services noted previously may offer acceptable options.

Chromebooks are predominantly Internet-dependent devices, so schools that lack a robust WiFi network will want to improve their network infrastructure. This may represent a (possibly significant) cost, so it should be carefully considered and tested during a Chromebook project analysis. Moreover, as with any network- or connection-dependent device, a break in service interrupts the device — whether it's a cable-connected TV for typical distance learning or a network-connected Chromebook. However, Google Apps tools like Gmail, Google Docs, and Google Calendar are cached on the system and remain accessible during network outages or when the device is offline. Google has also enabled developers of Chrome Web apps to design them to work offline by caching pages while online. Such applications include The New York Times, mySchoolNotebook.com, and MathBoard.

Finally, there is the need for sufficient Internet bandwidth. With all data stored in the cloud, every keystroke on a Chromebook can represent traffic going out to the Internet. Planning the appropriate capacity must include the likely and maximum usage patterns by students, and preparing for maximum bandwidth may involve significant ISP costs. In the same context, use of optional 3G services for connections could also result in significant costs.



## **CONCLUSION**

For the educational institutions in our study, the Chromebook is a low-cost, easy-to-manage, secure solution that allows students to take full advantage of the benefits of the Web. The Chromebook solution required 69% less labor to deploy and 92% less labor to support than the composite alternative device. The solution reduced time lost managing devices by 82%, enabling more teaching time.

Perhaps most important, the Chromebook approach gave the schools in our study a clear and achievable path to their desired one-to-one connected computing environment. One school realized its goal of "a Chromebook for every student," which it could not do with alternative devices. Many schools that we interviewed are now well on their way to achieving this goal, which was previously regarded as a hoped-for but realistically unattainable dream.

Chromebooks also delivered on the promise of increasing teacher availability. Because the solutions are highly reliable and require less in-classroom support, educators have more time to do what they love — teach their students. The connected device that was previously considered a potential time sink ("If it doesn't boot or doesn't work, we move on without it") has become a dependable and constant resource relied upon each day to enhance the learning environment.

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