A Forrester Total Economic Impact™ Study Prepared For Microsoft

The Total Economic Impact Of

Microsoft Windows MultiPoint Server 2011

In Emerging Market Countries

Project Director: Jeffrey North, Principal Consultant

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FORRESTER

Headquarters | Forrester Research, Inc.
400 Technology Square, Cambridge, MA 02139 USA
Tel: +1 617.613.6000 | Fax: +1 617.613.5000 | www.forrester.com

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Executive Summary

All over the world, ministries of education want universal access to modern computing technology for their nation's students. Government mandates for universal student access to computers, however, are seldom accompanied by all of the funds required in order to reach students with the hardware and software that are necessary to support national economic and technical achievement and competitiveness.

Windows MultiPoint Server 2011 by Microsoft puts modern computing into the hands of more students than would otherwise be affordable for many schools throughout the world, and it multiplies a teacher's ability to guide lab and classroom lesson activities with more than "over the shoulder" teaching.

Windows MultiPoint Server 2011 allows multiple students to simultaneously share one computer, with each student having his/her own independent and familiar Windows computing experience, using his/her own monitor, keyboard, and mouse. This type of solution is also known as "Shared Resource Computing." In most settings, a student-to-PC ratio of 1:1 provides maximum flexibility, mobility, and integration into the learning environment both inside and outside of school, yet that model may simply be out of reach budget-wise for many school systems and learning institutions. For schools making it a priority to provide more access, and willing or required to make trade-offs from 1:1 computing, a shared-resource solution with Windows MultiPoint Server 2011 can be a decisively cost-effective step toward extending reach. Simply stated, Windows MultiPoint Server enables schools to provide more computing for more students within the school's budget. And in many cases, it can enable schools to complement and also ramp up to a personalized 1:1 computing model for education.

The importance of the computing labs in a school in an emerging-market country is growing. No longer used just for teaching IT skills, school computer labs are becoming "dynamic learning centers," where a teacher can bring a class for specific computing-intensive sessions in academic or vocational subjects, from foreign language to science to job training. The facilities may also be used beyond school hours for community access. School officials interviewed for this study described how Windows MultiPoint Server 2011 will enable them to open more computing labs and even bring computing into more classrooms while staying on budget. For the many schools around the world at which the hardware and software in the computing lab is either old or broken, Windows MultiPoint Server 2011 can offer the opportunity to revitalize computing labs so that all students in the school will have access to computing and they can gain 21st century work skills.

In February 2011, Microsoft commissioned Forrester Consulting to examine the total economic impact and potential return on investment (ROI) that schools in emerging-market countries may realize by deploying Microsoft Windows MultiPoint Server 2011. The purpose of this study is to provide school officials, administrators, and IT decision-makers with a framework to evaluate the potential financial impact of Windows MultiPoint Server 2011 in their schools.

To understand that financial impact, Forrester conducted in-depth interviews with five learning institutions in five emerging-market countries that have started using Windows MultiPoint Server 2011. We compiled their experience and forward-looking expectations to create a composite secondary school with 500 secondary students that could be located in Africa, the Caribbean, Eastern Europe, India, or Southeast Asia. Like the schools included in the study, the composite school provides university preparatory courses in a community outside the country's capital, where resources are typically more limited. Prior to implementing Windows MultiPoint Server 2011, the school had five Windows XP machines located in their two computer labs, with a student to PC ratio of 100 to 1. The computers are

close to 10 years old and used for tech instruction only. The immediate goals of the school are to increase access to computers for its students and reduce the student to computer ratio to approximately 5 to1, to provide the up-to-date technology and to integrate technology into other areas of its curriculum. The new advances described in this study now support expanding the number of computers and extending their usage to other subjects, including the sciences, humanities, and languages.

Windows MultiPoint Server Is A Cost-Effective Catalyst For Education

The teaching and education benefits of Windows MultiPoint Server 2011, as described by the school administrators and teachers interviewed by Forrester, are the most compelling elements of this story for many readers of this study. For others, especially those in charge of budgets, the financial metrics presented here will be persuasive in their own right.

The composite school in our study can expect an ROI of 206%, a "payback" period of less than five months, and an overall cost savings of 66% compared to the alternative scenario of investing in a traditional 1:1 computing environment. This study demonstrates a cost per seat of $391 with Windows MultiPoint Server compared to $1,145 per seat in the traditional 1:1 scenario. That means that the school can extend the reach of its computing resources by almost three times, with another 207 seats, assuming a budget amount of $123,650, because Windows MultiPoint Server 20111 creates an overall savings of 66% (see Table 2 below). Note that the largest cost savings categories are hardware (62% of total savings), energy (29% of the total cost reduction) and labor (11%).

For teachers, the ability to enhance their efforts to the benefit of every student in the computing lab is more important than any financial impact. "The new features [of Windows MultiPoint Server 2011] help the teachers to do what they love: teaching, not wasting time. Teachers are able to cooperate and communicate with the students all the time, so it really helps us with everything," explained a teacher in the Czech Republic.

Our interviews with five existing education customers and subsequent financial analysis found that a composite institution based on the schools we interviewed can be expected to experience the risk-adjusted ROI, costs, and benefits shown in Table 1. See Appendix A for a description of the composite education institution.

Table 1

Composite School Three-Year Risk-Adjusted ROI[1]

ROI	Payback period	Total benefits (PV)	Total costs (PV)	Net present value
206%	< 5 months	$83,515	$27,255	$56,260

Alternatively, if we depict the financial impact in terms of a total cost of ownership (TCO) analysis, the results look this:

Table 2
Composite Organization Three-Year Total Cost of Ownership (TCO)

Category	Traditional 1:1 Environment	Windows MultiPoint Server 2011	Difference	% Saved	% Total
Hardware	$75,600	$25,475	$50,125	66%	62%
Energy cost difference	$35,640	$11,642	$23,998	67%	29%
Implementation labor & ongoing maintenance	$9,320	$42	$9,278	99%	11%
Software	$3,090	$5,057	$(1,967)	-64%	-2%
Total	$123,650	$42,216	$81,434	66%	100%
Cost per seat	$1,145	$391	$754	66%	

Source: Forrester Research, Inc.

- **Benefits.** The schools we interviewed experienced the following benefits. For the schools interviewed by Forrester, this savings translated into more computer access for more students rather than simply saving funds and bringing some budget relief. The benefits that are quantified are listed first, in order of their relative size, followed by benefits that while not quantified, were highlighted by customers as important to the learning environment and experience.
    - **Lower hardware costs** than the traditional 1:1 student-to-computer environment because one CPU can provide the computer power for up to ten students to perform different tasks simultaneously. In many cases, older hardware can be repurposed. The hardware cost savings is 66% for the composite school compared to purchasing standalone computers, or 62% of the total potential savings. .
    - **Energy cost reductions** sufficient to reallocate spending on electricity to other school needs. Direct savings result from powering fewer computers and devices, as well as reducing the need for air conditioning due to less heat build up from fewer machines. The energy cost savings is calculated to be 67% for the composite school, or 29% of the total potential savings.
    - **Lower labor and IT skill requirements** for maintaining computing resources. Windows MultiPoint Server 2011 greatly reduces the amount of labor needed to set up and maintain a high-functioning computing environment. The skill level required is significantly less than would be required to maintain as many standalone computers. School officials reported that they simply do not have the human resources needed for implementation and maintenance of so many PCs, but that fewer CPUs and a cluster of MultiPoint Server stations are easy to manage. Nearly all of the labor cost is eliminated for the composite school. Further, the level of instructor training is greatly reduced or even eliminated with Windows MultiPoint

Server 2011. Costs for labor and IT skills can be reduced by 99%, representing 11% of the overall potential savings.

- **Quieter operation** in language labs, with fewer fan-cooled CPUs running, is a benefit and removes an obstacle to learning.
- **A leap to modern technology** so that more students get a modern Windows 7 and Office 2010 experience instead of sharing older machines and operating systems. This is especially important for students in countries where they are less likely to have a computer at home.
- **Greater teacher leverage of class time** as the new management console in Windows MultiPoint Server 2011, MultiPoint Manager, enables teachers to direct and control class activity more effectively. The new ability to see desktop thumbnails, zoom in on a student's desktop, and broadcast the teacher's or a student's screen to the rest of the class, the "eyes on me" blocking feature, and application/Internet blocking tools enable the teacher to manage class computing activities while assisting individual students.

- **Costs.** The schools we interviewed experienced the following costs:
  - **Software license costs** for Windows MultiPoint Server 2011 Premium and Windows MultiPoint 2011 client access license (CAL). Microsoft offers special academic pricing and programs for emerging markets, which allows academic institutions to purchase MultiPoint Server 2011, as well as Windows 7, at significantly reduced pricing. Through the Partners in Learning program, schools in emerging markets can get inexpensive new starter editions of Windows, and then upgrade to Windows 7 for free. (See Appendix D for details)
  - **Hardware costs** that are significantly lower than the cost for a traditional computing lab / classroom.
  - **Implementation labor cost** amounting to several hours' effort to set up Windows MultiPoint Server 2011 hosts and stations in a classroom or computing lab.
  - **Energy** costs include direct costs to power the host computers as well as indirect costs such as cooling the room to offset the heat generated by the computers.

Factors Affecting Benefits And Costs

Table 1 illustrates the risk-adjusted financial results that were achieved by the composite secondary school institution. The risk-adjusted values take into account any potential uncertainty or variance that exists in estimating the costs and benefits, which produces more conservative estimates. The following factors may affect the financial results that an organization may experience:

- The computing station-to-host ratio, which can range from 5:1 to 10:1. The lower the ratio, the more full-featured host CPUs will be required per station and per student. In the study, we assume a ratio of 6:1.
- The performance required to support video and other CPU-intensive applications and activities.

- Purchasing new versus refurbished (or re-purposed) hardware for host CPUs and/or station monitors, keyboards, and mice.
- Cable or network connections.
- Battery power, power backup units and inverters required.
- Power costs in the region.
- Labor costs in the region and availability of basic-level IT skills.

Disclosures

The reader should be aware of the following:

- The study is commissioned by Microsoft and delivered by the Forrester Consulting group.
- Forrester makes no assumptions as to the potential return on investment that other organizations will receive. Forrester strongly advises that readers should use their own estimates within the framework provided in the report to determine the appropriateness of an investment in Windows MultiPoint Server 2011.
- Microsoft reviewed and provided feedback to Forrester, but Forrester maintains editorial control over the study and its findings and does not accept changes to the study that contradict Forrester's findings or obscure the meaning of the study.
- The customers for the interviews were provided by Microsoft.

TEI Framework And Methodology

Introduction

From the information provided in the interviews, Forrester has constructed a Total Economic Impact™ (TEI) framework for those organizations considering implementing Microsoft Windows MultiPoint Server 2011. The objective of the framework is to identify the cost, benefit, flexibility, and risk factors that affect the investment decision.

Approach And Methodology

Forrester took a multistep approach to evaluate the impact that Windows MultiPoint Server 2011 can have on an organization. Specifically, we:

- Interviewed Microsoft product marketing and in-country personnel to gather data relative to Windows MultiPoint Server 2011 and the marketplace and operating environments for the product.
- Interviewed five educational institutions from different emerging market countries around the world that are currently using Windows MultiPoint Server 2011 to obtain data with respect to costs, benefits, and risks.
- Designed a composite school organization based on characteristics of the schools interviewed (see Appendix A).
- Constructed a financial model representative of the interviews using the TEI methodology. The financial model is populated with the cost and benefit data obtained from the interviews as applied to the composite school.

Figure 1
TEI Approach

Source: Forrester Research, Inc.

Forrester employed four fundamental elements of TEI in modeling Windows MultiPoint Server 2011's service:

1. Costs.
2. Benefits to the entire organization.
3. Flexibility.
4. Risk.

Given the increasing sophistication that IT purchasing organizations have regarding ROI analyses related to IT investments, Forrester's TEI methodology serves the purpose of providing a complete picture of the total economic impact of purchase decisions. Please see Appendix B for additional information on the TEI methodology.

Microsoft Windows MultiPoint Server 2011: Overview

According to Microsoft, Windows MultiPoint Server 2011 is a Windows-based solution that is designed specifically to help educational institutions give every student individual access to PCs. Allowing multiple users to simultaneously share one computer — each with his or her own independent Windows experience — is a cost-effective way to get more technology into classrooms, computer labs, and libraries. Schools around the world can boost achievement and improve learning outcomes.

Comparing Windows MultiPoint Server And Windows 7

As mentioned above, with Windows MultiPoint Server 2011, each user's session is centrally hosted and since the CPU of the host PC is shared, there are trade-offs in the tasks one can accomplish compared to the full, single user-based experience powered by a rich Windows 7 client. Some examples of these tasks can include video editing, usage of CAD software, to name a few. Windows 7 features not available in Windows MultiPoint Server 2011 include:

- Aero desktop rendering features, which are a combination of cool graphics and navigation tools that enable users to move more easily between windows (snap, shake, flip).
- Windows Media Center.

See Appendix D for information about pricing options and programs for Windows MultiPoint Server and Windows 7 as well as Appendix E for more information on Windows MultiPoint Server 2011.

Analysis

Interview Highlights

A total of five interviews were conducted for this study, involving representatives from the following schools:

1. A 750-student school for information technology and business administration in Haiti. The school's entire infrastructure, including the computing facilities, is being rebuilt after the 2010 earthquake. Twenty Windows MultiPoint Server computing stations have put the school's programming computer lab back in operation. Plans are underway to expand to 300 stations.

2. A 500-student high school in the Czech Republic offering a broad curriculum of vocational, technical, and academic subjects. The school uses 20 Windows MultiPoint Server 2011 stations in several computer and language labs, with plans to expand to five computer labs in future.

3. The department of education in a Southeast Asian country, where plans have been drawn for widespread implementation of Windows MultiPoint Server 2011 to 37,000 elementary schools and 7,000 high schools.

4. An upper-secondary boarding school for girls in Rwanda that prepares students for university and sets high standards for learning in technology and sciences. Instead of purchasing 36 standalone PCs, this newly-founded private academy uses 36 Windows MultiPoint Server 2011 stations in the first of its computing labs (several more are planned).

5. A post-secondary college in India with 800 students who are working toward bachelor and postgraduate degrees in engineering and business administration. The institution has deployed 150 Windows MultiPoint Server 2011 stations in two large computing labs.

These five interviews with school officials in as many countries uncovered a number of important points common to schools that implement Windows MultiPoint Server 2011:

- Teachers and students report that using a Windows MultiPoint Server 2011 station is as good, in terms of speed and performance, as if they were working on a traditional personal computer.
- Overall student energy and enthusiasm is boosted when more students have a modern computing station to work on, instead of sharing an older machine and dated operating system amongst their classmates or having no computer access in the classroom at all.
- Teachers very much appreciate the administration and monitoring capabilities of the new MultiPoint Manager, with which they can direct and control class and individual students' lessons more effectively. The console is reported to be easy to learn, even for non-English speaking and non-technical instructors.
- A Windows MultiPoint Server 2011 system is relatively easy to set up and deploy, according to interviewees. This is especially valuable for schools in remote areas where IT skills are scarce.
- Power cost reductions are important in the many areas of the world where electricity is a large line item in the school's budget — assuming it is available.
- The overall cost savings compared to a traditional PC environment is substantial and analyses of these costs comprise the bulk of this study. All schools reported being able to re-allocate these savings to other assets for enhancing the education of their students.

Composite School

Based on the interviews with the five educational institutions provided by Microsoft, Forrester constructed a TEI framework, a composite school, and an associated ROI analysis that illustrates the areas financially affected. The composite school that Forrester synthesized from these results represents a secondary school that provides university preparatory courses, including information technology classes, for 500 students, located in Africa, the Caribbean, Eastern Europe, or Southeast Asia. Located outside the country's capital, where resources are typically more limited, many of the school's teachers are not highly digitally literate.[2]

IT support is handled by a computer science teacher or other tech savvy instructor or even several students, and occasionally by a small local IT vendor. Prior to implementing Windows MultiPoint Server 2011, the school had five Windows XP machines located in one computer lab. There were no computers in the language lab. Students do not have computers or internet access at home, but they can visit an Internet café. Although students might not have a PC at home, they know what Windows 7 is and they are eager to use it and to gain 21st-century computing skills. Many of these schools aspire to have a 1:1 computing environment but that amount of equipment is cost-prohibitive for them to pursue at this time. Further, electricity to run more computers is expensive and often unreliable, so energy efficiency is an important consideration. Yet the need to meet school, community and government aspirations for improving overall economic development and workforce readiness of students is vital. See Appendix A for a complete description of the composite school.

Framework Assumptions

The discount rate used in the PV and NPV calculations is 10%, and the time horizon used for the financial modeling is three years. Organizations typically use discount rates between 8% and 16% based on their current environment. Readers are urged to consult with their respective company's finance department to determine the most appropriate discount rate to use within their own organizations. Other assumptions include:

- A labor rate of $2.33 per hour or 400 per month.
- School operating 250 days per year.
- An electricity cost of $.33 per KWh.
- Standard educational software license pricing without discounts
- The composite school will deploy 36 Windows MultiPoint Server 2011 stations *per year*, or three labs of 18 stations each, which require three host computers or a station-to-host ratio of 6:1. By the end of Year 3 the student-to-computer ratio will reach the target of 5:1 (eight of the stations will be teacher workstations, and the remaining 100 will be used by students).

Costs

The cost assumptions associated with the deployment and management of Windows MultiPoint Server 2011 for the composite school are based on aggregated findings from the institutions interviewed in the TEI study. The following cost model can serve as a framework for other organizations; however, each organization's costs will vary according to the school's situation, including lab size, station-to-host ratio, the desired station-to-student ratio, performance requirements, cabling versus network connection, new versus refurbished equipment, or older terminal equipment, and technical knowledge of a few staff.

Software Licenses

Software licenses for this Windows MultiPoint Server 2011 implementation include Windows MultiPoint Server 2011 Premium licenses for each host computer and Windows MultiPoint 2011 CAL for each station. In this instance we assume three hosts per lab of 18 stations, or a 1:6 host-to-station ratio, and adding 36 more lab and classroom stations in Years 2 and 3, respectively. The total cost at the end of Year 3 will be just over $5,200.

Table 3
Software License Costs

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Total
A1	Windows MultiPoint Server 2011 Premium	Per host	$115.00	$115.00	$115.00	
A2	Windows MultiPoint 2011 CAL	Per station	$29.00	$29.00	$29.00	
A3	Number of hosts		6	6	6	
A4	Number of stations		36	36	36	
At	Software license costs	(A1*A3)+(A2*A4)	$1,734	$1,734	$1,734	$5,202

Source: Forrester Research, Inc.

Host CPU Hardware Costs

A Windows MultiPoint Server system consists of a host PC, the stations that will access the host, and the connectivity between each station and the host PC[3]. Windows MultiPoint Server 2011 stations are controlled by host computers, which are fully functional CPUs. In an implementation like the one featured in this study, the host CPUs need to have sufficient performance to power the stations while handling light to moderate multimedia requirements as well as productivity software and educational applications. The six units purchased each year will be quad-core CPUs with 4GB of RAM at a cost of $700 each or $12,600 over three years.[4]

Table 4
Host Computer Cost

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Total
B1	Hardware cost - hosts		$700	$700	$700	
B2	Number of units		6	6	6	
Bt	Host PC cost	B1*B2	$4,200	$4,200	$4,200	$12,600

Source: Forrester Research, Inc.

Station Hardware Costs

A Windows MultiPoint Server 2011 station consists of a video monitor, keyboard, mouse and a USB or multifunction station hub. It may also include headphones, speakers, and storage devices. It is also possible to reuse older PC hardware as stations. For the composite school, assume that the station hardware is newly acquired (except for 5 older PCs that will be re-purposed as stations), possibly with educational pricing, and the cost for the 103 stations at the end of three years totals $12,875 as shown in the table below.

Table 5
Station Hardware Cost

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Total
C1	Hardware cost per station: monitor, USB hub, keyboard, mouse		$125	$125	$125	
C2	Number of units (added)		31	36	36	103
Ct	Station hardware cost	C1*C2	$3,875	$4,500	$4,500	$12,875

Source: Forrester Research, Inc.

Implementation Labor Costs

The school staff interviewed for this study, several of whom set up and installed their school's Windows MultiPoint Server 2011 environment, described the effort involved as relatively easy and quick to complete. "I am the IT guy," explained a teacher in the Czech Republic. "For our language lab, it took me 2 hours for the first deployment. I can prep a (host) server in 20 minutes. Unpack, plug, play, so it takes 3 to 4 hours for a permanent lab, but we can deploy a [temporary] computer lab in any class in 1 hour." And in Haiti, student interns managing the computer labs set up and maintain the Windows MultiPoint Server 2011 system, giving them more practical experience beside their programming studies.

The table below indicates that labor cost for implementation is modest, given the small time requirements and an hourly wage rate equivalent to a salary of $400 per month.

Table 6
Implementation Labor Costs

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Total
E1	Number of staff		1	1	1	
E2	Hourly rate		$2.33	$2.33	$2.33	

E3	Hours		6.0	6.0	6.0	
Et	Implementation labor costs	E1*E2*E3	$14.00	$14.00	$14.00	$42.00

Source: Forrester Research, Inc.

Total Costs

Total costs for this implementation and rollout of Windows MultiPoint Server 2011 are shown in the table below.

Table 7
Total Costs

Costs	Year 1	Year 2	Year 3	Total
Software license costs	$1,589	$1,734	$1,734	$5,057
Host PC cost	4,200	4,200	4,200	12,600
Station hardware costs	3,875	4,500	4,500	12,875
Implementation labor costs	14	14	14	42
Total	$9,678	$10,448	$10,448	$30,574

Source: Forrester Research, Inc.

Benefits

We are saving 55% for initial hardware costs and 60% for software licenses and 40% for energy by using 60 or 70% of the computing power instead of 10%. And we get closer to a student-to -computing power ratio of 1:1.

Ministry of Education Official

In interviews with Microsoft education customers, Forrester identified the following key benefits of investing in Windows MultiPoint Server: 1) avoiding the cost of acquiring full-function machines; 2) extending the life of some older hardware; 3) labor cost savings compared to the cost of maintaining as many standalone computers; and 4) cost reductions in energy required to power the machines in computer labs and classrooms. These are the financial, quantified benefits that will be of interest to administrators and officials who allocate financial resources for a school. Teachers, students, parents and the community may focus more on the increased access to modern computing tools, and the benefits that accrue for students and the community when a school can offer more computing resources. The financial benefits support and enable the most important value of Windows MultiPoint Server 2011, which is to put computers in front of more students and enable their studies in technical subjects as well as humanities to ultimately prepare them to improve living standards for themselves and their families and to be stronger community contributors.

Direct Cost Avoidance – Hardware

The main financial benefit described by each school interviewed for this study is the ability to bring computing to more students, at lower cost, or even at all. Each school interviewed by Forrester examined the feasibility of implementing Windows MultiPoint Server 2011 against the alternative of acquiring standalone personal computers for computing labs and classrooms. The cost for all these schools to invest in that way would be daunting. If such an investment would even be possible, it certainly would mean using resources that would otherwise be directed elsewhere in the school. Instead, by setting up a computing labs with Windows MultiPoint Server 2011, each of six CPUs will support six students (in this scenario; the maximum is 10) doing different tasks simultaneously, using their own keyboard, mouse and monitor. As one teacher explained, "It is about spending the money on the students not on the machines."

Avoiding the cost to acquire 36 individual computers per year equates to a benefit of more than $75,000 over three years. The hardware cost savings amounts to 62% of the total amount saved in this implementation of Windows MultiPoint Server 2011 compared to an investment in traditional 1:1 computing.

Table 8

Direct Cost Avoided – New PCs

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Total
F1	Number of PCs avoided		36	36	36	
F2	Cost per PC		$700	$700	$700	
Ft	Direct cost avoidance - traditional PC environment	F1*F2	$25,200	$25,200	$25,200	$75,600

Source: Forrester Research, Inc.

Another benefit calculation that is just outside the window of this analysis is the subsequent cost, in this case an avoided cost, of having to refresh the inventory of computers on a three-year cycle. The equipment in Windows MultiPoint Server 2011 stations does not require refresh nearly as frequently. For some schools, the longer "desk life" of the equipment may make getting spending approval easier.

Other Costs: – Software for 1:1 Computing

In our composite school scenario, if standalone computers are used, the school would need to upgrade each of the 36 PCs in each lab to Windows7. The school can take advantage of low cost academic pricing under the Partners in Learning program to upgrade its existing Windows machines for free. For the 103 new computers required, the school would acquire the Windows7 licenses along with the new PCs from the manufacturer. In emerging markets, schools could acquire the most basic version of Windows available, Windows Starter Edition, pre-installed on the new computers for approximately $30 per machine. Then it would be entitled, under the Partners in Learning program, to upgrade these new machines to Windows7 Pro for free as well. The total cost for licensing Windows7 for the 108

machines would be $3,090 over three years. See the Appendix D for more information on Window7 pricing programs in emerging markets.

MultiPoint Manager provides some classroom/lab station monitoring and communication functionality, and therefore some schools could also avoid the costs of other classroom management applications, although we have not included that category of avoided software cost in this analysis. Schools that choose to have a complete classroom management solution may choose to include this solution to enhance the out-of the box classroom monitoring features in Windows MultiPoint Server 2011 .

Table 9
Other Costs – Operating System for 1:1 Computing

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Total
G1	Win 7 licenses (upgrade Win XP)	$0 per seat: 5	0	0	0	0
G2	Win 7 licenses (new)	$30 per seat: 31, 36, 36	$930	$1,080	$1,080	$3,090
Gt	Direct cost avoidance - other software	G1*G2	$930	$1,080	$1,080	$3,090

Source: Forrester Research, Inc.

Lower Labor Costs

Forrester gathered insight into the amount of labor a school requires for managing and maintaining standalone PCs — a cost that is reclaimed when the school uses Windows MultiPoint Server 2011 and the maintenance burden is very much less. In Haiti, before the school's 180 computers were destroyed in an earthquake, staff and student interns spent time fixing viruses, patching and upgrading software, and troubleshooting/fixing tasks. With Windows MultiPoint Server 2011, most of those tasks are eliminated when there is one host computer powering numerous computing stations. Forrester's estimate of time savings, shown in the table below, calculates to over $9,000 over three years. More importantly for schools that do not have access to more than the most basic IT skills, they can be more assured of computing uptime for entire classrooms instead of being plagued by several machines per class or lab that need fixing, and the resulting loss to the students.

Table 10
Reduction In PC Maintenance Labor Cost

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Total
H1	Number of hours saved / day		3	5	8	
H2	Days		250	250	250	

H3	Hourly rate		2.33	2.33	2.33	
Ht	Reduction in PC maintenance labor cost	H1*H2*H3	$1,748	$2,913	$4,660	$9,320

Source: Forrester Research, Inc.

Energy Cost Savings

Saving on energy costs is one of the main reasons why schools interviewed for this study invested in Windows MultiPoint Server 2011. In many parts of the world, electricity is a large item in the school's budget. Reducing this cost is a major win. And power availability may be unreliable, necessitating battery or generator backup. Not included in these calculations is any electricity savings resulting from lower air conditioning requirements, given fewer heat-emitting CPUs running in labs and classrooms.

The calculations for grid-supplied electricity cost savings for the composite school of $24,000 are shown below. Note that power costs vary greatly by country so users of this study should determine their local rates per kWh.

Additionally, with Windows MultiPoint Server 2011 schools will see reduced requirements for backup power supplies, power conditioners and inverters, batteries and in some cases diesel fuel for generators. In Haiti, for example, a different power calculation than the one shown here estimates that that school can now run its computer labs for 7 or 8 hours on battery power. With standalone computers (used before the earthquake) that run time was 2 hours, so they now see a three- or four-fold improvement. And diesel fuel consumption has been cut by 70% saving the school about $63,000 per year.

Table 11
Energy Cost Savings

Ref.	Metric	Calculation	Year 1	Year 2	Year 3	Total
I1	Number of PCs avoided		36	72	108	
I2	kWh avoided	x 250 watts x 8 hrs	72.0	144.0	216.0	
I3	Number of Windows MultiPoint Server stations		36	72	108	
I4	kWh required	x 65 watts x 8 hrs	18.72	37.44	56.16	
I5	Number of host computers		6	12	18	
I6	kWh required	x 200 watts x 8 hrs	9.6	19.2	28.8	
I7	**Savings per day - kWh**	**I2 - (I4+I6)**	**43.7**	**87.4**	**159.8**	
I8	Days per year		250	250	250	

I9	Power cost per kWh		$0.330	$0.330	$0.330	
It	Energy cost reduction / avoidance		$3,604	$7,207	$13,187	$23,998

Source: Forrester Research, Inc.

Total Quantified Benefits

Table 12 summarizes the quantified benefits described above.

Table 12
Total Benefits

Benefits	Year 1	Year 2	Year 3	Total
Direct cost avoidance - traditional PC environment	$25,200	$25,200	$25,200	$75,600
Direct cost avoidance - other software	$930	$1,080	$1,080	$3.090
Reduction in PC maintenance labor cost	$1,748	$2,913	$4,660	$9,320
Energy cost reduction / avoidance	$3,604	$7,207	$13,187	$23,998
Total	$31,481	$36,400	$44,127	$112,008

Source: Forrester Research, Inc.

Beyond Financial Benefits – More Computing Catalyzes Education

Teachers are reportedly very happy with the functionality in MultiPoint Manager. "It's the first application they open after they log in," noted one interviewee. "They can see the thumbnails [of each station], lock screens, block Internet access, and "push" examples and instructions to students at each station simultaneously. Non-technical and non-English speaking teachers are able to learn to use the console very quickly. The result is more teacher-student interaction, guidance and structure via the classroom network.

With more computing for more students, the education process improves in a variety of ways. For example, in the Czech Republic we learned, not surprisingly, that students can find vocabulary much faster with an online dictionary than they could when they had only paper dictionaries. Yet we also learned that students who might have been too shy to ask for a spoken sentence to be repeated from the CD-based language program (they would have to ask the teacher to play it again) can repeat a word or phrase as much as they wish when each student has a computing station and headphones.

Some of the benefits generated by a Windows MultiPoint Server 2011-supported environment are very significant even if they were not anticipated. "Some of our students had to leave school because of [unrest or natural disaster]. Now we hear that those students are more eager to return to schools because the schools have computers, where before many had none," noted one education official. "It used to be that students got exposed to IT outside of the schools, if at all. Some say students are aggressively attending schools [to get computer skills and experience]. We did not anticipate [this result from Windows MultiPoint Server]."

All of the schools interviewed for this study are in the early stages of deployment of WMS 2011, (yet some of them had implemented WMS 2010). We can expect other examples like these to arise when more students are able to use and benefit from personal experience with modern computing tools.

Flexibility

Flexibility, as defined by the TEI methodology, represents an investment in additional capacity or capability that could be turned into financial — or scholastic — benefit given a future additional investment. This provides an organization with the "right" or the ability to engage in future initiatives but not the obligation to do so. There are multiple scenarios in which a school might choose to implement Windows MultiPoint Server 2011 and later realize additional uses and educational opportunities or financial value.

These real options have been described to Forrester by study participants who outlined possible new routes on their technology road maps and some likely directions and next steps for their schools. Although data for calculating the value of these flexibility options was insufficient when this study was conducted, especially at an early stage of deploying the product, our interviews identified several areas that will produce flexibility options based on next-stage real options that have been described by study participants:

More Stations For More Students

Funds saved by avoiding a traditional 1:1 computing environment can be used for more computer stations and additional labs or for other teaching equipment like a data projector or an electronic whiteboard system. And as ease of initial Windows MultiPoint Server deployment and technical efficacy are demonstrated to school officials, these schools can deploy more Windows MultiPoint Server solutions to any classroom quickly. Officials can expect generally higher stakeholder support for IT investments as a result of Windows MultiPoint Server successes. And possible reuse of old computers as dumb, managed terminals can spread funds and computing power even farther.

Alternative Energy

A Windows MultiPoint Server computing environment uses a lot less electricity than a conventional classroom or lab configuration. Reducing the power footprint presents an opportunity for taking the system off the grid and power with an alternative source such as solar power, for some or all of the electricity to supply stations and hosts. With traditional computing, the solar infrastructure required is more likely to be out of reach financially and in terms of the space requirements. In Haiti, solar power would have required 700 solar panels and an investment of $1.5 million. Those requirements are now less than half with the energy savings from the adoption of Windows MultiPoint Server 2011.

Community Development

Forrester learned of new opportunities and development that can occur as the result of the spread of IT knowledge and use of computing. For example, the opportunity to use a school's computing lab as an after-hours community technology access center has been discussed at some schools in Africa. Spillover effects in the community could help spread learning in agricultural information, for example, or provide the means to sell products or handicrafts to distant markets.

Instructor And Administrator Productivity

Especially when a school becomes more networked, teachers can save administration time on clerical tasks, like recording grades and making and storing student evaluations. In the Southeast Asian school system that participated in this study, plans anticipate that teachers can save 400 to 500 hours per teacher per year, or about 20% of their time, by networking their computer to the output from students' work at the stations and then to central school databases

Risk

Forrester defines two types of risk associated with this analysis: implementation risk and impact risk. Implementation risk is the risk that a proposed investment in Windows MultiPoint Server 2011 may deviate from the original or expected requirements, resulting in higher costs than anticipated. Impact risk refers to the risk that the business or technology needs of the organization may not be met by the investment in Windows MultiPoint Server, resulting in lower overall total benefits. The greater the uncertainty, the wider the potential range of outcomes for cost and benefit estimates.

Quantitatively capturing investment and impact risk by directly adjusting the financial estimates results in more meaningful and credible estimates and a more accurate projection of the ROI. In general, risks affect costs by raising the original estimates, and risks affect benefits by reducing the original estimates. The risk-adjusted numbers should be taken as "realistic" expectations since they represent the conservative, pressure-tested expected values.

The following implementation risks that affect costs are identified as part of this analysis:

- Implementation labor costs could be higher than those modeled here.
- Hardware costs could increase due to local price increases.

Note that school officials interviewed for this study expressed no significant concerns around implementation risks.

The following impact risks that affect benefits are identified as part of this analysis:

- Labor cost savings might not materialize, or more labor and IT expertise could be required in the face of technical challenges
- Energy cost savings could be less than forecast.

Some school proponents of Windows MultiPoint Server spoke of the perceived risk of using a new technology, for many the first trial users in their countries or regions. "There was the risk of doing this for schools for the first time in

the country," noted one senior administrator. This official explained that disbelievers needed convincing by way of a proof-of-concept and that a lot of care was required in the initial deployment to satisfy them.

Table 13 shows the values used to adjust for risk and uncertainty in the cost and benefit estimates. The TEI model uses a triangular distribution method to calculate risk-adjusted values. To construct the distribution, it is necessary to first estimate the low, most likely, and high values that could occur within the current environment. The risk-adjusted value is the mean of the distribution of those points. Readers are urged to apply their own risk ranges based on their own degree of confidence in the cost and benefit estimates.

Table 13
Cost And Benefit Risk Adjustment Factors

Costs	Low	Most likely	High	Mean
Software license costs	100%	100%	100%	100%
Host PC costs	100%	100%	115%	105%
Station hardware costs	100%	100%	115%	105%
Implementation labor costs	100%	100%	125%	108%
Benefits	**Low**	**Most likely**	**High**	**Mean**
Direct cost avoidance - traditional PC environment	80%	100%	103%	94%
Direct cost avoidance - other software	90%	100%	105%	98%
Reduction in PC maintenance labor cost	50%	100%	100%	83%
Energy cost reduction/avoidance	50%	100%	100%	83%

Source: Forrester Research, Inc.

Financial Summary

The financial results calculated in the Costs and Benefits sections can be used to determine the return on investment (ROI), net present value (NPV), and payback period for the organization's investment in Windows MultiPoint Server 2011. These are shown in Table 14 below.

Table 14
Cash Flow – Non-Risk-Adjusted

	Initial	Year 1	Year 2	Year 3	Total	Present value
Costs	($9,678)		($10,448)	($10,448)	($30,574)	($26,162)
Benefits		$31,481	$36,400	$44,127	$112,008	$91,855
Net benefits	($9,678)	$31,481	$25,952	$33,679	$81,434	$65,692
ROI	251%					
Payback period	< 4 months					

Source: Forrester Research, Inc.

Table 15 below shows the risk-adjusted ROI, NPV, and payback period values. These values are determined by applying the risk-adjustment values from Table 14 in the Risk section to the cost and benefits numbers in Tables 7 and 12.

Table 15
Cash Flow – Risk-Adjusted

	Initial	Year 1	Year 2	Year 3	Total	Present value
Costs	($10,083)		($10,884)	($10,884)	($31,851)	($27,255)
Benefits		$29,041	$33,146	$39,559	$101,746	$83,515
Net benefits	($10,083)	$29,041	$22,262	$28,675	$69,895	$56,260
ROI	206%					
Payback period	< 5 months					

Source: Forrester Research, Inc.

Appendix A: Composite School Description

For this TEI study, Forrester has created a composite education organization to illustrate the quantifiable costs and benefits of implementing Windows MultiPoint Server 2011. Based on the interviews with five existing Windows MultiPoint Server education-sector customers, the composite institution is a secondary school that provides university preparatory courses, including information technology, to 500 students, and has the following characteristics:

Organization Size And Dimensions

- 500 secondary school students.
- Location: Africa, the Caribbean, Eastern Europe, or Southeast Asia. School is located outside of country's capital or primary city.
- Windows MultiPoint Server installed in two computer labs initially, one for language/humanities studies and the other for IT classes. Expanding deployment over three-year financial time span.
- Teachers not digitally literate.
- Small/remote IT staff, often outsourced to local small company.
- Limited existing hardware and no network.
- Expensive/unreliable electricity — may need generators/solar.
- Internet is expensive and bandwidth is limited.
- May be space-constrained (split screen).
- Students do not have Internet access at home but may go to an Internet café.
- Even though students do not have a Win7 PC at home, they know what it is, and they want the latest for 21st century skills.

Environment Prior To Windows MultiPoint Server Deployment

- No computer stations in the language lab. The IT lab required students to share five older PCs running Windows XP.
- Plans to expand the number of computers to approach a 1:1 environment are cost-prohibitive.

Reasons For Investment In Windows MultiPoint Server

- To provide more students with access to a computing station at lower cost compared to 1:1 computing solutions and with lower IT administration/maintenance requirements.
- To reduce the amount of energy required to power the computer labs.
- For language labs, to reduce the amount of noise created by as many PCs in a 1:1 environment.

- Government (provincial or national) concern with improving overall economic development and workforce readiness of its students. Drive to provide students with 21st-century skills and prepare them to be able to participate in the global workforce.

Benefit Categories

- Substantial cost savings compared to an all-standalone PC environment seeing a 1:1 student-PC ratio.
- For many schools such a solution is out of reach, so more students have access to computing stations.
- Energy cost savings and carbon emissions reduction.

Improving experience for teachers and students

- The student experience and the teaching process are greatly enhanced; teachers have more tools to guide the class and individual students.
- Students demonstrate renewed interest when curriculum includes the use of computers.
- Teachers can save many hours per year in administrative work.

Simpler IT administration and management

- Reduced IT administration and maintenance for virus protection, patching, break/fix, etc., which is especially valuable in areas where IT skills are not abundant.
- Increased flexibility in deployment — for example, possible re-use of old hardware.

Cost Categories

- Software, licenses.
- Hardware.
- Energy
- Internal labor.

Flexibility Categories

- Funds can be used for more computer stations and additional labs or for other teaching facilities like a data projector/electronic whiteboard system.
- Ease of initial Windows MultiPoint Server deployment validates that schools can deploy more Windows MultiPoint Server solutions to any classroom quickly, at lower cost.
- Opportunity to use solar power for some or all of the needed electricity.
- Spread knowledge and use of Windows MultiPoint Server to other schools and nearby communities.

- Generally higher stakeholder support for information technology investments as a result of Windows MultiPoint Server successes.
- Re-use of old computers as dumb, managed terminals.
- Opportunity to take advantage of upcoming low-cost client technologies like RemoteFX thin clients or network monitors.
- Opportunity to use labs as after-hours community technology access centers.

Appendix B: Total Economic Impact™ Overview

Total Economic Impact is a methodology developed by Forrester Research that enhances a company's technology decision-making processes and assists vendors in communicating the value proposition of their products and services to clients. The TEI methodology helps companies demonstrate, justify, and realize the tangible value of IT initiatives to both senior management and other key business stakeholders. The TEI methodology consists of four components to evaluate investment value: benefits, costs, risks, and flexibility.

Benefits

Benefits represent the value delivered to the user organization — IT and/or business units — by the proposed product or project. Often product or project justification exercises focus just on IT cost and cost reduction, leaving little room to analyze the effect of the technology on the entire organization. The TEI methodology and the resulting financial model place equal weight on the measure of benefits and the measure of costs, allowing for a full examination of the effect of the technology on the entire organization. Calculation of benefit estimates involves a clear dialogue with the user organization to understand the specific value that is created. In addition, Forrester also requires that there be a clear line of accountability established between the measurement and justification of benefit estimates after the project has been completed. This ensures that benefit estimates tie back directly to the bottom line.

Costs

Costs represent the investment necessary to capture the value, or benefits, of the proposed project. IT or the business units may incur costs in the form of fully burdened labor, subcontractors, or materials. Costs consider all the investments and expenses necessary to deliver the proposed value. In addition, the cost category within TEI captures any incremental costs over the existing environment for ongoing costs associated with the solution. All costs must be tied to the benefits that are created.

Risk

Risk measures the uncertainty of benefit and cost estimates contained within the investment. Uncertainty is measured in two ways: 1) the likelihood that the cost and benefit estimates will meet the original projections, and 2) the likelihood that the estimates will be measured and tracked over time. TEI applies a probability density function known as "triangular distribution" to the values entered. At minimum, three values are calculated to estimate the underlying range around each cost and benefit.

Flexibility

Within the TEI methodology, direct benefits represent one part of the investment value. While direct benefits can typically be the primary way to justify a project, Forrester believes that organizations should be able to measure the strategic value of an investment. Flexibility represents the value that can be obtained for some future additional investment building on top of the initial investment already made. For instance, an investment in a school wide upgrade of an office productivity suite can potentially increase standardization (to increase efficiency) and reduce licensing costs. However, an embedded collaboration feature may translate to greater worker productivity if activated. The collaboration can only be used with additional investment in training at some future point in time. However, having the ability to capture that benefit has a present value that can be estimated. The flexibility component of TEI captures that value.

Appendix C: Glossary

Discount rate: The interest rate used in cash flow analysis to take into account the time value of money. Although the Federal Reserve Bank sets a discount rate, companies often set a discount rate based on their business and investment environment. Forrester assumes a yearly discount rate of 10% for this analysis. Organizations typically use discount rates between 8% and 16% based on their current environment. Readers are urged to consult their respective organization to determine the most appropriate discount rate to use in their own environment.

Net present value (NPV): The present or current value of (discounted) future net cash flows given an interest rate (the discount rate). A positive project NPV normally indicates that the investment should be made, unless other projects have higher NPVs.

Present value (PV): The present or current value of (discounted) cost and benefit estimates given at an interest rate (the discount rate). The PV of costs and benefits feed into the total net present value of cash flows.

Payback period: The breakeven point for an investment. The point in time at which net benefits (benefits minus costs) equal initial investment or cost.

Return on investment (ROI): A measure of a project's expected return in percentage terms. ROI is calculated by dividing net benefits (benefits minus costs) by costs.

A Note On Cash Flow Tables

The following is a note on the cash flow tables used in this study (see the example table below). The initial investment column contains costs incurred at "time 0" or at the beginning of Year 1. Those costs are not discounted. All other cash flows in Years 1 through 3 are discounted using the discount rate (shown in Framework Assumptions section) at the end of the year. Present value (PV) calculations are calculated for each total cost and benefit estimate. Net present value (NPV) calculations are not calculated until the summary tables and are the sum of the initial investment and the discounted cash flows in each year.

Table [Example]
Example Table

Ref.	Category	Calculation	Initial cost	Year 1	Year 2	Year 3	Total

Appendix D: Microsoft Programs for Education and Emerging Markets

Microsoft offers several special programs for Academic organizations. Information on the full programs are available on Microsoft's education website http://www.microsoft.com/education/default.mspx.

Programs relevant to the topics in this paper are described below:

Partners in Learning

Microsoft Partners in Learning is a 10-year, nearly $500M global initiative aimed at improving teaching and learning experiences through ICT with the aim of helping students realize their greatest potential. In the last seven years, the program has trained more than 7 million teachers and reached more than 170 million students in 112 countries. Microsoft is deeply committed to helping teachers and school leaders use technology appropriately to achieve powerful results in every classroom by partnering with governments, academic institutions and NGOs to achieve both local and global impact.

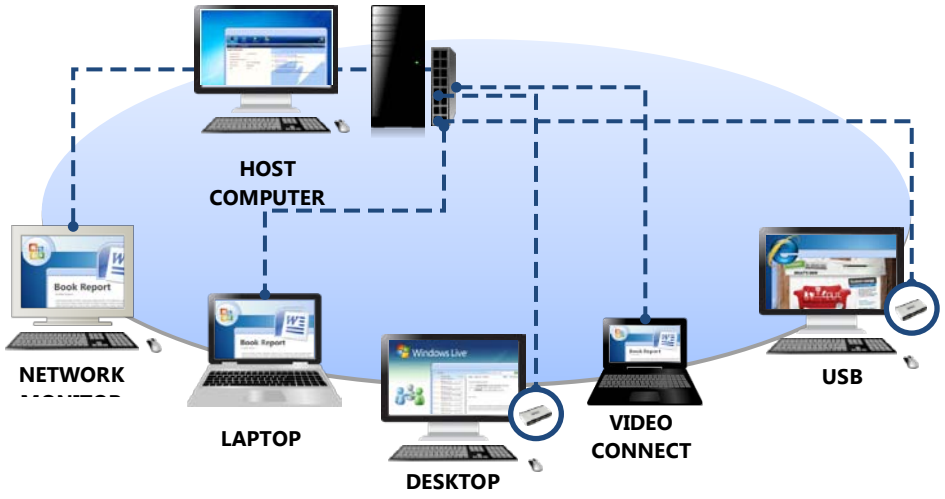
This program provides lessons plans and Windows software upgrades for use by students and teachers. The program is only available for K-12 education. Most countries have a Memorandum of Understanding (MoU) with Microsoft that qualifies schools in their countries for special discounts on Microsoft products. The program is available to all emerging markets and to 15% most disadvantaged students in Developed markets. For more information on the Worldwide Partners in Learning program please see http://www.microsoft.com/education/pil/partnersInLearning.aspx

Shape the Future

Microsoft offers a set of programs that are collectively called "Shape the Future" or National PC deals, for governments wishing to purchase Windows7 in very large volumes for students in their country. In such scenarios, the pricing for Windows7 is lower than that for Windows MultiPoint. However, in such cases the total costs of ownership are still less when using WMS, given the overall savings for hardware and energy. For the purposes of this study, we do not assume that the composite school in the scenario had access to pricing through a "Shape the Future" deal via their Government. For more information on Shape the Future please see
http://www.microsoft.com/Government/ww/solutions/Pages/public-private-partnerships.aspx

Appendix E: More information on Windows MultiPoint Server 2011

Windows MultiPoint Server 2011, the second version of a Windows product targeted at educational institutions, for use in classrooms, labs and libraries, allows multiple users to simultaneously share one computer. Users have their own independent and familiar Windows computing experience, using their own monitor, keyboard and mouse.



The benefits and key features of Windows MultiPoint Server 2011

- **More computing at a lower cost.** Many schools have limited budgets and limited IT staff resources. Windows MultiPoint Server 2011 gives more students access to technology in the classroom, computer lab, or school library. Multiple stations can be powered by a single host computer, reducing the upfront costs of technology and the ongoing costs of maintenance.
- **Reduced energy consumption.** Some schools have limited power capacity or higher power costs. Others simply want to be more environmentally conscious. With Windows MultiPoint Server 2011, energy consumption and associated costs can be lower when only powering one computer and its associated stations rather than multiple computers.
- **Easy to scale.** It is easy to add a Windows MultiPoint Server 2011 setup to each classroom with one station for each student, and it is easy to add additional stations. Existing monitors, mice, and keyboards can be used.
- **The latest Windows experience.** Windows MultiPoint Server 2011 provides the familiar Windows environment that students and teachers already know how to use. And with a user interface based on Windows 7 Teachers and students will spend less time having to learn new technology and navigating different user interfaces — and more time on teaching and learning.
- **Easy setup and management.** Windows MultiPoint Server 2011 is easy to set up and start using right away because it offers flexible configuration options. Connect workstations directly to the host computer by using

USB or video card solutions, or connect them through the school's local area network (LAN), or use a hybrid of both connection methods. Connect keyboards and mice at each station either using USB or a wireless connection.

- **Enhanced teaching and learning experiences.** When all students get their own independent computing experiences — just like having their own PC — teachers can be more effective and active in leading classroom activities and lessons. Windows MultiPoint Server 2011 enables teachers to:
    - **Provide every student their own account.** Teachers create an account for each student from the host computer. With individual accounts, students can set their own favorites in Internet Explorer, customize desktop backgrounds, set up their own desktop icons, customize the Start menu, and more.
    - **Manage student accounts.** Teachers can easily delete an account, create a new one, or change a password from one location. They can also see how many stations are being used, see which student is using which system, and check to see whether hardware is connected properly.
    - **Monitor and orchestrate the student experience.** Teachers can control and monitor their students' productivity. Thumbnail views in MultiPoint Manager give them an instant view of each student's desktop. Teachers can zoom in on an individual student's desktop. If they want everyone to see what's on a desktop — their own or a student's — they can broadcast it to the entire class. Teachers can also block all station activity when they want students to pay attention to them, open and close applications, and restrict Internet access to specific websites relevant to the particular lesson.
    - **Broadcast files, videos, and more.** When teachers want to share a file or video with students, they can save the file in a shared folder — or they can broadcast it to everyone's desktop. If students are working at different levels, teachers can assign and distribute files based on individual level or need.
    - **Install an application once and see it appear automatically on all user stations.** Whether a school wants to use Microsoft Office programs or compatible educational applications, Windows MultiPoint Server 2011 makes it simple to install software. A program simply needs to be installed on the host computer once and it will be ready to use on each user station.

Designed for use by non-technical teachers and students, MultiPoint Server 2011 is simple to manage and use. It is based on the latest Windows technology, support can be obtained through Microsoft or an authorized partner, and schools have access to its full capabilities and the latest updates and can be confident that they are getting an up-to-date experience.

Appendix F: Endnotes

[1]Forrester risk-adjusts the summary financial metrics to take into account the potential uncertainty of the cost and benefit estimates. For more information on Risk, please see page 17.

[2] There will be notable exceptions to the general level of IT literacy among teaching staff. According research conducted for Microsoft's Innovative Teaching program, many teachers in emerging markets tend to be more digitally literate than their counterparts in other professions in their countries. This contrasts to the developed world in which teachers are often less digitally literate than peers in other professions. One hypothesis sets forth that in emerging markets, more tech savvy young people are drawn to teaching as a promising and esteemed profession. And in less industrialized countries teaching may be one of the best occupations for educated people.

[3] The Windows MultiPoint Server 2011 Planning Guide and The Windows MultiPoint Server 2011 Deployment Guide provide guidance for selecting appropriate hardware and configuration options based on the customer's physical, technical, and educational requirements.

[4] For WMS 2011, the options for station hardware and connectivity are:

- USB 2.0 hub at the host PC: A cable for each station connects the hub at host to the hub at the station where keyboard, monitor and mouse are plugged in. Stations must be clustered near the host PC due to cable length limit (5'). This can provide the easiest way to add stations.
- Video cards installed in the host PC: In addition to the USB 2.0 cable and hub for each station, a cable runs directly from each video card in the host to each of the stations' monitors. Two cables per station. Video-based application may run better with this option. Cable length limit applies.
- LAN connect: LAN clients (stations) can be connected over the network, including older PCs, laptops, netbooks, network monitors. There's no need to cluster stations near the host PC. Hybrid systems are possible with both LAN and direct-connected stations. With the LAN configuration, the RemoteFX feature can be used to supercharge HD video.