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Project Planning Framework for Establishing an K-12 Student Laptop Program

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Project Planning Framework for Establishing an K-12 Student Laptop Program

A graduate project submitted to Dakota State University in partial fulfillment of the requirements for the degree of

Master of Science

in

Information Systems

May, 2015

By

Gabe Pooler

Project Committee:

Dr. William Figg

Dr. Mark Geary

Dr. Richard Christoph

PROJECT APPROVAL FORM

We certify that we have read this project and that, in our opinion, it is satisfactory in scope and quality as a project for the degree of Master of Science in Information Systems.

Student Name: Gabe Pooler

Master's Project Title:
Project Planning Framework for Establishing a K-12 Student Laptop Program

Faculty supervisor: William C Figg Ph.D Date: 5/8/2015

Committee member: Mark Geary Date: 5/8/2015

Committee member: Richard T. Christoph Date: 5/8/2015

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- I would like to acknowledge the advisory panel for their involvement in this project as well as other academic experiences they have provided.
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ABSTRACT

Educational 1:1 student laptop programs create large end-user networks. Planning and execution of these projects have a large impact on a school district operations and represent a significant amount of financial investment. Utilizing the "cloud" services over local server infrastructure for the support systems may be beneficial in these system scenarios. A comprehensive planning guide in conjunction with a list of peripheral risk points reduces the project's risk levels.

DECLARATION

I hereby certify that this project constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions or writings of another.

I declare that the project describes original work that has not previously been presented for the award of any other degree of any institution.

Signed,

_____

Gabe Pooler

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CHAPTER 1

INTRODUCTION

Background of the Problem

A student-laptop program is an important technological endeavor for a school district's learning environment as well as marketing for open enrollment. It represents a significant financial investment as well as a dramatic change to teaching operations. With student populations ranging from one hundred to a few thousand, 1:1 programs represent some of the largest information technology deployments in the Midwest region in terms of end users.

Many technology companies like Microsoft and Google have started offering both local software and cloud services at discounted prices to educational and non-profit institutions. Services that once were only financially feasible to large organization via economies of scale can now be utilized by smaller organizations on increments as small as per user. This allows for schools to deploy out 1:1 device program on a "per user" basis without depending on a large volume of users to offset costs.

Statement of the problem

While several states provide direct resources and services to support educational technology, other states leave it to local school districts, education co-ops, or vendors to assemble the needed services. This limits districts which are not provided support. In both cases, a comprehensive project plan is rarely available to establish a reasonable cost estimate; particularly when it comes to the man-hours required to establish large scale, continuous operations as well as minor tasks.

Objectives of the project

The project objective is to develop a tool that allows school administrations to properly budget for different types of 1:1 programs using one of three cloud ecosystems. This will be done by using the items as follows.

Technical and Environmental Considerations Overview:

The following list outlines considerations to review in preparation of planning and budgeting for a 1:1 student laptop projects.

- Computer labs
- Electrical considerations
- Student data protections
- Wireless deployments
- Classroom tools
- Content filtering systems
- Client hardware requirements for various software types,

User Requirement Matrix for Laptop Strategies:

Creating a comprehensive user requirement matrix allows non-technical people to assess the needs of a school district when evaluating student laptop programs. The user requirements will act in lieu of formal use cases while providing additional information for the Cost Estimate Calculator.

Estimated Cost Calculator:

The previous two section cumulate into the final step in the framework process, the Estimated Cost Calculator. This is the main deliverable in determining the feasibility of the 1:1 program. The calculation sheet helps determine the estimated project cost. Through research, user survey, and personal experience in the field, a table of estimated work break structures totals has been created. Each deployment type has 5-15 minute difference, but take by a multiplier of 100-1000 devices, the small increments quickly add up.

All three of the section above combine to create an accurate cost calculation for school administration to consider before moving to towards implementations of a 1:1 project.

CHAPTER 2

LITATURE REVIEW OF VENDOR OFFERINGS

The initial scope of this project included many of the traditional IT services "in-house" solutions.

There are three main companies for mobile computing in the education arena are Microsoft, Google, and Apple. Each platforms has a device operating system integrated into online services (cloud services) that are aimed at the needs of high school and college students.

Over the last few years, Microsoft, has made a major push towards the cloud with programs such as Office 365 with hosted exchange, SkyDrive file storage, and SharePoint. ("Office 365 Office in Education," n.d.)

Google's ecosystem is entirely cloud based with virtually no traditional internal infrastructure requirements beyond Internet access and a WIFI system. ("Google for Education," n.d.)

Apple Macintosh Laptops and iPad environments have traditionally never been focused on centralized management. In turn, they have developed the iCloud environment and an App Store. ("Apple and Education" n.d.)

Cloud solutions have low cost, easy setup, and minimal system maintenance. These benefits are ideal for education environments and traditional in-house services no longer seem feasible.

While there is a level of compatibility between the various vendor environments, there is benefits to using a single ecosystem. For example, each vendor provides step by step directions on the deployment their solution. This removes the need for work breakdown structures. With labor for system infrastructure resolved by the cloud vendor, school IT staff can focus on preparation of the end–user devices.

No matter which platform or devices are chosen, there are many pre-project consideration to be addressed to support a 1:1 program.

CHAPTER 3

PRE-PROJECT CONSIDERATIONS:

Student Data Protections:

Handling data issues such as risk, retention and validity require consideration. Unlike staff data, which falls in traditional models, student data presents several interesting scenarios.

The expiration rate for student assignment data ranges from 24 hours to 5 months. With a large volume falling into the 1-2 day range. The duration of time that data is exposed to loss could be considered low. With grading information retained by teachers, could data such as large assignments, semester projects, and final papers be protected by a simple USB flash drive or a cloud storage drive?

With data on student devices, how much is education verse entertainment? Personal photos and video media take up a significant amount of storage, while the average office document is comparatively small. Traditionally, focus has been on zero loss of any data. This protects important data that may be mixed with non-educational data. While these systems help an organization prevent loss, data ultimately has to be prioritized and safeguarded by the student themselves since they roam from multiple environments.

Wireless Deployments:

The wireless network in classrooms will be critical to the overall success of the student laptop program. It is important to consider that many older wireless networks were built to gain maximum coverage instead of client density. A good example would be where access point are located in hallways or spaced out to every other classroom. Different wireless access points have different maximum client requirements, with high end devices designed to have 100+ devices.

When budgeting for a high density deployments, consider using a ratio of one AP unit per classroom. With the current 802.11n and upcoming AC standards, it is advisable to rely

on the 5 GHz bands for all 1:1 devices. It is important to ensure that channel allocation has been deconflicted so that you can get seamless coverage throughout the expected use area.

With the increased quantity of access points in a high density deployment, the need for a central wireless access point controller becomes more prominent. Onsite controllers are fairly standard, but most vendors have developed cloud based controllers where access points connect to Internet for system via a web browser. These cloud solutions system do require a recurring subscription fee.

For budgeting purposes, anticipate purchasing a minimum of one Power Over Ethernet switch per wiring closet to provided power to the surrounding wireless access points. When considering capacity of the switches keep in mind many security systems and IP phones will utilize POE switches as well.

All the above guidelines provide a best practice for budgeting purposes, but consider seeking professional assistance when planning and executing a wireless system deployment. Professionals will have the tools to test for wireless interference and to identify potential trouble areas.

Classroom Tools:

Projectors and interactive boards may already be implemented in classrooms. At a minimum, each classroom needs a projector to provide a solid learning environment for 1:1 deployment. In the event the district has to install them, makes sure to budget for the project mounts and electrical work required by fire codes to put a visible power outlet to plug in the projectors into. A common alternative is to use a wall-mounted short-throw project located above the interactive board. With short throw projectors being more expensive than average ceiling mount projectors, paying for the electrician could be more cost effective.

As an alternative to a full interactive board, a dedicated touch screen computer next to the projector's display area can provide a similar touch screen experience without the teachers having to worry about blocking the users view. The ideal solution is a touch screen TV which have dramatically decreased in price over the last several years. This removes the need for mounting projectors all together.

Another helpful classroom tool is a student monitoring systems. These systems require students to log into it so the teacher can see everyone's screens to ensure they are

doing assigned work and not playing games or browsing the Internet. These system have quick keys for screen captures so staff can take snapshots and email to administration to validate discipline action.

Content Filtering System:

Protecting youth from **unexpected** inappropriate content is relatively easy. Working to actively block content from a young person who is seeking it is a whole different matter. A significant amount of energy is put into developing freeware tools to help citizens get around oppressive government censorships in many countries. Those tools are just as easily deployed to bypass web filtering programs.

School networks likely already have a content filtering system is in place at the network level to prevent productivity losses as well bandwidth resource management. This means building wide blocks on social media or streaming media services.

The student devices will need a local application on the device since they will be on various different networks. Considering having less stringent productivity policies for devices while they are off-campus. Be aware most content filter solutions are not free, so budget accordingly.

In line with normal security practices, the objective is to add in multiple reasonable protections without crippling the user experience. Ensure student parents understand the district's policy concerning breaches in conduct and evaluate your user agreements for when the content blocking systems are purposely bypassed.

Content Distribution Systems:

Each instructor will need some kind of medium to distribute course work to their students. Such systems range from network folders, to a HTML\FTP site, to a content managed website that allows users to click and drag content, to a full SharePoint solutions.

Google offers Google Drive as a method to store, upload, share, and manage documents. It is integrated into the rest of Google's ecosystem. Office 365 has one drive for storage, but also offers a full SharePoint solutions which be fully customized as needed.

Some states offer statewide systems specifically designed for this task that are used by both the school district and higher education levels.

Computer labs:

Equipping students with laptop devices may not completely remove the requirements for computer labs or specialized computers in classrooms. Many standardized testing environments have strict security requirements with preferences towards non-wireless locked down environments setup in a similar manner as a computer lab.

Multimedia and Industrial Tech courses may still require the use of specialized environments too. Applications like Photoshop and Auto-CAD may be too costly to put a licenses on every student device. This narrow gap of irregularly used software could artificially conflate the base system requirements needed by devices and dramatically increase their cost.

Hardware Requirements for client software:

When selecting student devices evaluate the usage required for 90% of activities. The technical requirements of Office application, Internet browsers, and communications software have traditionally been very low. Many video and photo editing applications function properly with high volumes of lost cost system memory that have become standard in most devices. All low cost devices can handle the CPU and RAM requirements for the current versions of office applications and Internet browsers.

Electrical Consideration:

Regardless of the device chosen, students will need to charge the device during the day. If the device does not have an easily replaceable battery, the second and third year of the devices life could see a negative performance impact with the battery. Power strips may be needed in homerooms, lunch areas, and hallways for use before and after classes.

CHAPTER 4

SYSTEM DESIGN PROCESS

USER REQUIREMENT MATRIX

Windows Laptops\Netbooks\Tablets

Window's hardware platform consist of laptops, netbooks, and tablets from multiple vendors. There are many hybrid laptops with touch screens and many tablets having keyboards integrated into the protective cases, but those three hardware profiles above allow for the best balance of general features for comparison. All three devices will rely on the same OS and have access to Office 365 suite of apps.

Laptops have the most diverse hardware options which range from hardware profiles comparable to high performance desktops to models with the efficient mobility of tablets and smart phones. There are many vendors, but for ongoing technical support it is best to keep the fleet of laptops within the same vendor and possibly model types. It is likely staff will be equipped with laptops of a similar type to provide a consistent platform that allows for a near identical user experience to the students. It may assist in streamlining various interaction between student and staff software.

Handheld tablets have many vendors, and use lower powered hardware to make gains on battery life, mobility, and to offset the price of the expensive touch screens. There is various vendors, but they tend to all rely on the same hardware parts. Microsoft's own "Surface" Pro series of tablets strive to find the perfect balance between handheld tablet and laptop. They feature a tablet like experience with an integrated keyboard in the cover and a full version of Windows 8.1.

Netbooks have the same size screens as a tablet with similar hardware processing, but are built like traditional laptops. Low cost is a strong focus which leads vendors to rely on the same few processors models and have similar system resources.

Google Devices

Chromebooks have multiple vendors but a single Chrome OS created by Google. They rely heavily on Internet Connectivity and have access to a marketplace for software developed specifically for them.

Android tablets use a similar OS as the Chromebooks and are also available from multiple vendors with similar hardware profiles. They are also very dependent on connectivity and focus on content distribution. There are various strategies for deployments using backups systems, but there does not seem to be a streamlined process similar to the Chromebook.

Apple Macbook\iPad

Macbooks are known for the elegant simplicity of their user experience, but compared to the other solutions, the experience comes at a financial cost. OS licensing is simplified since it only runs on Mac hardware and there is no licensing to worry about.

The iPad was one the first handheld tablets and now boast of one of the large software marketplaces of tested applications to be used for the tablet. Being a popular classroom tool for middle school and elementary; technical staff will benefit from student users having previous experience with them before entering the 1:1 program.

Device properties change so rapidly over time the value of the chart is not the rankings, but the perimeters used to evaluate it them.

In the table below, the lower the score the better for that topic

User Weight	Laptop	Netbook	Tablet	iMac	iPad	Chromebook
Cost	6	6	8	9	4	3
Use complexity	6	6	6	5	4	6
Fragile	8	7	5	8	5	4
Technical Deployment Skill	7	7	7	7	5	3
Bandwidth reliance	3	3	4	3	3	7
Battery Capacity	3	5	6	5	6	6

Work Breakdown Estimates for client device deployments:

Each platform has well documented methods of preparing devices for deployment. All have some kind of streamline method ranging from an imaging servers, to imaging via a USB drive, and cloud controlled imaging. Here are some hyperlinked guides directly provided by Microsoft, Google, and Apple. Full link listed in references.

Laptop & Netbook Imaging Server Surface Pro Imaging

Chromebooks Imaging MacBook Imaging iPad Imaging

When the school district has narrowed down the preferred device type, it is highly recommended a test run is done to validate and make adjustments to those numbers to prepare for actual cloning events which happened during the summer before school starts.

WBS Task	Frequency	Work Type	Laptop\ Netbook	Tablet (USB image)	Chromebook	iPad	iMac
Developing Image	Yearly	High Tech	4 hour	2 hour	2 hour	1 hour	2 hour
Imaging System Setup	Single	High Tech	4 hour	1 hour	1 hour	1 hour	1 hour
Account Creation	Single	Low Tech	1 hour	NA	1 hour	NA	1 hour
Hardware Prep per Unit	Yearly	Low Tech	10 min	5 min	10 min	5 min	5 min
Imaging per Unit	Yearly	Low Tech	10 min	15 min	15 min	5 min	10 min
Post Image per Unit	Yearly	Low Tech	10 min	5 min	5 min	5 min	0 min

Table Terms:

Developing Image – This activity covers gathering the software required for the image.
Imaging System Setup – Imaging servers, cloning via USB, cloud provisioning, etc.
Account Creation – All the device ecosystem have a cloud based security credentials.
Hardware Prep per Unit – Each unit will need to be cleaned, unpackaged, etc.
Imaging per Unit - The actual act of imaging the units. Apply a multiplier per device.
Post Image per Unit – Some devices will be required to join domain, reset account info, registering with cloud services, etc....
Complex work is defined as tasks that need specific technical expertise from Tech Coordinators or outsource to system engineers. The actual amount of high tech work is pretty minimal compared to the volume of low tech work making it ideal to be outsourced.
Low Tech work is defined as tasks work that can be completed by a non-technical person. Schools may want to utilize teaching staff, janitorial staff, interns, or students help to complete these tasks during the summer.

Cost Estimate Calculator

Below is the image final product. It is the accumulation the above outputs.
The yellow categories are the values entered by the person needing the estimate.
The purple cells are formulas used to formulate the values in light green cells.

1:1 Student Laptop Project		Cost Calculator	
Input Info	**Quanity**	**System**	**System Cost**
Number of Students	364	Device Costs	$210,865
Number of Classrooms	20	Wireless System	$13,410
Number of Wiring Closets	2	Classroom Tools	$80,500
Number of Staff	25	**Total Project Cost**	**$304,775**

Device Costs	**Price**	**x # of Students + 10%**	**Formula**
Device Price	$375	$150,150	# Students x 110%
Office Suite	$50	$20,020	# Students x 110%
Cloud Account (Yearly)	$48	$1,056	# Students x 110%
Operating System	$50	$20,020	# Students x 110%
Anti-Virus	$14	$5,096	# Students x 110%
Device Webfilter	$7	$2,803	# Students x 110%
Complex Labor	$100	$800	Labor Rate x (Developing Image + Imaging Sytem Setup)
Simple Labor	$15	$10,920	Labor Rate x (Hardware Prep + Imaging Time + Post Imaging)
Per Device Costs (minus Labor)	$544	**$210,865**	**Sum of Green Items**

Wireless	**Price**	**x Number of Clasrooms**	**Formula**
POE Switches	$280	$560	Wiring Closets x POE Switch Price + Hot Spare
AP Controller	$1,000	$1,000	1 per Network
Classroom AP	$350	$7,000	1 or 3 per Classroom depending on AP type
Large Area AP	$700	$2,100	1 or 3 per Gym\Auditoruim\Annex
Network Cabling	$25	$500	Per room or Wiring Project Rate
Wireless System Setup Labor	$150	$2,250	Labor x (WiringClosets + (AP Controller = 3) + (Classrooms/2))
Total:		**$13,410**	**Sum of Green Items**

Classroom Tools	**Price**	**x Number of Clasrooms**	**Formula**
Classroom Monitoring	$ 500	$500	Site License
Projector + Mounting	$ 1,000	$20,000	Per Classroom as needed
Interactive Board Solution	$ 3,000	$60,000	Per Classroom as needed
Total:		**$80,500**	**Sum of Green Items**

CHAPTER 5

CONCLUSIONS

Within the last few years both Microsoft office 365 and Google Drive have made tremendous strides in providing a cloud platform for their office productivity, file storage, and device management. This seems to be the final phase of what Nicolas Carr described as the migration of information technology into a low cost, low maintenance, highly scalable solution like electricity distribution (Carr, 2004).

The mobility of the students from multiple locations during all hours of the day has made services from a cloud the idea solution to use. Using a *software as a service* model (SaaS) at a discount rate for educational institutions makes them an easy choice for a 1:1 student laptop project.

The initial planning for this project included plans to develop work break down sheets to set up multiple infrastructure services. Reviewing the current cloud offerings, time, resources, and expertise needed to simulate these *legacy* solution was not feasible. Change of work was made, see Appendix A for further details.

Microsoft, Google, and Apple all provide excellent documentation on set ups of their cloud systems. They are web-based, intuitive and require very little technical skill to provision resources and set up accounts. With the objective being to allow administrators to successfully budget and plan a 1:1 laptop projects for students the set up times are so quick that it has minimal impact on the overall project.

Since it is not possible to "print" a functioning excel sheet, the formulas have been listed so that users can recreate the table as need. Ideally, a website could be created to convert the functionality of the excel sheet into a scripted webpage that would be easily accessible to everyone.

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APPENDICES

APPENDIX A: PROJECT WBS

INDEX	Work Hours	Activity
1	14.5	**K12 student laptop (Research and Report)**
1.1	**3.5**	**Client Devices**
1.1.1	1.5	Windows Computer\Netbooks\Surface Pro
1.1.2	1	Apple Macbook\iPad
1.1.3	1	Google Chromebook\Android
1.2.0	4	**Device ecosystems**
1.2.1	1	Windows Domain (Office 2013 + Exchange + Sharepoint)
1.2.2	1	Office 365 (Office Online + Outlook.com + Skype)
1.2.3	1	Google Drive (Google Docs + Gmail + Google Hangout)
1.2.4	1	Alternatives: iCloud, Dropbox, Open Office, ect.
1.3.0	1.5	**Wireless Systems**
1.3.1	0.5	Access Points
1.3.2	0.5	Additional Network Equipment
1.3.3	0.5	Wireless System Controllers
1.4.0	3.5	**Classroom Tools**
1.4.1	0.5	Interactive Boards
1.4.2	0.5	Projectors
1.4.3	0.5	Staff Computers
1.4.4	0.5	Activity Control and Monitoring
1.4.5	0.5	Content Filtering
1.4.6	1	Content Distribution
1.5.0	**2**	**Grade level considerations**
1.5.1	0.5	Elementary
1.5.2	0.5	Middle School
1.5.3	0.5	High School
1.5.4	0.5	College

2	**5.5**	**Create User Requirement Matrix for Client Devices**
2.1	0.5	District - Financial Constraints
2.2	0.5	District - Staff Equipment
2.3	0.5	Student - Grade Level
2.4	0.5	Student - Total participants
2.5	0.5	Student - Students per Classroom
2.6	0.5	Student - Technical Skill level
2.7	0.5	Infrastructure - Bandwidth capacity
2.8	0.5	Infrastructure - Network Capacity
2.9	0.5	Infrastructure - Electrical Outlet Accessibility
2.1	0.5	Infrastructure - Server Requirements
2.11	0.5	Infrastructure - Total Classrooms
~~3~~	~~25~~	~~Assemble WBS for systems setups:~~
~~3.1~~	~~12~~	~~Client Devices~~
~~3.1.1~~	~~2~~	~~Windows Laptop\Netbook~~
~~3.1.3~~	~~2~~	~~Windows Surface~~
~~3.1.4~~	~~2~~	~~Ipad Tablet~~
~~3.1.5~~	~~2~~	~~Macbook~~
~~3.1.6~~	~~2~~	~~Chromebook~~
~~3.1.7~~	~~2~~	~~Android Tablet~~
3.2	7	**Device ecosystems**
3.2.1	*4*	Windows Domain (Office 2013 + Exchange + Sharepoint)
3.2.2	1	Office 365 (Office Online + Outlook.com + Skype)
3.2.3	1	Google Drive (Google Docs + Gmail + Google Hangout)
3.2.4	1	~~Alternatives: iCloud, Dropbox, Open Office, ect.~~
3.3	1.5	**Wireless Systems**
3.3.1	1	Wireless Devices
3.3.2	0.5	Network Equipment
3.4	4.5	**Classroom Tools**
3.4.1	0.5	Interactive Boards
3.4.2	0.5	Projectors
3.4.3	1	Staff Computers

3.4.4	0.5	Activity Control and Monitoring
3.4.5	1	Content Filtering
3.4.6	1	Content Distribution
4	**7**	**Develop Student Laptop Cost Calculator:**
4.1	1	Create area for inputs
4.2	1	Create area for static product prices
4.3	1	Create formulas for calculating required man-hours.
4.4	4	Integrate data and values from user requirement matrix.
5	**16**	**Assemble Presentation Paper**
5.1	2	Write up framework introduction
5.2	1	Write up framework direction for use.
5.3	2	Package framework for ease of use into single excel document.
5.4	5	Write up project plan report.
5.5	6	Prepare presentation to promote use of this framework.