Module 2: Disseminating Low-Cost Computing Devices in Schools

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1 Introduction

?A growing number of governments around the world are investigating and implementing pilots or programs to distribute *low-cost computing devices* (LCCDs) for schools in their countries.?The potential LCCD market is vast.?According to Intel Corporation, "There are 1.3 billion school-age children around the world, and of those, only five per cent have access to a PC..."[1] This?toolkit module?examines the LCCD arena, analyzes costs, identifies implementation issues, and reviews different countries' experiences with LCCD programs.

More specifically, Section 2 defines LCCDs and provides examples of devices that are currently being tested and deployed in school projects around the world.?Section 3 identifies the various cost elements involved in LCCD deployments. In addition to the LCCD itself, there are?other items that must be consider in?implementing an LCCD project, including electricity, networking, software, training, transport, and distribution and maintenance.

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Section?4 examines implementation details, such as coordinating LCCD programs and deciding?which schools and students should receive?LCCDs. Section?5 provides several case studies about LCCD deployments in different countries around the world.? There is also a "checklist for planning and implementation of an LCCD project.

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?[1]http://www.intel.com/pressroom/archive/releases/20090109comp.htm.

2 What Are Low-Cost Computing Devices

Low-cost computing device is a relative term, given the wide differences in economic development around the world.?A USD 100 difference in the price of a computer may not seem significant in a developed country, but it can make an enormous difference in a developing country.?For example, in Benin, "…the cost of a generic PC is equivalent to a teacher's salary for eight months."[2]

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The cost of computers has influenced national strategies for introducing information technology in schools. The typical way to reduce expenses has been to install a?"computer lab" --?a shared location in the school where a few computers can serve?multiple students. A strategy for many countries has been to increase the number of such labs, introducing them into schools that previously had no computers. For instance, in 2003 Indonesia adopted its "One School One Lab" program aimed at expanding the availability of computer labs in its educational institutions.[3?]

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?Another strategy has been to reduce the ratio of students to computers. Take Chile, for example, where the number of students per computer dropped from 70 in the year 2000 to 26 in 2007, with the government aiming for 10 students per computer by 2010.[4] Lower-cost computers make it more affordable for countries to distribute them widely?in schools.

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To many researchers, academics, development specialists and government officials, a low-cost computing device is a specific concept, grounded in a philosophical context. The idea behind low-cost computing devices developed from then-MIT Lab researcher Nicholas Negroponte, who articulated a vision of an inexpensive laptop for every child in the world.

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A prototype of the computer was shown at the World Summit on the Information Society (WSIS) in 2005.[5] Describing the benefits of LCCDs, former UN Secretary-General Kofi Anan said, "Children will be able to learn by doing, not just through instruction.?They will be able to open up new fronts for their education, particularly peer-to-peer learning."?He added that the idea was inspiring, with real potential for students' social and economic growth in developing countries.[6]

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One important distinction is the difference between “one lab per school” and “one computer per student.”?Policies for introducing computers in schools have traditionally revolved around labs, with a number of students sharing one computer. The low-cost computer device movement is oriented toward each student having his or her own laptop:

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> “The mission of the One Laptop per Child (OLPC) movement is to ensure that all school-aged children in the developing world are able to engage effectively with their own personal laptop…”[7]
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> “The ultimate goal is to reach the point where there is one laptop for each student…”[8]

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The *one-to-one* concept gives pupils more time on the computer than in a shared, lab-type environment.?A calculation carried out for the Nepalese government?found that a computer lab user only spends 1?per cent of the time on a computer that a student with a LCCD spends.[9?] The Solomon Islands initially?explored providing?each school with?a computer lab, but with LCCDs, “…an even better outcome was ensured, as every child and teacher would have a laptop.”[10]

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Used computers can also be considered low-cost computing devices.?Although there are costs involved with recycling, the computer itself is generally donated for free.?Furthermore, some argue that recycled computers can be cheaper than low-cost laptops when all of the costs are factored in, including waste and social benefit to the country. A study on the sustainability of computers for schools in Colombia suggests that used computers that are refurbished in the beneficiary country have the highest “utility,” which factors in involvement of the local economy, creation of jobs and the environment.[11]

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Another model for reducing the cost of computers in schools is the “thin-client” approach, in which a simple computer (the “client”) is connected to a server that carries out most of the processing. This is similar to the environment that existed in the pre-personal computer era, when terminals were connected to host computers. This model is attractive from a cost perspective, since thin clients are cheaper than conventional computers. It is also attractive for a school environment, where a teacher

has more control over the computer learning environment. This solution has been used in rural schools in Brazil, where the cost per workstation is around USD 50.[12]

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While one-to-one computing is attractive, it is an expensive proposition. Using the figures referred to earlier, the cost of outfitting 1.3 billion developing-country students with their own laptops would be?more than?USD 100 billion.? This?assumes?a USD 100 cost for the laptop and?does not take into account all?of the other associated costs, such as transport, distribution, maintenance and training. The advantages and disadvantages of different approaches—one-to-one computing or computer labs—are shown in the table below. Given the high cost of providing each student with their own laptop, this is not a feasible short-term approach for many developing countries, and a more practical strategy may be a mix of approaches.

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Table 2-1: Pros and Cons of Computer Labs and One-to-One Computing

Model	Pros	Cons
One computer per?student (laptops)	• Can be taken home and shared with family • Creates sense of ownership with less theft and damage • Some designed for developing country rural environment (e.g., handle extreme temperatures, low battery use, etc.) • Some designed for children (e.g., rugged, ergonomic) • Some include educational software and ecosystem of support • More democratic in that all children receive computers	• Relatively Expensive • Can be disruptive
Computer labs (recycled computers, thin clients)	• Less disruptive than one-to-one model • Computer lab more economical than one-to-one	• Higher maintenance and support since likely to be different? • Students spend less time with computer

	• More practical for shared settings such as computer labs or community centres. Generally more powerful than laptops	• Labs may not be equitably distributed throughout school system or computers can be dominated by certain students

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[2]http://blogs.worldbank.org/edutech/print/497

[3]?http://www.apt.int/Program/ICT/WebHRDICT/Batch-5/OSOL-CAP.pdf

[4]Ministerio de Educación de Chile. *15 Años Integrando TIC a la Educación Chilena*. Mayo 2008.

[5]The unveiling occurred during the “Phase II” conference and trade show, held in Tunis, 16-18 November 2005.

[6]http://news.bbc.co.uk/2/hi/technology/4445060.stm

[7]http://ewasteguide.info/system/files/Streicher_2009_JEnvMgmt.pdf

[8]http://www.desktoplinux.com/news/NS2824724304.html

[9]http://laptopfoundation.org/en/program/

[10] http://pcworld.about.com/od/notebooks/Intel-s-Classmate-PC-Enrolls.htm

[11]http://202.70.77.73/downloads/olpc-english.pdf

[12] http://wiki.laptop.org/images/c/ca/Solomons_OLPC_Deployment_Report_Aug08.pdf

2.1 LCCDs for Education

Initially, low-cost computing devices were considered to be laptops with rugged construction and low power consumption that were specifically designed for students in developing countries. However, several computer manufacturers now offer laptops that have similar features, although they have not been designed solely for the educational market.?The main commonalities of LCCDs, regardless of the brand or specific functionality, are a relatively low price (less than USD 300 for the device), laptop form factor and small size (*e.g.*, screen size less than?10 inches).?

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Leading examples of LCCDs include:

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- XO – A laptop developed by One Laptop Per Child (OLPC), the XO is specifically designed for primary school students in developing nations, and it has a range of features appropriate to that environment.?The XO's design has?factored in technological issues such as local language support, as well as environmental conditions such as high heat and humidity."[13]?In order to minimize malfunctions, it has no movable parts (*e.g.*, no hard disk or fan), and it features special antennas to support mesh networking.

The ?XO is backed by a large ecosystem of system designers, education experts and development specialists.?The educational theories are tied into the operating system and software included with the XO.?Dozens of nations are piloting or carrying out large-scale XO implementations. Some of the most significant are Uruguay, where the government has provided?XO laptops to all public school primary students, and Rwanda, which, in addition to distributing XOs to schools, is also emerging as a research and training center for the XO.?

- Classmate – A laptop developed by semiconductor manufacturer Intel as a "mobile personal learning device for primary students in emerging markets."[14] Originally introduced in 2006, the second-generation Classmate is built around an Intel processor and has a rugged, "kid-friendly" design.?Features include hardware-based theft protection, Wi-Fi and a battery life of between 3.5 to 5 hours.[15] The Classmate runs Windows XP or Linux and is available in clamshell or convertible designs. Intel has licensed the technology to various manufacturers.

One of the largest deployments of Classmate is in Portugal, which has contracted around half a million of these laptops.[16] The Classmate is used for the country's *Magalhães* initiative ("Magellan" in English, named after the Portuguese navigator).[17] Local company JP Sá Couto manufactures the computers.?Portugal is leveraging the program to spread Magellan Classmates to developing countries. In September 2008, it signed a deal with the Venezuelan government to supply one million Portuguese-manufactured Classmates.[18] The country's incumbent telecommunications operator, Portugal Telecom, has targeted the Magellan for overseas social responsibility programs, with plans to distribute the laptop in Lusophone Africa[19] and Namibia.[20]

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- Netbooks -- Encouraged by the LCCD movement for students, computer makers have been downsizing laptops to also tap into the market (*e.g.*, netbooks).?A noteworthy one in terms of price and entry into the educational market is the Asus Eee.[21] Asustek, a Taiwanese computer

manufacturer, has developed rugged portable computers for use in space, off-car road races, Mount Everest and the North and South Poles.[22]?It introduced the Eee PC notebook in October 2007.?The Eee, like the XO and Classmate, is a portable laptop that uses flash drive storage, and the entry-level models are price-competitive.?But the Eee was not strictly designed for the educational environment as were some?other devices.?As with other commercial computers, it comes in a much wider range of configurations and models than the Classmate or XO.

One of the largest Eee educational deployments is in Russia, where it is being used in schools following an order for approximately USD 200 million from the Free Deed Foundation, a philanthropy organization.?The purchase of some 1 million Eee PC 700 models is to be delivered over the next five years.[23]?The Eee has also been deployed in various school projects in the United States.[24] It also emerged as the preferred LCCD in testing done at three African universities (it should be noted, however, that some LCCDs such as the OLPC XO or Intel Classmate are not designed for university students).[25]??

- ?Mobilis -- Another LCCD that may become the focus of greater attention is the Mobilis, manufactured by the Indian company Encore.[26] The Mobilis was recently selected in a tender for school laptops in Brazil.[27] Yet another is the Israeli-designed ITP-C, which is being used in school projects in Argentina and Chile.[28]

Figure 2-1: Low-Cost Computing Devices Used in Schools

				
OLPC XO	Intel Classmate	ASUS Eee	Encore Mobilis	ITP-C
Afghanistan, Bhutan, Brazil, Cambodia, Colombia, Ghana, Guatemala, Haiti, India, Iraq, Lebanon, Mali, Mexico, Mongolia, Mozambique, Nepal, Nigeria, Niue, Pakistan, Papua New Guinea, Paraguay, Peru, Rwanda, Solomon Islands, South Africa, Thailand, Uruguay	Argentina, Brazil, Chile, China, Egypt, India, Indonesia, Lebanon, Libya, Malaysia, Mexico, Nigeria, Pakistan, Philippines, Russia, South Africa, Sri Lanka, Thailand, Uganda, Vietnam	Russia	Brazil	Argentina, Chile

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Note: The list of countries where the devices are used in schools excludes developed nations.

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[13] http://laptop.org/en/laptop/hardware/index.shtml

[14] http://www.intel.com/intel/worldahead/pdf/CMPCbrochure.pdf

[15] The theft protection links the Classmate to a school server. If the Classmate loses connection to the server for a certain period of time, it is rendered unusable and can only be reactivated if returned to the school. See: http://blogs.intel.com/technology/2009/08/classmate_pc_as_a_one-to-one_l.php

[16] http://www.intel.com/pressroom/archive/releases/20080730corp.htm

[17] http://www.magalhaes.gov.pt

[18] http://www.eweek.com/index2.php?option=content&task=view&id=49762&pop=1&hide_ads=1&page=0&hide_js=1

[19] http://www.africanidade.com/articles/2607/1/Computador-quotMagalhAesquot-chega-As-escolas-de-STomA-e-Principe/Paacutegina1.html and http://www.telecom.pt/InternetResource/PTSite/UK/Canais/Media/DestaquesHP/ptlaunchessapomozambique.htm

[20] http://tv1.rtp.pt/noticias/?article=96746&visual=3&layout=10

[21] For a comparison of different commercially available low-cost laptops see: http://blog.laptopmag.com/low-cost-laptop-cheat-sheet

[22] http://www.asus.com/ContentPage.aspx?Content_Type=AboutASUS&Content_Id=9

[23] http://www.kommersant.com/p814940/philanthropy/

[24] http://www.olpcnews.com/commentary/academia/asus_eee_pcs_in_usa_schools_a.html

[25] http://www.computeraid.org/pdffiles/Report%20on%20Low-Power%20PC%20Research%20Project%20April%202009.pdf

[26] http://www.ncoretech.com/products/ia/mobilis/index.html

[27] http://www.agenciabrasil.gov.br/noticias/2008/12/17/materia.2008-12-17.8621960410/view

[28] http://www.itp-c.info/

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3 Low-Cost Computing Device Cost Elements

There are a variety of direct and ancillary costs involved in the implementation of a low-cost computing program.?The initial costs include the LCCD hardware, software licenses (if not included with the LCCD itself), as well as certain peripherals (printers, additional memory, etc.), network access, and development of content specifically for the LCCD program.

Other costs involve taxes, as well as the transportation and distribution costs related to the deployment of the LCCDs.?The size of the country can impact those distribution and transportation costs.??A smaller, more urbanized, country will have lower?costs than a large, rural?one.

The training of children and teachers on how to use the LCCD is another initial, ancillary cost.?There are also a variety of ongoing costs related to an LCCD program. These include costs related to the maintenance of computers, software upgrades, security, ongoing network access costs, electricity, and staff costs, if applicable.?

The above-mentioned initial and ongoing costs will vary substantially, depending on the scope of the program.?Some projects are national (*e.g.*, hundreds of thousands of LCCDs for a nationwide implementation in Uruguay) whereas others are more localized (*e.g.*, a 30 LCCD pilot in Mali).?The magnitude of the LCCD implementation has economy-of-scale implications for various elements, such as the price of the LCCD.?

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The software that comes with the LCCD, along with government policies for applications and educational content, impacts software costs.?Some countries may find that the applications that come with the LCCD are sufficient for their needs while others may want to use freely available applications that can be downloaded from the Internet or purchased commercially.?In terms of educational content, there are hundreds of free packages.

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Content is already available in some countries, even if it sometimes?must be modified to run on the LCCDs.?Brand-new content may need to be developed in other countries. Some costs can be *internalized,* such as training or content development.?In other words, rather than requiring additional government educational expenditures, elements of the LCCD project may have no impact on budgets if the activities already exist in government school systems.??For example,?there may already be a

content development center for computers.??Governments might be able to transfer funds from educational activities that are no longer a priority to new LCCD projects.

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Given this diversity in scope, it is possible to anticipate the necessary cost elements, but difficult to provide specific costs associated with these cost elements, since this will vary significantly based on the scope of the program and the country in which the program is being deployed.???

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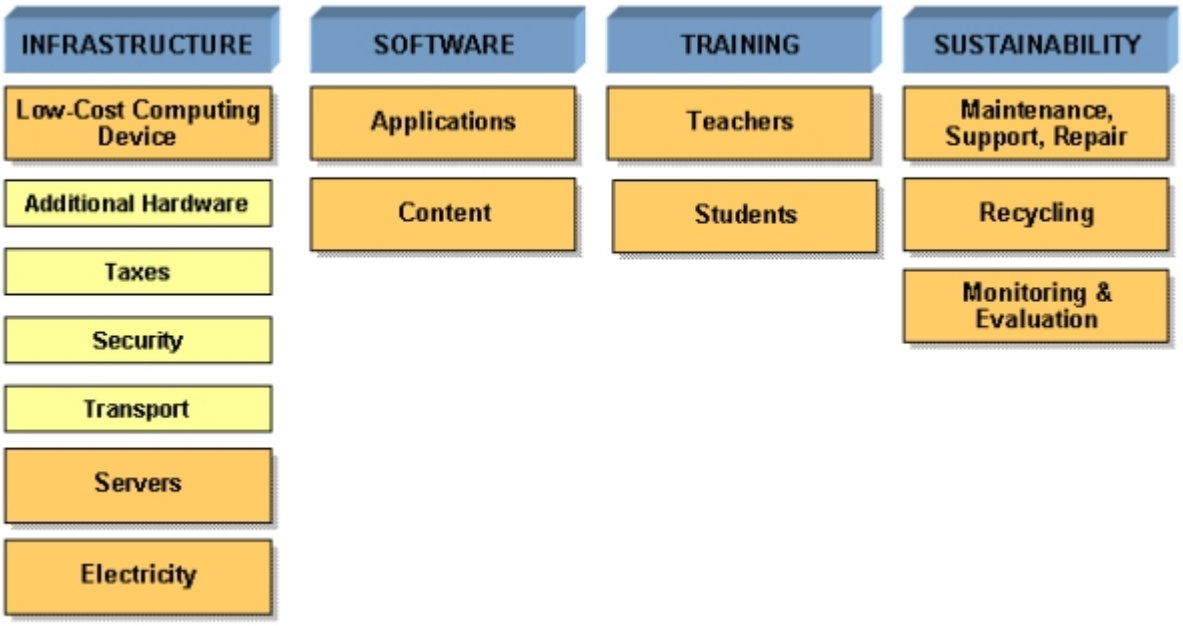
3-1: LCCD cost elements?



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3.1 Infrastructure

?*Infrastructure* refers to the ICT hardware and other infrastructure components typically required for an LCCD program.?Apart from the cost of the LCCD itself, other physical elements need to be factored into an LCCD program, including peripheral components for the LCCD, networking, servers, and electricity.?

3.1.1 The Low-Cost Computing Device

Although one of the goals of the one-to-one computing movement was a USD 100 laptop, this has yet to be achieved.?LCCD costs vary depending on brand, configuration and the number purchased. The unit prices of various LCCDs are shown in the table below. This assumes the purchase of a single unit with a default configuration and does not reflect volume discounts.?Prices range from USD199.99 to USD 299.99.

Table 3-1: Unit Price of Various LCCDs

Type of LCCD	Price (USD)	Remark
OLPC XO	?? 199.99?	Price for donating a new OLPC to a child in a developing country.[29]
Classmate PC	?? ? ? ?205.00	Price on Amazon.com for following model: CTL E09XPH 9-Inch 2goPC Laptop (900 MHz Intel Celeron Processor, 512 MB RAM, 40 GB Hard Drive, XP Home)
ASUS Eee	?? ? ? ?299.99	Price on Google Product Search for following model: 7" Eee PC 4G 701 Notebook

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Furthermore, because many LCCD projects are still pilots using donated equipment, it is difficult to get a firm figure about the price of LCCDs.?At the same time, large-scale implementations have typically involved many other cost elements, also making it difficult to isolate just the LCCD cost.

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Another perspective on the costs of the LCCDs is to look at project costs in various implementations around the world. One difficulty is that they typically include other items besides just the LCCD. However, the resulting price per LCCD is still cheaper than average?per-unit prices and thus provides an insight into the impact of volume discounts.

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Table 3.2: Cost of LCCD Programs in Various Countries

Country	Date	# of LCCDs	Total (USD million)	Price per LCCD (US$)	Note

Brazil	Dec-08	150,000 (Mobilis)	USD 35.2	USD 235	Including delivery to schools, taxes, 12 month guarantee, maintenance and equipment configuration.?
Haiti	Feb-08	13,700 (XO)	USD 5.1	USD 372	Including training, electricity, content development and networking. LCCDs valued at US$146.
Russia	?	1,000,000 (Eee)	USD 200	USD 200	Information is not available about what this amount covers.
Uruguay?	Oct-07 ? ?	100,000 (XO)	USD 19.9	USD 199	Including servers, guarantee, delivery to Montevideo and network-ready.

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[29]http://laptop.org/en/participate/ways-to-give.shtml?

3.1.1.1 Additional Hardware Components

All of the LCCDs described in Section 2 come with a number of features, such as Wi-Fi network capability, integrated cameras and microphones, etc., and are ready to use as-is. Additional components for the LCCDs might be needed, however, depending on?what each government deems necessary. These primarily revolve around storage, connectivity and peripherals.

- Storage: Most LCCDs used for education come with flash drives rather than hard disks. The capacity of the drives varies. If the storage is deemed insufficient, then the cost of obtaining higher capacity flash drives would need to be factored into the unit cost. Extra storage could also be supported through a school server.
- Connectivity: All of the LCCDs come with Wi-Fi connectivity. However, in order to connect to the Internet, access points need to be provided. This is discussed under *Servers* below.?In addition, most LCCDs do not include Bluetooth connectivity, so if that is deemed important, then the cost of Bluetooth adapters would need to be included.
- Peripherals: Printers and scanners might also be needed.

?The table below provides some indicative prices for additional hardware devices that might be needed.?

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Table 3-3: Prices for additional hardware devices

Product	Brand	Price (USD)
Bluetooth Adapter	Bluetooth USB 2.0 Micro Adapter Dongle	1.75
USB Flash Drive	SunDisk Cruzer 4/8/16	7.93/17.39/29.90/67.72
Printer/Scanner	Epson NX400 all-in-one Printer	59.95

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Note: Lowest price brands (excluding tax) for each product according to Amazon USA (accessed August 2009).

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3.1.1.2 Taxes

Import duties, Value-Added Taxes (VAT) and other taxes add to the cost of procuring an LCCD, as well as other supporting equipment.?Policies vary widely regarding the extent to which these taxes are applied.

The World Trade Organization's *Ministerial Declaration on Trade in Information Technology Products* (ITA) was agreed to by 29 participants in 1996.?The number of participants has since grown to 70, representing about 97 per cent of world trade in information technology products. The ITA calls for the total removal of import duties on ICT goods.?Many developing countries, the targeted group for most LCCD projects, have not signed the ITA. Nonetheless, some countries have eliminated import duties on computers even though they are not ITA signatories.

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Import duties are sometimes used to encourage local assembly, refurbishment or manufacturing. In Brazil's government auction for LCCDs, one of the alleged reasons OLPC had higher costs than its competitors was because it had to include the cost of import duties.? Some other bidders?were offering?domestically produced computers.?In Colombia, imported LCCDs have been rejected as the lowest-cost solution for schools because they do not add as much to the economy as domestically refurbished computers.

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Therefore, the impact of taxes on the LCCD program will vary from country to country. As noted, import duties are not an issue in countries that have abolished duties on information technology equipment. VAT also may not be applicable if the computers are shipped directly to the government instead of going through a third party.

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3.1.1.3 Security

Security costs must be contemplated in order?to minimize the theft of the LCCDs.?Both the XO and the Classmate have built-in security features, reducing the need for additional expenditures. The Classmate has hard-wired anti-theft features,[30] while the XO uses software-based security.[31] While these systems will generally render the LCCD unusable for unauthorized users, they may not be sufficient to reduce physical thefts, particularly if the thief is not aware of these features.?Having students take the LCCD home at night can reduce security costs. Conversely, having a locked or guarded location to store the LCCDs should be considered.?

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[30] http://www.classmatepc.com/pdf/CMPC_Product_Brief_Sec_Gen_Eng_HiRes.pdf

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[31] http://wiki.laptop.org/go/Bitfrost#Current_Status

3.1.1.4 Transport

Transportation can form a significant part of the costs of providing low-cost computing devices.?LCCDs need to be transported from the manufacturing location to the destination country. Each country's costs for distribution of LCCDs will vary tremendously, depending on the distance from the LCCD manufacturing locations and the breadth of deployment, as well as the shipping method.?Once in the country, the LCCDs then must be transported to different schools.

Priorities will dictate whether to use air or surface transportation. The former is more expensive (items are typically?priced by weight) but quicker, whereas surface shipping is less expensive (items typically are priced by?volume).?There may additional costs if the LCCDs need to be assembled or reassembled once in the country.?All of these factors make it difficult to provide a common figure for transport costs.

?Transportation problems impact the LCCD program. For example, in the Solomon Islands, laptops could not be distributed to some schools because of logistics, and some teachers could not be briefed on the project because of a lack of fuel to transport them.[32]

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[32]?http://wiki.laptop.org/images/c/ca/Solomons_OLPC_Deployment_Report_Aug08.pdf

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3.1.1.5 Adaptation for the Disabled

Since most LCCD projects are still pilots with few large-scale deployments, limited resources have been directed at making them usable for disabled children.?Nonetheless, certain countries, such as Portugal, Russia and Uruguay, have introduced measures to make LCCDs accessible for those individuals.

For example, an online forum exists for using the XO laptop as an assistive technology for disabled persons.[33] The Portugal Telecom Foundation has also carried out numerous projects to modify computers for use by disabled persons, including children.[34]?In Russia, a project was initiated to provide LCCDs for blind students.

Governments have encountered?some obstacles in modifying LCCDs for use by disabled persons.?In Russia and Uruguay, the governments were unable to install the accessibility application on the low-cost computers because of hardware limitations, so they?instead had to use regular computers.[35] Uruguay also plans to provide adapted computers for deaf and physically challenged children;

however, the cost of the adaptive software is expected to be more than the price of the computers (USD 150).[36]

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At this stage, it is too early to determine the costs of making?adaptations in each country.?However, various groups are?working on projects that will provide?a track record,?through shared experiences, to?identify ways to reduce costs.?In addition, charitable organizations, whose donations are often targeted for the disabled, could provide a funding resource to defray the costs of making computing devices accessible to disabled children.

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[33] http://www.olpcnews.com/forum/index.php?topic=65.0

[34]? http://www.fundacao.telecom.pt/Default.aspx?tabid=359

[35]? http://wiki.laptop.org/images/0/03/Evaluation_report_OLPC_Russia.pdf and http://latu21.latu.org.uy/es/index.php?option=com_content&view=article&id=460:plan-ceibal-brinda-laptops-a-ninos-ciegos-entre-mayo-y-junio&catid=36:noticias-de-ceibal&Itemid=262

[36] http://www.presidencia.gub.uy/_Web/noticias/2009/05/2009050509.htm

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3.1.2 Servers

LCCD programs are significantly enhanced through the inclusion of computer servers. These computers are generally more powerful than the LCCDs and provide a range of services, including Internet connectivity, printer sharing, file downloading and disk storage.?Assuming such services are desirable, then the cost of the servers, peripheral devices such as printers, and networking costs must be factored into the LCCD project.

Since LCCDs do not have sufficient capability to function as servers, most countries use more powerful computers.?The price of the servers varies by the amount of RAM, processor speed, disk capacity and computer brand.?In?some projects, one server is purchased per school. In addition, the purchase of

printers and scanners needs to be contemplated, along with consumables such as paper and ink cartridges or laser toners.

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Most LCCDs have Wi-Fi capability but require connectivity through an access point to?the Internet. Although a server is not needed for Internet connectivity, it provides additional features such as better network security and management.?In addition, performance can be enhanced by storing applications and content on the server for distribution to the LCCDs, instead of having each student access the Internet to download files.

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Other costs associated with Internet access include the cost of routers and monthly subscription fees. Depending on the type of Internet access, additional adapters may be required. For example, if the connectivity is through a?third-generation (3G) wireless network, then a wireless network adapter will need to be purchased.?Given the added complexity of computer servers and Internet access, some countries have outsourced the support and maintenance of their equipment.

3.1.3 Electricity

The availability of electrical power has a major impact on the scope of an LCCD program.?Some form of electrical current is needed to recharge the LCCD devices and to power servers for supporting the program. Power costs can be divided into three areas:

1. Existing electricity at schools slated for LCCDs;
2. The charging aspects of the LCCD itself; and
3. On-going electrical costs.

If electricity does not exist at the school, the cost of providing some type of power to recharge LCCDs needs to be factored into the project costs.?The type of power option will depend on whether the school is close to the electrical grid. If so, then the cost of connecting the school to the electrical grid must be contemplated. If not, then off-grid options need to be explored.

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One solution would be to use a generator, typically powered by diesel fuel.?This can be a costly proposition, because it requires the purchase of a generator, payment for the diesel and an on-going supply of fuel.

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Another option is solar or wind power.? Both involve hardware costs, but there are no recurring electricity or fuel costs. In Uganda, for example, a project run by an NGO has been using solar power to recharge LCCD batteries.

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The type of LCCD selected has an impact on power needs, since some have self-charging options. There may not be an immediate need for electricity, but the scope of any?program will be limited without having a reliable energy source. Networking options inevitably would be constrained, because?there would be no power to run a server.?

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If a school does?not have electricity, some households may have power at home, so the LCCDs can?often be taken home and recharged.?The battery power of the device itself varies among brands, as does the charging options. The figure below illustrates a variety of different options for charging the battery. One consideration is a charger and plug. Although all the LCCDs supply dual voltage chargers, plugs can be problematic, because they vary widely from country to country. This was an issue in the Solomon Islands, where the plugs that came with the laptops did not match the outlets used in that country.

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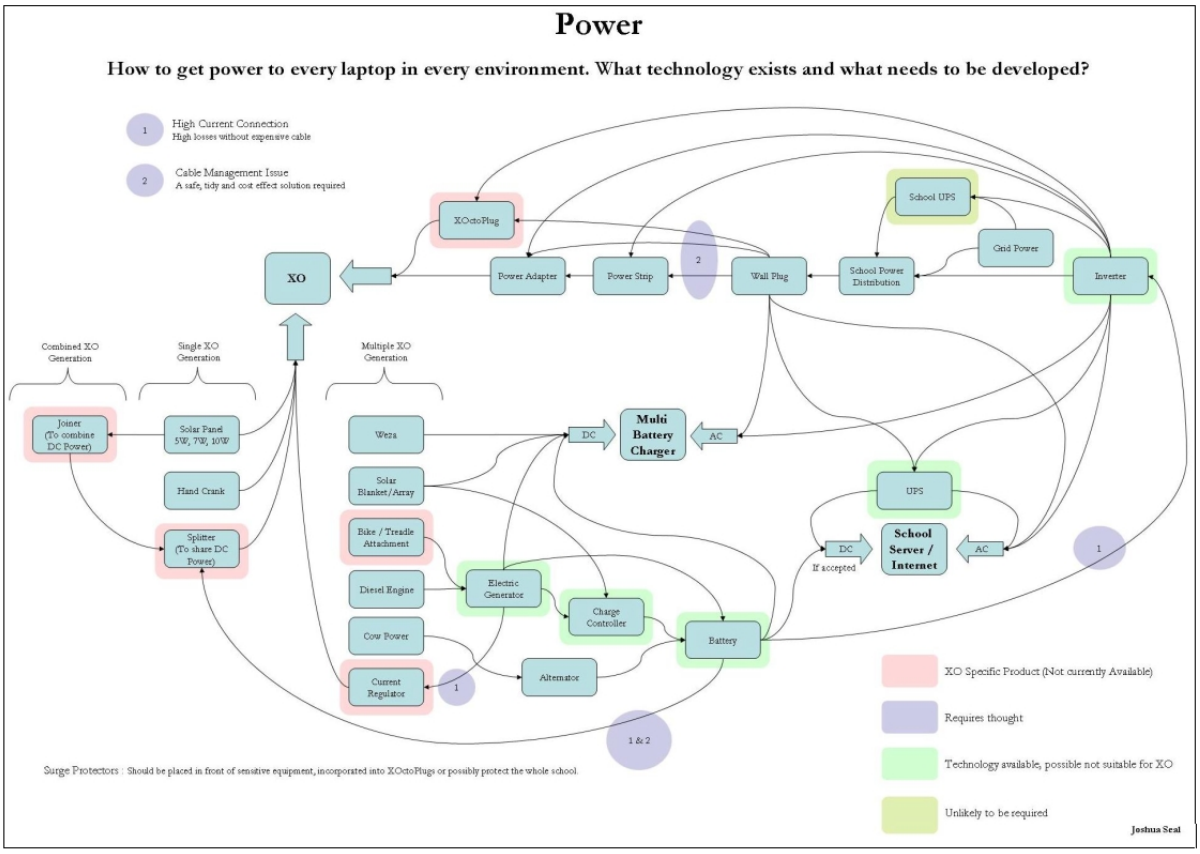
Figure 3-2: Power options for LCCDs



Source: http://wiki.laptop.org/index.php?title=Battery_and_power&oldid=213071

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3.2 Software

?*Software* refers to the LCCD's operating system and applications, as well as to the educational content delivered to the LCCD..

?

3.2.1 Applications

?*Applications* refer to programs such as word processors, spreadsheets, databases and Internet browsers.?Basic applications are not necessarily a significant cost item, depending on: (i) the type of LCCD; (ii) the operating system; and (iii) software applications desired.

All low-cost computing devices come with some application software, along with the operating system.?One cost consideration is whether commercial software such as the Microsoft Office suite of applications is necessary. If so, this software will need to be purchased; however, software manufacturers often?give significant discounts for educational use of their software in many countries.[37]

Many software applications are available at no cost. For example, popular Internet browsers (*e.g.*, Explorer, Firefox, Chrome, Opera, etc.) are free and run on different operating systems. Likewise, the Adobe Acrobat document reader is also a free download and runs on various operating systems. The *OpenOffice* suite can be downloaded for free and includes word processing, spreadsheet, presentation, graphic and database software.[38] It is available in various languages, runs on a number of operating systems (*e.g.*, Windows, Linux), and can read and write files from other common office software packages.

?

In some countries, LCCDs must be usable with?open-source software, because of?the high cost of commercial applications. There is also a philosophical argument that commercial applications are not really necessary for primary school children:

?

> "Children—especially young children—need the opportunity to learn far more than Word Excel, and Powerpoint. Of course, picking up these skills, having grown up with a laptop, will be readily accomplished."[39]

?

[37]Microsoft offers a Windows/Office bundle to Chinese students for $3. See: http://blogs.techrepublic.com.com/hiner/?p=525. It also has the same deal for Russian students: http://www.silicontaiga.org/home.asp?artId=7535

[38]http://www.openoffice.org/

[39] http://laptop.org/en/laptop/software/index.shtml

3.2.2 Content

The term c*ontent* covers the educational materials developed for use on computers and other LCCDs. That?will have to be developed that is specific to the educational system of each country. Development costs vary depending on:

- The complexity of the content that needs to be created;
- ?Whether?content already exists that can be modified for the LCCD that is being distributed;?
- Whether content from other sources can be utilized;?
- Whether the languages used in the country are specific to that country, or whether developers can draw on content developed in countries where the same language is spoken; and?
- How much of the content development is done?"in-house" and how much is?contracted to third parties.

One of the consequences of conducting technology trials, or starting pilot projects, is that content development will initially consume a larger portion of up-front costs. In Haiti, for example,?the development of Creole language content accounts for 2.6 per cent of total pilot project costs. But this?content can continue to be used if the pilot is scaled-up to a full program, so the total cost will be lower over time.

?

The availability of free content can help to alleviate these costs. The One Laptop Per Child (OLPC) effort?works with "Wikieducator," a site for open sharing of?curricular materials. In the Solomon Islands OLPC pilot, primary schools are using free biology lessons downloaded from the Wikieducator site.[40] The pilot project was also able to draw on content developed for an earlier distance-learning project covering teacher training in local languages, as well as agricultural content on beekeeping, turtle conservation and chicken farming.

?

[40] http://wiki.laptop.org/images/c/ca/Solomons_OLPC_Deployment_Report_Aug08.pdf

3.3 Training

Teachers and students require training on how to use LCCDs. Beyond that, teachers? need to understand how to use LCCDs in the classroom environment and incorporate them into their teaching methods.

Training in basic maintenance and repair may also be necessary in order to keep LCCDs operational. Some LCCD projects have an extensive support system of volunteers that can help defray training costs. Techniques such as “training the trainers,” where initial teachers or students are formally trained and they pass on what they learned to others, can also help to lower costs.

Training costs can also be internalized and incorporated into existing training frameworks. ICT learning is also different in that there is a significant amount of free training material provided with LCCDs or available online. Once initial skills have been taught, further advancement often depends on self-initiative and making use of the large amount of free training materials.??

?

3.3.1 Teachers

Teacher training involves a number of steps, which are generally sequenced. The initial group to receive LCCDs requires training in integrating the LCCD into the classroom environment and in routine trouble-shooting and maintenance. Those teachers, in turn, generally pass their experience on to the next group to receive LCCDs.?

The LCCD project plan for Paraguay, for example?illustrates how the “train the trainers” scheme is used. Four consultants were hired to train 20 teacher trainers, who in turn will train the 146 teachers from the participating schools.[41]

?

?[41] http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=1801223

3.3.2 Students

?Student training is typically not a cost item since it is part of the educational process. In other words, students learn how to use the LCCDs in the classroom, just as?they would learn mathematics or science.?

?

3.4 Sustainability

Sustainability costs revolve around elements for maintaining and monitoring the LCCD program. This includes equipment maintenance, repair, replacement and disposal, as well as?monitoring and evaluating the impact of the project.

?

3.4.1 Maintenance

LCCDs and other supporting equipment, such as servers and networking components, require maintenance and repair. In addition, support staff—including new personnel to be hired or contracted—need to receive LCCD maintenance training.

One way of managing maintenance and support costs is to introduce a tiered system. This involves providing adequate training at the local level, where the LCCDs are installed, to handle routine software and hardware fixes. This ensures that basic repairs can be made without having to send the equipment somewhere else, depriving students of LCCDs for a long period. A more sophisticated level of maintenance and repair can then be?provided at regional or national levels for more serious problems.

?

Maintenance costs depend on how the program is designed. Costs can be internalized if existing students and staff are trained in basic repair and maintenance and, in turn, pass their knowledge on to

others (“train the trainers”). Specialized staff will require training for more sophisticated repair activities.?

?

In some cases, maintenance and repair support has been included as part of the bidding requirements for government tenders.?Project administrators should obtain performance guaranties and equipment warranties?from vendors whenever possible.? They should also scope out the?logistics for getting LCCDs repaired or replaced.

?

Any LCCD program should?also maintain a stock of new components and replacement LCCDs. In the case of Haiti, for example,?5 per cent of project costs were set aside for replacement stock-piling.

?

3.4.2 Recycling

Policies must be established for the environmentally sound disposal of LCCDs and other equipment. The movement to distribute LCCDs in?schools?is a relatively recent phenomenon, so experience in this area is still evolving.?Furthermore, most LCCDs have yet to reach the end of their lifespans. For example, the estimated lifetime of the XO is five years.[42] One step governments could take is to raise this issue with vendors and see if they would be willing to recycle the equipment.

?

[42] http://wiki.laptop.org/go/XO

3.4.3 Monitoring

The?purpose of most LCCD pilots is to test the suitability of a particular?LCCD for the learning environment.? So it is vital to establish?a monitoring and evaluation process.?This involves testing students prior to the introduction of the computers, and then later evaluating how the computers impacted the students’ learning. The evaluation also should include testing the suitability of the LCCD, as well as the utility of the?supporting infrastructure and environment.

Costs for evaluation might include the monetary compensation for?personnel to carry out the evaluation, as well as the development of "before" and "after" tests.?Monitoring and evaluation costs vary by country, depending on the detail and complexity of the evaluation. In Haiti, 3.9 per cent of project costs?are set aside for monitoring and evaluating the project. ?Part of the evaluation in Haiti is based on a standardized test administered by UNESCO throughout Latin America and the Caribbean.

3.5 Managing Costs Effectively

LCCD programs have significant costs, and successful?management of those costs is?critical to the process of generating?funding.?One decision is whether the national government should adopt a national plan to minimize cost elements through economies of scale or whether local school administrations should adopt their own plans.

The scope of the project informs this decision.?If the LCCD initiative is still?in a pilot phase, then procurement may not require?centralized intervention. Indeed, most pilots are small-scale efforts,?often largely financed through development assistance and donations from equipment vendors. Therefore, they do not require a significant initial outlay from the government.?Furthermore, local administrations might be better placed to form partnerships and more able to get the project off the ground quickly.

?

A large-scale implementation through the government’s education ministry, however,?can aggregate purchases to achieve lower costs.?The national government is also more likely to have procurement expertise and the capability to evaluate rival offers.?One method of selection is?to use a tender process, in which?the project's requirements are laid out in detail.?In Brazil, for example,?a tender process was integrated into the country’s "e-procurement" system.

4 Implementing a Sustainable LCCD Programme

This section of the toolkit?identifies elements necessary to achieve a sustainable low-cost computing device (LCCD) program.

4.1 Project Coordination

The implementation of an LCCD program is a complex undertaking.?LCCDs can have?significant impacts on classrooms, teachers, training methods, distribution of educational materials and curriculum.?They also affect school funding and infrastructure requirements (*e.g.*, electricity and networking).?Given the complexity of such?programs, many countries have chosen to?implement LCCD projects with various?partners.

The decision to implement an LCCD program is sometimes made at the highest level of government.?If the government changes, then there may no longer be support for the program. This was the case in Ghana and Nigeria, where new governments stopped LCCD programs.?One way to avoid this is to create?a national coordinating committee, which adds legitimacy and sustainability to the project.

?

Once the decision is made to implement a low-cost computing device program, it is generally coordinated through the country's educational ministry.?Furthermore, partners often insist on some kind of commitment from the education ministry before they will participate.

?

Although the education ministry may take overall responsibility for the program, ongoing management is sometimes delegated to a technical branch of the ministry or another agency of the government.?In Uruguay, the Technological Laboratory of Uruguay (*Laboratorio Tecnológico del Uruguay* or LATU), a quasi-autonomous organization, coordinates the country's LCCD program.?LATU is managed by a board of directors overseen by a government representative (from the Ministry of Industry, Energy and Mining), a representative from the Chamber of Industry, and a delegate from the central bank.

?

In Haiti, the Ministry of Education and Vocational Training (MENFP) is responsible for overall LCCD coordination.? It chairs the ICT in Education Steering Committee, which consists of both public and

private sector representatives that oversee the project.?The pilot is implemented by the Project Coordinating Unit (PCU), located within the MENFP.

?

In Nepal, the LCCD project is coordinated by the Department of Education, with input from the Ministry of Education and Sports, the Curriculum Development Center and the National Center for Educational Development.? Participants also include?non-governmental organizations (NGOs) and international partners such as Danish development assistance (see figure below).?School administrators, teachers and parents are also part of the implementation process.?The Open Learning Exchange (OLE), a Nepalese NGO, has an agreement with the government of Nepal to help implement the project.

?

Table 7-1 provides a list of project responsibilities among different partners.

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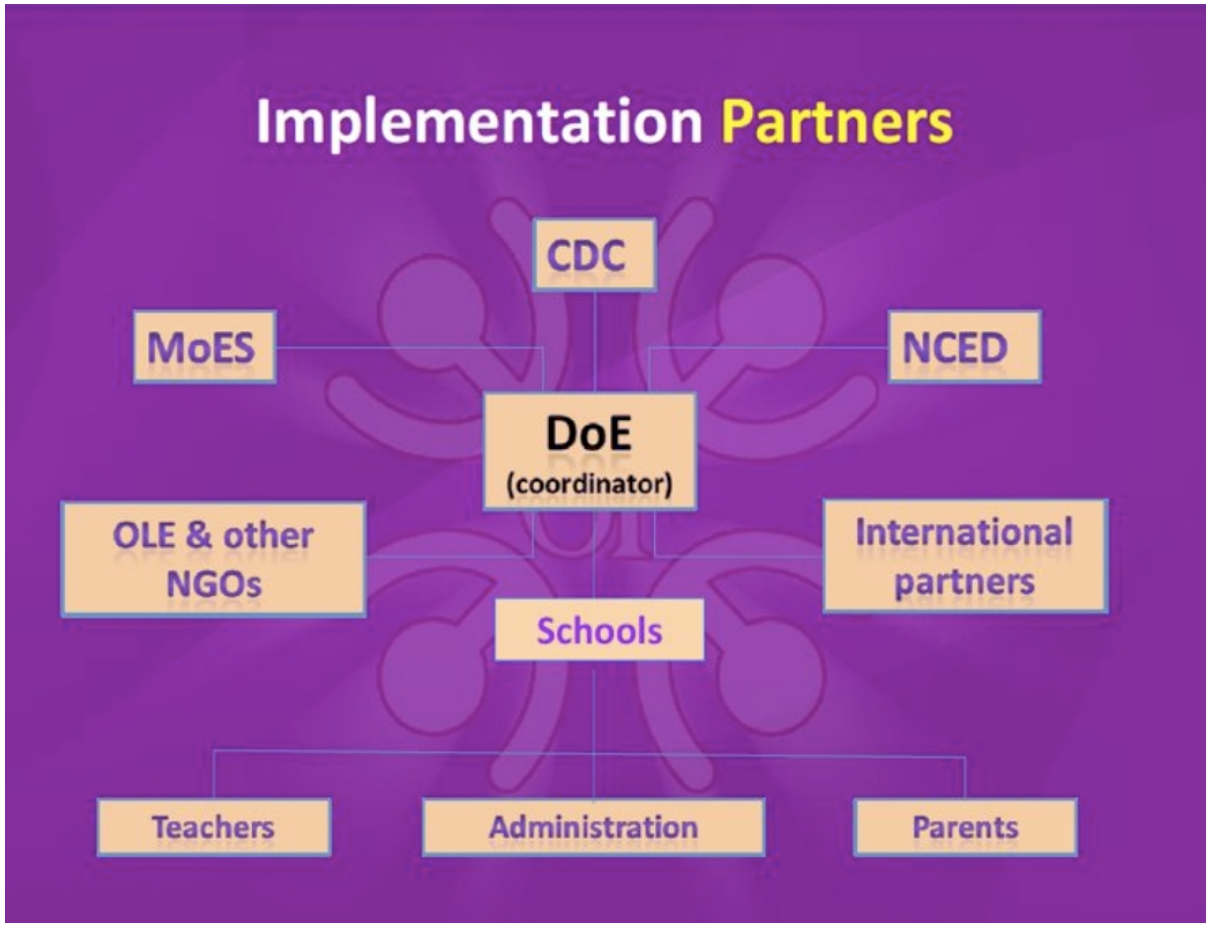
Figure 4-1: LCCD Project Coordination and Partners in Nepal



Note: DoE = Department of Education, MoES = Ministry of Education and Sports, NCED = National Centre for Educational Development, CDC = Curriculum Development Center, OLE = Open Learning Exchange.

Source: Open Learning Exchange Nepal.

4.2 Funding

A full-scale, one-to-one LCCD program typically exceeds the resources of most developing nations. Consider?Nepal,?where the government has drastically raised the education budget, planning?to spend?USD 688 million for the 2009/2010 school year.[43] Assuming a price of USD 150 for each LCCD, and with 4.4 million primary students, the cost of providing each Nepalese pupil with an LCCD would be USD 663 million -- practically the entire education budget.

In addition, if countries opt for the one-to-one model, they need to realize that this is a long-term commitment, since each year there will be a new class of children that will require their own new laptops.

Most LCCD programs are conceived as public-private partnerships so that costs can be spread among various parties.?In addition, some vendors sponsor initial donations of computers for pilot projects.?Somewhat surprisingly, development assistance has yet to be significant in this area, despite the educational potential and economic importance of access to ICTs.

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[43] http://www.pustakalaya.org/eserv.php?pid=Pustakalaya:675&dsID=SSR_Plan_Oct_15_Draft_Despatch.pdf

4.2.1 Government

Governments usually must cover some funding to demonstrate commitment and sustainability:

?

> The OLPC Association focuses on designing, manufacturing, and distributing laptops to children in lesser developed countries, initially concentrating on those governments that have made commitments for the funding and program support required to ensure that all of their children own and can effectively use a laptop.[44]

?

The extent of the government's financial support will depend on the scope of the program. A pilot project in a few schools will not entail significant government resources, whereas a full-scale national implementation would call for a government funding commitment.

?

In Haiti, the government is only financing USD 100,000, or 2 per cent, of a pilot LCCD program, with the balance coming from the Inter-American Development Bank and the OLPC Foundation. A key government decision will be how much it can internalize costs by absorbing the resources required for a LCCD program into existing processes. This will require prioritization of educational goals to show commitment to LCCDs and one-to-one computing.

?

Some governments have made a serious commitment to LCCD for schools by providing significant funding.?A few middle-income countries are largely funding LCCDs from their own education budgets. In the case of Uruguay, for example, the government allocated 497 million Uruguayan pesos (USD 21 million) to its LCCD program in 2007, almost 3 per cent of its education budget.?The Uruguayan government has attracted other partners to the program to help defray costs. This includes the incumbent telecommunication operator, which is providing Internet access.? Meanwhile,?a group of volunteer students has been set up to provide?computer training.

?

In Brazil, the federal government funds equipment, Internet access, training and assessment, while state and municipal governments are expected to provide the necessary school infrastructure (*e.g.*, electricity) and logistical support,?and to forge partnerships with other stakeholders and potential funding sources.

?

[44] http://laptopfoundation.org/en/program/

4.2.2 Private Sector Involvement

The private sector has been active, in some countries, in supporting low-cost computing device initiatives. Vendors such as OLPC and Intel have donated LCCDs for numerous projects around the

world. OLPC also has a facility on its web site allowing individuals to contribute money for donated computers.[45]

A growing number of telecommunication firms are becoming active in low-cost computing programs. They can use their?network management experience, particularly in countries where Internet access has been part of the deployment.?Although the provision of networking services has been a typical support activity, some operators have also donated computers. Examples include:
?

- In **Afghanistan**, mobile operator Roshan has provided networking support for the country's low-cost computing device project, as well as project management skills.
- MTC, a mobile operator in **Namibia,** contributes 1 per cent of its revenues each year to social projects.?It has invested over USD 1 million in the purchase and distribution of laptops with broadband connectivity.?Because many schools in Namibia are not connected to the national power grid, MTC is also giving generators to more than?300 schools,?in order to power the computers.[46]
- In **Uruguay**, the incumbent telecommunication provider ANTEL has supported the country's student laptop program by providing Internet connectivity to schools,?with a discount on the service fees.[47]
- ?In **Mexico,** Carlos Slim, has donated 100,000 computers to public schools through the Casa Telmex Foundation.[48]?Based on the Intel Classmate, the computers are being distributed to some 1,400 junior high schools throughout the country.? Mr. Slim is the majority owner of America Movil, Latin America's largest mobile operator group, as well as the incumbent Mexican operator, Telmex,

?

?

[45]?http://laptop.org/en/participate/ways-to-give.shtml

[46]?http://www.itnewsafrica.com/?p=1273

[47]?http://www.elpais.com.uy/081226/ultmo-389562/ultimomomento/antel-subsidia-conectividad-de-escuelas-para-plan-ceibal

[48]?http://www.carlosslim.com/responsabilidad_fundacion.html

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4.2.3 Non-Governmental Organizations (NGOs)

Non-Governmental Organizations (NGOs) are also supporting various LCCD programs. The Internet Society, for example,?has provided funding to?evaluate the LCCD project in the Solomon Islands.[49] In one of the world's largest non-governmental LCCD programs, the Volnoe Delo Educational Foundation is providing funding for implementing LCCDs in Russian schools.[50]? In Uganda, the Maendeleo Foundation operates a Mobile Solar Computer Classroom. A jeep takes Classmate PCs to schools in different villages; the LCCDs are recharged using solar panels mounted on the roof of the jeep.[51?]?

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[49] http://www.picisoc.org/tiki-read_article.php?articleId=45

[50]http://www.basel.ru/en/media/news/2008/news_23_12_2008/

[51?]http://www.intelchallenge.com/mobilesolar

4.2.4 Development Assistance

Some multi-lateral and bi-lateral development agencies are playing a significant role in the LCCD movement.?For example, the Inter-American Development Bank (IDB)[52] is providing funding support for LCCD pilots in Haiti[53] and Paraguay.[54] In Uruguay, it has provided assistance for technical support and evaluation of the LCCD program[55] and its extension to secondary schools.[56] The IDB is also funding evaluation of LCCD pilots in Brazil.

In terms of bi-lateral assistance, the United States Agency for International Development provides assistance for Afghanistan's LCCD project.[57] The Danish government is assisting with funding an LCCD pilot project in Nepal.[58]

?

[52] http://www.iadb.org/news/detail.cfm?language=English&ARTID=3668&ARTTYPE=pr&PARID=2&id=3668&CFID=1709965&CFTOKEN=51997935

[53] http://www.iadb.org/news/detail.cfm?artid=4413&language=En&id=4413&CFID=1280276&CFTOKEN=76605445

[54] http://www.iadb.org/Projects/project.cfm?id=PR-T1081&lang=en

[55] http://www.iadb.org/projects/Project.cfm?lang=es&id=ur-m1029&project=ur-m1029&query=

[56] http://www.bid.org.uy/projects/project.cfm?lang=en&query=&id=ur-l1058&project=ur-l1058

[57] http://afghanistan.usaid.gov/en/Article.540.aspx

[58] http://www.ambkathmandu.um.dk/en/menu/TheEmbassy/News/DanishsupporttoMinorProject.htm and http://www.ambkathmandu.um.dk/en/menu/TheEmbassy/News/DanishAmbassadorvisitsOLPCTestschool.htm

4.2.5 Volunteers

Although volunteers do not usually?provide direct funding, they can indirectly help defray training and logistical costs by providing free and often skilled labor.?Volunteers have been used in various LCCD projects, particularly to assist with training activities.

In Uruguay, volunteers are organized under the *Support Network of the Plan Ceibal* (*Red De Apoyo al Plan Ceibal* or?*RAP CEIBAL*).[59] University students, professionals and retirees from all over the country participate in local groups that offer assistance in areas such as equipment delivery, training children in using the LCCDs, developing learning exercises for students and parents and researching technical issues.

OLPC has an *OLPCorps Africa* project, in which 30 college students have been?trained to provide technical support for OLPC pilots throughout Africa.?After a 10-day orientation course in Rwanda, volunteers were sent in teams of two to different African countries for up to 10 weeks. They were provided with 100 XO laptops for deployment and USD 10,000 to cover costs.?The OLPC also organized an internship program for college students to work with local personnel?in Peru and Uruguay, where they?help to implement LCCD programs.[60]

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[59] http://rapceibal.blogspot.com/

[60] http://laptop.org/en/participate/get-involved/internships.shtml

?

4.2.6 Parents

In some countries, parents are required to contribute towards defraying the cost of purchasing the?low-cost computers.?This can lead to reduced theft and damage, if?parents and students assume ownership and responsibility for the equipment they have purchased.

In Rwanda, parents of students in private schools must purchase LCCDs. Arrangements are being made for long-term loans from banks to be repaid by parents of students.[61] Similarly, in Nigeria, parents of students from the private Corona Secondary School have purchased Classmate PCs for their children.[62]?In Portugal, the *Magellan* program charges parents for LCCDs based?on their economic situations.?Low-income households do not have to pay,?while?medium-income families pay EUR 20 and those with highter?incomes pay EUR 50.[63]

?

[61] http://allafrica.com/stories/200901080184.html

[62] http://download.intel.com/intel/worldahead/pdf/casestudy_nigeria.pdf

[63] http://www.magalhaes.gov.pt/portal/server.pt/community/e-escolinha/faq#Quanto_custa_o_computador [A Portuguese mobile operator ran?a contest in early 2009 to award one Magalhães PC per day for users who had topped-up their prepaid cards.? See http://www.telecom.pt/InternetResource/PTSite/UK/Canais/Media/DestaquesHP/uzomagalhaes.htm]

4.2.7 Universal Service Funds

Universal service funds can be a?source of financing in some countries.? These funds, generally administered by the nation's telecommunication regulator, are composed of contributions from operator revenues.? They are normally designed to defray the costs of?providing telecommunication?services in remote or rural areas, or to subsidize services for low-income?users.??Universal service funds?have been used in several countries to finance the acquisition of computers for schools:

- In **Colombia**, the *Computers for Education* project draws on the country's universal service fund to distribute recycled computers to schools.[64]?More than 14,000 schools have benefited from the project, which has distributed more than 200,000 computers.
- ?In **Morocco,** the universal service fund is used to finance the country's *GENIE* program, which?installs computer labs in schools.?In 2006, the program financed the distribution of more than?27,000 computers in more than 1,800 schools, impacting some 1.4 million students.[65]?
- In **Nigeria**, a tender was issued in 2009, inviting bids to install?to 100 PCs?in each of 550 secondary schools across the country. The project will be financed by the Universal Service Provision Fund.[66]

?

64 http://www.computadoresparaeducar.gov.co

65 ANRT. 2008. *Rapport Annuel 2007*.

66 http://www.uspf.gov.ng/index.php?categoryid=11&p13_sectionid=1&p13_fileid=23

4.2.8 Student Installment Plans

One method to help students buy low-cost computers is to let them pay over time, on an installment plan.?This makes the computers more?affordable and allows the students to begin using them immediately.

Installment programs are generally aimed at secondary and, more often, tertiary-level students. One of the first countries to implement this type of program was France. The Ministry of National Education launched the *MIPE*?(*Micro-Portable Etudiant*) program in 2004.? The effort was undertaken?in conjunction with almost all of the country's universities,?as well as with?private partnerships involving computer vendors and banks.[67]?MIPE offers university students an opportunity to purchase a laptop with Wi-Fi capability and pay for it in?installments. The payments are spread out over three years -- roughly the equivalent of paying EUR 1 per day.[68] For their part,?the universities have agreed to provide free Wi-Fi access.

More recently, the Portuguese government has worked with mobile operators to give secondary school students laptops, bundled with mobile broadband subscriptions (see the Portugal Case Study).?In

Namibia, mobile operator MTC offers university students a laptop for NAD 3,999, with a discount on monthly mobile broadband Internet access.[69]

?

[67] http://delegation.internet.gouv.fr/mipe/projet.htm

[68] http://www.atelier.fr/statistiques/10/30112004/operation--pc-1-euro-jour--40000-unites-vendues-28720-.html

[69] http://connected.mtc.com.na/

4.2.9 Donations

Contributions of money or used computers can help defray expenses.?Used computer donations are a key component of recycled computer programs, and they can play a part in projects to spread computers to schools in developing countries.?Computer Aid International accepts donations from both businesses and individuals.[70]

One?example of a national program is?*Colombian Computers for Education*, which accepts used computers from companies, the public sector and individuals.[71] OLPC accepts cash donations, which are then used to purchase a laptop for a child in a developing country.[72]

?

[70] http://www.computeraid.org/businessdonors.htm

[71] http://www.computadoresparaeducar.gov.co/website/es/index.php?option=com_content&task=view&id=88&Itemid=228

[72]? http://laptop.org/en/participate/ways-to-give.shtml

?

4.3 Distribution

?

Under the one-to-one LCCD philosophy, each child has his or her own computer.?In practice, however, this may be difficult for most developing nations to achieve, given the enormous expense of outfitting each child with a computer --?particularly in countries with large populations of children.

?

Although one-to-one computing may be a long-term strategy, in the short term, governments may have to?make choices about which schools and which students should benefit immediately from LCCDs, and which populations?will have to wait. One of the first distribution choices is deciding which grades should benefit from the program. Many programs and most LCCD features are aimed at primary schools, but there have also been implementations in secondary and even tertiary-level institutions.??

?

One approach may be to establish initial pilot projects in different school environments.? In a monitored environment, authorities can then test how?LCCDs will be used?in those?different school situations.? They can compare LCCD pilots in?urban and rural settings, with?public and private schools, and with younger and older students.?

?

This was the approach taken in Haiti, where a representative sample of different school environments was selected.[73]?Determining a representative sample size will determine the number of LCCDs that will be needed for a pilot to ensure a scientifically accurate evaluation across a range of school environments.

?

Saturation

?

Another distribution strategy is *saturation.*?This involves selecting?a small number of schools, but then providing LCCDs to all students, in all grades, in those schools. The benefit of this approach is that the pilot can be tested across a range of grades in one environment. Also, this?often requires fewer LCCDs and minimizes resentment among children that might arise if some students have LCCDs and others do not.[74]

?

One way of achieving saturation with a wider school distribution is through *sharing the LCCDs*, particularly where schools are operated in shifts.?For example, this was done in a few areas of Brazil.?One drawback is that students cannot take the LCCDs home to share with parents. This can be an issue where the intent is to implicitly raise household computer and Internet connectivity by having parents and siblings use the devices.? It may also be a problem if school administrators are counting on students to recharge the LCCDs' batteries at home.?

???

Another factor influencing the distribution for testing would be school and community acceptance. In Afghanistan this was one of the reasons cited for the selection of the first pilot school:

?

> "The parent's attitude, community acceptance, teacher's and school's representative overall attitude towards OLPC were the major factors for selection. Also the school size and the number of students in that school was the best match for our first pilot school."[75]

?

Electricity

?

The goal of many LCCD programs is to provide computers in rural areas. The main factor impacting this is the availability of electricity. For example, Brazil's *ProInfo* project established specific pre-qualification criteria for schools interested in obtaining computers.? One of those prerequisites?was the existence of electricity (see table below). Governments can install electricity in rural areas that are targeted for LCCD programs. However, the costs?can be high, particularly if the area is a long distance from the electricity grid. Other options include providing stand-alone solutions, such as diesel-powered generators or solar energy. Another consideration for areas with a lack of electricity is the type of LCCD selected. Some offer a number of off-grid and human-powered solutions for re-charging the battery.

?

?

Table 4-1: School Selection Criteria for Brazilian ProInfo Project

?	Rural	Urban
Type of School	Elementary	Elementary
Number of Students	>50	?
Electricity	Yes	Yes
Informatic lab	No	No

Source: http://portal.mec.gov.br/index.php?option=com_content&view=article&id=236&Itemid=471

?

Distribution Timetable

?

If the decision is taken to scale-up the program to incorporate the whole country, a timetable will be needed, since not all of the?devices can?be distributed simultaneously.?In Uruguay, LCCDs were distributed:?

- First, to a school in a pilot school in one province,
- Second,?to all the schools in the same province, then
- Third,?to all schools nationwide except for the capital, and finally
- Fourth, to?the capital (see figure below).

The process will take approximately three years, but it will?ensure that the less-privileged schools outside the capital receive LCCDs first. In Brazil, the current phase of the LCCD program calls for distributing 150,000 LCCDs to 10 schools in each of its 27 provinces, as well as in five municipalities.

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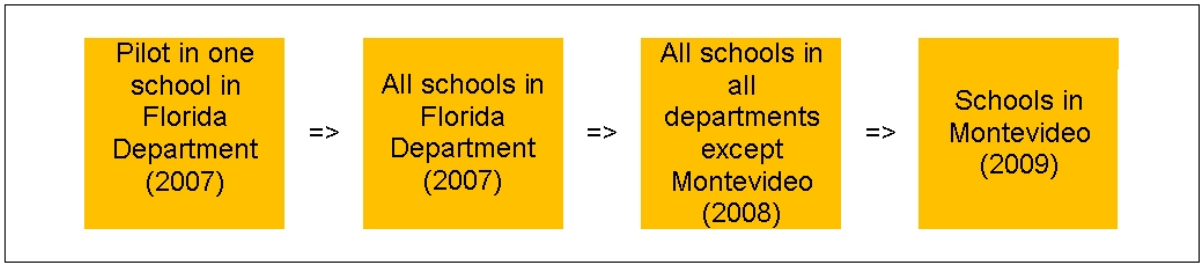
Figure 4-2: Sequencing LCCD Distribution in Uruguay



?Note: Departments are the top level administrative unit in Uruguay equivalent to a province or state. There are 19 departments in Uruguay.

Source: Plan Ceibal.

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Another concern might be to prevent?LCCD distribution only to the most privileged elements of the population.?Most of the trials and deployments to date, however,?have adopted?a conscious policy of distributing computers to public (rather than private) schools, generally outside urban areas.?In order to avoid allegations of favoritism or corruption,?the rationale and plan for LCCD distribution?should be documented and made publicly available.

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?[73]http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=1364380

[74]Schools in the Solomon Islands requested that they be saturated in the next phase of trials but the education ministry decided that evaluating the impact across different provinces was more important. http://wiki.laptop.org/images/c/ca/Solomons_OLPC_Deployment_Report_Aug08.pdf

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75 http://wiki.laptop.org/go/OLPC_Afghanistan/Deployment_News

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4.3.1 Gender Issues

Explicit discrimination regarding gender has not been a significant issue in the on-going LCCD trials and implementations around the world.

The concept of one-to-one computing is inherently more equitable than a shared environment, in which some students could come to dominate access to the limited number of computers.?Problems with equitable distribution are more likely to arise as a result of the existing socio-cultural environment in a country.?For example if schools are not integrated by gender, then there is more scope for a lack of transparency in LCCD distribution.?In Afghanistan, where many primary schools are separated by gender, LCCDs were distributed to a girl's school and a "mixed" school in Kabul. In the mixed school, girls study in the morning and boys in the afternoon.[76]

LCCDs also hold the potential to become devices for empowering and training mothers, if?students are allowed to bring them home.?OLPC has found that bringing home an LCCD has a great influence on the entire family.? Children often?teach computer skills to their?mothers and even grandmothers.?For this reason, OLPC often insists that governments let children take the LCCDs home.?

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76 http://wiki.laptop.org/go/OLPC_Afghanistan/Deployment_News#Second_Phase_of_Deployments

5 National Case Studies

The following national case studies illustrate varous aspects of the cost, coordination, logistical?and management issues associated with implementing and sustaining a program to provide or support low-cost computing devices in schools:

- Afghanistan case study

- Brazil case study

- Nigeria case study

- Peru case study

- Portugal case study

- Rwanda case study

- Uruguay case study

6 Conclusion

Greater government focus on ICTs for education, and ongoing reductions in the price of laptops for students, are generating a lot of?interest in the potential?for boosting computer availability for students in developing countries.?This?module has examined various issues that should be considered in implementing an LCCD distribution program?for schools.?It also has presented a variety of country experiences. Based on the analysis, several conclusions can be drawn:

- The selection of a particular LCCD depends on a country's educational strategy and development status.?Some LCCDs, such as the OLPC XO and Intel Classmate, are expressly designed for children in developing countries, featuring special ergonomic and technical features.?Other laptops may not have these features and?may not be as appropriate for young children.? Some laptops may not be suitable in?difficult environments, such as extreme temperatures or lack of electricity.?
- ?The selection of a particular LCCD is also dependent on the pedagogical orientation of a country, as well as on government software policies and the age of the schoolchildren.?The OLPC XO, for example,?is specifically aimed at primary school children and may not be suitable for older students.?At the same time, traditional, mass market laptops may not be as appropriate for primary school students.?Some countries have policies?to adopt or favor?certain operating systems and software, which also impact LCCD selection.?
- The immediate introduction of a one-to-one computing model is beyond the financial capability of most developing countries.?Therefore, countries need to consider a phased approach involving a mixture of installing computer labs and distributing individual computers --?the two methods are complementary rather than inconsistent.??One-to-one computing will radically impact the school environment.?Governments and educational institutions must consider the positive and negative aspects.?For example, one-to-one computing democratizes ICTs by making an LCCD widely available to all children regardless of income level, urban or rural location or gender. They can also be taken home, so that?every household with a child also becomes a household with a computer. This may well be?disruptive to the established learning environment.?
- Objective studies about the costs and benefits of education-oriented laptops, commercially available laptops, recycled computers and thin clients are still lacking. The evidence to date is

not entirely convincing, because?it is typically sponsored by organizations that have an interest in?a particular solution.?Countries also need to be aware that, although there is an altruistic element to many LCCD programs, private companies are profit-oriented.?Governments must carefully evaluate LCCDs and plan programs that are driven by the educational sector's needs and resources, rather than driven by?offers of donated computers for pilot projects.?

- There must be a long-term commitment to one-to-one computing and LCCDs.?Each year, new students will enroll and need additional?LCCDs.?Governments need to ensure ongoing funding and sustainability to?support this.?
- Another financial challenge for developing countries is the need to balance the introduction of broadband Internet connectivity in schools with promoting one-to-one computing. ?The goals of one-to-one computing and broadband connectivity are both important, but with limited budgets, governments need to balance priorities.? Therefore, it may be difficult to implement both one-to-one computing and broadband connectivity simultaneously.??One-to-one deployment plans may need to be adjusted in order for schools to also attain Internet connectivity.

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7 Checklist

Several useful steps, or decision-points,?in implementing an LCCD distribution program can be summarized in the following "checklist."?

Coordination

LCCD projects are usually a collaboration between the ministry of education and other partners such as NGOs, international donors and the private sector. Who will participate in the project? Who will take overall implementation responsibility, including integration of pedagogical questions, dealing with LCCD vendors, handling technological issues, coordinating transport and delivery and liaising with schools and volunteer groups? This step involves answering these threshhold questions.

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School Designations

Which schools will participate? How many students and teachers will be involved? Do the schools have electricity? What languages are spoken? What is the transportation situation? Are parents supportive?

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Finance

Where will funding come from? How much are import duties and taxes? Should a tendering process be used? How much of the project should be outsourced?

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LCCD Selection

What are the requirements for the LCCD (*e.g.*, operating system, applications, battery life, national language interface, keyboard, etc.)? How much does it cost? What kinds of discounts are available? What kind of support network (*e.g.*, content, training manuals, etc.) is available? What kind of warranties can be obtained? What kind of battery re-charging and plug configuration are available? Should LCCD selection be tendered?

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Networking

Is networking capability needed for the project? Do schools have access to the Internet? What kinds of connectivity options are available (*e.g.*, dial-up, DSL, WiMax, 3G mobile, VSAT)? Is mesh networking needed? What are the costs of networking (*e.g.*, installation?of network adapters and routers,

recurring?service costs)? Can local telecom operators or?ISPs assist with networking? Are firewalls needed for content control?

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Transportation and Distribution

How far is the country from the LCCD manufacturing location? What is the lead time for manufacturing the LCCDs? How will the LCCDs be transported (*e.g.*, by air, by ship, etc.)? What are customs formalities and how long is the delay? How will the LCCDs be distributed within the country? What is the deployment schedule??

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Content

What education content is needed to support teaching? What content comes with the LCCD? What content is available through the LCCD support network? Is it free? How easy is it to convert existing national content for use on the LCCD? Will new, nationally developed content be needed? Is content documentation available? How will free content be downloaded from the Internet and distributed?

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Servers and Peripherals

Will servers be used? What kind of computers will be used for the servers? How much additional disk space is needed? What kind?of?peripherals (and how many) will be needed (*e.g.*, printers, scanners)? Should servers be included in a tender? Should server support be outsourced??????????????????????????????????????

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Electricity

How will LCCDs be recharged (*e.g.*, on-grid or off-grid electricity)? Will universal power supply (UPS) backup be needed? What is the recurring electricity cost? ????????????????????????

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Training

How will teacher training be implemented? What will be taught? What are the logistics (*e.g.*, centralized training or training on-site)? What kind of documentation will be needed? Should training be outsourced and/or included in a tender? Do the LCCDs themselves have training modules?

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Support and Maintenance

How will the project be technically supported? Should support be outsourced and/or included in a tender? What is the maintenance procedure? How will students and teachers be trained in routine

maintenance and troubleshooting? What stock of inventory should be maintained for spare components or replacement? What is the procedure for sending LCCDs for repair? How will equipment be recycled?

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Monitoring

How will the project be monitored and evaluated? Who will carry out the monitoring and evaluation?

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Table 7-1: Project Responsibility Checklist

Government	Vendor	International agency
??? Coordinate all the parties concerned within the country; ??? Nominate a national project coordinator responsible for coordination with the?education ministry?and all other partners; ??? Exempt duties and/or taxes for the computers; ??? Identify schools to receive the computers; ??? Arrange for local transportation of the computers from the port of entry to the designated schools; ??? Provide supporting infrastructure (including electricity), Internet connectivity, as well as printers, scanners, additional memory devices and servers as required at local sites and provide IT specialists to install networks in the targeted schools;	?????? Donate computers, including any necessary adaptations for use in the beneficiary country (e.g., operating systems, national language keyboards,?PIN configurations, etc.) and reasonable warranties; ?????? Cover shipping costs of the computers, including packing for export, shipping charges, airfreight or vessel charges and insurance from the originating country to the port of entry; ?????? Contribute human resources to provide training and support to teachers in the target areas where the computers will be delivered; ?????? Provide an IT expert to provide service and support to each participating country for at least 6 months;	??? Coordinate with other partners to identify applications and content-related requirements to be included in the computers; ??? Support local training by?underwriting?expenses, making arrangements for training at local/regional training institutes, etc. ??? Negotiate, through the project coordinator, signed agreements with the beneficiary country to ensure its commitment to the project; ??? Conduct an evaluation of the pilot phase of the project and identify areas for improvement; ??? Following the evaluation of the pilot phase, assist the beneficiary country to design a comprehensive national LCCDs in schools program and assist

??? Create awareness and organize community learning and information exchange campaigns, including meeting at all schools with?teachers, students and parents to build their support for the project; ??? Keep other partners informed; ??? Translate donated training materials into local languages as required; ??? Identify a team of IT specialists to participate in the technical maintenance and support training to be provided by the vendor, so that local IT specialists will be able to maintain and support the laptops. ??? Assume responsibility for software upgrades as required. ?	?????? Provide initial trainer(s) and training materials on the maintenance of the laptops so that each participating country can train IT experts to repair and maintain the LCCDs; ?????? Provide trainers,?training materials and training sessions for teachers and students on?use of the laptops, peripherals and content.	the beneficiary country in launching public tenders for the provision of?LCCDs.

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Table 7-2: Feature Comparison of Low-Cost Computing Devices for Students

?	**XO (OLPC)**	**Classmate (Intel)**	**Eee (ASUS)**
Price	USD 199[104]	USD 280[105]	USD 300[106]
Dimensions	242?228?32mm	7.5 x 9 x 1.5 "	8.9x6.7x1.33 “
Weight	1.45 Kg with LiFeP battery; 1.58 Kg with NiMH battery;	1.27 x 1.49 Kg	2.2 pounds
Battery life	22.8 Watt-hours (LiFePO4) 16.5 Watt-hours (NiMH);	6 hours (6-cell) 4 hours (4-cell)	Up to 3.5 hours

?	XO (OLPC)	Classmate (Intel)	Eee (ASUS)
	About 4.3-6 hours depending on battery and assuming 3.81 Watts[107]		
CPU	AMD 433 MHz	Intel 1.6 GHz	Intel 900 MHz
USB ports	3 (2.0)	2 (2.0)	3 (2.0)
Form factor	Convertible laptop with pivoting, reversible display	Clamshell or Clamshell/ Tablet	Clamshell
Random Access Memory	256 MB	1 GB/512MB	1 GB
Storage	1 GB	8/4/2 GB Flash	16 GB
Operating system	Sugar (Linux-based)/ (Windows XP also available)	Windows XP / Linux	Windows XP Home
Networking	802.11b/g; 802.11s (Mesh) networking;	10/100M Ethernet; 802.11 b/g; WLAN Mesh with Linux	10/100M Ethernet; 802.11 b/g)
Display	Liquid-crystal display (LCD): 7.5” 1200 ? 900	8.9" 1024 x 600 color LCD 7" 800 x 480 color LCD	LCD 8.9” 1024x600
Camera	Yes	Yes	Yes
External audio / video ports	Headphone and microphone	VGA, headphone and microphone	VGA, headphone and microphone
Warranty	30 days	1 year	1 year

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[104]http://laptop.org/en/participate/ways-to-give.shtml

[105] http://www.target.com/gp/detail.html/187-0628532-5318435?ASIN=B001LGZ7VO&AFID=Froogle&LNM=B001LGZ7VO|Mirus_Educational_IntelPowere

?[106]http://www.axiontech.com/prdt.php?item=80843&PRICECOMPARISONSID=9e92343b6782b68be9bfff81f0728d40

?[107]http://news.cnet.com/8301-13512_3-9768920-23.html

Credits

The Module on Low Cost Computing Devices for Schools was drafted by Telecommunications Management Group, Inc. (TMG) a highly regarded international consulting firm providing regulatory, economic, market, and financial advisory services in the telecommunications and information technology sector. TMG is comprised of a team of regulatory experts, lawyers, economists, market analysts, financial specialists, engineers, and spectrum management experts. Its senior consultants, many of whom are former government policymakers and regulators, have up to 30 years of experience in the international telecommunications industry and collectively have worked on telecommunications regulatory projects over 50 countries in Africa, the Americas, Asia, Europe and the Middle East. More information on TMG can be found at www.tmgtelecom.com.

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- Nigeria: Bridging the Digital Divide
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- Rwanda: OLPC Creates a Global Center of Excellence for Laptops
- Solomon Islands: OLPC Deployment Report 2008
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- Solomon Islands: OLPC Trials Deployment Report
- Solomon Islands: OLPC Trials Deployment Report
- Uruguay: Description of Plan Ceibal
- Uruguay: Plan Ceibal Delivers Laptops
- Uruguay: Provisions for a Universal Access Network

Case Studies

- Afghanistan Case Study
- Brazil Case Study
- Nigeria Case Study
- Peru Case Study
- Portugal Case Study
- Rwanda Case Study
- Uruguay Case Study