.lk

Sri Lanka

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Total population	20,010,000 est.[a]
Literacy rate (disaggregate by gender)	Male = 92.3%; female = 89.1%[b]
GDP per capita (PPP in USD)	4,265 est.[c]
	4,000 est.[d]
	4,259 est.[e]
Computers per 100 inhabitants	8.2 households[f]
Fixed-line telephones per 100 inhabitants	15.5[g]
Mobile phone subscribers per 100 inhabitants	45.7[g]
Internet users per 100 inhabitants	3.65[h]
	4.0[i]
Domain names registered under .lk	7,000 est.
Broadband subscribers per 100 inhabitants	0.33[i]
Internet domestic bandwidth	NA
Internet international bandwidth	0.24 Mbps/10,000 population[i]

(Sources: [a]DCS 2007a; [b]DCS 2001; [c]IMF 2008; [d]CIA 2008a; [e]WB 2008a;
[f]DCS 2007b; [g]TRCSL 2008a; [h]CIA 2008b; [i]ITU 2008; [j]WEF 2008)

INTRODUCTION

Sri Lanka is number 99 out of 177 countries in the Human Development Index (UNDP 2008) and number 90 out of 157 countries in the Economic Freedom Index (The Heritage Foundation 2008). In South Asia, Sri Lanka is performing relatively well in terms of per capita GDP, life expectancy, literacy, economic freedom, and overall policy environment. In e-Government Readiness rankings (UN 2008), Sri Lanka is 101st of the 189 countries surveyed, but toward the top of the South Asian group. The country's Network Readiness Index (WEF 2008) is 79th among the 127 countries, while its e-Readiness Index (*The Economist* 2007a) is 60th among 70 countries.

These figures demonstrate the resilience of the economy and the people of Sri Lanka in the face of the unstable ethno-political situation that has had significant economic and human costs over the past three decades. This resilience would be quickly converted to prosperity were the situation in the country to improve. It is against this hopeful backdrop that the status of information and communication technology (ICT) in Sri Lanka is presented in the following sections.

TECHNOLOGY INFRASTRUCTURE

The telecommunications industry has grown continuously since its liberalization in the early 1990s and particularly since the introduction of Global System for Mobile communications (GSM) for mobile telephony. In 2007, 2.74 million fixed lines and almost 8 million mobile subscriptions put Sri Lanka's teledensity at 51.3 per 100 inhabitants (TRCSL 2008a). Fixed phone teledensity is 13.1 (35.2 in the Colombo district) while the overall mobile teledensity is 38.2.

The mobile telephony sector continues to be the most aggressive and innovative with the introduction of High-Speed Downlink Packet Access (HSDPA)-based third generation (3G) technology by the two main operators, Dialog Telkom and STL-Mobitel. With initial coverage in Colombo, this is now available in many of the main cities.[1] In fact, Sri Lanka's telecoms industry is known as the first to implement the 3G, 3.5G, and HSDPA network in South Asia.

Competition in broadband services provision was introduced in 2007. Asymmetric Digital Subscriber Line (ADSL) is now available in all cities, with more package options and with a reduced entry level monthly subscription of USD 10.[2] More broadband options using Worldwide Interoperability for Microwave Access (WiMAX) technology and with bandwidths of 2–10 Mbps are also available in several major cities.

Dialog Telkom launched a mobile television (TV) service on 3G, while Sri Lanka Telecom (SLT) has announced that it would launch Internet Protocol TV (IPTV) by the end of 2008.

Personal computer (PC) penetration has escalated since 2001 when a national census reported only 4 percent of households owning a computer, according to vendors.[3] The Information and Communication Technology Agency (ICTA) believes that its launching of the e-Sri Lanka low-cost PC in 2004 helped boost computer sales to a 15–19 percent increase year-on-year, despite the removal of the duty exemption for computers and peripherals in 2004.

SLT, the incumbent, has begun rolling out its national backbone based on Multi-Protocol Label Switching (IP/MPLS) technology to future proof it for the advent of Next Generation Network (NGN) services and standards. The 1,500-kilometre

high-speed fibre backbone is organized into multiple regional rings. The Colombo Metro, Central, and Southern rings are already in place; the Northern, Eastern, and Uva rings are being laid out; and rings to cover other major cities are being expanded. The backbone reaches the last mile via ADSL and ADSL2/2+ connections ranging from 512 Kbps to 24 Mbps.

Dialog Telekom, which currently has a national fibre backbone supplemented by their WiMAX technology option for broadband to the door, claims a coverage of up to 80 percent of the country.

The National Backbone Network plan of the Telecommunications Regulatory Commission (TRC) could be realized if the two big players, SLT and Dialog Telekom, can be persuaded to complement each other's efforts.

KEY INSTITUTIONS AND ORGANIZATIONS DEALING WITH ICT

The ICTA (www.icta.lk) was set up through an Act of Parliament in 2003 to implement the ambitious Sri Lanka National ICT Roadmap through the e-Sri Lanka program (discussed further under 'Key ICT Programs'). The ICTA's mission, which is closely linked but not identical to the implementation of the e-Sri Lanka program, has five main branches: building the information infrastructure, re-engineering government, private sector development, human resource development, and empowering citizens through ICT (e-Society).

The ICTA has provided a 'neutral ground' where key stakeholders can interact in a direct way to overcome suspicion of each others' motives. For example, in private sector development and ICT investment promotion, key industry players have come together to form an advisory committee that decides how a fund earmarked for this purpose, referred to as the ICT Capacity Building Fund (ICBP), is best spent. Key interventions by this informal consortium include:

- Providing grants or matching grants for ICT companies to gain ISO and CMMI — Capability Maturity Model Integration (SEI 2008) accreditation, train their employees in pre-identified areas of weakness, and expose senior management to best practices overseas;
- Initiating an annual awards event recognizing excellence in ICT leadership;
- Facilitating a matchmaking scheme to link local software companies with potential large customers overseas; and
- Providing research and innovation grants through competition.

Among the telecoms service providers, SLT is the largest and formerly the only operator of all types of services. Dialog Telekom is the largest mobile provider: since 2006 it has restructured and diversified into all types of services. Suntel is a wireless local loop (WLL) provider now concentrating on corporate services. Lanka Bell is the other WLL provider and it is currently planning a major expansion of services. LankaCom also owns its own submarine link.

In 2005 these companies protested an ICTA plan for a countrywide high-speed backbone to reach the 'un-profitable' rural areas. Subsequently however, they came up with their own solutions to regional connectivity that resulted in the TRC engaging the industry to form a public-private partnership for building a National Backbone Network (TRCSL 2008b).

The Licensed Internet Service Providers Association is an important player in the infrastructure optimization process since it houses the Sri Lanka Internet Exchange (LKIX).

The University of Colombo School of Computing (UCSC), University of Moratuwa (UoM), University of Peradeniya (UoP), Sri Lanka Institute of Information Technology (SLIIT), and Informatics Institute of Technology (IIT) provide ICT training at the Bachelor's and Master's level. The 'big three' — UCSC, UoM, and UoP — also engage in ICT research in collaboration with international and industry partners. All state universities and several other smaller private institutes, including the National Institute of Business Management (NIBM), Asia Pacific Institute for Information Technology (APIIT), and Australian College of Business and Technology (ACBT), also cater to the senior tiers of the skilled ICT workforce.

The industry organizations in the ICT field include the Software Exporters Association (SEA, www.islandsoftware. org) consisting of some 50 key software exporting companies aiming to promote Sri Lankan software. The older Sri Lanka Association for the Software Industry (SLASI, www.slasi. com) has over 50 member companies. The Sri Lanka Computer Vendors Association (SLCVA, www.slcva.lk) is composed of some 50 computer hardware and peripheral suppliers, while the Association of Computer Training Organizations (ACTOS, www.actos.lk) includes 30 key ICT training providers. The Sri Lanka ICT Association (SLICTA, www.slicta.lk) is an umbrella organization aiming to bring together these and other associations. The Computer Society of Sri Lanka (CSSL, www. cssl.lk) is an organization of IT professionals that promotes continuing education for members and organizes the annual National IT Conference.

The Infotel Society has held ICT trade exhibitions since the 1990s. It brings together representation from several key ICT associations formerly organized as the Federation of IT Industry in Sri Lanka (FITIS). Closely associated with this

exhibition is the International IT Conference (IITC) organized by Infotel and managed by the UCSC. More recently, the ITPro informal 'open' grouping of industry organizations has become an important portal (www.itpro.lk). Also, the leading IT and business process outsourcing (BPO) associations of Sri Lanka have decided to come together to make 'one voice heard in the indusry' through the formation of the Sri Lankan Association of Software and Services Companies (SLASSCOM, www.slascom.lk) modeled on India's NASSCOM.

Both the University Grants Commission (UGC) and the Ceylon Chamber of Commerce (CCC) have standing/sub committees on information technology that are the official channels through which tertiary education institutions and the non-IT industry coordinate efforts in their respective sectors and interface with other industry organizations and associations. The Sri Lanka Export Development Board has its own ICT Advisory Committee drawn from key organizations to help it coordinate efforts in promoting the ICT export market locally and overseas.

To create ICT communities, the president's office, the Ministry of Education, and the ICTA have collaborated on the launching of an eVillages[4] initiative in five communities. Building on the success of the Horizon Village (http://www.horizonlanka.org/) in Mahavilachchiya, the eVillages initiative uses ICT as a tool and enabler of socio-economic development, particularly by the youth in rural communities.

Citizen journalists or bloggers are rapidly becoming an influential community in Sri Lanka. The award-winning Ground-views blogsite (www.groundsview.org) has matured to publish excellent journalism and it is beginning to cover a wide range of issues in the country and the region. Its sister site Vikalpa (www.vikalpa.org) aims to provide a similar platform for Sinhala and Tamil citizen journalism. Kottu (www.kottu.org) remains a key Sri Lankan blog aggregator that also has some local language blogs in their new listing. The Sinhala Bloggers Union (www.sinhalabloggers.com) and the Sinhala Blog Syndicate (www.sinhalablogs.com) aim to promote local language blogging. These and other efforts bode well for a stronger civil society.

Another community that could contribute significantly to the development of the Sri Lankan ICT vision is the Free and Open Source Software (FOSS) community consisting of members of the Lanka Linux User Group (LKLUG, www.lug.lk) and members of the Open Source research and development (R&D) non-profit Lanka Software Foundation (LSF, www.opensource.lk). These two groups, together with the industry bodies, advocate FOSS under the umbrella community FOSS.lk (www.foss.lk).

ICT AND ICT-RELATED INDUSTRIES

Sri Lanka's GDP for 2007 was USD 31.2 billion, representing a 6.1 percent growth year on year and putting the country at number 78 out of the 183 countries listed (Wikipedia 2008). Exports stood at USD 7.9 billion, and imports accounted for USD 10.4 billion. Services dominated with 56.5 percent of GDP, followed by agriculture, forestry, and fishing (16.5 percent); manufacturing (13.9 percent); construction (9 percent); and mining (2.2 percent) (*The Economist* 2007b). The principal exports were textile/garments, tea, diamond/jewelry, and software.

Revenues from software export, BPO, and IT-enabled services (ITES) crossed USD 275 million in 2006, exceeding the previous year's income by over 30 percent (ICTA 2007a) and making this one of the most promising industries for wealth creation. In fact, Sri Lanka was recently ranked 29th among the top 50 outsourcing destinations in the Global Services Location Index. This index takes into account 41 measures in the three major categories of cost, people skills, and availability (Kearney 2008). In another study (Tholons 2007), Colombo was ranked 7th among top 50 emerging outsourcing cities. In particular Colombo was recognized as a Centre of Excellence for Financial and Accounting Outsourcing due to its having the largest pool of Chartered Institute of Management Accountants (CIMA) trained accountants outside the United Kingdom (UK).

According to the Software Exporters Association, there are over 175 software development companies providing products and services for both the domestic and export markets. IT firms in Sri Lanka that are serving Fortune 500 clients mainly in North America and Europe adhere to rigorous industry standards and regulations such as CMMI, ISO 27001, Basel II, SOX, and Data Protection Acts. Industry associations have identified the following niche sectors based on existing strengths: banking, financial and insurance applications, mobile application development, software testing, and Open Source R&D (FOSS 2007). One of the largest IT firms founded in Sri Lanka was ranked number one by the Brown-Wilson Group's annual 'Black Book' survey of Top Outsourcing Vendors in the Wealth Management Industry (Business Wire 2007).

Investments in the ITES and BPO sector in the last five years amounted to USD 44 million. To attract additional investments, the government is offering a tax holiday of 3–12 years depending on the size of a company. Industry associations are aiming for a BPO industry revenue of USD 2 billion and employment of over 100,000 people by 2012. However, the business environment needs to be improved as a World Bank study ranked Sri Lanka at a mediocre 101 of 178 countries in 2007 with regard to establishing new business, labour laws,

taxes, infrastructure, investment protection, and licences (World Bank 2008b).

Current demand for IT professionals is constrained mainly by lack of youth and graduates with good communication skills. This problem is partly due to the low capacity of the education system in Sri Lanka: many students are eligible for higher education but only a few can be taken into the system, especially for ICT-based programs. On the other side of the coin, roles and skill levels in the industry have matured and are now at par with those in India.

Over 20 percent of graduates are unemployed, signifying a mismatch between industry demands and education output. Thus, one of the main thrusts of the ICTA and industry associations is capacity development. In addition, the government's Board of Investment is establishing a partnership with firms, such as India's Mahindra and Mahindra, to establish IT parks.

KEY ICT POLICIES, THRUSTS, AND PROGRAMS

Arguably the most important ongoing ICT initiative in the country is the e-Sri Lanka program being implemented through the ICTA. The e-Sri Lanka initiative is the umbrella vision of the government of Sri Lanka to use ICT to develop the economy, reduce poverty, and improve the people's quality of life. This vision is being realized through a five-program strategy: building the implementation capacity, building information infrastructure, and an enabling environment, developing ICT human resources, modernizing government and delivering citizen services, and leveraging ICT for economic and social development through public-private partnerships.

Major funding comes from the World Bank and a government-wide network funded by the Korean government. Although the initial investment period ends in 2009, only about 35 percent of the initial grants have been disbursed to date, and it is likely that the investment period will be extended. There are also moves to ensure sustainability by transferring ownership of initiatives to the key institutions involved in e-Sri Lanka projects.

Two key connectivity projects have been tendered out by the ICTA. One is for connecting 1,000[5] Nenasala Telecentres (www.nanasala.lk/) scattered around the country with a 128 Kbps link. The other is the more critical Lanka Government Network (LGN) connecting some 650[6] divisional secretariats and key state institutions distributed throughout the country. The operators who won the tenders are reaching beyond their normal areas of operation into less economical areas using newer technologies such as Code Division Multiple Access (CDMA), Wireless Fidelity (WiFi), and Worldwide Interoperability for Microwave Access (WiMAX).

Re-engineering government is arguably the most ambitious of the ICTA's programs. The primary areas for improvement are: introduction of modern technology, upgrading IT skills, setting up local and intra networks, initiating ICT leadership within organizations, and providing a 'single window' for government services to the citizenry. Key local government agencies now have the necessary ICT equipment and are connected through the LGN network. Key human resource development strategies have targeted basic awareness training for 10,000 government employees and certification level training for up to 4,000 of them. In addition, around 1,000 are expected to be trained in technical skills such as system and network operations and basic maintenance. A cadre of chief information officers (CIOs) in state organizations and divisional secretariats are to be the 'champions of change'. The ICTA has been actively working with the independent Administrative Reforms Committee (ARC) that is now a permanent National Administrative Reforms Council (NARC).

A 'single window' concept for providing government information to the public was launched in August 2006 with a short-code number (1919) which provides a gateway to information about some 250 services provided by 20 agencies.[7] The main government Web portal remains at www.gov.lk. But there are plans to amalgamate the mostly informational services provided through this portal into the ambitious LankaGate portal that will provide a one-stop gateway to transactional level services for the citizenry. Twenty-five key government computerization projects have been facilitated by the ICTA to simplify cumbersome processes and eliminate bureaucratic delays to transform organizations into the 'Integrated' or 'Connected'[8] stage of e-government. An example is the drive-through service in Colombo for issuing a motor vehicle revenue licence.

An interesting program area is the e-Society development initiative. Aside from the Nenasala training program for telecentre operators, there is a competitive fund to stimulate innovative citizen services. Small grants have been used to experiment on using the FM spectrum to facilitate disaster preparedness, setting up a secondary school curriculum learning management system,[9] and deploying a Text-2-Braille system in the Colombo Deaf and Blind School. These and other smaller grants are expected to feed into services deployed through the Nenasala Telecentres, with some interesting results beginning to emerge. Among them are a job portal which also facilitates transfers of government employees, a cottage BPO industry for providing Sinhala language translation services, and remote health services. In addition, the ICTA has recently used the open source GRails framework technology to rapidly build an agricultural price tracking solution to support an e-Society

grant application. In the next stage of this project, an SMS-based interface is expected to be provided for crop price monitoring.

The Government of Sri Lanka has declared 2009 the 'Year of English and IT', giving the ICT industry a boost by funding several initiatives designed to help empower the human resource base of the country, and harness its true potential to make Sri Lanka more competitive in the global IT-BPO industry.

LEGAL AND REGULATORY ENVIRONMENT FOR ICT DEVELOPMENT

Sri Lanka has been steadily ramping up its regulatory environment in support of trends toward globalization and outsourcing (Fernando 2007). Computer software and digital media are given protection under copyright law. In addition, 'Computer' and 'Computer Program' have been explicitly defined in the 2000 Amendment to the Code of Intellectual Property and the Intellectual Property Act No. 36 of 2003 (WIPO 2001). The recently enacted Computer Crimes Act No. 24 of 2007 further enhances the protection measures already available for software (ICTA 2007b). And with the most recent amendment to the Intellectual Property Law in Sri Lanka, protected rights now include copyright, patents, trademarks, service marks, industrial designs, certification marks, unfair competition, undisclosed information and layout designs of integrated circuits (Sirisena and Kahatapitiya 2006). Patents remain valid for 20 years, industrial designs for five years and registered marks for 10 years from the date of grant.

Disclosure and acquisition of information without the consent of the rightful owner would constitute an act of unfair competition and there is statutory protection for Non-Disclosure Agreements (NDAs) that many firms now utilize to protect their intellectual property rights (IPR) and those of their clients. IP infringement is a punishable offense in Sri Lanka and the country is a signatory to several international conventions and treaties on intellectual property (BOI 2008). The National Intellectual Property Office (NIPO, www.nipo.lk) administers the intellectual property system and the director general of intellectual property has been empowered to conduct dispute resolution.

The Computer Crimes Act also criminalizes attempts at unauthorized access, modification, deletion, interception or denial of service to a computer, computer program, data or information. It contains a provision dealing with unauthorized use of computers regardless of whether the offender had authority to access the computer concerned (Fernando 2006a; LBO 2007).

The Electronic Transactions Act of 2006 was enacted to provide a legal framework for and to facilitate the expansion of electronic transactions and contracts (Fernando 2005, 2006b). Included in the law are modalities for the use of electronic records and electronic signatures in government institutions and statutory bodies. It also stipulates procedures for the appointment and accreditation of a certification authority. Most of the provisions are based on the United Nations Commission on International Trade Law (UNCITRAL) Model Law on e-Commerce (1996) and the Model Law on e-Signatures (2001).

The main gap that remains is a data privacy law that the government needs to enact to build greater confidence among the country's trading partners, especially in the European Union (LBO 2008b). In enforcement, the government has decided that investigation capability in computer crime should be strengthened, and a Computer Crimes Unit with computer forensic skills should be established. The ICTA has started a program to develop capacity in computer crime investigation at the Police Department. Additionally, a National Computer Emergency Response Team (SL-CERT, www.slcert.gov.lk) has been established by the government with subject matter experts in Information Security.

In telecoms regulation, the Telecommunication Regulatory Commission of Sri Lanka (TRCSL, www.trc.gov.lk) issues licences to operate basic telecom service, import telecoms apparatus, and manage the radio frequency spectrum. It regulates the telecom industry and resolves disputes on matters related to interconnection.

DIGITAL CONTENT

All government websites are required to be multilingual (in Sinhala, Tamil, and English) and to use Unicode fonts. A local languages portal containing software required for this purpose is available at www.locallanguages.lk/, with the Sinhala version at www.siyabas.lk/, and the Tamil version at www.emathumozhihal.lk/. These sites also have links to key local language websites. The Google country search interface now allows searches of local language websites encoded in Unicode, while an older but useful search service, www.sinhalasearch.com/, is able to decode most proprietary Sinhala encodings on-the-fly and render search results (and the relevant page if needed) in Unicode. Another useful webpage translation tool released by the UCSC is available as a Firefox plug-in with the twin objectives of making English Web content understandable while at the same time helping users expand their English vocabulary.

There are also Sinhala Unicode Communities promoting the use of Unicode for Sinhala and freelance bloggers organizing themselves into community journalism forums. Most Sinhala and Tamil newspapers have online versions, with several switching to Unicode as the standard encoding.

A large corpus of Sinhala text in various genres has been compiled by the Language Technology Research Laboratory at the UCSC.[10] There are projects aiming to generate new content or to translate existing English content. A parallel activity has been the localizing of software applications.

A learning management system (LMS) called Shilpa Sayura (www.shilpasayura.org) enables the creation of learning materials in Sinhala for high school subjects. It received awards from the Global Knowledge Partnership in Kuala Lampur, Malaysia in 2007 and the Stockholm Challenge in Education in Stockholm, Sweden in 2008.

ONLINE SERVICES

Government Services

Currently, almost all government institutions have a presence on the Web. Although most of these websites merely provide information, some government websites provide services that at least cut down the number of visits a person has to make to the government office in Colombo by giving clear instructions and making available the necessary forms for download. The 1919 Government Information Centre (GIC, gic.gov.lk) provides a particularly useful service over the phone in the three main languages used in Sri Lanka. More recently, the Registries of Births, Deaths, and Marriages have been computerized and all of the Colombo District-based Grama Sevaka (GS, the lowest government administrative level, originally based on the village headman) divisions have been networked, thereby allowing individuals to transact with any nearby GS Office without having to go to their own 'home' office (see 'e-Sri Lanka Procurement').

e-Commerce

e-Commerce sites continue to populate the local Internet, with some providing transactional services. Smaller retailers, particularly those targeting expatriate Sri Lankans who want to purchase goods and services for their relations in Sri Lanka, are increasing in number. Business portals such as www.srilankabusiness.org provide allied services and links to online businesses.

In a new and exciting development, the Horizon Lanka Foundation has started a new BPO thrust with the incubation of one of the first rural BPO companies.[11] It provides various data services, including entry, verification and scanning, and offers Web and graphics design outsourcing. It recently signed up with a leading Sri Lankan conglomerate, John Keels Holdings, to provide such services to and through them.

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e-Sri Lanka Procurement

The main issue with the traditional 'waterfall' based procurement process is that the end-user (i.e. the government unit or organization) is unable to envision the type of ICT solution needed while the solution provider has very little understanding of how the government works. A new approach utilizes agile development methodologies and incremental refinement of requirements to produce an evolving solution where the end-user's needs are gradually fine-tuned as they become more aware of how to effectively articulate their ICT and business process re-engineering needs. Additionally, to remove vendor lock-in and develop a transparent solution, the high-level architecture is defined by the ICT agency and aspects of the business requirement are broken into modules which are given separately to different vendors to develop independently and incrementally.

In this alternative approach, an initial high-level system study is used to define an overall architectural view. The objective is to build/assemble the solution by formulating more than one project based on a logical module/service/component breakup. The feasibility of such a 'composed' solution is first validated with a thin-slice prototype implementation by leveraging FOSS packages and frameworks. The ICTA then partners with software services providers to implement each module/service/component using identified FOSS-based technologies to prevent vendor lock-in, facilitate rapid solution development, and reduce the initial deployment costs while enabling the Government of Sri Lanka (GOSL) to retain ownership of the IP and source code. In this way, the GOSL derives the ability to improve, customize and deploy the solution anywhere in the country, at minimal additional cost. Long-term solution support and maintenance are also procured from a solution services provider, who in turn is typically expected to obtain an appropriate support licence/agreement from the relevant FOSS product vendor.

Currently, the Sri Lanka country portal LankaGate, one of the largest eSri Lanka projects, is being implemented using this novel approach. The upcoming welfare project eSamurdhi is also expected to employ this procurement methodology.

ICT EDUCATION AND CAPACITY-BUILDING PROGRAMS

One of the components of the Secondary Education Modernization Project (SEMP, www.moe.gov.lk/semp/) of the Ministry of Education is employing IT as a tool to facilitate learning. Aside from basic computer skills, teachers have been trained to use Computer Aided Learning (CAL) to develop instructional materials. Computer laboratories have been set up in over 1,000 schools and together they form a network of schools (SchoolNet, www.schoolnet.lk). In addition, 90 Computer Resource Centres (CRCs) established in the early 1990s have been enhanced to serve schools in their regions through ICT and CAL training programs. Several national Colleges of Education are training ICT teachers. There is a plan to have a College of Education dedicated to training ICT and CAL teachers for the schools.

In the tertiary education sector, a World Bank-funded project to improve the quality and relevance of undergraduate education (IRQUE, www.irque.lk) is underway in all state and the larger private tertiary educational institutions. Organizations participating in this project are required to upgrade their ICT infrastructure, facilities, and services. In addition, all Arts and Commerce undergraduates receive basic ICT training.

Furthermore, the inter-university Lanka Education and Research Network (LEARN, www.learn.ac.lk) connecting all state universities and several research institutes has been enhanced from the previous 2 Mbps backbone to 10 Mbps with capability to scale to 100 Mbps. LEARN's Internet connectivity has also been significantly enhanced from 7 Mbps to 45 Mbps.

The Distance Education Modernization Project (DEMP, www.depp.lk/demp.php) funded by the Asian Development Bank aims to facilitate the scaling up of higher education through the development and support of online distance education programs. It has an infrastructure component closely linked with the regional centre modernization of the Open University, a networking component to link all online education providers, and a distance education capacity and quality improvement component.

Two active online learning communities are the e-BIT (www.bit.lk) for undergraduate students and the award-winning Shilpa Sayura (www.shilpasayura.org) program for high school students in rural Sri Lanka. Both have received international recognition as innovations in the use of ICTs for education.

Also, at the secondary education level, the Ministry of Education has completed a pilot project to convert three of the most used text books in Year 6 and Year 10 into eText books distributed on CD. Eighteen of the most widely needed texts will be converted to eBook format in 2008 (see 'eBIT: Scaling up Terliary Education in ICT through Public-Private Partnership').

The first major assessment of IT literacy in Sri Lanka was made through the national census of 2001. The results, which were released in 2003–2004, showed that the average IT literacy in the country was a mere 9.7 percent. This is reported to have grown to 16.1 percent in 2006/2007 (DCS 2007b), due to various ICT awareness and literacy projects. A National IT Quiz organized by the UCSC in 2006–2007 has enhanced awareness of IT careers among high school students, their teachers and parents. An ICTA-sponsored Careers Fair (NICS '07) also helped improve awareness of IT among students planning to pursue tertiary education. In addition, ICTA's e-Citizen project aims to reach 100,000 people nationwide through a specially prepared curriculum.

The Ministry of Education introduced a General IT course for all Advanced Level (Grades 12 and 13) high school students in 2004. From 2006, an IT subject was introduced at the Ordinary Level (Grades 10 and 11). There are plans to introduce a Grade 6–9 IT curriculum to coincide with the development of a new cadre for the IT teacher service to be established soon.

All 15 state universities and several private institutes with a franchise on overseas degrees offer computer science, computer engineering, IT/ICT degrees, as well as degrees in which IT is a component or a minor. According to a recent survey,[12] the country needs 5,755 new IT graduates in 2008. However, existing programs are known to produce slightly less than 50 percent of the number of IT graduates needed each year. Thus, the aim of the UCSC's e-BIT program and the DEMP project is to increase the total online undergraduate population to 40,000.

Several universities, most notably the UCSC, UoM, UoP, and SLIIT, also offer heavily subscribed Master's level IT and computer science programs with various specializations. In addition, the UCSC and UoM offer research degrees leading to an MPhil and PhD, often in collaboration with international universities.

OPEN SOURCE/OPEN CONTENT INITIATIVES

The FOSS movement in Sri Lanka started with the Lanka Linux User Group (www.lug.lk) established in 1998 with 40 members and five advisors. It has since grown to a diverse community of over 500 technical users of Linux and related FOSS applications across the country. Linux User Groups also exist in universities to promote mutual learning and adoption of FOSS. In 2001 the Lanka Software Foundation (www.opensource.lk) was established by a Sri Lankan IBM researcher as an open source

eBIT: Scaling up Tertiary Education in ICT through Public–Private Partnership

Sri Lanka has one of the lowest university enrolment rates in the world, with only about 2 percent of the age cohort having access to the very few places available for undergraduate study. To scale up ICT education, which it recognized as important for meeting the chronic shortage of IT workers, the UCSC worked within the very restrictive state higher education system and without dependence on state funding.

Through a series of grants from the Japan International Cooperation Agency (JICA) and the Swedish International Development Cooperation Agency (SIDA), the UCSC set up an eLearning Centre which pioneered tertiary level e-learning both for in-campus programs and its flagship Bachelor of Information Technology (BIT) program. The three-year BIT program, first launched in 2000 when Internet access was limited, initially only provided an informational website with instructions, curricula, question papers with answers and examination results. In its first three-year curriculum cycle, it enlisted the support of several leading private ICT training institutes to provide tuition in the regions in what has become a landmark public-private partnership (PPP).

Students can temporarily or permanently exit with a Diploma after completing their first year or with a Higher Diploma after completing their second year. Thus, this innovative program has provided a flexible and scalable solution to expanding IT education at the tertiary level. In its second revision in 2003 the BIT introduced an online component in addition to its website (http://www.bit.lk/). The new e-BIT is a full-fledged e-learning platform providing interactive online learning content, quizzes and assignments, and attracting some 1,500 enrolees each academic year. More than 5,000 of its 15,000 student population are active during any year, with many opting to do the degree in stages. In 2007, the UCSC began conducting its own e-testing service for the BIT program through its e-testing centre in Colombo. This is expected to be decentralized during the coming year, in partnership with the DEMP project's 26 Access Centres affiliated with the Open University of Sri Lanka, to truly bring the benefits of higher education in IT to the community.

The eBIT project was recently recognized by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and it received special mention in the Innovative Use of ICT in Education Award in 2008.

R&D non-profit organization. These two key organizations, with the support of the Sri Lankan ICT industry and significant investments from well-known global organizations such as Google, IBM, the Swedish International Development Cooperation Agency (SIDA), the National Science Foundation (US), Intel, Redhat and MySQL, have fuelled the adoption of FOSS and FOSS R&D in Sri Lanka.

The landmark advocacy event was the National FOSS Week in 2005 which attracted over 1,000 participants (FOSS 2006). In 2006 the main FOSS event was ApacheCon Asia (apachecon.com/2006/Asia/), the first time an Apache Conference (ApacheCon) was held outside North America or Europe. In addition, numerous events are organized throughout the year by the FOSS community to take open source and open content to the general public.

There is a special focus on ICT in rural schools. However, the Ministry of Education has not adopted open source in its IT curriculum, which is still based on proprietary technologies. In contrast, universities are benefiting from an increased demand for open source courses which they offer to their students and as short courses for the IT industry.

The ICTA, in partnership with some of the main computer software vendors, has launched the e-Sri Lanka PC (www.icta. lk/insidepages/programmes/e-Sri_Lanka_PC.asp) which is pre-loaded with Linux and open source software as a low-cost alternative to desktop computing. However, for better adoption of open source software, there should be better training programs and a support network for users.

Additionally, the newly established OLPC Lanka Foundation, in partnership with the Ministry of Education and with support from the World Bank, is promoting the One Laptop per Child (OLPC) project to help bridge the digital divide (Bandula 2008).

Open source development has been identified as a growth sector for the country and there are now numerous companies supporting open source products and based on open source innovation and services.

In open content, the most significant initiative is the MIT Open Courseware which in Sri Lanka is hosted on the academic LEARN network (ocw.learn.ac.lk). Although Sri Lanka has a relatively high literacy rate, most content is in Sinhala, the dominant language. A large part of global open content repositories, such as Wikipedia, is not available in Sinhala and Tamil. To mitigate this, a dynamic translation tool called EnSiTip has been developed by the UCSC and is available as a plug-in to the open source Web browser Firefox (LBO 2006).

The importance of 'funding a broad program to foster Open Source software development in Sri Lanka' is stated in the e-Sri Lanka program Project Appraisal Document. Popularizing the use of FOSS applications and providing training to transfer expertise to the grassroots are expected to help build a strong workforce who would be conversant not only in the use of FOSS technology, but also in the design of new technology to suit the country's needs.

ICT AND ICTD RESEARCH AND DEVELOPMENT

The UCSC has research groups working in local language technologies, distributed computing, wireless and ad hoc sensor networks, e-learning, geographical information systems, and computer visualization. There are also research efforts in information security, strategic business systems, and disaster management. Several have international collaboration and are funded by external agencies.

In localization and language processing, much has been done in the standardizing process as well as ensuring the proper functioning of Sinhala and Tamil on computers while at the same time developing software for optical character recognition and text-to-speech chiefly for Sinhala. In addition, some key resources such as a 10m word text corpus, several lexical and morphological data have been collected for Sinhala. Research is also underway in handwriting and speech recognition for Sinhala. The software developed is also being tested on Sri Lankan Tamil to adopt or adapt them for use in Tamil language work.

The Wireless ad hoc Sensor Network Lab (WASN) at the UCSC was established in February 2006 with assistance from the Swedish Program for ICT in Developing Regions (SPIDER) and the Ericsson Microwave Systems AB. Currently, the centre's main focus is developing a sensor network called BusNet to be deployed over a public transport system. BusNet sensors mounted on public transport buses will monitor environmental pollution and road surface conditions. The collected data is to be 'transported' to a central collection point over the public transport network. This is pioneering work and some US and European universities have included published papers on BusNet in the required reading lists of their sensor network courses.

The University of Moratuwa has been involved in research with several private companies such as Dialog, Microimage and Zone 24×7 through its innovative University Industry Cell (Unic) to develop several technologies for communication and disaster alert.

Sri Lanka has also built a reputation for R&D in FOSS. Sri Lankan open source software developers have made significant contributions to organizations such as Apache where they (contributors from Sri Lanka) represent over 5 percent of the organization's global strength. There are several leading global open source R&D projects led by Sri Lankans in Web services, disaster management, Linux graphical interface, and networking applications. One of these is Sahana (http://www.sahana.lk/), developed to help manage the scale of the Asian Tsunami in December 2004 and deployed by the government's Centre of National Operations (CNO), which included the Consortium of Humanitarian Agencies (CHA). SIDA funded a second phase through the LSF to generalize the application for global use and to help in any large scale disaster.

Sahana is now globally recognized, with deployments in many other disaster situations, including the Asian Quake (Pakistan) in 2005, the Mudslide Disaster (Philippines) in 2006, the Yogyarkata Earthquake in 2006 (Indonesia), the Bangladesh Floods in 2007, and the Peru Earthquake in 2007. Sahana has won awards by Redhat and by Software 2006 (USA) and it has been featured in a BBC documentary called 'Code Breakers'. It was a finalist in the Stockholm Challenge in 2007, and it received the June 2007 Sourceforge 'Project of the Month' title. It has also had the active support of the IBM crisis response team. The Sahana community now consists of more than 200 disaster management experts, emergency management practitioners, humanitarian consultants, non-government organizations (NGOs), academics, and FOSS developers from around the world but mainly from Sri Lanka, Australia, New Zealand, Thailand, the UK, and the US.

Another good indicator of Sri Lanka's strength in R&D is the Google Summer of Code, where students are sponsored by Google to contribute to FOSS projects worldwide. Sri Lanka consistently ranks in the top 10 countries (GOOGLE 2008a). In 2008, the biggest group of students selected from a single university came from the UoM in Sri Lanka (GOOGLE 2008b).

CHALLENGES AND OPPORTUNITIES

A major challenge to Sri Lanka's continued development is the long drawn out civil war. This prevents the nation and its citizens from taking full advantage of the many opportunities that lie at its doorstep. An end to the war will mean an end to hesitation by investors, a reversal of the brain drain, and the discontinuance of propaganda that dilutes the potential and talents of the Sri Lankan people.

Sri Lanka's size compared to that of major players in the BPO and ITES sectors, such as India and China, prevents it from competing in areas that require a lot of human resources. Instead, it needs to pursue its own unique strategy for moving up the value chain by building on its strengths in niche areas. For instance, Sri Lanka is well positioned to provide globalized solutions to the emerging consumer societies of India and China. It can capitalize on its strengths in various professional service sectors such as accountancy, finance, healthcare and legal advice, which are at par with Western standards. In FOSS R&D, Sri Lanka has established itself as a major player globally. Moreover, the relatively high human development index and quality of life and the many award-winning projects in various sectors in academia and industry are a good indication of a culture of innovation that may be leveraged further.

Sri Lanka is also strategically placed as a neutral non-aligned hub for Asia. Its relatively high economic freedom index in Asia, its membership in the South Asian Association for Regional Co-operation (SAARC), and its strong ties to many other strategic nations in Asia (from Japan and China in the east, to Pakistan and Iran in the west) position it well to mediate and add value to economic relationships between these regions and nations.

NOTES

1. Some 90 cities are listed in http://www.dialog.lk/en/mobile/technology/3g/coverage_list.html
2. This is for a 512 Kbps link with monthly cap of 100 Mb. The unlimited subscription remains at USD 25.
3. However, these vendors are unable to give good estimates of either the total numbers or their regional distribution.
4. Information on the eVillages initiative is available at http://evillage.wordpress.com/
5. To date, nearly 500 Nenasala Telecentres are operational.
6. Around 325 of these sites have already been connected.
7. For more details, see the Government Information Service (GIC) website at http://www.gic.gov.lk
8. This goes beyond the 'transactional' stage to a point where all internal processes of an agency are also integrated to citizen, business and government services. (See, for instance, the 2008 UN e-Government Survey for a fuller definition.)
9. Named 'Shilpa Sayura', this effort won awards at the GKP Summit of 2007 and the 2008 Stockholm Challenge.
10. Information on this 10m word corpus and other language technology tools and resources is available at http://www.ucsc.cmb.ac.lk/ltrl/
11. This first company is called OnTime Technologies and can be accessed at http://www.ontimetechnologies.net/
12. The ICT Workforce Survey may be downloaded from http://www.itpro.lk/?q=node/100

BIBLIOGRAPHY

Bandula, S. (2008). Sri Lanka to introduce one laptop per child. *The Sunday Times Online*, *42*(37). Retrieved 19 February 2008 from http://sundaytimes.lk/080210/FinancialTimes/ft310.html

Board of Investment (BOI). (2008). *Registration and patents and trade marks*. Sri Lanka: BOI. Retrieved 19 February 2008 from http://www.boi.lk/boi2005/content.asp?content=settingup3_9&SubMenuID=10

Business Wire. (2007). *Virtusa Ranked #1 IT Systems Outsourcing Vendor in Wealth Management Industry by the 2007 Black Book of Outsourcing*. Retrieved 19 February 2008 from http://investor.news.com/Engine?Account=cnet&GUID=3300868&Page=MEDIAVIEWER

CIA. (2008a). *The World Fact Book* — Rank order GDP per capita PPP. Retrieved 20 October 2008 from https://www.cia.gov/library/publications/the-world-factbook/rankorder/2004rank.html

———. (2008b). *The World Fact Book — Sri Lanka*. Retrieved 20 October 2008 from https://www.cia.gov/library/publications/the-world-factbook/geos/ce.html

Department of Census and Statistics (DCS). (2001). *Literacy rates by district, sex and sector*. Retrieved 20 February 2008 from http://www.statistics.gov.lk/PopHouSat/PDF/Population/p9p10%20Literacy%20rates%20by%20district,%20sex%20and%20sector.pdf

———. (2007a). Statistical data sheet 2008. Retrieved 20 October 2008 from http://www.statistics.gov.lk/DataSheet/dataSheet.pdf

———. (2007b). *Computer literacy survey 2006/2007*. Retrieved 20 October 2008 from http://www.statistics.gov.lk/computer%20literacy%20english.pdf

Fernando, J. (2005). Electronic transactions legislation — Background and features. *BASL Law Journal*, *11*, 82

———. (2006a). *Legal reforms for ICT*. Retrieved 19 February 2008 from http://www.lawnet.lk/docs/articles/sri_lankan/HTML/CV20.html

———. (2006b). *Cyber Law developments: How it affects you, the nation*. Retrieved 19 February 2008 from http://www.nation.lk/2006/05/21/newsfe9.htm

———. (2007). *Key features of the Computer Crimes Act*. Retrieved 19 February 2008 from http://sundaytimes.lk/070729/FinancialTimes/ft308.html

Free and Open Source Software (FOSS). (2006). *National FOSS week*. Retrieved 19 February 2008 from http://www.foss.lk/events/2005/foss-week/index.html

———. (2007). *News articles archived at FOSSSrilanka*. Retrieved 30 May 2008 http://fosssrilanka.blogspot.com/

Google. (2008a). *Two top-10's for Google summer of code 2008*. Retrieved 30 April 2008 from http://google-opensource.blogspot.com/2008/04/two-top-10s-for-google-summer-of-code.html

———. (2008b). *This week's top-10's: Universities for Google summer of code 2008*. Retrieved 10 May 2008 from http://google-opensource.blogspot.com/2008/05/this-weeks-top-10s-universities-for.html

Information and Communication Technology Agency (ICTA). (2007a).
    National ICT/BPO Workforce Capacity Development Strategy.

———. (2007b). *Computer Crimes Act 24 of 2007, Information and
    Communication Technology Agency of Sri Lanka*. Retrieved
    19 February 2008 from http://www.icta.lk/InsidePages/
    downloadDocs/Computer_Crimes_Act_No_24_of_2007(E).pdf

International Monetary Fund (IMF). (2008). *World Economic Outlook
    Database*. Retrieved 20 October 2008 from http://imf.org/external/
    pubs/ft/weo/2008/02/weodata/download.aspx

International Telecommunication Union (ITU). (2008). *ICT Statistics
    database: 4 – Internet indicators*. Retrieved 20 October 2008 from
    http://www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx

ITPRO. (2008). *Mahindra and Mahindra to establish IT Park at
    Katunayake*. Retrieved 19 February 2008 from http://www.itpro.
    lk/?q=node/739

Kearney, A.T. (2007). *Kearney Global Services Location Index*.
    Retrieved 19 February 2008 from http://www.atkearney.com/shared_
    res/pdf/GSLI_2007.pdf

Lanka Business Online (LBO). (2006). *Google Funds Sri Lankan Open
    Source development*. Retrieved 19 February 2008 from http://www.
    lankabusinessonline.com/fullstory.php?newsID=526160689&no_
    view=1&SEARCH_TERM=5

———. (2007). *Sri Lanka enacts first Computer Crimes Bill*.
    Retrieved 19 February 2008 from http://www.lbo.lk/fullstory.
    php?newsID=979682240&no_view=1&SEARCH_TERM=5

———. (2008a). *Sri Lanka rupee depreciates 1-pct in 2007,
    reserves US$3bn: Central bank*. Retrieved 19 February
    2008 from http://www.lankabusinessonline.com/fullstory.
    php?newsID=1319511163&no_view=1&SEARCH_TERM=1

———. (2008b). *Sri Lanka urged to have data protection law to develop
    e-commerce, Lanka Business Online, Sri Lanka*. Retrieved
    19 February 2008 from http://www.lankabusinessonline.com/fullstory.
    phpnewsID=346187378&no_view=1&SEARCH_TERM=11

Telecom Regulatory Commission Sri Lanka (TRCSL). (2008a).
    *Statistical overview of the telecommunication sector by the
    telecommunications regulatory commission of Sri Lanka*. Retrieved
    20 October 2008 from http://www.trc.gov.lk/pdf/statover1.pdf

———. (2008b). *National Backbone Network Consultation document*.
    Retrieved 20 February 2008 from http://www.trc.gov.lk/pdf/public_
    consultation_on_NBN.pdf

Sirisena, P.B.M. and D. Kahatapitiya. (2006). *Country report, situation
    on intellectual property*. Retrieved 20 May 2008 from http://www.
    unescap.org/tid/mtg/ip_s4sl.pdf

Software Engineering Institute (SEI). (2008). *Software Engineering
    Institute, What is CMMI?* Retrieved 3 November 2008 from http://
    www.sei.cmu.edu/cmmi/general/index.html

Sri Lanka ICT Association (SLICTA). (2007). *ICT workforce survey
    2007*. Retrieved 19 February 2008 http://www.icta.lk/Insidepages/
    downloadDocs/ICTWorkforcSurvey2007.pdf

The Economist. (2007a). *The Economist Intelligence Unit's 2007
    rankings (excluding many developing countries).* Retrieved
    20 February 2008 from http://a330.g.akamai.net/7/330/25828/20080
    331202303/graphics.eiu.com/upload/ibm_ereadiness_2008.pdf

———. (2007b). *Economic structure*. Retrieved 19 February 2008
    from http://www.economist.com/countries/SriLanka/profile.
    cfm?folder=Profile-Economic%20Structure

The Heritage Foundation. (2008). *Index of Economic Freedom World
    Rankings 2008*. Retrieved 20 May 2008 from http://www.heritage.
    org/research/features/index/countries.cfm

Tholons. (2007). *Top 50 emerging outsourcing cities*. Retrieved
    19 February 2008 from http://www.tholons.com/pages/cover_story.asp

United Nations (UN). (2008*). The e-Government Survey 2008*. Retrieved
    20 January 2008 from http://unpan1.un.org/intradoc/groups/public/
    documents/UN/UNPAN028607.pdf

United Nations Development Programme (UNDP). (2008). *The Human
    Development Index rankings of 2007/2008*. Retrieved 18 January
    2008 from http://hdr.undp.org/en/statistics/

Wikipedia. (2008). *GDP*. Retrieved 19 February 2008 from http://
    en.wikipedia.org/wiki/List_of_countries_by_GDP_(nominal)

WIPO. (2001). *Intellectual Property, Act (Code), 08/08/1979 (2000),
    No. 52 (No. 40)(lk001)*. Retrieved 19 February 2008 from
    http://www.wipo.int/clea/en/fiche.jsp?uid=lk001

World Bank (WB). (2008a). *World development indicators database*.
    Retrieved 20 October 2008 from http://siteresources.worldbank.
    org/DATASTATISTICS/Resources/GDP_PPP.pdf

———. (2008b). *Building the Sri Lankan knowledge economy*. Finance
    and Private Sector Development Unit, South Asia Region, World Bank.

World Economic Forum (WEF). (2008). Global Information Technology
    Report 2007–2008. Retrieved 20 February 2008 from http://www.
    insead.edu/v1/gitr/wef/main/home.cfm