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Improving E-Readiness of Sri Lanka with Supplementary Grid Supplied Electric Power

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ABSTRACT

This paper focuses on identification of a micro project for improvement of e-readiness of Sri Lanka. First, the proposed strategy by the Government of Sri Lanka is presented. Second, from the proposed strategy, requirement analysis is done to draw a set of requirements, using two approaches: a) E-readiness measurement, b) System analysis using the theory of connection. Third, from the requirements, a micro project is identified that can improve e-readiness of Sri Lanka; the micro project – supplementary grid supplied electric power – is given priority as this project is people-centric, low-cost, and sustainable.

INTRODUCTION

In November 2002, the government of Sri Lanka launched *e-Sri Lanka* – the information and communication technology development roadmap to achieve e-governance by the year 2007. According to the official document, the main purpose of e-Sri Lanka is to achieve the desired levels of development by enhancing national competitiveness, and to reduce or eradicate poverty by realizing enhancements in the quality of life of its citizens (Government of Sri Lanka, 2003). The government of Sri Lanka believes that the vision will take the dividends of information and communication technology (ICT) to every village, to every citizen, to every business and also transform the way Government works. However, studies show serious shortcomings in the proposed strategies (Davidrajuh, 2004). Studies also reveal that proper measures for improving e-readiness of Sri Lanka has not been identified or put into practice (Davidrajuh, 2004).

The main purpose of this paper is to identify a micro project that can improve e-readiness of Sri Lanka. To do this, a scientific approach is used in this paper that consists of four steps: First, the proposed strategy by the Government of Sri Lanka is presented; this serves as the needs analysis. Second, from the proposed strategy, requirement analysis is done to draw a set of requirements;

this is done using two approaches: a) E-readiness measurement, b) System analysis using the theory of connection. Third, from the requirements, a micro project – supplementary grid supplied electric power – is identified that can improve e-readiness of Sri Lanka; though different types of projects can be chosen, the micro project on grid supplied electric power is people-centric, low-cost, and sustainable.

The uniqueness of this paper lies in the scientific analysis of the proposed strategies for e-Sri Lanka in order to identify the micro project that can be implemented to improve the e-readiness.

NEED ANALYSIS

This paper starts with the need analysis for e-Sri Lanka, as the authors believe that any system cycle or system engineering process should begin with the identification of a need based on a want or desire for something arising from a deficiency (Blanchard & Fabrycky, 1990). The need in this case is the gap between current and desired (or required) level of e-readiness or the gap in results between what is now and what should be after (successful) completion of e-Sri Lanka. Needs analysis is a process of determining the reasons and causes for a need so that appropriate interventions may be identified and later selected.

Rather than using surveys, questionnaires and interviews for the needs analysis, we present or restate the government of Sri Lanka's strategy for e-Sri Lanka. However, the strategy is presented in a highly intelligible format so that requirement analysis and implementation can be done in later sections.

The needs assessment

In November 2002, the government of Sri Lanka launched *e-Sri Lanka* – the information and communication technology development roadmap to achieve e-governance by the year 2007. Sri Lanka's first ever e-government conference was held in May 2003. The event was given utmost importance by the government of Sri Lanka, and was supported by some of the inter-governmental organizations such as the United States Agency for International Development (USAID) and the Swedish International Development Agency (Sunday Leader, 2003).

According to the official document, the main purpose of e-Sri Lanka is to achieve the desired levels of development, by enhancing national competitiveness, reduce or eradicate poverty by realizing enhancements in the quality of life of its citizens (Government of Sri Lanka, 2003). The government of Sri Lanka believes that the vision will take the dividends of information and communication technology (ICT) to every village, to every citizen, to every business and also transform the way Government works (Sunday Leader, 2003).

Zhou (2001) identifies that in a model of e-government, a society has three constituents: government, citizens, and businesses. Accordingly, we classify the benefits of e-Sri Lanka pointed out in Government of Sri Lanka (2003), into three different category; the benefits of e-Sri Lanka are:

For the government:

- Empower civil servants with information and communication tools, to facilitate coordination across government agencies, and to improve competition and transparency in public procurement.
- Integrate marginalized regions and communities within an equitable resource distribution framework, to facilitate effective decentralization and broadening of public participation in development policy formulation and program implementation, and to transform government services cost-effective and citizen-centered.
- To provide quality education at all levels and to all parts of the country. To provide students and teachers throughout the country access to world-class educational curriculum via the Internet.

For businesses:

- To revitalize Sri Lanka's main and traditional industries like agriculture, tourism, and apparel, so that the share of value-addition to the end product is increased, and to penetrate into new markets via Internet-based sales channels.
- To emerge as a major transportation hub for air and sea cargo, by modernizing ports and by developing a modern trade net that dramatically reduced the transaction costs for importers and exporters. To enable businesses to become increasingly competitive and to attract foreign investors.
- To reduce transaction costs to businesses.
- To create a communication environment that allows optimal opportunities for businesses to engage in all forms of e-commerce

For citizens:

- To improve the delivery of public services, and knowledge and education to all, and to make government accessible and accountable to the average citizen
- To create a communication environment that allows optimal opportunities for all Sri Lankan citizens to participate fully in the global information economy and for all citizens to support their economic, learning and personal needs.
- To facilitate inexpensive contact with family abroad via email and voice over Internet via Cyber Cafes in all towns.

REQUIREMENT ANALYSIS

This section starts with the results of the needs analysis done in section-2, and performs the requirement analysis. By the requirement analysis, we are trying to establish a statement about the proposed system that will make all stakeholders agree to it so that the system can be adequately solved (Lethbridge & Laganriere, 2001).

The requirement analysis is done in two steps:

- Identifying the primitive system: We further dissect the need assessment from

section-2 further so that the primitive elements (or the basic building blocks) of the system become visible. This is done in subsection-3.1.

- Identifying the current status of the system: For this purpose, we measure the e-readiness of Sri Lanka. This is done in subsection-3.2.

From these two steps, we identify corrective measures that can lead to a better solution.

Dissecting the Proposed Strategy

The implementation strategy for e-Sri Lanka is further dissected in order to find the primitive system; a primitive system consists of the primitive elements or the fundamental building blocks of a system (Davidrajuh, 2000). Dissecting the strategy into programs, subprograms, and actions, is presented in Table-1.

Table 1: Proposed strategy.

Program	Subprograms	Actions
A: Building implementation capacity	(A)	Forming control and coordinating committees, to advice the Cabinet of ministers: A top-level consultative committee will be formed, made up of secretaries of key ministries, industry leaders, etc., to advise the cabinet. In addition, an agency will be established to look into the intricacies of capacity building.
	B1: Hard infrastructure	Building hard infrastructure to provide affordable telecommunications services for various users.
	B2: Soft infrastructure	Building soft infrastructure to support the Sri Lankan software companies, such as stimulation of domestic demand for software applications, establishment of ICT parks and ICT development zones.
	B3: Learning capacity	The government will recruit multinational companies to invest and partner with the local counterparts
	C1: Software industry	To increase the supply of ICT professionals, a new policy will be devised on issuing of visas for foreign ICT professionals; Providing incentives for leading ICT multinationals and training institutions to invest in Sri Lanka
	C2: Educational establishments	Training programs on ICT tools in primary and secondary schools for students and teachers; Increased undergraduate intake for ICT courses in universities; Increased training to university staff
	C3: General public	ICT awareness programs for general public; Tertiary education on ICT, and e-learning
	D1: G2G	Establishing a government wide-area-network supporting email linking every government institution and employee; Development of fundamental databases of citizen data; Establishing a Sri Lanka Portal for global front-end as administration and service delivery channel
	D2: G2B	Establishing G2B interface that will facilitate interaction between businesses and the government
	D3: G2C	Establishing G2C service delivery infrastructure; establishing a

		government call center for voice based interactive support to citizens
	E1: Rural development	Establishing a national fund to support innovative applications of ICT for social and rural development
	E2: Strengthening connectivity	Establishing telecommunication centers and other forms of public access to information and communication services
	E3: Mass media	Revising mass media and multi media policy in-order to adhere to internationally established principles

From the analysis given in table-1, we can already recognize some of the primitive elements: government officials and employees, experts and technologists, computer hardware and software resources, entrepreneurs, and general public. To see how the individual programs influence the primitive elements, we check each program and subprogram of the five-program strategy against the primitive elements; the results are summarized in table-2. In table-2, abbreviations HRD, GO, T, GP, IE, BIF, HID, SID, ICTP, SMEs, CCs, BF, EDU, RF, S, and ER stands for human resource management, government officials, technologists, general public, investors and entrepreneurs, building information infrastructure, hard infrastructure development, soft infrastructure development, ICT parks and cyber zones, small to medium-sized enterprises, Internet service providers and Internet cafes, banking and financial institutions, educational institutions, regulatory framework, Source, and E-readiness, respectively.

Table-2 indicates that the proposed implementation strategy is very influential on human resource development, especially on ICT education. This has two effects, a positive one – the population becomes more IT-literate, and a negative one – surplus computer professionals but lack of inventors and entrepreneurs. A country’s capability for innovations and internal improvements cannot be flourished by IT education alone; production technology, supply- and demand chain management, economics, and psychology are all too important in the digital economy era.

Measuring the E-readiness

Figure-1 (taken from the authors previous paper Davidrajuh, 2000) depicts detailed benchmarking of e-readiness of Sri Lanka based on the eight major factors. For comparison, values for Norway are also shown in the figure. In Sri Lanka, demand forces (capability of the people) are about the average value. However, supply forces and societal infrastructure are poor. In some of the areas (English language usage, tertiary enrollment, high-tech exports, GDP per capita, computers per 1000 people, and telecom costs) Sri Lanka performs poorly.

Some other indicators (political stability = 1.0, and government effectiveness = 1.0) show that there is a serious problem in running the country. In addition, investment in ICT sector is low. After many technology investment debacles, private investors are not so enthusiastic about telecom ventures. The government has also problems in investing in technology sector mainly due to ever increasing health care costs.

Table 2: Effect of programs and subprograms on primitive elements and units.

<u>llx6132</u> GO	HRD				<u>BIF</u>			<u>Units</u>				<u>S</u>
	T	G P	IE	H I D	SI D	IC TP	SM Es	CCs	BF	ED U	R F	E R
A	X	X		X								
B	X				X	X	X		X	X	X	X
brdrw15B-1					x							x
brdrw15B-2	x				x	x	x		x	x		x
brdrw15B-3											x	
C		X	X								X	
brdrw15C-1		x										
brdrw15C-2											x	
brdrw15C-3			x									
D	X	X		X	X	X				X		X
brdrw15D-1	x	x			x	x				x		
brdrw15D-2	x	x		x	x	x				x		x
E			X		X	X			X			
brdrw15E-1			x		x	x						
brdrw15E-2					x	x			x			
brdrw15E-3			x						x			
All programs	X	X	X	X	X	X	X		X	X	X	X

The Requirements Analysis

The analysis done in subsections 3.1 and 3.2 shows that the policy makers have not given proper consideration to the concept of “domestic digital divide”. For example, from figure-1, it is clear that e-readiness measures gauge disparities that exist between countries (the “international digital divide”). Thus, improving e-readiness of Sri Lanka means improving its stand on the ICT usage compared to the developed countries. However, figure-1 indicates nothing about the domestic

digital divide - the gap between citizens of a country in knowledge, access, usage, and mastery of ICT and the Internet. E-readiness improvements may push a country to a better position in competing with the other countries, but it is not clear whether all the citizens of that country will enjoy the benefits due to the improvements. The following examples are on the effects of e-readiness improvement on domestic digital divide:

- Sri Lankan example: Though the government of Sri Lanka believed in reduction of both international and domestic digital divide by its e-government initiatives, however, two official reports recently published prove the opposite results on domestic digital divide, though effects on international digital divide is on Sri Lanka's favor (Davidrajuh, 2000; World Bank, 2004). For example, the share of national income of the poorest 10 percent of the population fell from 1.3 percent in 1997 (before the induction of e-Sri Lanka) to 1.1 percent in 2004. For the richest 10 percent, their share rose from 37.2 percent to 39.4 percent over the same period (Davidrajuh, 2000).
- Indian example: Referring to e-government implementation processes in India, Sharma and Soliman (2003) reports similar unintended negative effects on India's domestic digital divide.

From the above examples, it is clear that e-readiness improvements should benefit all the citizens of a country, especially if it is developing country.

IDENTIFYING MICRO PROJECTS

Figure-2 shows a classification of e-readiness improvement projects. Based on the magnitude of the project or on the size of the projects, the projects are broadly classified as national level projects and community level projects. Also, depending on the complexity or newness of the adopted technology or mechanisms, the projects are classified as incremental projects, innovative projects, and radical projects. We define micro projects as the community level projects that fall into incremental and innovative types. It is the micro levels projects that mainly uplift the lower masses ("don't-haves") of a country; thus, the micro projects not only improve e-readiness of a country, it also reduces the domestic digital divide of that country.

Given below are some of the micro projects that could improve e-readiness of a country (Tamilnet, 2005):

- Community restoration and development projects
- Women's development, rehabilitation, and job training
- Rehabilitation efforts of Irrigation development project
- Skill development programs
- School building projects
- Micro projects on income earning
- Village upliftment projects
- New technology adoption (e.g., solar power, wind mill)
- Grid supplied electric power to everyone

Micro Project: Grid Supplied Electric Power to Everyone

Out of the nine micro projects mentioned above, we select the project “grid supplied electric power” as the case study. This micro project is given close consideration as:

- This micro project adheres to the proposed strategy; this project falls directly into subprogram E1: Rural development (see table 1) and also indirectly into programs B, C, and D.
- It also encourages community participation as it is the communities that are directly going to benefit from this project.
- This project incorporates SMEs; SMEs are neglected in most of the programs, see table 2. As explained below in the case study, for generation of grid supplied electric power, SMEs can participate as suppliers of agriculture residues and bi-products and contractors of production of electricity from these agriculture residues.
- This project improves the domestic digital divide as it will enable everyone especially those who live in the remote regions to use communication facilities.
- It allows incremental development; step-by-step, more and more generators can be added to the grid with the support and guidance from central authorities.

CASE STUDY: MICRO PROJECT - GRID SUPPLIED ELECTRIC POWER

In this section, a case study is presented on the feasibility of the micro project on grid supplied electric power to every one.

The location

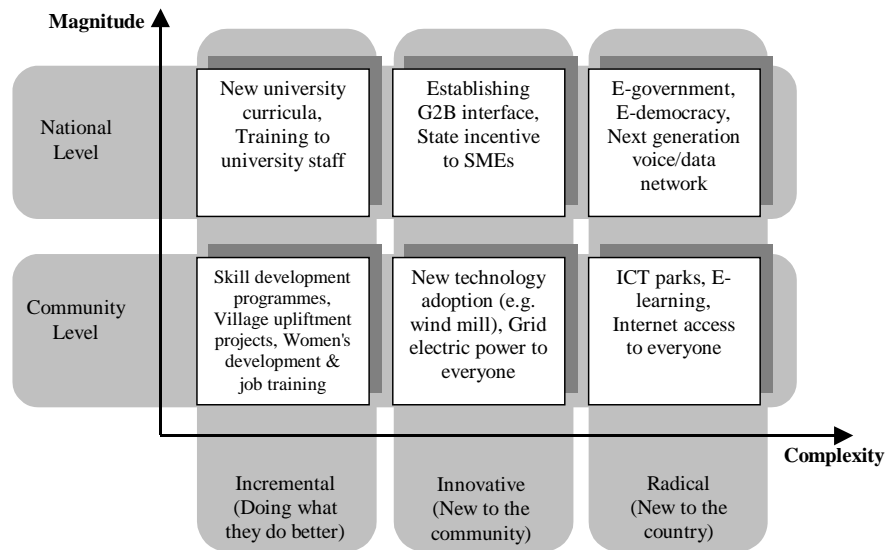


Figure-2: Classification e-readiness improvement projects for Sri Lanka

In **Northern and Eastern Sri Lanka (NE-SL)**, due to the raging civil-war, electricity is not available in most of the places. There is practically no electricity production and distribution system available or planned. Since Sri Lanka, as a whole, is suffering from power-shortage, it will be not possible for her to supply electricity to NE-SL, by the time the civil war comes to an end. An independent generation and distribution system should, therefore, be designed to supply electricity to NE-SL.

Needs and Requirements for Sustainable Power Supply

The long term life cycle scenarios for energy to the planet Earth points to massive utilisation of solar power, or its derivatives such as hydro, wind or biomass power (Weinberg, 1990). Power from tidal waves, geothermal and ocean thermal power is insignificant as far as NE-SL is concerned. Each type of energy has its own economy, life cycle and complications. Direct solar power and wind power is complicated by its diluted form and its variation with time and location. However, some of these variations are predictable and may be used in optimal predictive control of cogeneration systems (Asbjornsen, 1984). Example of such cogeneration system is a combination of solar, wind and biomass power. The power generating systems interconnected by the power grid is an existing technology. But incorporating intermittent power supplies (like solar, wind) to the grid requires careful planning. Nuclear power or hydro power systems acting as the base-load supplier of the utilities, try to even out any fluctuations or failures in the intermittent power supplies, if the intermittent power supplies are connected to the grid. With absence of fossil fuels, hydropower or nuclear power, a sustainable cogeneration system for NE-SL has to use biomass as buffer in incorporating intermittent power supplies. The other option is to include energy storage in the cogeneration system. The energy storage will store energy when the generated electricity from intermittent supply is in excess and it will contribute electricity to the grid when demand exceeds supply. However, studies show that energy storage systems are generally expensive (Friberg, 1993).

Basic Requirements Definition

A set of requirements could be defined fairly simply:

- The cost of electric power generation and distribution in NE-SL shall be within the price range for customers and users in the rest Sri Lanka
- Compared to the rest of Sri Lanka, the power generation system designed for NE-SL shall have the same or better, reliability, availability and fair distribution of electric power. Cogeneration system should also meet the customers' power requirement at any time.
- The power generation system shall have none or minimal harmful pollution effects, on the air, soil or water environment, or on the social environment.

There are some other requirements too, due to the varying nature of the intermittent energy sources, and due to the economic requirement on conversion technology:

- In case of intermittent primary energy source is used, energy back-up shall be

- provided by the system
- Existing technology for energy conversion shall be utilized to a degree, which is the most feasible economically
 - The economy of scale shall be utilized optimally in terms of size and capacity of units, modularization and standardization, distribution and centralization

System Integration: Responding to Customers' Power Requirements

Changes in customers' power requirements will automatically be taken care of by the demand management system through control of the turbines in the power generation systems. The optimal strategy will be to let the solar power generation run at its maximum capacity at any time. This capacity will change during the day and go to zero when the sun sets. It is also optimal to let the wind power run at its maximum capacity, which will also change with the intensity of the wind. The remaining power requirement will be taken care of by the biomass and fossil fuel power generation systems. As long as the system is designed to tackle all possible situations, as described, the customer will see the power generation system as totally reliable. The key issue in the whole system is to match capacities of the total cogenerating system to the customers' power requirements and to the availability of the energy sources, solar radiation, and wind speed.

Because of the intermittent nature of solar and wind power, when incorporating these generators into the grid, the total plant capacity must always exceed the maximum expected demand by a large margin (penalty for intermittence), in-order to increase system reliability. In NE-SL, where wind and solar power will be contributing most of the time, thermal plants that have higher operating fuel costs but cheaper to build become more attractive (such as natural gas plant), because the reduced operating time will make fuel costs less important. There is a limitation on the extent to which the intermittent sources like solar and wind contribute to the total power generation. As the percentage of power generation of wind and solar increases, there is steady decline in value, because adding intermittent sources reduce the reliability. Contribution from wind energy ranging from 0% to 50% of overall installed capacity is feasible before operational losses become prohibitive (Grubb & Meyer, 1994).

System Integration: Smaller the Better

For a developing country like NE-SL which does not have any large scale hydrologic resource for electricity generation, the selection of optimum power plant mix should be based on small, affordable power generators. Reliability of the power generation and distribution system will be increased if large number of small generators, scattered throughout the nation, is used rather than few large plants. By using a large number of smaller plants, the potential danger of over building or commissioning less cost effective large plants could be avoided. Small plants can be added quickly as they are needed and even disassembled and moved if loads decline; whereas, the economics of the larger plants depend heavily on long-term forecasts (Johannson et al., 1993; Kelly & Weinberg, 1994).

In case of biomass generated electricity, power plants are modest in scale (less than 100MW) to assist collection and transportation of dispersed biomass supplies (Williams & Larson, 1994). If the small generators are scattered throughout the region, a number of other benefits emerges:

heavy pollution of a region (congestion) is avoided; employment (less rural exodus) and community participation (awareness) is also increased in distributed power generation. Ideally, each region should become self-sufficient in electricity generation; if the demand exceeds its supply, the utility in that region imports electricity from the neighboring utilities, and similarly, the excess capacity is also sold to the neighboring utilities.

Participatory development in System Integration

For a sustainable cogeneration system to succeed, the participation of the community becomes essential. Take for example, production of electricity from residues from paddy: today rice husk is normally sold at the rice mills, for insignificant price for trivial use. Now, the rice mill is expected to sell the husk to the utility. The mill management will certainly hesitate to sell if high expenses are incurred in doing so (transportation). However the question is, even if the extra expenses incurred are negligible, whether the management will be willing to sell. The answer to this question depends on the participation of the management in the communities affairs. This 'bottom up' approach where grass roots organize, assist and take responsibilities, and solve (save energy) the energy problem will certainly promote the efficient supply of electricity to the whole nation.

CONCLUSION

This paper proposes a scientific analysis to identify micro projects that can improve e-readiness of Sri Lanka. By this approach, while improving national e-readiness, domestic digital divide that exist between the citizens can also be minimized. A closer look into the effects of introducing supplementary grid supplied electric power to Sri Lanka is also done.

Further work: Due to the ongoing civil war in the location scrutinized in the case study (NE Sri Lanka), it is extremely difficult to get data. All the data used in this paper are from 1994-1995, when there was a lull in the civil war. For a more infallible study newer data must be used.

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