A Post-Implementation Analysis of Digital Transformation Regime for E-Governance in Sri Lanka.

スリランカ電子ガバナンスのためのデジタル変革レジーム

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Chapter No. 1

The Introduction

1.1 Sri Lanka

Sri Lanka is pear-shaped island nation in the Indian Ocean 29 kilometers off southeastern coast of India and is located between the Laccadive Sea in west and the Bay of Bengal in east. It covers an area of 65,610 km², of which land area 64,740 square kilometers. Sri Lanka consists of a main island and a number of smaller islands. Until 1972 the country was known as Ceylon. Sri Lanka has a population of 22 million people, capital is Sri Jayewardenepura Kotte, a district of Sri Lanka's largest city Colombo. Spoken languages are Sinhala (official and national language) 74%, Tamil (another official and national language) 18%, other 8%. About 10 % of the population speak English as a second language. Sinhalese people constitute around 2/3rd of the country's populace. The Sinhalese claim to have been the earliest colonizers of Sri Lanka, first settling in the dry north-central regions as early as 500 B.C. The Sinhalese arrived probably from northern India. Buddhism was introduced about the mid-third century B.C. Between the third century B.C. and the twelfth century A.D., Sinhalese established a great civilization centered around the cities of Anuradhapura and later Polonnaruwa, which was renowned for its brilliance in hydraulic engineering — the construction of water reservoirs and irrigation canals. State patronage gave Buddhism a heightened political importance that enabled the religion to escape the fate it had experienced in India, where it was eventually absorbed by Hinduism. The history of Buddhism in Sri Lanka, especially its extended period of glory, is for many Sinhalese a potent symbol that links the past with the present. An enduring ideology defined by two distinct elements — Sinhaladipa (unity of the island with the Sinhalese) and Dhammadipa (island of Buddhism) — designates the Sinhalese as custodians of Sri Lankan society. This theme finds recurrent expression in the historical chronicles composed by Buddhist monks over the centuries, from the mythological founding of the Sinhalese "lion" race around 300 B.C. to the capitulation of the Kingdom of Kandy, the last independent Sinhalese polity in the early nineteenth century.

1.2 A Brief History

Ancient Indian and Sri Lankan myths and chronicles have been studied intensively and interpreted widely for their insight into the human settlement and philosophical development of the island. Confirmation of the island's first colonizers — whether the Sinhalese or Sri Lankan Tamils — has been elusive, but evidence suggests that Sri Lanka has been, since earliest times, a multiethnic society. Sri Lankan historian K.M. de Silva[1] believes that settlement and colonization by Indo-Aryan speakers may have preceded the arrival of Dravidian settlers by several centuries, but that early mixing rendered the two ethnic groups almost physically indistinct.

The Sinhalese arrived in Sri Lanka late in the 6th century B.C., probably from northern India. Buddhism was introduced beginning in about the mid-third century B.C., and a great civilization developed at the cities of Anuradhapura (kingdom from circa 200 B.C. to circa 1000 A.D.) and Polonnaruwa (from about 1070 A.D. to 1200 A.D.). In the 14th century, a south Indian dynasty seized power in the north and established a Tamil kingdom. Occupied by the Portuguese in the 16th century and by the Dutch in the 17th century, the island was ceded to the British in 1796, became a crown colony in 1802, and was united under British rule by 1815. The institutions of Buddhist-Sinhalese civilization in Sri Lanka came under attack during the colonial eras of the Portuguese, the Dutch and the British. During these centuries of colonialization, the state encouraged and supported Christianity — first Roman Catholicism, then Protestantism. Most Sinhalese regard the entire period of European dominance as an unfortunate era, but most historians — Sri Lankan or otherwise — concede that British rule was relatively benign and progressive compared to that of the Dutch and Portuguese. Influenced by the ascendant philosophy of liberal reformism, the British were determined to anglicize the island, and in 1802, Sri Lanka (then called Ceylon) became Britain's first crown colony. The British gradually permitted native participation in the governmental process; and under the Donoughmore Constitution of 1931 and then the Soulbury Constitution of 1946, the franchise was dramatically extended, preparing the island for independence two years later.

The country got its independence from British colonial rule in in 1948. Later the country's name was changed from Ceylon to Sri Lanka in 1972. Tensions between the Sinhalese

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[1] Silva K. M. De. A History of Sri Lanka. Berkeley and Los Angeles: University of California Press or C. Hurst, London. 1981.

majority and Tamil separatists erupted into war in 1983. Tens of thousands died in an ethnic conflict that continued for some 30 until the end of the war in 2009. After two decades of fighting, the government and Liberation Tigers of Tamil Eelam (LTTE) formalized a cease-fire in February 2002, with Norway brokering peace negotiations. Violence between the LTTE and government forces intensified in 2006, but neither side has formally withdrawn from the cease-fire. In May 2009 government forces defeated the LTTE. Since the end of the conflict, the government has enacted an ambitious program of economic development projects, many of which are financed by loans from the Government of China.

Figure 1.1 A Broad Map of Sri Lanka[2]

1.3 Governance Structure in Sri Lanka

Sri Lanka with a current population of 21,520,018[3] on May 30, 2021, has a complex government structure that has evolved over many centuries. Though at present the government is governed by the constitution of the republic passed in 1972, many of the governmental agencies and departments are remnants of the past kingdom, colonials and earlier era after the country got independence in from British colonial rule in 1948. It is thus important that we quick explain background of the present-day governance structure and then explain it in order to set a context in which it all evolved.

a. Evolution to The Present State of Governance

As I have mentioned earlier, before the colonization took hold, Sri Lanka was a ruled by kings who were monarchs. During the colonial period, administrative and governmental reforms were introduced by interchanging colonial administrations under the Portuguese, Dutch and British rulers. However, finally the then Dutch territories and the Kandyan Kingdom were taken over by the British in 1815. Executive Council and the Legislative Council, the very first legislative bodies of colonial Ceylon, were set up in 1833 as per the recommendations of the Colebrook-Cameron commission. Later in 1944, upon Soulbury Commission's recommendations, a bicameral parliamentary system based upon the Westminster model was introduced. The Parliament consisted of the Queen (represented by the Governor - General) and two Houses, namely the Senate and the House of Representatives. The House of Representatives consisted of 101 Members and the Senate consisted of 30 Members, of whom 15 were elected by the House of Representatives and 15 nominated by the Governor - General.[4] The Senate was abolished on 2nd October 1971. The present parliamentary buildings at Sri Jayewardenepura Kotte were commissioned to a Japanese consortium of 2 Mitsui Companies for the construction of the new building complex which was completed in April 1982.

Presently, Sri Lanka is a multiethnic country with many assorted cultures, languages, and ethnic groups. The Sinhalese form the majority of the nation's population; followed by Tamils, Moors, Burghers, Malays, Chinese, and the indigenous Vedda as recognized groups.[5] Sri Lanka is member of United Nations, the South Asian Association for

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[3] Source: http://esa.un.org/unpd/wpp/

[4] For details on chronology of Heads of State in Sri Lanka please refer to Appendix 2.

[5] Vedda were the island's aboriginal inhabitants prior to the 6th century BCE.

Regional Cooperation (SAARC), member of the Commonwealth, the G77, and the Non-Aligned Movement.

Figure 1.2 Parliament of Sri Lanka, Kotte District of Colombo

b. Present Government Structure[6]

At present the national government in Sri Lanka is formed under the 1972 constitution where most executive authority rests with the president of the country (formal title is the Executive President). President in supported by a cabinet of ministers headed by a prime minister. The cabinet members are selected from the majority party in the parliament. The majority of members of the parliament are elected through direct voting by general public, while some are elected indirectly through proportional voting system. The total number of parliament members is set at 225 in the country constitution established in 1972. The Figure 1.3 gives a quick snapshot of the top tier of the national government in Sri Lanka. For a detailed observation of the governmental structure in the country at national, provincial and district level please refer to the Appendix 3 provided at the end of the thesis.

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[6] For a detailed government structure in Sri Lanka please refer to Appendix 3
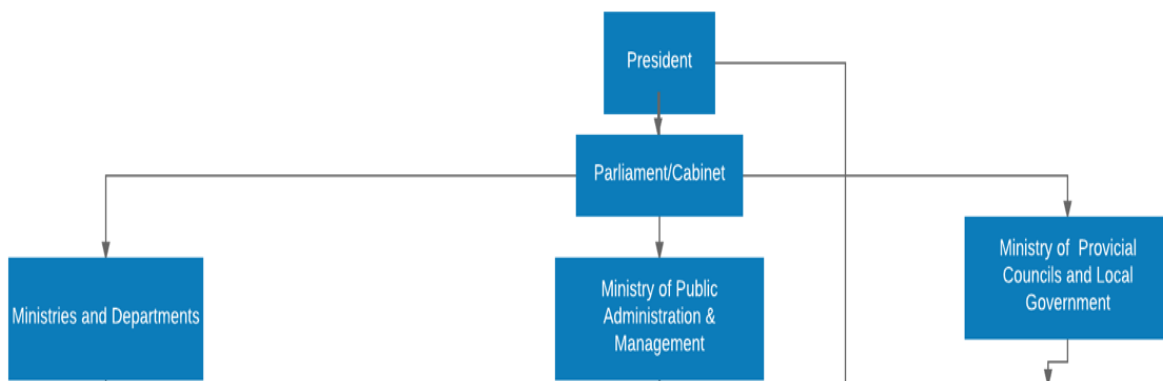
Figure 1.3 A snapshot of the top tier of the government in Sri Lanka[7]

The Sri Lankan state has shown a strong and consistent preference for a centralized and unitary state with strong inclinations towards concentration of powers towards Sri Jayewardenepura Kotte near Colombo (McCourt 2007).[8] Constitution of 1972 is a centralist constitution in its original form and shape. The constitution was, however, formally put into practice in 1978. However, over the time the need for development, economic growth and improved public service delivery (PSD) especially has resulted in delegation of powers had necessitated the establishment for meaningful provincial as well as district level governments. By 2009 a total of 30 local government authorities have been established to deliver better public services in the country at public level.[9] It may not be an exaggeration to mentioned that end of civil war had necessitated the delegation of power at provincial and district level in order to make sure that gains of war were not spoiled for the same reason which in one way gave rise to the conflict in first place.

Figure 1.4 Emblem of the Government Sri Lanka[10]

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[7] License CC BY-NC 4.0

[8] McCourt, W. (2007). Impartiality through bureaucracy? A Sri Lankan approach to managing values. Journal of International Development, 19(3), 429–442. https://doi.org/10.1002/jid.1372

[9] Source: Sri Lanka Department of Elections. Source: Department of Elections, (Accessed on May 30, 2021, http://www.slelections.gov.lk/)

[10] The emblem represents the state of Sri Lanka

Briefly I can quickly explain the political or governance structure in Sri Lanka as a system scattered over three tiers, central, provincial and local government. Provinces have Provincial Councils. A province is divided into districts which are is further divided into various divisions. Local level is further divided into three categories of local governments level denoted to as local authorities, urban councils, municipal councils and at the bottom rung of the structure are divisional councils also called Pradeshiya Sabha. The divisions are administered by a Divisional Secretary appointed by the central government. The Divisional Secretariat (DS) division oversees village level administration dividing the structure further into Grama Niladharis (GN).

By year 2000, there was start realization of inefficiency of public service in general in the country and voices were raised to devise ways and means to improve the efficiency and delivery of the public services. The wave became even stronger by 2009, when a long civil war came to an end, thus paving the way for greater governmental overhaul and reorganization. Digitalization was realized as one important way in which the country needed to work on. In the next section I explain the background, issues and solutions that were adapted in the country in order to move the public service delivery from age-old paper-based system towards a digitalized system more in line with the requirements of the 21st century.

1.4 Digitalization in Sri Lanka

Use of information and communication technology (ICT) in PSD in developing countries remained considerably slow as compared to the developed countries. Many factors can be mentioned as reasons for this situation like low literacy levels, lack of training, lack of initiative, and paucity of resources. The coverage of internet and social media among private sectors and general public in developing countries transpired before the ICT transition started reaching government services. Spread of information and greater access to worldwide knowledge resources, in turn, prompted a greater demand for better and efficient public services of these countries. In Sri Lanka, this change was delayed for a long time due to a long-drawn-out civil war in the country. Turn of the 21st century saw a greater demand for improved PSD got buoyance and a thrust for introduction of ICT in all public operations and services got speed. Many international donor agencies and governments came to aid these efforts and provided substantial funds to introduce and execute large scale digital transformation of the government operations and the services provided. The

Sri Lankan government started the e-Sri Lanka project in 2002, and in 2003 Information and Communication Technology Agency (ICTA) was established, in addition to the establishment of Lanka Government Network (LGN). With these developments, the digital transformation process took pace in earnest throughout the ministries and departments of the Sri Lankan government. The drive towards e-governance was set into motion with an objective to improve efficiency of the government operations and improve public service delivery at all governmental levels.

Since 2000, Sri Lanka has embarked upon a path towards digitalization of the most government functions and the process of public service delivery in the country. The process started with several disjointed initiatives culminating by 2010 into a full-scale program funded by many international donors around the world. Digital promotion agencies, like ICTA and infrastructure development entities, like LGN were established and the process picked up pace in earnest in various government agencies and departments. This process, sometimes called e-governance, was set into motion to improve the efficiency of the government operations and public service delivery at all governmental levels. By 2020, a full decade has passed since many primary public services had undergone a digital transformation. In this thesis, I analyze the digital governance process and assess what is the efficiency status of public services in the country. I conducted an output-oriented, nonparametric analysis of the performance data applying data envelopment analysis (DEA). The data was collected through a questionnaire-based field survey. The findings suggest that most public services have not achieved optimal efficiency levels, and there is still plenty to be achieved by performance enhancement measures that have been adopted by the various agencies of the Sri Lankan government.

Since the start of most recent millennium, Sri Lanka started a most ambitious plan for introduction of information and communication technology (ICT) throughout most of the government functions and the process of public service delivery (PSD) in the country. The process started in early 2000 in earnest and with several local and internationally funded intuitive gained quite a momentum. Information and Communication Technology Agency (ICTA) and Lanka Government Network (LGN) were established and the process covered operations of most government agencies and departments with an objective to improve efficiency of the governance and public service delivery at all governmental levels. I am very much interested in understanding and analyzing the

utility of the ICT regime introduced in various departments and ministries (D&Ms) of the government of Sri Lanka. In this thesis I analyze the overall and relative effectiveness of the ICT regime process inputs and the outcomes. After explaining the summary statistics of the data collected and various correlations, I apply ordinal logistics analysis to understand the interrelations amongst various ICT inputs and their impact upon the outcomes. Cronbach alpha has been calculated to test the robustness of the data. Finally, I conducted specificity, sensitivity and predictive values analysis in order to assess the accuracy of the model applied. The findings suggest a positive, though at times weak amongst some of the variables, correlation between the inputs and outcomes of the ICT regime put into place to digitalize the PSD in the country. It may be noted that ICTA and the infrastructure developed and handled by ICTA like LGN and Lanka Government Cloud (LGC) are important pivots of the efforts towards digitalization of PSD in the country, it is thus important that I present a quick introduction of these very important institutions and projects in the country.

1.5   Information and Communication Technology Agency

Information and Communication Technology Agency (ICTA), is a public institution solely owned by the Government of Sri Lanka. The agency is an heir to e-Sri Lanka project funded by the World Bank started in 2004. The agency is the top ICT institution of the Government of Sri Laka. ICTA has been authorized to take all necessary measures to implement the Governmental measures related to ICT. ICTA is further required to assist the government on national policy on ICT and provide all information necessary for its policy, infrastructure and operational mechanisms to implement the digital governance vision. [11] ICTA is an all-encompassing body for providing ICT related direction and co-ordination with an objective to provide efficient citizen centric services. It does so by regulating and serving as a go between market and state mechanisms. In addition to designing new laws and organizational frameworks, the functions of ICTA can be briefly mentioned as expanding digital governance, formalizing the use of IT as a knowledge exchange tool, establishment of international e-commerce and e-payment systems, data protection, cyber security and protection of intellectual property rights.[12]

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[11] Information and Communication Technology Act No. 27 of 2003, (ICT Act) as amended by Act No. 33 of 2008

[12] For details on the history, vision and functions - https://www.icta.lk/

One of the main functions of ICTA is to design and develop digital infrastructure in the country in order to achieve the objectives mentioned above. One of the major achievements of the agency is ICT development and execution of Lanka Government Network (LGN) connecting more than 850 government organizations in the country. Also, the agency made provisions for development of Lanka Government Cloud (LGC) in order to provide cost effective, reliable and secure infrastructure facilities. These major infrastructural projects were necessary to accommodate all governmental functions through IT based platform. Also, the same were necessary to make information technology and internet base services for businesses and general public more accessible. The figure 1.5 presents are compact picture of the activities and functions of ICTA.
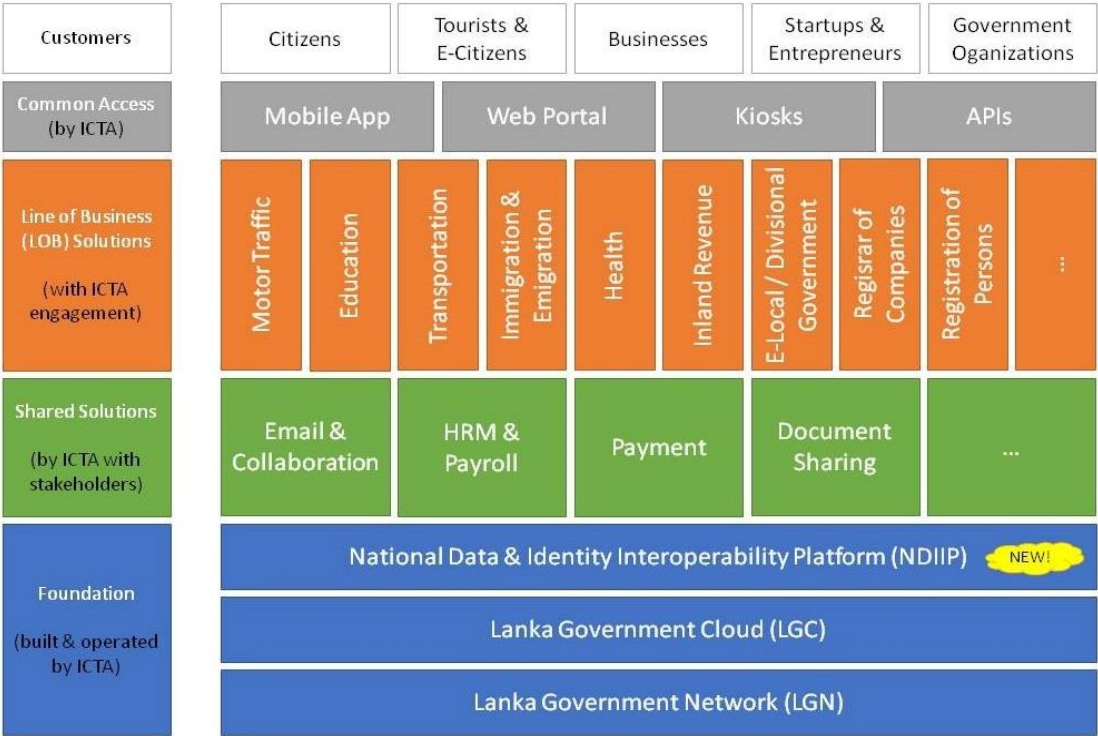
Figure 1.5 Sri Lanka Government Digital Architecture and ICTA[13]

I can notice that in addition to LGN and LGC, the agency has also founded National Data and Identity Interoperability Platform (NDIIP) which takes of the task of digitalizing the national identification matters and makes sure that all government organs are provided with most accurate data sets that are needed for provision of various aspects of PSD.

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[13] Source: https://www.icta.lk/digital-infrastructure/; Accessed on 20 March, 2021

1.6 Summary of the Thesis

The thesis has been produced in 6 chapters in total starting with this chapter no. 1 titled introduction. In this section of the introductory chapter I shall explain the major features of my thesis. The thesis is about analyzing the state of affairs related to digitalization of government functions in Sri Lanka. As it is discussed in the last section, the process of digitalization was started in sync with introduction of ICT in the country. ICTA designed and promoted the architecture, infrastructure and implementation of digitalization of government functions in the country. The prime objective was to bring the country's government functions and public service in line with the requirements of the modem age. At the same time, it was desirable to improve the efficiency and effectiveness of PSD through modern means of information and communication. The government and ICTA have been actively pursuing these objectives for more than a decade, more actively since the end of the civil war in 2009. It is thus pertinent at this crucial juncture that I assess the impact of the digitalization efforts in the country. In order to do that we need to raise some important and relevant questions that will explain the state of affairs in a post ICT implementation scenario. So, in the following section I have laid down the list of important research questions that need to be investigated and answered in order to form and informed opinion about the state of affairs in the country in post ICT implementation scenario.

a. Research Questions

I have formulated three important research questions for the purpose of this thesis as follows:

- To what extent the operational efficiency has been achieved with ICT deployment in 20 D&Ms of the government of Sri Lanka?
- To what extent informational efficiency increased with the ICT deployment in the D&Ms?
- To what extent PSD efficiency has increased in a post ICT deployment scenario in the country?

These are important questions that are central to the analysis and inquiry carried out in this thesis. In order to carry out a meaningful analysis to answer these questions, we needed some relevant data. The nature of data and the method of data collection is briefly explained in the next section of this chapter.

b. The Data

The data was collected through a field survey conducted during February through March of 2020. In total, I surveyed 20 representative departments and ministries (D&M) of the government of Sri Lanka where ICT regime was implemented for ten years starting in 2010 as per the details as per Appendix no. 5A[14]. It was a bifocal survey, on one hand I questioned the ICT regime implementors (officer and employees) about the ICT implementation. 10 questionnaires were distributed and collected from each of the entities. On the other hand, a similar number of questionnaires were distributed and collected from general public who availed services from these D&Ms. In total 400 responses were collected, as I collected 200 from each from both sides of the service spectrum. The questionnaire comprised of 20 questions divided into input and outcomes questions (input for D&Ms and outcomes for the public). The responses were sought on a Likert scale: 5 standing for strong agreement, 4 for agreement, 3 as neutral, 2 as disagreement, and 1 as strong disagreement. Input questions have been coded as ICT; whereas the outcomes have been coded as satisfaction to reflect the degree of satisfaction users of the ICT based PSD had from the regime implementation. Originally the questionnaires were designed in English and then translated into Sinhala language, one of the major official languages of Sri Lanka, in order to assure ease of understandability and response to the questions.

In Appendix no. 4, I have listed the D&Ms from where the survey data was collected. Inputs and outcomes related responses of 10 employees from each of 20 D&Ms were tabulated along with responses from 10 clients from the same D&M. These D&Ms were at the center of the ICT regime that was put into place from 2010 and are major PSD hubs for governance and the service delivery in Sri Lanka. The data thus collected was recorded into separate excel sheet and tabulated for further treatment and analysis. The originality and novelty of the data sets this study apart from some other studies that were conducted in the past. Also, keeping in view the ordinal nature of the data, a transformed binary variable agree/disagree (AD) was created from the variable "satisfaction" to allow a better analysis and understanding of the data outcome without dropping other variables from the final analysis.

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[14] For Questionnaire in English see Appendix No. 5A

For Questionnaire in Sinhala see Appendix No. 5B

c. The Analysis

In this thesis, I have applied a two-way analysis to cover multiple dimensions of the analysis and to reach comprehensive results. First, I applied data envelopment analysis (DEA) to estimate overall and relative efficiencies of various D&Ms studied in this thesis. Secondly, I carried out regression analysis to understand the relationships between various ICT input measures and the outcomes of the implementation of the ICT regime. In the next two sub sections, I briefly explain the nature of methodologies applied to conduct the data analysis. The detailed analyses have been reported in chapter no. 3 and chapter no. 4.

i. Data Envelopment Analysis

First, I have applied a nonparametric-multistage data envelopment analysis (DEA) to understand how the ICT regime performed. The three outputs factors (OP1, OP2, and OP3), were used in the analysis, and the technical efficiency (TE) has been measured on a variable return to scale (VRTS) from an output orientation. Making use of standard VRTS and DEA models, I assumed output orientation as the magnitude and the direction of input has already been defined and is not alterable in the short-run (Fare et al. 1994). Thus, only outputs, i.e. services, information, and operations can be adjusted to allow our entities to perform at optimum scale to achieve maximum efficiency levels. Farell originally developed these efficiency measures; however, over time, DEA has evolved as a body of knowledge and technique. I also relied on the work of Charnes et al. regarding efficiency measurement models (Charnes et al. 1976). The efficiency assessment model presented by Charnes et al., is commonly referred to as CCR model, hence the use of the term CCR model in this paper (Farell 1957). Using the CCR model, I carried out a detailed assessment of the historical performance of the public service delivery system in Sri Lanka after the implementation of ICT regime. Charnes (1991) demonstrates that DEA is a useful and robust approach to assess historical performance. Our decision to use output orientation allows us to compute the extent to which output quantities may be altered without making any changes to the input quantities.

CCR model defines the efficiency of a decision-making unit (DMU) as the maximum of a ratio of weighted outputs to weighted inputs, subject to the condition that the similar ratios for every DMU can be less than or equal to unity (Fare 2005). CCR model can be presented with mathematical programming methods, as later suggested by both Boles

(1967) and Afriat (1972). As I am proposing to use a variable return to scale technical efficiency (VRTS) measure, I shall start from a CRTS CCR model in linear programming form and then introduce convexity constraint to adapt it for VRTS. Details of the methodology and the analysis can be found in chapter no. 3.

ii. Regression Analysis

For the purpose of the regression analysis, the response data was categorized as inputs and outcomes based on the nature of the response data. IT has been used as the independent variable. The dependent variable is satisfaction. Another dependent variable i.e. AD has been used in the data, it is a transformed binary variable for which satisfaction and ICT are independent variables. I established a limit of 4 to convert outcomes (satisfaction) into a binary dependent variable AD of 1 (overall agreement) and 0 (overall disagreement). It may be noted that our response data is of ordinal nature on a 5-point Likert scale where 5 stands for strongly agreed, 4 agreed, 3 neutral, 2 disagreed and 1 for strongly disagreed. In order to achieve this transformation all client responses ≥ 4, I allocated value of 1 to this additional variable and for all responses < 4, I assigned 0. In this way, I assumed a careful approach in handling and analyzing the response data. The robustness of the data was checked via Cronbach's alpha. I calculated Cronbach's alpha to assess the reliability and internal consistency of data's test items. Cronbach's alpha has been applied to test the strength of that consistency (Tavakol 2011).

Additionally, I produced multivariate ordinal logistic (ologit) regression results to deepen our understanding of the nature of the relationships that exist among various variables used in the analysis. Ologit regression model is a generalization of a binary logistic regression model when the outcome variable has more than two ordinal levels which in our case is 5. Ologit estimates the probability of being at or below a specific outcome level, conditional on a collection of explanatory variables. The ordinal logistic regression model can be expressed as a latent variable model (Long & Freese, 2006; Agresti, 2002). Assuming Y* can be defined as a function of a set of predictor variables and a random error. Let Y* be divided by thresholds: $\alpha 1, \alpha 2, \alpha 3, ..., \alpha j$, and $\alpha 1 < \alpha 2 < \alpha 3 ... < \alpha j$. The values of the observed ordinal variable, Y, fall within the regions divided by these thresholds. For example, Y = 0, if $Y* \leq \alpha 1$. The observed ICT satisfaction level as in the survey is the ordinal outcome, y, ranging from 0 to 5 as described in the data section. As the response categories in my data are limited up to 5, using a nonparametric ordered

logistic regression model seems most appropriate for our analytical purpose. Further details of the methodology and analysis can be found in chapter no. 4.

d. Results

The results thus obtained through a rigorous statistical analysis show that there are reasonable and understandable basis for continuing to invest in the ICT infrastructure as it has positive bearings upon the PSD in Sri Lanka. I conducted non-parametric ordered logistic analysis. Analyzing survey data beyond descriptive statistics always comes with a certain uncertainty as to which analytical approach will offer the best analysis of the data. While some would suggest using a logistic regression model; but again, there are multiple options which need to be carefully selected in view of the nature of the data. The problem become more acute as the responses to the question do contain certain level of subjective evaluation. As the questionnaire asked respondents to answer the questions on a 5-point Likert scale (5 strongly agreed …. and 1 for strongly disagreed), we needed to use a regression approach that could take care of the ordinal nature of the data. Finally, I decided to use ordinal logistic regression to analyze our data. This approach allowed us a deeper understanding of the interrelationships amongst our independent and dependent variables while attending to most issues with the nature of the data.

Research findings shows that deployment of the ICT in the country has not been entirely smooth. The results of the study indicate disparate performance across the entities of the Sri Lankan government. I can identify benchmarks as well as slackers in the whole PSD structure through this study. I suggest that apparent incongruity of results across various PSD entities should be minimized, to allow a smoother ICT continuum ending in a complete transformation of the PSD structure in the country. Chen (2003) suggests that the e-government initiative of a country progresses along an information-communication-transaction-transformation continuum (ICTT). In other words, the digital transformation can be regarded as the capability of a country to move along the aforementioned 4-stage ICTT continuum. We have, however, taken a 3-output factors (OP1, OP2, and OP3) approach towards performance assessment in this study, those three factors correspond to the first three factors of the ICTT continuum suggested by Chen. Fernando (2006) states that under limited resource conditions, I shall need to improve performance in order to satisfy public expectation regarding public service delivery. Bonina and Cordella (2008) observed that when public attaches a higher value

to use of ICT in governance, this leads to further developments and innovation. Castelnovo and Simonetta (2007) stressed this point even further in their paper where they proved that ICT, governance and public value are interconnected.

Consequently, I mapped out the performance of the public services in the wake of the ICT regime in three areas, i.e. services (OP1), information (OP2) and operations (OP3). Our findings suggest that OP1, i.e. technical efficiency score regarding public service delivery is not consistent across all entities. With a TE score of 0.957 (CRTS) and 0.976 (VRTS), service delivery at the Department of Imports and Exports (E3) has been the least efficient area as compared to others. That suggests that while departments and ministries have benefited from the implementation of the ICT regime, the same cannot be said for the public service delivery efficiency across all of them. The situation becomes further apparent as I look at the returns to scale where I noted that most departments and ministries are faced with decreasing returns to scale situation and would require a scale adjustment in order to improve their efficiency levels. There are few exceptions like E6, E10, E11, and E12. Department of Labor (E11) has come out as a star performer in a comparative analysis as with TE = 1 and a constant returns-to-scale situation. It can serve as a peer to the highest number of other departments and ministries, which is 8 in total. This result suggests that other entities should at least replicate the Department of Labor's performance per the peer weights. Also, from a scalar perspective, the Department of Pensions (E8) has plenty of unused capacity; and at the same time is facing a decreasing returns-to-scale situation. This situation may be indicative of a structural issue of the department, and the situation requires more in-depth insight in order to pinpoint the exact cause of the problem with the department.

In regression analysis, I have analyzed the effectiveness and acceptability of the ICT regime in Sri Lanka and results have shown that inputs of the regime are positively contributing towards the success of the program, though the contribution has not reached to very significant levels so far. After explaining the summary statistics of the data collected and various correlations, I use ordinal logistics analysis to understand the interrelations amongst various ICT inputs and their impact upon the outcomes. Cronbach alpha has been calculated to test the robustness of the data. Finally, I conducted specificity, sensitivity and predictive values analysis in order to assess the accuracy of the model applied. Our findings suggest a positive, though at times weak amongst some of the variables, correlation between the inputs and outcomes of the ICT regime put into

place to digitalize the PSD in the country. Also, sensitivity and specificity tests have been carried out for the for AD and the results show sensitivity and specificity results for our model. The uniqueness and originality of our data makes the study first of its kind and it can of enormous use to both PSD operators as well the researcher who plan to build upon our results and find other angles to the case in point. One such research may be the exploration of factor efficiencies per se by applying other techniques of inquiry. The authors plan to expand the scope of research in future by examining factor efficiencies too.

Chapter No. 2
Literature Review

There are numerous studies published variously over time that affirm the utility of ICT into governance. Such studies highlight one or the other use of ICT in explaining the pros and cons thereof. ICT has been found to help in information dissemination, improved PSD, improved transparency and greater citizen participation. Bhatnagar (2014) has carried out an extensive study and explained the potential of e-governance for both large-scale and small-scale project. Gurubaxani (1991) stated that use of ICT resolves the agency issues by addressing the asymmetry in information provision and is thus desirable.

2.1 A Theoretical Perspective

Regarding the use of ICT in PSD, United Nations Public Administration Network (UNPAN) survey emphasized the importance of governance rethinking in an e-government framework while continuing with PSD (UN E-Survey 2012). Some other studies have focused on the technical aspects of the ICT into PSD. Averweg et al. (2012) stressed upon the importance of connectivity and bandwidth of ICT infrastructure while truncating discussion on its relationship with PSD. Bhatnagar (2014) emphasized the importance of consulting all stakeholders, especially the citizens, for whose benefit the ICT is deployed. Arild (2012) points out towards a mismatch between the functions implicit in the stated objectives for eGovernment, and the way ICT is deployed; the mismatch can, at least partly, be attributed to an inadequate understanding of ICTs and its many functions.

The mismatch between the stated objectives and the actual deployment can both be devastating as well as costly. This mismatch can obviously be a result of the knowledge gap that arises due to misunderstanding or not fully understanding the final objectives of the system, i.e. catering the citizens' needs. In theory, taxpayer money is spent on the provision and reformation of public services. So, people are naturally inclined to know the rationale of spending on such services. Similarly, people would like to be sure of the propriety of such spending, i.e. whether money is allocated directly in proportion to the services provided by the government or not. In the case of Sri Lanka, though a significant amount of funds to introduce e-governance and related ICT regime has come from

international donor agencies, still a large amount of investment has been allocated from the public exchequer in the last ten or so years. So, an assessment should be made about how the performance has improved with the changes due to ICT deployment. The success of reform and spending will improve public confidence in such measures and the related expenditure. Korneta (2019) stresses it is crucial to justify the value of such services in public perception, in order to allow continued support for investments into technologies. It has been observed with ample evidence that improvement in service delivery is considered an important performance indicator of e-governance (Zheng, 2017). While many studies have been conducted on e-administration, the efficiency of ICT regimes in post-implementation scenarios has not been explored. It is also a fact that the concept of e-governance, especially in the context of developing countries, is relatively new and not fully understood (Del Sordo et al., 2017). An earlier study about the efficiency of public services in Sri Lanka conducted by ICTA found that in public perception, most public services in Sri Lanka are not efficient (ICTA, 2008b). Now more than a decade has passed since the strenuous effort, and investment was poured into this ICT regime, it is thus essential to assess the value of investment into ICT and find out where the public services stand in terms of efficiency. Time and again, studies have found that the effectiveness and the efficiency of public services enhance the value of services (Moore, 1995) in public perception. Thus, it is highly essential to provide a framework for service evaluation, too (Alford, 2009). Jehan et al. (2010a) presented a transformational view of the change management that may be a caused by introduction of ICT in Sri Lanka's PSD. In a later study Jehan et al. (2010b) presented a practical framework in which change management can be incorporated in the organization of certain public service departments of Sri Lanka. Elapatha and Jehan (2020) conducted a study about the efficiency of PSD in a post BPR implementation scenario in Sri Lanka. Such studies may explain to some extent about the background of our study, however, those studies do not overlap the scope of this study and both are entirely different in the approach and the findings.

2.2   A Case for Public Service Delivery

The turn of the 21st century saw a greater demand for improved PSD; therefore, the impetus for the introduction of ICT in government functions and services gained traction. Biller and Nabi (2013) mentioned that many international donor agencies and

governments provided substantial funds to introduce and execute large-scale digital transformation in the country. The Sri Lankan government started the e-Sri Lanka project in 2002, and in 2003, the ICTA was established. In addition to these organizations, the LGN was established as a key ICT infrastructure. Digital transformation started in the Sri Lankan government with the establishment of these institutions in earnest. Dissanayake and Lakshman (2013) noted that the push toward e-governance was put into motion to improve the efficiency of government operations and improve public service delivery at all governmental levels. The regime adopted a bottom-up, transition-based system innovation concept. This gradual scheme of PSD transformation and innovation in the country followed an evolutionary path, and the ensuing implementation experience has largely been smooth and agreeable. Geels (2002) noted that "technological transitions are defined as major, long-term technological changes in how society functions, such as transportation, communication, housing and feeding are fulfilled". Digital transformation adopted a similar path towards this systematic change. Rotmans et al. (2001) found that a complete digital transition is preceded by learning processes and developments in small niches of the system and is currently under evolution and evolving. Geels' (2002) treatise should be an interesting read for those who wish to develop a deeper conceptual understanding of how sociotechnical system transitions have influenced innovation-based policies targeting system-wide change.

Public money is used for the delivery and renovation of public services, making it crucial to assess the usefulness of such spending. The public is therefore obviously interested in understanding the reasoning behind such expenditures. They would like to be assured of the propriety of such spending, i.e., whether the money allocated for service provision is justified. In Sri Lanka, a significant amount of the funds to introduce e-governance and the related ICT regime have come from international donor agencies. Still, a large amount of investment has been allocated from the public exchequer in the last decade. An assessment of the performance of public services is thus necessary. The success of reform will improve public confidence in such measures, and the related expenditures will be able to be justified.

Developing countries can provide limited financial and human resources to initiate and implement a bigger system transformation. However, one should not discount the role governments can play in kickstarting bigger changes despite the lack of internal resources. First, Dawley (2014) noted that governments can provide directionality by instituting

niches. Second, as suggested by Rotmans et al. (2001), governments can create an enabling environment for shared learning processes. Third, as Mazzucato (2017) explained, governments can also fund or acquire external funding for research, development, and education. Tanner's (2016) study supports connotations like those expounded by Mazzucato and Semieniuk (2017). Sri Lanka has been quite active in most of these areas. In a report on the role of ICT in Indian public services, Pardhasaradhi et al. (2013) underlined the significant role played by ICT and the related infrastructure in improving the quality of public services. Korneta (2019) stressed that it is essential to justify the value of such services in public perception to allow continued support for investments into technologies. Zheng (2017) observed, with copious substantiation, that an improvement in service delivery is considered an important performance indicator of e-governance. Alahakoon and Jehan (2020) conducted a post-ICT implementation analysis of public services in Sri Lanka; however, they mainly dealt with organizational efficiency and used a data envelopment approach in their research. Del et al., (2017) noted that the concept of e-governance, especially in the context of developing countries, is relatively new and not fully understood. An earlier study about the efficiency of public services in Sri Lanka conducted by the ICTA (2008b) found that, in the public's perception, most public services in Sri Lanka are not efficient. Currently, after a decade of the introduction of this regime, it is essential to assess the value of the investment and determine where the public services stand in terms of efficiency. Moore (1995) found that the effectiveness and efficiency of public services enhance the value of benefits in the public's perception. Thus, as John and Janine (2009) noted, it is also essential to provide a framework for service evaluation.

2.3   ICT and Public Service Delivery

The introduction of ICT into public services in developing economies, on the other hand, lagged both in time and scale. Lack of knowledge, training, initiatives, and resources are usually mentioned as reasons for the delayed introduction of digital transformation in developing economies. The spread of the Internet and social media among the general populace of developing countries happened before the same technological wave hit the public sectors and government agencies in general. The spread of information and greater access to worldwide knowledge resources, in turn, prompted a greater demand for better and efficient public services in these countries. Sri Lanka is a case in point where

this transformation was delayed for a long time. However, in the early years of this millennium, a greater demand for better services gained momentum, and a push for the digital transformation of all government operations and public services came to the forefront of reform efforts in the country. Many international donor agencies and governments came to aid these efforts. They provided substantial funds to introduce and execute large-scale digital transformation of the government operations and the services provided. The Sri Lankan government started the e-Sri Lanka (ESL) project in 2002, and in 2003, the Information and Communication Technology Agency (ICTA) was established, in addition to the establishment of the Lanka Government Network (LGN). With these developments, the digital transformation process thoroughly took place throughout the ministries and departments of the Sri Lankan government. The drive towards e-governance was set into motion to improve the efficiency of the government operations and improve public service delivery at all governmental levels.

Chen and Hsieh (2014) note that despite many pitfalls, it is correct to state that the digitalization of public services can lead to better public service policies and better services. They contend that this is due to newer technologies that allow big data processing in a better and faster manner. Hence, as Bhatnagar (2014) also noted, a better-informed policy making and service delivery can take place. There is no doubt that digitalization in public services is both encouraged as well as loathed, as it is inevitable that the process comes with both pros and cons. The positive side is better information and consequent efficiency in the PSD. On the flip side, however, most governments are criticized for acting as a big brother as they further invade the private space of the public with big data analytics. Such analytics are not always used altruistically by the governments as Linkov et al. (2018) noticed in their treatise on government strategies for sustainable digital governance. However, as our motive in this study is not to test the altruistic or villainous nature of digital governance, we will depart from that discussion here and move on to the operational consequences of the use of ICT into PSD. It is the operations and the resultant efficiency in the PSD that we are concerned with in this paper. While there are plenty of arguments for and against the specificity of results that should be expected from the introduction of ICT into PSD, nevertheless, the studies that correlate ICT and PSD are far more numerous and provide reasonable assurance that these two are related. Von Hayek (1945) has extensively elaborated on the nature such transformations into governance and has explained how and when digital governance

can go awry and why one must be very careful in assessing the cause and effect relationship thereof. In a later and relatively recent study, Von Hayek (1989) warns that making such transformations on the pretense of knowledge of citizens' needs may be a fallacy and lead to undesirable consequences.

It must be noticed that ICT initiatives in PSD in Sri Lanka started without much understanding of the citizens' needs, as there is hardly any documentary evidence to suggest this. The country did not have a concept or infrastructure of big data before the launch of the ESL initiative; rather, it can be termed as a precursor of a big data system in the country. More recently, ICTA and the United Nations Development Programme (UNDP) in Sri Lanka signed a 4-year memorandum of understanding to support Sri Lanka's aspirations for digital transformation. This program focuses particularly on the digital transformation of the public sector, along with re-engineering processes to ensure effective digital deployment. It may also be noted that LGN and ESL started almost simultaneously, and this meant the introduction of ICT into PSD without much assessment of the operational or citizens' needs. It is thus apparent that whatever transformation has taken place in this period is mostly disconnected with the results expected from such reforms. I, therefore, undertook this study from ground up and conducted an extensive survey about the results of this digital transformation to fill the gap that is there, i.e., whether ICT usage in the governance in Sri Lanka has resulted in improving PSD, and to what extent.

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Chapter No. 3
ICT, Public Service Delivery and Efficiency
in Sri Lanka – DEAP Analysis

3.1   ICT and PSD in Sri Lanka

The advent of the internet opened collaborative opportunities for businesses and governments around the world. By the end of the last millennium, internet technology had become commonplace, well within reach of ordinary individuals. This phenomenon had two significant outcomes in the arena of public service delivery, i.e. increased awareness of individual rights and higher expectations from public services. Utilization of information and communication technology (ICT) by developed countries started early on, and many studies found positive outcomes of using ICT in public services. The positive results were not limited to service providers only, rather public in general benefited from digital services too. Use of ICT resulted in better information dissemination, in addition to enhancing the efficiency of public service delivery in many countries that opted for public service transformation. Many studies have been conducted to evaluate the role of ICT in promoting the efficiency of public services. Findings of such studies support the initial observations in this regard.

Introduction of ICT into public services in developing economies, on the other hand, lagged both in time and scale. Lack of knowledge, training, initiative, and resources are usually mentioned as reasons for the delayed introduction of digital transformation in developing economies. The spread of internet and social media among the general populace of developing countries happened before the same technological wave hit the public sectors and government agencies in general. The spread of information and greater access to worldwide knowledge resources, in turn, prompted a greater demand for better and efficient public services of these countries. Sri Lanka is a case in point where this transformation was delayed for a long time. However, in the early years of this millennium, a greater demand for better services gained momentum, and a push for the digital transformation of all government operations and public services came to the forefront of reform efforts in the country. Many international donor agencies and governments came to aid these efforts. They provided substantial funds to introduce and execute large scale digital transformation of the government operations and the services provided. The Sri

Lankan government started the e-Sri Lanka (ESL) project in 2002, and in 2003 Information and Communication Technology Agency (ICTA) was established, in addition to the establishment of Lanka Government Network (LGN). With these developments, the digital transformation process took place in earnest throughout the ministries and departments of the Sri Lankan government. The drive towards e-governance was set into motion to improve the efficiency of the government operations and improve public service delivery at all governmental levels.

Chen and Hsieh (2014) note that despite many pitfalls, it is correct to state that the digitalization of public services can lead to better public service policies and better services. They contend that this is due to newer technologies that allow Big Data processing in a better and faster manner. Hence, better-informed policy making and service delivery can take place. There is no doubt that digitalization in public services is both encouraged as well as loathed as it is inevitable that the process comes with both pros and cons. The positive side is better information and consequent efficiency in the PSD; however, inevitably most governments get charged with the vile of acting as a big brother as they get farther deeper into privacies of the public with Big Data analytics. Such analytics are not always used altruistically by the governments as Linkov et al. (2018) noticed in their treatise on government strategies for sustainable digital governance. However, as the motive in this study is not to test the altruistic or villainous nature of the digital governance, I shall leave that discussion over here and move on the operational consequences of the use of ICT into PSD. It is the operations and the resultant efficiency in the PSD is the focus of this research. While there are plenty of arguments for and against the specificity of results that should be expected from the introduction of ICT into PSD, nevertheless, the studies that correlate ICT and PSD are far more numerous and provide reasonable assurance that these two are related. Hayek (1945) has extensively elaborated on nature such transformations into governance and has explained how and when digital governance can go awry and why one must be very careful in assessing the cause and effect relationship thereof. In a later and relatively recent study, Hayek warns that making such transformations on the pretense of knowledge of citizens' needs may be a fallacy and lead to undesirable consequences (1989).

It may have been noticed that ICT initiatives in PSD in Sri Lanka started without much understanding of the citizens' needs, as there hardly any documentary evidence to show that. The country did not have a concept or infrastructure of Big Data before the launch

of ESL initiative; rather, it can be termed as a precursor of a Big Data system in the country. More recently, ICTA and the United Nations Development Programme (UNDP) in Sri Lanka signed a 4-year memorandum of understanding to support Sri Lanka's aspirations for digital transformation. This program commits a particular focus on the digital transformation of the public sector, along with re-engineering processes to ensure effective digital deployment. It may also be noted that LGN and ESL started almost simultaneously, and that meant the introduction of ICT into PSD without much assessment of the operational or citizens' needs. It is thus apparent that whatever transformation has taken place in this period is mostly disconnected with the results expected from such reforms. I, therefore, undertook this study from ground up and conducted an extensive survey about the results of this digital transformation to fill the gap that is there, i.e. whether ICT usage in the governance in Sri Lanka has resulted in improving PSD and to what extent. I can list the basic research questions as:

3.2 The Research Questions

- To what extent the operational efficiency has been achieved with ICT deployment in 20 D&Ms of the government of Sri Lanka?
- To what extent informational efficiency increased with the ICT deployment in the D&Ms?
- To what extent PSD efficiency has increased in a post ICT deployment scenario in the country?

3.3 The Data and The Methodology

a. The Data

The data was collected through a field survey conducted in the summer of 2020 during February and March. In total, we studied 20 representative departments and ministries (after this referred to as entities) of the government of Sri Lanka where ICT regime was implemented for ten years starting in 2010 (Appendix 4). Data on the efficiency or inefficiency of the public service delivery after the ICT implementation was collected on a 5-points Likert type scale. Twenty questionnaires were distributed and collected from each of the 20 entities. In total, 400 responses were collected. Originally the questionnaire was designed in English and then translated into Sinhala language, one of the major

official languages of Sri Lanka, to assure ease of understandability and response to the questions. The responses were sought on a Likert scale: 5 standing for a strong agreement, 4 for agreement, 3 as neutral, 2 as disagreement, and 1 as strong disagreement (Table 3.1). The questionnaire comprised of 40 questions divided into ICT input measures and ICT performance-related output questions. Output questions were classified into three categories: service efficiency (OP1), informational efficiency (OP2), and operational efficiency (OP3). As we were interested in assessing output efficiency, I took output orientation in our analysis.

It seems relevant that we explain three output response variables briefly. The questions in the OP1 category related to various aspect of PSD services in the respondents' respective entities. OP1 refers to the extent to which the ICT deployment has increased the service efficiency of the entities. Service efficiency refers to how PSD handling improved as a result of the ICT implementation; and reflects the time and ease with which a client was dealt with after a specific public service was requested.

Table 3.1. Data and Questionnaire Structure

No. of Questions	Response				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Input Questions (1, 2, 3….20)	5	4	3	2	1
Outcome Questions (1, 2, 3….20)	5	4	3	2	1
Total Questions 40	Total responses 400				

Informational efficiency (OP2) is about the ease with which information flow took place both vertically and horizontally across the whole PSD system. Operational efficiency (OP3) entails a decrease in the time and effort exerted by the employees after the implementation of such measures. The questions in this category related to the impact of ICT in making the flow of information accumulation, handling and processing in a post-

implementation scenario. In Table 3.2, are listed the departments and the ministries, and allotted each of them an entity number from 1 to 20. The input-average column gives the average response of all 20 respondents from that entity. Last three columns show the average response to each output question put to the respondents from each organization.

b. Methodology

In this paper, we have applied a nonparametric-multistage data envelopment analysis (DEA) to understand how the ICT regime performed. The three outputs factors (OP1, OP2, and Op3), were used in the analysis, and the technical efficiency (TE) has been measured on a variable return to scale (VRTS) from an output orientation. Making use of standard VRTS and DEA models, we assumed output orientation as the magnitude and the direction of input has already been defined and is not alterable in the short-run (Fare et al. 1995). Thus, only outputs, i.e. services, information, and operations can be adjusted to allow our entities to perform at optimum scale to achieve maximum efficiency levels. Farell (1957) originally developed these efficiency measures; however, over time, DEA has evolved as a body of knowledge and technique. We also relied on the work of Charnes et al. (1976 and 1991) regarding efficiency measurement models. The efficiency assessment model presented by Charnes et al. (1991), is commonly referred to as CCR model, hence the use of the term CCR model in this paper. Using the CCR model, we carried out a detailed assessment of the historical performance of the public service delivery system in Sri Lanka after the implementation of ICT regime. Cooper demonstrates that DEA is a useful and robust approach to assess historical performance. Our decision to use output orientation allows us to compute the extent to which output quantities may be altered without making any changes to the input quantities.

CCR model defines the efficiency of a decision-making unit (DMU) as the maximum of a ratio of weighted outputs to weighted inputs, subject to the condition that the similar ratios for every DMU can be less than or equal to unity (Charnes 1976). CCR model can be presented with mathematical programming methods, as later suggested by both Boles (1967) and Afriat (1972). As we are proposing to use a variable return to scale technical efficiency (VRTS) measure, we shall start from a CRTS CCR model in linear programming form and then introduce convexity constraint to adapt it for VRTS.

Table 3.2 Input and Output Data

Department/Ministry	Entity No.	Input/Output Data			
		Input Avg.	OP11 Avg.	OP2 Avg.	OP3 Avg.
Department of Immigration & Emigration	E1	3.620	3.830	3.830	3.630
Department of Register of Persons	E2	3.540	3.540	3.780	3.460
Department of Import and Export	E3	3.700	3.710	3.850	3.610
Department of Examination	E4	3.720	3.800	3.840	3.760
Department of Customs	E5	3.430	3.480	3.640	3.410
Department of Motor Traffic	E6	3.190	3.740	3.440	3.140
Department of Registrar General	E7	3.730	3.810	3.850	3.720
Department of Pension	E8	3.900	3.860	4.120	3.780
Department of Fisheries	E9	3.670	3.710	4.020	3.510
Department of Railway	E10	3.600	3.950	3.760	3.750
Department of Labor	E11	3.390	3.690	3.660	3.500
Ministry of Education	E12	3.310	3.460	3.640	3.310
Ministry of Healthcare	E13	3.810	3.930	4.050	3.710
Election Commission	E14	3.630	3.820	3.810	3.730
Police Commission	E15	3.490	3.700	3.560	3.610
Foreign Bureau	E16	3.890	4.010	4.010	3.960
Electricity Board	E17	3.420	3.640	3.480	3.480
Central Bank	E18	3.690	3.880	3.950	3.520
National Transport Commission	E19	3.660	3.940	3.930	3.650
Ministry of Foreign Affairs	E20	3.560	4.000	3.810	3.280

Given the constant returns to scale constraint our goal is to maximize efficiency, i.e. to maximize output (y) divided by input (x) subjected to weights vectors u' for outputs and v' for inputs (Fare, 1994). Hence, our goal is to

$$\max_{u,v} \left(\frac{u\prime y_i}{v\prime x_i} \right), \qquad\qquad (1)$$

subject to
$$\left(\frac{u\prime y_j}{v\prime x_j} \right) \leq 1, j = 1,2, \dots, N$$
$$u, v \geq 0$$

Imposing the constraint $\quad\quad\quad\quad\quad v'x_i = 1 \quad$ (to avoid infinite solutions problem)

We get

$$\max_{u,v} (\mu'y_i), \quad\quad\quad\quad\quad\quad\quad (2)$$

subject to
$$v'x_i = 1,$$
$$\mu'y_j - v'x_j \leq 0, j = 1,2,\dots, N,$$
$$\mu, v \geq 0,$$

Here, μ and v, instead of u and v represent transformation into multiplier form of linear programming. At this point CCR model proposes to introduce duality in linear programming to derive the following envelopment form;

$$\min_{\Theta,\lambda} \Theta \quad\quad\quad\quad\quad\quad\quad (3)$$

subject to
$$-y_i + Y\lambda \geq 0,$$
$$\Theta x_i - X\lambda \geq 0,$$
$$\lambda \geq 0,$$

Here, θ is a scalar and λ is an Nx1 vector of constants.

Finally, CCR model introduces the convexity constraint $N1'\lambda = 1$ to (3) to introduce VRS as

$$\min_{\Theta\lambda} \Theta, \quad\quad\quad\quad\quad\quad\quad (4)$$

subject to
$$-y_i + Y\lambda \geq 0,$$
$$\Theta x_i - X\lambda \geq 1$$
$$N1'\lambda = 1$$
$$\lambda \geq 1$$

Thus, we end up getting the VRTS version of CCR model, which can work under the constraints as stipulated in the equations above and provide a reliable measure of the efficiency of our entities covered this study. Using DEAP 2.0 version, we can calculate not only efficiency per se, but peers, peer targets and slacks for amongst our entities.

3.4   Overall Results

Based upon the VRTS CCR model presented in the earlier section, we ran our data through DEAP 2.0 version for DEA and calculated efficiency measures, peer entities,

targets and slacks for our data set of 20 entities. The results can be categorized and summarized as laid down the next subsections. First, here I present overall efficiency and related results. Later in next section, I shall present entity-wise results one by one.

Table 3.3 Efficiency Results

Entity No.	Efficiency Results Summary			
	CRTS	**VRTS**	**Scale**	**Return to Scale**
E1	0.977	0.992	0.985	DRS
E2	0.973	0.983	0.990	DRS
E3	0.957	0.976	0.981	DRS
E4	0.974	0.988	0.986	DRS
E5	0.976	0.979	0.997	DRS
E6	1	1	1	-
E7	0.964	0.982	0.981	DRS
E8	0.964	1	0.964	DRS
E9	0.996	1	0.996	DRS
E10	1	1	1	-
E11	1	1	1	-
E12	1	1	1	-
E13	0.971	1	0.971	DRS
E14	0.990	0.998	0.992	DRS
E15	0.993	0.998	0.995	IRS
E16	0.979	1	0.979	DRS
E17	0.977	0.984	0.992	IRS
E18	0.978	0.995	0.982	DRS
E19	0.988	1	0.988	DRS
E20	0.987	1	0.987	DRS
Means	0.982	0.994	0.988	

a. *Efficiency Results*

The results tabulated in Table 3.3 present efficiency results both on CRTS as well as on VRTS, but as per our scheme mentioned earlier in the methodology section, we shall be

focusing mostly on VRST results. However, we can see that moving from CRTS to VRTS; we have a better insight into the TE measure for our entities. On CRTS, only four entities, i.e. entities with TE=1, are on the efficient level; however, with VRTS half of the entities are on the efficient level. Also, adjusted of scale, E6, E10, E11, and E12 at efficient level with CRTS (-). We also note that E15 and E17 are having increasing reruns to scale (IRS) and can improve their performance by increasing the level of operations and services. They should do so until they have achieved the optimum scale. All other entities have decreasing returns to scale (DRS) situation, and there is a need for capacity building in order to improve service efficiency. In short, other than those entities with TE=1 and scale efficiency of 1, all other entities with TE < 1 have room for improvement either by changing scale upwards or downwards. In order to do more, we may need to look into peer situation, which we will discuss in the next subsection.

b. Peer Analysis

Table 3.4 reflects the peer situation to show which entities can serve as a benchmark for other entities to mimic their performance and achieve a higher level of efficiency. E11, E16 and E19 stand out at the benchmark as they are peer to most other entities, i.e. E11 is a peer to 8 other entities, and E16 and E19 are peer to 5 other entities followed by E9 and E10 which are peers to 4 other groups. Peer analysis is useful to understand how another entity in the peer group takes weight in a particular entity. Adjusting the performance in conjunction with the benchmarking peer will steer the lagging entity to move towards better efficiency levels. It may be noted that underlying assumption regarding weights is that the limit we imposed upon VRS CCR model is maintained here too, i.e. $\Sigma\lambda=1$ (meaning sum of peer weights does not exceed 1).

Table 3.4 Peer Analysis

Entity No.	Peers, Peer Weights Analysis						
	Summary of Peers (Entity No.)			Summary of Peers' Weights			Peer Count
E1	19	16	11	0.515	0.182	0.303	0
E2	19	9	11	0.101	0.438	0.461	0
E3	16	9	19	0.173	0.025	0.802	0
E4	16	11	10	0.634	0.304	0.062	0
E5	9	11	12	0.169	0.738	0.093	0
E6	6			1.000			0
E7	16	11	19	0.538	0.199	0.263	0
E8	8			1.000			0
E9	9			1.000			4
E10	10			1.000			4
E11	11			1.000			8
E12	12			1.000			1
E13	13			1.000			1
E14	16	11	10	0.370	0.369	0.261	0
E15	11	10		0.524	0.476		0
E16	16			1.000			5
E17	11	10		0.857	0.143		0
E18	13	19	9	0.188	0.637	0.174	0
E19	19			1.000			5
E20	20			1.000			0

c. Targets Analysis

In Table 3.5, we have presented input, output, and overall output targets for all of our 20 entities analyzed for this study. Target analysis allows us to compare and ascertain differential between actual performance levels achieved and the projected targets that should have been achieved by the various entities. Here we have targets inputs and output for all 20 entities. We should observe that entities with steady superior efficiency score across various efficiency measure only pursue the target scores with relatively smaller differential. Most of the entities have some target differential, meaning a room

for improvement in the performance. The improvement can be achieved either by decreasing the level of inputs or by increasing the level of outputs.

Table 3. 5 Targets Analysis

Entity No.	Targets Analysis				
	Output Targets			Overall OP Targets	Input Targets
	OP1	OP2	OP3		
E1	3.877	3.863	3.661	3.801	3.620
E2	3.724	3.845	3.520	3.695	3.540
E3	3.946	3.946	3.700	3.863	3.700
E4	3.909	3.888	3.807	3.867	3.720
E5	3.672	3.719	3.484	3.626	3.430
E6	3.740	3.440	3.140	3.440	3.190
E7	3.928	3.919	3.787	3.877	3.730
E8	3.860	4.120	3.780	3.920	3.900
E9	3.710	4.020	3.510	3.740	3.670
E10	3.950	3.760	3.750	3.820	3.600
E11	3.690	3.660	3.500	3.620	3.390
E12	3.460	3.640	3.310	3.470	3.310
E13	3.930	4.050	3.710	3.890	3.810
E14	3.876	3.816	3.736	3.809	3.630
E15	3.814	3.708	3.619	3.715	3.490
E16	4.010	4.010	3.960	3.990	3.890
E17	3.727	3.674	3.536	3.649	3.420
E18	3.898	3.968	3.637	3.832	3.690
E19	3.940	3.930	3.650	3.840	3.660
E20	4.000	3.810	3.280	3.690	3.560

d. Slacks Anlysis

Analyzing slacks, under the DEA approach of frontier construction, may not be convenient to thing to both calculate as well as to interpret, many researchers also maintain this that significance of the slacks is exaggerated (Coelli 1997). In terms of slacks analysis (Table 3.6), we see that there are no input slacks. However, we note several output slacks, most of them are OP1 slacks, i.e. output related to efficiency in the data. In

principle, any non-zero slacks should be noted and analyzed. It may be pertinent to note that output slacks will be equal to zero only if $Y\lambda-Y_i = 0$. In short, we need to observe slacks from OP1 more closely while there are not many slacks in the case on OP2 and OP3. Finally, our entities can be considered technically efficient if they are efficient frontier and all related slacks are zero.

Table 3.6 Slacks Analysis

Entity No.	Slacks Analysis				
	Output Slacks			Overall OP Slacks	Input Slacks
	OP1	OP2	OP3		
E1	0.014	0.000	0.000	0.009	0.000
E2	0.123	0.000	0.000	0.043	0.000
E3	0.144	0.000	0.000	0.052	0.000
E4	0.061	0.000	0.000	0.019	0.000
E5	0.116	0.000	0.000	0.040	0.000
E6	0.000	0.000	0.000	0.000	0.000
E7	0.049	0.000	0.000	0.019	0.000
E8	0.000	0.000	0.000	0.000	0.000
E9	0.000	0.000	0.000	0.000	0.000
E10	0.000	0.000	0.000	0.000	0.000
E11	0.000	0.000	0.000	0.000	0.000
E12	0.000	0.000	0.000	0.000	0.000
E13	0.000	0.000	0.000	0.000	0.000
E14	0.051	0.000	0.000	0.014	0.000
E15	0.105	0.139	0.000	0.086	0.000
E16	0.000	0.000	0.000	0.000	0.000
E17	0.029	0.139	0.000	0.062	0.000
E18	0.000	0.000	0.101	0.034	0.000
E19	0.000	0.000	0.000	0.000	0.000
E20	0.000	0.000	0.000	0.000	0.000
Mean	0.035	0.014	0.005	0.019	0.000

3.5   Entity Wise Results

Now we present grouped results for each entity one by one. It will help us to understand in detail about the inner workings of each entity as well its comparison on one on one basis with other entities.

Results for E1:   1

Technical efficiency = 0.992

Scale efficiency   = 0.985 (drs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.830	0.033	0.014	3.877
output	2	3.830	0.033	0.000	3.863
output	3	3.630	0.031	0.000	3.661
input	1	3.620	0.000	0.000	3.620

LISTING OF PEERS:

peer	lambda weight
16	0.182
19	0.515
11	0.303

Results for E2

Technical efficiency = 0.983

Scale efficiency   = 0.990 (drs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.540	0.061	0.123	3.724
output	2	3.780	0.065	0.000	3.845
output	3	3.460	0.060	0.000	3.520
input	1	3.540	0.000	0.000	3.540

LISTING OF PEERS:

peer	lambda weight
19	0.101
9	0.438
11	0.461

Results for E3

Technical efficiency = 0.976

Scale efficiency   = 0.981 (drs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.710	0.093	0.144	3.946
output	2	3.850	0.096	0.000	3.946
output	3	3.610	0.090	0.000	3.700
input	1	3.700	0.000	0.000	3.700

LISTING OF PEERS:

peer	lambda weight
16	0.173
19	0.802
9	0.025

Results for E4

Technical efficiency = 0.988

Scale efficiency   = 0.986 (drs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.800	0.048	0.061	3.909
output	2	3.840	0.048	0.000	3.888
output	3	3.760	0.047	0.000	3.807
input	1	3.720	0.000	0.000	3.720

LISTING OF PEERS:

peer	lambda weight
16	0.634
11	0.304
10	0.062

Results for E5

Technical efficiency = 0.979

Scale efficiency   = 0.997 (drs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.480	0.076	0.116	3.672
output	2	3.640	0.079	0.000	3.719
output	3	3.410	0.074	0.000	3.484
input	1	3.430	0.000	0.000	3.430

LISTING OF PEERS:

peer	lambda weight
9	0.169
12	0.093
11	0.738

Results for E6

Technical efficiency = 1.000

Scale efficiency   = 1.000 (crs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.740	0.000	0.000	3.740
output	2	3.440	0.000	0.000	3.440
output	3	3.140	0.000	0.000	3.140
input	1	3.190	0.000	0.000	3.190

LISTING OF PEERS:

peer	lambda weight
6	1.000

Results for E7

Technical efficiency = 0.982

Scale efficiency   = 0.981 (drs)

 PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.810	0.069	0.049	3.928
output	2	3.850	0.069	0.000	3.919
output	3	3.720	0.067	0.000	3.787
input	1	3.730	0.000	0.000	3.730

LISTING OF PEERS:

peer	lambda weight
16	0.538
19	0.263
11	0.199

Results for E8

Technical efficiency = 1.000

Scale efficiency   = 0.964 (drs)

 PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.860	0.000	0.000	3.860
output	2	4.120	0.000	0.000	4.120
output	3	3.780	0.000	0.000	3.780
input	1	3.900	0.000	0.000	3.900

LISTING OF PEERS:

peer	lambda weight
8	1.000

Results for E9

Technical efficiency = 1.000

Scale efficiency   = 0.996 (drs)

 PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.710	0.000	0.000	3.710
output	2	4.020	0.000	0.000	4.020
output	3	3.510	0.000	0.000	3.510
input	1	3.670	0.000	0.000	3.670

LISTING OF PEERS:

peer	lambda weight
9	1.000

Results for E10

Technical efficiency = 1.000

Scale efficiency   = 1.000 (crs)

 PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.950	0.000	0.000	3.950
output	2	3.760	0.000	0.000	3.760
output	3	3.750	0.000	0.000	3.750
input	1	3.600	0.000	0.000	3.600

LISTING OF PEERS:

peer	lambda weight
10	1.000

Results for E11

Technical efficiency = 1.000

Scale efficiency   = 1.000 (crs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.690	0.000	0.000	3.690
output	2	3.660	0.000	0.000	3.660
output	3	3.500	0.000	0.000	3.500
input	1	3.390	0.000	0.000	3.390

LISTING OF PEERS:

peer	lambda weight
11	1.000

Results for E12

Technical efficiency = 1.000

Scale efficiency   = 1.000 (crs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.460	0.000	0.000	3.460
output	2	3.640	0.000	0.000	3.640
output	3	3.310	0.000	0.000	3.310
input	1	3.310	0.000	0.000	3.310

LISTING OF PEERS:

peer	lambda weight
12	1.000

Results for E13

Technical efficiency = 1.000

Scale efficiency = 0.971 (drs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.930	0.000	0.000	3.930
output	2	4.050	0.000	0.000	4.050
output	3	3.710	0.000	0.000	3.710
input	1	3.810	0.000	0.000	3.810

LISTING OF PEERS:

peer	lambda weight
13	1.000

Results for E14

Technical efficiency = 0.998

Scale efficiency = 0.992 (drs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.820	0.006	0.051	3.876
output	2	3.810	0.006	0.000	3.816
output	3	3.730	0.006	0.000	3.736
input	1	3.630	0.000	0.000	3.630

LISTING OF PEERS:

peer	lambda weight
16	0.370
11	0.369
10	0.261

Results for E15

Technical efficiency = 0.998

Scale efficiency   = 0.995 (irs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.700	0.009	0.105	3.814
output	2	3.560	0.009	0.139	3.708
output	3	3.610	0.009	0.000	3.619
input	1	3.490	0.000	0.000	3.490

LISTING OF PEERS:

peer	lambda weight
10	0.476
11	0.524

Results for E16

Technical efficiency = 1.000

Scale efficiency   = 0.979 (drs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	4.010	0.000	0.000	4.010
output	2	4.010	0.000	0.000	4.010
output	3	3.960	0.000	0.000	3.960
input	1	3.890	0.000	0.000	3.890

LISTING OF PEERS:

peer	lambda weight
16	1.000

Results for E17

Technical efficiency = 0.984

Scale efficiency = 0.992 (irs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.640	0.058	0.029	3.727
output	2	3.480	0.056	0.139	3.674
output	3	3.480	0.056	0.000	3.536
input	1	3.420	0.000	0.000	3.420

LISTING OF PEERS:

peer	lambda weight
10	0.143
11	0.857

Results for E18

Technical efficiency = 0.995

Scale efficiency = 0.982 (drs)

PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.880	0.018	0.000	3.898
output	2	3.950	0.018	0.000	3.968
output	3	3.520	0.016	0.101	3.637
input	1	3.690	0.000	0.000	3.690

LISTING OF PEERS:

peer	lambda weight
19	0.637
13	0.188
9	0.174

Results for E19

Technical efficiency = 1.000

Scale efficiency   = 0.988 (drs)

 PROJECTION SUMMARY:

variable		original value	radial movement	slack movement	projected value
output	1	3.940	0.000	0.000	3.940
output	2	3.930	0.000	0.000	3.930
output	3	3.650	0.000	0.000	3.650
input	1	3.660	0.000	0.000	3.660

LISTING OF PEERS:

peer	lambda weight
19	1.000

Results for E20

Technical efficiency = 1.000

Scale efficiency   = 0.987 (drs)

 PROJECTION SUMMARY:

| variable		original value	radial movement	slack movement	projected value
output	1	4.000	0.000	0.000	4.000
output	2	3.810	0.000	0.000	3.810
output	3	3.280	0.000	0.000	3.280
input	1	3.560	0.000	0.000	3.560

LISTING OF PEERS:

peer	lambda weight
20	1.000

3.6 DEAP Analysis - Discussion

Sri Lanka is a lower-middle-income country with a per capita GDP of USD 3,852 in 2019; the same was USD 4102 in 2018. After three decades of civil war that ended in 2009, the economy grew at an average of 5.3 per cent during the period 2010-2019; however, the growth has slowed down in more recent years. After growing by 2.3 per cent in 2019, the economy contracted by 1.6 per cent year-on-year in the first quarter of 2020. According to the World Bank Report (2020) on Sri Lanka, the country represents a success story in many ways and is making a steady transition towards a more competitive country. The country's transition towards digital governance is more noteworthy, as its e-governance digital index (EGDI) is steadily improving over many years. The EGDI shows an improvement in the country's e-governance ranking since 2012 followed by a more recent decline which may be attributed to lingering political instability in the country since a couple of years.

Figure 3.1 EGDI Ranks (Lower is Better)
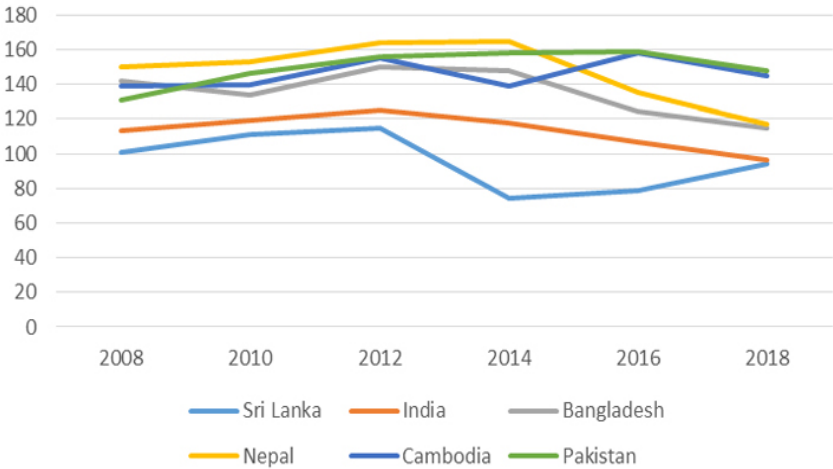
Source: UN e Government Database

The research shows that deployment of the ICT in the country has not been entirely smooth. The results of our study indicate disparate performance across the entities of the Sri Lankan government. We can identify benchmarks as well as slackers in the whole PSD structure through this study. We suggest that apparent incongruity of results across various PSD entities should be minimized, to allow a smoother ICT continuum ending in a complete transformation of the PSD structure in the country. Chen (2014) suggests that

the e-government initiative of a country progresses along an information-communication-transaction-transformation continuum (ICTT). In other words, the digital transformation can be regarded as the capability of a country to move along the aforementioned 4-stage ICTT continuum. We have, however, taken a 3-output factors (OP1, OP2, and OP3) approach towards performance assessment in this study, those three factors correspond to the first three factors of the ICTT continuum suggested by Chen (2003). Fernando (2006) states that under limited resource conditions, we shall need to improve performance in order to satisfy public expectation regarding public service delivery. Bonina and Cordella (2008) observed that when public attaches a higher value to use of ICT in governance, this leads to further developments and innovation. Castelnovo and Simonetta (2007) stressed this point even further in their paper where they proved that ICT, governance and public value are interconnected.

Consequently, we mapped out the performance of the public services in the wake of the ICT regime in three areas, i.e. services (OP1), information (OP2) and operations (OP3). Our findings suggest that OP1, i.e. technical efficiency score regarding public service delivery is not consistent across all entities. With a TE score of 0.957 (CRTS) and 0.976 (VRTS), service delivery at the Department of Imports and Exports (E3) has been the least inefficient area as compared to others. That suggests that while departments and ministries have benefited from the implementation of the ICT regime, the same cannot be said for the public service delivery efficiency across all of them. The situation becomes further apparent as we look at the returns to scale where we noted that most departments and ministries are faced with decreasing returns to scale situation and would require a scale adjustment in order to improve their efficiency levels. There are few exceptions like E6, E10, E11, and E12 (the corresponding names of the departments or the ministries can be cross-checked in Table 1.2). Department of Labor (E11) has come out as a star performer in a comparative analysis as with TE = 1 and a constant returns-to-scale situation. It can serve as a peer to the highest number of other departments and ministries, which is 8 in total. This result suggests that other entities should at least replicate the Department of Labor's performance per the peer weights given in Table 1.4. Also, from a scalar perspective, the Department of Pensions (E8) has plenty of unused capacity; and at the same time is facing a decreasing returns-to-scale situation. This situation may be indicative of a structural issue of the department, and the situation

requires more in-depth insight in order to pinpoint the exact cause of the problem with the department.

Earlier, I have mentioned in the methodology section that we have taken an output orientation in conducting DEA. This orientation allows us to compute how much output quantities may be altered without making any changes to the input quantities. So, we can see that how much performance of each entity can be improved only by mimicking the performance of peers that lie at the efficiency frontier. At the same time, the level of inputs (components of the ICT regime) remains unaltered. It is essential to take this position as we know that ICT regime cannot be altered in the short run, but we can improve the efficiencies of our entities even with the current ICT regime in place. Input and output targets also indicate differential in the actual performance and the expected performance for each of the entities. We should be able to adjust actual performance by comparing it with the targets for all three outputs. We shall restrict our comments to the output targets as we took an output orientation in our analysis. Additionally, it was found that there are multiple slacks, especially in OP1, i.e. many entities can achieve a higher level of service delivery even at the present scale. Entities numbered E1-E5, E7, E14, E15, E17 and E20 have significant slacks, and a performance improvement regarding the OP1 is possible after careful investigation of the underlying causes.

3.7 DEAP Analysis - Conclusions

Evaluating a publicly funded project related to public service is very important in order to ensure continued investment in the project and also to ensure public support for such projects. E-governance project with a comprehensive ICT regime initiated with the support from many international donors, in addition to local funding, has never been assessed in the way we did in this paper. The project started with a comprehensive field survey conducted right through the departments and ministries where the project was implemented, which provided us with really excellent data to work. Due diligence was applied to ensure the robustness of the data and balanced deployment of the questionnaire-based survey in order to gain meaningful and usable data. The results from the study portray the weaker areas of ICT deployment in the country; that, in turn, allows us to put forward meaningful advice to the related entities for improving managerial performance. There is a room for improvement both in the managerial performance and ICT related measures, i.e. service, information and operations. However, this also

portrays a limitation of our analysis; as, while one can point out the weaknesses in the ICT deployment in a geospatial manner, I can suggest the specific ICT related measures that would require an improvement. That would require an analysis of the technical aspects of the ICT regime.

Further, I would like to point out one more limitation of our study that the fourth factor of ICTT continuum we mentioned earlier, i.e. transformation. I suppose an additional study with a different set of inquiry variables would be required to assess the degree of transformation brought in this ICT regime. Finally, I have presented a composite picture of the efficiency at various departments and ministries in the wake of the ICT regime implementation. Presenting each entity's performance data individually and explaining individual performance on a one-to-one basis could further extend the analysis. However, as I wanted to get an overall picture of the situation after the ITC regime implementation, we shall leave a detailed entity-wise performance analysis for a later study.

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Chapter No. 4
Digitalization of Public Services in Sri Lanka – Regression Analysis

4.1 Digital Deployment in Sri Lanka

Development of internet in the 20th century unlocked the prospects for cooperation across corporations and governments with an all-encompassing omnipresence. 21st century started with an internet technology that was both mature and ubiquitous. This resulted in twofold changes in societies in general i.e. amplified cognizance of public rights and greater expectations from public services. Application of ICT by industrialized and economically developed countries started early on; and many reports can be found relating to the positive consequences of exploiting ICT in provision of public services. both service providers as well as the public on the receiving end benefited from its use. Improved communication and efficiency of PSD can be mentioned as most ubiquitous benefits of ICT application. Numerous studies in the past evaluated role of ICT in improving communication and efficiency of public service delivery.

Use of ICT in PSD in developing countries remained considerably slow as compared to the developed countries. Many factors can be mentioned as reasons for this situation like low literacy levels, lack of training, lack of initiative, and paucity resources. The coverage of internet and social media among private sectors and general public in developing countries transpired before the ICT transition started reaching government services. Spread of information and greater access to worldwide knowledge resources, in turn, prompted a greater demand for better and efficient public services of these countries. In Sri Lanka, this change was delayed for a long time due to a long-drawn-out civil war in the country. Turn of the 21st century saw a greater demand for improved PSD got buoyance and a thrust for introduction of ICT in all public operations and services got speed. Arunatilake et al. (2019) noted that many international donor agencies and governments came to aid these efforts and provided substantial funds to introduce and execute large scale digital transformation of the government operations and the services provided. The Sri Lankan government started the e-Sri Lanka project in 2002, and in 2003 ICTA was established, in addition to the establishment of LGN. With these developments, the digital transformation process took pace in earnest throughout the ministries and departments of the Sri Lankan government. The drive towards e-governance was set into motion with an objective to

improve efficiency of the government operations and improve public service delivery at all governmental levels (Shyamika, 2018).

The paper is about understanding the effectiveness and perception of ICT regime implementation process in the PSD infrastructure of the government of Sri Lanka. The paper takes a bifocal approach and explains the perception of ICT both from inside as well as from outside. On the inside we, using the data gathered from the regime implementers i.e. the employees of the D&Ms surveyed, we assess the efficacy of the regime from insiders' perspective. Then we do the same from the clients' perspective, by gathering and analyzing the public service users' data gathered in the similar manner. Finally, we bring together the inputs and outcomes together and assess how the ICT has impacted the public perception of PSD after its implementation over the last decade. The results thus obtained through a rigorous statistical analysis (as explained in the results section) show that there are reasonable and understandable basis for continuing to invest in the ICT infrastructure as it has positive bearings upon the PSD in Sri Lanka.

Public money is expended on the delivery and renovation of public services, which makes it very important to assess the usefulness of such spending. Public is therefore obviously interested to understand the reasoning of such expenditures. They would like to be assured of the propriety of such expenditures i.e. whether money is allocated for the service provision is justified or not. In the case of Sri Lanka, though a significant amount of funds to introduce e-governance and related ICT regime has come from international donor agencies, still a large amount of investment has been allocated from the public exchequer in the last ten or so years. So, it is important that an assessment should be made as to how the performance of public services has improved with the changes brought in by the digitalization of public services. The success of reform and spending will improve the public confidence in such measures and the related expenditure. Korneta (2019) stresses it is important to justify value of such services in public perception, in order to allow continued support for investments into technologies. Zheng (2017) has observed with copious substantiation that improvement in service delivery is considered an important performance indicator of e-governance. While many studies have been conducted on e-administration, the efficiency of ICT regimes in post implementation scenarios has not been explored. Del Sordo et al. (2017) noted that the concept of e-governance, especially in the context of developing countries, is relatively new and not fully understood. An earlier study about efficiency of public services in Sri

Lanka conducted by ICTA found that in public perception, most public services in Sri Lanka are not efficient (ICTA 2008b). Now more than a decade has passed since serious effort and investment were poured into this ICT regime, it is thus important to assess the value of investment into ICT and find out where the public services stand in terms of efficiency. Moore (1995) found that the effectiveness and the efficiency of public services enhances the value of services in public perception. Thus, it is highly important, as John and Janine (2009) noted, to provide a framework for service evaluation too.

4.2 Materials and Methods for Regression Analysis

a. Data & Materials

The data was collected through a field survey conducted during February through March of 2020. In total, we surveyed 20 representative departments and ministries (D&M) of the government of Sri Lanka where ICT regime was implemented for ten years starting in 2010 as per the details presented below (Table 4.2). It was a bifocal survey, on one hand we questioned the ICT regime implementors (officer and employees) about the ICT implementation. 10 questionnaires were distributed and collected from each of the entities. On the other hand, a similar number of questionnaires were distributed and collected from general public who availed services from these D&Ms. In total 400 responses were collected, as we collected 200 from each from both sides of the service spectrum. The questionnaire comprised of 20 questions divided into input and outcomes questions (input for D&Ms and outcomes for the public). The responses were sought on a Likert scale: 5 standing for strong agreement, 4 for agreement, 3 as neutral, 2 as disagreement, and 1 as strong disagreement. Input questions have been coded as ICT; whereas the outcomes have been coded as satisfaction to reflect the degree of satisfaction users of the ICT based PSD had from the regime implementation. Originally the questionnaires were designed in English and then translated into Sinhala language, one of the major official languages of Sri Lanka, in order to assure ease of understandability and response to the questions.

Table 4.1 Survey Questionnaire Format

No. of Questions	Response				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Input Questions (1, 2, 3….20) ICT (from implementers)	5	4	3	2	1
Outcome Questions (1, 2, 3….20) Satisfaction (from public)	5	4	3	2	1
Total Questions 20 each side	Total responses 400 (200 each from both sides)				

In Table 4.2, I have listed the D&Ms from where the survey data was collected. Inputs and outcomes related responses of 10 employees from each of 20 D&Ms were tabulated along with responses from 10 clients from the same D&M. These D&Ms were at the center of the ICT regime that was put into place from 2010 and are major PSD hubs for governance and the service delivery in Sri Lanka. The data thus collected was recorded into separate excel sheet and tabulated for further treatment and analysis. The originality and novelty of the data sets this study apart from some other studies that were conducted in the past. Also, keeping in view the ordinal nature of the data, a transformed binary variable agree/disagree (AD) was created from the variable "satisfaction" to allow a better analysis and understanding of the data outcome without dropping other variables from the final analysis. The details of the peculiar and novel nature in a comparative framework have been laid down in the methodology section (section 4.2.b) of this chapter.

Table 4.2 Departments and Ministries Surveyed

Department/Ministry	No. of Questionnaires Collected from Employees (n1=200)	No. of Questionnaires Collected from Clients (n2=200)
1. Department of Immigration & Emigration	10	10
2. Department of Register of Persons	10	10
3. Department of Import and Export	10	10
4. Department of Examination	10	10
5. Department of Customs	10	10
6. Department of Motor Traffic	10	10
7. Department of Registrar General	10	10
8. Department of Pension	10	10
9. Department of Fisheries	10	10
10. Department of Railway	10	10
11. Department of Labor	10	10
12. Ministry of Education	10	10
13. Ministry of Healthcare	10	10
14. Election Commission	10	10
15. Police Commission	10	10
16. Foreign Bureau	10	10
17. Electricity Board	10	10
18. Central Bank	10	10
19. National Transport Commission	10	10
20. Ministry of Foreign Affairs	10	10
		Total responses (n=400)

b. Method of Analysis

IT has been used as the independent variable. The dependent variable is satisfaction. Another dependent variable i.e. AD has been used in the data, it is a transformed binary

variable for which satisfaction and ICT are independent variables. We established a limit of 4 to convert outcomes (satisfaction) into a binary dependent variable AD of 1 (overall agreement) and 0 (overall disagreement). It may be noted that our response data is of ordinal nature on a 5-point Likert scale where 5 stands for strongly agreed, 4 agreed, 3 neutral, 2 disagreed and 1 for strongly disagreed. In order to achieve this transformation all client responses ≥ 4, we allocated value of 1 to this additional variable and for all responses < 4, we assigned 0. In this way, we assumed a careful approach in handling and analyzing the response data.

Secondly, I calculated Cronbach's alpha to assess the reliability and internal consistency of data's test items. and Cronbach's alpha has been applied the strength of that consistency (Tavakol, 2011). In order to calculate Cronbach's alpha, I have correlated the score for each scale item with the total score for each observation of our survey, and then comparing that to the variance for all individual item scores as per the following equation;

$$\alpha = \left(\frac{j}{j-1}\right)\left(1 - \frac{\sum_{i=1}^{k} \alpha_{y_i}^2}{\alpha_x^2}\right) \qquad (1)$$

here, j refers to the number of scale items $\alpha_{y_i}^2$ refers to the variance associated with item i, and α_x^2 refers to the variance associated with the observed total scores.

Additionally, I produced multivariate ordinal logistic (ologit) regression results to deepen our understanding of the nature of the relationships that exist among various variables used in the analysis. Ologit regression model is a generalization of a binary logistic regression model when the outcome variable has more than two ordinal levels which in our case is 5. Ologit estimates the probability of being at or below a specific outcome level, conditional on a collection of explanatory variables. The ordinal logistic regression model can be expressed as a latent variable model (Long & Freese, 2006; Agresti, 2002). Assuming Y* can be defined as a function of a set of predictor variables and a random error. Let Y* be divided by thresholds: α1, α2, α3, ..., αj, and α1 < α2 < α3 ... < αj. The values of the observed ordinal variable, Y, fall within the regions divided by these thresholds. For example, Y = 0, if Y* ≤ α1. The observed ICT satisfaction level as in our survey is the ordinal outcome, y, ranging from 0 to 5 as described in the data section. As the response categories in our data are limited up to 5, using a nonparametric ordered

logistic regression model seems most appropriate for our analytical purpose. I can describe the model as;

$$logit[P(Y \leq j)] = \left[\frac{P(Y \leq j)}{P(Y > J)}\right] \qquad (2)$$

$$= \alpha_j - \beta X, j \in [1, J-1] \qquad (3)$$

where j ∈ [1, J−1] are the levels of the ordinal outcome variable Y. The proportional odds model assumes there is a common set of slope parameters β for the predictors. The ordinal outcomes are distinguished by the J−1 intercepts αj. The benchmark level is J. For ordinal regression we make certain assumptions about the underlying data i.e. the response variable is ordinal, and that the explanatory variables are continuous or categorical (though too are ordinal), but we treat them either as continuous or categorical. We also assume that there is no multicollinearity and the odds are proportional where each independent variable has an identical effect at each cumulative split of the ordinal dependent variable. See Fullerton et al. (2009), and Daniel et al. (2019), for an exhaustive debate and understanding of the issues involved in the application of these type of regression models for the type of data that is being used in this paper.

4.3   Results

a. Summary Statistics

In Table 4.3 are presented summary statistics of the bifocal response data (n=200). The summary statistics reflect a noticeable fluctuation of responses around the means values. There is visible skewness of the responses towards left side and our input data responses (IT) do reflect a significant kurtosis among the respondents. On the other hand data shows relatively lesser degree of skewness amongst the public's perception of the post ICT regime implementation PSD system's performance. Also, noticeable are the means for IT and satisfaction representing a level above the neutral scale point of 3.

Table 4.3 Summary Statistics

stats	IT	Satisfaction	AD
N	200	200	200
Mean	3.651	3.364	0.15
Max	4.950	4.800	1.00
Min	1.900	1.8500	0.00
SD	0.486526	0.570879	0.357968
Variance	0.236708	0.325903	0.128141
Skewness	-0.24047	-0.02558	1.960392
Kurtosis	3.565879	2.770013	4.843137

However, as was mentioned in section on data and materials (section 4.2.a), the conservative threshold of 4 for converting our satisfaction variable into transformed variable of AD has resulted in lower mean value. Additional examination of the summary statistics can be carried out from the chart presnted below in Figure 4.1.
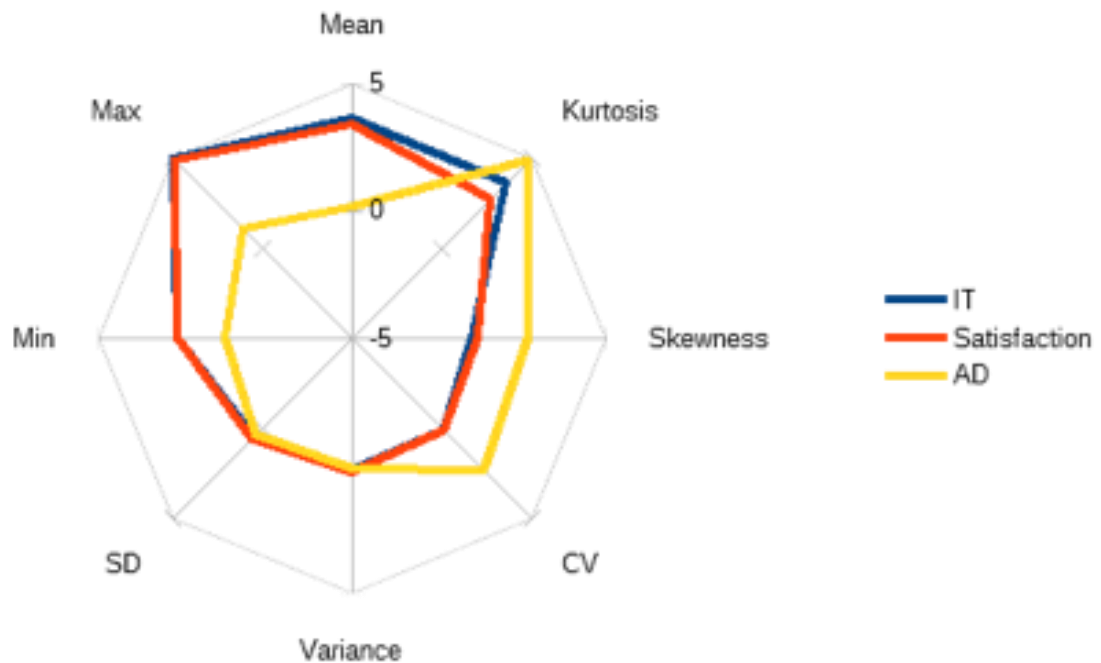
Figure 4.1 Summary Statistics Graph (n=200)

b. Data Consistency Test

Table 4.4 gives an outline of the consistency analysis of our data. The table consists of correlated score for each scale item with the total score for each observation of our survey, and then comparing that to the variance for all individual item scores as per the model presented in the methodology section of this paper. While item-wise correlations range from moderate to strong, the inter-item covariances read along alpha values suggest that our data is fairly consistent and can be used in order to estimate further relationships e.g. correlations and regression analysis.

Table 4.4 Cronbach alpha

Item	Obs.	Item-test corr.	Item-rest corr.	Inter item cov.	alpha
IT	200	+ 0.5565	0.0939	0.1336055	0.7410
Satisfaction	200	+ 0.8394	0.4560	0.0106533	0.1104
AD	200	+ 0.7478	0.5123	0.0281520	0.1819
Test scale				0.0574703	0.4995

c. Correlations

Table 4.5 lays down pariwise correlation estimates for IT, satisfaction and AD. We can see that IT and AD are reasonably and positively correlated. Also, satisfaction and AD are correlated to a similar extent in a positive way. However, what should be worrying that IT measures adopted so far have not much strong correlation with the satisfaction levels of the customers. It is therefore important that some measures or ICT regime should be recalibrated in order to achieve higher levels of customer satisfaction.

Table 4.5 Pairwise Correlations (n=200)

Item	IT	Satisfaction	AD
IT	1.0000		
Satisfaction	0.1014	1.0000	
AD	0.6612	0.6538	1.0000

As the data response is of rank ordered nature both for ICT inputs and the outcomes. It is therefore more appropriate to investigate beyond the usual pairwise correlation in order to get a better picture of the relationships between the three i.e. IT, satisfaction, and AD. It should be noted that a positive Spearman correlation coefficient corresponds to an increasing monotonic trend between the sets of our three factors under investigation in this study. Spearman results have been presented here and find a weak correlation between IT and satisfaction and so is the situation between IT and AD. However, Spearman correlation indicates a relatively stronger positive correlation between the satisfaction and AD, somewhat similar to the results depicted by pairwise correlation. Here too, we can reach the conclusion that ICT regime has not been upto the expectations and results have not been positively reached the end users of the regime. So, there is a need to explore further and see what is lacking in the regime in order to assure higher levels of satisfaction.

Table 4.6 Spearman Correlations (n=200)

Item	IT	Satisfaction	AD
IT	1.0000		
Satisfaction	0.0888	1.0000	
AD	0.0740	0.6188	1.0000

d. Regression

Table 4.7 gives results of ordered logistic regression based upon the model we explained in the mothodology section above in this paper. As we can see that the test of the model (prob. > chi^2) and found that model fits with our data and can lead us to some meaningful conclusions.

Table 4.7 Ordered Logistic Regression

					n = 200
					LR chi2(1) = 1.82
					Prob > chi2 = 0.1771
					Log likelihood = -738.58902
					Pseudo R2 = 0.0012

Satisfaction	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
IT	1.432329	0.5958207	0.860	0.0388	0.6338111	3.236875
_Cons	1.432329	0.0731656	-1.970	0.0490	0.0022293	0.992195

Note: _cons estimate baseline odds.

This suggested that using the model will be appropriate and our test statistic i.e. z-test will explain the relationship between dependent and independent variables with an acceptable confidence level (95% in this case). All z values were found significant and thus it can be concluded that a strong dependence of satisfaction on the ICT regime. Also, as our all P > |z| values are less than 0.05 (for a 95% confidence) which is pointing out towards the fact that regime's reform measures have a strong bearing upon the efficiency of the ICT regime.

e. Sensitivity and Specificity Test

Finally, Sensitivity and specificity tests have been carried out for the for AD and the results are produced in the table 4.8 show sensitivity and specificity results for the model. One simple way of measuring accuracy is simply the proportion of responses that were correctly classified i.e. the proportions of true positives and true negatives. It should be noted that sensitivity measure reveals the proportion of observed positives that were predicted to be positive. Specificity is the proportion of observed negatives that were predicted to be negatives. Earlier part of the table sets the rules that define the sensitivity and specificity of the data. The later part shows our results and we can rest assured that our data and model suit well to each other and the results thus generated are neither falsely true or falsely false.

<div align="center">**Table 4.8** Sensitivity and Specificity for AD</div>

Classified	--------------------- **True** --------------- ---		
	D	~ D	Total
+	0	0	0
-	30	170	200
Total	30	170	200

Classified + if predicted Pr (D) > 0.5, True D defined as AD! = 0

Sensitivity	Pr (+ǀD)	0.00%
Specificity	Pr (-ǀ~D)	100.00%
Positive predictive value	Pr (Dǀ+)	0.00%
Negative predictive value	Pr (~Dǀ-)	85.00%
False + rate for true ~D	Pr (+ǀ~D)	0.00%
False - rate for true D	Pr (- ǀ D)	100.00%
False + rate for classified +	Pr (~Dǀ+)	0.00%
False - rate for classified -	Pr (Dǀ -)	15.00%
Correctly classified		85.00%

4.4 Regression Analysis - Discussion

The paper is about understanding the effectiveness and perception of ICT regime implementation process in the PSD infrastructure of the government of Sri Lanka. The paper takes a bifocal approach and explains the perception of ICT, using the data gathered from the regime implementers i.e. the employees of the D&Ms surveyed as well as from the clients' perspective. The inputs and outcomes were compared in order to assess how the ICT has changed the public opinion of PSD after the regime's over the last decade. The results thus obtained through a rigorous statistical analysis show that there are reasonable and understandable basis for continuing to invest in the ICT infrastructure as it has positive bearings upon the PSD in Sri Lanka. We conducted non-parametric order logistic analysis. Analyzing survey data beyond descriptive statistics always comes

with a certain uncertainty as to which analytical approach will offer the best analysis of the data. While some would suggest using a logistic regression model; but again, there are multiple options which need to be carefully selected in view of the nature of the data. The problem become more acute as the responses to the question do contain certain level of subjective evaluation. As our questionnaire asked respondents to answer the questions on a 5-point Likert scale (5 strongly agreed …. and 1 for strongly disagreed), we needed to use a regression approach that could take care of the ordinal nature of the data. Finally, we decided to use ordinal logistic regression to analyze our data. This approach allowed us a deeper understanding of the interrelationships amongst our independent and dependent variables while attending to most issues with the nature of the data.

Starting with summary statistics and for most of our observed variables, the mean values are above 3 but below 4 i.e. mean response towards the ICT measures. The mean for outcome reflecting comparatively better level of agreement amongst our surveyed population about the expected performance of the regime. Our results related to paired correlations reflect a positive correlation between the independent and dependent variables which means that efficiency of the PSD is explained by the ICT regime's reform initiatives. Spearman and pairwise correlations, while adjusting for the ordinal and raked nature of the data, reemphasize the similar nature of the connection between the reforms and the satisfaction from the regime. We also conducted ordinal logictic regression analysis to understand the nature the relationship between our variables. We conducted the test of the model and found that model fits with our data and can lead us to some meaningful conclusions. This suggested using the model will be appropriate and our test statistic i.e. z-test will explain the relationship between dependent and independent variables with an acceptable confidence level (95% in this case). All z values were found to be significant and thus we can conclude a strong dependence of satisfaction on the ICT regime. Also, all $P > |z|$ values are less than 0.05 (for a 95% confidence) again pointing out towards the fact that regime's reform measures have a strong bearing upon the satisfaction from the ICT regime. Finally, sensitivity and specificity tests have been carried out for the for AD and the results show sensitivity and specificity results for our model. It should be noted that ssensitivity measure reveals the proportion of observed positives that were predicted to be positive. Specificity is the proportion of observed negatives that were predicted to be negative. Earlier studies on the similar issues by the author, performed with different approach and analytical, techniques should be of

interest to the readers. More recent studies by the authors dealing with similar matter, performed with a different perspective and analytical approach should also be compared in order to understand the subject in a better light.

4.5 Regression Analysis - Conclusions

In conclusion, at this stage I have analyzed the effectiveness and acceptability of the ICT regime in Sri Lanka and results have shown that inputs of the regime are positively contributing towards the success of the program, though the contribution has not reached to very significant levels so far. After explaining the summary statistics of the data collected and various correlations, we use ordinal logistics analysis to understand the interrelations amongst various ICT inputs and their impact upon the outcomes. Cronbach alpha has been calculated to test the robustness of the data. Finally, I conducted specificity, sensitivity and predictive values analysis in order to assess the accuracy of the model applied. Our findings suggest a positive, though at times weak amongst some of the variables, correlation between the inputs and outcomes of the ICT regime put into place to digitalize the PSD in the country. Also, sensitivity and specificity tests have been carried out for the for AD and the results show sensitivity and specificity results for our model. The uniqueness and originality of our data makes the study first of its kind and it can of enormous use to both PSD operators as well the researcher who plan to build upon our results and find other angles to the case in point. One such research may be the exploration of factor efficiencies per se by applying other techniques of inquiry. I plan to expand the scope of research in future by examining factor efficiencies too.

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Chapter No. 5
Conclusions and Recommendations

In the earlier chapters of this thesis it can be noticed that ICT initiatives in PSD in Sri Lanka started without much understanding of the citizens' needs, as there hardly any documentary evidence to show that. The country did not have a concept or infrastructure of Big Data before the launch of ESL initiative; rather, it can be termed as a precursor of a Big Data system in the country. Later on, ICTA and the United Nations Development Programme (UNDP) in Sri Lanka signed a 4-year memorandum of understanding to support Sri Lanka's aspirations for digital transformation. This program focused in particular on the digital transformation of the public sector, along with re-engineering processes to ensure effective digital deployment. It may also be noted that LGN and ESL started almost simultaneously, and that meant the introduction of ICT into PSD without much assessment of the operational or citizens' needs. It is thus apparent that whatever transformation has taken place in this period is mostly disconnected with the results expected from such reforms. This was original study from ground up and I conducted an extensive survey about the results of this digital transformation to fill the gap that is there, i.e. whether ICT usage in the governance in Sri Lanka has resulted in improving PSD and to what extent. The survey data was employed in a two-way analysis (DEAP and Regression) and final conclusions and recommendations based on the results of the survey and analysis are described below. I am dividing the final conclusion and recommendations section in two parts i.e. DEAP analysis-based and regression analysis-based conclusions and recommendations.

5.1 Conclusions and Recommendations – DEAP Analysis

The research shows that deployment of the ICT in the country has not been entirely smooth. The results of our study indicate disparate performance across the entities of the Sri Lankan government. We can identify benchmarks as well as slackers in the whole PSD structure through this study. We suggest that apparent incongruity of results across various PSD entities should be minimized, to allow a smoother ICT continuum ending in a complete transformation of the PSD structure in the country. Chen suggests that the e-government initiative of a country progresses along an information-communication-transaction-transformation continuum (ICTT). In other words, the digital transformation

can be regarded as the capability of a country to move along the aforementioned 4-stage ICTT continuum. We have, however, taken a 3-output factors approach towards performance assessment in this study, those three factors correspond to the first three factors of the ICTT continuum.

I evaluated the performance of the public services in three areas, i.e. services, information and operations and the findings suggest that. technical efficiency score regarding public service delivery is not consistent across all entities. Service delivery at the Department of Imports and Exports has been the least inefficient area as compared to others. That suggests that while departments and ministries have benefited from the implementation of the ICT regime, the same cannot be said for the public service delivery efficiency across all of them. The situation becomes further apparent as we look at the returns to scale where we noted that most departments and ministries are faced with decreasing returns to scale situation and would require a scale adjustment in order to improve their efficiency levels with few exceptions. The results suggest that other entities should at least replicate the Department of Labor's performance. Also, from a scalar perspective, the Department of Pensions has plenty of unused capacity; and at the same time is facing a decreasing returns-to-scale situation. This situation may be indicative of a structural issue of the department, and the situation requires more in-depth insight in order to pinpoint the exact cause of the problem with the department.

We can see that how much performance of each entity can be improved only by mimicking the performance of peers that lie at the efficiency frontier. It is essential to take this position as we know that ICT regime cannot be altered in the short run, but we can improve the efficiencies of our entities even with the current ICT regime in place. Input and output targets also indicate differential in the actual performance and the expected performance for each of the entities. We should be able to adjust actual performance by comparing it with the targets for all three outputs. We shall restrict our comments to the output targets as we took an output orientation in our analysis. Additionally, it was found that there are multiple slacks, especially in OP1, i.e. many entities can achieve a higher level of service delivery even at the present scale. Evaluating a publicly funded project related to public service is very important in order to ensure continued investment in the project and also to ensure public support for such projects. E-governance project with a comprehensive ICT regime initiated with the support from many international donors, in addition to local funding, has never been assessed in the

way I did in this paper. The project started with a comprehensive field survey conducted right through the departments and ministries where the project was implemented, which provided us with really excellent data to work. Due diligence was applied to ensure the robustness of the data and balanced deployment of the questionnaire-based survey in order to gain meaningful and usable data. The results from the study portray the weaker areas of ICT deployment in the country; that, in turn, allows us to put forward meaningful advice to the related entities for improving managerial performance. There is a room for improvement both in the managerial performance and ICT related measures, i.e. service, information and operations. However, this also portrays a limitation of our analysis; as, while we can point out the weaknesses in the ICT deployment in a geospatial manner, we can suggest the specific ICT related measures that would require an improvement. That would require an analysis of the technical aspects of the ICT regime.

Further, we would like to point out one more limitation of our study that the fourth factor of ICT continuum that was mentioned earlier, i.e. transformation. We suppose an additional study with a different set of inquiry variables would be required to assess the degree of transformation brought in this ICT regime. Finally, I have presented a composite picture of the efficiency at various departments and ministries in the wake of the ICT regime implementation. Presenting each entity's performance data individually and explaining individual performance on a one-to-one basis further extends the analysis. It has allowed us to get an overall picture of the situation after the ICT regime implementation.

5.2 Conclusions and Recommendations – Regression Analysis

The results thus obtained through a rigorous statistical analysis show that there are reasonable and understandable basis for continuing to invest in the ICT infrastructure as it has positive bearings upon the PSD in Sri Lanka. We conducted non-parametric order logistic analysis. Analyzing survey data beyond descriptive statistics always comes with a certain uncertainty as to which analytical approach will offer the best analysis of the data. While some would suggest using a logistic regression model; but again, there are multiple options which need to be carefully selected in view of the nature of the data. The problem become more acute as the responses to the question do contain certain level of subjective evaluation. As our questionnaire asked respondents to answer the questions

on a 5-point Likert scale (5 strongly agreed …. and 1 for strongly disagreed), we needed to use a regression approach that could take care of the ordinal nature of the data. Finally, we decided to use ordinal logistic regression to analyze our data. This approach allowed us a deeper understanding of the interrelationships amongst our independent and dependent variables while attending to most issues with the nature of the data. Results related to paired correlations reflect a positive correlation between the independent and dependent variables which means that efficiency of the PSD is explained by the ICT regime's reform initiatives.

In short, at this stage I have analyzed the effectiveness and acceptability of the ICT regime in Sri Lanka and results have shown that inputs of the regime are positively contributing towards the success of the program, though the contribution has not reached to very significant levels so far. After explaining the summary statistics of the data collected and various correlations, we use ordinal logistics analysis to understand the interrelations amongst various ICT inputs and their impact upon the outcomes. Cronbach alpha has been calculated to test the robustness of the data. Finally, we conducted specificity, sensitivity and predictive values analysis in order to assess the accuracy of the model applied. Our findings suggest a positive, though at times weak amongst some of the variables, correlation between the inputs and outcomes of the ICT regime put into place to digitalize the PSD in the country. Also, sensitivity and specificity tests have been carried out for the for AD and the results show sensitivity and specificity results for our model. The uniqueness and originality of our data makes the study first of its kind and it can of enormous use to both PSD operators as well the researcher who plan to build upon our results and find other angles to the case in point. One such research may be the exploration of factor efficiencies per se by applying other techniques of inquiry. I plan to expand the scope of research in future by examining factor efficiencies too.

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Appendix 1
Sri Lanka – Country at A Glance

Official Name:
Socialist Republic of Sri Lanka
short form: Sri Lanka
in Tamil: Ilankai
former: Serendib, Ceylon

People:
Nationality: Sri Lankan(s).
Population: 21.2 million (2016)
GNI per capita PPP: $ 4145 (year)
Ethnic groups: Sinhalese (74%), Tamils (18%), Moor 7%, Burgher, Malay, and Vedda 1%.
Religions: Buddhism (69%), Hinduism (15%), Christianity (8%), and Islam (7%).
Languages: Sinhala and Tamil (official), English.
Currency: Sri Lanka Rupee (LKR)
Literacy: 91%

Time & Codes
Actual Time: Tue-May-25 10:01
Local Time = UTC +6h
Country Calling Code: +94
ISO Country Code: lk, lka

Other Cities:
Dehiwala-Mount Lavinia (210 000), Moratuwa (200 000), Kandy (150 000), Jaffna (100 000), Galle (80 000), Anuradhapura (50 000).

Government:
Type: Republic
Independence: 4 February 1948 (from the UK)
Constitution: 31 August 1978.
Capital: Sri Jayewardenepura-Kotte, Colombo (pop. 1.3 million--urban area)

Geography:
Location: Asia, south of the Indian subcontinent.
Area: 65,610 km² (25,332 sq. mi.)
Terrain: Coastal plains in the northern third of country; hills and mountains in south-central Sri Lanka rise to 2 133 meters (7 000 ft.).

Climate:
Tropical; rainy seasons--light in northeast, fall and winter, with average rainfall of 50 in.; heavy in southwest, summer and fall, with average rainfall of 200 in.

Natural resources:
Agricultural products: Paddy, maha, yala, rubber, tea, coconut, rice, sugarcane, grains, pulses, oilseed, spices, tea, rubber, coconuts; milk, eggs, hides, beef.

Industries
Rubber processing, tea, coconuts, and other agricultural commodities; clothing, cement, petroleum refining, textiles, tobacco.

Exports
Commodities: textiles and apparel, tea and spices; rubber manufactures; precious stones; coconut products, fish.
Exports - partners: USA 26%, UK 9%, India 7.2%, Germany 4.3% (2015)

Imports
Commodities: petroleum, textiles, machinery and transportation equipment, building materials, mineral products, foodstuffs.
Imports - partners: India 24.6%, China 20.6%, UAE 7.2%, Singapore 5.9%, Japan 5.7% (2015)

Appendix 2
List of Heads of State
(from Ceylon to Sri Lanka)

Monarchs	
King George VI	04 February 1948 - 06 February 1952
Governor-General	
• Henry Monck-Mason Moore	1944 - 1949
• Viscount Soulbury	1949 - 1952
Queen Elizabeth II	1952 - 1972
Governor-General	
• Viscount Soulbury	1952 - 1954
• Oliver Ernest Goonetilleke	1954 - 1962
• William Gopallawa	1962 - 1972
President	
William Gopallawa	1972 - 1978
Executive Presidents [1]	
• J. R. Jayewardene	04 February 1978 - 02 January 1989
• Ranasinghe Premadasa	02 January 1989* - 01 May 1993
• D. B. Wijetunga	07 May 1993 - 12 November 1994
• Chandrika Bandaranaike Kumaratunga	12 November 1994 - 19 November 2005
• Mahinda Rajapaksa	19 November 2005* - 09 January 2015
• Maithripala Sirisena	09 January 2015* - 16 November 2019
• Gotabaya Rajapaksa	17 November 2019 - to date

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[1] With 2nd amendment to the constitution of Sri Lanka (Ceylon) in 1972 the office of Executive Presidency was created.

Appendix 3

Political Government Structure in Sri Lanka[1]

Level labels (left to right column): National, Provincial, District, Division, Grama Nilidhari, Village

Diagram boxes:
- President
- Parliament/Cabinet
- Ministries and Departments
- Ministry of Public Administration & Management
- Ministry of Provicial Councils and Local Government
- Governor
- Chief Minister
- Board of Ministers
- Chief Secretary — Provincial Ministeries and Departments — Commissioner of Local Government (CLG)
- Line Agencies
- District Secretariat Government Agent/Divisional Secretary & Central Departments
- Provincial Departments
- Assistant Commissioner of Local Government (ACLG)
- Line Agencies
- Divisional Secretary & Central Departments
- Provicial Departments
- Pradeshiya Sabha — Secretary & Administrative Units — Chairman & Executive
- Samurdhi Officer
- Grama Nilidhari
- Development Officer
- Various Officers
- Various Officers
- Voluntary Organizations
- RDS
- WRDS
- Sports Club
- Community Center

Appendix 4
Departments and Ministries Surveyed

1. Department of Immigration & Emigration
2. Department of Register of Persons
3. Department of Import and Export
4. Department of Examination
5. Department of Customs
6. Department of Motor Traffic
7. Department of Registrar General
8. Department of Pension
9. Department of Fisheries
10. Department of Railway
11. Department of Labor
12. Ministry of Education
13. Ministry of Healthcare
14. Election Commission
15. Police Commission
16. Foreign Bureau
17. Electricity Board
18. Central Bank
19. National Transport Commission
20. Ministry of Foreign Affairs

Appendix No. 5A
Survey Questionnaire
(English)

Question No.	Questions	Response				
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1.	Using the computer system is more accurate, easier, and faster than the manual system.					
2.	It is good enough to use the computer system for daily works.					
3.	Official website provides useful information and guidance to the public.					
4.	Digital transformation was easy to do because the organization has IT experts.					
5.	Government organizations deliver efficient public service by integrating databases.					
6.	It is easy to make a decision by using the digitalized system					
7.	Human resource utilization decreases with digitalization.					
8.	Services are decentralized through digital transformation.					
9.	The digital transformation is moving the organization towards globalization					
10.	The management of the organization accepts the ideas of the employees in the digitalization process					
11.	The procurement and financial activities are transparent by digital transformation					
12.	It can review and transparent of any decision when using the digital transformation system					
13.	The employees have an ability to know the present condition of the work process by the digital system					
14.	The organization provides the organizational policies and required information to employees via the computer system.					
15.	Statistics dashboards can be used as a monitoring tool to minimize processing delays.					
16.	Due to digitalization, organizational processes are not subject to external influences.					
17.	Identify the organizational responsibilities and roles of each employee within the digitalization system					
18.	The computer system updates the records of the organization.					
19.	Digitization promotes inter-organizational collaboration and coordination.					
20.	The methodological processes minimize the working errors in the digitalized system					
21.	The customers can check the current position of their request due to digitalization					

22.	The organization can integrate information within subsections of the organization by the digitalized system and customers receive accurate information from itself.					
23.	The network security of the database has supplied by digitalization					
24.	System hardware is properly maintained by digitalization					
25.	There is a substitute plan for the main computer system in the organization in case of its collapse.					
26.	The organization can tender fast service due to digitalization					
27.	The organization can deliver service on time using digitalization					
28.	Ability to enable system audit to maintain error-free records.					
29.	The organization ensures that client information is secure in cash transactions.					
30.	The management of the organization has identified the need for innovation.					
31.	System flexibility can quickly adapt to problem-solving techniques.					
32.	The company has a staff that is full of specialization.					
33.	Electronic media such as email and social media can be used to solicit customer feedback, problems or grievances and provide solutions.					
34.	The performance of e-government services is excellent.					
35.	The organization has a performance-based employee incentive system due to digitalization					
36.	To update the service knowledge of the employees in the organization are implemented continues training programs					
37.	An effective work process ensures customer loyalty to the organization.					
38.	The challenges that arise in digitalization can be discussed with the management and those ideas can be used for the progress of the organization.					
39.	Through digitalization, the existing government can provide formal services to its citizens.					
40.	Digitalization reduces the mental stress on the employees of the organization.					

Appendix No. 5B
Survey Questionnaire
(Sinhala)

ඊ-රාජ්‍ය සංකල්පය යටතේ ඩිජිටල් පරිවර්තනය නිලධාරීන්ට බලපාන ආකාරය සොයා බැලීම සඳහා වන සමීක්ෂණය

★ කරුණාකර පහත දැක්වෙන සෑම පුකාශයක් සඳහාම ඔබගේ අභිමතය ඉදිරියෙන් දැක්වෙන කොටුවේ කතිරයක් මගින් සටහන් කරන්න.

ආයතනය : ....

	දැඩි ලෙස එකඟ වේ	එකඟ වේ	මධ්‍යස්ථ වේ	එකඟ නොවේ	දැඩි ලෙස එකඟ නොවේ
01.ලිපිගොනු භාවිතයෙන් රාජකාරී කටයුතු සිදු කරනවාට වඩා පරිගණක පද්ධතියක් තුළින් කටයුතු කිරීම නිවැරදි, පහසු සහ වේගවත් වේ.					
02. රාජකාරී කටයුතු සඳහා පරිගණක පද්ධති භාවිතා කිරීමට ඉතා කැමැත්තක් තිබේ.					
03. අපගේ ආයතනයේ වෙබ් අඩවිය මහජනතාවට පුයෝජනවත් තොරතුරු හා උපදේශන ලබාදෙයි.					
04. අප ආයතනය තුළ තොරතුරු තාක්ෂණය සම්බන්ධ විශේෂඥ ඥානය සහිත නිලධාරීන් සිටීන බැවින් ඩිජිටල් පරිවර්තනය සිදු කිරීමට පහසු විය.					
05. රාජ්‍ය ආයතන වල තොරතුරු පද්ධතීන් එකිනෙකට සම්බන්ධ වී ඇති බැවින් මහජන සේවාවන් ලබාදීම පහසුව ඇත.					
06. ඩිජිටල්කරණය කරන ලද පද්ධතිය තුළ පුමාණවත් තොරතුරු ඇති බැවින් තීරණ ගැනීම පහසුය.					
07. ඩිජිටල්කරණය සමඟ මානව සම්පත් භාවිතය අඩම වේ.					
08. ඩිජිටල් පරිවර්තනයක් තුළින් සේවාවන් විමධ්‍යගත කිරීමේ හැකියාවන් ඇත.					
09. ඩිජිටල් පරිනාමනය තුළින් ගෝලීයකරණය කරා ගමන් කරයි.					
10. ඩිජිටල් පරිවර්තනයේදී ආයතනයේ කළමණාකාරීත්වය, සේවකයින්ගේ නවෝ අදහස් සඳහා ඉඩ ලබාදේ.					
11. ඩිජිටල් පරිවර්තනය සමග අපගේ ආයතනය තුළ පුසම්පාදන කියාවලිය සහ අරමුදල් භාවිතය විනිවිද භාවයකින් යුතුව කියාත්මක වේ.					
12. ඩිජිටල් පරිවර්තනයෙන් අනතුරුව ගන්නාවූ ඕනෑම තීරණයක් විනිවිද භාවයෙන් යුක්ත අතර පසුකාලීනව හෝ ඒ පිළිබඳව පරීක්ෂා කිරීමේ හැකියාව ඇත.					
13. වැඩ කියාවලියේ වත්මන් තත්වය නිලධාරීන්ට පද්ධතිය ආශුයෙන් දැක ගැනීමේ හැකියාව ඇත.					
14. පරිගණක පද්ධතිය හරහා ආයතනය තම පුතිපත්ති හා අවශ්‍ය තොරතුරු නිලධාරීන්ට ලබාදෙමින් ඔවුන් දැනුවත් කරයි.					
15. සැකසුම් පුමාදය අවම කිරීම සඳහා අධීක්ෂණ මෙවලමක් ලෙස සංඛ්‍යාන උපකරණ පුවරු භාවිතා කිරීමේ හැකියාව ඇත.					
16. ඩිජිටල්කරණය හේතුවෙන් ආයතන කියාවලිය බාහිර බලපෑම් වලට යටත් නොවේ.					
17. ඩිජිටල් පරිවර්තනයේදී සෑම නිලධාරියෙකුගේම ආයතන වගකීම් සහ කාර්යභාරයන් හඳුනා ගැනේ.					
18. පරිගණක පද්ධතිය මගින් අපගේ ආයතනයේ වාර්තා යාවත්කාලීන කරයි.					
19. ඩිජිටල්කරණය තුළින් අන්තර් ආයතන සහයෝගීතාවය හා සම්බන්ධීකරණය වර්ධනය කරයි.					

20. ඩිජිටල්කරණය නිසා කාර්ය ක්‍රමවේද ක්‍රියාවලියේදී නිරවද්‍යතාවය පරීක්ෂා කළ හැකි බැවින් දෝෂ හෝ වැරදි අවම වේ.					
21. ඩිජිටල්කරණය හේතුවෙන් අදාළ සේවාලාභියාට තම ඉල්ලීමේ වත්මන් තත්වය හෝ ප්‍රගතිය පරීක්ෂා කළ හැකිය.					
22. එකම ආයතනය තුළ ඇති සියලුම අංශ ඩිජිටල්කරණයත් සමඟ සම්බන්ධ කිරීමේ හැකියාව ඇති බැවින් අවශ්‍ය නිවැරදි තොරතුරු පද්ධතිය තුළින්ම ලබාගැනීමේ හැකියාව ඇත.					
23. ඩිජිටල්කරණයේදී ජාල ආරක්ෂාව සපයන බැවින්, තොරතුරු පද්ධතිය වඩාත් සුරක්ෂිත හා නිවැරදි වේ.					
24. ඩිජිටල් පරිවර්තනය නිසා දෘඪාංග නඩත්තුව සඳහා නිසි ක්‍රියාදාමයක් ඇත.					
25. පද්ධති බිඳවැටීමක් සිදුවුවහොත්, පාරිභෝගිකයාට අප්‍රමාදව සේවාවන් ඉටුකර දීම සඳහා අමතර සහයක සැලැස්මක් ක්‍රියාත්මක කිරීමේ හැකියාව ඩිජිටල්කරණය තුළින් අප ආයතනයට ලැබී ඇත.					
26. ඩිජිටල් පරිවර්තනයත් සමඟ මහජන අවශ්‍යතාවයන් කඩිනමින් විසඳීමේ හැකියාව ආයතනයට ලැබේ.					
27. ඩිජිටල්කරණයෙන් අනතුරුව සැලසුම් කළ කාලය තුළදී සේවා අවශ්‍යතාවය ඉටුකිරීමේ හැකියාව අපගේ ආයතනයට ඇත.					
28. දෝෂ රහිත වාර්තා පවත්වාගෙන යාම සඳහා පද්ධති විගණනයේ සහය ලබාගැනීමේ හැකියාව ඇත.					
29. මුදල් ගනුදෙනු වලදී සේවාලාභියාගේ තොරතුරු සුරක්ෂිත බව අපගේ ආයතනය සහතික වෙයි.					
30. නවීකරණයේ අවශ්‍යතාවයක් ඇති බව ආයතනයේ කළමණාකාරිත්වය හඳුනාගෙන ඇත.					
31. නම්‍යශීලිත්වය නිසාම උද්ගත වන ඕනෑම ගැටලුවක් විසඳාගැනීමේ ක්‍රමවේදයන්ට ඉක්මණින් අනුගත විය හැක.					
32. ක්‍රියාශීලිත්වයෙන් පරිපූර්ණ කාර්ය මණ්ඩලයක් ආයතනයට හිමිවේ.					
33. ඊ-මේල්, සමාජ මාධ්‍ය ජාල වැනි විද්‍යුත් මාධ්‍ය භාවිතයෙන් පාරිභෝගික අදහස්, ගැටළු හෝ දුක්ගැනවිලි ලබා ගැනීමේ හා ඒවාට විසඳුම් ලබාදීමේ හැකියාව ඇත.					
34. ඊ-රාජ්‍ය සේවාවන් හි කාර්ය සාධනය විශිෂ්ඨය.					
35. ඩිජිටල්කරණය හේතුවෙන් කාර්ය සාධනය පදනම්ව සේවකයින් දිරිගැන්වීමේ ක්‍රමවේදයක් ආයතනය සතුව ඇත.					
36. නිලධාරීන්ගේ සේවා දැනුම යාවත්කාලීන කිරීම සඳහා අඛණ්ඩව පුහුණු පාඨමාලාවන් ක්‍රියාත්මක කෙරේ.					
37. එළඳායි වැඩ ක්‍රියාවලිය තුළින් අපගේ ආයතනය කෙරෙහි සේවාලාභීන්ගේ විශ්වාසනීයත්වය තහවුරු වේ.					
38. ඩිජිටල්කරණයේදී පැන නගින අභියෝගාත්මක කරුණු කළමණාකාරිත්වය සමඟ සාකච්ඡා කළ හැකි අතර, එම අදහස් ආයතනයේ ප්‍රගතිය උදෙසා යොදා ගැනේ.					
39. ඩිජිටල්කරණය හරහා පවත්නා රජයට තම පුරවැසියන් වෙනුවෙන් වඩා විධිමත් සේවාවන් ලබාදීමේ හැකියාව ඇත.					
40. ඩිජිටල්කරණය නිසා ආයතන නිලධාරීන්ගේ මානසික ආතතිය අවම කරයි.					

Appendix No. 6
Raw Survey Response Data Tabulated

Raw Survey Data - Response to All Questions

Responses to Questions

Strongly Agreed - 5 | Agreed - 4 | Nutral - 3 | Disagreed - 2 | Strongly Disagreed - 1

No	Organization	No.	1	2	...	40
1	Department of Immigration and Emigration	1–20				
2	Department of Registar of Persons	1–20				
3	Department of Import and Export Control	1–20				
4	Department of Examination	1–16				

Raw Survey Data - Response to All Questions

Responses to Questions

Strongly Agreed - 5   Agreed - 4   Nutral - 3   Disagreed - 2   Strongly Disagreed - 1

Organization	No.	1	2	3	4	5	6	7	8	9	10	...	40
Department of Customs	Average												
Department of Moter Traffic	Average												
Department of Registrar General	Average												
Department of Pension	Average												

Raw Survey Data - Response to All Questions

Responses to Questions

Strongly Agreed - 5   Agreed - 4   Nutral - 3   Disagreed - 2   Strongly Disagreed - 1

Organization	No.	Responses (Q1–Q40)
Department of Fisheries and Aquatic Resources (9)	1–20	...
Department of Railway (10)	1–20	...
Department of Labour (11)	1–20	...
Ministry of Education (12)	1–20	...

Raw Survey Data - Response to All Questions

Responses to Questions

Strongly Agreed - 5 Agreed - 4 Nutral - 3 Disagreed - 2 Strongly Disagreed - 1

No	Organization	No.	Responses to All Questions (Questions 1–40)
13	Ministry of Healthcare and Indigenous/Medical Services		
14	Election Commision		
15	Police Commision		
16	Foreign Bureau		

Raw Survey Data - Response to All Questions

Responses to Questions

Legend: Strongly Agreed - 5 | Agreed - 4 | Nutral - 3 | Disagreed - 2 | Strongly Disagreed - 1

No.	Organization	No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
17	Electricity Board	Average	4.70	4.60	4.60	4.10	3.60	3.95	4.05	4.50	4.25	3.75	3.55	3.65	3.50	4.10	3.95	3.70	3.75	4.10	4.10	4.15	4.10	3.95	4.05	3.70	3.60	4.20	3.95	4.05	4.00	3.75	3.80	3.75	4.30	3.65	3.30	3.75	3.75	3.85	4.15	3.70
18	Central Bank	Average	4.45	4.55	3.55	3.10	3.20	3.55	3.70	3.65	3.85	3.10	3.00	3.40	3.50	3.30	3.25	3.45	3.50	3.60	3.65	3.65	3.55	3.50	3.15	3.50	3.75	3.35	3.35	3.40	3.35	3.60	3.85	3.50	3.55	3.30	3.35	3.95	3.40	3.70	3.80	3.90
19	National Transport Commission	Average	4.65	4.80	3.95	3.50	3.30	3.60	3.60	3.70	4.70	3.10	3.40	3.60	4.05	3.75	3.50	2.80	3.45	3.55	3.35	3.95	4.00	4.00	3.80	3.45	3.55	3.75	3.65	3.35	4.00	3.60	3.60	3.85	3.70	3.55	3.50	3.90				

Raw Survey Data - Response to All Questions

Legend: Strongly Agreed - 5 | Agreed - 4 | Nutral - 3 | Disagreed - 2 | Strongly Disagreed - 1

Organization	No	No.	Responses to Questions (1–40)																																						
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
		Average	4.50	4.50	3.80	3.60	3.75	3.85	3.60	3.80	4.60	3.40	3.80	3.70	3.65	3.60	3.75	3.40	3.80	3.75	3.45	3.85	3.80	4.00	3.80	3.35	3.30	3.80	3.75	3.65	3.80	3.60	3.75	3.60	3.85	3.90	3.40	3.65	3.75	3.60	4.10	3.85
Ministry of Foreign Affairs	20	1																																								
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		Average	4.85	4.75	4.10	3.35	3.45	3.20	3.50	3.20	4.95	3.65	3.15	3.40	3.60	3.30	3.00	2.50	3.15	3.50	3.25	3.75	3.95	3.70	3.40	3.00	3.75	3.65	3.60	2.95	3.40	3.65	3.60	3.90	3.25	3.70	3.70	3.80	3.90	3.55	4.60	4.40

Appendix No. 7
Averaged Reponses (Including Input/Output Averages)

		Consolidated Response to Questions (averaged)							
Organization		**Questions**							
		OP1	IP	OP2	IP	OP1	OP3	OP3	OP3
	Entity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Department of Immigration and Emigration	E1	4.10	4.10	4.00	3.40	3.95	3.55	3.55	3.90
Department of Registar of Persons	E2	4.15	4.30	3.70	3.25	3.05	3.50	3.10	3.85
Department of Import and Export	E3	4.20	4.35	3.55	3.15	2.90	3.30	3.80	3.95
Department of Examination	E4	4.30	4.20	4.05	3.55	3.85	3.80	4.10	4.00
Department of Customs	E5	4.20	4.30	3.70	3.80	3.35	3.30	3.40	3.90
Department of Moter Traffic	E6	4.30	4.55	3.55	2.75	3.30	3.70	2.45	3.20
Department of Registrar General	E7	4.40	4.15	4.05	3.75	3.10	3.15	3.75	4.05
Department of Pension	E8	4.20	4.50	4.35	4.05	3.15	4.00	3.75	4.20
Department of Fisheries	E9	4.60	4.10	4.20	4.20	3.10	3.75	3.05	4.25
Department of Railway	E10	4.35	4.55	3.70	3.00	3.65	3.75	3.80	4.00
Department of Labour	E11	4.65	4.65	3.40	2.80	2.75	3.45	3.50	4.10
Ministry of Education	E12	4.45	4.40	3.85	3.45	3.25	3.20	3.15	3.75
Ministry of Healthcare	E13	4.40	4.30	3.75	3.20	3.50	3.55	3.60	3.95
Election Commission	E14	4.10	4.30	3.95	3.50	3.40	3.60	3.60	4.05
Police Commission	E15	4.40	4.35	3.60	2.55	3.00	3.50	3.65	3.55
Foreign Bureau	E16	4.70	4.60	4.60	4.10	3.60	3.95	4.05	4.50
Electricity Board	E17	4.45	4.55	3.55	3.10	3.20	3.55	3.70	3.65
Central Bank	E18	4.65	4.80	3.95	3.50	3.30	3.60	3.60	3.70
National Transport Commission	E19	4.50	4.50	3.80	3.60	3.75	3.85	3.60	3.80
Ministry of Foreign Affairs	E20	4.85	4.75	4.10	3.35	3.45	3.20	3.50	3.20

	Organization	Entity	OP2 9	IP 10	OP2 11	OP2 12	IP 13	IP 14	OP3 15	OP3 16
5	Department of Immigration and Emigration	E1	3.95	3.40	3.20	3.75	4.20	3.85	3.65	3.70
6	Department of Registar of Persons	E2	4.10	3.45	3.15	3.60	4.10	3.55	3.50	3.15
7	Department of Import and Export	E3	4.30	3.80	3.80	3.85	3.80	3.65	3.45	3.70
8	Department of Examination	E4	4.10	3.60	3.55	3.65	4.05	3.85	3.90	3.35
9	Department of Customs	E5	3.85	3.10	3.10	3.35	3.85	3.30	3.65	2.90
10	Department of Moter Traffic	E6	4.15	2.40	2.65	3.65	3.65	2.60	3.25	2.65
11	Department of Registrar General	E7	4.20	3.80	3.75	3.75	3.85	3.60	3.85	3.45
12	Department of Pension	E8	4.15	3.85	3.70	3.95	4.25	4.10	3.90	3.70
13	Department of Fisheries	E9	4.00	3.85	3.50	4.00	3.75	3.10	3.10	3.05
14	Department of Railway	E10	4.25	3.60	3.25	3.60	3.85	3.65	3.80	3.50
15	Department of Labour	E11	3.45	3.55	3.30	3.70	3.95	3.35	3.55	3.20
16	Ministry of Education	E12	3.70	3.45	3.25	3.50	3.80	2.95	3.45	3.05
17	Ministry of Healthcare	E13	4.30	3.70	3.65	3.75	4.30	3.90	4.20	3.35
18	Election Commission	E14	4.05	3.50	3.25	3.60	3.75	3.90	3.90	3.30
19	Police Commission	E15	3.90	3.40	2.90	3.60	3.80	3.60	3.75	3.45
20	Foreign Bureau	E16	4.25	3.75	3.55	3.65	3.50	4.10	3.95	3.70
21	Electricity Board	E17	3.85	3.10	3.00	3.40	3.40	3.30	3.25	3.45
22	Central Bank	E18	4.70	3.10	3.40	3.60	4.05	3.75	3.50	2.80
23	National Transport Commission	E19	4.60	3.40	3.80	3.70	3.65	3.60	3.75	3.40
24	Ministry of Foreign Affairs	E20	4.95	3.65	3.15	3.40	3.60	3.30	3.00	2.50

Table header (columns K–R): **Consolidated Response to Questions (averaged)** — **Questions**

		A	B	S	T	U	V	W	X	Y	Z
1		Organization		Consolidated Response to Questions (averaged)							
2				Questions							
3				IP	IP	OP3	OP1	OP2	OP2	IP	IP
4			Entity	17	18	19	20	21	22	23	24
5		Department of Immigration and Emigration	E1	3.60	4.10	3.80	3.90	4.10	3.95	3.60	3.20
6		Department of Registar of Persons	E2	3.35	3.65	3.80	3.60	4.00	4.00	3.45	3.30
7		Department of Import and Export	E3	3.70	3.70	3.95	4.05	3.90	3.85	3.80	3.80
8		Department of Examination	E4	3.80	4.00	3.75	3.65	3.95	4.00	3.50	3.40
9		Department of Customs	E5	3.30	3.70	3.40	3.75	4.00	3.95	3.45	3.05
10		Department of Moter Traffic	E6	3.40	3.10	3.40	3.55	3.00	3.55	3.40	2.70
11		Department of Registrar General	E7	3.65	3.50	3.80	4.25	3.90	3.90	3.65	3.55
12		Department of Pension	E8	3.70	4.15	3.90	4.10	4.25	4.25	4.00	3.65
13		Department of Fisheries	E9	3.20	3.95	3.85	3.65	4.30	4.25	3.45	3.20
14		Department of Railway	E10	3.55	3.90	4.10	4.15	3.90	4.05	4.05	3.55
15		Department of Labour	E11	3.30	3.50	3.65	3.75	3.95	4.15	3.65	3.25
16		Ministry of Education	E12	3.25	2.90	3.50	3.75	3.60	4.05	3.70	3.35
17		Ministry of Healthcare	E13	3.90	4.10	3.70	4.30	4.30	4.35	3.75	3.45
18		Election Commission	E14	3.35	3.80	3.85	3.85	4.10	4.05	3.90	3.50
19		Police Commission	E15	3.50	3.95	3.85	3.95	3.85	3.90	3.50	3.00
20		Foreign Bureau	E16	3.75	4.10	4.10	4.15	4.10	3.95	4.05	3.70
21		Electricity Board	E17	3.50	3.40	3.60	3.65	3.65	3.55	3.50	3.15
22		Central Bank	E18	3.45	3.55	3.35	3.95	4.00	4.00	3.80	3.45
23		National Transport Commission	E19	3.80	3.75	3.45	3.85	3.80	4.00	3.80	3.35
24		Ministry of Foreign Affairs	E20	3.15	3.50	3.25	3.75	3.95	3.70	3.40	3.00

	A	B	AA	AB	AC	AD	AE	AF	AG	AH
1			**Consolidated Response to Questions (averaged)**							
2	**Organization**		**Questions**							
3			IP	OP1	OP1	IP	OP2	IP	IP	IP
4		**Entity**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
5	Department of Immigration and Emigration	E1	3.10	3.90	3.80	3.55	3.85	3.95	3.40	3.60
6	Department of Registar of Persons	E2	3.00	3.90	3.40	3.70	3.90	4.05	3.40	3.15
7	Department of Import and Export	E3	3.00	3.65	3.65	3.55	3.70	4.20	4.05	3.75
8	Department of Examination	E4	3.35	3.85	3.85	3.75	3.55	3.85	3.80	3.80
9	Department of Customs	E5	3.10	3.55	3.30	3.50	3.50	3.65	3.30	3.15
10	Department of Moter Traffic	E6	3.65	3.45	3.75	2.60	3.50	3.40	2.90	3.75
11	Department of Registrar General	E7	3.45	3.80	3.70	3.40	3.40	4.10	3.75	4.00
12	Department of Pension	E8	3.35	4.15	3.95	3.65	4.21	4.40	3.90	3.95
13	Department of Fisheries	E9	3.10	3.75	3.55	3.65	3.90	4.25	3.30	3.90
14	Department of Railway	E10	2.70	3.90	3.70	3.80	3.55	3.40	3.75	4.15
15	Department of Labour	E11	2.65	3.90	3.60	3.70	3.70	3.40	3.35	3.45
16	Ministry of Education	E12	3.10	3.50	3.40	3.15	3.55	3.35	3.40	3.25
17	Ministry of Healthcare	E13	3.30	3.85	3.70	3.70	4.25	4.15	4.10	4.15
18	Election Commission	E14	3.40	4.00	3.95	3.75	3.70	3.45	3.60	3.60
19	Police Commission	E15	2.55	3.60	3.50	3.55	3.20	3.80	3.70	3.85
20	Foreign Bureau	E16	3.60	4.20	3.95	4.05	4.00	3.75	3.80	3.75
21	Electricity Board	E17	3.15	3.50	3.35	3.40	3.35	3.40	3.35	3.65
22	Central Bank	E18	3.55	3.75	3.65	3.35	4.00	3.60	3.60	3.85
23	National Transport Commission	E19	3.30	3.80	3.75	3.65	3.80	3.60	3.75	3.60
24	Ministry of Foreign Affairs	E20	3.75	3.65	3.60	2.95	3.40	3.65	3.60	3.90

Organization	Entity	Consolidated Response to Questions (averaged) Questions							
		OP3	OP1	OP3	IP	OP3	IP	OP1	OP1
		33	34	35	36	37	38	39	40
Department of Immigration and Emigration	E1	3.60	3.70	3.30	3.30	3.65	3.55	3.95	3.35
Department of Registar of Persons	E2	3.60	3.30	3.15	3.35	3.50	3.60	3.95	3.00
Department of Import and Export	E3	3.65	3.55	2.90	3.25	3.75	3.60	3.95	3.70
Department of Examination	E4	3.85	3.55	3.40	3.35	3.70	3.60	3.95	3.40
Department of Customs	E5	3.75	3.20	2.90	3.10	3.45	3.20	3.85	2.65
Department of Moter Traffic	E6	2.70	3.60	3.75	3.20	3.20	3.00	4.05	3.95
Department of Registrar General	E7	4.20	3.95	3.45	3.55	3.75	3.85	3.65	3.65
Department of Pension	E8	3.95	3.85	2.95	3.10	3.70	3.85	4.00	3.45
Department of Fisheries	E9	3.40	3.75	3.25	3.80	3.85	3.95	3.95	3.30
Department of Railway	E10	4.15	3.70	2.85	2.75	3.80	3.40	4.05	4.10
Department of Labour	E11	3.70	3.45	2.90	2.55	3.45	3.10	3.90	3.50
Ministry of Education	E12	3.50	3.10	2.80	2.45	3.40	3.05	3.45	2.75
Ministry of Healthcare	E13	4.15	3.75	3.20	3.15	3.65	3.80	4.25	3.65
Election Commission	E14	4.15	4.15	3.20	3.35	3.90	3.45	3.95	3.15
Police Commission	E15	3.95	3.55	3.10	3.30	3.65	3.50	3.95	3.65
Foreign Bureau	E16	4.30	3.65	3.30	3.75	3.75	3.85	4.15	3.70
Electricity Board	E17	3.50	3.50	3.30	3.35	3.30	3.40	3.70	3.80
Central Bank	E18	3.70	3.55	3.50	3.95	3.90	3.65	4.30	3.90
National Transport Commission	E19	3.85	3.90	3.40	3.65	3.75	3.60	4.10	3.85
Ministry of Foreign Affairs	E20	3.25	3.70	3.70	3.80	3.90	3.55	4.60	4.40

	A	B	AQ	AR	AS	AT	AU
1			**Input/Output Averages**				
2	**Organization**						
3			IP	OP 1	OP 2	OP 3	Overall Output Average
4		Entity	Average	Average	Average	Average	
5	Department of Immigration and Emigration	E1	3.62	3.83	3.83	3.63	3.76
6	Department of Registar of Persons	E2	3.54	3.54	3.78	3.46	3.59
7	Department of Import and Export	E3	3.70	3.71	3.85	3.61	3.72
8	Department of Examination	E4	3.72	3.80	3.84	3.76	3.80
9	Department of Customs	E5	3.43	3.48	3.64	3.41	3.51
10	Department of Moter Traffic	E6	3.19	3.74	3.44	3.14	3.44
11	Department of Registrar General	E7	3.73	3.81	3.85	3.72	3.79
12	Department of Pension	E8	3.90	3.86	4.12	3.78	3.92
13	Department of Fisheries	E9	3.67	3.71	4.02	3.51	3.74
14	Department of Railway	E10	3.60	3.95	3.76	3.75	3.82
15	Department of Labour	E11	3.39	3.69	3.66	3.50	3.62
16	Ministry of Education	E12	3.31	3.46	3.64	3.31	3.47
17	Ministry of Healthcare	E13	3.81	3.93	4.05	3.71	3.89
18	Election Commission	E14	3.63	3.82	3.81	3.73	3.79
19	Police Commission	E15	3.49	3.70	3.56	3.61	3.62
20	Foreign Bureau	E16	3.89	4.01	4.01	3.96	3.99
21	Electricity Board	E17	3.42	3.64	3.48	3.48	3.53
22	Central Bank	E18	3.69	3.88	3.95	3.52	3.78
23	National Transport Commission	E19	3.66	3.94	3.93	3.65	3.84
24	Ministry of Foreign Affairs	E20	3.56	4.00	3.81	3.28	3.69

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WHO WE ARE   DIGITAL SRI LANKA   OUR FUTURE   PROJECTS   PROCUREMENT   NEWS   GET INVOLVED   RTI

INDUSTRY DEVELOPMENT

In supporting the ICT sector of Sri Lanka, this program aims at Establishing a competitive marketplace for SME's amongst large ICT providers Making Sri Lanka an attractive destination for products, services and investments related to ICT

DIGITAL INFRASTRUCTURE

In view of digitally empowering Sri Lankan citizens by way of a knowledge based society, ICTA sees digital Infrastructure as most invested strategy.

LEGAL FRAMEWORK & DEVELOPMENT

Sri Lanka has its own set of eLaws that should be adhered to by the Government and citizens.

POLICY FRAMEWORK & DEVELOPMENT

ICTA works towards creating a pro-active policy and an environment that is aligned with the ICT improvement program in the country.

DIGITIZATION IN GOV

This program is catered towards continuously improving the efficiency, transparency quality and effectiveness.
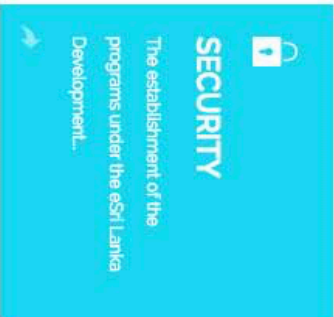
CAPACITY BUILDING

In achieving a digitally inclusive Sri Lanka, the ability of the Government and society to meet ICT development challenges should be enhanced.

SECURITY

The establishment of the programs under the eSri Lanka Development.

CITIZEN EMPOWERMENT

Digital technology and infrastructure is presented to citizens in view of giving them the power to better consume government and educational services.

We ensure to create a Digitally Inclusive Sri Lanka in 2018.

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Information and Communication Technology Agency of Sri Lanka

WHO WE ARE   DIGITAL SRI LANKA   OUR FUTURE   PROJECTS   PROCUREMENT   NEWS   GET INVOLVED

Search....

Home › Our Future › Government

Government

Information and communications technologies (ICTs) are playing an increasingly vital role in the daily lives of all communities by revolutionizing their working procedures and rules of governance. ICTs offer a unique opportunity for governing elite, as ICT has the capacity to empower civil society to play its role more effectively and facilitate the performance of governments' main function—serving the citizens of the country. Executing in the government sector, ICT applications are promising to enhance the delivery of government services to citizens not only by improving the process and management of

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Search....

Home > Our Future > Education

Education

As per the vision of the government and the national development agenda, education sector is considered as a key thrust area which directly contributes towards the development of a knowledge based society and knowledge based economy. ICT has a significant level of role in the development of education to the next era. This will directly contributes government policy on "Digitization of the economy" by promoting IT education at all levels of education and made younger generation more accessible to global job opportunities. It also aligns and contributes towards government education policy on "Facilitation to access to the digital world".

https://www.icta.lk/who-we-are

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MILESTONES
ICTA

A history of 12 years which guided Sri Lanka in its journey through the ICT revolution.

WHAT IS
ICTA

Information and Communication Technology Agency of Sri Lanka is the head ICT agency of Sri Lanka and is responsible for implementing all ICT projects initiated by the government.

RESULTS
ICTA

A Geographical View of results across the country from ICTA's inception

VISION
ICTA

The overall vision of ICTA is to make Sri Lanka a digitally inclusive country.

MISSION
ICTA

ICTA aims to Transform Sri Lanka towards a creative knowledge-based society.

LEADERSHIP
ICTA

The Leaders who are tasked to lead the ICT direction of the country

CAREERS
ICTA

A place to ideate your actions! Be a part of 'Ideas Actioned' team!

ENABLING E-LAWS AND POLICIES
ICTA

Acts which enable ICTA as Apex body of ICT direction

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Appendix No. 8
ICTA Brochure

WHO WE ARE?

About us
Mission
Vision
Achievements
Leadership
Careers
Acts

OUR FUTURE

Government
Communication
Education
Medical
Transportation
Private Sector
Agriculture

Current Projects

PROCUREMENT

EXTENSION OF DEADLINE FOR SUBMISSION OF BIDS – Procurement of Supply, Delivery and Installation of Equipment for Establishment of 66 Digital Classrooms – ICTA/GOSL/GOODS /NCB/2016/65

Event Manager to Organize and Facilitate Workshops for Identifying Most Viable eServices and Mobile Applications for Government Organizations – ICTA/SG2/GOSL/SER/NS/2017/006

Purchase of Office Automation and Information Technology Equipment – "ICTA/SG2 /GOSL/GOODS/NS/2017/003 – "ICTA/SG2/GOSL /GOODS/NS/2017/004 A – F"

WHAT WE DO?

Digital Infrastructure
Industry Development
Legal Framework
Digitizing Gov.
Capacity Building
Citizen Empowerment
Security
Policy Framework