Chapter 2

Literature Review

2.1 Introduction

The present study envisages a survey on the status on the use of Information and Communication Technology (ICT) use in road infrastructure development. In this the term “use” includes the way of using and the system enabling the usage. Therefore the identification of use involves an assessment of “use” and also “available systems”. ICT application systems can be further divided into the system of Government and the systems of particular sectors and respective organizations.

The role to be played by systems of the Government would be the facilitation or support by the Government. Systems pertaining to particular sectors would be the ICT facility availability in sector of the Government and the respective organizations

2.2 ICT policy in Sri Lanka

According to “Mahinda Chintanaya” of year policy statement ,the following activities were envisaged to be implemented for the development of ICT in Sri Lanka.[20]

- “Nenasala Programme.” to provide internet and e-mail facilities for the rural sector.
- E-Government programme to be introduced for effective public service.
- All island ICT infrastructure development programme.

Information and Communication Technology Act, No. 27 of 2003 was gazetted in September 2003 to provide for the setting out of a national policy for ICT. Accordingly, The Information Communication Technology Agency (ICTA) of Sri Lanka was established considering it as the apex body for ICT development in Sri Lanka. ICTA is presently preparing a National ICT policy and an ICT policy for Government institutions [27].

The ICT policy for Government is to act as a guide for the government in using ICTs to achieve overall development within its agencies and in the delivery of their services, while providing assistance in benchmarking activities of its entities which will enable them to identify the areas which need rectification. Moreover it will ensure consistency in ICT activities. Thus, the Policy will be a first step towards implementing a standards-based approach in implementing e-Government services. Especially in the road sector[27].

The National ICT Policy is to formally recognize ICT as a major thrust area for national development. In this regard, the Policy will highlight strategies and action plans for an enabling infrastructure, legal frameworks, information security and standards, human resources capacity building, socio economic development (including poverty alleviation, health care and use of ICT in local languages), and utilizing ICT for trade facilitation and e-commerce, e-government, industry and global competitiveness, and environmental issues. The policy will be drafted with stakeholder participation to ensure the document is representative and holistic in nature [27].

2.3 ICT policies in other countries

ICT policies in India, Thailand, U.K., and Japan are described in this section.

2.3.1 ICT policy in India

The path towards technology induced development associated with ICT started from 1984. The then government adopted information of Indian society as an effective route to development, with programmes launched in public sectors, commercial undertakings and administrative departments. By 1985 large sectors had announced computerization plans, which included railways, banking operations, schools etc. A high power National task Force on Information technology and Software development was set up in 1998. The ICT was initially started in Education, Health and in the Transport sectors. The task force was required to provide recommendations on the path of development and economic growth and leveraging the ICT capabilities [15].

2.3.2 ICT policy in Thailand

In Thailand the ICT policy was initially started in March, 1992 for the development of national information infrastructure, human resources development, and national school information system. Government information network (GI net) was started in 2000. Amendments to the national policy were adopted in year 2001, to implant the following.

- e Society
- e Commerce
- e Law
- e Education.

The current ICT programmes implementing in Thailand are, ICT for disabled person and ICT for cultural development [5].

2.3.3 ICT policy in U.K.

In March 2005 the Department for Education and Skills published its ambitious e-strategy 'Harnessing Technology: Transforming learning and children's services'. The strategy describes the use of digital and interactive technologies to achieve a more personalized approach within all areas of education and children's services. Almost two years have passed since the strategy was launched and it is worth looking at what has been achieved in a country that comes well off in recent international comparisons such as the Euro barometer Benchmarking survey [3].

2.3.4 ICT Policy in Japan

In Japan the basic policy started with establishment of the Policy Promotion Department in August 1994. Prime Minister was the Director General and all Cabinet Ministers were staff members. In 1999 action programme was formulated to implement the following.

- Full fledged dissemination of e-Commerce.
- Computerization of the public sector.
- Improvement of information literacy
- Considerations of the advanced information and communication infrastructure.

E-Japan stage 1 was started in January 2001 to accelerate the above development work [23].

2.4 ICT applications at Organizational level

The e-Government policy framework provides the basis for a framing policy for all e-government policy implementations in Sri Lanka. Chief Information Officers have now been appointed in all major government institutions and they will be the key to implement ICT initiatives in their respective organizations.

2.4.1 "Nenasala" Programme

One aspect of the e-Sri Lanka initiative that the Agency will address is the current ICT infrastructure deficiencies in rural areas. A key objective of this programme is to establish multi-service community information centre, or Nenasala-s (Nenasala : meaning global knowledge centres), which provide access to Internet, telephones and other information services along with training etc. to the public in rural communities.

The central aim of Nenasala s is the delivery of positive economic, social and peace building impacts on a long term and sustainable basis [27]

2.4.2 E-Pension project

The key responsibilities of the Department are 'Computation and payment of pension gratuities compensation and other retiring benefits to public officers',' Implement Pension Scheme for Widows / Widowers and Orphans of state officers and manage the Widows and Orphans Pension Fund', 'Compute and pay awards to non-pensionable monthly-paid public officers',. There are approximately 600,000 public sector pensioners and roughly Rs. 250 millions of funds are disbursed among them monthly as

pension's payments. Although pension's grants are worked out at the department of Pensions, the monthly pension's payments are made at Divisional Secretariats which are scattered across the island.

The irregularities in various pension schemes have gone unattended as the complaints are numerous for the limited number of staff to attend. This has made it necessary for the pensioners to visit the Department of Pensions several times for attending to their pension issues.

However, e Pensions project envisages developing and implementing a comprehensive ICT solution to bridge this gap, which would include all functions related to pensions matters that are carried out by the Department of Pensions. This solution would also incorporate the pension's disbursement module for the Divisional Secretariats as well as the communication solution for exchanging data between the Department of Pensions and Divisional Secretariats. This project would utilize the inputs of other Re-Gov projects such as Lanka Government Network (LGN) and public sector ICT capacity building

The proposed computerized e Pension system project would bring in a new pension management system which needs to be practiced entirely in ICT based systems and procedures. The business processes of the Department of Pensions were studied with a view to reengineer the processes to make those simple and effective and it was very successful. This is one project, where the Government Process Re-Engineering (GPR) had fine tuned the current processes hundred percent and unusually the department was very receptive to all the changes, which was a actually a pleasant surprise even to ICTA having involved in number of e Government Projects[27].

2.4.3 Parliament Website

The benefits of this parliament trilingual website are two –fold. One aspect is that the members and staff of the parliament could login to their personalized area and make use

of the system to publish materials for the public use, could access the documents published and etc.The other important aspect is that the citizens could in their mother tongue make use of the information published and could also interact with the parliament, The Citizens could interact with their representatives online and submit their petitions or grievances online; they could access the parliamentary information such as Hanzards, Committee Papers, and Agendas etc online[27].

Any citizen from any remote village even could come online via their closer “Nenasala-Rural Tele Center” and access the entire parliamentary related information and interact with the parliament very effectively [27].

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2.4.4 Performance monitoring at Ministry of Public Administration

The Performance Monitoring System was developed leveraging on a Free and Open Source Software (FOSS) tool called “GRails” .One key advantage derived using the above technologies were the reduced entry-level costs. Since these application development tools and server software do not carry proprietary licenses, this enabled the Ministry and ICTA to complete the project, without being held up due to budget constraints [27].

2.4.5 Laksala – E-Commerce Programme

Sri Lanka Handicrafts Board, started the Laksala Automation Project to provide an ICT solution to the Laksala Head Office as well as to computerize three of their retail outlets; York Street, Thummulla and Kandy. iOM Lanka (Pvt) Ltd used their Retailigence software solution to enable Laksala’s supplier management, inventory control, distribution management, sales automation, statistical and trend analysis and provide management information reports, all via ICT[27].

2.4.6 E-Society Development

E- Society Development was implemented where all sections of society would reap the benefits of ICT. By facilitating more balanced access to information within the Sri Lankan society, it is expected that the e-SD will help in closing the development divide between urban and rural areas and contribute to the broader national objectives of development, growth and peace. Since its launch three years ago 100 projects has been initiated under the Community Assistance Programme and 20 projects under the Partnership Assistance Programme. The response of rural communities to the e-SD has far exceeded expectations with almost 300 applications coming in for implementing ICT based rural projects. While the Community Assistance Programme has focused on giving assistance direct to communities to implement projects that would improve their day to day lives the Partnership Assistance Programme addressed the need to develop innovative applications and develop content of value to society. The recipients of these grants have been both state and private sector organizations as well as NGOs but the ultimate beneficiary has been disadvantaged communities [27].

2.4.7 Motor Vehicle Registration

Department of Motor Traffic is going to introduce a new Driver's license instead the current one. This new Driving license contains an electronic chip that data can be stored, rewrite and retrieved. All the Information of the driver will be included into the chip. In addition to the information currently obtain from a Driver, two finger prints and the Blood Group will also be captured, and this will needful in identification and in an emergency.

This new Driving License has newest and high-tech security failures in order to prevent fraud printing. Data are printed in Laser Engraving method ensuring the durability. It will be an ISO compliant Driving License and the current vehicle classes will be converted in to ISO compliant classes, so that expiry date for each class will be printed separately [24]

It is observed that, we have been enhancing the ICT application in different sectors. Under e-Government policy, ICTA is helping organizations to gear programmes in ICT development.

2.5 Road Infrastructure Development

The major areas of Road infrastructure development can be identified as follows

- Feasibility studies
- Detailed Engineering Design
- Construction
- Operation and Maintenance

2.5.1 Feasibility Study

Feasibility study is a preliminary study undertaken to determine and document a project's viability. The term is also used to describe the preliminary analysis of an existing system to see if it is worth upgrading all or a part [8]. In road sector, the ICT components incorporated with the Feasibility study can be described as

- Data Collection
- Data Checking and Analysis
- Selection of Project Alternatives
- Environment Impact Assessment (EIA)

2.5.1.1 Common ICT Uses in Roads

Global Positioning System (GPS) receivers are used to send data to Road Measurement Data Acquisition System (ROMADS) computer which is integrated the chainage other measurements such as roughness. ROMADS is a unique completely portable modular system for collecting data on roads, pavements and traffic conditions. This provides a way of quickly obtaining detailed maps [31].

Marksman Target Lite is a traffic data analysis package specifically developed to meet the needs of today's data collection professionals. It offers a familiar, easy to understand and simple to use tree view in the database [14].

Raster Images Management has developed RASTA the solution offered by Sierrasoft to obtain high performance display, plotting transformation editing, mosaicing and georeferencing of black and white or color images[36].

Road Doctor is project based software which can read, link output various data sets from the survey object. The user creates a project based on survey lines attaches all related data sets to it. The user can then simultaneously view on screen, either all data or only selected data connected to a project [31].

As mentioned above different kinds of software, instruments are available for road planning/feasibility studies

2.5.2 Detailed Engineering Design

The term design means many things to many people. Engineering Design is somewhat more specific in being seen as an activity common to all the branches of Engineering. It is one which is taught, in one way or another, over the four years of an undergraduate course, culminating in a level of achievement appropriate to that of the industry in which the graduates are subsequently employed [13].

Detailed Engineering Design in the road infrastructure development can be identified as follows [21].

- Pavement Design
- Drainage Design
- Bridges and Culverts Design

- Lighting
- Safety

2.5.2.1 ICT usage in Engineering Design

Road planners use different kinds of software in the process of designing bridges, culverts, and pavements as given below.

- Drainage design.
- Alignment creation
- Automatic construction of roundabouts
- Automatic construction of intersections.
- Evaluation of vehicle path movement
- Pre stressed girder design in the area of Load rating , post tensioning and
- Visualization
- Masonry arch bridges.

HighRoad is software produced by Creative Engineering Co. uses a fully integrated graphical interface tailored for road design work. It uses familiar terms, tools, and graphics. Instead of using lines and groups of lines to construct roads on screen we can design with intelligent objects such as kerbs, cross sections, pavements and batter slopes [16].

Bently Co. Ltd produced different kind o software for bridge design , pavement design, Survey data management and drafting, reinforced concrete detailing and scheduling[4].

CIRCLY pavement design package which has been produced by Mincads Co. is widely used for pavement design in road infrastructure development[6].

2.5.3 Road Construction

Road construction requires the creation of a continuous right of way overcoming geographic obstacles and having grades low enough to permit vehicle or foot travel and may be required to meet standards set by law or official guidelines process is often begun with the removal of earth and rock by digging or blasting, construction of embankments, bridges and tunnels, and removal of vegetation (this may involve deforestation) and followed by the laying of pavement material. A variety of road building equipment and software is employed in road building [18].

The tasks associated with road construction can be identified as follows [9]

- Road pavement
- Bridges and Culverts
- Lighting
- Drainage
- Safety
- Provision for utilities

2.5.3.1 ICT usage in Construction

Different kinds of software are available for following.

- Terrain model
- Simple road lines Cross section models.
- Complete road model with built up layers.
- Grade checking and quality control.

GeoPad Construction which has been produced by SBG Co. may be used with virtually any model of measurement sensor, total station or GPS, from any manufacturer. Total station and GPS measurements may even be combined within the same project. A straight forward GPS localization wizard is available for making sure you measure in the correct

site co-ordinates as is a wizard for setting-up a total station that ensures that most possible error sources are eliminated [14]

Nilex Co. leased to support the “Spectra System” that utilizes the stiffness and durability to reinforce soils or fill and enhance the performance of the underlying sub grade or aggregate base and sub-base courses. With the introduction of SpectraPave2 is software for sub grade improvement, cost analysis, and base reinforcement published by Tensar that is available from Nilex .

2.5.4 Operation and maintenance

Like all structures, roads deteriorate over time. Deterioration is primarily due to accumulated damage from vehicles; however environmental effects such as frost heaves thermal cracking and oxidation often contribute [21].

Virtually all roads require some form of maintenance before they come to the end of their service life. Pro-active agencies continually monitor road conditions and apply preventive maintenance treatments as needed to prolong the lifespan of their roads. Technically advanced agencies monitor the road network surface condition with sophisticated equipment such as laser/inertial Profilometers These measurements include road curvature, cross slope, unevenness, roughness, rutting and texture (roads). This data is fed into a pavement management system, which recommends the best maintenance or construction treatment to correct the damage that has occurred [38].

The components associated with road construction and maintenance can be described as follows [33].

- Survey and investigation
- Rehabilitation
- Estimation
- Preventive Maintenance

2.5.4.1 ICT used in Operation and Maintenance

The Highway Design and Maintenance Standards Model (HDM 4) developed by the World Bank has been used over two decades to combine technical and economic appraisal of road maintenance projects. This new model provides a powerful system for

- Road management
- Programming road works
- Estimating funding requirements.
- Budget allocations.

The HDM 4 system is designed with a modular structure there by permitting its total or selected integration with Pavement Managements Systems [39].

2.6 User Survey & Questionnaire Development

Statistical surveys are used to collect quantitative information about items in a population. Surveys of human populations and institutions are common in political polling and government, health, and research. A survey may focus on opinions or factual information depending on its purpose, and many surveys involve administering questions to individuals. When the questions are administered by researcher the survey is called a structured interview when the questions are administered by the respondent, the survey is referred to as a questionnaire.

In using questionnaires and interviews to collect primary data the questions themselves are as important as answers. Wrong questions lead to unwanted answers. Personal questions if badly worded may result in no response. Answer to open ended questions may vary considerably. For this reason open ended are particularly useful in exploratory research to gather new ideas. However, since the responses are not standard data processing may be a problem. Fixed alternative questions require candidates to tick the appropriate box out of different alternatives [35].

2.6.1 Methods of Data Collection

The following methods are commonly used for data collection [35].

(i) Telephone

There are three types of telephone interviewing.

- traditional telephone interviews
- computer assisted telephone dialing
- computer assisted telephone interviewing

(ii) Mail

- response rate 5% - 30%
- cost is very low, since bulk postage is cheap in most countries
- long time delays, often several months, before the surveys are returned and statistical analysis can begin
- not suitable for very complex issues
- no interviewer bias introduced

(iii) Online surveys

- often inexpensive to administer
- very fast results
- easy to modify
- if not password-protected, easy to manipulate by completing multiple times to skew results
- data sets created in real time

(iv) Personal in-home survey

- respondents are interviewed in person, in their homes or office response rate 40% - 50%
- suitable when graphic representations, smells, or demonstrations are involved
- suitable for long surveys
- suitable for locations where telephone or mail are not developed

(v) Personal mall intercept survey

- shoppers at malls are intercepted - they are either interviewed on the spot, taken to a room and interviewed, or taken to a room and given a self-administered questionnaire
- response rate about 50%
    - discount coupons
    - promise of contribution to charity
- preliminary notification
- foot-in-the-door techniques - start with a small inconsequential request
- personalization of the request - address specific individuals
- follow-up requests - multiple requests
- claimed affiliation with universities, research institutions, or charities
- emotional appeals
- bids for sympathy
- convince respondent that they can make a difference

2.7 Summary

The ICT policy for Government of Sri Lanka is to act as aguide for the government in using ICT achieve overall development among agencies and in the delivery of their services. ICT policies in other countries are also formulated to implement e-Commerce,

e-Law, E-Education, etc. ICT deficiencies in rural areas have been rectified by introducing various programmes. Government of Sri Lanka has initiated several programmes under e-Government.

The key elements in road infrastructure development can be categorized as follows

- Feasibility studies
- Detailed Engineering Design
- Construction
- Operation and Maintenance

Different kinds of software are used in the implementation of sub components in road sector development.

In using questionnaires and interviews to collect primary data the questions themselves are as important as answers. Answer to open ended questions may vary considerably. Fixed alternate type questions are easy to understand and candidates can select answers from different alternatives.