E-Road Management System

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Project ID: - P2011-072

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Abstract

Monitoring of road traffic in Sri Lanka has become a major task for police. Due to increase in volume of road traffic in the Island the Sri Lanka police facing many challenges to get control of it. But this is a difficult task to manually control the traffic. There is an increase in accidents due to the number of road vehicles and passengers rapidly growing.

The researchers have indicated that the traffic jams accidents and the environmental costs are increasing due to lack of monitoring and control. An application which can monitor and control the transportation in Sri Lanka can be a solution to manage this problem. The author intends to provide a traffic monitoring system, which can be a solution for above mentioned problems.

A thorough research was carried out on transportation in Sri Lanka to identify the importance of the traffic monitoring system, while determining the research objectives and the scope of the study as well, on which, the research would be based. The methodology in carrying out the practical research of primary data gathering and analysis was determined, while also identifying the sample size of the research. Based on the literature review and the analyzed data requirements were identified in order to develop an information system solution.

The system is designed and developed in order to create auto generated graphs for Road Vs traffic, Road Vs No of vehicles and Road Vs Time. By viewing these graphs the users of this application will be able to manage their time and prevent unwanted delays. In addition to this an auto generated mail will be sent to the users to advise them on special occasions. System will also send alert messages to the users about the accidents, road blocks, fire, explosions and other disasters. So the users can plan their programs ahead and avoid the unexpected circumstances related to traffic.

Therefore the major purpose of the system is to provide safe road accessibility facilities to the people through road development maintenance and providing legal provisions through an optimum road network constructed by efficient utilization of resources.

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Acronyms and Abbreviations

Abbreviation	Meaning
ERMS	E- Road Management System
ESA	E- Statistical Analyzers
SRS	Software Requirement Specification
EDMS	E-Destination Management System
EMT	E-Mobile Tracker
MSSQL	MSSQL is the relational database management system (RDMS), which has more than 11 million installations. The program runs as a server providing multi-user access to a number of databases.
Web	A subnet of internet providing hypertext service.
HTTP	HyperText Transfer Protocol
Database	Information relating to the registered Client, logins, selected locations.
USDP	Unified Software Development Process
PDF	Portable Document Format
RAD	Rapid Application Development

Chapter 1

INTRODUCTION

1.1 *Problem to be addressed*

E-Statistical Analyzer System Using Semantic Web Technology allows users to predict Sri Lankan future motor ways, Population status using the past actual data's of the Country.

Automotive technologies are gaining ground in modern road traffic-control systems, since the number of road vehicles and passengers is rapidly growing. There is a perpetual need for safety-critical traffic automation, and traffic engineering makes the dynamic or static analysis and the synthesis of automotive vehicle technologies possible. The main goal of engineering is the planning and management of traffic systems. The project supports the development of reliable and optimal control structures for urban traffic and for motorway systems. The intelligent and cooperative set-up of actuation and its linkage to the central control system is vital for avoiding traffic jams and accidents. Moreover, environmental costs (e.g. pollution) can be decreased. One aspect of the project aims at developing a traffic control algorithm for future technology. The design of the traffic control system can be evaluated in two steps – synthesis and analysis. Several models and multiple control strategies exist, and engineers must decide between them using a priori knowledge of the real system. Previously collected information can help to choose the appropriate model, parameters, measurement and control methodologies to create the optimal solution.

In many cases, control-related variables are almost inaccessible for design

unless estimation techniques are applied. In a situation like this, the approximation, computer-based estimation of the variables could be useful.

Traffic simulations can be classified in several ways, including the division between microscopic and macroscopic, and between continuous and discrete time approaches. The methodologies of static and dynamic analysis of traffic systems are known. Several state variables, derived from the description of the dynamic system, can be used for operational and planning aspects. A newly emerged area is demand estimation through microscopic traffic modeling. The dynamic aspect of traffic simulation requires previously measured or estimated volumes of traffic.

Since the measurement of certain variables in the dynamic description is rather costly, one tries to estimate them. For instance, the observation of constantly varying turning rates at a simple intersection is fairly costly. However, the number of turning vehicles could be applied to traffic light harmonization, or generally speaking to traffic light control.

1.2 *Background Context*

E-Statistical Analyzer (ESA), this is the main module under E-Road Management System. It is mainly focus on Analyzing the past and future. The outcome of the module (ESA) is full of graphs generation and the Simulator to predict the future. Graphs are often an excellent way to display the results. In this system "graph generation" is one of the most important parts for managing the traffic in Sri Lanka. It will helps to easily read data on a graph rather than paragraphs as the data are visually appear in the graph. It handles large data in a small area. About traffic rates, accident rates, birth and death rates from that the system is generating the future predict graphs. Like how the population will be in the future year, and how the no of vehicles and traffic will be.

1.3 *Research Gap*

1.3.1 Focus

Most of the roads in the country especially the national Highway network have been built long time back and it has passed the useful life of these roads. Most of the roads need complete rehabilitation. In addition to that considerable lengths of roads need realignment to meet the present day vehicle speed requirement.

As it has been identified as the appropriate strategy in low level of funding the major investment of Highways during the last 15 years had been on the rehabilitation of the existing road system, in spite of this substantial increase in traffic demand.

The selection of projects for this rehabilitation has been based preliminary on the following. Traffic Level Road Condition Connectivity My module mainly focuses to predict the future by analyzing the past data's. This is full of graph generator part to provide a mechanism to get an idea about the future from the past statistical data. This is better for ease the workload, provides accurate and efficient reports, minimize the unwanted delay time, Generate statistical graphs and reports and get an idea about the future.

With E-Statistical Analyzer module user can get Better relationship with motorist, more accurate history and information, improved road management information , faster processing of services details , this solutions are providing by graphs to users.

1.3.2 Current Procedure

In current situation road traffic injuries are the leading cause of injury related mortality and morbidity in Sri lanka accounting for 25%to 30% of the burden. And the global burden more than 20 million people are injured and killed annually. Burden falls most heavily on developing countries (particular Asia) , due to the rapid increase in the no of vehicles. So this is the biggest challenge in world widely. Through feasibility studies have found many traffic monitoring systems all around the world.

In Sri Lanka traffic monitors and collecting and getting data, informa-

tion's are done manually. And no devices (Camera) to monitor the road situations and all. This is the main problem having in Sri Lanka to develop the traffic monitoring system. But nowadays in Sri Lanka using helicopters to get traffic information's in the peak time from some particular roads.

Sri Lankan Governments Vision & Mission in Road Development is. . . ,

Vision:

Provision of accessibility for prompt and safe transportation of people and goods through a high standard National Highway Network.

Mission:

To provide safe road accessibility facilities to the people Through road development, maintenance and providing legal provisions through an optimum road network constructed by efficient utilization of resources.

In current small unmanned vertical takeoff and landing vehicles are used to provide the eye-in the-sky alternative to monitoring and regulating traffic dynamically. Spatial-temporal visual data are collected in real time and they are used to generate traffic-related statistical profiles, serving as inputs to traffic simulation models. Generated profiles, which are continuously updated, are used to calibrate traffic model parameters, to obtain more accurate and reliable simulation models, and for model modifications. This method overcomes limitations of existing traffic simulation models, which suffer from outdated data, poorly calibrated parameters because of outdated data, questionable accuracy and poor predictions of traffic patterns. In some other country the real-time traffic monitoring is controlled with UAV VIDEO DATA. But in Sri Lanka the traffic monitoring is controlled by manual like human interruption (Traffic police). This is inefficient methods to get fast information's.

1.3.3 What is eliminated by system?

This new system is going to radically change the way the Traffic control, transport services, as the will be input directly into the computer in this function. This solution will also provide the following non quantifiable benefits.

- Better relation with Clients.

- More accurate motorway history and information.
- Improved management information.
- Faster processing of staffs and services details.
- This solution will provide e-mail and internet facilities to all staffs of the ERMS.

And ESA system minimizing the workload , eliminating the inconvenience of getting road and traffic rates. By logging on to this system the user will be able to see the traffic congestions in cities especially during the peak hours and will be able to see the alternative paths to particular places.

By viewing these graphs the users of this application will be able to manage their time and prevent unwanted delays. so E-Statistical Analyzer system minimizing the unwanted delay times In addition to this an auto generated mail will be sent to the users to advise them on special occasions such as Kandy Perahara, Nuwara-Eliya season Anuradhapura season, Kataragama and Thalavila feast May Day and visit of Heads of states and State functions. System will also send alert messages to the users about the accidents, road blocks, fire, explosions and other disasters. So the users can plan their programs ahead and avoid the unexpected circumstances related to traffic.

1.4 *Research Questions*

How does the system gather data to E-Statistical Analyzer module?

Data collection will be carried out through two major sources; primary data and secondary data, which involves many methods of data gathering, where some of these methods will be applied in data collection process. The system gather information's from road development authority, police department. How to analyze past data? Using the past data the module can predict the future. There were some equations used. To Predict the future population : To Predict the Birth and death: N = Future Birth or Death r = rate of increase t = time taken

How the system fended with the past data? ESA is providing an Administrator panel to insert the past data to the database, using this the system

Admin can insert millions of data in split second.

Why Graphs need? The best and efficient way to analysis the data is using the graphs. Using the graphs the user will get an clear idea about the outcome.

In which way ESA module helps the User? provide a mechanism to get an idea about the future from the past statistical data. This is better for ease the workload , provides accurate and efficient reports , minimize the unwanted delay time , Generate statistical graphs and reports and get an idea about the future. With my module we can get Better relationship with motorist , more accurate history and information , improved road management information , faster processing of services details , this solutions are providing by graphs to users.

1.5 *Structure of the Report*

Introduction (Chapter 1) of this document expresses the need and purpose of the project and other background descriptions . Body of the report (Chapter 2) of the document addresses methodologies used in the project. And it describes how to overcome the problems and constraints raised in the way of discussion section. Next the solution was conclude to the problems that are raised in introduction, limitations faced in development process. At the appendices section include all documents were used in problem solving approach and describe all form of complex terms.

Chapter 2

Body Of The Report

2.1 *Addressing the Literature*

The deliverable product is referred to as E-Road Management System (ERMS).A more enhanced system with lots of new features is proposed. The existing ERMS is also considered when designing the system as it already facilitates some of the administration process. Thus the proposed system is going to be used in the environment as an integrated system, using the facilities provided by other existing systems as well.

The typical users of the system are Travelers, Administrator of ERMS & Administration staffs. There are number of operations that are to be supported through the proposed system. Some of them are indicate accidents, road blocks, traffic in Google map and a calendar it carries the pre-planned road blocks by the Government in addition to this the system will provide an alternative path to the Client by using the Google map by graphically. The other problem which was brought to attention was, how an Administrator update the system in a short predate of time, to this problem sms function is used.

It's sufficient to change the approach according to the current situation in the World. The vision of the project is to provide the client with an accurate and efficient system to solve the existing problem domain.

Automate their day-to-day functions by a web based system, and a mobile based web with more features such as each and every day relevant person can

update the system by just login to their account through the website, and they can easily keep track of the details of roads through the proposed system. E-Statistical Module introducing feature is auto generate graphs, this will help to get a brief idea about the past in road vs. traffics time, road vs. no of vehicles uses a particular road, accidents per year and population vs. vehicles. This is more helpful to the government to take the decisions and other to get some idea. Also introduce a simulator.

By using this simulator the user can get to know about what will happened in the future when no of vehicles increase, population increases and when road conditions change what will happen. This is little challenge for this module. Hence satisfying all the requirements specified the project is going towards the goal of developing a reliable and easy to use tool for the ERMS.

2.2 *Methodology*

2.2.1 Step by Step Process

E-Statistical Analyzer modules have mainly two users as normal users and special user .Normal users are peoples. Special user is administrator. Special user is registered user. Normal users are The non registered users can also use the system.

Register to the System

The Admin (Special user) have to register before using the system. Admin have to enter the Fist Name, Last Name, Email address The email address will be the user name. If the Admin has login to the system he/she can update the traffic rates of the day, accident statistical, population of the district, birth rates , death rates etc

Changing the password

This option is only for the Special users. By using this option the admin can change their existing password

- Select change password option.
- Enter the old password, new password and confirm the new password again.After

changing the password this will be the new password for the particular user.

The other user normal user can view the system without register or login to the system. Normal user can view the auto generated graphs and can get to know about the future by using the simulator. The simulator predict the future populations changing with years and accident rates changing with years, and no of vehicle rates also. The normal user can enter the future year to get to know how the populations, traffic, accident rates will be in future. For example if the normal user enter the future year "2015" and the user select the region in the drop down list the simulator will predict the answer and the future value is shown in the 2 dimensional graph. Login to the System

A particular user can login to the system by providing username and password. The username is the email address given when the registration. The system validates the username and the password with the given username and the password. If the special user enters the invalid user name and password the system provide error message.

Using the System

Normal Users (People) - The other user normal user can view the system without register or login to the system. Normal user can view the auto generated graphs and can get to know about the future by using the simulator. The simulator predict the future populations changing with years and accident rates changing with years, and no of vehicle rates also.

Special Users (Administrator) - After login to the system the administrator can maintain the Database. The administrator allows the normal users to use the system without registering to the system. The administrator can also remove the traffic information's from the system and also can insert or update the Database by adding traffic and population data.

2.2.2 Project Approach

The waterfall approach is a popular version of the system development life cycle model in software engineering. Waterfall model is often considered as classic approach to the system development which describes a development method that is linear and sequential as figure2 shows.

The advantage of waterfall development is that it allows for departmentalization and managerial control.

The disadvantage of waterfall development is that it does not allow reflection or revision. Once an application is in the testing stage, it is difficult to go back and make changes. The final stage of the cycle can lead to either deployment or project cancellation.

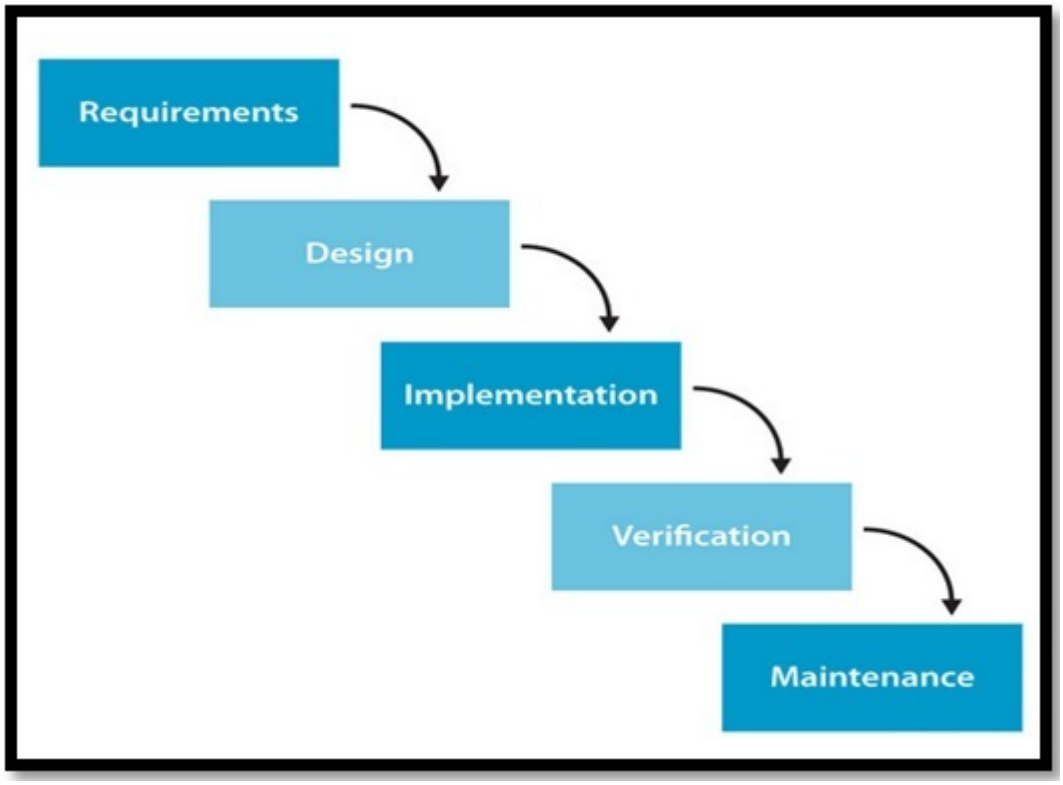

Figure 2.1: Waterfall model

Alternatives to the waterfall method include iterative and incremental approach which incorporates prototypes at the end of each phase. The iterative method allows the user to change the requirements. This method can be suitable for any project as it gets constant feedback from the stakeholder at the end of each stage. In the incremental or iterative approach each phase is visited iteratively until the stakeholder is satisfied.

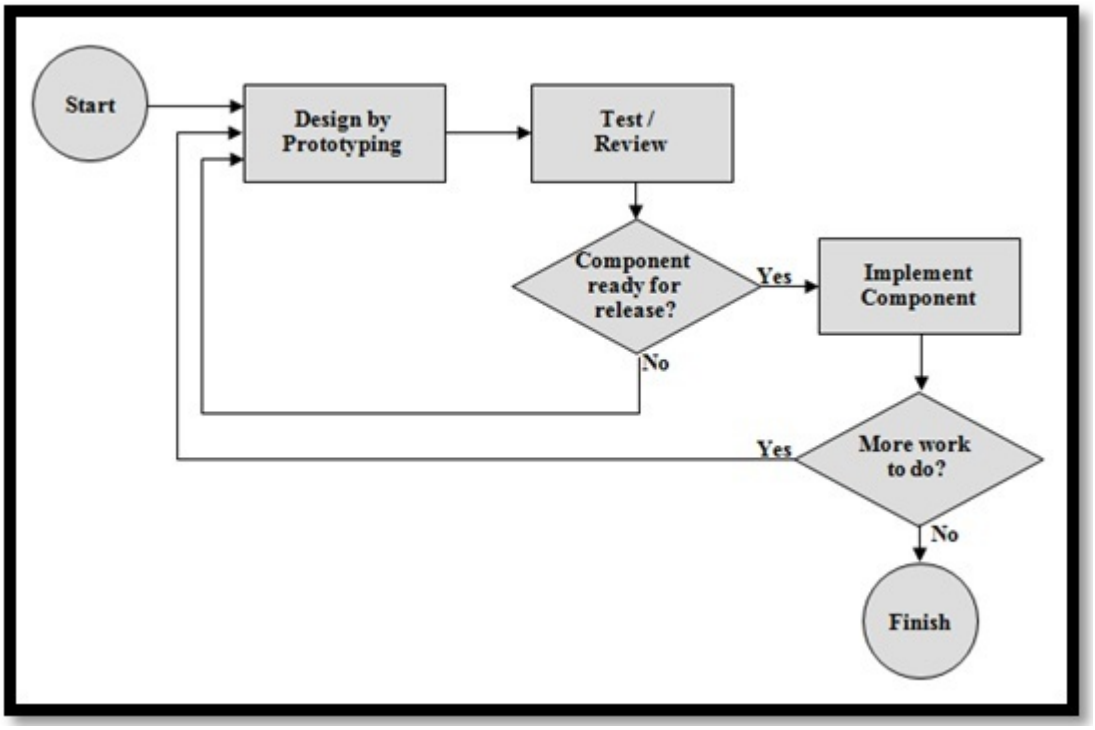

Figure 2.2: Iterative Approach

2.2.3 Agile methods and Non Agile methods

Agile is an iterative and incremental approach to software development which is performed in a highly collaborative manner by self organising teams within an effective governance framework that produces high quality solutions in a cost effective and timely manner which meets stakeholder's changing needs. Agile development allows the developer to communicate with the customer directly till the end, so the customer expectations are fulfilled throughout the project. Non agile processes enforce proper planning and minimize the changes.

As the agile methods are flexible for changing requirements and short lifecycles for system development, it is appropriate to apply agile methodology for the work life balance system. For instance the author can start developing the system with the basic requirements gathered through the literature review. New changes and the stakeholder's expectations can be achieved through the iterations.

2.2.4 Research Methodology Study

A methodology is a system of organizing principles underlying an area of study. It is a form of standardization or framework that allows continuous review, refine and validate the findings, until knowledge that is as accurate. Methodology includes the methods, techniques, and procedures which are used to collect and analyze information.

2.2.4.1 Rapid Application Development

Rapid Application Development (RAD) is a development lifecycle designed to give much faster development and higher quality results. Rapid Application Development is far more than a simple management strategy or methodology. RAD is an alternative approach to software development that helps create software prototype in much shorter time. With the implementation of powerful software tools, RAD becomes a practical and realistic method for faster and efficient software development.

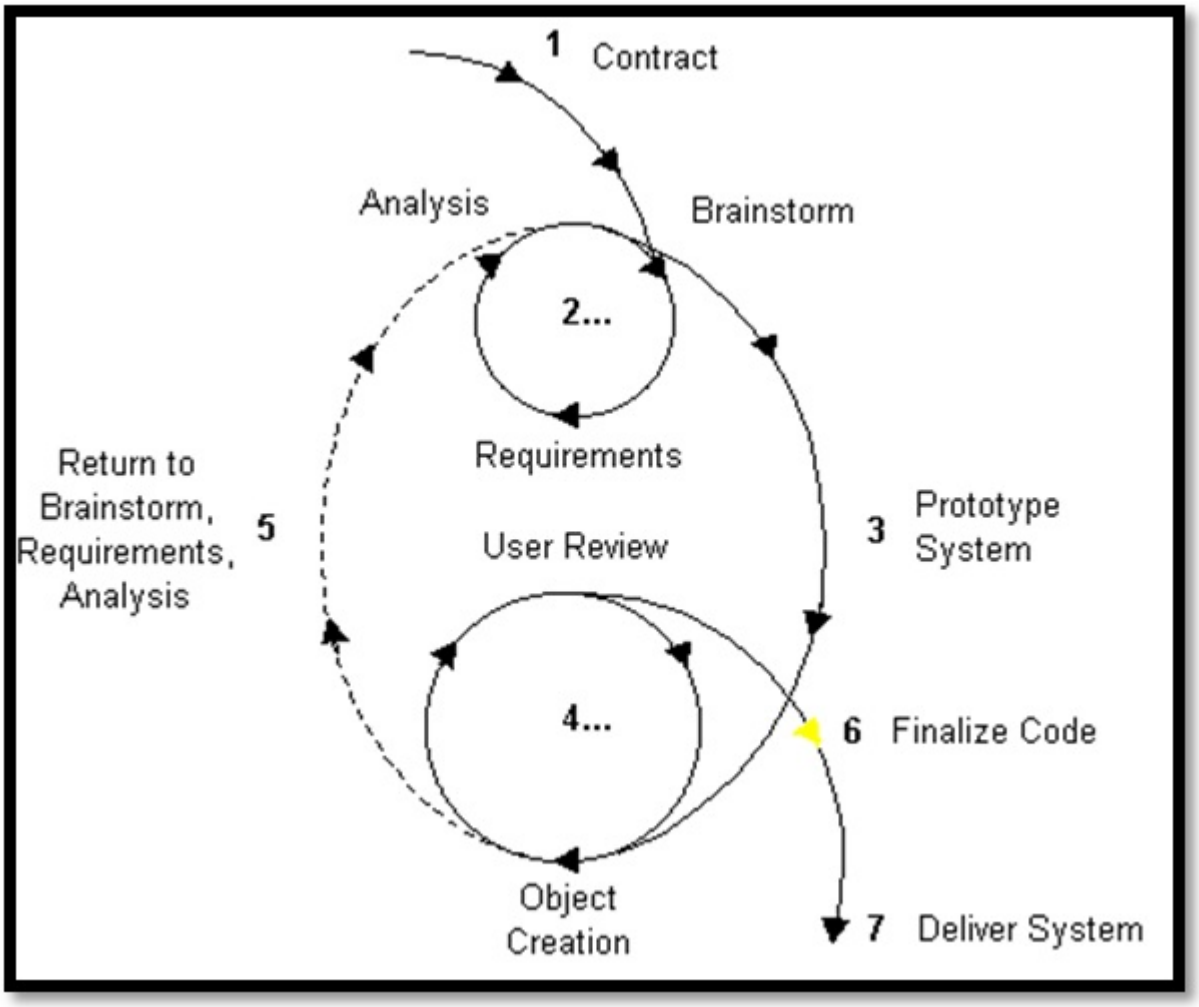

Figure 2.3: Rapid application development methodology

RAD also goes through a series of phases that actively engage users and analysts, in order to quickly produce the desired system. First, they identify the requirements of the system. Then, they quickly design and refine working prototypes through iterative workshops. Finally, test and implement the final product for its intended use. Figure 1 shows how prototyping is used to practically demonstrate the system based on the requirements gathered, discrepancies are rectified utilizing reusable components such as code generators which reduces manual coding (Cockburn, 2006). However there are some disadvantages in RAD such as users may be contempt to prematurely adopt a working prototype as the finish product and analyst may be tempted to rush the product, skipping important planning and design consideration (Wyster, 2008).

2.2.4.2 Dynamic Systems Development Method (DSDM)

DSDM is a type of framework where it takes a software development from beginning to the end by adopting its characteristics and principles to deliver a fit-for-its-purpose system. DSDM focuses on delivery of the business solution, rather than just team activity. Prototyping is one of the characteristics of DSDM which is used to have a clear picture of all aspects of the system. Since the users are actively involved in the development of the system, meeting stakeholder requirements and expectations are possible by adapting to DSDM methodology. System is delivered on time and on budget within DSDM.

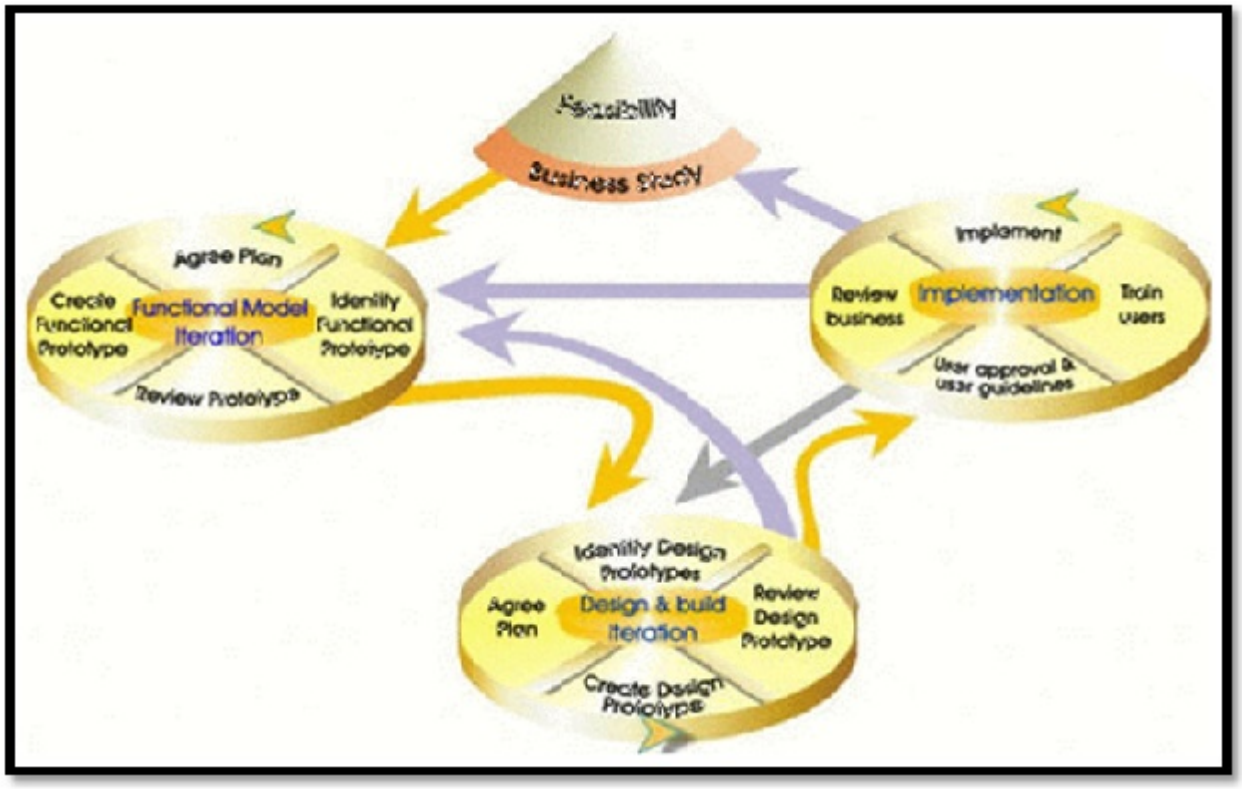

Figure 2.4: Dynamic system development methodology approach

2.2.4.3 Unified Software Development Process [USDP]

USDP [Unified Software Development Process] is a generic software engineering process which has to be customized for each project. Key elements to USDP are use case driven, architecture centric, iterative and incremental. Iteration is like a mini project including planning, analysis and design, integration and test, and internal and external release. Iterations contain workflows and organized into phases.

Decisions are taken about the architecture of the system at an early stage, to provide the framework around which the system should be developed. This means that the development activity has a clear model for its construction. The process employs use case specification which provides clear means for identifying how the requirements will be structured and modelled (Massimo, 2003).

2.2.4.4 Choice of Methodology

The author finds DSDM as the most appropriate approach because of the characteristic time boxing effectiveness. Time boxing gives the opportunity to break the tasks into subtasks and set dates to complete those tasks within a period. In DSDM, prototyping helps to ensure that the system is designed correctly and the stakeholders can get to know how it will work. In addition, using MoSCoW rules to prioritize the tasks to determine which tasks are most important to be completed first. So the important tasks will be completed before any unexpected situations such as lack of time.

The author prefers this method rather than using other methodologies because this method is particularly useful for the system to be developed in short time span and where the requirements cannot be frozen at the start of the system development. Whatever requirements are known at a time, design can be developed and can be incorporated into system. For instance system development can be start right after the literature survey and changes can be made according to the requirement gathering process later.

DSDM allows user testing all through the development process and allows getting feedback on the usability and suitability of the system. As shown in the figure 6 analysis, design, and development phase can overlap.

2.2.5 Summary

Iterative or incremental methodologies provide a cyclic approach to software development, which is especially useful for this particular project where requirements change often and response need to be quick. There are several iterative methodologies have been discussed above, including RAD, DSDM, and USDP. DSDM has been chosen to carry out this project as it allow designing from the early stage of requirement gathering.

Changes can be incorporated into the system according to the requirement gathering process. DSDM also allow prototyping which helps to ensure that the system is designed correctly and the stakeholder expectations are met. In addition, using DSDM helps to deliver the product within the time frame.

2.2.6 The techniques and tools for project development

This Heading involves identifying suitable techniques and tools for the development of a ERMS. It is essential to chose proper tools to model the gathered requirements. This chapter will outline the tools and techniques used to gather requirements, analyze the requirements, and model the requirements for this project. Software development tools are also indicated here. All the chosen tools and techniques are justified by the author.

2.2.6.1 Specific Techniques Applied

Given below is the description of specific tools and techniques that will be used for this particular project. Justification for the tools and techniques (why author chosen these particular techniques) also discussed below.

Use Case Modelling

The use case modeling provides detailed information about the behaviors of the system or application. It contains use case diagrams and activity diagrams that describe how users interact with the system. The use case model identifies the requirements of the system in terms of the functionality that must exist to achieve the goals set out by the author or to solve a problem identified by the author. Use cases illustrate the activities that are identified through requirement gathering process and it describe the results of the activities which will be received by the user.

They do not describe how the system operates internally (Larman, 2001). Actors are the users of the system who interacts with the system directly. Use case diagrams depict the relationships between the uses cases and actors.

This diagram can be refined iteratively until the requirements of the system are fully understood. Author prefers use case modelling as use cases are

powerful technique for capturing and communicating functional requirements for system development.

The author finds this methodology the most appropriate to ERMS to work with the stakeholders to identify the initial ideas of the system, model those ideas, and use that conceptual model to have stakeholder validate the requirements.

Sequence Diagram

Sequence diagrams will be used to map the scenarios described by a use case in step by step detail to define how objects collaborate to achieve the application's goals. A sequence diagram focuses on time sequencing and the order of the messages which are sent. Booch, G. et al., (1999) indicates that the sequence diagrams are a means to model some aspect of the dynamic behavior of the system and can be used in the context of whole system, a sub system or they can be referred to a particular use case.

The author prefers this technique as it depicts the sequence of actions that occur in the system and it is a very useful tool to easily represent the dynamic behavior of the system. (Refer Appendix A 1.1 for the sequence diagram of proposed system.)

Class Diagram

Class diagrams are widely used to describe the types of objects in a system and their relationships. Class diagrams model class structure and contents using design elements such as classes, packages and objects. This diagram used to describe the classes of the system and the relationships between each other.

High Level Diagram

The high level diagram of the system is used to identify the basic functions of the system. By viewing the high level diagram the reader or stakeholder can be understand the full system in a view. Each and every function of the system is clearly defined in the high level diagram in order to demonstrate the system to the reader.

2.2.6.2 Information Gathering Methods

Information gathering was carried out through two major sources; primary data and secondary data, which involves many methods of data gathering, where some of these methods were applied in data collection process. These methods include; experiment, survey, case study, grounded theory, ethnography, and action research, where survey method was selected as the most appropriate strategy in carrying out the research, taking in to consideration all the above methods.

This allows collection of a large amount of data in a highly economical way and this would also give more control over the research process (Saunders et al., 2003). Data collection methods that belong to the survey strategy include interviews, questionnaires and observation according to Saunders et al. (2003).

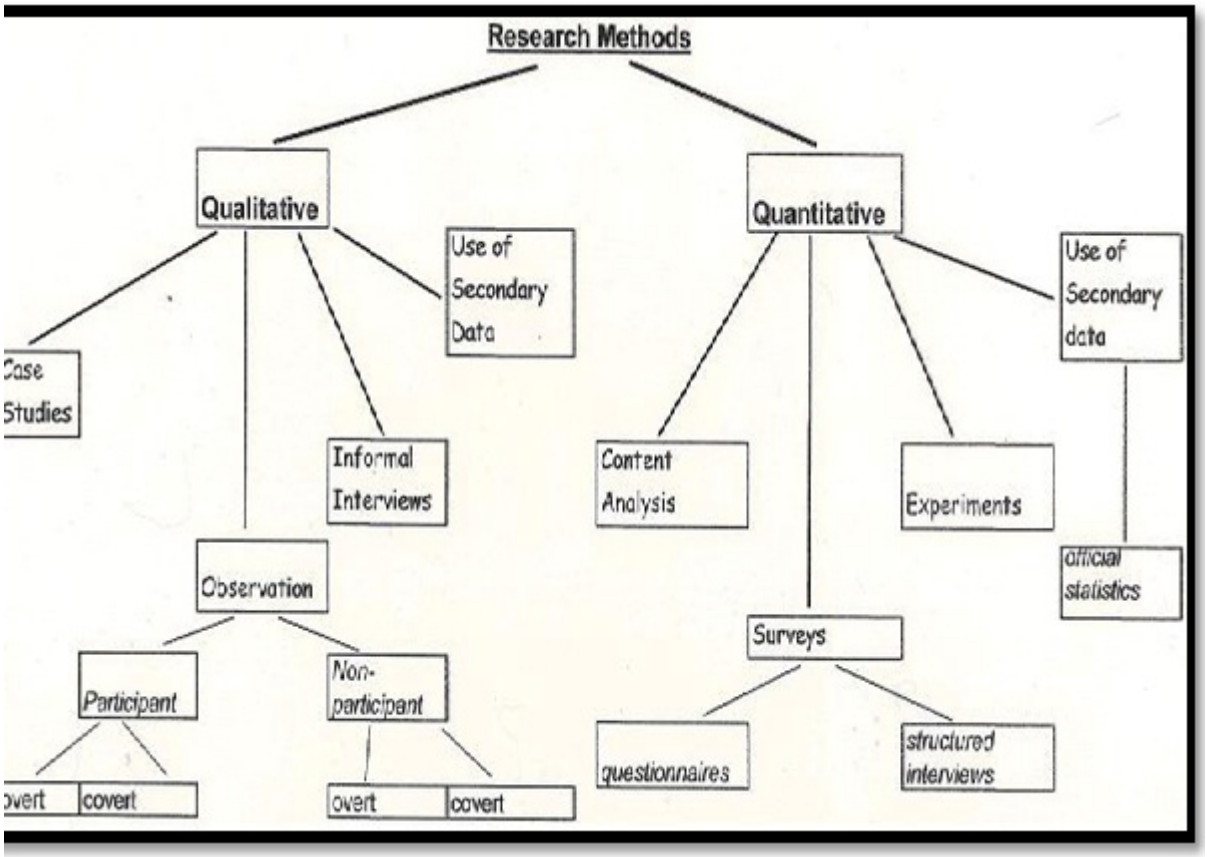

Figure 2.5: Research methods

Interviewing

Interviews are one of the primary techniques for information gathering during the requirement gathering phase of a project. Interviews are useful for gather details like the participant's point of view, opinions and the background information on the research area, although interviews are time consuming.

Interviews are also useful to obtain additional in-depth information and clarification from some of the questionnaire respondents.

Questionnaires

Questionnaires used to gather data from large number of people and saves researcher time and money. Considerably questionnaire results are more truthful because people are more straightforward while responding to the questionnaires regarding controversial issues in particular due to the fact that their responses are anonymous. Questionnaires can be quickly done and data analysis can be carried out in a timely manner. It can be expressed statistically as the same question asked from large amount of people.

Observation

Direct observation of work performance is an excellent means of gathering data. Observations are usually done in conjunction with another data gathering method that is used to fill in the gaps and answer questions.

Focus Groups

Focus groups are used to gather data relating to the feelings and opinions of a group of people who are involved in a common situation. This is a valid method to gather realistic information from the employees.

Survey

A survey is a data collection tool allows the researcher to gather large amount of data in short period of time. Surveys produce quantitative data, which has reliability and validity.

2.2.6.3 Justification of Information Gathering Methods

Given below is the summary of chosen information gathering methods that will be applied for this project.

Interviews - Interviews are planned in order to gather data on current work life polices in the organization from the management. The author prefers interviews as it is useful for gather details like the participant's point of view, opinions and the background information on the research area, such as barriers in implementing work life policies in an organization and problems raised by having particular policies.

Questionnaires - Questionnaires are used in this project, as this is a more convenient way to reach more people at some distance. It is also an appropriate method of gathering qualitative and quantitative data. Since the author had planned to send the questionnaires via mail, the author expects to get more accurate and honest answers from the respondents because they are not intimated by the presence of the researcher. The general population for this study is composed of apparel industry staff. These respondents will be asked questions regarding their current status of work life balance, their expectations and their personal views on the impact of maintaining work life balance.

Survey - The author will be conducting the survey through sending questionnaires via e-mail. This information is collected through use of standardise procedures, every participant will be asked the same questions. As this is a structured format of gathering valid data, the author will be using it to gather reliable data from apparel industry staff.

Observation - As the author completed her placement year in one of the larger apparel organization in Sri Lanka. Facts gathered during the placement period also will be used for this project.

2.2.6.4 Software Tools

Software tools were critically analyzed in order to determine the ideal software to exploit in developing ERMS.

System Development Application

Visual studio 2010 is used to create the user interfaces. The author decided to use ASP.Net to develop the system, as the author is familiar and finds easy to use this particular programming for system development. Visual Studio 2010 software will interact with a relational database- MSSQL 2008 as the proposed system will require a back end database

Diagrammatic Tools Development

StarUML is an open source project to develop fast, flexible, extensible, and freely available UML platform. The goal of the StarUML project is to build software modeling tool and also platform that is a compelling replacement of commercial UML tools such as Rational Rose. Author used StarUML for use case diagram, class diagram and sequence diagram as she familiar with using StarUML. Pencil 1.1 is used to draw the sample interfaces of the system.

Diagrammatic Tools Development

As the ERMS need a back end database, SQL 2008 was used to create a back end database in order to store the relevant details. All the relevant data such as user name, pass word, ERMS measure, Accident Rates, Past Populations data's, Birth data's, new vehicles registrations, traffic data's, road busy time all will be stored in this database.

2.2.6.5 Summary

In here discussed the tools and techniques available for the project and the selection of tools for this particular project. The diagram given below clearly shows the author's selection of tools and techniques needed for this project. These tools and techniques are selected according to the author's familiarity on the particular tools and supportiveness of the tools and techniques to the ERM system. Data gathering methods are selected in order to cover large number of people within a

short period. Due to time and resource constraints author selected online questionnaires as the best solution.

2.2.7 Project Management

A success of a project is not solely dependent on the use of an effective research methodology and selection of tools and techniques. Effective project management also directs a project to its success. The author chose techniques taken from the PRINCE2 methodology to manage this particular project. This chapter outlines initial project plan, revised plan, and project management methods that are used to ensure the timely delivery of the project deliverables.

2.2.7.1 Project planning, management, and techniques

Project planning is a critical factor for project success. Project planning includes selecting the appropriate tools and techniques that will be needed for the successful completion of the project. Activities and the deliverables must be defined using techniques such as work break down structure. Time and the effort required for each activity, dependencies between activities must be estimated in order to develop a realistic project schedule to complete the tasks.

Milestones can be set, which will indicate the critical dates during the project. PRINCE2 project management methodology that is used in this project is a process based method for effective project management. The author uses this methodology as it gives skills to feel confident in managing a project successfully within the available resources. Also PRINCE 2 is recognized as a world class standard method for project management. Using PRINCE2 enables managing the risks more effectively. Following diagram shows process of PRINCE2.

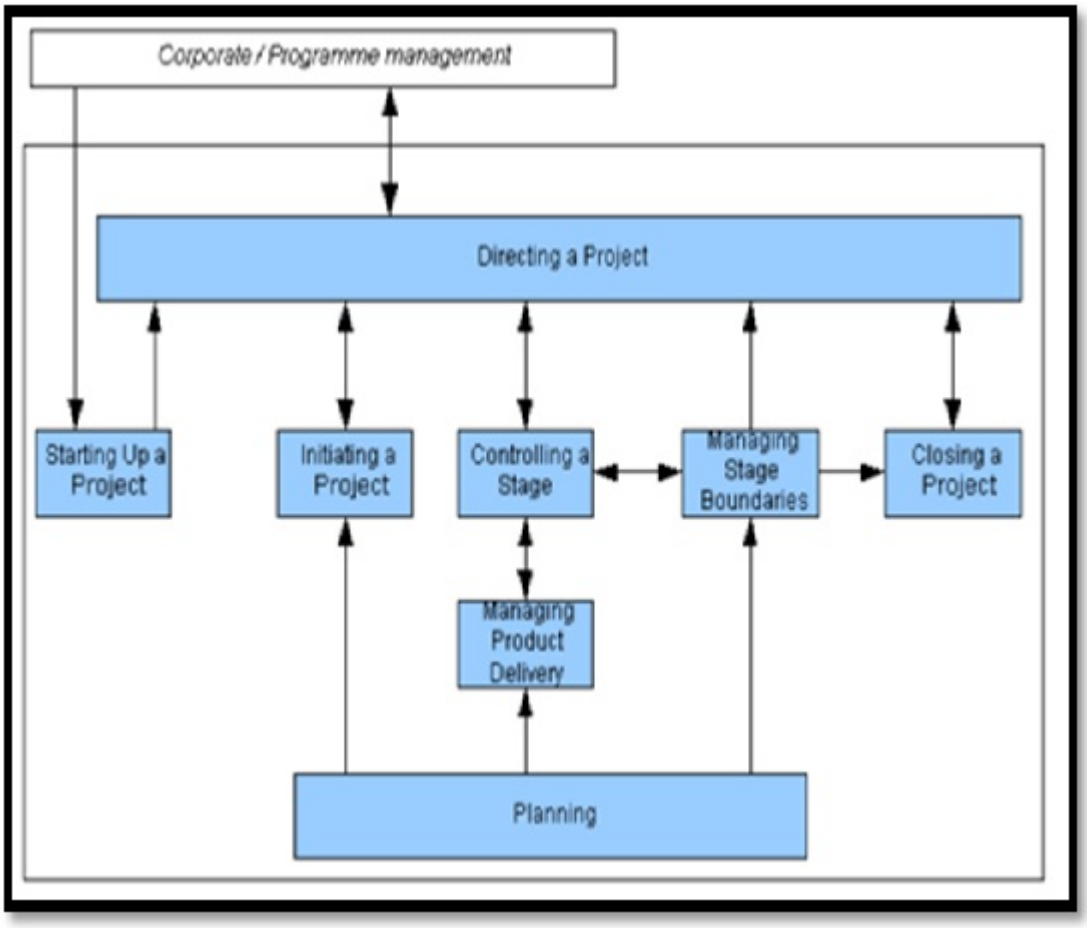

Figure 2.6: PRINCE2 Process

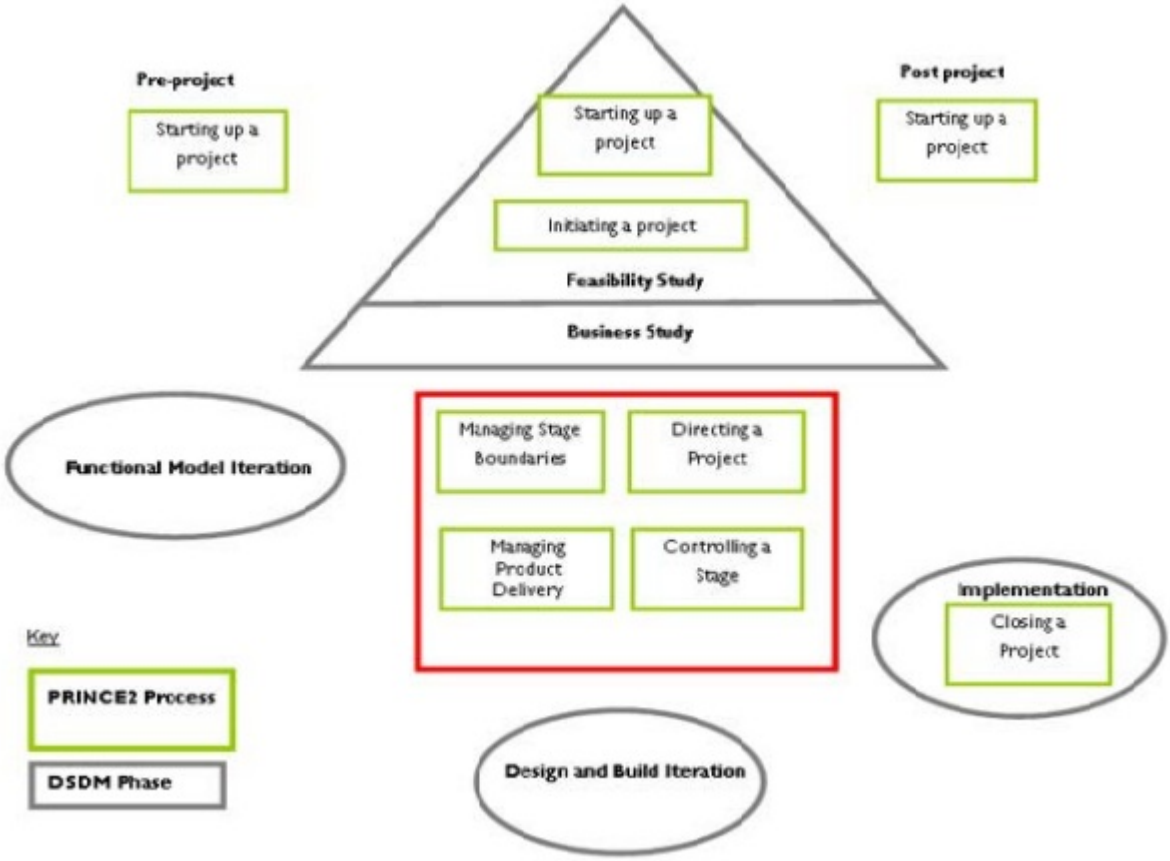

Figure 2.7: PRINCE2 processes fit into DSDM lifecycle

Above figure shows the combined method of PRINCE2 and DSDM. The chosen methodology DSDM, combined with PRINCE2 will improve the project management. Therefore DSDM methodology which are managed and controlled within PRINCE2 standards can easily achieve the objectives and targets of a project.

Risk Management

Managing risk is a key element within PRINCE2 for the successful project management. A risk register is a tool commonly used in the project planning within the context of PRINCE 2. The author has been maintaining a risk log according to overcome some unexpected risks. It is helpful for identifying, analysing and managing the risks. It contains the information on the identified project risks, impact of the risks and the contingency plan for the risks. A complete risk log has been attached in the Appendix.

Project Deliverables and Support Project Plan Chart

The following are the deliverables identified within the project.

- Proposal Document
- SRS
- Prototype
- Mid review Document
- Final project report
- Research papers

2.2.7.2 Original Project Plan

Microsoft Project was used to draw the Gantt chart and plan the activities. This Gantt chart illustrates a project schedule, start finish dates of the terminal elements and summary elements of a project. It also shows the dependencies between activities. Mile stones focus mainly on the end dates which reminds the particular task need to be complete or certain objective need to be achieved. Given below is the actual project plan from the outset. For detailed plan refer appendix.

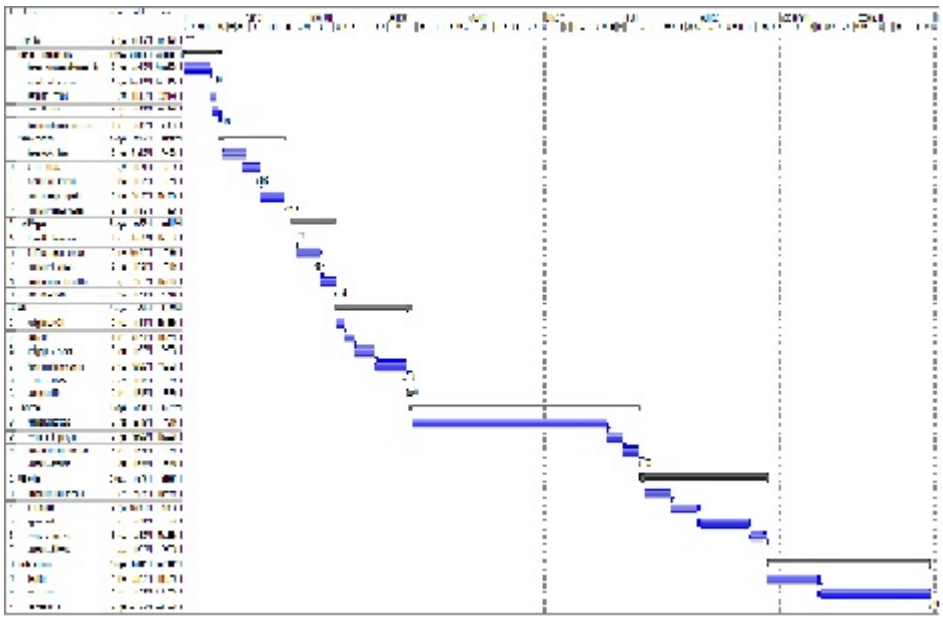

Figure 2.8: Gantt Chart

2.2.7.3 Project Supervision

Regular meetings were conducted with the supervisor in order to evaluate the components and deliverables. Given below is a sample of project supervision log. Project Log book is attached in the appendix which provides details of each meetings.

2.2.7.4 Requirements Specification

Requirements Specification presents the detailed description of the ERMS. It explains the purpose and the features of the system, the interaction between the users, what the system will do, and how it will work. This chapter includes functional requirements, non functional requirements, and the use case diagrams and descriptions. This section gives an overview of functionality of the proposed software product.

Functional Requirements

- F1.User views the graphs

  Input: - Select form of the graph (Line graphs, Pie Charts, Bar Charts)

  Output: - Displaying graph according the selection. Process: - System produce the graph by using the statistical data's which is stored in Database. Description:-User can be selecting the form of the graph. The displaying graph will be the bar charts or line graphs or pie charts etc. The graph going to be containing the accident ranges per year in Sri Lanka, traffic data's example traffics time vs. no of vehicles uses a particular road and population vs. vehicles.

- F2. Simulator

  Input: - enter the value (user input).

  Output: -Will display what will happen in the future when no of vehicles increase. Process: - System auto generate and the outcome will future analyze data's, using the user input values.

  Description: - By using this simulator user can get to know what will hap-

pened in the future when no of vehicles increase, when population increase and when road conditions change what will happen.

- F3. Providing best path to the Motorist.

  Input: - Motorist's indicating where they want to go.

  Output: - will show the entire best path with the help of Google Map.

  Process: - System auto generate and the outcome.

  Description:-.Providing best path to motorist with the help of Google Map. After Motorist's indicating where they want to go it may show the entire best path avoiding traffic and road blocks, etc.

- F4. In real time System will give an Alternative path when any road or two end points jammed in traffic.

  Input: - User will enter the destination place.

  Output: - Will automatically show the entire best path without Traffic.

  Process: -System automatically generates and shows the outcome in Google Map.

  Description:-.In real time if any road or two end points jammed in traffic, in a short amount of time it will be updated in the system. After that the system will automatically set the best path between two end points with the help of Google Map.

- F5. If any accident happens system will automatically send emergency alerts to nearby hospitals, police stations.

  Input: - just login to the system.

  Output: - Will automatically sends alerts.

  Process: - System automatically generate.

  Description:-.If any accident happens, after the authorize person update the system. The system automatically looks for nearby Hospitals, police

stations and send emergency alerts (using auto generated SMS& mails).And direct them to the point. All this happens in the short amount of time.

- F6. Point the place when the person enters the entire place.

  Input: - Enter the place (Eg: Colombo)

  Output: - System will point the place in Google Map.

  Process: - System will automatically generate.

  Description:-.Client can search a place (E.g.: Colombo) and in on enter. The system will provide with pointing the place in Google Map and it may pointing all important places in that location just like Hospitals, Airport, Railway Station, Police Station.

Non-Functional Requirements

Non-functional requirements are requirements which specify criteria that can be used to judge the operation of a system, rather than specific behaviours. This proposed ESA (E-Statistical Analyzer) System would satisfy the following non functional requirements.

- Ease and reduce the work load of the end users.
- Increase the reliability and efficiency of the work process.
- Provide more capabilities in order to fulfill user requirements up to the maximum level.
- Increase user friendliness towards the system.
- Interoperability of the system.
- The response time for Graph generations and simulator outcome will be no more than 8 seconds.
- The time to verify the username and password will be no more than 3 seconds.
- Security requirements will be included in the system.

Test Case 1	Login to the System	
Pre conditions	System is in working order.	
Actors	Internal User	
Description	1.	User is asked to fill the user name and the Password.
	2.	User gives the command to login
	3.	System will automatically match the user name and the password.
	4.	User will be redirected to the main menu.
	5.	The use case ends.
Exception	3.a	System will generate an error message.

Table 2.1: Test Case-1

Internal users of the system should enter their password and username when they are going to access the system. This case is same for all users and Admin when the user has logged in successfully, window gets expanded automatically. If the user name or password does not match with the stored value in the database, the system will show an error message. User can try again with the correct user name and password.

Test Case 2	View Graphs	
Pre conditions	System is in working order.	
Actors	Client	
Description	1.	User can view graphs.
	2.	User can view traffic graphs, Accident graphs through clicking the province in the Sri Lankan map.
	3.	The use case ends.

Table 2.2: Test Case-2

This test case shows automated generation graphs for traffic, accidents rates, population, birth and death rates of Sri Lanka, number of vehicle, income rate of Sri Lanka, new vehicle registration of country. User can view all these graphs. The graphs will predict the future. It will show how will be the population, no of vehicles, traffic will be in future.

Test case 3	Select the format of the graphs	
Pre conditions	System is in working order.	
Actors	Client	
Description	1.	User can select the format of the Graphs. (Example:- Pie Charts, Bar Charts, Line Graphs)
	2.	User clicks Pie or any Charts
	3.	System will automatically generate charts.
	4.	The use case ends.
Exception	2.a	System will generate an error message when user didn't select any of them.

Table 2.3: Test Case-3

User can select the graph style by clicking the dropdown list in the page in website. Can select the form of the graph Pie Chart, or Bar chart, or line graph.

Test case 4	User can input data's system will analyze the future	
Pre conditions	System is in working order.	
Actors	Client	
Description	1.	System asked to input values
	2.	User enter the data's
	3.	System will automatically analyze the
	4.	The use case ends.
Exception	2.a	System will generate an error message when user didn't select any of them.

Table 2.4: Test Case-4

In E-Statistical Analyzer have a simulator which is user can input data; the output will appear in graph. If the user needs to get the past year graph of the population he/she have to enter the year that which year wants to know and have to select the providence date need to get to know about population rates.

Test case 5	Create new account	
Pre conditions	user logged in	
Actors	Administrator	
Description	1.	User initiates the create account command
	2.	User is prompted for username, I.C no, account type, Set username, set password.
	3.	User gives the username, I.C no, account type, set Username, set password.
	4.	System does authentication
	5.	New account is registered with the system
	6.	The use case ends.
Exception	4.a	Authentication Fails
	4.a.1	Prompt the user that he typed the wrong I.C no
	4.a.2	Allow him to re-enter the I.C no.

Table 2.5: Test Case-5

Administrator have login prompt to do his updating of traffic data's, accident data's etc. Can create new accounts with complete the details of him. After the admin create new accident the administrator receive a user name and password.

Test case 6	Update the statistical data	
Pre conditions	Locked up login.	
Actors	Administrator	
Description	1.	Update the new accidents data's every year.
	2.	Update the traffic details
	3.	The use case ends.

Table 2.6: Test Case-6

E-Statistical Analyzer has a major research area so module analysis many past and present data's to get to know about the future. So the administrator have to update the database with such kind of data's (Accident rates, population data's, Vehicle population data). For this updating administrator have to login to the system. This test case shows how the administrator updating rates into the database Management System.

2.3 *Research Findings*

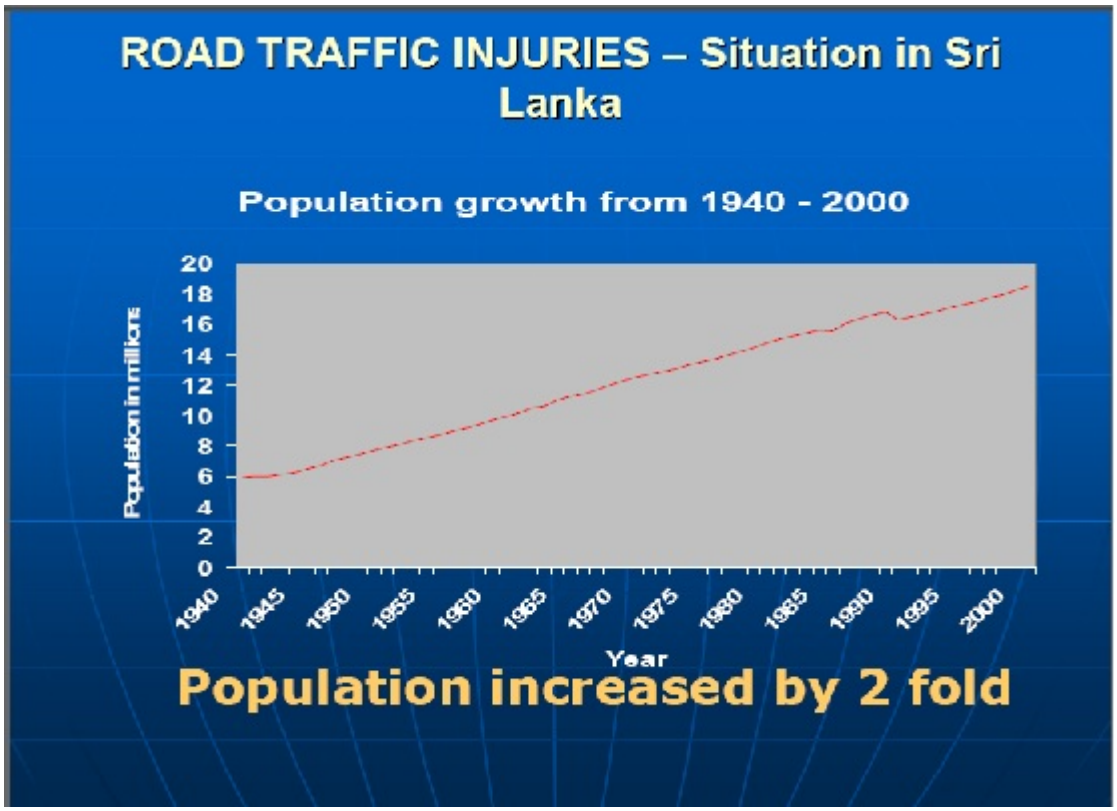

Figure 2.9: Population Shows

This Graph shows the Road Traffic – Population Growth in Sri Lanka. And this clearly indicates while growth increase how the traffic injuries growing up so using this graph the user can get the clear idea that there is a relationship between population increase and Road traffic.

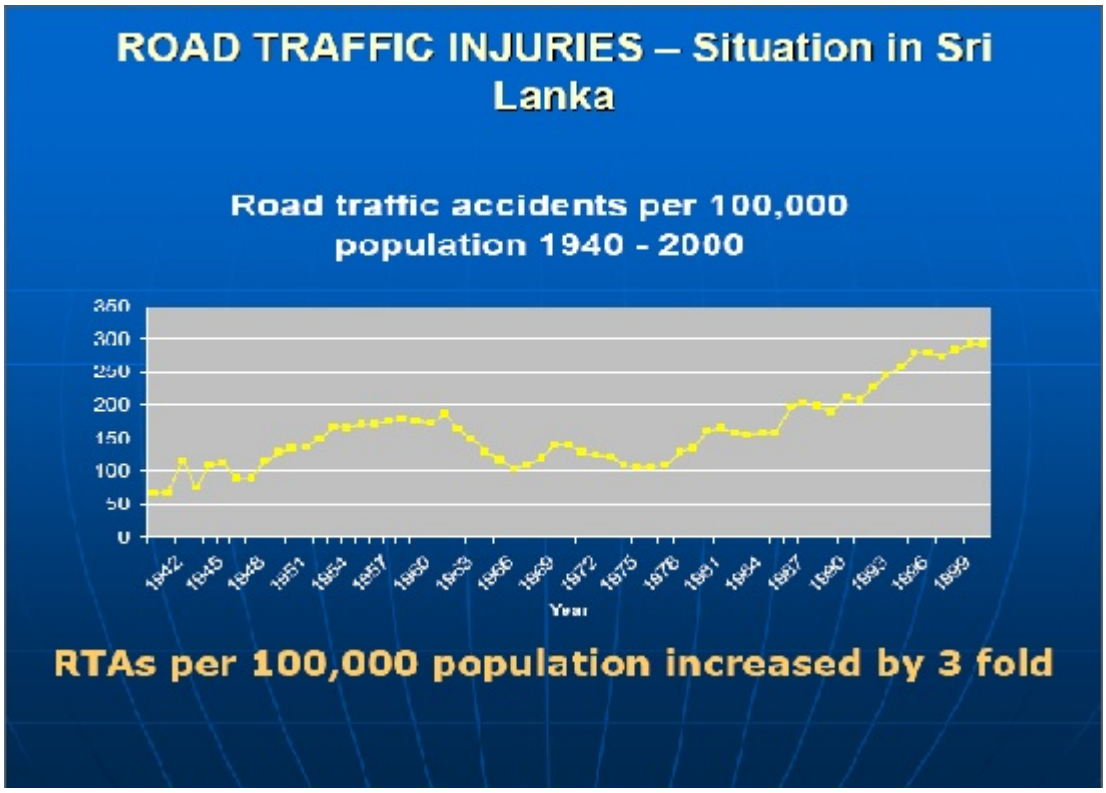

Figure 2.10: Road Traffic Accident with Populations

While population increases no of vehicle usage will increase. The increase of the no of vehicles it lead us to traffic increase in the country. The Graph above is the example for this statement.

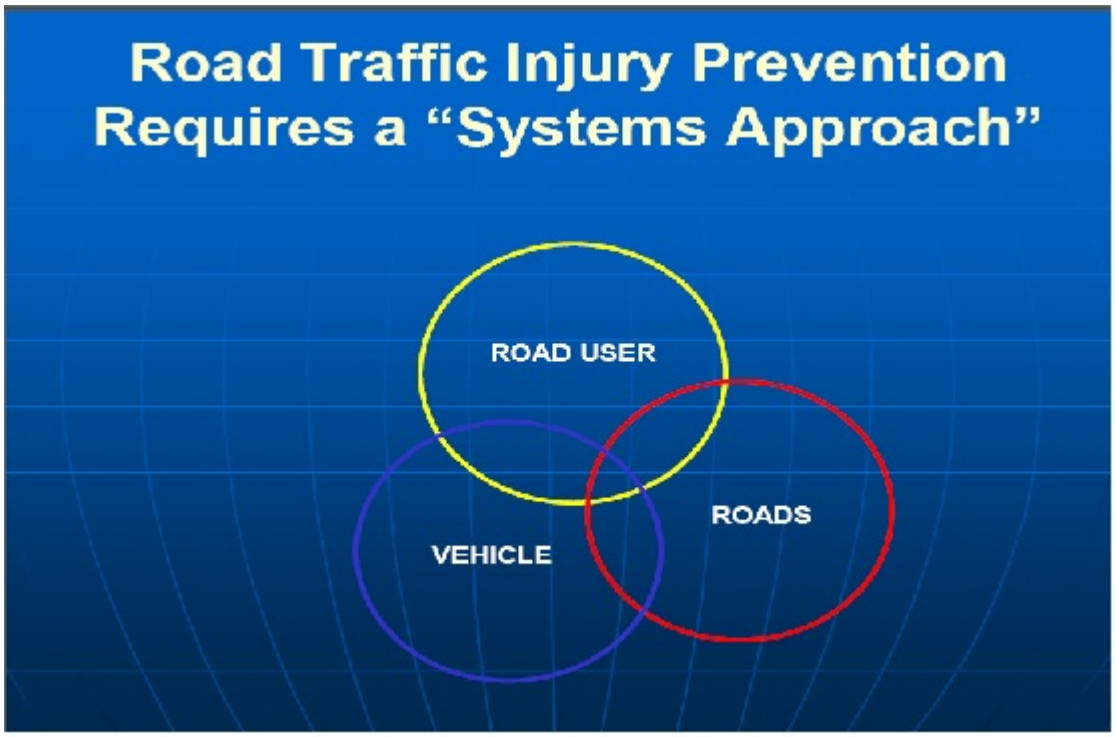

Figure 2.11: Road traffic injury prevention

The "Road User", "Roads" and "Vehicles" are interrelated. The above graphs show the relationship between these three. So according to this graph when the Road User increases the no of Vehicle increase to manage this increment no of roads also have to increase.

System Overview

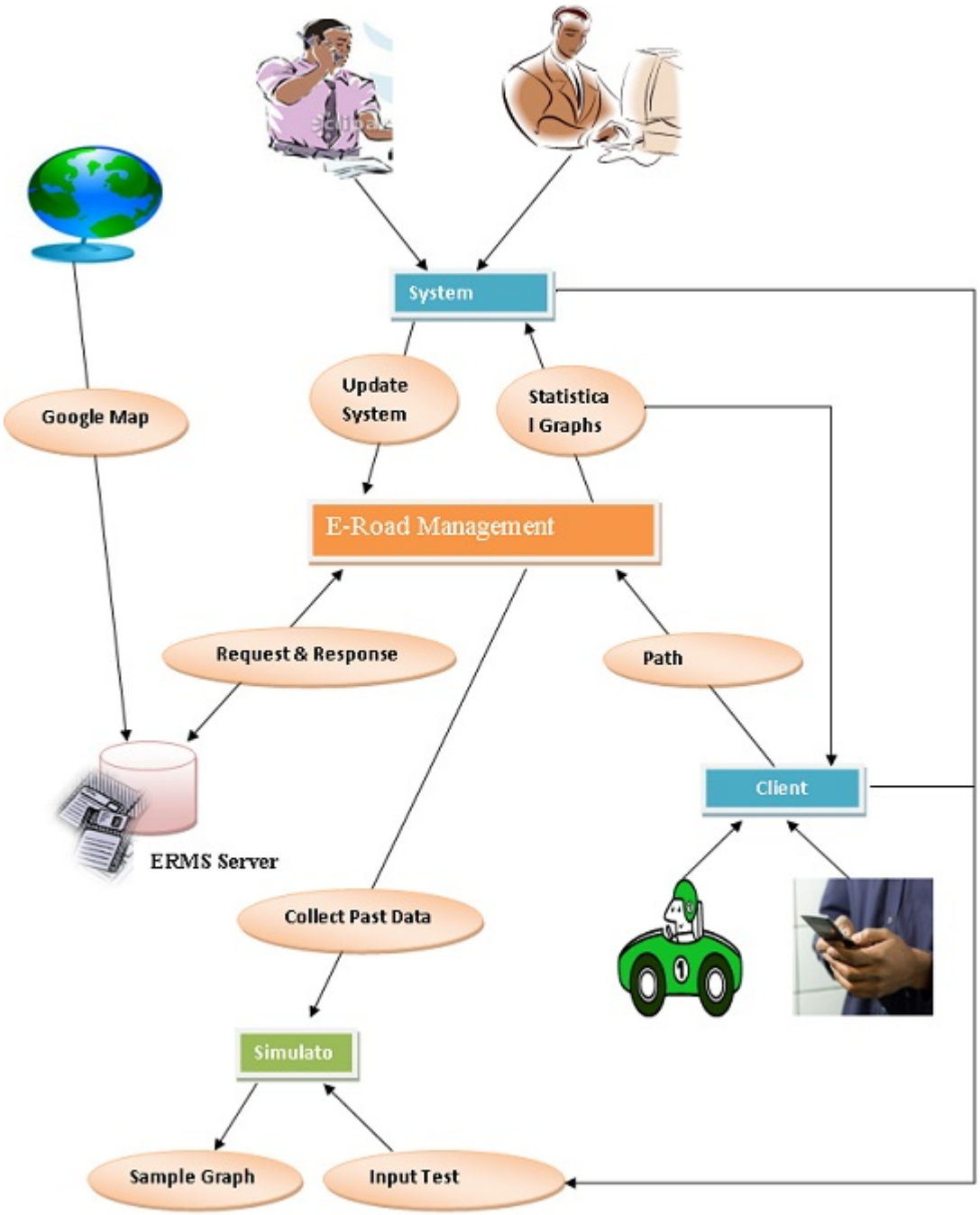

Figure 2.12: High level diagram of the system

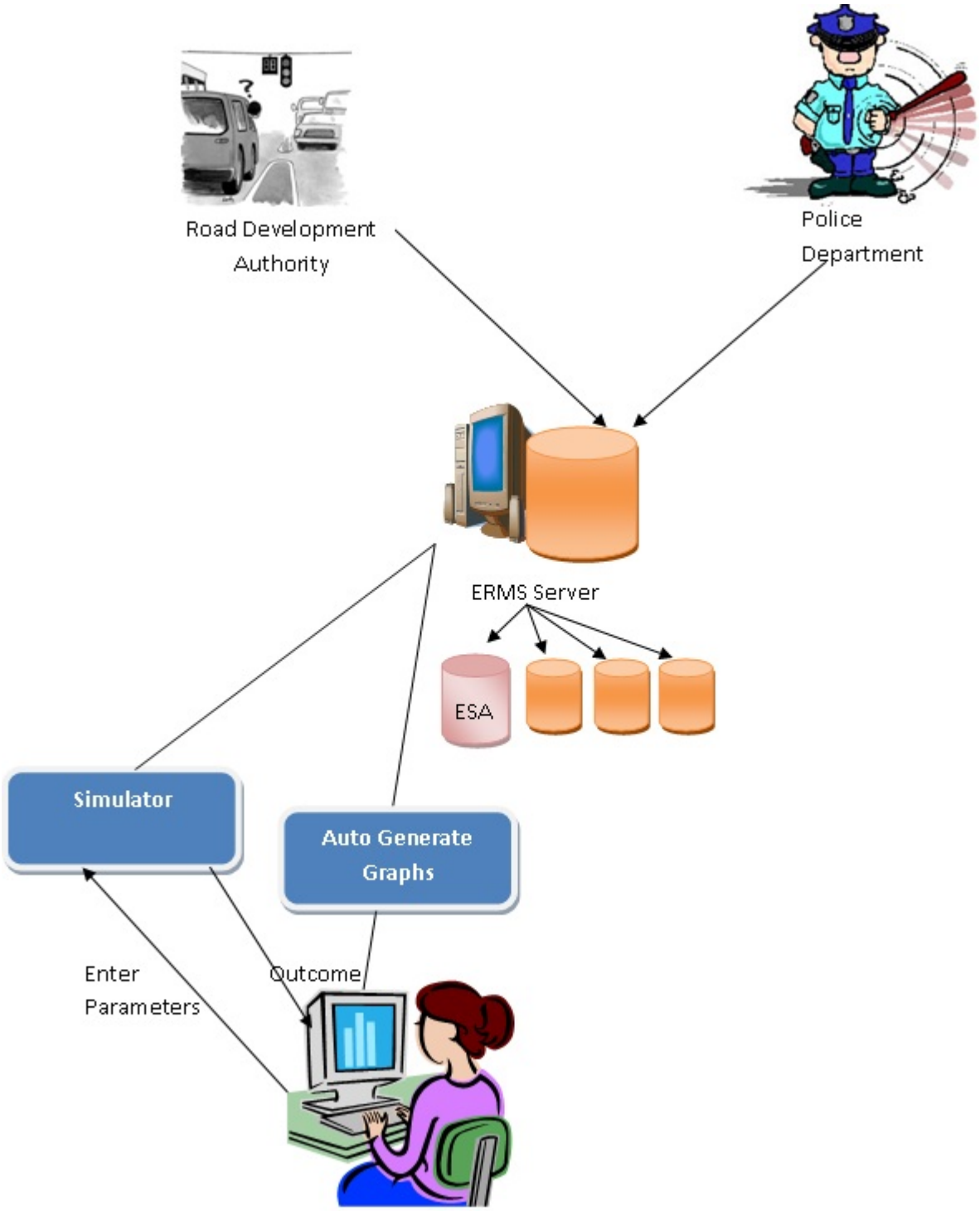

Figure 2.13: E-Statistical Analyzer Diagram

Chapter 3

Results & Discussion

3.1 *Evidence*

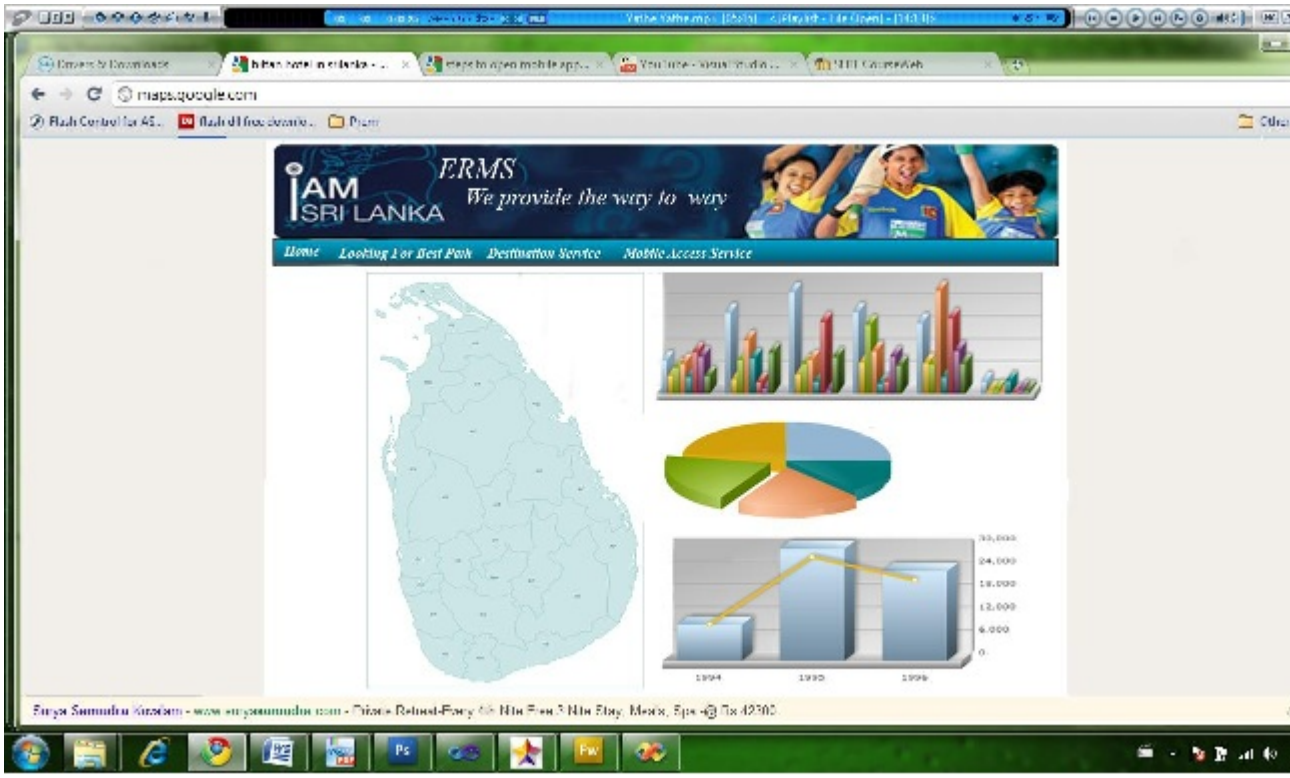

Figure 3.1: E-Statistical Analyzer Diagram

Figure 3.2: Birth Predictor Simulator Interface

Figure 3.3: Birth Prediction Graph and data's appear by year

Figure 3.4: Future prediction Interface

3.2 *Discussion*

The outcome from this module is statistical graphs and a simulator. Using the past data the system generates user friendly graphs to the user. And the simulator which helps us to predict the future motor ways, population and so many.

The major advantages from this module:

- Better relation with motorist.
- More accurate history and information.

- Improved road management information.
- Faster processing of staffs & services details.
- This solution will provide e-mail and internet facilities to all staffs.

Chapter 4

CONCLUSION

It is intuitively and naturally pleasing to come to an end of a research project, but it is more pleasing and relieving to come to an end of a research project with convincing and satisfying research findings, which provide adequate answers and solution to research problem in the project. This chapter gives a summary of the overall picture of the study. In its mission to achieve this goal, it deals specifically with achievement of the research objectives, challenges established, summary of research findings and possible benefits, possible future research emanating from the study and recommendations given for future improvement.

Policing of road traffic in Sri Lanka has become a major task for police. Due to increase in volume of road traffic in the Island the Sri Lanka police facing many challenges to get control of it. But this is a difficult task to manually control it. So the author and the team are planning to create an application to solve this problem. By logging on to this system the user will be able to see the traffic congestions in cities especially during the peak hours and will be able to see the alternative paths to particular places.

Author's task in this application is to create auto generated graphs for Road Vs traffic, Road Vs No of vehicles and Road Vs Time. By viewing these graphs the users of this application will be able to manage their time and prevent unwanted delays. In addition to this an auto generated mail will be sent to the users to advise them on special occasions such as Kandy Perahara, Nuwara Eliya season Anuradhapura season, Kataragama and Thalavila feast May Day and visit of Heads of states and State functions. System will also send alert messages to the users about the accidents, road blocks, fire, explosions and other disasters. So

the users can plan their programs ahead and avoid the unexpected circumstances related to traffic.

Furthermore the application will points out the speed limits in dangerous bends and curves. This will be done by lesson learnt by past accidents. By the initial analysis the numbers of accidents are increasing because of increased number of vehicles, poor development of road and poor traffic management. So this system will help to reduce the accidents by having good safety management measures. A graph will be generated within the application to see the statistics of the accidents.

In addition this application will also support to extend the knowledge of the users on road traffics. For example, the system will provide advice such as accidents can be avoided by limiting speeds in particular places; maintain safe distance with the vehicle in front and wearing helmets both the rider and the back seat person.

Chapter 5

References

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Chapter 6

APPENDIX

Appendix A:Diagrams

Risk Id	Risk Category	Risk Description	Risk Impact	Probability of occurrence	Risk response category	Contingency plan	Risk Status	Risk Actionee
R1	Commercial risk	Poor identification of problem domain about work life balance	High	Low	Avoid risk	To use proper technique to identify the problem & get supervisor's feedback on problem domain	Close	Project owner (Author)
R2	Commercial risk	Poor identification of scope in the project of work life balance in the Apparel industry of Sri Lanka	High	Low	Avoid risk	To define the scope according to the time limit and according to the contacts in the industry. (Double check with the supervisor)	Close	Project owner (Author)
R3	Relationship risk	Poor contacts with stakeholders of the project	High	High	Mitigate the risk	To check availabilities of contacts in various companies (Small companies such as Tri star)	Open	Project owner (Author)
R4	Relationship risk	Users not committed to system or unwilling	High	Low	Mitigate the risk	Negotiations and training of users	Open	Project owner (Author)

Figure 6.1: Risk Management-1

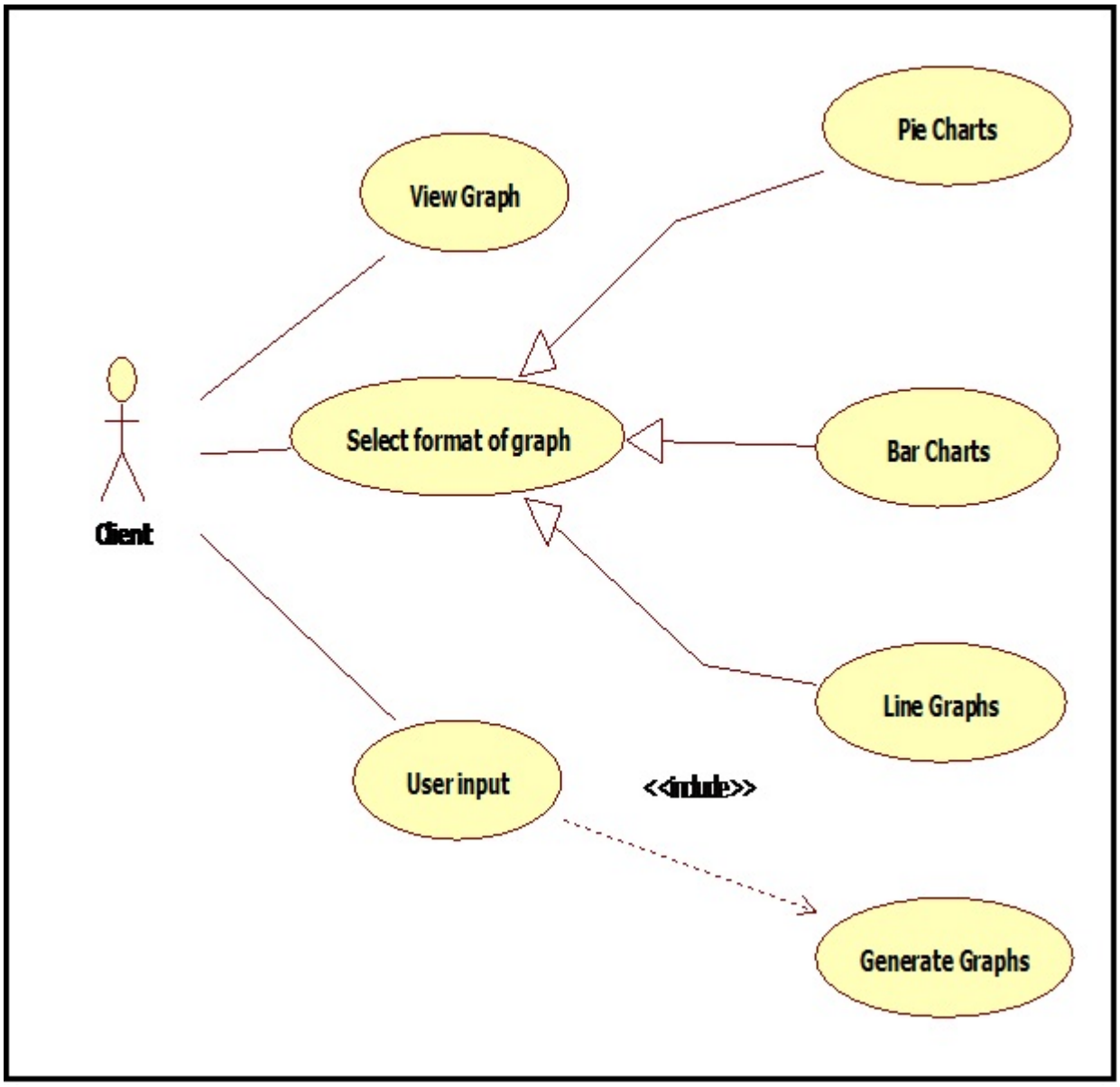
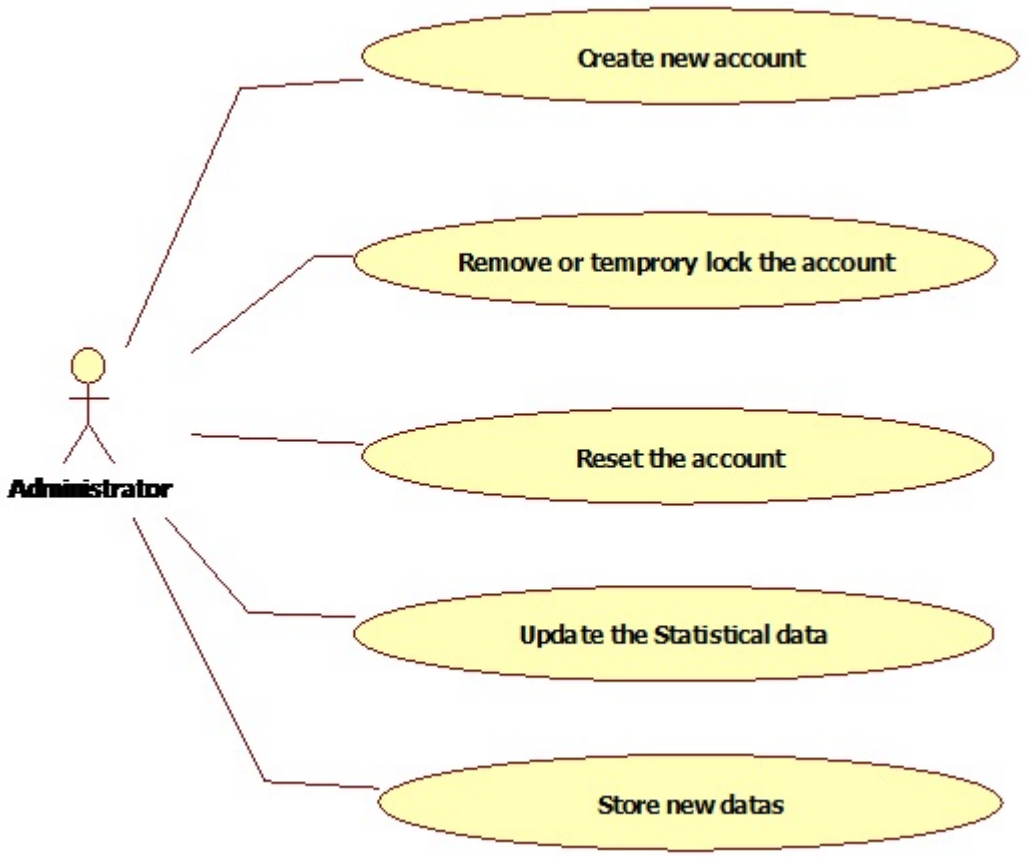


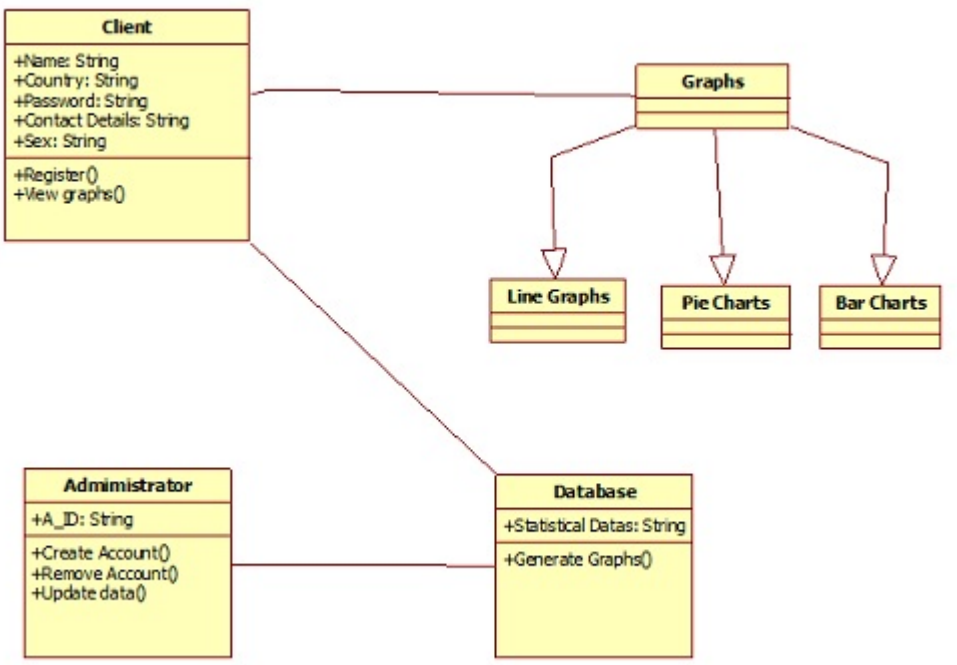
Figure 6.2: Usecase Diagram

Usecase scenario



Classes / Objects

Class diagrams are widely used to describe the types of objects in a system and their relationships. Class diagrams model class structure and contents using design elements such as classes, packages and objects. This diagram used to describe the classes of the system and the relationships between each other.



Appendix B**:Source Code**

```
using System;

using System.Collections.Generic;

using System.Linq;

using System.Text;

using DL;

using System.Data;

using System.Data.SqlClient;

using System.Collections;

namespace BL
```

```
{
public class PopulationPredict
{
/// <summary>
/// Birth Proper
/// </summary>
private int BirthYear;
public int intBirthYear
{ get { return BirthYear; }
set { BirthYear = value; }
}
private int BirthCount;
public int intBirthCount
{ get { return BirthCount; }
set { BirthCount = value; }
}
/// <summary>
/// Death Proper
/// </summary>
private int DeathYear;
public int intDeathYear
{ get { return DeathYear; }
```

```
set { DeathYear = value; }

}

private int DeathCount;

public int intDeathCount

{ get { return DeathCount; }

set { DeathCount = value; }

}

/// <summary>

/// Population Proper

/// </summary>

private int PopulationYear;

public int intPopulationYear

{ get { return PopulationYear; }

set { PopulationYear = value; }

}

private int PopulationCount;

public int intPopulationCount

{ get { return PopulationCount; }

set { PopulationCount = value; }

}

/// <summary>

/// District,Year — >> Pass From Front End—
```

```
/// </summary>
private string PredictDistrict; public string strPredictDistrict
{
get { return PredictDistrict; }
set { PredictDistrict = value; }
}
private int PredictYear;
public int intPredictYear
{ get { return PredictYear; }
set { PredictYear = value; }
}
/// <summary>
/// ———————————————— ///
</summary>
/// — Find Current Year —
int CurrentYear = DateTime.Now.Year;
/// ————————————-
ArrayList myBirthArray = new ArrayList();
int b = 0;
ArrayList myDeathArray = new ArrayList();
int d = 0;
/// — Birth —
```

```
/// <summary>
/// ————————-
/// </summary>
public ArrayList FindBirth(PopulationPredict myFindBirth)
{
SqlConnection sqlConn = new SqlConnection(DL.SQL.conn);
SqlDataReader sqlRdr = null;
try {
sqlConn.Open();
//————————-
SqlCommand sqlCom = new SqlCommand("BirthPredictor", sqlConn);
sqlCom.CommandType = CommandType.StoredProcedure;
sqlCom.Parameters.Add("@SelectedRegion",myFindBirth.strPredictDistrict);
sqlRdr = sqlCom.ExecuteReader();
//————————
while(sqlRdr.Read())
{
ArrayBirth objArrBirth = new ArrayBirth();
objArrBirth.intBirthYear = Convert.ToInt32(sqlRdr["tempYear"]);
objArrBirth.doubleBirthCount = Convert.ToInt32(sqlRdr["tempCount"]);
myBirthArray.Insert(b, objArrBirth);
b = b + 1;
```

```
}

/// Close The Connections

sqlRdr.Close();

sqlConn.Close();

/// — Find Oldest Year & Value —

ArrayBirth objOldBirthFind=(ArrayBirth)(myBirthArray[0]);

int DB_Old_BirthYear = objOldBirthFind.intBirthYear;

double DB_Old_BirthCount = objOldBirthFind.doubleBirthCount;

/// — Find Newest year & Value —

int NoOf_tblBirth_DB_Row = myBirthArray.Count;

int NoOf_Rows = NoOf_tblBirth_DB_Row - 1;

ArrayBirth objNewBirthFind = (ArrayBirth)(myBirthArray[NoOf_Rows]);

int DB_New_BirthYear = objNewBirthFind.intBirthYear;

double DB_New_BirthCount = objNewBirthFind.doubleBirthCount;

/// — Predict Future —

int FindYear = myFindBirth.intPredictYear;

int t = FindYear - CurrentYear;

int CalcYear=CurrentYear;

for (int i = 0; i <= t; i++)

{

/// Algo For Birth
```

```
double NFuture = DB_New_BirthCount * Math.Exp((Math.Log((DB_New_BirthCo
/ DB_Old_BirthCount), Math.Exp(1)) / 4) * 1);

/// Algo For Birth

ArrayBirth objPredictArrBirth =new ArrayBirth();

objPredictArrBirth.intBirthYear = CalcYear;

objPredictArrBirth.doubleBirthCount = Math.Ceiling(NFuture);

myBirthArray.Insert(b, objPredictArrBirth);

b = b + 1;

// Copy Predicted value to calc next year value

DB_New_BirthCount = NFuture;

// Increment The Year

CalcYear++;

}

}

{

}

return myBirthArray;

}

/// — Death —

/// <summary>

/// ————

/// </summary>
```

```
public ArrayList FindDeath(PopulationPredict myFindDeath)
{
SqlConnection sqlConn = new SqlConnection(DL.SQL.conn);
SqlDataReader sqlRdr = null;
try {
sqlConn.Open();
//————————-
SqlCommand sqlCom = new SqlCommand("DeathPredictor", sqlConn);
sqlCom.CommandType = CommandType.StoredProcedure;
sqlCom.Parameters.Add("@SelectedRegion", myFindDeath.strPredictDistrict);
sqlRdr = sqlCom.ExecuteReader();
//————————
while (sqlRdr.Read())
{
ArrayDeath objArrDeath = new ArrayDeath();
objArrDeath.intDeathYear = Convert.ToInt32(sqlRdr["tempYear"]);
objArrDeath.doubleDeathCount = Convert.ToInt32(sqlRdr["tempCount"]);
myDeathArray.Insert(d, objArrDeath);
d = d + 1;
}
/// Close The Connections
sqlRdr.Close();
```

```
            sqlConn.Close();

            /// — Find Oldest Year & Value —

            ArrayDeath objOldDeathFind = (ArrayDeath)(myDeathArray[0]);

            int DB_Old_DeathYear = objOldDeathFind.intDeathYear;

            double DB_Old_DeathCount = objOldDeathFind.doubleDeathCount;

            /// — Find Newest year & Value —

            int NoOf_tblDeath_DB_Row = myDeathArray.Count;

            int NoOf_Rows = NoOf_tblDeath_DB_Row - 1;

            ArrayDeath objNewDeathFind = (ArrayDeath)(myDeathArray[NoOf_Rows]);

            int DB_New_DeathYear = objNewDeathFind.intDeathYear;

            double DB_New_DeathCount = objNewDeathFind.doubleDeathCount;

            /// — Predict Future —

            int FindYear = myFindDeath.intPredictYear;

            int t = FindYear - CurrentYear;

            int CalcYear = CurrentYear;

            for (int i = 0; i <= t; i++)

            {

            /// Algo For

            Death double NFuture = DB_New_DeathCount * Math.Exp((Math.Log((DB_New_D
/ DB_Old_DeathCount), Math.Exp(1)) / 4) * 1);

            /// Algo For Death

            ArrayDeath objPredictArrDeath = new ArrayDeath();
```

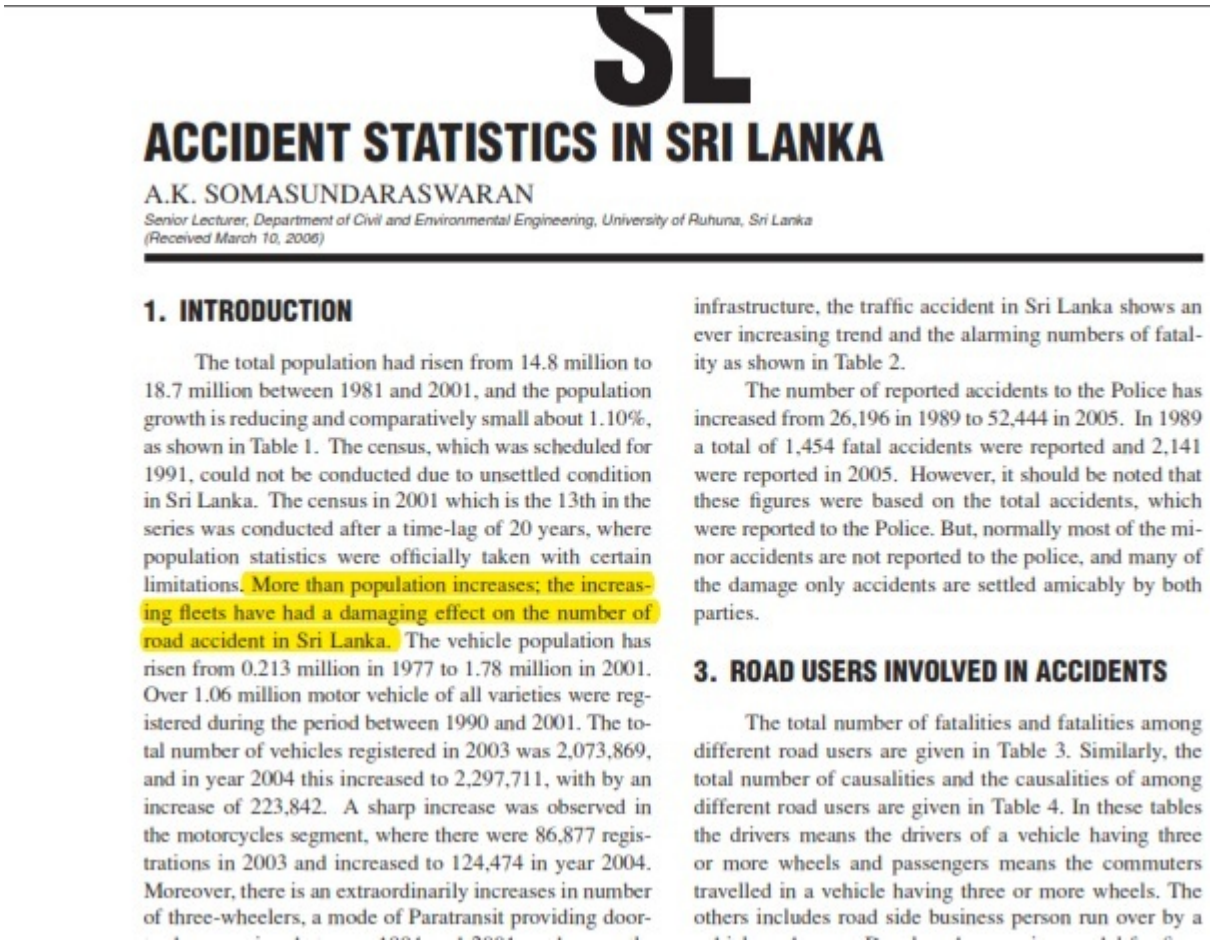
```
objPredictArrDeath.intDeathYear = CalcYear;

objPredictArrDeath.doubleDeathCount = Math.Ceiling(NFuture);

myDeathArray.Insert(d, objPredictArrDeath);

d = d + 1;

// Copy Predicted value to calc next year value

DB_New_DeathCount = NFuture; // Increment The Year CalcYear++;

}

}

catch (Exception ex)

{

}

return myDeathArray;

}

/// — Population —

/// <summary>

/// ————

/// </summary>

public ArrayList FindPopulation(PopulationPredict myFindPopulation)

{

ArrayList myPopulationArray = new ArrayList();

int p = 0;

/// — Get the Newest Value from DB –>> tblPopulation
```

```
SqlConnection sqlConn = new SqlConnection(DL.SQL.conn);

SqlDataReader sqlRdr = null;

try {

sqlConn.Open();

//————————-

SqlCommand sqlCom = new SqlCommand("PopulationPredictor", sql-
Conn);

sqlCom.CommandType = CommandType.StoredProcedure;

sqlCom.Parameters.Add("@SelectedRegion", myFindPopulation.strPredictDistrict);

sqlRdr = sqlCom.ExecuteReader();

//————————

while (sqlRdr.Read())

{

ArrayPopulation objArrPopulation = new ArrayPopulation();

objArrPopulation.intPopulationYear = Convert.ToInt32(sqlRdr["tempYear"]);

objArrPopulation.doublePopulationCount = Convert.ToInt32(sqlRdr["tempCount"]);

myPopulationArray.Insert(p, objArrPopulation);

p = p + 1;

}

/// Close The Connections

sqlRdr.Close();

sqlConn.Close();
```

```
/// — Find Newest year & Value —

int NoOf_tblPopulation_DB_Row = myPopulationArray.Count;

int NoOf_Rows = NoOf_tblPopulation_DB_Row - 1;

ArrayPopulation objNewPopulationFind = (ArrayPopulation)(myPopulationArray[No

int DB_New_PopulationYear = objNewPopulationFind.intPopulationYear;

double DB_New_PopulationCount = objNewPopulationFind.doublePopulationCount;

/// — Predict Future —

int FindYear = myFindPopulation.intPredictYear;

int t = FindYear - CurrentYear;

int CalcYear = CurrentYear;

for (int i = 0; i <= t; i++)

{

/// — Birth Of The Year —

ArrayBirth objGetBirth = (ArrayBirth)(myBirthArray[NoOf_Rows]);

double GetBirth = objGetBirth.doubleBirthCount;

/// — Death Of The Year —

ArrayDeath objGetdeath = (ArrayDeath)(myDeathArray[NoOf_Rows]);

double GetDeath = objGetdeath.doubleDeathCount;

/// Population Predict Algo

double FuturePopulation = DB_New_PopulationCount + GetBirth -
GetDeath;

/// Population Predict Algo
```

```
ArrayPopulation objPredictArrPopulation = new ArrayPopulation();

objPredictArrPopulation.intPopulationYear = CalcYear;

objPredictArrPopulation.doublePopulationCount = Math.Ceiling(FuturePopulation);

myPopulationArray.Insert(p, objPredictArrPopulation); p = p + 1;

// Copy Predicted value to calc next year value

DB_New_PopulationCount = FuturePopulation;

// Increment The Year CalcYear++;

// Increment The Birth & Death Year Value NoOf_Rows++; }

}

catch(Exception ex)

{

}

return myPopulationArray;

}

}

}
```

Appendix C: Findings



SL

ACCIDENT STATISTICS IN SRI LANKA

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(Received March 10, 2006)

1. INTRODUCTION

The total population had risen from 14.8 million to 18.7 million between 1981 and 2001, and the population growth is reducing and comparatively small about 1.10%, as shown in Table 1. The census, which was scheduled for 1991, could not be conducted due to unsettled condition in Sri Lanka. The census in 2001 which is the 13th in the series was conducted after a time-lag of 20 years, where population statistics were officially taken with certain limitations. More than population increases; the increasing fleets have had a damaging effect on the number of road accident in Sri Lanka. The vehicle population has risen from 0.213 million in 1977 to 1.78 million in 2001. Over 1.06 million motor vehicle of all varieties were registered during the period between 1990 and 2001. The total number of vehicles registered in 2003 was 2,073,869, and in year 2004 this increased to 2,297,711, with by an increase of 223,842. A sharp increase was observed in the motorcycles segment, where there were 86,877 registrations in 2003 and increased to 124,474 in year 2004. Moreover, there is an extraordinarily increases in number of three-wheelers, a mode of Paratransit providing door-

infrastructure, the traffic accident in Sri Lanka shows an ever increasing trend and the alarming numbers of fatality as shown in Table 2.

The number of reported accidents to the Police has increased from 26,196 in 1989 to 52,444 in 2005. In 1989 a total of 1,454 fatal accidents were reported and 2,141 were reported in 2005. However, it should be noted that these figures were based on the total accidents, which were reported to the Police. But, normally most of the minor accidents are not reported to the police, and many of the damage only accidents are settled amicably by both parties.

3. ROAD USERS INVOLVED IN ACCIDENTS

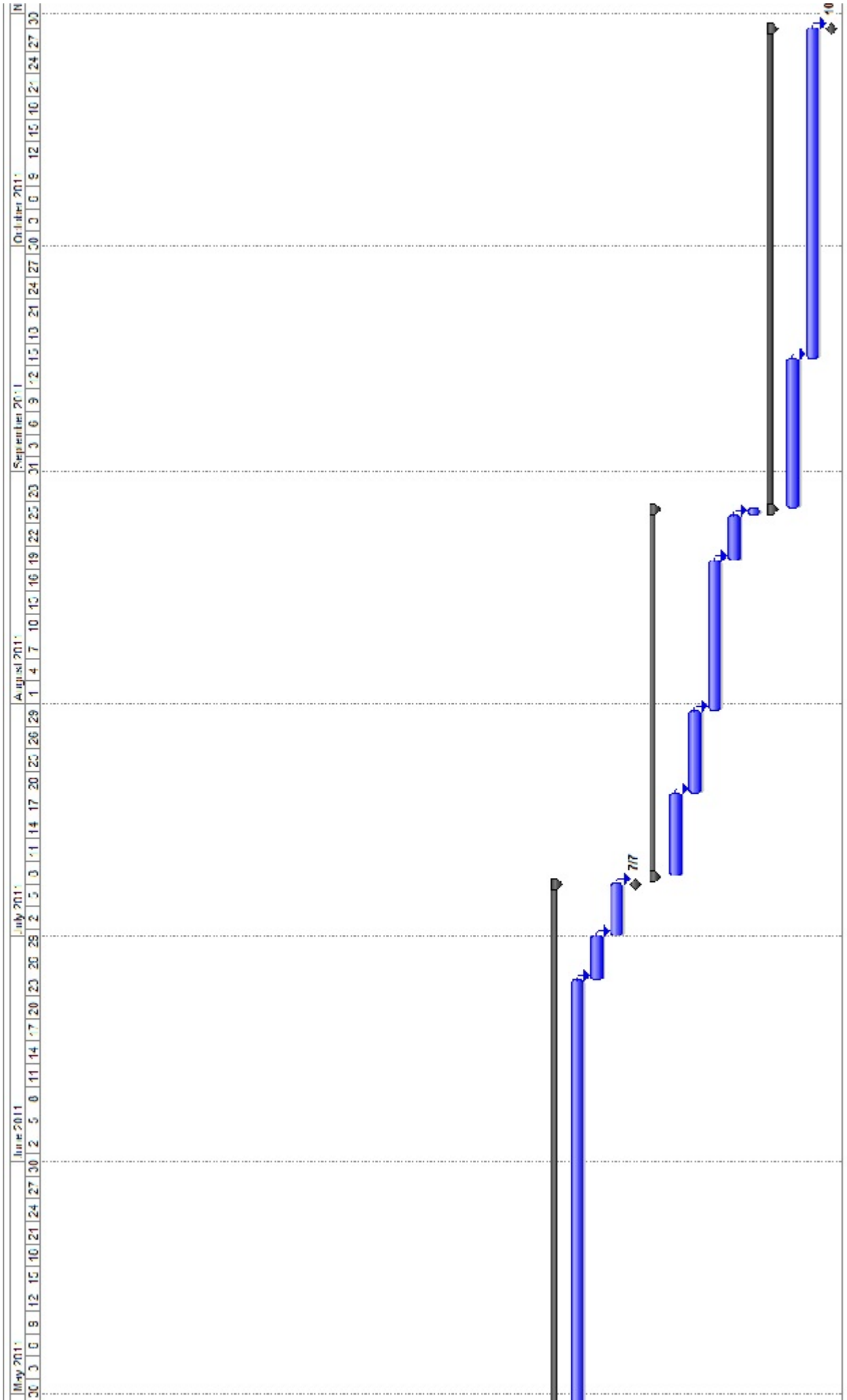
The total number of fatalities and fatalities among different road users are given in Table 3. Similarly, the total number of causalities and the causalities of among different road users are given in Table 4. In these tables the drivers means the drivers of a vehicle having three or more wheels and passengers means the commuters travelled in a vehicle having three or more wheels. The others includes road side business person run over by a

Figure 6.3: Research Finding-1

Population, Intercensal growth 1981-2001 and population density by district

District	Population		Intercensal growth		Average Annual Growth rate (per cent)	Populati densit (person per sq.k
	Census 1981	Census 2001	Number	Per cent		
Sri Lanka[a]	14,846,750	18,797,257	3,950,507	26.6	1.2	
Colombo	1,699,241	2,251,274	552,033	32.5	1.4	3,
Gampaha	1,390,862	2,063,684	672,822	48.4	1.9	1,
Kalutara	829,704	1,066,239	236,535	28.5	1.2	
Kandy	1,048,317	1,279,028	230,711	22.0	1.0	
Matale	357,354	441,328	83,974	23.5	1.0	
Nuwara Eliya	603,577	703,610	100,033	16.6	0.8	
Galle	814,531	990,487	175,956	21.6	1.0	
Matara	643,786	761,370	117,584	18.3	0.8	
Hambantota	424,344	526,414	102,070	24.1	1.1	
Jaffna[a]	738,788	490,621	-248,167	-33.6	-2.0	
Mannar[a]	106,235	151,577	45,342	42.7	1.7	
Vavuniya[a]	95,428	149,835	54,407	57.0	2.2	
Mullaitivu[a]	77,189	121,667	44,478	57.6	2.2	
Kilinochchi[a]	91,764	127,263	35,499	38.7	1.6	
Batticaloa[a]	330,333	486,447	156,114	47.3	1.9	
Ampara	388,970	592,997	204,027	52.5	2.1	
Trincomalee[a]	255,948	340,158	84,210	32.9	1.4	
Kurunegala	1,211,801	1,460,215	248,414	20.5	0.9	
Puttalam	492,533	709,677	217,144	44.1	1.8	
Anuradhapura	587,929	745,693	157,764	26.8	1.2	
Polonnaruwa	261,563	358,984	97,421	37.2	1.6	

Figure 6.4: Research Finding-2


May 2011
June 2011
July 2011
August 2011
September 2011
October 2011
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