Vehicle Management System for Lanka Broadband Networks Ltd

G. S. C. Fonseka

2019

Vehicle Management System for Lanka Broadband Networks Ltd

A dissertation submitted for the Degree of Master of Information Technology

G. S. C. Fonseka
University of Colombo School of Computing
2019

UCSC

Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

Student Name: G. S. C. Fonseka

Registration Number: 2013MIT027

Index Number: 13550279

…………………

Signature: Date:

This is to certify that this thesis is based on the work of Mr. G. S. C. Fonseka registration no 2013/MIT/027 index no 13550279 under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

Certified by:

Supervisor Name: Mr. G. K. A. Dias

…………………

Signature: Date:

Abstract

Lanka Broadband Networks Ltd is a leading Cable TV operator in Sri Lanka and provides high quality TV channels to its varying audience around the island. Currently they are catering around 30000 customers in Colombo, Negombo, Wattala, Beruwala and Nuwaraeliya areas. Lanka Broadband Networks Ltd has 7 branches and its Head Office located at Narahenpita. Currently they are using more than 30 motor vehicles for their operations. The idea of this project is centralized and managed the vehicle maintenance process by connecting all of their branches spread around the country.

The Vehicle Management System was implemented successfully for Lanka Broadband Networks Ltd, with the help of their staff who are involved in the process. The System basically handles team allocation for each vehicle, monitor fuel consumption, Eco-Test, License Renovation for vehicles, keep repairing history and maintain vehicle service calendar. Also, the management and supervisors can track down the current location through the short message service (sms).

The system developed using some of the latest technologies available in the industry. The .NET framework is a software development framework from Microsoft. It provides a controlled programming environment where software can be developed, installed and executed on Windows-based operating systems. and C# were selected to developing process, where as Microsoft SQL Server 2014 was used as the database management system. Microsoft Visual Studio was used as an integrated development environment.

When the system was implemented the organization experienced a significant deduction of workload assigned to the transport division's staff. Also, the system kept properly organized and easily retrievable information with printing facilities.

With the assistance and correct supervision from LBN Ltd, the proposed system was successfully achieved most of the functional and non-functional requirements. Presentations of trial runs were verified to be successful and all the users have accepted it as a practical solution suitable for the full implementation.

Acknowledgements

I owe a great many thanks to a great many people who helped and supported me during the writing of this project. Also, I would like to express my gratitude to the following groups and individuals.

I'm highly indebted to the supervisor Mr. G. K. A. Dias for his guidance and supervision as well as for providing necessary information regarding the project and also for his support in completing the project.

Also, would like to thank all the academic and non-academic staff of University of Colombo – School of computing who helped me in numerous ways during the project.

I would like to express my special gratitude and thanks to Mr. Shirantha Herath- Managing Director of Lanka Broadband Networks Ltd where I am working and his staff for giving me such attention and time.

My thanks and appreciation also go to my MIT colleagues in developing the project and to the people who have willing helped me out with their abilities.

G.S.C. Fonseka

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List of Abbreviations

MIT – Master of Information Technology

LBN - Lanka Broadband Networks Ltd

VMS - Vehicle Management System

GPS – Global Positioning System

SQL - Structure Query Language

OOP – Object Oriented Programming

IDE - Integrated Development Environment

MS - Microsoft

URL – Uniform Resource Locator

UI – User Interface

GUI – Graphical User Interface

PC – Personal computer

1   Introduction

1.1 Introduction to the company

Lanka Broadband Networks Ltd (LBN) is a leading Cable TV operator in Sri Lanka and provides high quality TV channels to its varying audience around the island. Currently they are catering nearly 32000 customers in Colombo, Negombo, Wattala, Beruwala and Nuwaraeliya areas. Lanka Broadband Networks Ltd has 7 branches with its Head Office located at Narahenpita. They are using more than 30 company owned motor vehicles and few hired vehicles for their operations. All branches and head office maintain company owned vehicles and mainly use them by technical teams to visit customers for new connection installations and trouble shootings. Each branch separately maintains their vehicles and keeps their records manually and each day end sends them as excel sheet to the head office through emails. [1]

1.2 About current vehicle management

Daily Customer Service receives nearly 100-150 complaints, most of them are technical issues and technical teams have to visit each customer's home for solving the technical problems. After logged a complaint the customer expects the technical team attains their complaint soon. However, there are time delays when allocating vehicles for the technical teams. The main reason is manual system and paper works. The management expects to reduce the time-delay as much as possible. The management realize that the delay can eliminate easily with a good Vehicle Management System.

1.3 Workflow of Vehicle management

There are 2 supervisors and one manager work in the transport division. Everyday morning, they should allocate vehicle and driver for each technical team. Also records the vehicle starting millage, date and time and other details in to an excel file. At the day end supervisors note down day-end mileage, fuel usage, time and other details when the vehicle arrived.

In the Same time, they maintain another two separate-excel files for vehicle repairing details and services details. The transport division provides reports to the management once a month and these manual reports preparation is a time-consuming hard task. When a vehicle needs a repair, the driver should inform to the supervisor and basically, he checks the past vehicle's records and prepares a summary report to the manger about the relevant vehicle status. This will take more than 2 hours. Ultimately manager approves the repair by observing the

supervisor's report which contains repairing-history of the vehicle. They do not keep records of the replaced vehicle-parts in repairing-history excel file.

Generally, a driver gets the approval for the vehicle service when the routing work load is low. There is no any service calendar or proper time table for vehicle service.

There is no any vehicle tracking system, when the supervisor needed to know about the vehicle location basically, he calls the driver's phone and ask. So, the supervisor should depend on the details given by the driver.

The Fuel consumption calculates with the entered records and fuel-bills which provided by the driver. There is no any fuel-consumption comparisons or historical record checking with current data.

Each vehicle has a master physical file which created when they added a new vehicle to the branch; mainly it contains vehicle registration book copy, insurance policy copy, Vehicle emission test certificate, Vehicle revenue licence and other important document. Simply we can consider this as some sort of vehicle registration in to their manual system.

1.4 Objectives [2]

The main aim of the proposed new system is to improve the overall efficiency and effectiveness of the vehicle management at LBN by converting the existing manual system to an online system. In the same time, it should provide information for better decision making, in the same way the managers able to operate the company more efficiently. Some of the main objectives are reduce the paperwork associated with Vehicle Management operations, reduce the time taken to find the vehicle information for inquiries, provide an efficient service to the internal staff and management of the organization and making proper process for vehicle management.

- This system controls and guide the all vehicles' maintenance by a central place (Head office). And reduces the communication gap between Head office and the branches.

- The proposed new system generates comprehensive reports quickly and accurately.

- Develop the processes to enter vehicle information, Employee/driver information, vehicle tracking information, repairing & service information, Vehicle related documents' information and government related licenses information.

- Develop a tracking system to find vehicle location.

- A mechanism to allocate teams for vehicles.

- A process to handle vehicles breakdown.

1.5 Scope

The proposed system which will be developed for the users and staff of the Lanka Broadband Networks head office and all its branches. The followings are the proposed main functionalities by the new system.

- Build up a system that includes, vehicle registration and keeping the information about all company owned vehicles, fuel usage management, team allocation for vehicles and track the vehicle with short message service (sms).

- Daily vehicle allocation to teams and keep running charts for vehicles together with Route Details.

- Create a report generation module to get accurate detail reports.

- Daily vehicle allocation to the teams and keep running charts for vehicles together with Route Details.

- Monitoring fuel consumption of vehicles which can be checked against the route details which will ensure reducing waste and misuse of fuel.

- The system is responsible for managing the login and logout function for the system users. For the better security measures, the system has three user levels, such as admin, supervisor level and general user level. The privileges allocate according to their job profiles.

- Reminders and Calendar – As a part of the system needs a way to remind and schedule maintenance tasks for   the particular vehicle.

- The system generates expiration- notifications of the vehicle's license, insurances, Eco test and revenue license before it expires.

- Manage vehicles repairing and vehicle status- This includes vehicles repairing requirements, history, spare-parts price-comparison and maintain parts serial numbers of the vehicles.

- Electronic document storage – store the scanned copy of the vehicle's important documents in a sever hard disk and retrieve/ print them when needed.

2 Background

2.1 Introduction

Lanka Broadband Networks Limited uses various kinds of vehicles for the customer complaints handling and maintenance purposes. Currently they are handling the processes manually. Now the company wants to implement a software solution to improve the efficiency and to save the time of manual processing. The system must have the features like vehicle maintenance, repairing, employee assigning, team allocation, licensing (revenue license), monitor fuel consumption, document archiving and so on.

There are Standard Features available in VMS: [3]

- Most VMS supports most type of vehicles – Passenger, truck, construction, and other commercial vehicles.

- It really reduces vehicles cost while increasing performance and dependability.

- Track miles and travel expenses.

- Eliminate costly unscheduled maintenances.

- Keep accurate records of any type of vehicles.

- Help plan annual vehicle budget faster, easier and more accurately.

- Keep track of drivers and other employee's ledgers.

- Management of users, Type, Insurance, Maintenance, Accident and scheduling.

- Expense management and cost allocation.

- Electronic document storage.

Commercially available products are designed to a pre-defined business process where as it does not match the current process followed by client. These products expect client to be changed according to business processes they have designed in order to be implemented. In Sri Lanka several large companies who has the large number of motor vehicle owned, use bespoke vehicle management systems (Figure 2-1) .

Most of VMS functions which allow companies to remove or minimize the risks associated with vehicles owned by the companies. Generally, this software managing the vehicle includes the daily management of vehicles, fuels, service and drivers. When it comes to improving

efficiency, productivity and reducing overall costs involved with a company's vehicles. It is essential to have VMS.

Figure 2-1: GPS Based Vehicle Tracking

2.2 Existing Similar Systems

Most Vehicle Management systems are designed targeting American, Australian and European market. Also, most of them are very expensive. Vehicle Management Software can be purchased as a standalone version, also available in online subscription-based systems where you can pay per vehicle, per month. Normally they come with supporting advance mobile devices. Comparatively all developers provide domain general features such as Track vehicle's fuel efficiency, Track vehicle's service schedules and service history, Track vehicle's drivers, parts, vendors, and contacts, Total Vehicle Cost accounting and reporting, Vehicle locate using GPS, Keep track of drivers and other employee's ledgers, Insurance management and Electronic document storage. Some systems may non-customizable and have limitations. This chapter explains existing similar systems' and their advantages and disadvantages.

2.2.1 Kaizen Software Solutions - Vehicle Manager [4]

Vehicle Manager mainly focuses on the vehicle maintenance and services. LBN strive to increase efficiency in all areas not only maintenance. Specially in team allocation for each vehicle. Kaizen Vehicle Manager has main basic vehicle management system features such as Track vehicle's fuel efficiency, Track vehicle's service schedules and service history and Track vehicle's drivers, parts, vendors, and contacts (Figure 2-2) .

Differences between LBN Vehicle Management System when compared with Kaizen Software Solutions - Vehicle Manager is presented below (Table 2-1).

Kaizen Vehicle Manager	LBN Vehicle Management System
3 versions are available according to number of licenses.	No license issue
Print reports in various formats	Limited number of printing formats
GPS tracking is not available	Integrated with GPS tracking with smart Mobile phones.
	Deal with Drivers and employees both

Table 2-2: Comparison VMS

Vehicle Manager Features are available in Kaizen Vehicle Manager (Figure 2-2**):**

- Track up to 10 (home edition), 50 (professional edition) or an unlimited number of vehicles (fleet edition).

- Schedule recurring maintenance and inspection items by miles, kilometers, or hours.

- Track vehicle's completed service and expenses.

- Track vehicle's fuel efficiency over time (miles/gallon, kilometers/liter).

- Maintain a database of the parts used on vehicles.

- Track related vendors and contacts.

- Set options to track in US or Metric units.

- Print reports and export to various formats.

- Track and report on business vs. personal miles.

- Track drivers and their licenses/certifications/accidents (Pro and Fleet versions only).

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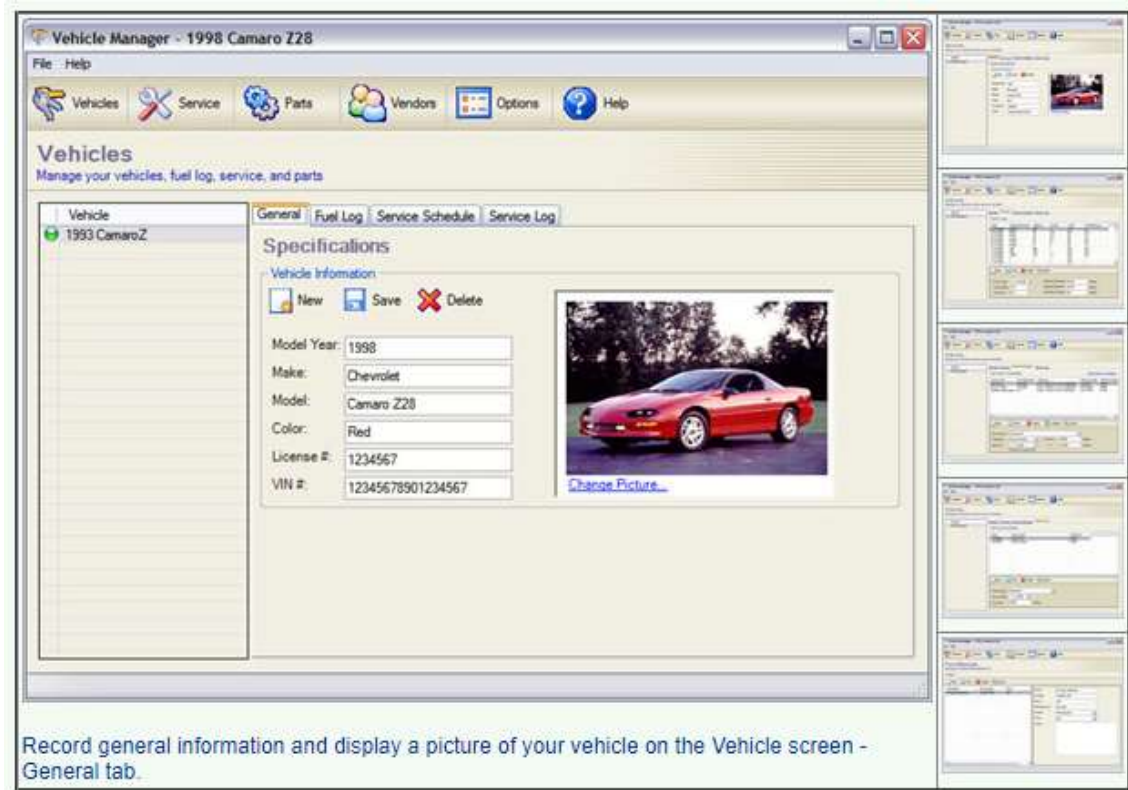
Figure 2-2: Kaizen Vehicle Manager

2.2.2   FleetWave/ RoadBASE - Chevin Fleet Solutions [5]

Chevin offers world-class flexible fleet and maintenance management software designed to meet the needs of fleet professionals around the world. Offering features such as flexible screen design, dynamic maintenance, work order and inventory management, touch screen and bar coding, comprehensive driver and accident management. Web-based FleetWave offers larger fleets flexibility and ease of use. RoadBASE offers smaller fleets sophisticated capabilities and analysis at an affordable price (Figure 2-3).

FleetWave Features:

- Fuel Tracking

- Cost Tracking

- Maintenance History

- Maintenance Scheduling

- Parts Inventory Management

- Repair Maintenance

- Tire Management

- Vehicle Information

- Warranty Tracking

- Work Order Management

Figure 2-3: Fleet Wave Web-Based Enterprise Fleet Management

3   Analysis and Design

3.1   Requirement Analysis

3.1.1   Fact Gathering Techniques [6]

Formal system analysis was conducted for the better understand of the client's working domain and gather requirements for the new system. This helps to identify problems and drawbacks of the current system, clearly identify all the functional and non-functional requirements and find ways of optimizing their work procedure. System analysis was primarily conducted based on Interviews, observations and document inspections. [7] [8]

Initially observation method used to understand the flow of documents, existing manual system processes and users. Also interviewed experienced staff members to understanding their needs and requests for the new system. The transport manager and supervisors were interviewed as the administrative participants to get broad picture of the existing manual system at Lanka Broadband Networks Ltd. All administrative functions were identified using this method. Document review method was more helpful while gathering information within short period of time.

Several rounds of interviews were carried out with Manager, Supervisor, Drivers and Technical staff with open ended questions (Figure 3-1). Main idea of these questions was what tasks each employee is currently engaged their day to day activities. And what they are expected from the new system to ease their job. These interviews were the main resource of each user's role in the entire process. Also got understanding about the bottle necks of the current process they follow in the organization.

Name: ……………………………………………………………

Position: ……………………………………………………………

Gender :   Male [ ]   Female [ ]

1.   I am satisfied with the current manual system.   Yes [ ]   No [ ]

2.   What is the most delaying part in the current manual process?

         [ ] Team allocation in each day start.

         [ ] Routine vehicles services.

         [ ] Requested vehicle repairing.

         [ ] Get a fuel consumption summary (weekly / monthly)

         [ ] Available teams and vehicles in each day start.

         [ ] Other ……………………………………………………………..

         ……………………………………………………………………..

3.   Do you prefer to work without papers (online)?   Yes [ ]   No [ ]

4.   Do you think system support to vehicle tracking system? Yes [ ]   No [ ]

5.   Current millage monitoring system is in a satisfaction level? Yes [ ]   No [ ]

6.   What are the reports you expect from the system which relevant to you?

         ……………………………………………………………………

         ……………………………………………………………………

7.   Do you think new system must have your ideas (write your ideas)?

         ……………………………………………………………………

         ……………………………………………………………………

         ……………………………………………………………………

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         ……………………………………………………………………

         ……………………………………………………………………

Figure 3-1 Questioner

3.1.2 Requirements Analysis– Interviews

Several rounds of interviews were carried out with Manager, Supervisors, Drivers and Technical staff with open ended questions. Main idea of these questions was what tasks each employee is currently engaged their day to day activities. And what they are expected from the new system to ease their job. These interviews were the main resource of each user's role in the entire process. Also got understand about the bottle necks of the current process they follow in the organization. [9]

3.1.3 Brief the summarized-output:

Manager's expectations:

- Increase efficiency of the organisation vehicle management process. Decrease the staff because he believes after introducing the new system, doesn't need more employees for the future.

- Proper maintenance of records about vehicle details, repairs proceeded and services performed.

- Ability to generate reports on historical data.

- Get rid of unorganized paper-based record keeping system.

- Easy way to assign a team to a particular vehicle.

- Vehicle-related important documents need to be stored electronically and have to stay easily accessible.

- Expect the popup reminders to remind upcoming or past-due vehicles' services, License renewals and Insurance policy expirations.

Supervisors' feedback:

- Need to get rid from the manual excel sheet data entering.

- System should provide vehicle tracking facility.

- Vehicle service calendar.

- Vehicle repairing history with spare parts replaced.

- Vehicle in-out attendances capture.

- Increase the accuracy of the fuel usage figures.

Driver's / Tech staff feedback:

- Vehicles' licenses and service date reminder with SMS.

- Vehicle repairing history report with full details (replaced serial numbers / garage / date).

- Tire Management – they expect well-informed, well-defined tire maintenance and replacement.

- Fuel Usage Report - This includes the vehicle name, driver, current fuel level, the amount of fuel used and runtime. The report can be run by any custom time period.

3.1.4 System Analysis Methods – Document Inspection

During the inspection I have identified some issues which can be easily eliminated with the current proposed system. [10]

Report generation – it is a time-consuming task; supervisors should refer the several files for a simple report. e.g.: Who are the drivers covered more than 500km mileage per week. The process sequence they follow in an acceptable order when considering entire manual system. But the issue is the delay in manual data entering, retrieving delay and preparing documents (reports).

3.1.5 System Analysis Methods – Observation

Observation of work carried out in each step in the office and outside the office (field) to determine how the information workflow runs. Other than understanding organizations main business flow these observations helped to understand the alternative workflows that can occur during real working environment.

3.1.6 Identified issues of the current system

Most of the time branch offices and head office records were not in up-to-date. Management try to kept all vehicles' records at the head office as the central place, also it was a very difficult task. One of the main problems was a particular branch office vehicle's records are not tally with same vehicle's records at the head office. Apparently, the company doesn't have proper centralized system to manage their vehicles. The proposed system is a centralized online system, so it allows system user to get the current situation of the vehicle management of LBN instantly.

Vehicle maintenance history – presently it takes few hours to get a maintenance report. Also, they have to refer several files to get them. And it is a time-consuming process when asking for long history reports. The proposed system reduces the waiting time for reports vastly compare with manual system and the reports are very customizable.

Running charts - There is no proper way to track the vehicle routine. All depend on the running chart that given by the drivers. Management expects establish a proper vehicle tracking system to overcome this issue. The proposed system introduces a vehicle tracking system which helps the supervisor and manager to locate the vehicles in the field.

Fuel consumption – Accurate & average fuel consumption of each vehicle is usually requested by the Finance Department from the Transport Dept. But the figures were given not in satisfactory level due to manual calculations. The Finance Dept. realizes some of fuel consumption reports are not in acceptable standard. Existing reports are needed to update with more attributes, such as fuelled-time and fuel station. The proposed system can be captured all fuel consumption related information island wide, so it can generate reports customizable way within few seconds.

Current work load of existing vehicle management system – Three employees are involving in total vehicle maintenance operation. They spend more time for paper works and information gathering. Also, management believes that if they use computerized system, one employee can handle the entire process. The proposed system needs only one supervisor and the manager operate the entire vehicle management process.

Vehicle repairing – Limited vehicle-repairing detail are kept by the manual system (e.g. they do not keep some repaired items serial numbers) so it may reason for some problems and leads frauds. Also repairing-cost comparison with past records is a time-consuming task. And they expect the repairing history reports should contain more information and lengthy than manual reports. All repaired item details can be stored with the proposed system. Also, the proposed system can review and compare the repairing history of each vehicle with current details

Vehicle related documents – Basically the supervisors and manager need to access the hard copies of vehicle related documents such as vehicle registered book, insurance policy documents, etc. Generally, it is difficult to access these physical documents quickly when they needed. Management wants to store a soft copy of each document in the proposed system. So, they can retrieve soft copy anytime when they needed. The proposed system provides a electronic document storing facility so anytime users can store and access these documents.

There is no proper vehicle service calendar – They manually maintain a paper-based service calendar. Sending a vehicle for a routine service may disturb the operational works. Because unable to arrange replacement vehicle for operation tasks due to lack of upfront information.

The proposed system provides calendar which helps to manage vehicle services properly with reminders without disturbing the routing jobs.

Driver / Team allocation for a vehicle – This is a Technical department and Transport department join task. According to the number of jobs (complaints and operational jobs), the transport manager advises to the supervisor to allocate driver, vehicle and a team for each area. Although, it is very difficult to get a full complete picture of each vehicle's details, their status, maintenance, etc due to lack of updated data. So, the transport manager faces difficulties when arranging the regular vehicle-services and repairs without effecting the normal day to day operations. However, LBN lost considerable amount of money in every year because of the human working hours wastage because of manual team-vehicle allocation. New system facilitates transport department to allocate team for each vehicle in few seconds. This approach will be increasing the efficiency as well as earn customer satisfaction.

3.1.7　Basic Functional requirements

- Registrations: Add/Edit/Delete functions to insert details of following items to the system.

  o　LBN Vehicles

  o　Employees (all employees in technical department and transport department).

  o　Teams

  o　Routes

  o　Drivers.

  o　Available Branches.

  o　Service Centres.

  o　Garages.

  o　Items (Repairing items).

  o　Insurance Companies.

  o　Filling Stations.

  o　Suppliers.

- Assign & unassign Driver, Team-member & Vehicle to a Team

  o　Vehicle information – allocated date & time.

  o　Vehicle allocated Team and Team-members information.

  o　Vehicle allocated driver information.

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- Vehicle Logs

  - Vehicle Mileage Log - Enter in-time and out-time of the vehicle. The new system can be used to track mileage of LBN vehicles.

  - Log Fuel - Select the vehicle & enter following data: odometer reading, receipt number & date, fuel type, Capacity, amount, Filling Station, etc. Generate reports for Fuel Log on given parameters (date range / vehicle number)

  - Vehicle Service Log - Enter routine services details for the selected vehicle & popup reminders for pending vehicle-services.

  - Vehicle Repairing Log – Firstly select the repaired vehicle and enter the repairing related details (Date / Garage/ Cost / Invoice number / Driver), and secondly enter the used items and their serial numbers, supplier and individual prices.

  - Log Other Expenses - Enter vehicle related expenses which are unable to include as repairs or License renewal or Insurance-cost. E.g. Hood rack installation cost.

  - Log Fitness Certificates - Information about the vehicle fitness certificate.

  - Tire Assignment - System can be used to handle tire replacing.

- Reporting tool to analyse the work.

- Annual Renewals - Every registered LBN vehicles renew its Licensees / Insurance Policies / Emission Test on an annual basis. And set popup alerts about Approaching Due Dates.

- Store the soft copies of vehicle related important documents – Scanned copies of Vehicle Registration book, insurance card, etc will be scanned and store.

- Use Message service to communicate with vehicle-phone.

3.1.8 Non- Functional requirements [11]

One of the most important non-functional requirements is security. There should be 3 security levels have introduced. Some users have administrative privileges, some has limited access. Only administrator has the rights to delete data.

Supervisor level security:

The Basic level permitted users can have access most of the pages that only view the details in the pages except deleting features.

Manager level security:

The users who have administration privileges. Able to access / insert / delete data from the database.

- Client is expecting the proposed system should keep on working without the performance significantly dropping.
- Failure management
- Operability
- Portability
- Stability
- Extensibility
- Usability
- Resource constraints (disk space, memory)

3.1.9 Actors of the system

A brief description of actors of the system;

- System operator – The Supervisor who is accountable for data entering into the system, team allocation, vehicle service, repairs arranging, report generating, etc.

- Manager: The person who view management reports and get necessary decisions.

- Administrator: The person who can totally control the system

3.1.10 Use Case Diagram [12]

Figure 3-2: Use Case Diagram

3.1.11 Use case narratives [13]

This section contains use case narratives, and provides a detailed description of use cases.

Use case name: Login	ID: 1	Priority: High
Actor: Supervisor, Manager		
Precondition: User should have account registered on system in active state		
Post condition: User will be logged in to system and proper user session should be created		
Main Path: 1. Display Login Screen 2. User enter login credentials 3. System validates credentials 4. User session created and user logged in to system		
Alternative Path: a. System detects invalid login b. System display error message and redirect back to login screen		

Table 3-1 Use Case Narrative: Login

Use case name: Register Vehicle	ID:2	Priority: High
Actor: Supervisor, Manager		
Precondition: User should be logged in to system, Vehicle master data should be available on system		
Post condition: Vehicle Details should be stored on database and should be able to view on Vehicle list		
Main Path: 1. User Select Register Vehicle from Menu 2. User enters Vehicle details on registration screen 3. System validate input 4. User Click on Save button on Screen 5. System writes to relational store. 6. System display success or failure message		

Alternative Path:
3. a. System detects invalid input
 	
    b. System displays validation error and disable save button
5. a. System fails to save data or database error occurred
 	
    b. System display error message with entered data on screen		

Table 3-2 Use Case Narrative: Vehicle Registration

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Use case name: Register Garage	ID: 3	Priority: Medium
Actor: Supervisor, Manager		
Precondition: User should be logged in to system		
Post condition: Garage Details should be stored on database and should be able to view on Garage list		
Main Path: 　1. User Select Register Garage from Menu 　2. User enters Garage details on registration screen 　3. System validate input 　4. User Click on Save button on Screen 　5. System writes to relational store. 　6. System display success or failure message		
Alternative Path: 　3. a. System detects invalid input 　　 b. System displays validation error and disable save button 　5. a. System fails to save data or database error occurred 　　 b. System display error message with entered data on screen		

Table 3-3 Use Case Narrative: Register Garage

Use case name: Register Team	ID: 4	Priority: High
Actor: Manager		
Precondition: User should be logged in to system.		
Post condition: Team should be registered on system.		
Extend: Register Branch – Extension Condition Relevant Branch Details not available on System		
Main Path: 　1. User Select Register Team from Menu 　2. User enters Team details on registration screen 　3. User Selects Branch 　4. User add team members to team. 　5. System validate input. 　6. User Click on Save button on Screen 　7. System writes to relational store. 　8. System display success or failure message		
Alternative Path: 　3. a. System detects invalid input 　　 b. System displays validation error and disable save button 　5. a. System fails to save data or database error occurred 　　 b. System display error message with entered data on screen		

Table 3-4 Use Case Narrative: Register Team

Use case name: Vehicle Repair	ID: 5	Priority: High
Actor: Manager		
Precondition: User should be logged in to system. Vehicle, Garage details should be available on system		
Post condition: Vehicle Repair active record should be added to system. Vehicle running state should be set to "On Repair"		
Main Path: 1. User Select Add Vehicle Repair from Menu 2. User Selects Vehicle from List. 3. User Selects Garage Details. 4. User Enters details for repair details. 5. System validate input. 6. User Click on save button on Screen. 7. System writes to relational store. 8. System display success or failure message		

Alternative Path:
5. a. System detects invalid input
 	
   b. System displays validation error and disable save button
7. a. System fails to save data or database error occurred
 	
   b. System display error message with entered data on screen		

Table 3-5 Use Case Narrative: Vehicle Repair

Use case name: Register Insurance Company	ID:6	Priority: High
Actor: Supervisor, Manager		
Precondition: User should be logged in to system, Vehicle master data should be available on system		
Post condition: Vehicle Details should be stored on database and should be able to view on Vehicle list		
Main Path: 7. User Select Register Vehicle from Menu 8. User enters Insurance company details on registration screen 9. System validate input 10. User Click on Save button on Screen 11. System writes to relational store. 12. System display success or failure message		

Alternative Path:
6. a. System detects invalid input
 	
   b. System displays validation error and disable save button
8. a. System fails to save data or database error occurred
 	
   b. System display error message with entered data on screen		

Table 3-6 Use Case Narrative: Register Insurance Company

Use case name: Record Fuel Usage	ID:7	Priority: High
Actor: Supervisor, Manager		
Precondition: User should be logged in to system, Vehicle master data, Payment Method and Filling station detail should be available on system		
Post condition: Fuel Usage Details should be stored on database and should be able to view on Vehicles fuel usage history.		

Main Path:
  1. User Select Register Vehicle from dropdown list
  2. User enters meter reading, receipt no, Date, Fuel type, Capacity, Amount, Payment method, Filling station name
  3. System validate input
  4. User Click on Save button on Screen
  5. System writes to relational store.
  6. System display success or failure message		

Alternative Path:
  9. a. System detects invalid input
 	
     b. System displays validation error and disable save button
  11. a. System fails to save data or database error occurred
 	
     b. System display error message with entered data on screen		

Table 3-7 Use Case Narrative: Record Fuel Usage

Use case name: Scanned Document Store	ID:8	Priority: High
Actor: Supervisor, Manager		
Precondition: User should be logged in to system. Vehicle master data & Document type detail should be available on system		
Post condition: Scanned documents details should be stored on database and should be able to view on form and print		

Main Path:
  1. User select registered vehicle from dropdown list
  2. User select registered document type from dropdown list
  3. System validate input
  4. User Click on Save button on Screen
  5. System writes to relational store.
  6. System display success or failure message		

Alternative Path:
  12. a. System detects invalid input
 	
     b. System displays validation error and disable save button
  14. a. System fails to save data or database error occurred
 	
     b. System display error message with entered data on screen		

Table 3-8 Use Case Narrative: Scanned Document Store

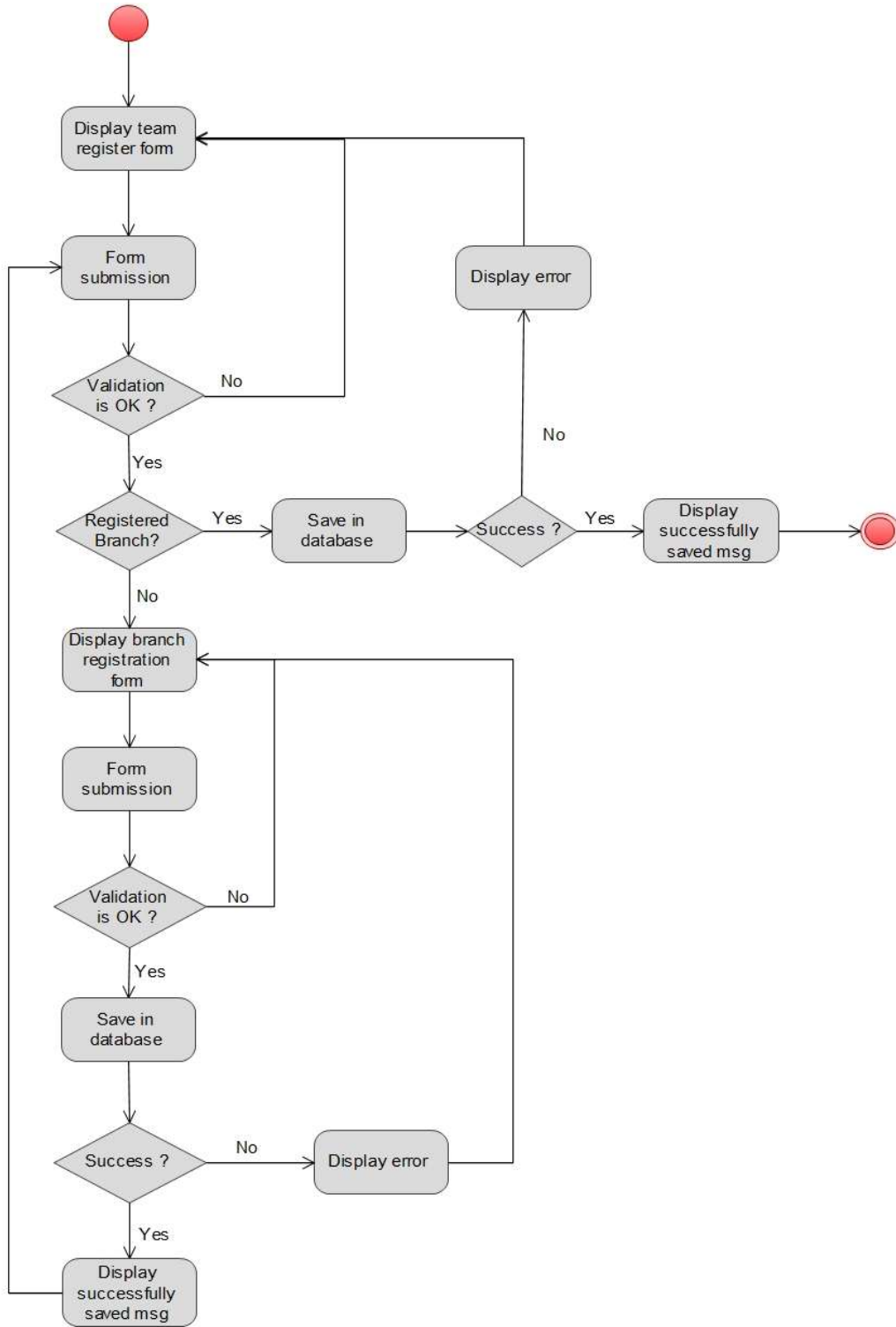## 3.1.12 Activity Diagrams

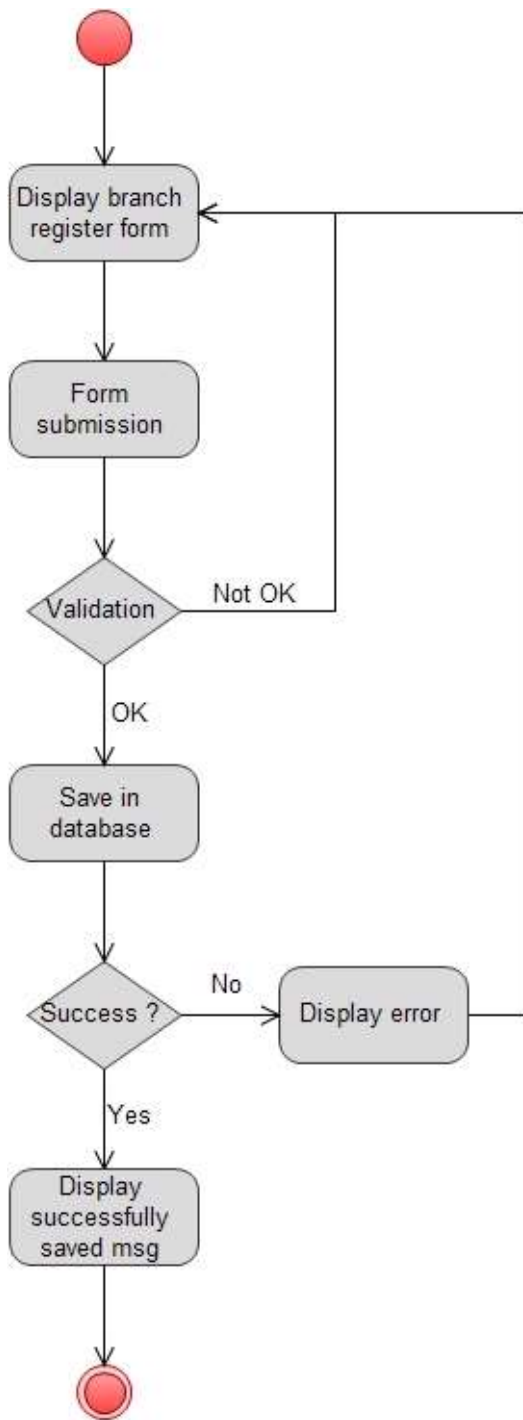

Figure 3-3 Activity Diagram: Team Registration
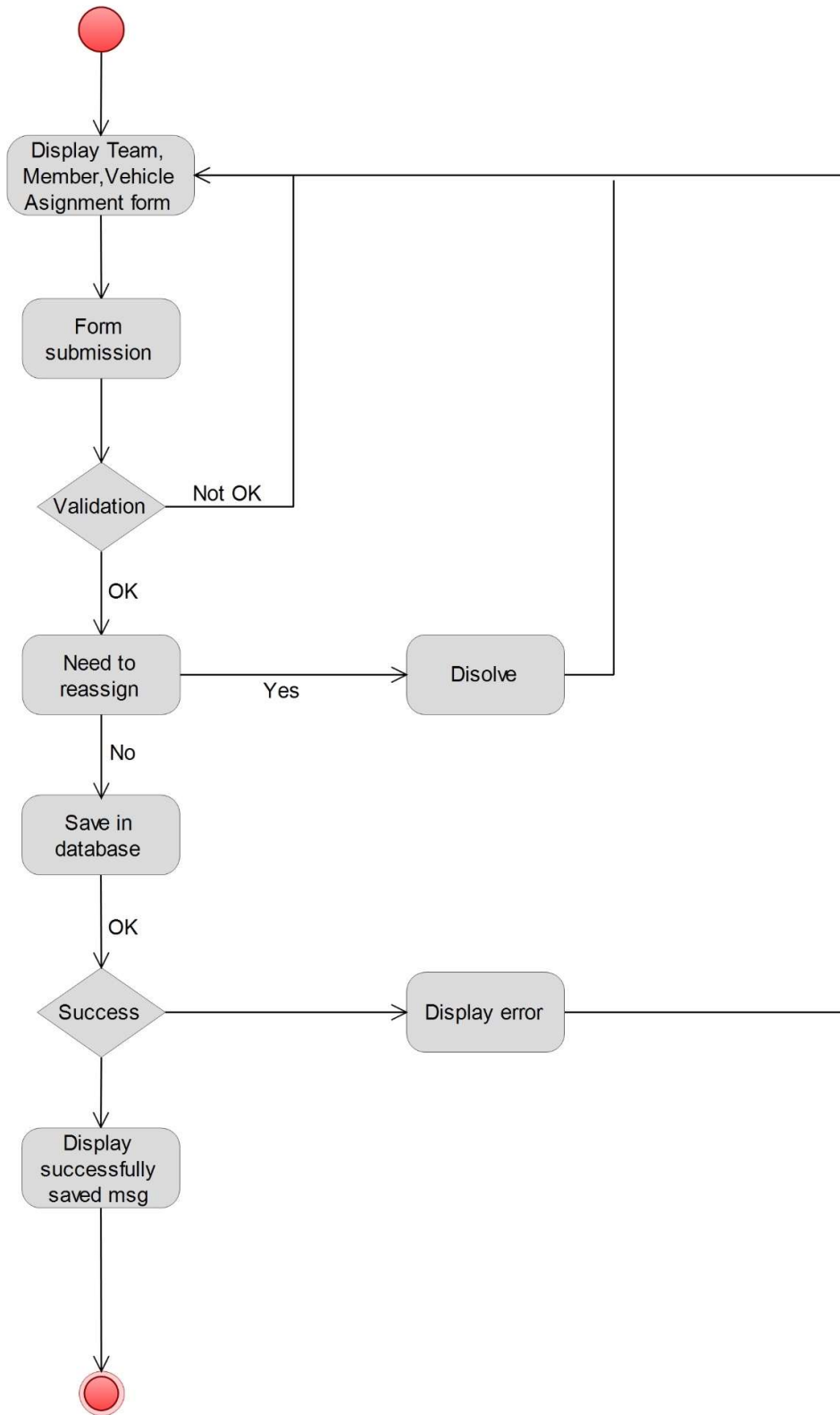
Figure 3-4 Activity Diagram - Branch registration

Figure 3-5 Activity Diagram - Team-Employee-Vehicle Assignment

3.2   Design

Proposed Vehicle Management System is designed according to the client/server architecture. The client runs programs and access data that are stored on the server. Client computer provide interface to allow a computer-user to request services of the server where business logic and database stored and display the results the server returns.

There are several technologies use in software designing field. Few of them are structured methodology, Object Oriented methodology, Top-down and Bottom up designed and etc. Object oriented methodology has been selected as the design methodology for the project. "Object Oriented Design (OOD) provides a mechanism that encompasses three important concepts in software design: modularity, abstraction, and encapsulation (also called information-hiding)."

In this project I used Microsoft Visual Studio 2015 community edition as the IDE and uses .Net as the development frame work. Also use C# as the development language. LBN has the licensee for Microsoft SQLServer 2008 R2 so they requested to use MS SQLServer as system's backend.

3.2.1   Database Design

A properly designed database provides up-to-date, accurate information. Because a correct design is essential to achieving the goals in working with a database. Database design is the process of producing a detailed data model of a database [14] . This data model contains all the needed logical and physical design choices and physical storage parameters needed to generate a design in a data definition language, which can then be used to create a database. A fully attributed data model contains detailed attributes for each entity. In an object database the entities and relationships map directly to object classes and named relationships. However, the term database design could also be used to apply to the overall process of designing, not just the base data structures, but also the forms and queries used as part of the overall database application within the database management system.

3.2.2   Entity Relationship Diagram

An entity-relationship (ER) diagram is a graphical representation of entities and their relationships to each other, typically used in computing in regard to the organization of data within databases or information systems [15] . An entity is a piece of data-an object or concept

about which data is stored. Cooperating with the normalization process can create a successful system. A relationship is how the data is shared between entities (Figure 3-6).
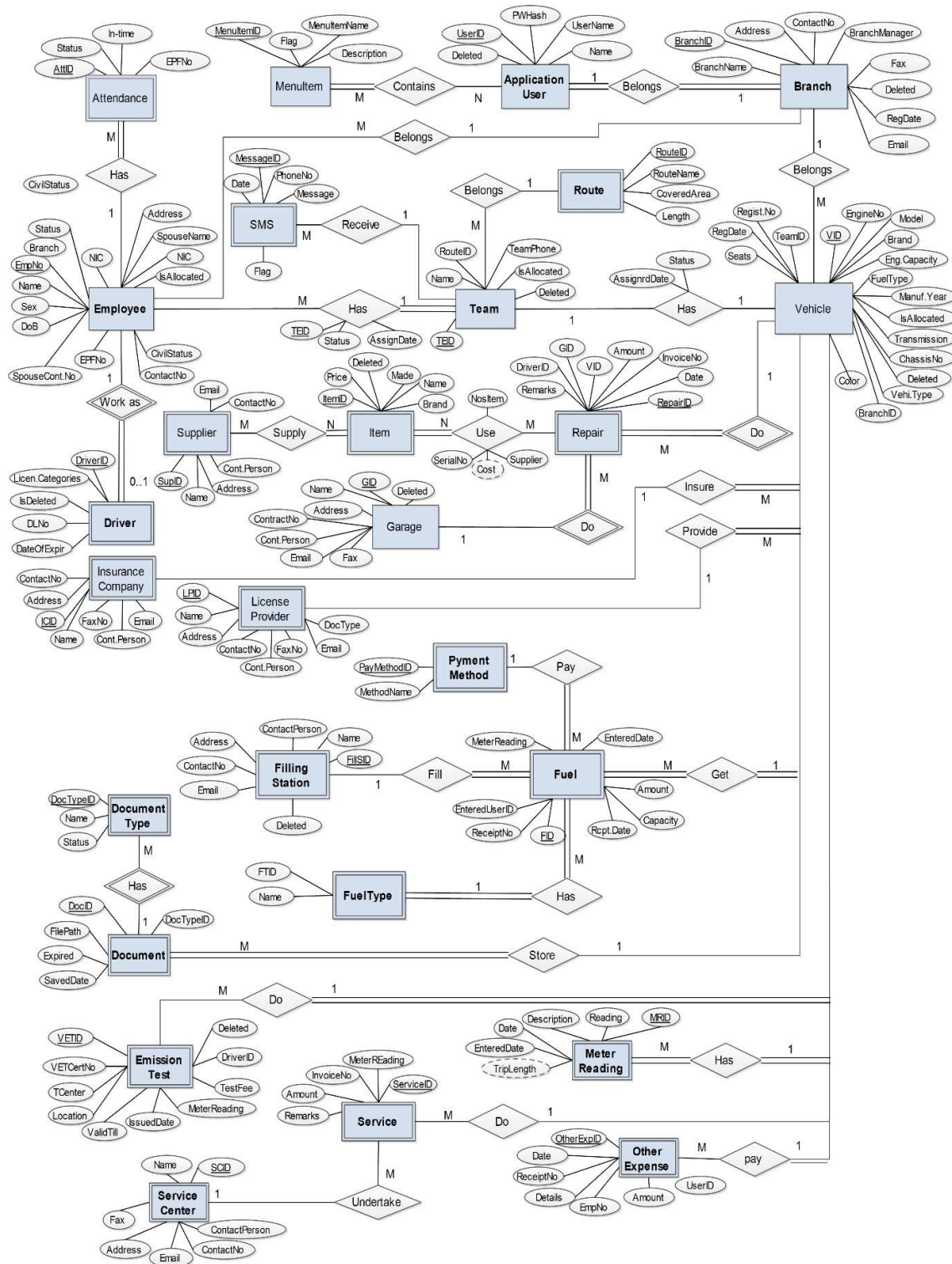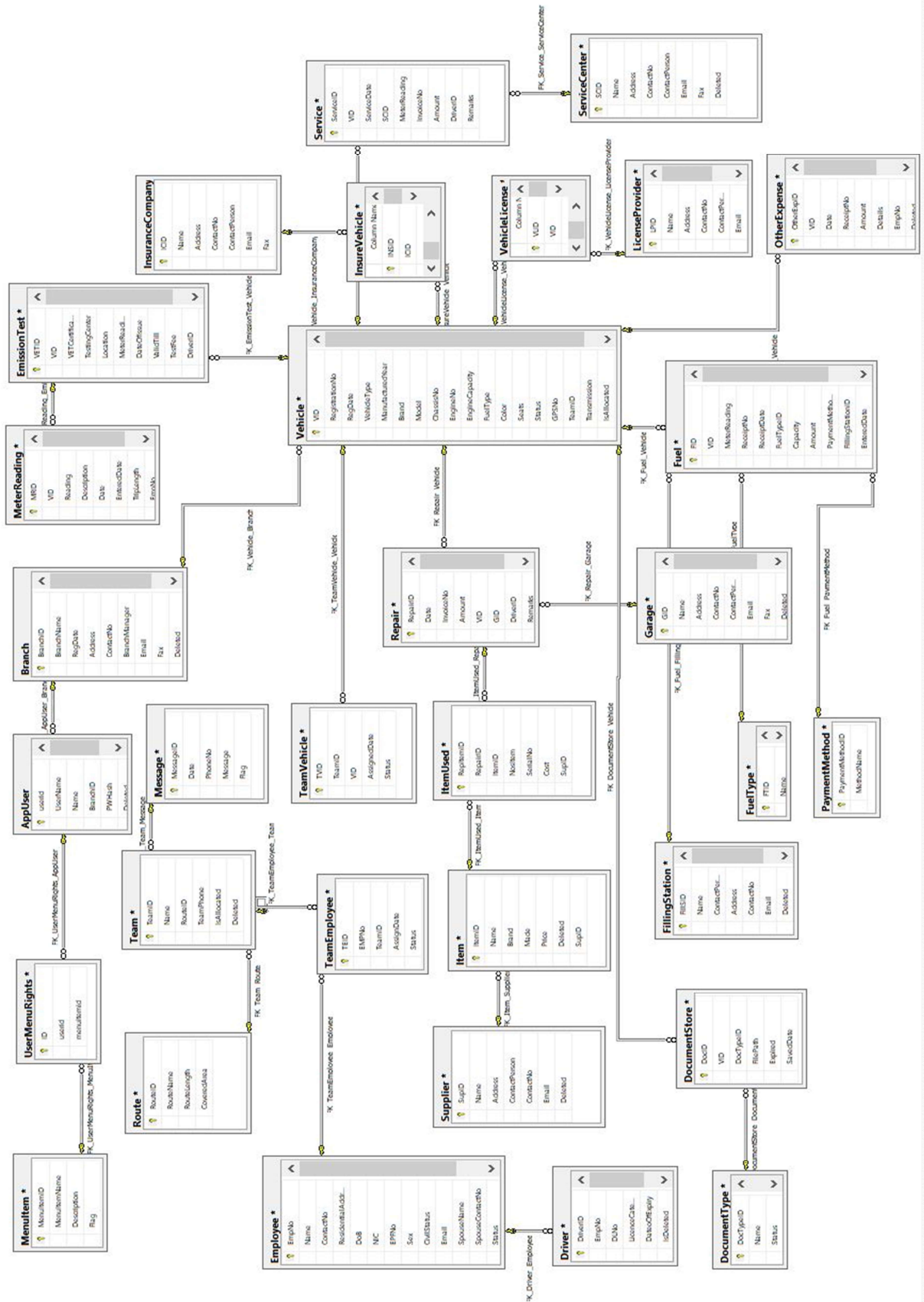

Figure 3-6 ER Diagram

Figure 3-7 Table Relationship Diagram

3.2.3   User Interface Design

3.2.3.1 Introduction to User Interface

The user interface is one of the most important parts of any program because it determines how easily you can make the program do what you want. A powerful program with a poorly designed user interface has little value. Graphical user interfaces (GUIs) that use windows, icons, and pop-up menus have become standard on personal computers. Creating the suitable user interface will gain more effective results to the company or the organization. Also, User interface is the unique identity of the particular organization. [16]

3.2.3.2 User Interface Design

User Interface (UI) Design focuses on anticipating what users might need to do and ensuring that the interface has elements that are easy to access, understand, and use to facilitate those actions. UI brings together concepts from interaction design, visual design, and information architecture. The system developed in windows form system has many types of users (Mangers, System Operators, and Administrators). Since these users have different levels of interests and different levels of needs of the system it was important to spend adequate time to analyze a user interface that was appropriate for all users. Emphasis was given on producing an interface that appears simple but user friendly. However, it was important to provide all the necessary information clearly to the user. In this system mostly used input validations to reduce input errors and also it displays relevant error message when user make mistakes. [17]

3.2.3.3 Main User Interface

The first form is user login form (Figure 3-2). When the user logged in to the system, it will display the main form (Figure 3-3). When user click the login button without submitting any information or if unregistered users try to login to the system it will give error message
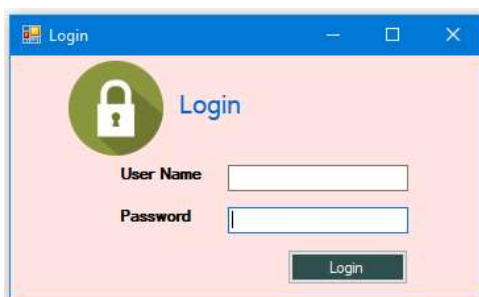

Figure 3-8 Login Form

Figure 3-9 - Main Form
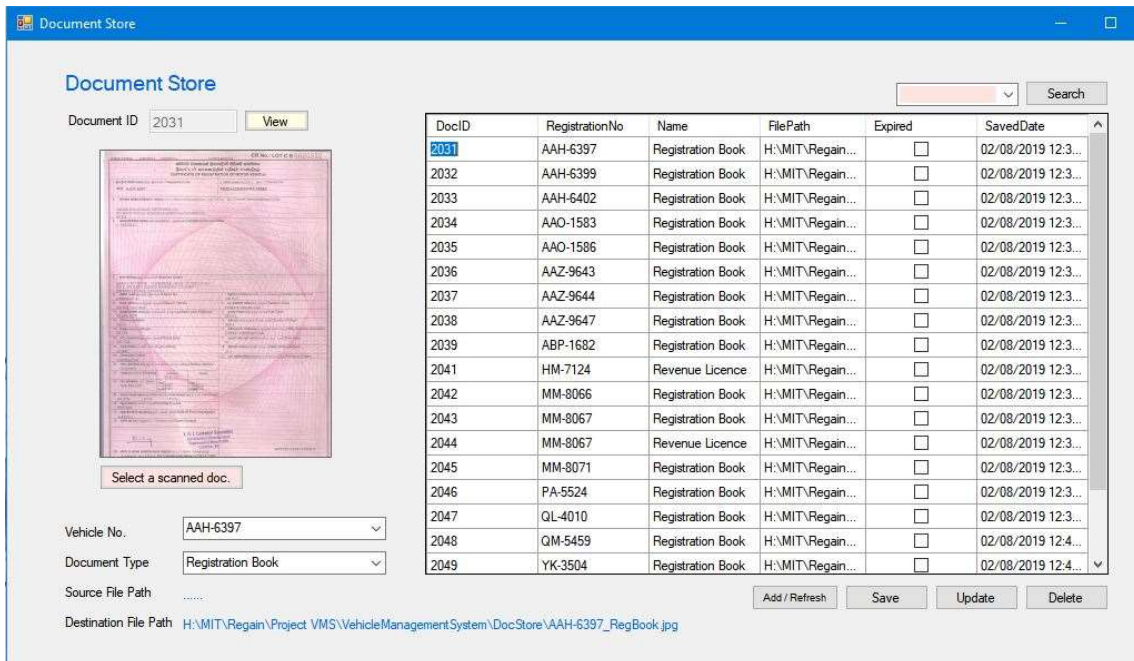
3.2.3.4 Other important Interfaces

Figure 3-10

Form Document Store

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Figure 3-11 Form Running Chart

Figure 3-12 Form Fuel Usage

4   Implementation

The project utilized agile concept to achieve this work. Following sub sections will explain the core functionalities implemented.

4.1   Limitations

- This project mainly focuses on LBN head office at Narahenpita.

- Use android smart phones to get the location coordination.

4.2   Technology used

4.2.1   C# used for the development

The main language used for the development of LBN is C#. It is a general-purpose language designed for developing apps on the Microsoft platform and requires the .NET framework on Windows to work. C# is often thought of as a hybrid that takes the best of C and C++ to create a truly modernized language. Although the .NET framework supports several other coding languages, C# has quickly become one of the most popular.

C# can be used to create almost anything but is particularly strong at building Windows desktop applications and games. C# can also be used to develop web applications and has become increasingly popular for mobile development too.

C# has many features that make it easy to learn. It's a high-level language, relatively easy to read, with many of the most complex tasks abstracted away, so the programmer doesn't have to worry about them. Memory management, for example, is removed from the user's responsibility and handled by .NET's garbage collection scheme. [18]

4.2.2   .Net Framework

The .Net framework is a software development platform developed by Microsoft. The framework was meant to create applications, which would run on the Windows Platform. The .Net framework can be used to create both - Form-based and Web-based applications. Web services can also be developed using the .Net framework. The framework also supports various programming languages such as Visual Basic and C#. [19]

One great benefit of using .Net is its rich set of libraries and helpers. The LBN Vehicle Management Project mostly need a common set of functions or classes. .Net has a set of such commonly used classes, which save developer time.

The .NET Framework has a good security mechanism. The inbuilt security mechanism helps in both validation and verification of applications. Every application can explicitly define their security mechanism. Each security mechanism is used to grant the user access to the code or to the running program. Also, applications built on the .Net framework can be made to work on any Windows platform. LBN needs a secure application. They need their application secure from attacks and SQL injection etc. In using the framework, the application security can be achieved by using built-in classes and libraries. [20] [21]

4.2.3   Microsoft SQL Server as backend

Microsoft SQL Server is a relational database management system developed by Microsoft. As a database server, it is a software product with the primary function of storing and retrieving data as requested by other software applications. LBN has license for MS SQL Server 2014 and system users communicate with the server. The system-users communication with the database server via a local network or the VPN. [22] [23]

Installation and setting up an implementation of Microsoft SQL Server is easy and a relatively simple task. It is also a convenient database to work with. If the developers understand the sql language, they should not face many problems. [24]

Stored procedure is one of the best methods to deal with the data in the database. Many stored procedures are used in the LBN system to increase the efficiency of the system. A procedure can execute bundle of the SQL statements that leads to save time to execute SQL statements. The MS Visual Studio can connect with MS SQL Server easily.

4.2.4   MS Visual Studio 2015

Microsoft Visual Studio 2015 is an integrated development environment (IDE) from Microsoft. It is used to develop the LBN Vehicle Management System. Visual Studio includes a code editor supporting IntelliSense (the code completion component) as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. Other built-in tools include a code profiler, forms designer for building GUI applications, web designer, class designer, and database schema designer. It accepts plug-ins that enhance the functionality at almost every level—including adding support for source control systems and

adding new toolsets like editors and visual designers for domain-specific languages or toolsets for other aspects of the software development lifecycle [25].

4.3 Implemented modules and Source codes

4.3.1 Team-Employee-Vehicle Assignment

In this module the application load Team-Employee form (Figure 4-1). With the form expect to do assign Employees and vehicle to the empty team dissolve filled-team. Also this is a very important task in the system.

Figure 4-1 Team-Employee Assignment form

The form load database connection source code (Figure 4-2). [26]

```
private void frmTeamEmployee_Load(object sender, EventArgs e)
{
    //available teams
    dgvTeamAvialble.RowHeadersVisible = false;
    string qry = "select Name from team where IsAllocated = 0";
    SqlConnection con = new SqlConnection(cs);
    SqlDataAdapter da = new SqlDataAdapter(qry, con);
    con.Open();
    DataTable tbl = new DataTable();
    da.Fill(tbl);
    dgvTeamAvialble.DataSource = tbl;
    DataGridViewColumn tcolum = dgvTeamAvialble.Columns[0];
    //tcolum.Width = 40;
    dgvTeamAvialble.Columns[0].AutoSizeMode = DataGridViewAutoSizeColumnMode.Fill;
    dgvTeamAvialble.ClearSelection(); // default selection removing
    dgvTeamAvialble.AllowUserToAddRows = false;
```

Figure 4-2 Team-Employee form load source code

4.3.2   System user rights

System user rights manage by enabling and disabling of menu items in the main form (Figure 4-3).

Figure 4-3 Form Assign User Rights

Figure 4-4 Assign user rights source code [27]

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5   Testing and Evaluation

5.1   Testing

5.1.1   Introduction

Software Testing is a method of finding out whether a software is working as it should, e.g. giving correct output, working fast enough, handling expected loads, responding to user inputs properly. It also essential to prevent mistakes. Most of mistakes are hazardous. The Developers also make mistakes. So, the developer needs the support of another person to visualize the same thing in different way.

A good test plan is vital for appropriate testing with the software. The quality system can be formed only after right testing with the system.

5.1.2   Testing process

Testing procedure was established during project initiation and all testing were conducted according to the test plan. Basic steps of the testing process are given below:

- First, run the test case defined by the test plan. If there is a severe error, then the process will terminate. Otherwise, it should be continuing until the end of all test cases. Errors can be addressed next.

- There is a need to write down the results of test cases. The result can be a success or a failure. If the result is a failure, then the reason for failure and nature of the problem should be written down accurately.

- Next, the developer should correct the errors that were documented from the test run.

- The Team has to repeat above steps until no errors are identified or error rate is sufficiently low.

5.1.3   Test Cases

Test case should include test, test case, expected results and actual result. Test case acts as the starting point for the test execution, and after applying a set of input values, the application has a definitive outcome

Login test case

Login test case displays in below table

Test	Test case	Expected result	Actual result
Login by system user or Administrator or Supervisor	Enter correct username and password	Successfully logged in to the system	Successfully logged in to the system
	Enter incorrect username	Message: Please enter correct Username	Message: Please enter correct Username
	Enter incorrect password	Message: Invalid password	Message: Invalid password
	Username is empty	Message: Please enter correct username	Message: Please enter correct username
	Password is empty	Message: Please enter correct password	Message: Please enter correct password

Table 5-1- Login Test case

Test case for Vehicle Registration

Vehicle Registration test case displays in below table.

Test	Test Case	Expected result	Actual Result
Add Vehicle information	Press Add button – clear all textboxes. Then Fill the Vehicle number and other necessary fields. Press Save to add details into Grid (database).	Message should display "Vehicle details have been saved successfully"	Error when inserting vehicle
	Vehicle number field is empty and press save button.	Form validation message should display "Please enter Vehicle Number"	Form validation message displayed "Please enter Vehicle Number"
	Engine Number field is empty and press save button.	Form validation message should display "Please enter Engine number"	Form validation message displayed "Please enter Engine number""

	Vehicle Brand field is empty and press Save button	Form validation message should display "Please select a value from dropdown list."	Form validation message displayed "Please select a value from dropdown list."
Delete Vehicles from Vehicle information list	Select a vehicle from the grid and press delete button.	Message should display "Vehicle has been deleted successfully"	Message displayed "Vehicle has been deleted successfully"
Edit Vehicle details	Select a vehicle from the grid and change the chassis number and press update button.	Message should display "Vehicle details have been updated successfully"	Message displayed "Vehicle details have been updated successfully"
Refresh Vehicle form	Click refresh button in the Vehicles registration form	All the textboxes and dropdowns should reset	Textboxes and dropdowns reset successfully

Table 5-2- Test Case for Vehicle

Test Case for assigning Employees and Vehicle to a Team

Assigning Employees and Vehicle to a Team test case displays in below table

Test	Test Case	Expected result	Actual Result
Allocate Employees and Vehicle to a Team	Removed all previous allocations in each day start. Press Dissolve button on Team-Member Assignment form.	Confirmation message to remove all the allocated team members from teams. When press OK button and remove all member allocations in Teams allocated List and Employees Allocated list.	Removed all items in 'Team Allocated List, and "Employees Allocated List"
	Select only Team, Driver and Members and press Assign button	Message should display "Vehicle No. must not be empty."	Message displayed "Vehicle No. must not be empty."

	without entering Vehicle number		
	Select only Team, Vehicle number, Driver and press Assign button without entering Members	Message should display "Team member must not be empty."	Message displayed "Team member must not be empty."
	Select only Team, Vehicle number, Members and press Assign button without entering Driver	Message should display "Driver name must not be empty."	Message displayed "Driver name must not be empty."
	Select only Driver, Vehicle number, Members and press Assign button without entering Team	Message should display "Team name must not be empty."	Message displayed "Team name must not be empty."
Delete an allocated particular team from the list	Click on a particular team in 'Allocated Teams List.'. Press dissolve button on popup form called "Team Details"	Message should display "Dissolved the team that you selected"	Message displayed "Dissolved the team that you selected"
Get Allocated team full details. (Team name, Driver name, Members, Vehicle Number)	Click on a particular team in 'Allocated Teams List.'.	Popup form should display full Team details	Popup form displayed full Team details

Test result for login test case **(**Figure 5-1**)**
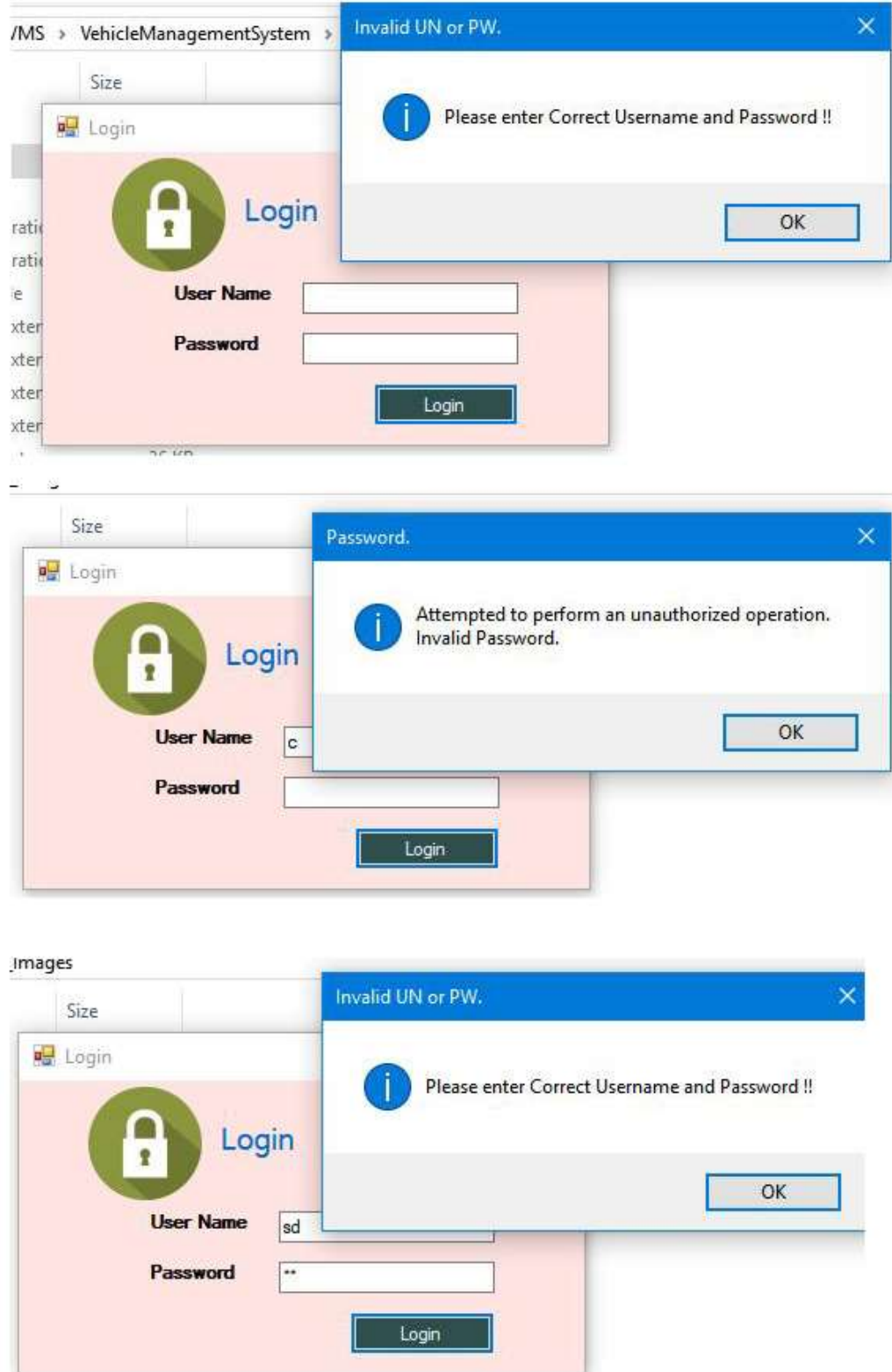
Figure 5-1- Login test results

5.2 User Evaluation

Evaluating usability is now considered an essential part of the system. In a typical user-based evaluation, test subjects are asked to perform a set of tasks with the technology. Depending on the primary focus of the evaluator, the users' success at completing the tasks and their speed of performance may be recorded (Table 5-3). Author used the User Feedback form to gather information.

The used user feedback form:

Name : ………………………		Position:…………………………..	
Strikethrough the unwanted word			
Factors	User satisfaction		
User friendliness of the data entry forms and pages	Bad	good	excellent
Report provides sufficient details	bad	good	excellent
What is the experience you had with new system in comparison with manual system	difficult	no change	much easier now
Navigating links	difficult	easy	Very easy
Frequency of errors or problems	low	medium	high
Ease of learning and familiarizing system	difficult	easy	Very easy
Achieving requirements	Worst	good	Very good
Is the system efficient?	Yes	No	
Data security	Low	medium	high

Table 5-4 - User feedback form

Factor Number.	1	2	3	4	5	6	7	8	9
User 1	good	bad	Much easier now	easy	low	difficult	good	yes	medium
User 2	excellent	good	Much easier now	easy	low	easy	very good	yes	high
User 3	good	good	Much easier now	easy	medium	easy	very good	yes	medium
User 4	good	good	Much easier now	easy	high	easy	good	yes	medium
User 5	good	good	Much easier now	very easy	low	difficult	good	yes	medium
User 6	good	good	Much easier now	easy	medium	easy	good	yes	low
User 7	good	good	Much easier now	easy	low	easy	good	yes	high
User 8	good	bad	Much easier now	very easy	low	easy	good	yes	medium
User 9	good	good	Much easier now	easy	low	easy	good	yes	medium
User 10	good	good	Much easier now	Difficult	low	easy	good	yes	low
Acceptable %	100%	90%	100%	90%	100%	80%	100%	100%	80%
Total Acceptable %	93%								

Figure 5-2 User Feedback data

10 Users have been selected (Figure 5-2) and 5 of them work in Transport Department and this system related with their job. Also, others work in other departments not directly relate with their jobs.

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6 Conclusion

In this chapter all features and steps are reviewed thoroughly. Also taking into attention of results of the project and whether all the objectives were achieved or not. this was developed under agile process and clients participated throughout the development phase. It supports to decrease any misunderstanding among author and the client

6.1 Achievement of Objectives

This project includes many achievements. LBN has a substantial issue to handle their vehicles and the author of this study have confidence in that the solution given from this project is enough to control their vehicles. When a vehicle leaves from the office, it is monitor and guide by the transport department's supervisors and the manager until it coming back. Through this project, LBN is able to overcome the matters effectively.

LBN Transport Department's staff is able to store vehicle details, driver information, vehicle related documents, repairing and fuel usage details, vehicle licenses details and license expirations, route details, vehicle maintenance details, emission test details and etc.

Each day start the system user should update "Today's attendance details" data to the VMS database. Then refreshing the main form, it shows available employees and vehicles for the day start. So, there is no any manual attendance checking. Previously it took more time and the presented data was not accurate. Now it gets few minutes to upload the attendance details to the system. This is one of the main achievements in this project system.

Very important part in the application is "Team-Vehicle-Employee Assignment". Initially teams are predefined without team members, vehicle and driver. Firstly, the system user should dissolve all the teams at say start. That means all teams, employees and vehicles are available for assignment. The windows form named 'Team-Member-Vehicle Assignment' facilitate the allocation process. By selecting team-name, driver, vehicle and members are created an assigned-team. This is the team entitled for field works. Automatically Assigned team, vehicle and employees are removed from the available list in the windows form: 'Team-Member-Vehicle Assignment'. When using new assign- process, LBN can save 95% of time compare with previously time consumed in the manual allocation process and it is a great achievement in this project.

The project system supports scanned documents storing in a particular folder in the server. Initially the system user scanned the document and enter it to the system with details, after that the system can display and print the stored document any time. However, the application supports document searching.   Normally the supervisors need to access vehicle related documents such as Vehicle Registration books, revenue licenses, Insurance policies and other documents for various purposes in day to day work. Keeping a soft copy with the system which make easy for their vehicle related document handling.

There were many practical issues when implementing GPS tracker with the vehicles. Most of the vehicles are three wheelers and motor bikes. So, it was difficult to protect the GPS unit and time responding of the tracker disturbed by the location where the vehicle in. Anyway, we have experienced that an android smart phone is better to locate a vehicle. Since the driver can easily get the location and send the latitude and longitude as SMS. So LBN decided to use smart phones. When the driver reached the customer premises, he should send the location SMS to the given particular sim number. These SMS captured by a USB dongle and load into the database. With this coordination the system maps the vehicle location on Google Map.

 The system is able to send SMS and it is an important feature in routine activities. Supervisors use this feature to inform new customer inquiries details to the driver and crew while they are in field.

System user levels mange with menu item enabling and disabling for the particular system user. This is the easiest way to control system user levels. LBN satisfied with that due to its simplicity.

Report generation is in the very satisfactory level and recommend by the system users and the transport manager. System can generate history reports with filters for Fuel consumption, running chart, vehicle service, vehicle repair, Other expenses, vehicle emission test, Insurance claims / policies and revenue licenses.

Also, the system can render the entire picture of the selected vehicle, for the given date and time. That means where were the vehicle location? what was the team? who were the members? what was the route? who was the driver and what was mileage?

6.2 Lessons learnt

The entire project was a lesson to the Author. The Author is well experienced with C# and SQL are the main languages of this project. MS Visual Studio 2015 was selected as the development IDE. The project uses a .Net frame work and developed system only support for windows flatform.

The System has to connect with Microsoft SQL database and retrieve data, insert data, and delete data are new learning objects.

SMS application developed using C# with .Net framework to send and retrieve SMS. This is a considerable achievement and another new lesson. The AT commands are the key commands to handle SMS. Thus, the Author had to learn AT commands initially and subsequently find a way to execute AT commands through C# and .Net.

6.3 Future improvements

LBN except to integrate their Human Resources system with VMS. Currently VMS get the daily employee attendance details as text file upload. They are asking a way to sync HR system employee   attendance details with VMS employee attendance table.

LBN has Subscriber Management System and their customers log complaints into this system. These complaints need to forward to field-Teams. Currently send them manually type in VMS SMS sending form. They expect to automated this process by integrating two system.

The teams send location coordination via SMS. They copy the Google map coordination of their current location and send it to dongle (particular number). Hope to develop an android app for this process. With that app just press a button send the location coordination so no need any copy and paste Google coordination.

6.4 Difficulties encountered and how they were solved

A practical problem arises when finding the exact location of a vehicle. It needs some time to get a response from GPS Tracker and it is difficult to display the location on time. In cloudy days the GPS tracker not responding properly. Also not responding in huge building areas, most of LBN customers are Apartment and Flats residents. To overcome this issue, we use android smart phones to get the location SMS. When staff needs to find the location, the form will upload the received location coordination Sms and maps the coordination on Google map.

Initially we planned to enter employee morning attendance into VMS manually. It seemed very time-consuming work. So, decided to upload need-data extracted text file from HR System and upload it into VMS with a button click.

When inserting data to the system, the database engine has to execute couple of Sql commands simultaneously. This can be avoided by using stored procedures and views it is an efficient method than using Sql commands directly.

In SMS sending and receiving form, system need to identify the Dongle connected COM port name. It seems difficult do that part automatically, so we give the option to the user to select the correct COM name manually.

6.5 Summary

This project provides solutions to manage LBN vehicles. Most objectives were realized [1] during the period. LBN evaluated and confirmed that this project is applicable under their practical environment with few adjustments. All LBN branches connected to the VMS successfully via the VPN.

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       Available: https://stackoverflow.com/questions/41372709/how-do-nested-for-loops-
       work-in-c-sharp. [Accessed 4 01 2019].

Appendix A - Use cases

UC9: Reports

Use-Case Name:	Reports	Use-Case Type	
Use-Case ID:	UC-9	Business Requirements:	Staff can generate reports
Priority:			
Source:	Requirement definition		
Primary Business Actor:	Staff		
Other Participating Actors:	System		
Other Interested Stakeholders:			
	Generate reports by staff		

Preconditions
System should be up and running and log on to the system
Trigger
Staff can generate reports by clicking on "Generate" button
Typical Course of Events
1. Staff can go to the report panel 2. Select report type and time period 3. Press "Generate" button
Alternate Courses
If there is no data related to the time period, then it will display a message
Post conditions
1. Staff can see report data according to the time and report type

Table 0-1 Use Case Narrative 9 : Reports

UC10: Vehicle Repair

Use-Case Name:	Vehicle Breakdown	Use-Case Type	
Use-Case ID:	UC-10	Business Requirements:	Driver can inform when there is a requirement of the repair vehicle .
Priority:			
Source:	Requirement definition		
Primary Business Actor:	Driver		
Other Participating Actors:	System and Manager		
Other Interested Stakeholders:			
Description:	Driver can inform when there is a requirement of repairing		
Preconditions			
System should be up and running			
Trigger			
Can send sms by the driver, mentioning the problem.			
Alternate Courses			
-			

Table 0-2 Use Case Narrative 9: Vehicle Repair

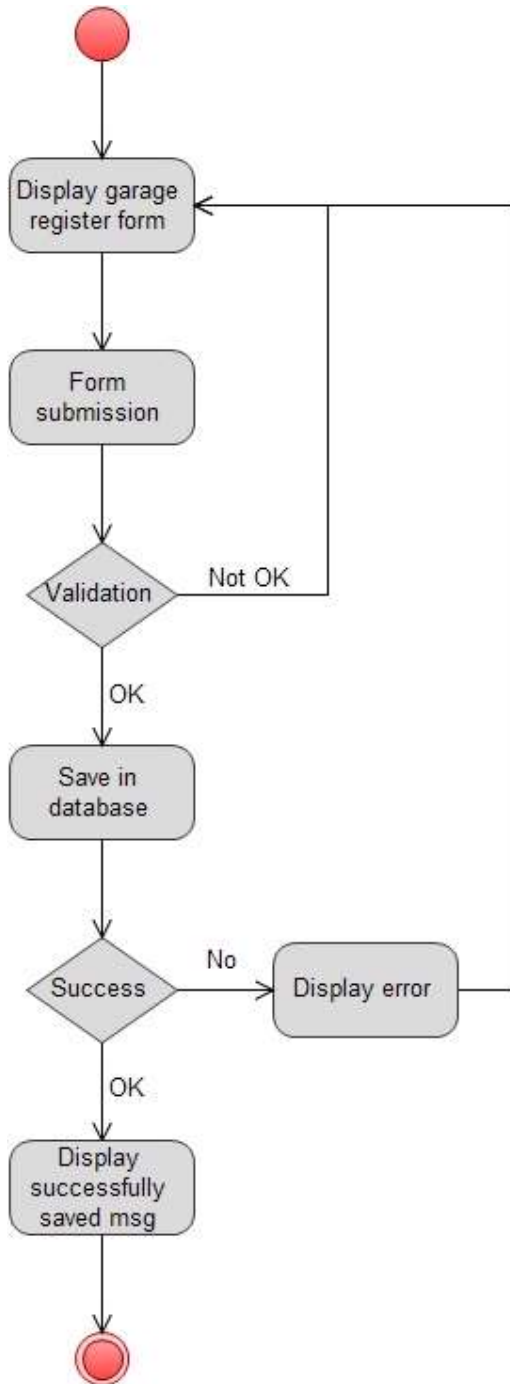# Appendix B – Activity Diagrams

Register Garage

Table 0-1 Appendix B – Activity Diagrams: Register Garage
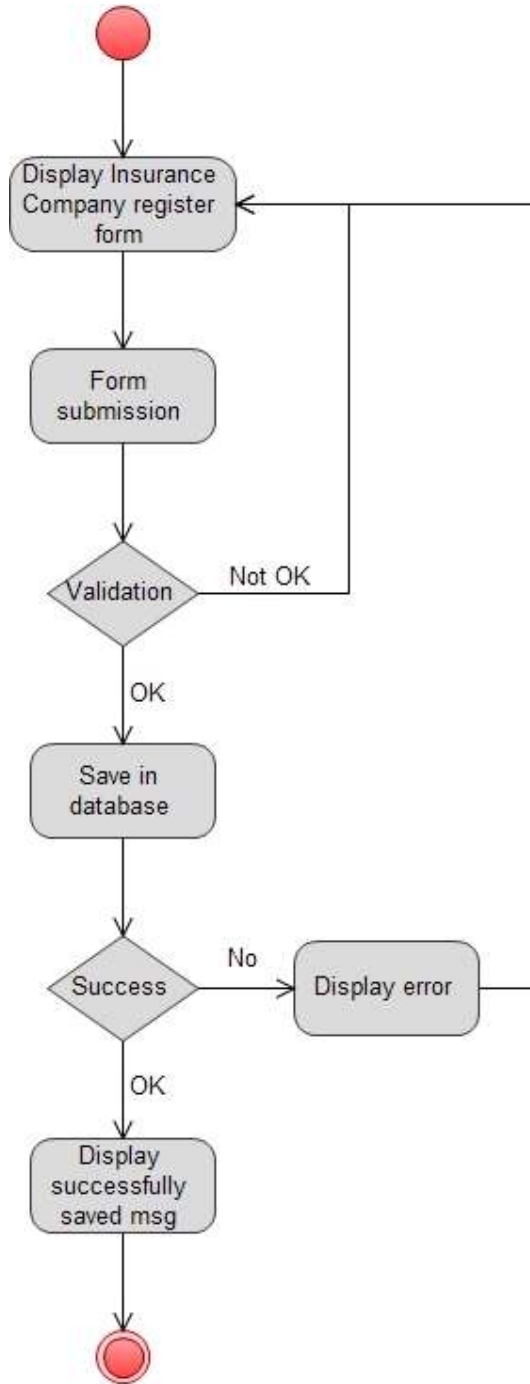
Register Insurance Company

Table 0-2 Appendix B – Activity Diagrams: Register Insurance Company
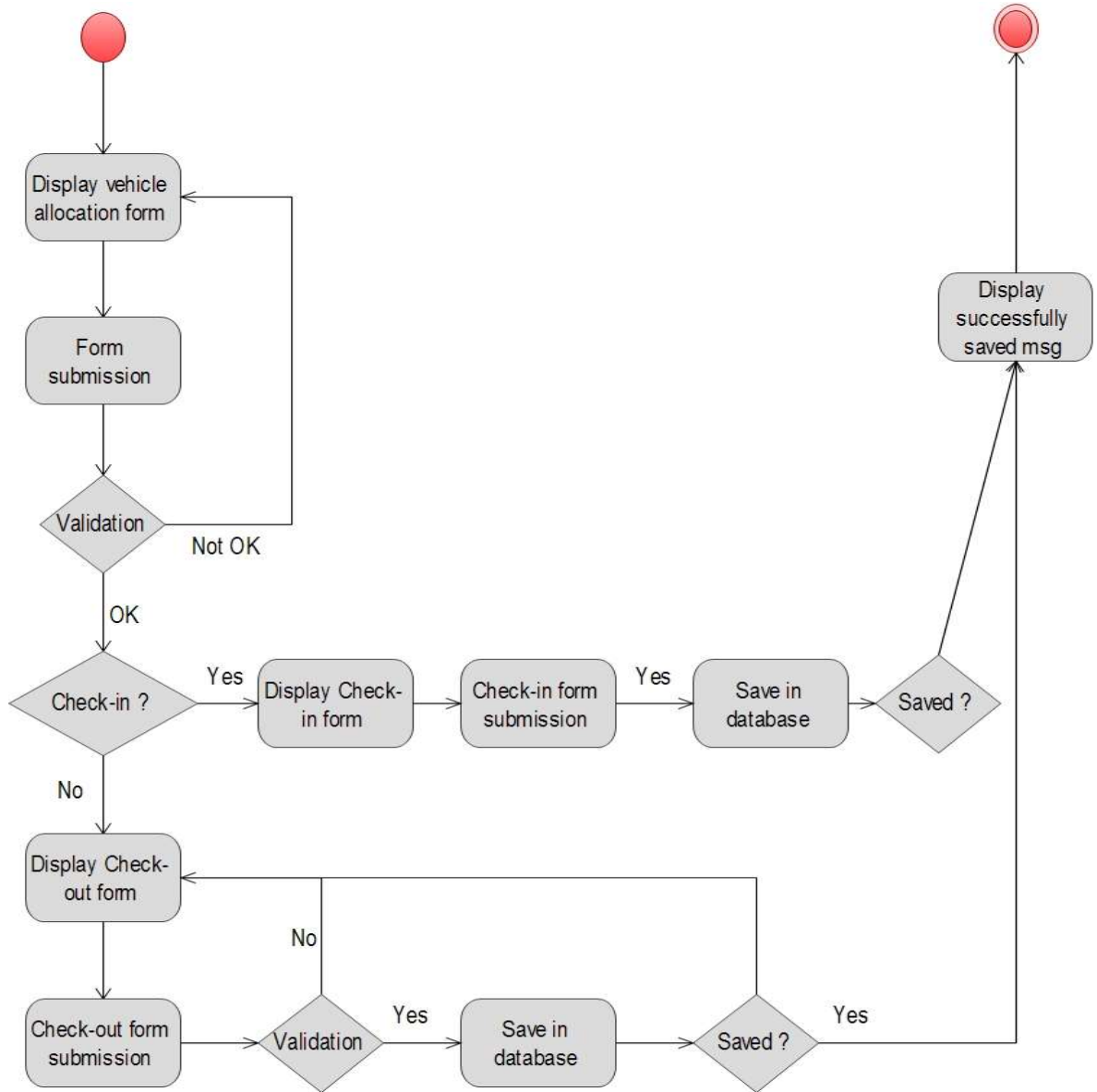
Vehicle Allocation

Table 0-3 Appendix B – Activity Diagrams: Vehicle Allocation

Appendix C – Evaluation Certificate

28th December 2018

MIT Project Coordinator
University of Colombo School of Computing
35, Reid Avenue,
Colombo 7.

Dear Sir,

**RE: EVALUATION CERTIFICATE OF THE VEHICLE MANAGEMENT SYSTEM FOR
LANKA BROADBAND NETWORKS LTD**

The Vehicle Management System contains Vehicle Team- Vehicle - Employee allocation
function and it is an important function because it helps to send our technical teams to field
according to the prepared schedule on time. The rest of the functions are very useful and
can find vehicle locations and all these functions are beneficial to maintain the vehicles
efficiently. It is realized that this can be used as our Vehicle Management Software by
making a few adjustments. The speed of the system and the UI design are friendly to us. I
would like to appreciate Mr. G.S. Chaminda Fonseka since he has achieved our
requirements and fulfilled the expectations.

This letter is issued on the request from Mr. G.S. Chaminda Fonseka.

Thanking You

Yours Sincerely
Lanka Broadband Networks

Sameera Kalupe
Chief Executive Officer

Lanka Broadband Networks Ltd
241/32, Kirula Road, Narahenpita, Colombo 05.
Tel : 5 300 300 Fax : 4 517 220 E-mail: info@lbn.lk
Web : www.lbn.lk