

# **The Progressive Android Based Road Rules Defensive Driver's License Application**



**By**  
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# **The progressive android based road rules defensive driver's license application**



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## **ABSTRACT**

The progressive Road Rules Defensive Driver's License Application will permit users to practice questions remotely using their devices. The system will give users more satisfaction and comfortability than the current system. The android based application can be accessed from any internet browser across the globe on any active internet garget. This system is used as a practice platform fort defensive driving and will create customer loyalty and build trust in between the company and its clients. A careful analysis of the system was conducted and considerations of what the users expects from the system were noted and considered. Observations, interviews and questionnaires where used as data gathering methodologies to help in development of the system.

**DECLARATION**

I, **Tafadzwa Rusere**, hereby declare that I am the sole author of this dissertation. I authorize the **Midlands State University** to lend this dissertation to other institutions or individuals for the purpose of scholarly research.

Signature: .....

Date: .....

**APPROVAL**

This dissertation, entitled “**The Progressive Android Based Road Rules Defensive Driver’s License Application**” by **Tafadzwa Rusere** meets the regulations governing the award of the degree of **BSc Honours Information Systems** of the **Midlands State University**, and is approved for its contribution to knowledge and literary presentation.

Supervisor’s Signature: .....

Date: .....

## **ACKNOWLEDGEMENTS**

This dissertation was a long, arduous and at times, daunting undertaking. I would not have completed it without the help and support of numerous people. Most significant of them all is my project supervisor Mr T.G Rebanowako therefore place on record my deepest gratitude appreciation for his invaluable guidance and support at all levels of this project. I would also want to express my sincere gratitude to colleague, Tawanda Chikosi who supported me in the completion of this work. At the same time, I would also want to extend my thanks to Road Rules Solutions staff that assisted in all my research work and systems analysis. Thank you, especially for your time, patience and resources which have made this project a success. Finally, and most importantly, I would want to say a million thank you to the one and only who gave me the strength, wisdom and the grace to complete this project the all mighty God! His grace and love reflected greatly towards my life, achievement and success which are truly testimony he has done in my life.

## **DEDICATION**

I dedicate this work to my family for working tirelessly to afford me the foundation upon which my achievement is built and the moral support and guidance they have given me through the course of my life. These people are special for they could give consistency and solid support without giving up. I say special thanks to you all and may the dear Lord bless you.

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## **LIST OF ACRONYMS**

VID	Vehicle Inspection Department
TSCZ	Traffic Council of Zimbabwe
IIS	Infrastructure Surveillance System
DB	Database
SQL	Structured Query Language
DFD	Data Flow Diagram
ERD	Entity Relationship Diagram
MSU	Midlands State University

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## **Chapter 1: Introduction**

### **1 Introduction**

Road Rules Solutions Pvt Ltd, is a Zimbabwean start up that closed off 2016 on a high note after entering into a content partnership with the Traffic Safety Council of Zimbabwe (TSCZ). Traffic Safety Council of Zimbabwe (TSCZ) aims to promote road safety through education, training, publicity and research in co-operation with stakeholders in order to encourage the community to understand and adopt safer road usage principles.

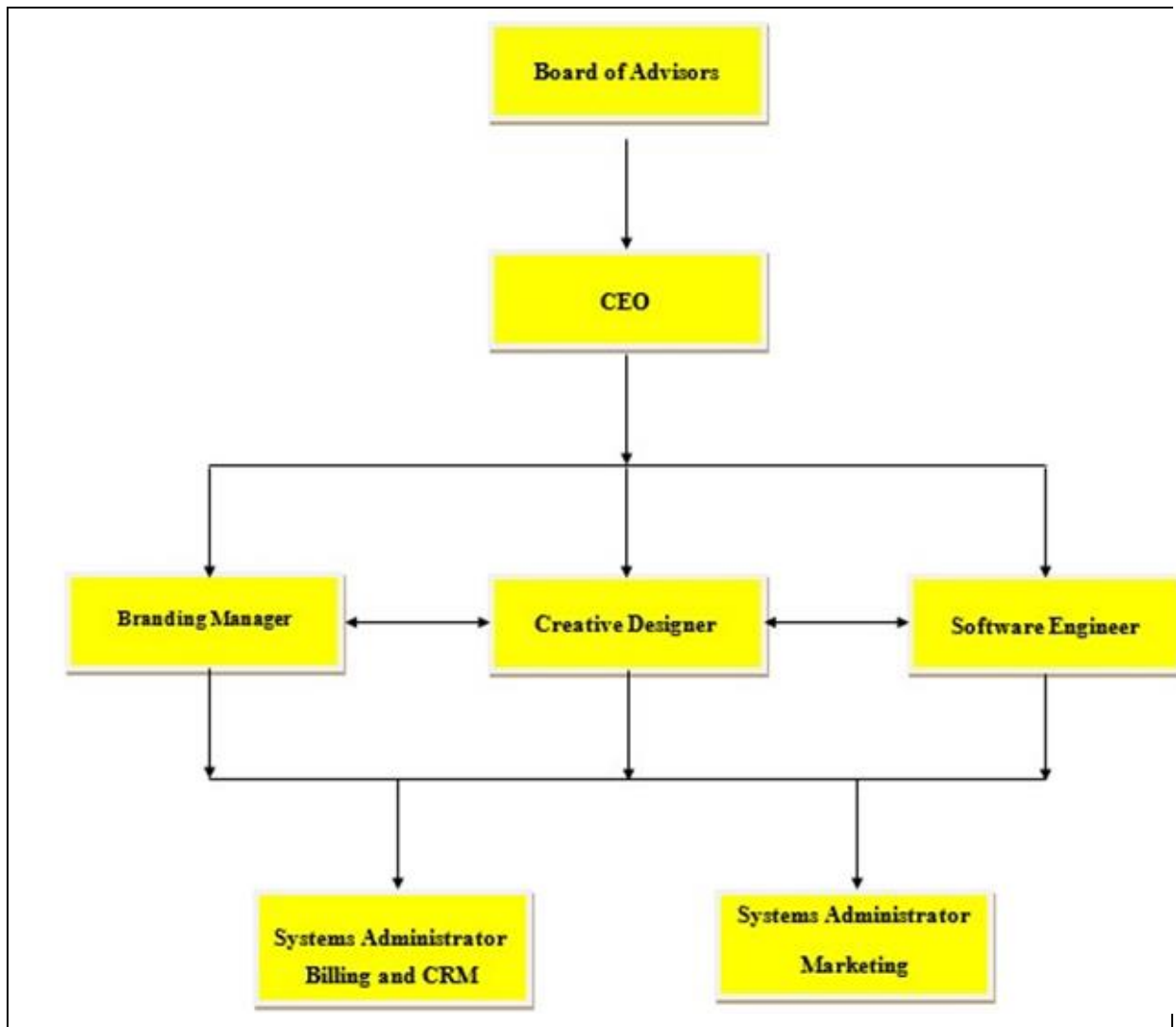
### **1.2 Background of the study**

The project will offer defensive drivers license students a reliable and easily accessed platform to practice and prepare themselves for the defensive drivers license examination which is regulated and conducted by TSCZ.

#### **1.2.1 Background of the Organisation**

Road Rules Solutions is a private owned pan African company that was founded to be a preeminent pioneer of innovative traffic, road safety and transportation technologies in Africa. After competing with over 250 companies in the **Total Africa Start-upper of the year 2016** Challenge, Road Rules won 3<sup>rd</sup> prize in Zimbabwe. When Road Rules was still at concept stage, won the **DEMO Africa 2015** competition, as one of Africa's top 30 startup ideas with potential to scale and grow across Africa. In Zimbabwe, the company competed with more than 160 competitive companies and became a finalist during the 2015 innovation Baraza competition, which was run by **UDUNGU Institute**. Road Rules has received the support of the government of Zimbabwe through the office of the President and Cabinet, the **Ministry of Information Communication Technology and the Zimbabwe Youth Council**.

## 1.2.2 Organisational Structure



## 1.2.3 Vision

To drive a premiership role in the adoption and use of traffic safety innovations in Africa.

## 1.2.4 Mission Statement

To save lives and make Africa's roads safer through the provision of cutting edge technologies and innovations.

### **1.3 Problem definition**

Currently TSCZ regulates, trains and tests drivers across the defensive driving curriculum. However the TSCZ only offers defensive driving material in booklet format at their offices which are only 4 across the nation that is (Harare, Bulawayo, Gweru and Mutare). Below is a list of cited problems with the current system.

- In the current system one has to go to the TSCZ office for the purchase of a defensive driving booklet only to access State approved learning content required for defensive driving certificate.
- The more popular offline methods of learners booklets that are widely distributed through StreetSide vendors.
- Some of these sources have often been highlighted as pools of misinformation by unsuccessful students who end up taking the defensive drivers license test repeatedly.
- Booklets becomes obsolete with time therefore they become expensive to both TSCZ and users as a printed book cannot be updated and requires new print.
- The current system involves too much paperwork.
- Some users are having difficulties with the printed format due to the font used on the booklets so as to accommodate the required material in an A5 booklet.

### **1.4 Aim**

The main aim of the application is to create an affordable, secure complementary learning tool for the defensive driving License and general traffic rules for Zimbabwe, albeit with State approved content.

### **1.5 Objectives**

- To offer unique digital and relevant questions across the Defensive Driver's License curriculum, which has state approved learning content.
- To grade and show results Identity Weaknesses Focus studies to pass the Defensive Driver's License test.
- To design a user – friendly system, which allows anyone with little digital knowledge to user.

- To capture process, store and transmit of sensitive customer data (e.g. personal details, credit card numbers, social security information, etc.) for immediate and recurrent use.
- To allow users to view entire test bank.
- To allow easy retrieval of information.
- To allow many to access the system at the same time.

### **1.6 Instruments and methods**

- **React Js v 15.3/2** is a Java Script library for building user interfaces. React makes it painless to create UIs and render just the right components when data changes.
- **GitHub v 15.54** is a web based Git or version control repository and internet hosting service.
- **PHP\HTML** flexible and simple rapid application development tool that results in rich Graphic User Interface.
- **JetBrains Web Storm 20171.2** creates best java IDE.
- **MySQL** a scalable and robust relational database system .
- **Android studio package** provides the fastest tools for building apps on every type of android device.

### **1.7 Justification and rationale**

Information Systems is a backbone to any business operation since it is a tool that supports business integration, information system is now a key area in an organization it's no longer a department for cutting costs. The application will not only reduce overload to employees, but also improve performance in procedures. The purpose of the application is to offer on a 24/7 basis unique digital and relevant questions across the Defensive Driver's License curriculum which has State approved learning content. The application will efficiently evaluate the candidate thoroughly through a fully automated system that not only saves lot of time but also gives fast results and quick revision with expanded notes on questions taken.

### **1.8 Conclusion**

In this phase, the researcher identified problems experienced by Road Rules Solutions using the current application. The outline of the current framework operations was discussed and a few

objectives of the proposed system were situated. A speculation of adding an Online Defensive License Test application to aid on the usefulness of the current system.

## **Chapter 2: Planning Phase**

### **2.1 Introduction**

Planning is an act of formulating a program for a definite course of action. This chapter covers the planning phase of the proposed system. It determines the worthwhileness of the newly proposed information system. That is the overall benefits to be achieved after the implementation

of the new system matched with the risk associated with the development of that system. This chapter shall focus mainly on the feasibility studies and business value of the proposed system so as to come up with the best blue print to carry out the project.

### **2.1.1 Reasons For Building The System**

The inefficiency of the current system has triggered the need to come up with a new system. Questions and answers are compiled manually and booklets are printed for users. Processing sets of test questions, checking answers and distributing respective material is laborious and time consuming. The application will reduce the hectic job of the current system. The digital application will reduce the risk of users getting outdated and invalid and material for the state regulated Defensive driver's license test certificate. The application will reduce paperwork and counter illegal street vending of booklets. Users can practice the timed tests get answers with further explanations and assess themselves before taking the regulated final test, hence reducing the expense of failure

### **2.2 Business Value**

The focus of this section is to identify the business value of the system to be developed. The development and implementation of the proposed system will work a great deal in improving the effectiveness and efficiency of TSCZ and Road Rules Solutions services hence benefits to the organization. The system will be of great value in the following ways:

- Increased market share, since the new system is a digital application it incorporates everyone an active internet digital device
- Increase in revenue turnover. Through access fees collected from users for the use of the 24/7 available application
- Brand equity, a value premium that Road rules will generate from the product to its users.
- Cost reduction. The amount of paperwork involved is going to be drastically reduced
- Reduction in manual labour.
- Analysis will be very easy in proposed system as it is automated.
- The new system improve customer satisfaction.
- Improvement of Goodwill.

**Table 2.1: Project Business Value Table**

The system will add:
Shareholder Value – Through increased customer acquisition and retention by faster resolution of customer queries, customer base will and market will be maintained and sustainable cashflow maintained.
Customer Value – Easier and quicker detection of the customer faults through the automated system will result in delivering a quality service to the customer and better customer experience.
Employee Knowledge - Enhance business efficiency and attitude among workers since it will be quicker, exact, and easy to understand and solid. The system logs of all faults and solutions will create a knowledge base for future reference to engineers.
Channel Partner Value - Offer acceptable security by using a secure database framework that will thwart connections that are not authorized to the acute data stored.
Manager Value - Enable rapid informed corporate decisions to be made through detailed periodic reports at the disposal of management and access to updated incident archives.
Societal Value – Because of the proactive nature of the system surveillance nature, the status of all equipment is constantly monitored and maintained and will reduce chances of causing hazards to the environment and the community which host the infrastructure such as wireless base stations.

### **2.3 Feasibility Study**

Theuri (2014), this is an investigation to decide whether a prospective project is worth starting. Feasibility analysis measures how practical or beneficial the development of the proposed application is going to be to the organization. This involves ascertaining whether the organization has the capacity to support the project with respect to economical, technical, economical requirements, and operational support within the organizational resource constraints. It therefore justifies the development of the new system or highlights why the project should not continue. The primary concern is to establish if the environment is conducive enough to support the project otherwise it will be infeasible



### **2.3.1 Technical Feasibility**

According to Bentley and Whitten (2007), technical feasibility addresses questions with reference to having the system developed given the clear imperatives as far as resources and time among numerous other constraints. It envelops the capability to use around date improvement, for example, the latest more capable Personal Computers, regardless of if the recognized user requirements might be satisfied using currently employed encoding styles or apparatus. The accomplishment of this investigation likewise relies upon the possibility that the workers will be enthusiastic to prepare to be trained and will not be resistant to change.

#### **2.3.1.1 Technical Expertise Availability**

Taking into consideration the resources at disposal, the system can be built. An analysis on the accessibility the specialized skills was taken into consideration and it revealed that the organization has resident staff with capabilities to harness the proposed innovation since it is a telecommunications company whose core business is technological. Relevant skills are available and at disposal to keep the computerized system running after it is finished since the venture has a requirement of basic technological skillset requirements in order to setup and keep running, therefore the IT department workforce can debug issues faced in the use of the system.

#### **2.3.1.2 Technical Risk Analysis**

The researcher conducted a preliminary scrutiny of the technical risks relating to the likelihood of a technical breakdown hindering the completion or operation of the system. It was discovered that the venture objectives are not theoretically far-fetched to actualize. The venture is attainable technical as it really intends to bring about a thing for which current technologies exist (software and hardware is easily accessible). More so is also compatible with current software and hardware which cannot be modified within the prescribed limits of the project.

#### **2.3.1.3 Hardware and Software Requirements**

Under hardware requirements the researcher will be comparing the hardware that is required and the hardware that is currently available. This will be done in the table below.

*Table 2.2: Hardware and Software Analysis Table*

Quantity	Item	Specifications
1	VPS server	<ul style="list-style-type: none"> <li>• 8GB RAM</li> <li>• Core i7 processor</li> <li>• 3.40 GHz Speed.</li> <li>• 40 GB Hard drive</li> </ul>
1	Backup VPS Server	<ul style="list-style-type: none"> <li>• 2GB RAM.</li> <li>• Core i3 processor.</li> <li>• 2.4GHz Speed.</li> <li>• 20GB Hard drive</li> </ul>

Table 2.1 Hardware requirements

### 2.3.2 Organizational Feasibility

According to Bentley and Whitten (2007), organizational refers to the stage that surveys and evaluates the dangers concerning the progression of the project relating to the company workers. The projected framework ought to compliment the general purposes and aims of Road Rules.

#### 2.3.2.1 Management

This suggested system will impact the management in a progressive manner. The management's professional processes rely a lot on the dependability and integral qualities of the information and the system in its entirety. Amongst the goals of the venture is the ability of the system to provide precise and updated data for managers. The commissioning of the new system will enable the generation of timeous report and facilitate effective communication. Managers rely on reports and use them as measuring tool for productivity since they offer them control. In this regard the usefulness of the administrative business procedures will be enhanced significantly.

#### 2.3.2.2 Employees

The effective execution of the planned system will transform the mentality of the workers in respect of their work by being a morale booster. The presently used system has become a hindrance to progress and time consuming for the mainstream workers who have been using it. As soon as all system users are inducted, the workers will be empowered to do away with the cumbersome process that they were accustomed to and constantly going through in network and system monitoring. Employees are going to be assisted swiftly and the chances of errors will in turn be significantly decreased enabling effectiveness.

### **2.3.2.3 System Engineers and Administrators**

The system engineers' work will be to support the proposed system. Road Rules will benefit from technical support it will get from the equipped resident engineers and system administrators and this will not be an issue since this group is already highly conversant with systems development and implementation. Drawing from the overhead organizational feasibility investigation, the suggested system would require extra support from the general workforce involved in the venture all in all and chances are high that it will be invited as the new framework will significantly address the vast majority of the present system issues.

### **2.3.3 Operational Feasibility**

According to Bentley and Whitten (2007), operational feasibility refers to the emphasis on the operations of the system as to how useful it is, and also if we have at our disposal the skilled resources to satisfy the project requisites. This as well looks the effects the system will have on the stakeholders in the company and also whether or not it will be fully supported by the managers. More so it assesses if the venture will put the workers' jobs at risk or if it will work in their favour by further widening prospects. Training of system users once it gets operation will be of essence but however a proactive step of attaching a self-help guide built into the system will also be adopted to clarify any grey areas.

Operational feasibility relies on the following:

- Support and management of users.
- Involving users in the planning.

Following the assessment of operational feasibility, we realised that we can work the proposed new system. We have the hands-on staff that meets the venture requirements beginning up from development manager to the system users. In instances of crisis, a reinforcement team has been extended to standby. The identification of organizational stakeholders has been conducted taking into consideration their goals prior to the passing of the ultimate objectives. Widespread support is being received from the stakeholders as they have also come to the realization that the present system is proving to be costly to the institution as well as not delivering any significant benefits the employees.

Be that as it may, the new system will expand worker prospects. Workshops will be conducted to train users on every module of the system once it has been finalized and an accompanying user guide will come as an attachment to the system for users' consultation on system related issues.

### 2.3.4. Economic Feasibility

According to (Kendall, 2006), economic feasibility study should show viability in costs and benefits of the project before financial resources are allocated thereby providing independent project assessment and enhance project credibility. This study is commonly the final analysis in a number of projects. It seeks to address questions such as whether or not the system should be developed and in the event that it was developed, will there be sufficient financial resources to see it through. This will hence include every cost that will be related with the development process of the new system. This can be related to the cost – benefit assessment that is cognisant of the measurement of the project’s impact on finances. In the case of Road Rules Investments, the system will be developed in house using the company’s already available technical, financial and system resources.

#### 2.3.4.1 Costs

##### 2.3.4.1.1 Development Costs

Costs associated with development are once-off cost that are encountered during the course of the system development, and these can be estimated from the beginning of the venture and can be amended at the conclusion of each stage of the project. Costs of development are tabulated below.

*Table 2.3: Development Costs Table*

<b>Development Costs</b>	<b>Year 1</b>
	<b>S</b>
Server	160
Digital Ocean.com	240
Expect labour	350
<b>Total development costs</b>	<b>750</b>

Table 2.2 Development Costs

### 2.3.4.1.2 Operational Costs

These happen to be incurred through the lifespan of the respective system. An example of this is costs associated with system maintenance. These costs can be further classified as variable costs and fixed costs.

Fixed: These are incurred regularly at rates that do not change for example rentals, staff salaries and software licensing.

Variable: These are incurred at rates directly proportional to the usage for example prorated costs on overheads.

**Table 2.4: Operational Costs Table**

<b>Operating costs</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>
	<b>\$</b>	<b>\$</b>	<b>\$</b>
Maintenance fees: Hardware	0	100	250
Software	0	200	200
Support	300	150	100
Training costs	50	0	0
<b>Total operating costs</b>	<b><u>350</u></b>	<b><u>450</u></b>	<b><u>550</u></b>

Table 2.3 Operational Costs

### 2.3.4.2 Benefits

Through the use of the system, the organization is expected to realize the benefits illustrated in the below table.

**Table 2.5: Benefits Table**

<b>Description</b>	<b>Approximate Value (USD)</b>
Reduction in SLA target fines	6000
Reduction in revenue leakage	2000
Reduction in labour costs	4000
Reduction in stationery costs	300
<b>Total</b>	<b>12300</b>

### 2.3.4.3 Cost Benefit Analysis

According to Ramia (2014) this is a structured methodology of forecasting and comparing the anticipated costs and benefits of alternative courses of action in order to identify the most effective manner of achieving a stated goal or objective. This phase assesses whether it is financially viable to continue the project.

**Table 2.6: Cost Benefit Analysis Table**

<b>Benefits/Costs</b>	<b>Year 1 \$</b>
<b>Tangible benefits</b>	
Defensive drivers App Revenue	250 000
<b>Intangible benefits</b>	
Increase in employee morale	200
Improved quality service	1000
Goodwill	2000
<b>Total benefits</b>	<b><u>253 200</u></b>
<b>Costs</b>	
Loss of market share (0.8*250 000)	200 000
Operational costs	350
Development costs	910
<b>Total costs</b>	<b><u>201 810</u></b>
<b>Net benefits</b>	<b><u><u>51 380</u></u></b>

Table 2.4 Cost-Benefit Analysis

Drawing for the table for cost-benefit analysis above it is visible that the first year through to year end will yield positive financial results of \$5 990. We can therefore reach a conclusion that the project implementation proposal is feasible economically.

### 2.3.4.4 Return on Investment Analysis

This can be characterized as a money-related measure of the results of a business venture. This is defined as a financial measure of the return from an investment typically conveyed as a percentage of profit delivered through an asset for the sum introduced into the resource. The ROI per annum can be figured out using the following formula.

“Return of Investment, (ROI) provides a simple way to calculate the measure on return of capital invested or compares the net profitability to the investment required.”

$$\text{“ROI} = \frac{\text{average annual net benefit}}{\text{“Total Costs”}} * 100\text{”}$$

$$= \frac{\text{“51380”}}{\text{“200 910”}} * 100\text{”}$$

$$= \text{“26%”}$$

“**Comment:** The return on investment is positive showing that it is favorable to carry out the project.”

A high ROI (above average) for the % might indicate that the undertaking shows viability.

#### **2.3.4.5 Net Present Value Analysis**

This scheme takes into consideration the consistency of the venture the cash flow timings. The discount rate factor is used here as well. This is done by applying a discount on future cash flows by a fraction known as the discount rate. This scheme is commonly applied where the projected cash flows are for several years and not just for a single year as it might give a misleading result.

$$\text{NPV} = \frac{\text{Benefits (Total)} - \text{Costs (Total)}}{(1+r)^n}$$

Whereby: Interest Rate = r

No of Year = n

#### **Advantages**

- Not only are just the benefits and costs considered, they are more so adjusted factoring in the timing.
- Future estimates are also factored in.

**Discount Factor** =  $1 / (1 + r)^t$ ; where  $r$  = Discount rate and  $t$  = time

**Present Value** = Value in Year \* Discount Factor

**Net Present Value** = Total of Present Values

Based on a discount factor of 20%.

$$\begin{aligned} \text{NPV} &= \frac{51\,380}{(1 + 0.20)^1} \\ &= \underline{\underline{\$42\,817}} \end{aligned}$$

**Comment:** A positive and valuable NPV shows that the project can be considered. However payback would have done more justice to consider this kind of a project.

#### 2.3.4.6 Comments

The prior solution put into comparison with other solutions produced the most favourable Return on Investment. Therefore, from the Return on Investment Analysis perspective, the project viability is visible.

#### 2.4 Risk Analysis

This stage classifies, assesses and attempts to bring about resolutions to issues that may go wayward in the venture way before they develop into threats that may become a hindrance to the accomplishment successfully of the project and/or the commissioning of the planned system. The following log of risk analysis is corroborated by the economic, technological and several other classes of risk that can be linked with the commissioning of the new system proposal. The successive logs scrutinize and give recommendations in order to decrease the probabilities of endangering the new system as well as any other tasks linked to it.

**Table 2.7: Risk Analysis Log**

	<b>Risk Statement</b>	<b>Occurrence Probability</b>	<b>Risk Occurrence Impact</b>	<b>Action to Prevent</b>
1	Shortage of resident resources	Low	Delivering less than expected due to mounting pressure on few human resources	To cease allocation of resources towards the improvement of the old system



2	Shortage of resident project management and technical skills	Low	Protracted learning curve  High staff turnover as a result of the exit of skilled workforce	Encourage peer training groups  Recognize necessary trainings and offer it to all relevant team member
3	Poor execution against timetable by project members	Medium	Inability to finish the project inside the planned time and budget, thereby extending the costs of the project	Meticulously evaluate the performance of the developers and in house participants.
4	Inability to forecast deliverable to satisfy requirements	Medium	Inability of the coders to adhere to specifications will in turn lead to delays in the launching of the product	Support a rational joint group of relationship of in-house members and engineers
5	Lack of data integrity	Medium	Will foul up the project execution if the information is taken online without a tidy up	Get an appreciation of data conversion pre-requisites and clean up all the data upon conversion
6	Loss of Equipment	Low	Delay of the project  Increase project costs	Security systems on all equipment  Fire preventive measures on the indoor equipment  Insurance for all equipment

## **2.4.1 Other Risks**

### **2.4.1.1 Users**

The other risk that the system might face is that the users might have the impression that it may be too challenging and in this case they may risk losing their jobs. There will be need to restore confidence in the users otherwise the system will be bound to fail due to sabotage. With the Road Rules proposed system no jobs are threatened instead job opportunities are likely to increase and users will be informed that the new system will not jeopardize any one of their jobs.

### **2.4.1.2 Technical Risks**

- Diverting expects time of the I.T department to the development of the new web based system might compromise servicing time of the current system. Therefore careful allocation of expect resources must be made. The system must be thoroughly developed and it must meet a high degree of satisfaction.
- The users might find it difficult to maintain the system or restore it in the event of a crush. It being a new system, it will need to be backed up and fully supported. Once the system has been implemented, there would be support for the system and maintenance of the proposed system in the first couple of months till the system is in them and they can fully operate it independently.
- Deployment of the system is going to require the use of sideway compatibility modules for integration with the web based platform on the same system to cater for those users who do not use Android based mobile devices. The two systems will operate at the same time for a short duration of time just until the risk of failure or difficulty for new system is cushioned, especially the accounting side so as to avoid errors of omission and if already done be able to refer to manual process. The technical risks would be of no further importance considering that there is a fall-back plan in case the new system fails to deliver.

### **2.4.1.3 Economic Risks**

- Costs of hardware and software, which keep escalating can jeopardize the project and may actually be at the risk of termination. If the organization really needs the system, it has to budget for it to avoid shortfalls in the development process. All the resources must be readily available

and fully functional. The risk is thus avoided by the allocation of a supplementary budget for the system in the event of prices continuing to escalate.

#### **2.4.2 Feasibility Study Conclusion**

After analysing the feasibility of the proposed system recommendations were passed to go ahead with the development of the proposed system. The benefits outweigh costs and within a year.

#### **2.5 Stakeholder Analysis**

Stakeholder analysis is an important step in designing a new program. Stakeholders include individuals, community leaders, groups and other organisations who will be impacted by the program, or who could influence the outcome. Stakeholders are all those who need to be considered in achieving project goals and whose participation and support are crucial to its success. Hence identification of all stakeholders is an important activity of the project manager to ensure project success

##### **2.5.1 Users**

The support engineers and customer services representatives disclosed that they had a fear of the unknown but after elaborations of the new system they realized the importance and efficiency of it. The introduction of the new system will improve service efficiency as troubleshooting tools are built into the system and system monitoring will be done in Realtime.

##### **2.5.2 Management**

Management expected to be able to pull reports from the system. This requirement has been fulfilled as the management can pull on-demand reports weekly, monthly, quarterly and so on. These reports can help management make business decision like which systems need more attention and investment to gain competitive advantage.

##### **2.5.3 Customer**

Customer are also another group of stakeholders to the system. Customer generally expected greater system uptime to be able to access the service they pay for when they want to use it. This system addresses this need by allowing minimal downtime by giving Realtime notifications whenever a tracked entity or node goes down hence prompting rapid response from the engineers to meet the agreed service level agreements with the customers.

#### **2.6 Work Plan**

The aim of a work plan is to come up with a schedule of events and expected time of completion of all tasks involved to enable project progress monitoring. The Systems Development Life

Cycle shall be used to model the activities that are going to be followed in the system development of the project. The stages of SDLC have time spans allocated considering the amount of time needed for work involved in each task.

- This model has been chosen over other models, since it is a well-documented and widely used approach.
- This is a linear approach involving the stages that are clearly defined at each stage.
- Each phase is given a time allocation from the beginning to the end of the project.
- Targets are easy to set with this approach, and one knows exactly what needs to be done from which period of time.
- There is an elaborately written documentation at each phase, this helps in developing a well-documented system.

### 2.6.1 Project Schedule

*Table 2.8: Project Schedule*

<b>Project Phase / Stage</b>	<b>Start Date</b>	<b>Finish Date</b>	<b>Duration in Days</b>
<b>Proposal</b>	<b>13/10/2017</b>	<b>18/10/2017</b>	<b>5</b>
<b>Planning</b>	<b>19/10/2017</b>	<b>25/10/2017</b>	<b>7</b>
<b>Analysis</b>	<b>26/10/2017</b>	<b>10/11/2017</b>	<b>13</b>
<b>Design</b>	<b>11/11/2017</b>	<b>01/12/2017</b>	<b>21</b>
<b>Implementation</b>	<b>02/12/2017</b>	<b>17/12/2017</b>	<b>15</b>
<b>Maintenance</b>	<b>18/12/2017</b>	<b>Ongoing</b>	<b>1+++</b>
<b>Documentation</b>	<b>28/01/2018</b>	<b>Ongoing</b>	<b>7+++</b>

### 2.6.2 Time Plan Gantt Chart

It shows the time taken to carry out the activities, which are grouped into different phases. The phrases are carried in weeks as shown below.

**Table 2.9: Time Plan Gantt Chart**

Activity / Duration (Weeks)	WK 1	WK 2	WK 3	WK 4	WK 5	WK 6	WK 7	WK 8	WK 9	WK 10	WK 11
Project proposal											
Planning											
Analysis											
Design											
Implementation											
Maintenance											
Documentation											

**2.6.3 Project Size**

The project size should be moderate. The system to be designed should be fairly understood so as to avoid complexities. In this case our (project) proposed system is small and manageable and encompasses on few modules.

**2.7 Conclusion**

Despite the constraints we will face in coming up with the system, it is now clear that it is feasible to carry out the project and hence we are going to proceed to the next phase that is the Analysis phase. The Analysis phase focuses on the detailed study of the current system and its main aim is to determine the importance, complexity and the scope of the problems that exist in the current system giving a go ahead to the logical design of the proposed system.

## **Chapter 3: Analysis Phase**

### **3.1 Introduction**

“Analysis is a problem solving technique that decomposes a system into component pieces for the purpose of studying how well those components parts work and interact to accomplish their purpose”, **Laudon(2014)**. This phase takes a closer look at the analysis of the existing system and system to be developed. It is also one of the most important phases in the systems developmental cycle. It will also look at the operations within the current system, how are processes linked within the proposed system and how are the activities going to be coordinated. A detailed analysis of the current mobile application system being used by TSCZ and that of the proposed system was conducted to enable the developers to:

- Have an understanding of the processes involved in the company’s activities
- Have an insight into the needs of users of the system to be developed

### **3.2 Information Gathering Methodologies**

The procedure of collecting requirements typically goes beyond querying clients of their needs and noting down the responses. The procedure of collecting requirements consists of a well outlined and characterized progression of its own basing on the sophistication of the system. With an end goal of accumulating all the imperative details relating to the present system framework so as to enable its qualities and shortcomings to be realized, the researcher made use of three data collection strategies that highlighted with clarity the shortcomings in the present system framework as well as the system’s qualities that should be maintained in the new system framework.

The data collection strategies employed are highlighted below:

- Interview
- Questionnaire

- Observations

### **3.2.1 Questionnaires**

According to Willimack (2013), a questionnaire is a study tool comprising of a progression of inquiries and different prompts in order to effectively gather the required data for the respondents. These can be utilized to gather both quantitative and subjective information and are regularly intended for factual examination of the responses. A collection of questions were set up for specific members of staff relating to the tasks they undertake in the organization and were handed over to these employees to complete on 22 October 2017 with an expectation of having them back by 26 October 2017. The researcher noticed a few points of interest and weaknesses that this data gathering strategy presented.

#### **3.2.1.1 Advantages**

- Respondents are awarded enough time to think through the question and understand before given back responses.
- Arranging and conducting them was easier as compared to interviewing since the requisite for constant personal monitoring was limited.
- A lot of time was saved since a number of participants undertook them at the same time.
- The identities of the respondents were anonymous hence the benefit of getting honest opinions without fear of intimidation.
- Compilation of the data was far much easier as the questions from all documents were structured the same way.

Even though this data gathering strategy had the above advantages, it did not come without its own drawbacks and these are highlighted below.

#### **3.2.1.2 Disadvantages**

- The number of returned questionnaires was not consistent with number of questionnaire that were distributed.

- In comparison with interview, questionnaires take more time as the feedback is not given instantly.
- Respondents only responded to questions they were comfortable with or understood and left out some questions unanswered making it difficult to draw some conclusions.

### **Results from Questionnaire**

Majority of employees responded reviewing that they are facing great challenge with the current system and they are willing to migrate the new infrastructure surveillance system because of the inconveniences of the current system

Some staff said they were comfortable with the current system and there is no need to change it but most of them reviewed that they want a better monitoring and troubleshooting system. The administrator points out that the response time of the current system and its manual processes is the reason they are willing to change it.

### **3.2.2 Interviews**

Clifford (2000), pointed out that interviews are prescribed discussions comprising of no less than two parties with the aim of exchanging information. In an interview, responses to any question are given in real-time with a brief moment for the interviewee to process the question.

Outcomes from the conducted interviews:

A progression of interviews was conducted with a given number of staff members from all the departments which are Network Operations Centre, Customer Services, Field Services, Marketing, Human Capital, Finance and Administration also encompassing input from members from all the branch offices, include other employees who oversee and use the present system. The interviews also assessed the employees' state of mind, responsiveness and insights.

#### **3.2.2.1 Advantages**

- The researcher had one to one conversations with the involved employees and both parties had the opportunity to seek clarity on seemingly vague questions and responses.
- Data was collected instantaneously as all the valid points were noted down as the interview progressed.
- Questions imposed directly give room for probing for particular responses.



- Non-verbal communication by the respondents were also observed such as facial expressions and other body language that helped the interview progress by noting if the respondent was uncomfortable with a certain area.
- Allowed the interviewer to interact with the respondents at a personal level and assure them of confidentiality.
- Only relevant questions were posed to respondents from the pool of question based on department and job roles.
- First-hand information was extracted from the respondents directly who utilize the current system such as:
  - Functionality of the system
  - Currently faced problems
  - Areas that need addressing and improvement.

#### **3.2.2.2 Disadvantages**

- Chances of getting incorrect responses as from the question or the way they are delivered the interviewer might have influenced the respondent towards a certain answer.
- Interview take up a lot of time since all the respondent have to be interviewed separately hence in the long-run costly.
- Reliability of results concluded from an interview is questionable due to the use of a single interviewer who might be biased.

#### **3.2.2.3 Results from Interviews**

Even though most of the interviewed employees were not free to disclose their full thoughts due to fear, the interviewer managed to get useful information about the current system. It was clear that most of the customers are not happy with the inconveniences caused by system downtimes and well as the time it takes engineers to fully resolve the fault.

The support staff were afraid of the unknown as they feared the introduction pf the automated system would threaten their job security by making them irrelevant hence they were not in harmony with the proposed system.

### **3.2.3 Observations**

Bradburn, Sudman and Wansink (2006), states that an observation is an evidential centric approach that is more concerned with the “behaviour” as compared to the “opinions” of the clients/users. Complicated responsibilities are usually not easy to translate words with clarity. Using observations, the researcher identified responsibilities that had been overlooked and/or not accurately presented by the use of the other data gathering methodologies.

#### **3.2.3.1 Advantages**

- Gave room for the researcher to gather information on his own without interaction with the study population and minimised chances of getting biased information through interaction.
- The normal business operations were not interrupted as it was business as usual whilst the observation was getting on with the data gathering process.

#### **3.2.3.2 Disadvantages**

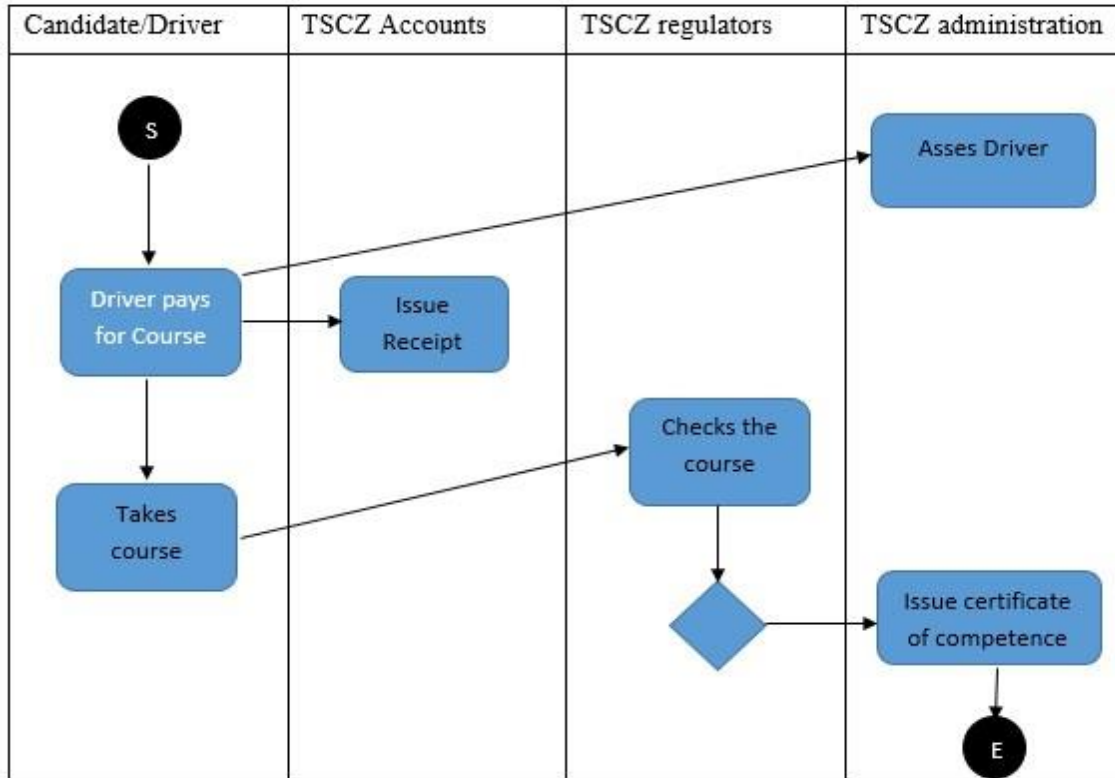
- It is not every task or responsibility that can be understood through observation.
- There are chances of that the deduced data could have been manipulated since if someone is aware that they are being monitored they tend to adjust their normal routine.
- There are also chances that some actions could have been misinterpreted.

#### **3.2.3.3 Results from Observations**

The researcher observed that the current system was complex, time consuming and had poor security which made it less favourable by the support staff, this depicts that the Infrastructure Surveillance System is the solution to the problems currently faced by the organization.

### **3.3 Process Analysis**

According to Kendal (2005), activity diagrams are defined as the graphical representation of activities and actions for the purpose to model organizational and computational process transactions and they represent the overall control of activities and workflows in an organization. Activity diagram can help the organization to describe the flow of control of the target system.



**Key**

- S- Start
- E-End
- Event
- Flow

Figure 3.1 Activity Diagram

**Figure 3.2: Activity Diagram**

**3.5 Data Analysis**

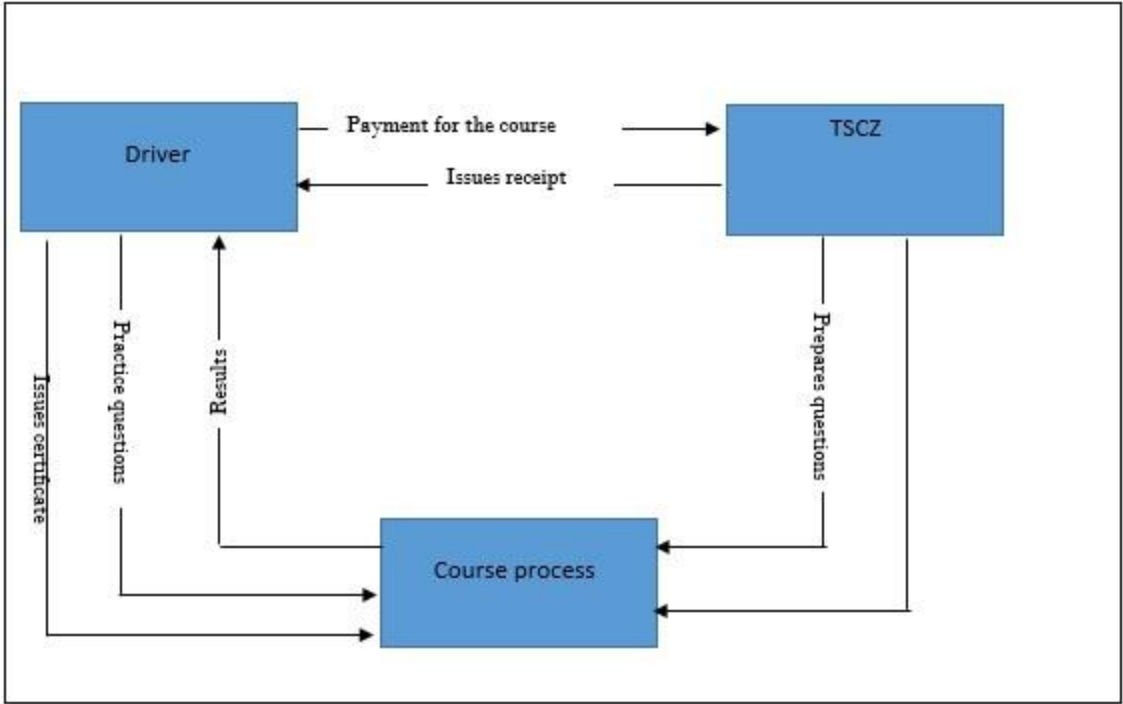
According to Godfrey (2001), data analysis as a process which analyses information process as well as modelling data with the goal of highlighting important information in an organization.

There are two methods of representing inputs, outputs, data and processes, which are:

- Data Flow Diagram
- Context Diagram

**3.5.1 Context Diagram**

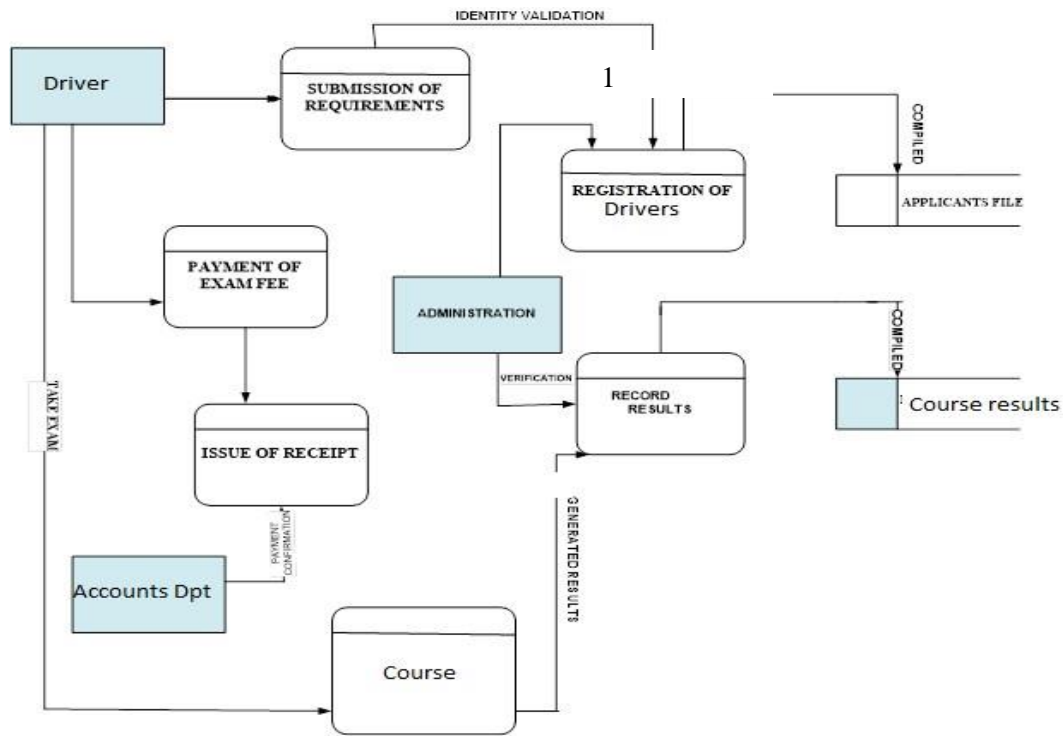
Scott (1999) defines a context diagram as a representation flow of data through the information system. The context diagram of an existing system demonstrates all project boundaries.



*Figure 3.3: Context Diagram*

**3.5.2 Data Flow Diagram**

DFDs are illustration apparatus for the modelling of data in order to facilitate the provision of a clear representation of all organizational functions. This method begins with the general overview of the organization and proceeds to analyze every one of the useful area of concern. The DFD of the present system is illustrated below:



**Figure 3.4: Data Flow Diagram**

### 3.6 Weaknesses of the Current System

The current system has the following weaknesses:

- Booklets becomes obsolete with time
- The current system is very time consuming.
- It is very difficult to analyze the course manually.
- The chances of student failure are more in current system.

### 3.7 Evaluation of Alternative

Following the outlining of progressions involved in the present system as well as defining the manner in which data flows in the system, the researcher got a clearer viewpoint of the system requirements. Concurrently other alternatives were assessed to determine the most viable and suitable resolution.

The following alternatives were reviewed:

### **3.7.1 Outsourcing Software (preferred alternative)**

This means hiring of an external system developer or service provider to create the system. The first and preferred alternative of resolving the problem is to contract external developers to do the project for the company and it has the following advantages.

- Services are generally cheap if charged on hours as the developers are going to take to develop the system. Since the company has freelance developers who are contacted only when necessary this the best alternative.
- The external developers already have an understanding of the organization's culture and methods to create a system that readily identifies with the users.
- No overhead cost since the developers are expects and work targets agreed.
- The internal team can focus on the current system hence there will be no deadlocks.

#### **3.7.1.1 Advantages**

- The system changeover process will be quick.
- Technical requirements of this approach are limited to implementation staff.
- Costs associated with product development are eliminated.

#### **3.7.1.2 Disadvantages**

- Initial costs of acquiring these packages are usually high.
- Costs of maintaining the system might rise exponentially especially in the case that the vendor has limited support for the supplied product.
- In turn the high maintenance costs will thereby defy the main objective of bringing down costs within the organization.
- Most of these packages are proprietary hence cannot be fully customized to meet all the requirements of the customers.

### **3.7.2 Improving the Existing System**

According to Ghezzi (2004), improvement is defined as a process whereby the system requirements of a current system were analysed, developed and modified to the new project.

Problems in the current manual system are solved in the current project through improvement, implementation and computerization of the system.

#### **3.7.2.1 Advantages**

- Financial resources which would have to be channelled towards the development of a new system will be saved through amendments to the current system.
- The status quo is maintained hence ensuring familiarity with the system users.

#### **3.7.2.2 Disadvantages**

- The manual way of doing things would be carried on which is limiting.
- High costs will continue to be experienced through the printing of the physical form.
- New technology centric features cannot be incorporated into a manual system.
- Time will continue to be wasted as the manual system is time consuming.

#### **3.7.3 In-house Development**

Mahapatra and Verma, (2016), defines this as the development of the product or solution that is meant specifically for the given organization to address the known issues and satisfy the identified user needs.

##### **3.7.3.1 Advantages**

- Unlimited control over the development process.
- Tailor made specifications to meet exact need can be incorporated.
- The manual way of doing things is eliminated.
- Duplication of information is eliminated.
- The correctness of data is safeguarded through the enforcement of integrity constraints.
- Overhead costs on stationery are reduced.
- Tailor fitting to user needs and system can be simplified to what the users can basically understand.
- Efficiency is introduced.

##### **3.7.3.2 Disadvantages**

- The workers might be resistant to change and reject the system.
- More time is required in development as compared to the other alternatives like buying.
- The initial costs associated with development are also high though cheaper in the long run.

### **3.8 Requirements Analysis**

After thoroughly investigating some of the functions and processes of the present system, the following stage will be identifying the pre-requisites of the present system. These necessities are sub-divided into practical/functional and non-practical/non-functional requirements. The functional aspects address the goals that the system, has to support whereas non-functional aspects address those controls on different qualities of these tasks

#### **3.8.1 Functional Requirements**

(Use Case diagram)

These define the capabilities and functions that a system must be able to perform successfully. The Road Rules progressive android based defensive driver's license practice and test application should be able to allow the following functional requirements:

- Allow users to register on Road Rules Solutions platform
- Perform its function irrespective of the android version running client side.
- Allow users to retrieve data and interact with content located on Road Rules Solutions web page.
- Offer unique and relevant questions across the defensive Driver's License curriculum.
- Grade and show results Identify Weaknesses Focus studies to pass the defensive Driver's License test.
- Allow Road Rules to make alterations to the content provided without any challenges.
- Capture, processing, storage and transmission of sensitive customer data (e.g., personal details, phone numbers, credit card numbers, social security information, etc.) for immediate and recurrent use.
- Be able to direct or provide a link to download the mobile application version of the system. □  
Deny access to unrecognized users.

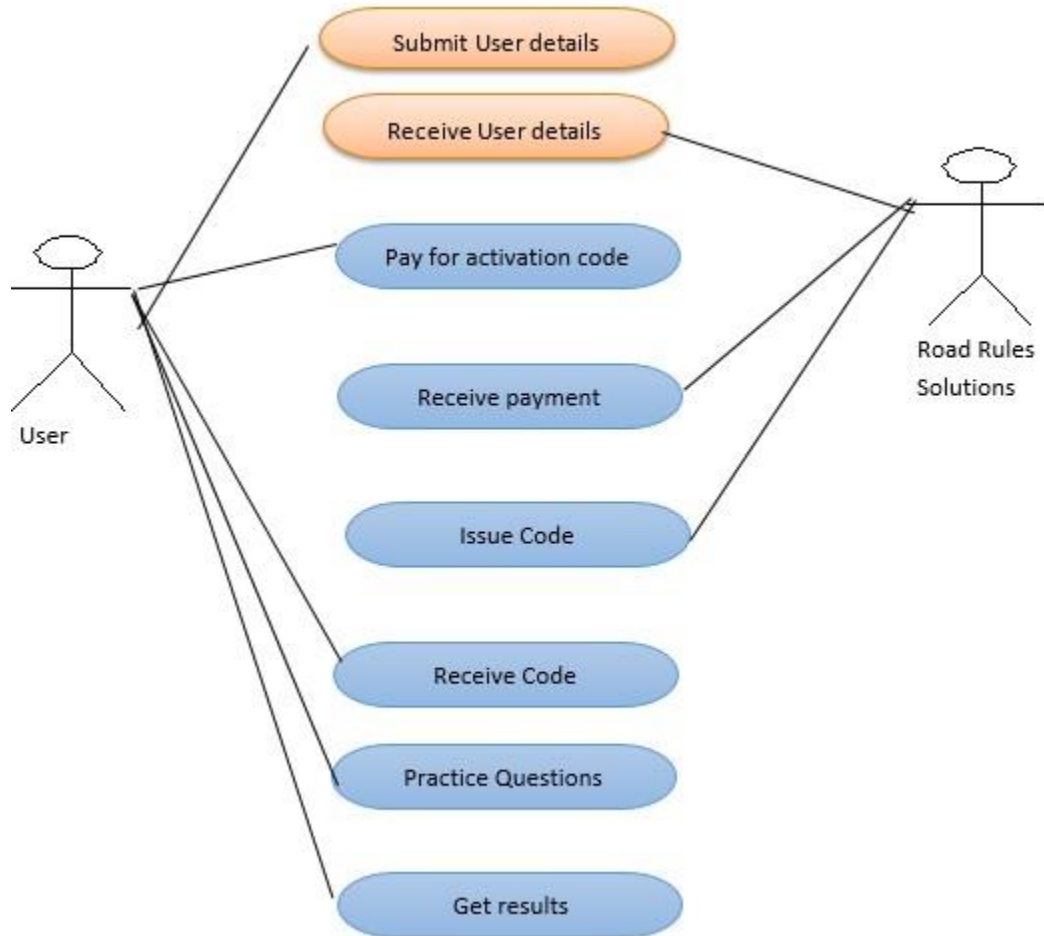
These requirements may be categorized by the use of a case diagram as illustrated below:

##### **3.8.21.1 Use Case**





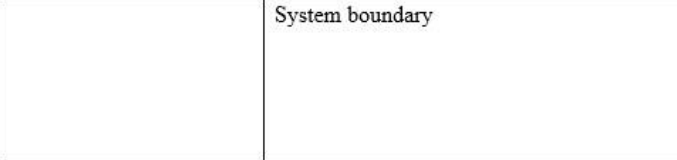


According to Gillharm (2008), a case diagram is defined as a graphical representation through interactions among the components or elements of a system project. It was used in system analysis for clarification, modification and to identify system requirements.

This is an explanation of the order of tasks executed by the system for the production of results of an actor. These use cases lay down the anticipated performance but not the actual way of achieving it.



**Figure 3.5: Use Case**

## KEY FOR USE CASE DIAGRAM

Symbol	Description
	Actor
	Use case
	System boundary
	uses
	extends

### 3.8.2 Non-Functional Requirements

When we deduce non-functional requisites relating to a new system the constraint encountered during the system development are taken into consideration. The requirements of the suggested system vary from the expectations pf the basic end users to the expectations of the organization's managers.

- Simplicity of the system to learn and use.
- User friendliness of the system should be acceptable.
- Recovery from errors should be error free.
- The system should offer access control through the use of usernames and passwords.
- Granting of different access levels in the system based on organizational roles.
- Should allow password enforcement policies of at least six characters.
- Updating of information in real time.

### **3.9 Conclusion**

Utilizing the information collected using the afore mentioned information gathering methodologies and more so having highlighted the present system's drawbacks and the potential substitutes in order to resolve the issues that were analysed, a conclusion that the in-house development approach of the system was the most suitable way forward to come up with a comprehensive solution to all the issues in the most cost-effective manner. Hence the subsequent stage will be the actual design of the system. Therefore the next step is to proceed to the actual design of the proposed system.

## **Chapter 4: Design Phase**

### **4.1 Introduction**

The design phase entails outlining how the proposed system was developed, configured and deployed. System design is the process of deciding how the system will be implemented and how it will look like. The design process breaks the system into smaller parts that can be implemented independently of each other. This idea seeks to make the system more manageable since it is easier to work with a relatively small piece or part of a system at a time. The design phase gives an outline of the System Design, Physical Design, System Architecture, Database Design, Interface Design and Program Design.

### **Effectiveness**

The system to be constructed should work efficiently with little or no errors and should not affect the working process within the organization. **Reliability**

The system should be able to deliver timely outputs to facilitate for quicker decision making.”  
**Maintainability.**

The system should provide the clients with ease of maintainability. New features must be easily added on to the system and it should be able to adjust to the turbulent changes in the software environment

## **4.2 System Design**

### **4.2.1 How the System Works**

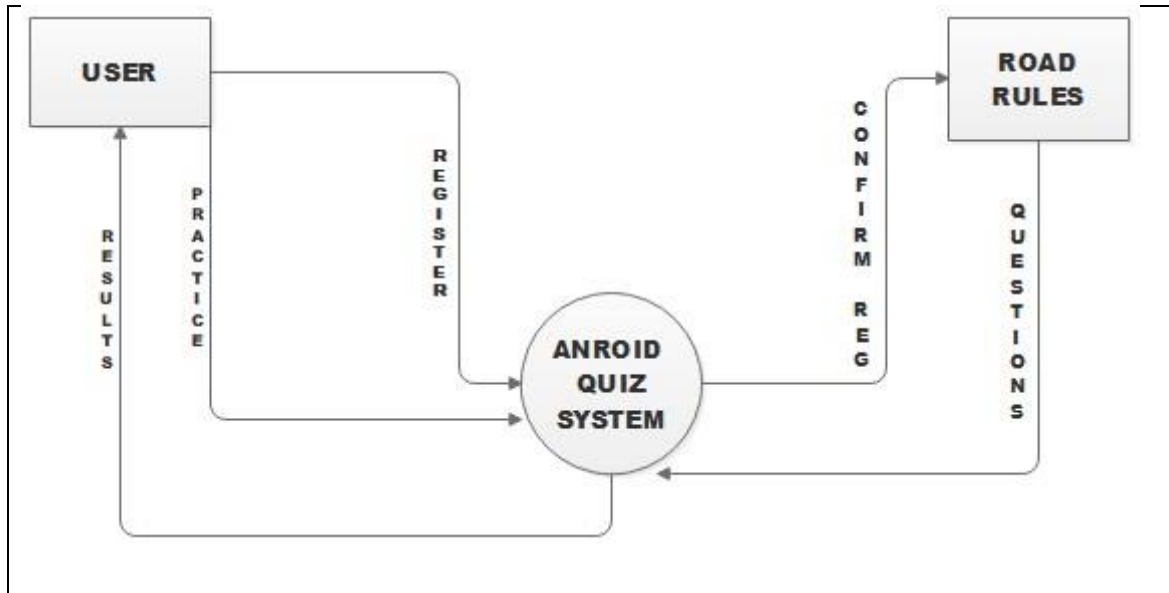
- A support engineer for the first time creates an account on the system portal and goes through a once off process of populating all the required details such as full name, employee number, department name, job title, contact details and desired username and password.
- A management level user cannot create his/her own account and this can only be done by the system administrator assigning sufficient rights to the system.
- The senior engineers also cannot create their own accounts and this is done by the administrator assign sufficient rights to the account.

If the employee account already exists on the system, the user logs in with his/her unique username and password and upon successful login the user is redirected to the system dashboard where all the staff details are automatically populated from the user's profile. Android applications are composed of one or more application components activities, services, content providers, and broadcast receivers. Each component performs a different role in the overall application behavior, and each one can be activated individually even by other applications. The manifest file must declare all components in the application and should also declare all application requirements, such as the minimum version of Android required and any hardware configurations required. On code application resources (images, strings and layout files should include alternatives for different device configurations such as different strings for different languages.

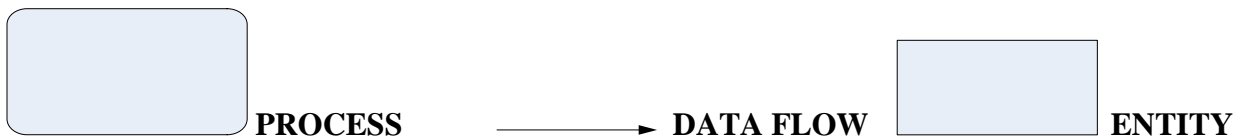
The major aspect for proposed system will be to create an online test simulator system integrated with a web interface which will enable remote candidates to register and write exams online. Below is the context and the data flow diagram for the proposed system. The examiner will

evaluate answers, through the automated process and the results will be sent to the candidate through email or made available in the web site created on registration and assigned relevant login rights on the system.

#### 4.2.1 Context Diagram



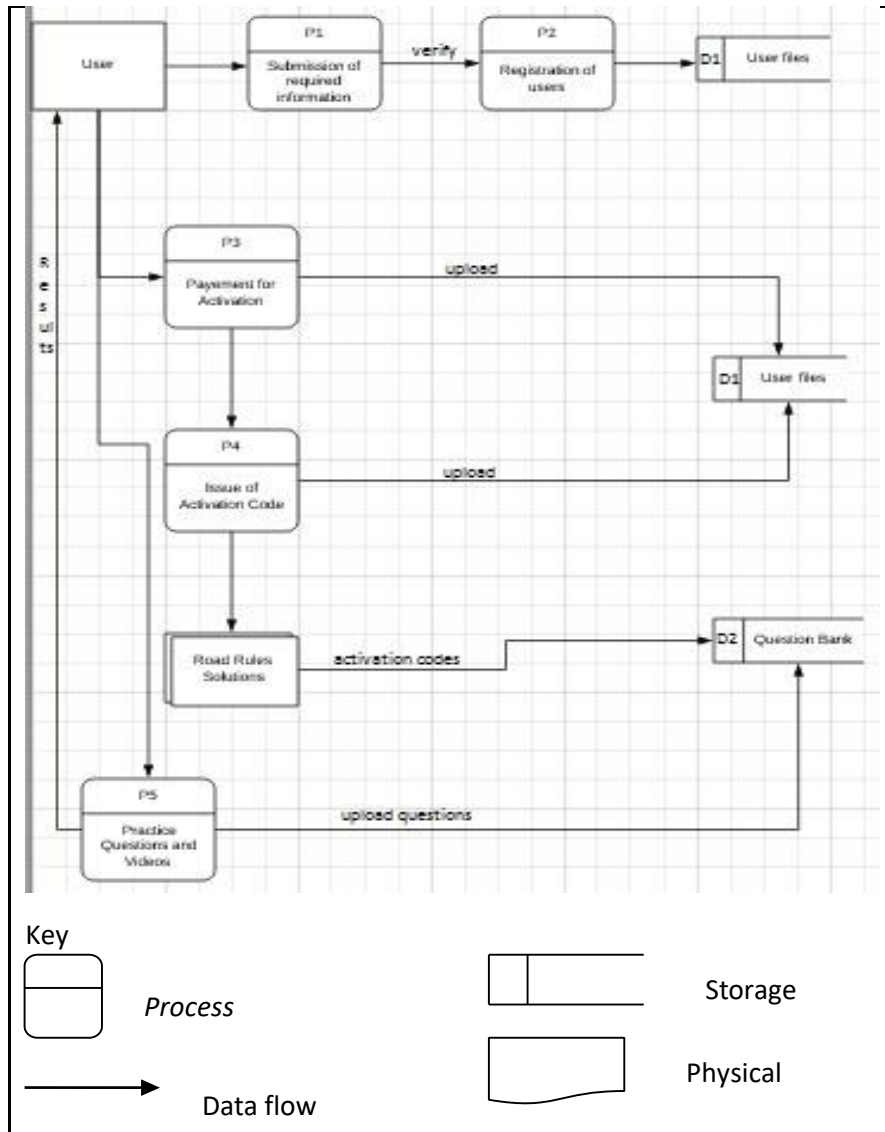
Key:



*Figure 4.1: Proposed System Context Diagram*

#### 4.2.2 Data Flow Diagram

#### 4.2.2 DFD of the proposed system



*Figure 4.2: Proposed System Data Flow Diagram*

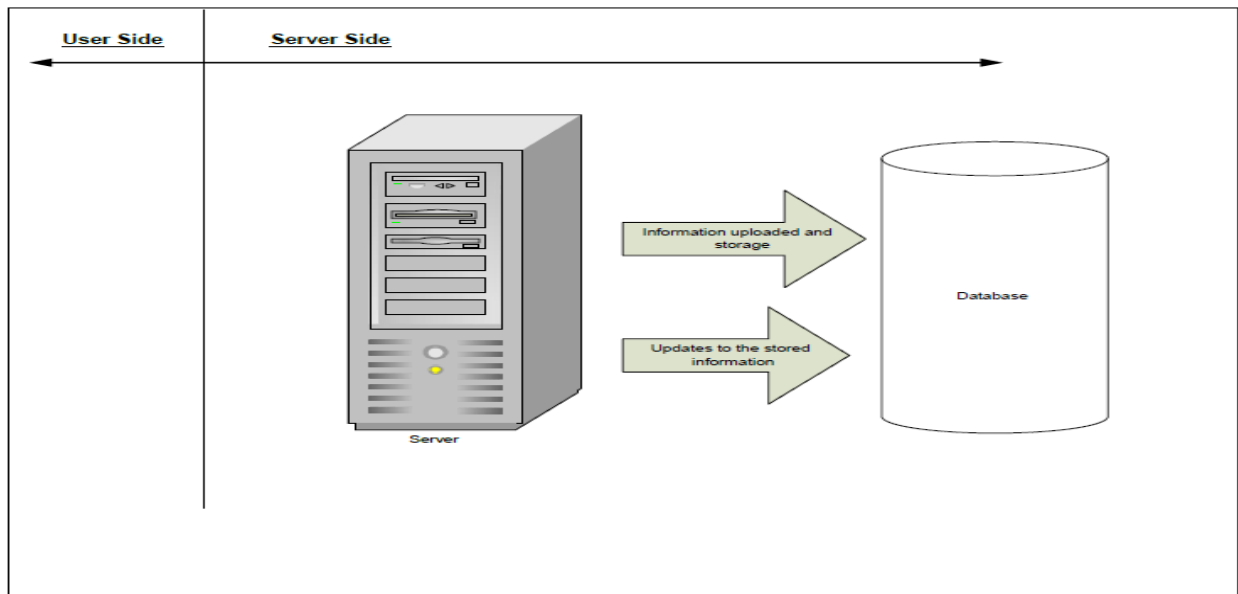
#### 4.3 Architectural Design

This is the initial design process of identifying sub-systems and establishing a framework for sub-system control and communication. The first step is to determine whether the system will be a standalone or a networked based system (Client-server Architecture). Server based architecture

builds the processing operations of the system into the server (Main Computer) and relegates all the other computers in a typical network infrastructure to clients (those computers hiring the services of the server).

On the stand-alone, net workless model, all activities of initiating service requests (for data processing) and deploying the services are vested in a single computer that operates alone.

Even if they are many computers in an organization, if it is a stand-alone network, the individual computers do not have any links; therefore, do not communicate with each other. The analyst shall compare the two models of architecture in the table below to select the suitable one.



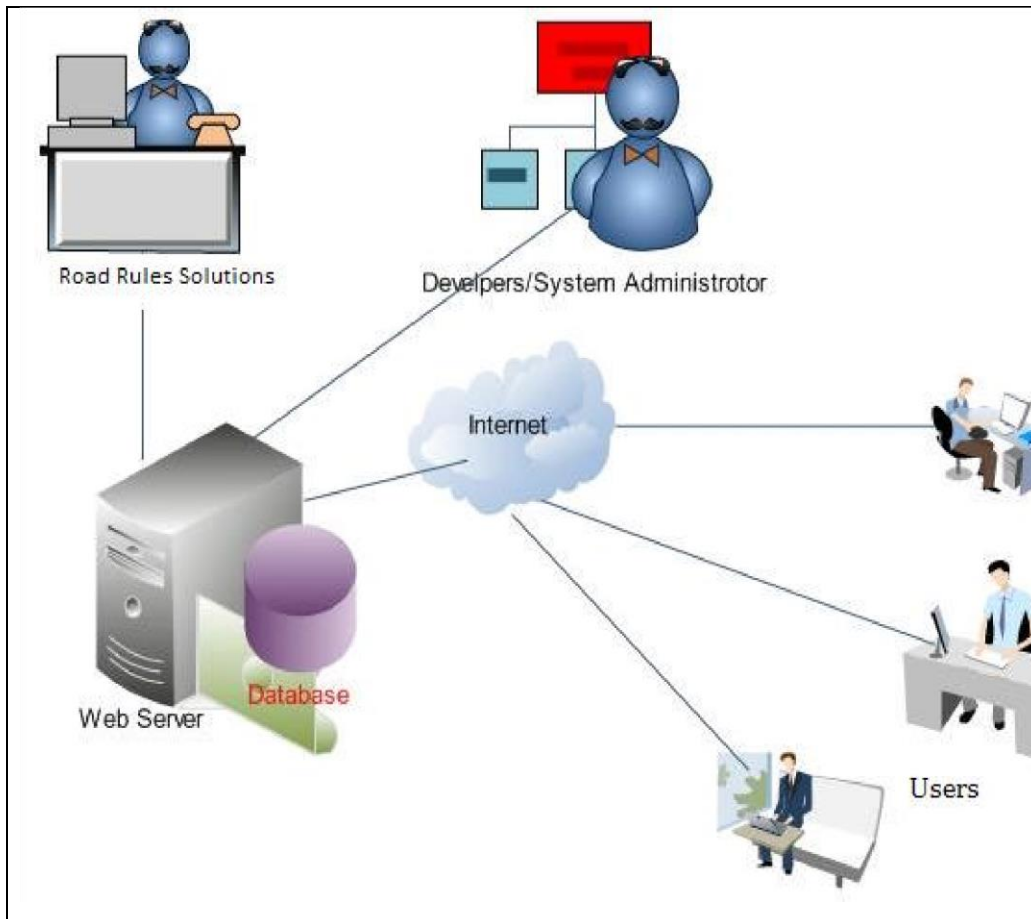
**Figure 4.3: Architectural design**

In order for a user to have access right to the information inside the server, he/she must have authorization credentials such as the username and password and once they are validated to be correct, the user will be allowed to access to information and depending on the access level of the user. The system will reside in the corporate Tier 3 data center behind a Cisco ASA firewall to safeguard it from unauthorized access and intrusions.

#### **4.4 Physical Design**

Bleisch (1998), states that it is important to design both the software and hardware environment in which the new system will resides and work in. It is the design that shows how the components are physically connected in different environments. The physical design focuses

mainly on the layout of the proposed system in terms of hardware components and the interaction or communication amongst these components. All user mobile devices will be connected to the database server on the intranet together with the rest of the employee devices such as PCs and network printers. The hardware and software components requirement for the system to function and the environment are taken into account, so as to come up with total design of the system.



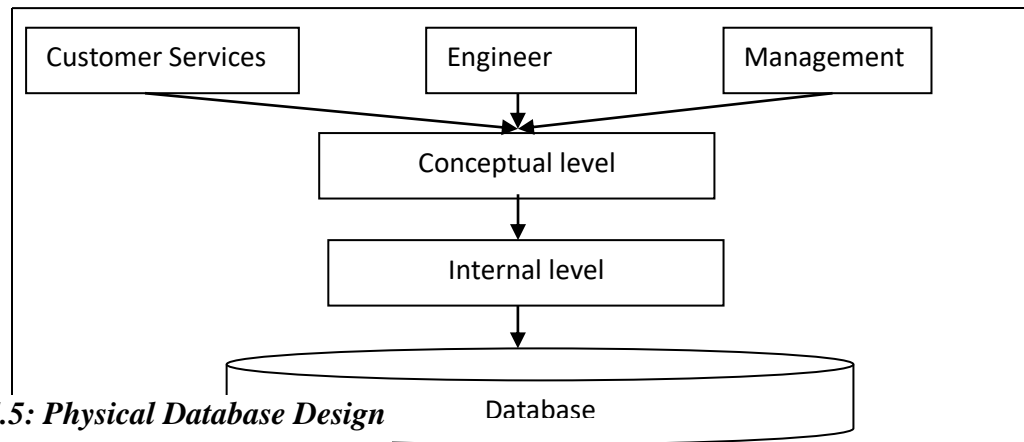
**Figure 4.4: Physical Design**

#### **4.5 Database Design**

Adams (2010), describes database design as the process of producing a detailed data model of a database. It is a logical data model that contains all the required logical and physical design alternatives and storage parameters needed to generate a design in a Data Definition Language which can then be used to create a database.



### 4.5.1 Physical Database Design



**Figure 4.5: Physical Database Design**

**External Level:** The external level represents the users' view of the database. It consists of a number of different views of the database, that is, one for each user. External schema shows only the part of the database that is important to the user. Tables in the database can have the following relationships, one-to-one, one-to-many, many-to-many.

**Conceptual Level:** The conceptual schema shows the kind of data that resides in the database and the relationships among the data. This is a total view of the data specifications of the organization that is independent of any storage considerations.

**Internal Level:** The internal schema explains the physical representation of the database on the computer and this can be done using a programming language. Internal level shows how the data resides inside the database that is the structures of certain data and the way files are organized in terms of particular data structures and file organizations.

### 4.5.2 Logical Database Design

Logical database design involves identifying the entities and relationships among them. These entities of the system are elaborated showing their attributes. The construction of an entity relationship was done so as to express the outcomes of the logic database design.

An entity-relationship diagram is a data modeling technique which shows the entities graphically and the relationship between these entities within a system and also shows the structures of the proposed system database. Entity relationship clearly defines the interaction between the entities and their dependence on each other and all components relationship are illustrated in an entity relationship diagram. It is structured in an organized manner that makes easy for one to navigate and one will be able to determine and identify the relationships among these entities.

The following table shows an entity-relationship table that represents entities and their attributes.

**Table 4.1: Entity Relationship Table**

<b>Entity</b>	<b>Attributes</b>	<b>Description</b>	<b>Type</b>
<b>Admin</b>	Id	Admin ID	Int (6)
	Username	Admin's Username	Varchar (20)
	Password	Admin's Password	Varchar (20)
	Fullname	Admin's Fullname	Varchar (20)
	Email	Admin's Email Address	Varchar (20)
	Createdon	Creation Date	Date
	Modifiedon	Modification Date	Date
<b>User</b>	Id	User ID	Int (6)
	Username	Username	Varchar (20)
	Password	User's Password	Varchar (20)
	Fullname	Name of User	Varchar (20)
	Email	User's Email Address	Varchar (20)
	Createdby	Name of Creator	Varchar (20)
	Createdon	Creation Date	Date
	Modifiedon	Modification Date	Date

### **Entity Relationship Diagram**

Rouse (2005), describes an entity-relationship (ER) diagram as a specialized graphic that illustrates the interrelationships between entities in a database. ER diagrams often use symbols to represent three different types of information. Boxes are commonly used to represent entities. Diamonds are normally used to represent relationships and ovals are used to represent attributes.

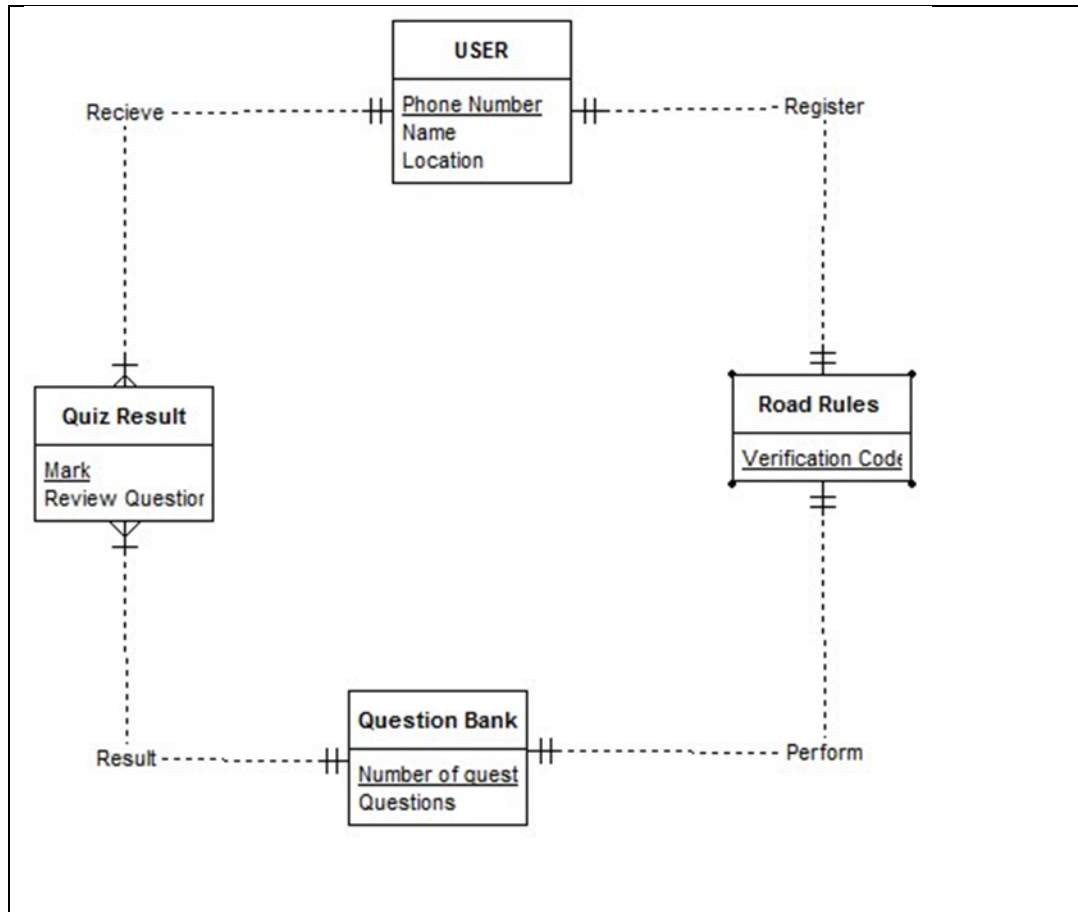
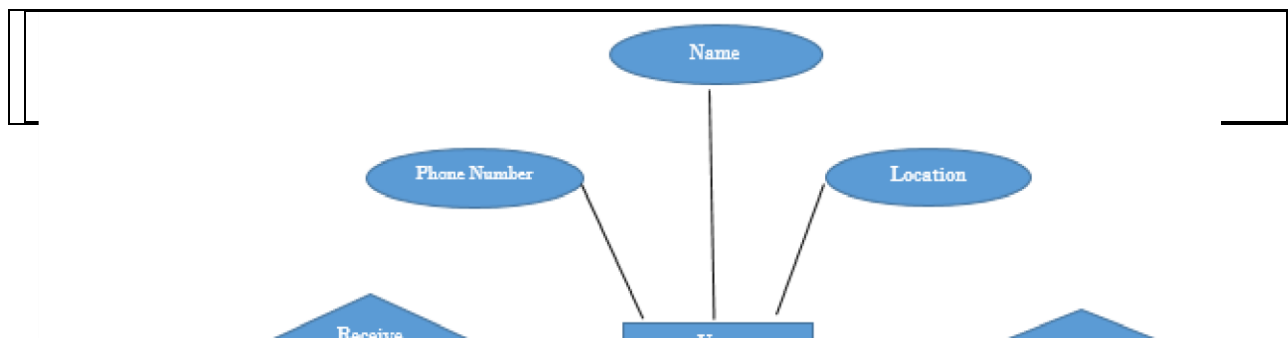


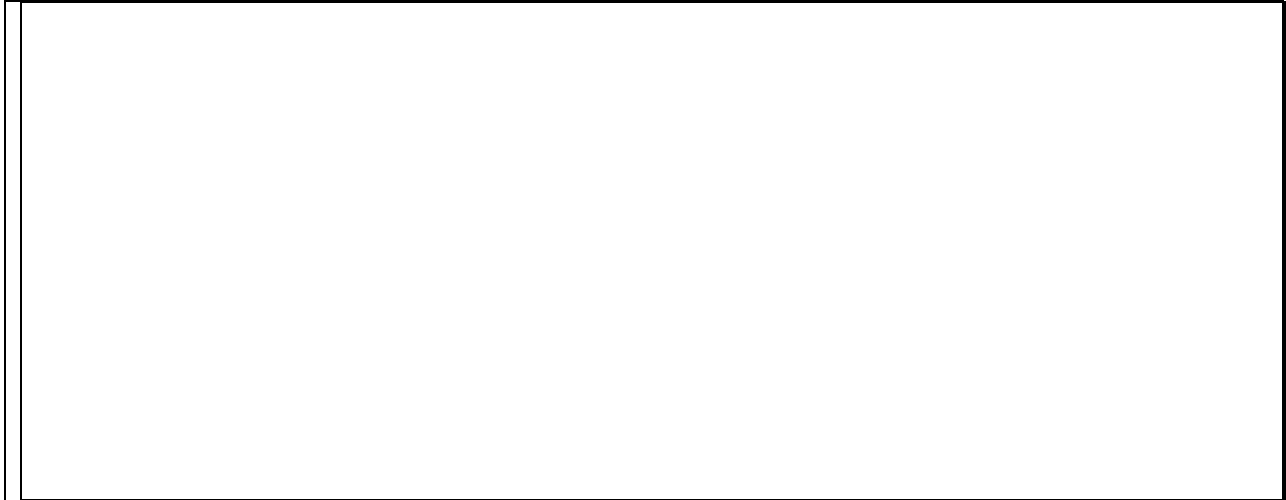
Figure 4.6: Entity Relationship Diagram

## 4.6 Program Design

### Package Diagram for the System

This shows the collection of the logically related UML elements. The different classes within the quiz simulator system were grouped into packages to reduce the complexity and enabling each part to have a better understanding of the System. The diagram below illustrates the packages within the system:





*Figure 4.7: Sequence Diagram*

#### **4.7 Interface Design**

The system interface defines how the user interacts with the system. This includes defining internal and external control and data flows. It's highest level of abstraction and hides the complex parts of the system by simplifying the user's interaction with the database by the provision of an interface. Interface design outlines the design for the menus, forms, reports, and the help screens. Interface design is the graphical views of that the user will get to communicate with the system through. Interface design helps the proposed system to progress in a desired manner. This is where users get output from the system which include ideas from other as well reports from the system.

##### **1 Best Practices for Designing an Interface**

Everything stems from knowing the intended users, including understanding their goals, skills, preferences, and tendencies. Once information about users is available, the following considerations must be taken when designing the interface:

- **Keep the interface simple.** The best interfaces are almost invisible to the user. They avoid unnecessary elements and are clear in the language they use on labels and in messaging.
- **Create consistency and use common UI elements.** By using common elements in your UI, users feel more comfortable and are able to get things done more quickly. It is also important to

create patterns in language, layout and design throughout the site to help facilitate efficiency. Once a user learns how to do something, they should be able to transfer that skill to other parts.

- **“Be purposeful in page layout.** Consider the spatial relationships between items on the page and structure the page based on importance. Careful placement of items can help draw attention to the most important pieces of information and can aid scanning and readability.”
- **Strategically use color and texture.** You can direct attention toward or redirect attention away from items using color, light, contrast, and texture to your advantage.” **“Use typography to create hierarchy and clarity.** Carefully consider how you use typeface. Different sizes, fonts, and arrangement of the text to help increase scalability, legibility and readability.
- **Make sure that the system communicates what’s happening.** Always inform users of location, actions, changes in state, or errors. The use of various UI elements to communicate status and, if necessary, next steps can reduce frustration for users
- **Think about the defaults.** By carefully thinking about and anticipating the goals people, defaults can be created that reduce the burden on the user. This becomes particularly important when it comes to form design where there might be an opportunity to have some fields pre-chosen or filled out.

## **Input Design**

**The forms are developed to capture data and send it to the main database or queries. The input forms are developed to be user friendly and to enhance accuracy in capturing and updating of data. Warning message should be displayed at the page of entry of data.**

### **4.7.2.1 Registration Form**

**Below is an input form shows the new user creation form. All fields in form are mandatory and should be completed for the user account**

### 4.7.1 Menu Design

The Main Menu interface consists of a title 'Main Menu' at the top. Below it is a horizontal row of four buttons: 'Practice', 'Test', 'Progress', and 'Notes'. Underneath this row are three separate rectangular boxes, each containing a unit title: 'Unit 1 : Highway Practice', 'Unit 2 : The Driver', and 'Unit 3 : Traffic laws'.

*Figure 4.8: Main Menu*

The Registration form interface has a title 'Registration form' at the top. It contains three input fields: 'Province' with a dropdown arrow, 'Name' with a text box, and 'Phone' with a text box. At the bottom of the form is a 'Save' button.

*Figure 4.9: Sub menu*

The above form shows the overall system overview of the registration process.

<b>NOTES</b>
<p>Road traffic safety issues are treated, and rightly so, as a matter of life-and-death! Driving is more than the movement of a vehicle from point A to point B.</p> <p>Driving does not only necessarily imply being in control of the steering apparatus of a vehicle, it includes a variety of deliberations which involve cooperation; rational and very clear communication with fellow road users.</p> <p>Therefore, thorough knowledge and respect of road regulations, traffic signs and traffic signals are an <b>absolute</b> pre-requisite. Any aspiring and responsible driver</p>

**Figure 4.10: Notes**

The above form depicts the tools sub-menu where the user is presented with a segment of notes to the curriculum .

<b>PROGRESS QUESTIONS</b>
<p>If your car begins to hydroplane you?</p>
<p>Correct!</p> <p>Reduce speed and let the car decelerate.</p>
<p><input type="radio"/> Immediately slam the brakes.</p>
<p><input type="radio"/> Do nothing and allow your car to turn into the plane dreamed of.</p>
<p><b>Continue</b></p>

**Figure 4.11: Questions Form**

## 4.7.2 Input Design

The forms are developed to capture data and send it to the main database or queries. The input forms are developed to be user friendly and to enhance accuracy in capturing and updating of data. Warning message should be displayed at the page of entry of data.

	<b>About Us</b>	<b>Home</b>	<b>Messages</b>	<b>Incident Records</b>	<b>Help</b>
--	-----------------	-------------	-----------------	-----------------------------	-------------

The above input form shows the new user creation form. All fields in form are mandatory and should be completed for the user account to be successfully created. However, this is a once off form in which the employee supplies the information only on account creation and once the account has been created on the system all the relevant details will be automatically populated on the form depending on the task to be performed once the correct username and password are supplied to

## 4.8 Pseudo Code

Neapolitan (2014) defined pseudo code as a detailed readable description of what a computer algorithm should do, presented in natural language rather than in programming language. Pseudo code helps programmers to express program design in detail. The pseudo code for Road Rules Infrastructure Surveillance System is presented below.

### 4.8.1 User Login

#### Sign Up New User

##### Adding New User Phone Number

```
{  
    Function Capture New User Phone Number  
    {  
        Capture new User Phone Number;  
        Verify if phone number is a valid phone number;  
    If Yes  
        Then accept phone number and Store data in user table  
    Else
```



```

        Enter new phone number;
Validate new user phone number
        Store data in user table
Display confirmation details verify; end
        } // close capture details function
    }

```

#### Adding New User Information

```

{
    Function Capture New User Information
    {
        Capture New User Province, Name, Age;           Store data in user
table end
    } // close capture details function
}

```

#### Accessing the main menu

```

{
    Route User to the main menu
        Accept selection made on menu options end
    } // close main menu function
}

```

#### Attempting quiz questions

```

{
    Function Quiz Practice
    {
        Accept answer from User;
        Verify if the answer is correct;
    If Yes
        Then accept answer and proceed to the next question

    Else
        Wrong answer;
    }
}

```

**Display** correct answer with explanation and **proceed** to the next question;

end

*} // close quiz practice function*

### Reading Notes function

#### **4.9.1 Physical Security**

According to Harris (2003), physical security describes measures designed to ensure the physical protection of IT assets like facilities, equipment, personnel, resources and other properties from damage and unauthorized physical access. The system database server will be housed in the corporate data centre which will be always locked and can only be accessed using dual control by authorized personnel. The use of 24hr video security surveillance will also be employed in the server room to monitor activity in the server room. The room housing the servers will also be equipped with smoke and fire detectors and standby fire extinguishers and alarms will also provide aid in case of fire.

#### **4.9.2 Network Security**

Simmonds (2004), states that network security consist of the provision and policies adopted by a network administrator to prevent and monitor unauthorised access, misuse, modification or denial of a computer network and network accessible resources. The full client subnet will reside behind a CISCO ASA firewall. This firewall is an essential aspect of network security of the mobile application.

#### **4.9.3 Operational Security**

The users of the mobile application will all have entry access that will be encrypted using database encryption alternatives. Bunch approaches will be implemented to guarantee that users just get into the application and utilises conscious of them utilising the database security reassurance. Data about the users of the application will not be uncovered to anybody.

#### **4.10 Conclusion**

The design phase has helped the developer to be able to come up with an organized way of how the system to be developed is going to look like. Entity relationships, database, inputs, processes and outputs as well and how data is going to flow in the proposed system were done in this phase. This was all done to ensure that the developer develops a system that is user oriented and a system that will fulfill the intended objectives. The next chapter is implementation which will focus on the newly developed system.

### **Chapter 5: Implementation Phase**

#### **5.1 Introduction**

This phase looked at the development, installation, testing and maintenance of the new proposed system. The implementation phase includes user training on the data flow and use of the system to make easy understanding. After the system was done, it was tested repeatedly for errors and errors corrected up until the system reported no errors.

#### **5.2 Coding**

This involved turning program logic into specific instructions that are to be executed by the computer system. Java was used for the application and MS SQL database was used as database backend. All the elements in the data dictionary conceptualized during the database design were mapped into the relevant tables.

The system functionality was developed as modules. The modules were finally integrated into one working system. This stage helped developers to gain extra expertise as it introduced them to new areas of programming that they never had a chance to use elsewhere before. Reviews and walkthroughs were conducted to assure that the process was in track, within budget and within the scope of the scope of the project.

#### **5.3 Testing**

Testing is a process of checking out if the software being built or developed has errors before implementing it on an organization. Any duty and task is focused in assessing the ability of the system to ensure that it meet the user requirements. System testing is to be done iteratively with qualified engineering team which will mainly focus to preventing faults than to remove them. The following are the methods of testing which are going to be used.

### **5.3.1 Unit Testing**

Williams (2006), states that testing is where distinct or units of code are tested to see their ability for a selected task. The code will be tested according to its work or functionality. The units must be small for testing to commence and must include one output and input. Black box and white box are the two categories which the unit testing will use, this is explained below. McFarlin (2012), states that, this includes the close look on individual units on the system to check if all functionality works well. Units might be functions and algorithms that do some actions and give back feedback.

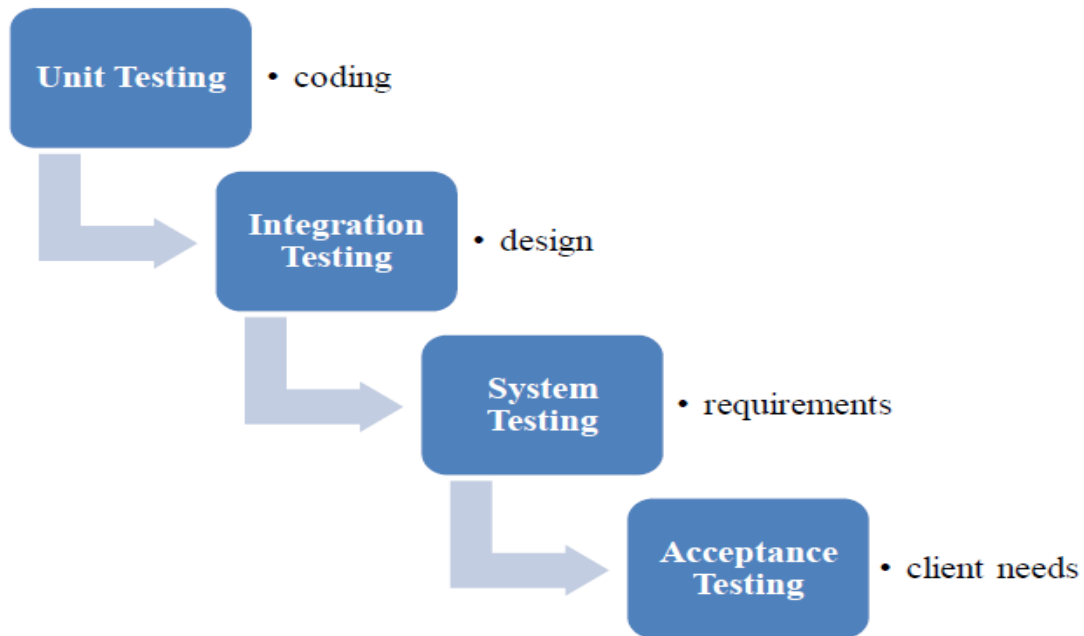
### **5.3.2 Integration testing**

As stated by Microsoft (2004), integration testing of software is an addition of unit testing and units are joined and tested to check out for interface errors. The core reason for this testing is to look for the defects that happen when components integrate. Integration testing was conducted using a bottom-up approach which involved testing smaller combined units followed by bigger combined units called modules. Black box and white box were used for integration testing. The methods that were used for integration testing were black-box testing and white-box testing. Black-box testing was mainly used to test and verify the performance of the interfaces that facilitate the interaction between components of the system.

### **5.3.3 Acceptance Testing**

Powers (2012), states that acceptance testing is manly focusing on the system users' requirements whereby testing will be done to check if it meets all systems user requirements found on the research findings. Before the operational use of the system can be done, acceptance testing is done and this is the final stage in testing the system. The testing is repeatedly done till satisfied.

The diagram below shows the procedures for testing.



*Figure 5.1: Testing Process*

### 5.3.4 Testing Methods

There are three methods that the developer will use for testing namely white box, black box and defect testing.

#### 5.3.4.1 Black Box Testing

According to Beck (2000), black box testing is a technique of testing without having any knowledge of the internal working of the system. This is where the functionality of the system is completely tested. Black box testing involves an exercise of locating errors such as performance, initialization and interface as well as wrong functions in the system.

#### 5.3.4.2 White Box Testing

White box testing is an examination of the system based on the structure of the code and the interior logic of the code also (Williams, 2006). It only examines the fundamental aspects of the system and has no or little relevance with the internal logical structure of the system (Nancy et al 2004). This involves thorough investigation of the internal structure and logic of the program. This was exercised by individuals who have the knowledge of the internal working of the programs and was done with the aim of identifying snippets of code which misbehaving.

#### 5.3.4.3 Defect Testing

Discovering of defects inside the system is very important. The aim of defect testing is to ensure that the system is delivered to the final user perfect.

### **5.3.5 Test Cases (Verification and Validation)**

#### **Verification**

Verification is the action that is taken to see if the built computer programs or systems meet all user requirements noted before the developing of the system (Beizer, 2002). Verification and testing work together and it is much important for the system to bring out results expected meeting all objectives correctly. The process was done by looking at the outcome comparing with expected user outputs. This also refers to the process of calculating the products of work done of the development stage to ensure that stated user requirements are met for that stage (Tannenbaum, 1990).

#### **Login Verification and Authentication**

If wrong login credentials are supplied in the username and password text fields, then the system will give a warning error message to give valid credentials. The below is the login form showing the username and password text fields.

roadrules

Please enter your current phone number below and click Send Verification Code, a verification code will be sent to your phone.

+263

Send Verification Code

If wrong phone number is inserted in the phone number text field the system will give a warning error message to give valid credentials. The below is the login form.

**Figure 5.2: Login Form**

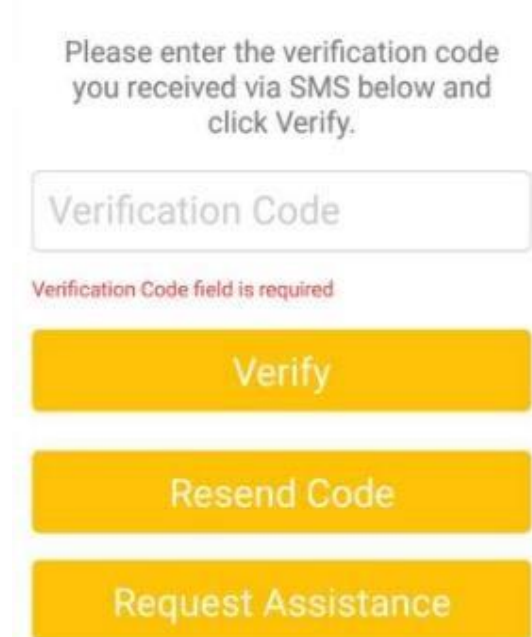
### **Validation**

The process of making sure that the developed product, program and system satisfies the user needs is referred as validation. The reason for building a new system is to eliminate and remove all drawbacks been faced by system users to build the correct system that will tackle down all the noted challenges. This can be also explained as assessing of a computer system during and at the end of the software during or at the end of the progress stage to ensure stated business requirements are accepted (Dixit, 2002).

### **Data Validation**

The process of making sure that the developed product, program and system satisfies the user needs is referred as validation. The reason for building a new system is to eliminate and remove all drawbacks been faced the system users, so as to build the correct system that will tackle down all the noted challenges. This can be also explained as assessing of a computer system during and at the end of the software during or at the end of the progress stage to ensure stated business requirements are accepted (Dixit, 2002).

The following will test the system response if the user supplies invalid data for processing. There are some fields such as the verification code page with integrity constraints and a valid code should be supplied there.



Please enter the verification code you received via SMS below and click Verify.

Verification Code field is required

Verify

Resend Code

Request Assistance

**Figure 5.3: Verification code**

The following test validates if the specified mobile phone number is valid following the specified format. If the mobile number does not follow the correct format, then the system rejects it and notifies the user to input correct phone number. This is also a mandatory field and hence it had to be validated as this is used to alert engineers of system and network incidences after working hours and during weekends.



### **5.3.6 System Review**

The system was also tested against the entire project objectives. This was done to ensure that the project was actually able to meet the initial objectives set out in the system proposal document. This would serve as proof that the project has been able to satisfactorily solve the problems that were faced by the organization.

Objectives tested for:

1. Realtime monitoring of network elements
2. Produce Realtime network statistics
3. Create a log of all system events
4. Allow concurrent users system access

### **5.4 Installation**

In order to install the new system, it was deemed appropriate to use parallel conversion. Parallel conversion is when a new system will be deployed on a full scale while the existing system will still be running on the other hand (Crocket 2008). This prime advantage of this procedure is that if the new system fails or faces resistance then the old system will be intact to cover the loop hole. This stage also consists of different methodologies such as parallel running, direct change over as well as pilot operation. These will be put into test as well during this phase.

#### **5.4.1 User Training**

The new Infrastructure Surveillance System has four users namely the system administrator, support engineer, customer services representative and manager. User training is going to be done in two diverse ways since it includes the general staff and the privileged users. Mass user training is going to be conducted to general staff and for the privileged users involved it is going to be done on individual bases. There are levels of training which are going to be used:

- **Module level:** The user must get well versed with each module of the system that the user will access or work with.
- **System level:** The management must appreciate the construction of the system and all the work it can do. Only a few individuals who have full or complete access rights to the entire system must have knowledge of how all the modules within the system work that is its functionality.

#### 5.4.1.1 Training Plan

Training is going to be in-house and is split into three sessions and system administrators will attend all the three sessions since they should have an overview of the entire system for trouble shooting and maintenance purposes as well as further development.

*Table 5.1: Training Session 1*

<b>User Group</b>	Support Engineers, System Administrators
<b>Training Scope</b>	Systems overview, Troubleshooting Tools and Ticket Resolution
<b>Requirements</b>	Two computers and an overhead projector
<b>Trainer</b>	System Developer (Tafadzwa Rusere )

*Table 5.2: Training Session 2*

<b>Venue</b>	Road Rules HQ - Harare
<b>User Group</b>	Customer Services Representatives, System Administrators
<b>Training Scope</b>	Systems overview, Incident Response and Ticket Assignment
<b>Requirements</b>	Two computers and an overhead projector
<b>Trainer</b>	System Developer (Tafadzwa Rusere )

*Table 5.3: Training Session 3*

<b>Venue</b>	Road Rules HQ - Harare
<b>User Group</b>	Management, System Administrators
<b>Training Scope</b>	Systems overview, Reports Generation & Extraction and Logs Review
<b>Requirements</b>	Two computers and an overhead projector
<b>Trainer</b>	System Developer (Tafadzwa Rusere )

#### 5.4.2 Changeover

System changeover is the process of taking out the current system replacing with a new system, Huassain (2007). The main reason is to make changes or shift from the old system without having any problems. It also looks on how the existing information can be incorporated with the one of the new system. The below are the types of changeover that can be used and one method will be selected.

#### **5.4.2.1 Pilot Changeover**

Pual et al (2003), states that with pilot changeover the new system will be installed on a small department of the organization and few users will evaluate and see its functionality and performance before it is installed and implemented on the whole organization. Pilot changeover is said to have low risks since installed on a small part of the organization if risks occurs its cost will be low.

#### **5.4.2.2 Direct Changeover**

According to Krugman (2009), direct changeover is completely ruling off the existing system replacing it with a new system. This change over process is time saving and there are minimized cost but this in accompanied with elevated risk of losing all data since there will be no back up of the current system.

#### **5.4.2.3 Phased Changeover**

Sommerville (2004), states that this is where one part of the system is introduced at a time up until the old system is totally removed. When the part selected is working properly the system is installed to the next up until the current system is overwritten. This encounters fewer risks since one area chosen is affected and its time consuming to affect the whole organization.

#### **5.4.2.4 Parallel Changeover**

Hutchens (2007), states that, parallel changeover is the process of running both the old system and the new system at one time parallel. If the user is satisfied with the performance of the new system the old one is eliminated and ruled off. This changeover process is safe since both systems is used to evaluate if the new system is usable over the old existing one. Parallel method is dare and time wasting since two systems will be running at the same time. Hence the researcher will recommend the parallel changeover to be used.

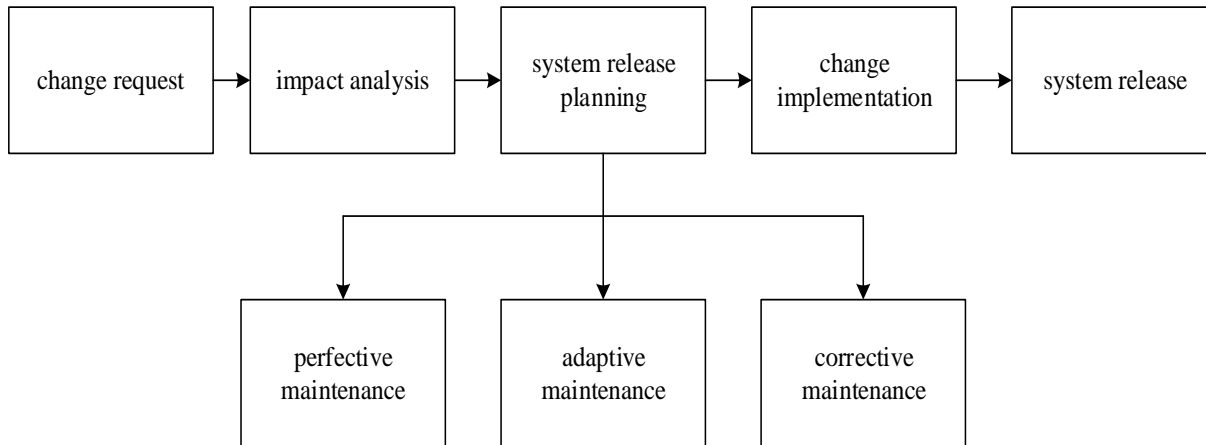
#### **5.4.3 Reasons for choosing Parallel Changeover**

- The changeover has less risks
- Low employees and student stress since they will be still using the old one.
- Gives more time of learning the new system while using the old one.

### **5.5 Maintenance**

The main objectives of the system maintenance are to provide maintenance and improvements for the new system as well as support users and help them to obtain the most value from the new

system. It will also entail upgrading; adjusting and modifying the system to keep abreast with the goals of the organization. In brief the maintenance of a system is and always should be an on-going process that normally involves updating the system. For this to occur, then the system would be expected to have already be deployed and in use. Maintenance types vary, but with this type of system Corrective, Adaptive and Perfective Maintenance will be used.



**Figure 5.10: Software Maintenance Diagram**

### 5.5.1 Corrective maintenance

Its main functionality is to address all adjustments carried out during implementation stage as well as the design stage (Sommerville, 2005). Moreover, corrective maintenance also looked at the type and nature of the errors made by the anticipated users as well as the necessary procedures that were used to make corrective changes. During this phase errors such as coding errors were discovered, for instance a field area had to be adjusted to accept integer's values only.

### 5.5.2 Adaptive maintenance

Edwards and Bramante (2009), states that this type of maintenance will be put into use whenever a change in environment has been encountered. In short, it permits a change in the software whenever changes in hardware or operating system are in question. The main reason for making the changes will be to constantly update the hardware and software platforms so as to meet the ever-changing user requirements and increase the best of quality to services offered. A system administrator is required to be readily available when this type of maintenance is in use since he/she will be tasked with checking the validity of the system in meeting its short and long-term goals.

### **5.5.3 Perfective maintenance**

It is common knowledge to all that once viewed as the best development among a series of others is not always the one to be implemented (Sommerville, 2005). The reasons for not implementing the best development is not because of its design but that in most cases there are neglected due to schedule constraints or even ignorance. Firstly, this type of maintenance assesses the worthiness of the energy to be deployed in perfecting the system to such levels. If the assessment proves to be worthy then design specifications will be drawn down and if there are approved there then should be implemented. Having implemented the design, the next step will be reviewing the implantation and all the necessary activities done in the review will then be documented for future reference. The goal of perfective maintenance is to enhance an application so that it performs efficiently. Like corrective maintenance, perfective maintenance can be carried out by users, management or even the system developer.

### **5.6 Recommendations for Future Development**

It was advisable to recommend perfective maintenance, since this type of maintenance not only modifies system requirements but it also adds to those already in place in regard to the ever-changing business environment.

The system is subject to review and updates and it can be upgraded to accommodate ‘WHAT IF ANALYSIS’ that enhances the management to come up with uncompromised decisions for future organization information sharing and how it is structured within the organization.

The following was recommended for future development:

- To add another module to link the Infrastructure Surveillance System to the billing system and introduce additional product offering through on-demand access were customers are only billed for the total time they were online and accessed the system
- To add SMS notifications for even more interactive notifications and greater reliability as users pay more attention to their mobile phones than their emails.
- To add a compatibility module to allow connectivity from mobile platforms such as Android and IOS based devices.

### **5.7 Conclusion**

The chapter discussed in brief the implementation and coding process of the project. Furthermore, it also looked at the technologies that were used in the system and managed to give

a graphical representation of the entire system through the practice of screen shots and code snippets. Tests were carried out in scrutinizing the systems behaviour. To conclude, the project has been executed successfully, though it still requires some perfection soon, this is so because system development is an on-going process.

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**APPENDICES**

**APPENDIX A: USER MANUAL**

# THE PROGRESSIVE ANDROID BASED ROAD RULES DEFENSIVE DRIVER'S LICENSE APPLICATION



## INTRODUCTION

It is a mandate for a user manual to be created so as to supplement on user training as well as providing help to users whenever they interact with the system.

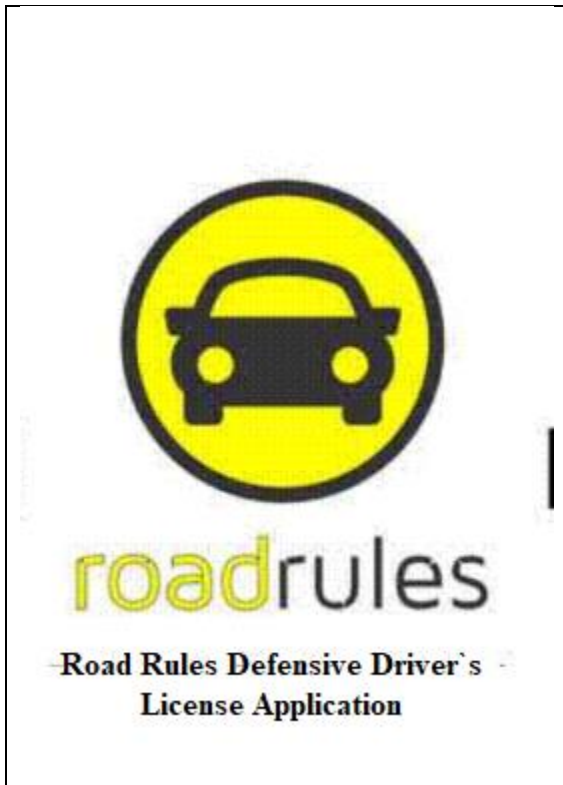
## GENERAL REQUIREMENTS OF THE SYSTEM

The system requires the user to have an internet connection on their devices and visit the Road Rules Website to download the defensive driving application on the home page of road rules.

**NB With the use of touch technology the application is designed in such a way that the users can simply manoeuvre through the application taking note of each and every option within the application, each and every step self-explanatory and an individual with basic knowledge of digitised gadgets can be able to use it.**

### 1. Getting Started

Download and install the android application from road rules solutions webpage.



*Figure A1 Road Rules Web Page*

### **1. Login**

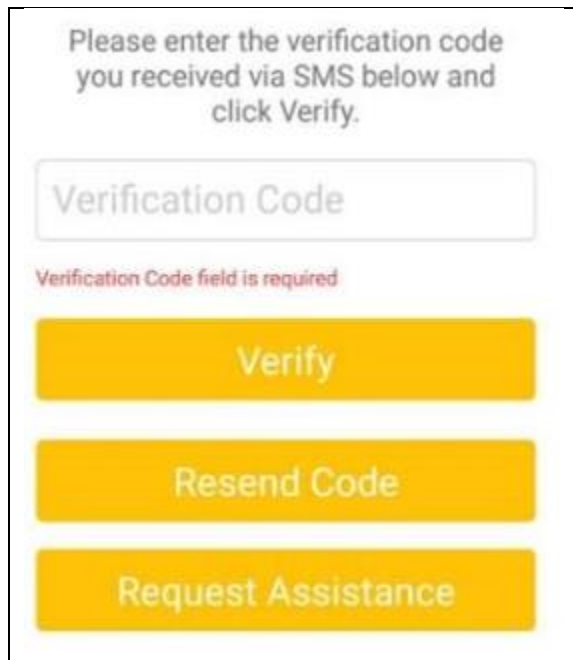
The user is then requested to enter the required fields which are province, name, surname and valid cell phone number for validation and approval.



*Figure A2 login page*

## **2. Validation**

Validation failed because the number is already in the database. This is security to discourage users from using multiple devices.



Please enter the verification code you received via SMS below and click Verify.

Verification Code field is required

Verify

Resend Code

Request Assistance

*Figure A3 Validation*

### **3. Validation not accepted**

A valid phone number has to be produced, if otherwise request for assistance by pressing request for assistance button



*Figure A4 Select from available sources in the system*

#### **4. Validation accepted**

If the verification is successful, upon log in the user selects what to do by a single click of the available menu options.



*Figure A5 Main menu*

- The “**PRACTICE**” section gives the user immediate feedback after completion of every question, thus allowing the user to learn and retain information quickly and more efficiently.
- The “**TEST**” section of Road Rules Driving Test App provides a fixed eight (8) minute count down timer period of answering the test questions. This is meant simulate or create a life exam scenario. This has been specifically designed to assist the user on time management and to get them acquainted to time constraints so as to avoid panicking in the actual exam.
- Whereas “**NOTES**” **section provides** Highway Code rules and road rules test notes that cover the defensive license test curriculum.
- The “**PROGRESS**” section tracks and monitors the user’s progress over a period of seven (7) days. This is to assist the user in deciding on whether they are ready to sit for the official government driver’s license test. It ensures that the Road Rules Driving Test App users are advised of their test readiness.

**NB: Users can exit from the system by clicking the Exit Icon on the top right corner of the window.**



## **Appendix B: Interview Checklist**

### Interview Question

The following is an extract from some of the interviews that were conducted within Road Rules:

1. Do you enjoy working with the current manual system and if so why and if not why?

2. What problems are you facing using the current system?
3. What view or opinion do you have about migrating from the current manual system to a fully computerized system do you have?
4. What expectations of the proposed system do you suggest?
5. How do you get notified when your network host or server goes offline?
6. How long does it take to resolve a reported network issue?
7. What do you think the current system's major weakness is and does it affect your efficiency?
8. How easy is the process of collecting data for reporting on the total downtime or average downtime of a given host?
9. Has a network incident ever gone for more than an hour without being noticed or resolved?
10. How many tools are you expected to know to be able to successfully carry out your troubleshooting of network and system issues?
11. Do you think the introduction of an automated infrastructure surveillance system would make the process of network monitoring and troubleshooting less cumbersome?

### **Appendix C: Questionnaires**

Road Rules Infrastructure Surveillance System is an online web based solution system that allows the current and future employees to monitor network activity and troubleshoot issues in realtime and receive instant notifications via email once a network node exceeds a set threshold. The information from this study will be used for academic purposes only. Your assistance in filling this questionnaire is greatly appreciated.

#### **Checklist Section A: Staff**

1. How do you rate the current system?

Excellent  Good  Fair  Poor

2. Given the choice to migrate from the current manual application system to a fully computerized system, would you choose to migrate?

Yes  No

If No, what may be the reason \_\_\_\_\_  
\_\_\_\_\_

3. Do you feel the current process of network monitoring is time consuming?

Agree  Disagree

4. Have some of employees complained about the current system?

Yes  No

If YES what were the complaints?

\_\_\_\_\_  
\_\_\_\_\_

5. What problems are you facing with the current system?

\_\_\_\_\_  
\_\_\_\_\_

### **Checklist Section B: Management**

1. Are you satisfied with the current manual system that you have been using all along?

Yes  Not at

If YES, give the reason

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2. How do you rate the current system?

Excellent       Good       Fair       Poor

3. Are you pleased with the processing speed of the current manual system?

Yes       No

If No what are the suggestions? \_\_\_\_\_

4. Have you ever failed to get a system report that you required?

Yes       No

5. Do you feel a considerable amount of productive time is lost through the process of manual network monitoring and troubleshooting?

Yes       No

### Appendix D: Observation Scoresheet

Name of Observer: \_\_\_\_\_ Department: \_\_\_\_\_

Date: \_\_/\_\_/\_\_/      Time: \_\_\_\_\_

Observation: \_\_\_\_\_

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Conclusion: \_\_\_\_\_

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**Appendix E: Code Snippet**