

Electronic Criminal Vetting and Management System (*eCVMS*)



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Electronic Criminal Vetting and Management System (eCVMS)



By

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ABSTRACT

The purpose of this research was to provide a working and lasting solution to the challenges being faced by the Zimbabwe Republic Police (ZRP) at Criminal Investigations Department (CID), Central Criminal Bureau (CCB) in particular. To achieve the best results for this project, a number of methodologies, information gathering techniques and development tools were carefully used. The researcher used Interviews, Observations and Questionnaires to gather data from the users/CID officers at CCB. The information was collected on how the current system operates, challenges they are facing and what they suggest could be done to better the current system. The tools which were used to develop the Electronic Criminal Vetting and Management System include Visual Studio 2012, SQL Server 2012(relational database) , Microsoft 2010 (documentation). The electronic **Criminal Vetting and Management System (eCVMS)** is an application that focuses on the activities of police officers in their dealings with criminal elements within Zimbabwe. It tracks criminal history of all convicted persons within the country from the time they are arrested a local police station, prosecuted and convicted at our local courts. The system will ignore petty offences that are dealt with by way of fines at police stations such as minor traffic offences and other miscellaneous offences. The system will electronically issue Police Clearance certificates to individual clients referred by various organisations seeking their (clients) criminal record. It will also supply management at police establishments and courts with vital criminal information needed for decision making.

DECLARATION

I, **Wellington Sibanda** 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 “**Electronic Criminal Vetting and Management System**” by **Wellington Sibanda** 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.....

Date.....

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DEDICATION

This paper is dedicated to my late Mother and Father, Mrs. S. Sibanda and Mr. A. Sibanda for their unconditional love and unwavering support they rendered me throughout my early stages in life. They inspired me and encouraged me to always do my best in academic endeavours in order to fulfill my dreams. May they REST IN PEACE

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LIST OF ACRONYMS

| | |
|------|--------------------------------------|
| ZRP | ZIMBABWE REPUBLIC POLICE |
| DBMS | DATABASE MANAGEMENT SYSTEM |
| DFD | DATAFLOW DIAGRAM |
| ERD | ENTITY RELATIONSHIP DIAGRAM |
| ICT | INFORMATION COMMUNICATION TECHNOLOGY |
| NPV | NET PRESENT VALUE |
| CCB | CENTRAL CRIMINAL BUREAU |
| CID | CRIMINAL INVESTIGATION DEPARTMENT |
| SQL | STRUCTURED QUERY LANGUAGE |
| ERD | ENTITY RELATIONAL DIAGRAM |
| CR | CRIME REGISTER |
| MIS | MANAGEMENT INFORMATION SYSTEM |
| ZPS | ZIMBABWE PRISON SERVICES |
| JSC | JUDICIAL SERVICE COMMISSION |
| IWL | IN WITH LABOUR |
| LAN | LOCAL AREA NETWORK |
| UML | UNIFIED MODELLING LANGUAGE |
| HDD | HARD DRIVE |
| RAM | RANDOM ACCESS MEMORY |

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CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

National Police organizations the world over are mandated to provide Police Clearance Certificates to confirm the criminal status of its citizens for various reasons such as seeking employment, visa application, prosecution or for emigration purposes. The Zimbabwe Republic Police (ZRP) in discharging its duties is required to keep records of all individuals who are convicted of any criminal offence within Zimbabwe. There is need for the organization to take advantage of advances in technologies to share information thereby effectively combating any form of organized transnational crime. For the organization to effectively and efficiently discharge its obligations there is need to implement an electronic Criminal Vetting and Management System (eCVMS).

1.2 BACKGROUND

Background in a research study as observed by Pachon and Arias (2010) is a summary of the conceptual and methodological characteristics of the research project. With the emergency of Information and Communication Technologies (ICTs), and e-Government, it is possible to improve efficiency and effectiveness of the internal operations of the ZRP and to re-locate its services close to members of the public. The ZRP, through this research study aims to develop and enhance their services to maximize quality assurance benefiting from advanced information and communications technology (ICT) and to change their working practices in order to provide the best and maximum possible service.

1.2.1 BACKGROUND OF THE ORGANIZATION

The Zimbabwe Republic Police (ZRP) is a government Department under the Ministry of Home Affairs which is constitutionally mandated to maintain law and order and prevent property from malicious damage by the Constitution of the Republic of Zimbabwe. On attainment of Zimbabwe's independence on 18 April 1980, the British South African Police (BSAP) was renamed Zimbabwe Republic Police (ZRP) on July 1980. The rank structure remained the same but the flag and its badge changed.

The Constitution of the Republic of Zimbabwe Chapter 11 under the Security Services section Part 3, Police Services and its functions stipulates the powers and responsibilities of the ZRP. It states that "There shall be a Police Service which is responsible for:-

- (a) Detecting, preventing and investigating crime
- (b) Protecting and securing the lives and property of the people
- (c) Maintaining law and order; and
- (d) Upholding the Zimbabwe Constitution and enforcing the law without fear or favour.”

The demand for police accountability and better service by the members of the community has been increasing since the country gained its independence. It became evident that the ZRP had to reposition itself and align with the community it served (ZRP Crime Strategy, 1995). At that juncture visionary leadership was required to stir the ZRP towards the new world of policing. As a result in 1995, the ZRP embarked on a transformation process code – named ZIMPOD (Zimbabwe Police Organizational Development Project) to spearhead the change process. The ZIMPOD consists of the three major components namely Strategic Development, Human Resources Development and Information Systems / Information Technology.

The Information Systems / Information Technology component of the ZIMPOD led to the development of an Information Systems Strategy with the aim to ensure that the development and use of IS would support the ZRP in achieving its strategic objectives (ZRP IS/IT Strategy, 1998). The IS Vision Statement is: “Relevant, accurate, timely information should be accessible to all ZRP staff, to help them do their job more efficiently and effectively” (ZRP IS/IT Strategy, 1998:1). The IS Strategy initiated a number of IS/IT pilot projects in the areas of crime management, traffic management, human resources management and financial management.

1.2.2 ORGANIZATIONAL STRUCTURE

According to the Constitution of Zimbabwe, the Police Service shall be under the command of Commissioner General of Police (CGP) appointed by the President on the advice of the Police Service Commission and subject to the approval of the National Assembly. For smooth running of the organization, the CGP is deputized by four Deputy Commissioner Generals (DCG) heading four portfolios namely; Administration, Operations, Human Resources and Crime. There are also five Commissioners of Police, four of which are under the above portfolios and one of them on special assignment by the CGP. All these above ten senior officers constitute the organizations top management responsible for Strategic Management. They are known as the Central Planning Committee (CPC) whose duties among others include:

- Plan and co-ordinate establishment and estimates of the organization.
- Resolve problems of the organization and development of the organization.
- Deal with the best distribution of resources.
- Stimulate and maintain efficiency.
- Initiate and encourage new research projects and ideas.

ZRP has a classical management structure comprising a clear organization hierarchy with three (3) distinct levels of management which are top level, middle level and operational level management as outlined below.

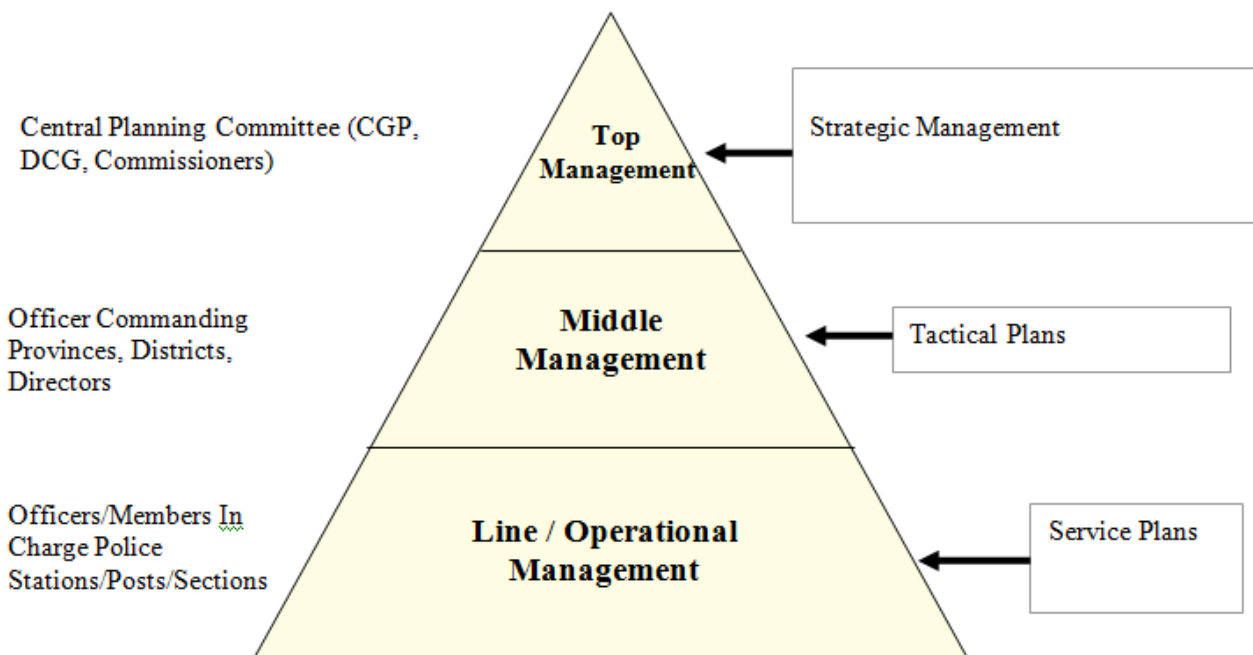


Fig.1.1: Management structure (Source: ZRP Tactical Planning manual (1999))

The middle management is comprised of Officer Commanding police establishments and Directors of technical sections of the rank between Superintendent and Senior Assistant Commissioners who are responsible for tactical planning in the organisation. There are ten (10) operational provinces which are headed by Senior Assistant Commissioners with three deputies responsible for Administration, Operations and Crime respectively. Also there are five (6) specialised ancillary support sections, Support Unit, Police Protection Unit, Criminal Investigation Department, Anti-stock Theft, Minerals and Border Control Unit and Traffic which are also under the Command of a Senior Assistant

Commissioner. There are several districts with the provinces which are led by Officer Commanding Districts who are of the rank of Chief Superintendent and have three superintendents who deputise them with same portfolios as that of the province – Administration, Operations and Crime.

In carrying out its daily activities at Police General Headquarters (PGHQ), the Central Planning Committee (CPC) is assisted by a team of senior officers called Staff Officers. These comprise of eight (8) Senior Assistant Commissioners code – named Chief Staff Officers (CSO) who lead the following departments; Administration, Human Resources, Operations, Crime, Planning and Development, Press and Public Relations, Internal Investigations and Inspectorate Unit. Under their command are Senior Staff Officers (SSO) and Staff Officers (SO) of the rank of Assistant Commissioner and Chief Superintendents respectively. The organisation also has some technical departments which offer support services and are led by Directors who are of the rank of Senior Assistant Commissioners and these are; Director Finance, Director Legal Services, Director Information and Communication Technologies, Director Intelligence, Director Medical Services and Director Transport and Logistics who are all based at Police General Headquarters.

At the base of the organisational management triangle are Line / Operational managers who are of the rank of Chief Inspector and Inspectors also known as Officers In Charge. These junior officers are responsible for the day to day running of police stations and sections within the organisation. The Officers In Charge make service plans which guide them in their operations. They lead a pack of non-commissioned members who are responsible for daily operations of the organisation.

ORGANOGRAM

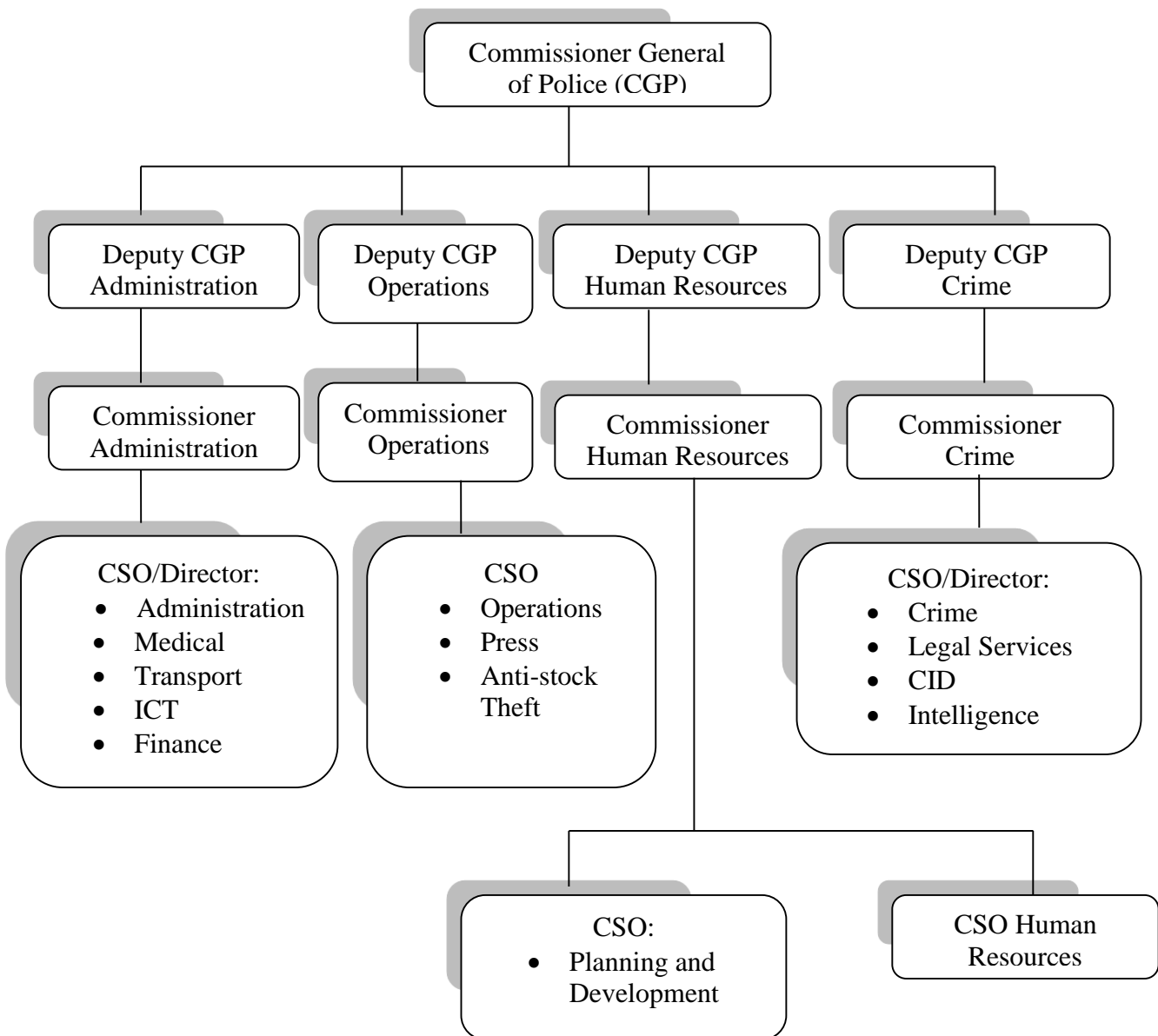


Fig. 1.2: Organogram of ZRP

1.2.3 VISION

To be a leading Police Service provider in the world by 2020. (ZRP Vision 2020).

1.2.4 MISSION STATEMENT

The Mission Statement for the ZRP is derived from the organizational constitutional mandate (Constitution of Republic of Zimbabwe Chapter 11: Part 3) which states that the mission of the Police is:

To provide an effective policing service to the public in order to maintain peace and stability and create an environment conducive to social and economical development.

1.3 PROBLEM DEFINITION

- **Loss of records**

The important criminal records are increasingly getting lost or misplaced along the way as they move from one office to another jeopardizing the whole criminal justice system. The Central Criminal Bureau (CCB) housed at the Criminal Investigations Department (CID) headquarters is using a manual system to keep records and is no longer reliable as more and more criminal records pile up resulting in misfiling of records. It has become cumbersome to track some criminal records which get lost on daily basis at the CCB using the current system.

- **Corruption**

Criminals can easily evade their unlawful deeds through corrupt means in connivance with unscrupulous police officers. Physical files of criminal records and their fingerprints forms can easily be destroyed by officers manning the records offices to protect criminals for personal gains. Once such records are tampered with criminals get off the hook and continue perpetrating offences since the investigating and judicial officers need this information for the justice delivery system to be effective. The organization's stakeholders and other agencies such as embassies and employers may end up getting incorrect criminal history of some individuals from ZRP. Convicted or wanted persons can also easily change their names and obtain new forged identity particulars with the assistance of officers from the Registrar General's office for the sake of escaping from their old crime records.

- **Centralized vetting process**

The Criminal Vetting process is currently centralized at CID headquarters in Harare and this causes a lot of inconveniences to members of the public and organizations that need Police Clearance Certificates. It is not possible to decentralize the process to provinces or police stations due to large volume of files and fingerprints that are kept at CCB. When a person is convicted of any crime the record is sent for filing in Harare and it is pointless to keep a filing copy at the station because criminals are very nomadic. There is also a lot staff that is involved in processing and maintenance of these files making it impossible to decentralize the process.

- **Availability of Fingerprints Experts**

The organization relies on highly trained and specialized fingerprints experts who are responsible for classifying fingerprints manually. Most of these experts have since left the organization and it is difficult to recruit and train new experts. The organization has limited capacity to train these experts since it relied on these few experts who have since left the organization for training purposes. Some developed countries such as South Africa and other European countries which used to offer assistance in training fingerprints experts have since automated their criminal records and no longer rely on human experts.

- **Lack of backup services**

There are no backup services for all the records at CCB since all files are kept at main offices in Harare. The voluminous nature of files makes it very difficult to create backup files which need a lot of space, stationery and other resources. Once these files are destroyed by malicious acts or natural causes such as fire or water there cannot be any other means to obtain these important records.

- **Information sharing**

Criminals have become highly sophisticated and mobile hence the need for the ZRP to share important information about such criminals with other law enforcement agents across the globe. There is need for the organization to effectively share useful information and biological data of criminals such as fingerprints with partners such as Interpol and SARPCCO to effectively deal with these criminals who hop from one country to another committing various offences such as robbery, drug trafficking, murder and many other serious crimes.

1.4 AIM

The aim of the research is to implement an automated Criminal Vetting Management System in order to address some problems that are being encountered by Police Officers at CCB.

1.5 OBJECTIVES

- To facilitate addition and maintenance of electronic criminal records.
- To electronically capture and store fingerprints for known criminals.
- To provide automated searches for criminal history using personal data and fingerprint.
- To provide top management with important information for decision making purposes.
- To produce Police Clearance Certificates.

1.6 TOOLS

There are many different developing tools which have emerged on the market for development of computer applications. In developing the system the following tools will be used by the researcher;

- **Microsoft Visual Studio**

Microsoft Co-operation Inc developed Visual Studio which is a suite of applications that give developers a platform to create enterprise windows applications. Using Visual Studio the developers can write Windows applications; console applications, ASP.NET applications, Windows Mobile applications and ASP.NET web services using a programming language of choice such as C#, VB.NET, C++, J# and many more. Many added tools are being found with new versions of Visual Studio such as Visual Safe Source which enables the developers to protect their code.

Visual Studio Ultimate 2012 edition will be used to develop the front end of the application which will interface database through various controls. The researcher chose this development tool due to its numerous advantages. It will enable the writer to write code quicker and easier due to its production enhancing features such as auto-completion, code refraction, method look up and many more. It also have pre-built blocks for managed and native code which will help the researcher reduce code.

- **Microsoft SQL Server 2008**

The database for the system will be created using Microsoft SQL Server 2008. This is a relational database management system (RDBMS) developed by Microsoft Corporation Inc for the design of enterprise applications. It is comprised of a set of programming extensions to improve the functionality

of Structured Query Language (SQL) which is an interactive standard programming language for fetching and updating records from a database.

In this research I opted for Microsoft SQL Server 2012 for its numerous advantages over other DBMS. It is easy to install, it uses “wizards” with installer detecting, and downloading any required updates at no further cost. Some individual components such as Analysis Services, Database Services and Integration Services can be installed separately. It has better performance as compared to most DBMS due to its inbuilt encryption and transparent data compression. Moreover its access control and permission management tools are very efficient offering better data collection and it integrates well with Microsoft Office. It can supports large databases up to 524 terabytes (TB) with its compression features enabling reduction of size.

Its security features are excellent with strong authentication and access protection with best password management features to instill strong passwords and constant change of passwords. SQL Server 2008’s Policy Based Management helps in detecting non-compliance security tendencies, allowing only authorized staff to gain access to the data. Audit trails will be easy to implement. It has low ownership cost as it includes enterprise features such as disks partitioning, data mining tools, data management tools, Advanced Security and Compression tools at no additional cost. It is equipped with backward compatibility features with lower versions so there is no need to upgrade each and every computer.

1.7 JUSTIFICATION / SIGNIFICANCE

This study is very significant to the ZRP as it seeks to find remedies to the problems associated with manual criminal vetting process. Other researchers who intend to do studies in the same dimension within ZRP can also use this research. Through this research the researcher will also gain some knowledge concerning the field of work for some police officers and civilian staff at CCB and use this knowledge to improve their professional ability. The nation will also benefit from the study in that if the criminal vetting exercise is computerized, the security of its citizen and neighbours will be enhanced.

Citizens of any state may be asked to present Police Certificates by any commercial or government agency such as embassies to verify the applicant’s criminal history. All potential employers also have the responsibility to exercise diligence when recruiting so as to avoid employing criminals. Prosecuting authorities also depend on criminal history when prosecuting offenders for fair delivery of justice

system. Gone are the days of waiting for long periods for the results of police background checks. The advancement in ICT technologies will enable the Police to avail results of checks within few minutes.

Electronic Criminal Vetting Management System (*eCVMS*) includes a broad range of services from biographic data (such as name, date of birth etc) and biometric (fingerprint, facial etc) based background checks using advanced ICT technologies. It has a comprehensive managed service capable of directly submitting electronic biometric fingerprints to the database and compare with criminal history information in the database with response in few minutes. The system can further be enhanced for mobile environment giving an all-in-one client based solution that gives the user capabilities to work in a networked or non-networked platform.

1.8 CONCLUSION

In this chapter all the problems currently experienced by the ZRP in vetting criminals were successfully analyzed. A number of objectives for the proposed system were set after an overview of the current manual system. Also in this chapter a hypothesis was done by the researcher on the development of an electronic application to solve current existing problems. It can be now concluded that it is justifiable to proceed to the next stage.

CHAPTER 2: PLANNING PHASE

2.1 INTRODUCTION

The planning phase involves project management tasks involving deciding in advance what has to be done, how to do it, when to do it and who will do it. It includes those processes performed to define the scope, develop the project management plan and identify the schedules and activities that occur within the project. According to Schwalbe (2010) the planning phase is about defining the goals and objectives for a project and planning the course of action required to meet the scope and objectives.

2.2 REASONS FOR DEVELOPING THE SYSTEM

Law enforcement agents need a good record keeping and sharing practices to effectively administer criminal justice system. There is need for timely access to accurate criminal records when dealing with highly mobile and sophisticated fugitives. Crime threats have become globalised, and as Wakefield (2009) observed most law enforcements agents are adapting their practices, broadening their expertise and creating partnerships in order to move beyond their country's borders to address these 'global village' challenges. The following are some of the challenges of the current manual system which then necessitated the development of the system.

- **Vetting time frame**

The current manual vetting process is cumbersome and it is taking long time to provide clients with police clearance certificates. It takes 7 days for normal clearances while urgent applications need at least 24 hours to be processed. The criminal records held at Central Criminal Bureau are increasing daily and currently stands at more than three million making it very difficult to process them within a short space of time. The management at some of the organisation that seek criminal vetting of individuals such foreign embassies and employers needs to be furnish with such records timely so as to make correct decisions pertaining to the application they are processing. The delays in the vetting process also greatly inconvenience members of the public (police clients) as they are forced to travel to CCB in Harare and stay longer there processing the applications.

- **Reliability of the search**

Manual vetting of criminal history has become unreliable due to large volume of work against the manpower available. There is high demand for criminal vetting as Zimbabweans migrate from one place to another in search for better opportunities. The CCB uses both biographic and biological data to search for criminal records thereby creating large chunks of records which need to be searched. Biographic records such as identity particulars (names, identity numbers etc) are used are used for searches against the fingerprints (biological data) of the applicant. It is very difficult for management to put in place mechanism to ensure effective and efficient services as they are required to make verification and validation checks on the large manual files which is very difficult to implement. It's now difficulty to come up with positive criminal identification especially through fingerprints searches as the system now heavily rely on name searches whereas many people can share same biographic details such as names and surname.

- **Resource constraints**

The Zimbabwe Republic Police (ZRP) just like any other government department is operating against a background of limited resources such human, financial and material aspects. A lot of staff is needed at CCB to effectively carry out criminal vetting process using the manual system. It also relies on a limited number of fingerprints experts remaining in the organisation for classification of the applicant fingerprints against the manual data bank of prints for criminals held at the section. The task for vetting applicants is monotonous and boring impacting negatively on the morale of the staff. A lot of stationary in the form of fingerprints forms and associated registers are needed at CCB for police officers to effectively discharge their mandate. These files are stored in expensive steel cabinets which also occupy a lot of space as they are stored in store rooms for security reasons.

- **Centralised processing**

The criminal vetting process is currently centralised at CCB which is at CID headquarters in Harare. This is causing a lot of inconvenience to the organisations clients who are made to travel long distance to get the service. These manual records are voluminous and cannot be decentralised taking into considerations of the limited resources that the organisation have. Clients are forced to make a double trip to submit and collect the prints respectfully and thus causing a lot of inconvenience to them (customers) in terms of cost and time.

- **Corruption**

The image of the ZRP has been severely dented due to alleged acts of corruption by members of the police force. With the manual system applicants with known criminal history can easily get away with their previous wrong deeds through connivance with unscrupulous members of the organisation. Files containing these records can be easily be maliciously destroyed for personal gains by members of the police service thereby letting loose well known criminals. It is difficult for the management to enforce controls on the manual system to make sure that police officers are not bribed to provide ‘favorable’ outcomes in criminal vetting.

- **Backup and communication**

The manual files are very difficult to make a backup especially taking into consideration of the volume of the records. It is very expensive to create manual backups (due to stationary and storage space) and currently there is no backup of all the records that are filed at CCB.

The new computerised system will enable electronic capture, storage and retrieval of both biographic and biometric data. This system will enable the Director Criminal Investigations Department and his managers to effectively control all the activities associated with the management of important criminal records. It will enable the organisation to achieve all its goals as set in their Vision 2020.

2.3 BUSINESS VALUE

Information and Communication Technologies often entails large capital investments in organisations in which corporations are faced with a number of stakeholders that are demanding the creation of business value through these investments (Grembergen, 2009). A simple definition states that business values come from minimizing cost and maximising benefits (van der Zee, 2002). The implementation of computerised Criminal Vetting System will result in improved business operations in terms of important business drivers such as operational cost and enhanced speed and efficiency of the Central Criminal Bureau. In the first place these are drivers that trigger any project.

2.3.1 VALUE GAINED FROM USING THE SYSTEM

This system will help the ZRP to achieve its goals of providing efficient and effective service to its customers through improved service delivery. The organisation through its Service Charter in year 2000 spelt out standards of performance defining the minimum of service expected from its staff and

the system will therefore assist the organisation in achieving its set values (ZRP Service Charter, 2000) which are as follow;

- Highest quality service to the public
- Maximum co-operation with the public
- Highest professional standards in all our operations
- The efficient and effective use of all existing resources
- Transparency in our operations
- Accountability
- Avoiding the easy way out of problems

2.4 FEASIBILITY ANALYSIS

A feasibility study occupies a place of importance in contemporary project management. The purpose of the feasibility study is to see if it is worthy going ahead with the new system (Doyle, 2003). The proposed new Criminal Vetting System requires substantial amount of money and will take time and effort so there is no point in starting such a project only to abandon it half way through. According to Chandra (2009), feasibility study is an in-depth study covering technical, financial, social and other aspects of a project in order to provide a base for the investment decision on a project. Findings from a feasibility study helps in deciding whether to go ahead with the project and whether the intended benefits from the project will be accrued.

Hereunder are the four factors that categorise feasibility study;

- Technical feasibility
- Economic feasibility
- Social feasibility
- Operational feasibility

2.4.1 TECHNICAL FEASIBILITY

The existing technology should be able to support the implementation of the new system to solve identified business problems. Technical feasibility should answer the simple question – are the necessary technical resources and people available for the project (Shelly, 2010). In assessing the technical feasibility, the writer is going to consider whether the ZRP has the necessary hardware, software and network resources to support the project and if not ascertain if the needed resources can

easily be acquired. The same applies to the availability of needed expertise such as programmers, network specialist and others within the organisation. If not available can it be made available?

A close analysis of the technological situation in the ZRP as enunciated above it shows that the organisation has sufficient technology to fully support the project. The organisation has some technical experts such as programmers and systems administrators who can give the necessary support for the system taking into consideration of their professional qualifications and experience. The necessary Local Area Network (LAN) at CID headquarters and a Wide Area Network (WAN) already exist in the organisation with fibre optic linkage in all provincial headquarters with a linkage at PGHQ being provided by TelOne. The TelOne also provides internet facilities to the organisation using ADSL broadband connectivity making it easy to implement the system.

However there is need to upgrade the platform by acquisition of extra new hardware and software as follows:

2.4.1.1 TECHNICAL EXPERTISE

Lack of technical feasibility according to Bidgoli (2014) can also stem from an organization lacking the expertise, time or personnel required to implement the new system. An analysis was carried out by the researcher to assess the technical expertise that is needed to develop, operate, and maintain the system in the ZRP. In order to successfully implement the eCVMS the organization need to have some qualified and experienced technical expertise in arrears such as programming, networking and security management and other technical areas. An organization might opt to use internal staff or outsource the experts by employing additional staff or through consultancy.

2.4.1.2 HARDWARE AND SOFTWARE REQUIREMENT

The hardware and software requirements for the eCVMS will specify tools that provides the necessary environment in which the system will operate. The listed tables below indicate the minimum requirements of various hardware and software that is required for installation of the system.

Table 2.1: Application Server Specifications – HP/Dell/Intel/IBM

| Item | Specifications | Quantity | Quantity Available |
|------------|---------------------------------|----------|--------------------|
| Processor | Quad Core Xeon (2.40GHz) IP | 2 | 0 |
| Ram | 4 GB DDR | 2 | 0 |
| Hard Drive | Plugable 500GB, 6G SATA 7.2k | 2 | 0 |
| Raid | Smart Array p420i | 2 | 0 |

Table 2.2 Desktop Computer Specifications – Hp Pavillion All in One

| Item | Specifications | Quantity | Quantity Available |
|--------------|-----------------|----------|--------------------|
| Processor | Intel Core i5 | 40 | 0 |
| Ram | 4 GB | 40 | 0 |
| Hard Drive | 500GB | 40 | 0 |
| DVD/CD | DVDRW | 40 | 0 |
| Monitor | 20" LED | 40 | 0 |
| Network Card | Inbuilt WAN/LAN | 40 | 0 |
| OS | Windows 8 | 5 users | 1 |

Table 2.3 Networking Requirements Specifications

| Item | Specifications | Quantity | Quantity Available |
|-------------------------------|----------------|----------|--------------------|
| Cnet 5 Port Switch | 5 port | 2 | 1 |
| TP-LINK 48 Port GIG Switch | 48 Port | 2 | 1 |
| Cables | UTP Cat 35 | 1 | 0 |
| UPS | | | |

Table 2.4: Scanner Specifications

| Item | Specifications | Quantity | Quantity Available |
|-------------------------------------|------------------------|----------|--------------------|
| CanoScan 9000 F MK II | CCD, 9600 dpi, 48bit | 20 | 5 |
| Biometric Fingerprint Reader MA 300 | RS485, TCP/IP, USB-hot | 20 | 10 |

Table 2.5 Software Specifications

| Item | Specifications | Quantity | Quantity Available |
|-----------------|----------------------|-------------|--------------------|
| Database | MS Sql Server 2012 | 5 Licences | 0 |
| Development Kit | .net 2012 | 5 Licences | 0 |
| Antivirus | Esset Smart Security | 10 Licences | 0 |

2.4.1.3 OVERVIEW OF TECHNICAL FEASIBILITY

It can be concluded that it is technically feasible for the organisation to carry on with the project with the above additional resources. The cost of additional resources is not prohibitive taking into consideration the ever falling prices of hardware and software on the international market due to innovation. The ZRP has the required expertise such as programmers, systems administrators and other computer literate staff who can help successfully implement the system.

2.4.2 ECONOMIC FEASIBILITY

Economic feasibility analysis is in most cases referred to as cost benefit analysis and is the most frequently used criteria for evaluating the effectiveness of proposed new projects. According to Shelly (2010) economic feasibility means that the anticipated benefits from the proposed system outweigh the estimated cost usually considered the total cost of ownership which encompasses acquisition cost, maintenance and ongoing support. The study should provide answers to simply critical question such as – is the system cost effective?, are benefits outweighing cost? and other questions of economic interest. Through this study the ZRP should be able to see value of the investment it is pursuing by accurately weighing the cost versus benefits before embarking on any project of this nature.

The cost involved can be categorised into two forms, developmental and running cost.

2.4.2.1 DEVELOPMENT COST

These costs encompass all the expenditure incurred during the development and implementation of the proposed system. The costs usually include the finances expended in the acquisition of acquiring hardware and software for the project. In this Criminal Vetting System, the cost that will be incurred by the ZRP will constitute the bulk of the financial outlay for the organisation.

Table 2.6 Development Costs

| Item | 2015 USD\$ | 2016 USD\$ | 2017 USD\$ |
|-------------------------------|-----------------------|-----------------------|-----------------------|
| Installations (Plus Licences) | 50 000.00 | 0 | 0 |
| User training | 5 000.00 | 0 | 0 |
| Salaries | 30 000.00 | 30 000.00 | 30 000.00 |
| Total | 85 000.00 | 30 000.00 | 30 000.00 |

(i) OPERATIONAL COSTS

After the system has been fully implemented the organisation will continue to incur other inevitable extra cost such as maintenance cost for the system to run efficiently and effectively. There are many other costs such as backup (media), upgrades (both software and hardware), licence renewals and other security related costs such as antivirus software which can also increase operational cost. Operational costs are simple routine cost for the day to day business operation.

Table 2.7: Operational Costs

| Item | 2015 USD\$ | 2016 USD\$ | 2017 USD\$ |
|--------------------------------|-----------------------|-----------------------|-----------------------|
| Storage Media (Tapes / DVD/CD) | 5 000.00 | 0 | 0 |
| Stationery | 2 000.00 | 0 | 0 |
| Maintenance | 5 000.00 | 5 000.00 | 5 000.00 |
| Total | 12 000.00 | 5 000.00 | 30 000.00 |

2.4.2.2 TANGIBLE BENEFITS

Tangible benefits are benefits that can be measured in monetary value (Shelly, 2010), hence will appear in books of accounts. These benefits result from a decrease in expenses, an increase in revenue or both. Tangible benefits can manifest themselves in various forms such as reduction in salaries due to automation, floor space savings, stationery and other costs.

The table below indicates tangible benefits to be realised from the implementation and use of the system.

Table 2.8: Tangible benefits expected

| Item | 2015 USD\$ | 2016 USD\$ | 2017 USD\$ |
|-------------------------------------------|-----------------------|-----------------------|-----------------------|
| Increase in revenue from Certificate fees | 100 000.00 | 100 000.00 | 100 000.00 |
| Decrease in labour cost | 50 000.00 | 50 000.00 | 50 000.00 |
| Total | 150 000.00 | 150 000.00 | 150 000.00 |

2.4.2.3 INTANGIBLE BENEFITS

Tangible benefits are merits of the system that are not easy to measure in monetary terms but are very important to the organisation (Shelly, 2010). Some of these benefits are long term while some occur as soon as the system is operational. When the ZRP successfully implement the proposed user friendly system it will improve job satisfaction of its employees resulting in better services from the workers who are now motivated. The system will also result in informed decision due to availability of accurate information to the organisations top management. It will also lead to increased public support and satisfaction as a result of enhanced corporate image.

Table 2.9: Intangible benefits

| Item | 2015 USD\$ | 2016 USD\$ | 2017 USD\$ |
|--------------------------------|-----------------------|-----------------------|-----------------------|
| Storage Media (Tapes / DVD/CD) | 5 000.00 | 0 | 0 |
| Stationery | 2 000.00 | 0 | 0 |
| Maintenance | 5 000.00 | 5 000.00 | 5 000.00 |
| Total | 12 000.00 | 5 000.00 | 30 000.00 |

2.4.2.4 COST BENEFIT ANALYSIS

One of the major deliverables of the feasibility study is the cost benefit analysis. It is used as a toolkit for the selection of policies and projects. As Sanchez (2008) observes most computer systems development projects demand tangible benefits. Sanchez (2008) further notes that this does not mean that every system must generate a profit, but rather that the expected benefits must justify the cost. The system's economic justification under normal circumstances is the most important result of the feasibility study since it is a critical factor. In this document the ZRP's financial and technical aspects of creating the new system are put into dollars and cents so as to determine whether the cost exceeds the benefits of the new system.

The table below shows a comparison of the cost versus benefits

Table 2.10: Cost benefit Analysis

| | 2015 | 2016 | 2017 |
|---------------|-------------------|-------------------|-------------------|
| Item | USD\$ | USD\$ | USD\$ |
| Benefits | | | |
| Tangible | 12 000.00 | 5 000.00 | 3 000.00 |
| Intangible | 150 000.00 | 150 000.00 | 150 000.00 |
| Total | 162 000.00 | 155 000.00 | 153 000.00 |
| Cost: | | | |
| Development | 85 000.00 | 30 000.00 | 30 000.00 |
| Operational | 12 000.00 | 5 000.00 | 30 000.00 |
| Total | 97 000.00 | 35 000.00 | 60 000.00 |
| Profit / Loss | 65 000.00 | 120 000.00 | 93 000.00 |

Profit / Loss = Benefits – Total Cost

Figures from the above table of Cost Benefit Analysis indicates that benefits would outweigh the estimated cost by a very big margin hence it is hereby concluded that the project is viable.

2.4.2.5 PAYBACK PERIOD

According to Michael (2011) information on the timing of net cash flows is an input to a simple and often used budgeting technique called payback period. The method is used to measure time required for a project's cash inflows to equal the original capital investment. The payback is complete when the organisation has recouped its investment. Under normal circumstances projects with shorter payback period are preferred especially taking into consideration the risk element. There is an assumption that the longer it takes to recover the initial investment the greater the risk for the project simply because the cash flows in more distant future are more uncertain than those that are relatively near. The ZRP will also be eagerly waiting to recover its investment more quickly son that the investment can be re-invested in other needy projects.

(i) Advantages of Payback Period

- Ease to use and understand.
- Can help firms measure risk

(ii) Disadvantage of Payback Period

- It completely ignores the value of money over a period of time, for example there is no difference between the cash inflow received in the first year and the same amount of cash in a later year.
- It does not count the cash inflows produced after the initial investment has been recorded

Table 2.10: Proposed cash flow for a period of 3 years

| Year | Cash Flows (\$) | Cumulative Balance (\$) |
|-------|-----------------|-------------------------|
| One | 13 500 | (13 500) |
| Two | 10 500 | 800 |
| Three | 14 500 | 16 500 |

The above table shows that a period of 1 year is needed to recover initial cost or break even. The project will repay itself in a period of 1 year and thus it can be concluded that it is economically viable.

2.4.2.6 RETURN ON INVESTMENT (ROI)

The basic idea when calculating ROI is to compare net earnings against initial cost of a project by adding all future net earnings together and dividing the sum by the average investment (Nikbakht, 2006). It is sometimes referred to as Accounting Rate of Return (ARR).

(i) Advantages of ROI

- Easy to work with and understand

(ii) Disadvantages of ROI

- AAR completely ignores the time value of money

- AAR uses book earnings rather than the actual cash flows, thus ignoring depreciation as a source of cash inflow.
- The present value of salvaged equipment is not calculated in the average return, therefore underestimated.

The method for calculating ROI is as follows;

$$\begin{aligned}\text{ROI} &= [\text{TB}-\text{TC}]/\text{TB} \times 100 \\ &= [(162\,000 - 97\,000)]/162\,000 \times 100 \\ &= 40.12\%\end{aligned}$$

The above Return On Investment for the ZRP is positive thus the investment for the project is favourable. The ROI is thus in this case indicate that it is economically feasible to undertake the proposed project.

2.4.2.7 NET PRESENT VALUE

If the present value of a project's future cash flow is greater than the initial cost, the project would be worthy taking (Nikbakht, 2006), while on the other hand if the present value is less than the initial cost project should be rejected the investor would loose money if the project was accepted.

The Net Present Value will be computed in the following manner;

$$\text{PV} = (\text{Value in Year } *T) / (1 + R)^1$$

(i) Advantages of NPV

- It is consistent with modern financial theory as it uses cash flows rather than net earnings which include depreciation as a source of funds.
- NPV recognises the time value of money
- By accepting only projects with positive NPVs the organisation will also increase its value of the company which will lead to an increase in stock price (wealth for share holders)

(ii) Disadvantages of NPV

- It's not easy for managers to make detailed predictions of cash flow for future years.
- Overestimation or underestimation of cash flows may lead to rejection of projects which should have been accepted or acceptance of projects which should have been rejected.
- NPV assumes that the discount rate is the same over the life of a project

Table 2.11: Net Present Value

| Year | Cash Flow | Discount Factor | Discount Cash Flow |
|-------|-----------|-----------------|--------------------|
| One | 6 000 | .909 | 5.454 |
| Two | 4 000 | .862 | 3.304 |
| Three | 3 000 | .683 | 1.253 |

From the above calculations, the project is a good candidate for implementation as it has a favourable positive Net Present Value

2.4.2.8 OVERVIEW OF ECONOMIC FEASIBILITY

From this study it is possible to implement the project with existing resources, therefore it can be concluded that the project is economically feasible.

2.4.3 SOCIAL FEASIBILITY

Social feasibility addresses the influence that a proposed project may have on the social systems surrounding the project (Badiru, 2010). The implementation of the system may require some technical staff that are not available within the organisation resulting in the organisation having to bring in additional staff. On that same note the system may lead to abolishing of other posts may be rendered unnecessary by the new system and thus affecting the social structure of the organisation. Such changes in the operating environment may be resisted by the internal staff and hamper the successful implementation of the system.

The general social issues pertaining automation which include employee replacement,, turnover, privacy issues, employee dissatisfaction and so forth on the feasibility of implementation of the project. For the project to be socially feasible the following should be taken into account;

- **Staff morale** – A well motivated workforce would result in the success of any organisation due to high performance of its workers. The morale of the ZRP staff is high and this will have a positive bearing on the success of the project.

- **Resistant to change** – The project usually fails due to resistance to change by the staff including both users and managers. This issue will be addressed through training of internal staff and intensive involvement of users in the development of the system.

2.4.4 OPERATIONAL FEASIBILITY

Operational feasibility tests whether the system will be used effectively after it has been developed (Whiteman, 2011). The analysis will cover several important areas which were not covered by other feasibility measures. The study examines user acceptance and support, management acceptance and support and the overall requirements of the organisational stakeholders. The measurement of behaviour of users is very important for the system to be successfully implemented and it is sometimes known as organisational feasibility.

The users of the system may not expressly oppose change, but if they support the intended new system, they will always find ways of circumventing or disabling it thereby creating yet another problem. Failure by users to accept the new technology will result in the failure of the program or policy hence need for full user involvement from the beginning of the project up to the end.

2.4.4.1 OVERVIEW OF OPERATIONAL FEASIBILITY

It is operationally feasible to implement the proposed eCVMS taking into consideration the enthusiasm of users towards the proposed new system. The management and all stakeholders have also developed keen interest into the system as their support is very crucial in the development and implementation of the system.

2.5 RISK ANALYSIS

All projects of whatever nature contains some elements of risks although some are inherently more 'risk' than others due to the nature of their task, the technology on which they are dependant or the environment in which they are based on which they operate on. A risk according to (Vose, 2008) is a random event that may possibly occur and if it did occur would have a negative impact on the goals of the organisation. It is a requirement by stakeholders in a project that risk management be given top priority it deserves. The risk management process should be applied immediately at the outset of the project and should continue in an appropriate form throughout the project life cycle.

2.5.1 TECHNICAL RISK

The risk in a project comes in different forms and it is important to identify risk associated with the technical aspects of the project at an early stage. Berman (2007) states that technical risk is related to specific technology or capability that your project will require as part of implementation, for example the new software application such as Android. This type of risk is not only related to software only but it can be required equipment, tools or the ability of availability of skilled staff to support the system.

Solution

The system will be developed using tools which are readily available on the market and easy to use such as .Net and SQL Server 2010. There will also be total user involvement during the development and implementation of the system.

2.5.2 ECONOMIC RISK

The assessment of risk associated to the economic aspect of the project need also to be fully analysed for the success of the project.

Solution

Monitoring of financial resources was done.

2.5.3 QUALITY ASSURANCE RISKS

A time limitation usually leads to a compromise on the quality of the software product. This may be countered by having more experienced developers to work on the project.

2.5.4 TIGHT SCHEDULE RISK

The user of the system usually exerts pressure on the developers to quickly deliver the software product. This also affects the successful implementation of the project and can be rectified by increasing the number of programmers so as to ensure that project functionalities are met.

2.6 WORK PLAN

A project work plan according to Donaldson and Siegel (2001) is a living document which provides both the customer and seller a tool that gives them visibility into project progress or lack of progress. It is a tool that will help the researcher plan, manage implementation of, report on and evaluate the project. The project work plan simply assist the project planners by outlining the activities to be accomplished, time frames and inputs needed including how project results will be sustained and lessons learned.

2.6.1 PROJECT SCHEDULE

In order to build a complex application like the eCVMS many software engineering task occur in parallel. Wysocki (2006) states that the results of work performed during one task may have profound effect on work to be conducted in another task. These interdependencies according to Wysocki (2006) are very difficult to undertake without a schedule and it was virtually impossible for the researcher to assess progress on such a large project without detailed schedule. The researcher allocated each effort and duration to each task and a task network in manner that enabled the researcher and stakeholders to meet the delivery deadline established.

Table 2.13: Project schedule

| Activity | Start Date | End Date | Weeks |
|----------------|------------|------------|-------|
| Initiation | 04/01/2015 | 10/01/2015 | 1 |
| Planning | 11/01/2015 | 17/01/2015 | 1 |
| Analysis | 18/01/2015 | 07/02/2015 | 3 |
| Design | 08/02/2015 | 21/02/2015 | 2 |
| Implementation | 22/03/2015 | 04/04/2010 | 2 |
| Maintenance | | | |

2.6.2 GANTT CHART

According to Argawal et al (2011) a Gantt chart is a bar chart which provides a graphical illustration of a schedule that helps to plan, co-ordinate, and track specific task in a project. Gantt's chart are routinely deployed by the project managers, planners and systems developers and working on a projects without them was unthinkable for the researcher. In the eCVMS, a work breakdown structure was developed by the researcher to identify the tasks before constructing a Gantt chart. The Gantt chart helped the researcher organize a plan to implement a new project and documented what has to be involved, who will be involved and when each step will take place.

| Task/ Week | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|------------------|---|---|---|---|---|---|---|---|---|----|
| Project Proposal | ■ | | | | | | | | | |
| Planning | | ■ | | | | | | | | |
| Analysis | | | ■ | ■ | ■ | | | | | |
| Design | | | | | | ■ | ■ | | | |
| Implementation | | | | | | | | ■ | ■ | |
| Maintenance | | | | | | | | | | |
| Documentation | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

Figure 2.1: Gant chart

2.7 STAKEHOLDER ANALYSIS

According to Luckey and Phillips, stakeholder analysis is the process of determining who your stakeholders are and what their interest and concerns for the project are. Technically a stakeholder is any individual who has vested interest in your projects success for example the sponsor. However the biggest stakeholder in the eCVMS is the government of Zimbabwe which has influence on this project decision as it pay for the project work.

There are various other stakeholders that were involved in the development and implementation of the eCVMS. The Judicial Service Commission (JSC) through the Criminals courts were identified by the researcher as very significant in this study as they are the custodian of criminal justice management system. The court records are the main input to the system while the prosecution authorities at the criminal courts needs information from ZRP on the criminal history of individuals who are brought to

court for prosecution. The Zimbabwe Prison Services (ZPS) also plays an important role in the sense that some of the criminals especially persistent offenders usually find themselves in prisons and there is need for such records to be incorporated into the system. The office of the Registrar General (RG) which is responsible for registration of births and deaths of the country's citizen is also a major stakeholder as it issue the important national identity documents which form the basis for police investigation and prosecution. The identity of criminals is often cumbersome and a vibrant record management system at the office of RG has proved vital in the success of justice delivery system.

2.8 CONCLUSION

A good project plan is needed for the successful implementation of the project. A feasibility analysis was carried out and the outcome indicates that the project is ideal for implementation. The analysis of the current system would be undertaken in the next phase.

CHAPTER 3: ANALYSIS PHASE

3.1 INTRODUCTION

The analysis phase is the first stage of full scale information system development project to investigate what the new system will do. This phase presents an important challenge to this researcher in the process of fully investigating the current Criminal Vetting System of the ZRP and the specific business needs (or the system requirements) for the new information system. It is not a simple process of asking the users what they expect from the new system but a detailed study that ensures that the new system full meets the requirements of the users. This can only be achieved if the current system is well understood by the analyst and the proposed system well defined.

Roger (2013) defines analysis phase as a systematic evaluation, modification and refinement of system's requirements gathered during requirements elicitation phase into a final, functional requirements specification. During the requirements elicitation phase of the software development life cycle, information that will be used to define the software is gathered from a number of sources and organised for this process. This information comes in the form of requirements which are categorised as functional and non functional requirements. Functional requirements spells out what the system must do while non functional requirements dictate environment and constraints within which the system must operate.

At the end of the end of the analysis phase, final requirements specification or requirements specification statement is formed into the specification document that formally express all of the requirements that make up the system (Stiller and LeBlank 2002). The specification document serves as the basis for the next phase in software life cycle. In order for the document to serve this purpose, it must be of sufficient detail to enable the engineer to draw up a design (Schach, 2008).

3.2 INFORMATION GATHERING TECHNIQUES

Gathering information about the existing system forms the key part of systems analysis (ISR Group, 2007). In order to design an information system the analyst must know what exactly is to be designed; as such they use several techniques to gather data and information. In designing the *eCVMS* the researcher had various data gathering techniques to use such as documents reviews, observations, surveys, interviews, conducting joint application design, and other techniques in order to gather information about the existing system. Each and every technique had its own merits and demerits and

in most situations the analysts usually employ more than one method to gather a wide view about the system from users. However due to limited resources and nature of the study the researcher opted to use the following common data gathering techniques;

- Interviews
- Observations
- Questionnaires

3.2.1 INTERVIEWS

These are formal meetings where an analyst can collect information about the working of the present systems and the requirements of any planned system (ISR Group, 2007). Interviews are the most common fact finding method which has to be conducted with full cooperation of the employees using the system. This technique has qualities that other methods of data gathering do not possess. In this study the researcher (interviewer) came face to face with the person being interviewed at CCB creating a chance of flexibility in getting the required information. The researcher was also able to observe the subject (interviewee) and studied their body language. Based on the degree of structuring, interviews can be divided into three categories: structured interviews, semi-structured interviews, and unstructured interviews (Fontana & Frey, 2005).

The researcher had targeted to interview a sample target of 5 users at the top level of management which include the Director CID, Officer Commanding Criminal Intelligence Unit (CIU), Officer in Charge CCB, and his two deputies. The interviews were targeted mostly to top level management due to limited resources and time. Although the targeted sample was low the researcher had other options such as observations and questionnaires to aid the study. However the researcher successfully managed to interview three users including the Officer In Charge CCB. It was unfortunate that the researcher could not interview the Director CID who was busy at the scheduled time but he kindly referred me to his deputy responsible for criminal intelligence. The sample target achievement was 60 percent as shown in the below calculation:

$$(\text{number interviewed} / \text{total targeted}) * 100 = (3/5) * 100 = 60\%$$

3.2.1.1 STRUCTURED INTERVIEWS

In structured interviews a set of similar questions are put across all interviews while in unstructured interviews different set of questions are asked (Fontana & Frey, 2005). The researcher did not use this type of interview as it has a lot of short comings. The structured interviews are interviews that often just require 'yes' or 'no' answers to the questions - or they may be questions which require a set answer. Whatever type of question is used, the important thing to note is that the person being interviewed cannot just talk about things that are important to them; rather the interviewer dictates how the interview will progress, and what questions he or she wants answers for. There is little place in the interview for spontaneity.

3.2.1.2 SEMI-STRUCTURED INTERVIEWS

Semi-structured interviews were also used and are more flexible. An interview guide was prepared and used, which included both closed-ended and open-ended questions, but in the course of the interview, the researcher had certain amount of room to adjust the sequence of the questions to be asked and had to add questions based on the context of the participants' responses.

3.2.1.3 UNSTRUCTURED INTERVIEWS

The researcher comes to the interview with no predefined theoretical framework, and thus no hypotheses and questions about the social realities under investigation (Fontana & Frey, 2005). Rather, the researcher in this study had conversations with interviewees and generated questions in response to the interviewees' narration. As a consequence, each unstructured interview might generated data with different structures and patterns.

(i) ADVANTAGES OF INTERVIEWS

Interviews have a number of advantages such as listed below;

- The researcher was able to validate some information during the interview as he could make further probe on questions being asked and also by observing and studying body language.
- The technique was effective in gathering information about complex fingerprint issues and for sensing the feelings underlying expressed opinions.
- The researcher was able to achieve high rate of response.

(ii) DISADVANTAGES OF INTERVIEWS

The following are the setbacks of using interviews;

- The interviews took time for the researcher to prepare
- It also required more time and money for its conduction by the researcher.
- There was no confidentiality in interviews which made interviewees reluctant to divulge some sensitive data.

3.2.1.3 FINDINGS FROM INTERVIEWS

All users that were interviewed indicated that the current manual system is now no longer reliable and there is need for an automated criminal vetting process. The researcher was told how redundant the system has become such that some of their internal stake holders such as courts and police stations are querying the validity of the vetting process as they also deal with same criminals who visit CCB seeking Police Clearance.

3.2.2 QUESTIONNAIRES

The use of questionnaires is also another popular and useful technique for data gathering especially when information is being solicited from a large group of people although it can also be used for small groups (ISR Group, 2007). This technique was best suitable for this study as was not possible for the researcher to interview all persons involved in the system due to varying factors such as time, distance, cost and other factors. There are two types of questionnaires, that is open ended and close ended questionnaires. The researcher used both types of questionnaires in gathering user requirements. The questionnaires were targeted to users mostly at operational level because they are many such that it was not feasible to interview most of them due to limited time and resources. They were also targeted to the members of the public (clients) due to their scattered geographical locations.

3.2.2.1 OPEN ENDED QUESTIONNAIRES

An open ended question is one which does not need a specific response. The questionnaire is written with some space provided for the response, for example the respondents were asked to comment on challenges of the current system and their suggestion on the solution to the problem.

3.2.2.2 CLOSE ENDED QUESTINNAIRES

A closed question is one in which the responses are given as a set of options and the interviewee selects the from the given choice, for example in this study the researcher asked respondents to tick appropriate boxes like 'yes' or 'no'.

(i) ADVANTAGES OF QUESTIONNAIRES

- It was easy to administer questionnaires as the researcher simply sent them to the OIC CCB and simply got there for collection on the same date interviews were conducted.
- It was also cheap as the researcher printed few copies and photocopied the rest.
- The respondents were free to express themselves due to confidentiality of questionnaires.
- In these questionnaires respondents were not under pressure to answer questions there and then. They were given enough time and then respond.

(ii) DISADVANTAGES OF QUESTIONNAIRES

This method of gathering information is not without drawbacks and listed below are some of the disadvantages of questionnaires;

- Most people are not good at writing but talking and as such it was difficult to understand some of their expressions
- Literacy also had negative aspects on this technique as some interviewees could read and write and they returned blank forms.

3.2.2.3 FINDINGS FROM QUESTIONNAIRES

Most of the people responded to the questionnaires and they are all agreeing that the manual system at CCB is now defunct and there is need computerising the Criminal Vetting process. A total number of 20 questionnaires were printed and distributed and only two were not returned. The response rate was pleasing at 90 % as indicated below:

$$(\text{number returned} / \text{total distributed}) * 100 = (18/20)*100 = 90\%$$

The targeted group for the questionnaires were users of the system at the operational level (Assistant Inspectors, Sergeants and Constables) since they have in-depth knowledge of the system. It was also targeted to the members of the public who visit CCB seeking for Police Clearance Certificates. The general comment about the system was that it is very slow and cumbersome to provide services in such an environment. The table below summarizes some of the popular answers that were obtained through questionnaires.

Table 3.11: Findings from interviews

| Question | Popular answer |
|------------------------------------------------------------------------------------------|-------------------|
| Do you think there are some problems in the current system? | Yes |
| If there are problem how do you rate current system? | Very slow |
| What do you think is the solution to the problem | Computerisation |
| Do you think computerization will make operations easier | Yes |
| What challenges / advantages if any do you think will arise with the new computer system | It will save time |

3.2.3 OBSERVATIONS

The researcher had an opportunity to observe the existing system in normal operations as this enabled revelation of many other features which could not be revealed by other data gathering techniques. This has proved beneficial in collecting information about office conditions of which employees takes for granted. Onsite observation also gave insight to the researcher an insight into the levels of supervision and control, the flow of work, the occurrence of obstruction in the work flow, the pace of work and the levels of normal and peak workload. There are two types of system observation methods that were employed by the researcher, overt and covert.

In overt type the researcher observed the system while the users were fully aware of what was taking place unlike in covert were the users are not aware of the observations. The covert observation usually yields good results as employees behave naturally since they are not aware of the observation. It is however difficult to carryout covert operations in security organization like ZRP.

(i) ADVANTAGES

- There was no subjective bias by the researcher.
- The process was easier at it is independent of users as there was no need for willingness on their part thus it requires less or no user co-operation.
- The method enabled researcher to gather information related to what is taking place around the system.

(ii) DISADVANTAGES

- It was time consuming for the researcher especially on complex situations like the eCVMS.
- It was expensive for the researcher especially in terms of training and logistical arrangements for observation.

3.2.3.3 RESULTS FROM OBSERVATIONS

The researcher managed to observe most of the operations at CCB after spending some few hours observing how they are carrying out day to day duties. From the onsite observations the researcher noted that the old system is no longer appropriate because it is slow. The staff morale is very low due to strenuous processes characterised by the current manual system. The clients who visited the section seem not satisfied about the service they are getting from the police. A lot of files were seen all over the office and this clearly indicated that loss of records was rampant within the section.

3.3 ANALYSIS OF THE CURRENT SYSTEM

The criminal vetting process at the CCB in Harare is currently being done using a manual system. The process of creating criminal records is a long one and starts at the police station as soon as an accused person is arrested for any offence. If the crime is minor the officer in charge assesses a fine and the accused is made to pay a fine and the record kept at station. If the offence does not fall under miscellaneous offences a criminal record (docket) is opened at that station and taken to court for prosecution together with a fingerprint form. The docket contains particulars of the accused, complainant and nature / circumstances of the offence.

If the accused is acquitted at the court the clerk of court endorses the verdict on the docket which is then sent back to station and does not constitute a criminal record. When an accused is convicted at the court the verdict and sentence is recorded by the clerk of court on the docket and the fingerprint form. The endorsed fingerprint print form is then sent to CCB in Harare for filling purpose. At the CCB a reference is opened for all new cases and if the convict commits more offence further endorsement is made on the record.

If a client approaches any police station with a request for a police clearance, the applicant's fingerprint are taken indicating full particulars of police officer taking the prints after production of an identification card. The applicant is then referred to CCB in Harare where the actual vetting takes

place. At the CCB upon payment of the stipulated fees the manual searching of criminal record is initiated. It takes at least twenty four hours for an urgent application to be processed at a fee of \$20.00 while a normal application takes seven days at \$10.00.

The criminal records are manually kept and secured in metal cabinets at storerooms and the search process is manually carried out using indexes referencing identity particulars and surnames of the convicted persons. The first search known as name search is done using index for the applicant's particulars and if the search yields negative results a second search is done using the fingerprint. If the first search is simple but not reliable as people usually fake their particulars but if it comes positive there would be no need to carry out a cumbersome fingerprint search. When the first search comes out negative a second search using manual fingerprints is done using fingerprints classification technique and this can only be done by trained fingerprints experts. If both searches produces negative results then the applicant receives a certificate indicating that he has no criminal record and if any of the two searches becomes positive a certificate endorsed with nature and date of crimes committed by the applicant is issued.

The outcome of the vetting process is usually posted through registered mail but due to the inefficiency of the postal services, applicants are encouraged to go and collect in person their certificates. This forces the clients to make at least two trips or more to Harare to process their applications.

The same process is done is done for any accused persons who are being sent to court for prosecution. The investigating officer takes the fingerprints to CCB for vetting and the outcome of the vetting process will assist the courts in coming out with verdicts and sentences for perennial offenders who need stiffer penalties. The process outlined above can be summarised as follows;

3.3.1 CREATING CRIMINAL RECORD

Criminal records from all police stations are sent to CCB where they are manually filed in records storerooms. This centralised databank becomes a repository for criminal vetting processes. Records of petty cases which are fined at a local police need not to be sent to CCB as this would create a large and complex manual databank which would be very difficult to manage hence the need for filing such cases at station level and such records do not constitute a crime for the purpose of criminal vetting.

3.3.2 SUBMISSION OF AN APPLICATION

A client submits an application for police clearance at a nearest police station. The application form together with applicants fingerprints are sent to CCB via post and the response is also sent back through postal service thus taking time. Clients are now forced to travel to CCB in Harare for fast processing of their application as they constantly go missing along the post and takes time. The applicant needs to constantly communicate with CCB staff through telephones to trace their application in case they take longer than expected.

3.3.3 SEARCHING FOR CRIMINAL HISTORY

The search for criminal history is manually carried out using both applicants biographic and biological information against the criminal records kept at CCB. The biographic data includes first names and surname of the application, identity particulars, date and place of birth, race and many other features. Biological data such as complexion, height, color of eyes, fingerprints among other biological features can be used for searching criminal record.

3.3.4 ISSUANCE OF POLICE CERTIFICATE

If the search produces negative results the applicant will be issued with certificate indicating that he does not have a criminal record recorded in Zimbabwe. On the other hand if the search is positive the certificate will indicate all crimes recorded against the applicant detailing the nature of offence, sentence and brief circumstances of the case.

3.3.5 MANAGEMENT REPORTS

The managers need summarised information about the operations of the section. The current system requires that the supervisor compile periodic reports indicating the number of applications that were processed by the section and the outcomes of each application. These reports will assist the management and taking appropriate measures to improve the operations of the section such as employing more staff if the work load increases.

3.4 INPUTS, PROCESSES AND OUTPUTS

3.4.1 INPUTS

- Log on credentials
- Personal details of criminals
- Details of offence committed and sentence given

- Personal details of applicant
- Reasons for application for clearance certificate

3.4.2 PROCESSES

- Search for a criminal record
- Issue police clearance

3.4.3 OUTPUTS

- Police clearance certificate
- Management reports.

3.5 DATA ANALYSIS

The DFD model of a system is constructed using a hierarchy of DFDs.

3.5.1 CONTEXT DIAGRAM OF THE CURRENT SYSTEM

The top level DFD is called the Context Diagram of Level 0. It is the most abstract (simplest) representation of the system (Mall, 2009), and it represent the system as a single bulb. The bulb in the context diagram is annotated with the name of the software system being developed. The purpose of the context diagram is to capture the context of the system rather than its functionalities.

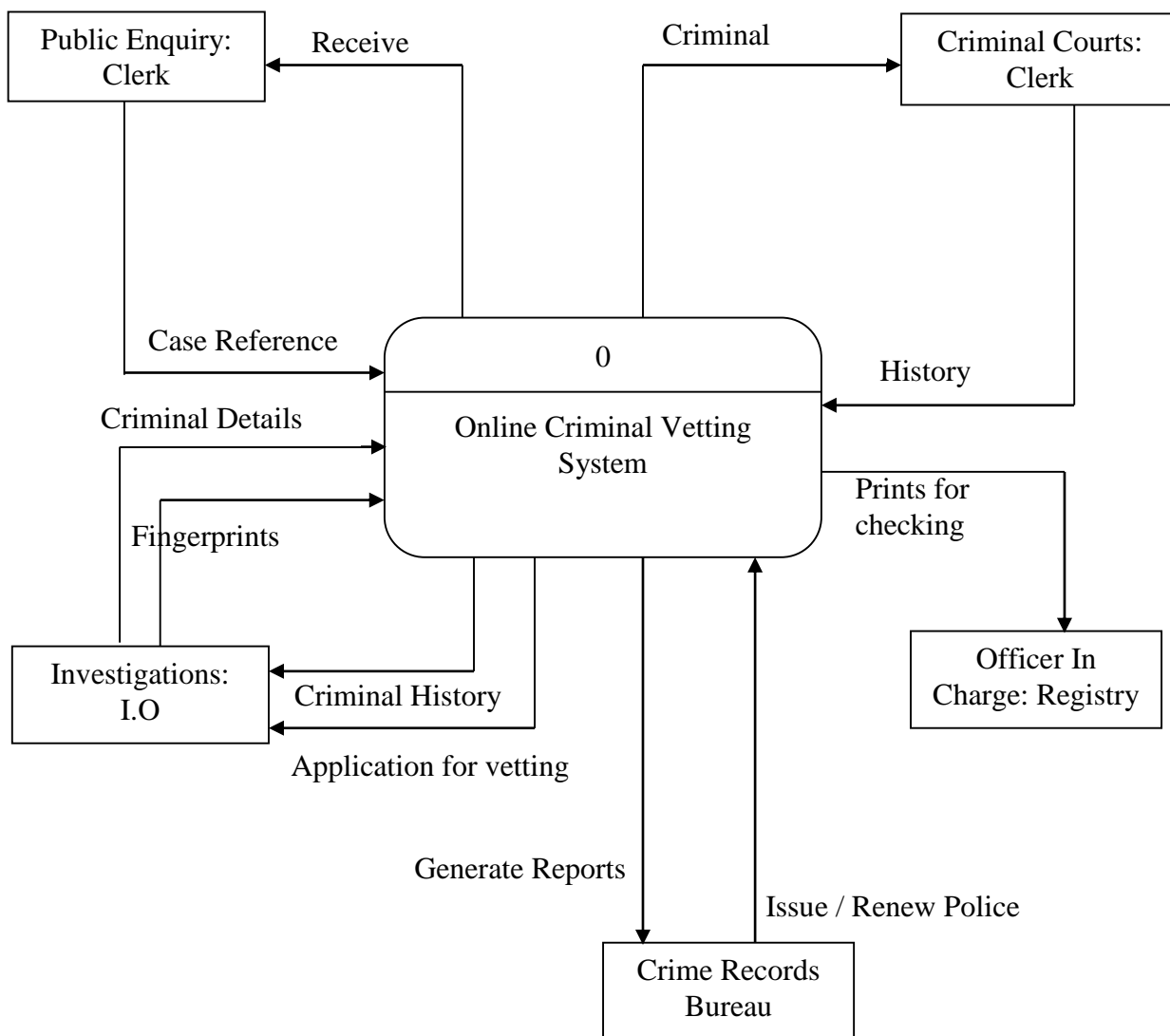


Figure 3.1: Context Diagram of the current system

3.5.2 DATA FLOW DIAGRAM

Data Flow Diagram is a representation of the flow of data between many different processes in a business. DFD is a graphical technology that depicts the flow of information and the transforms that are applied as data moves from input to output (Mall, 2009)

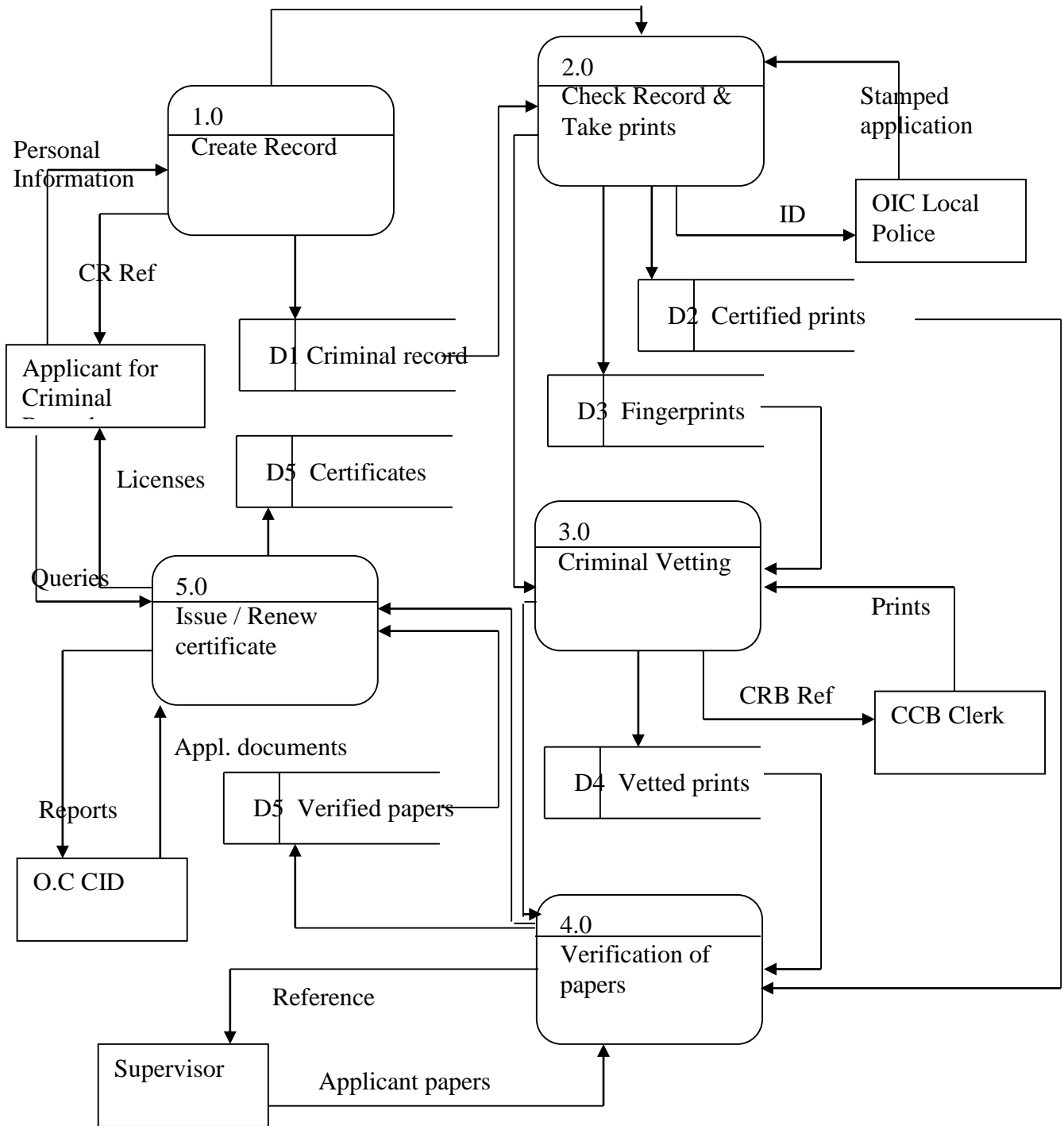


Figure 3.2: Data Flow Diagram for the current system

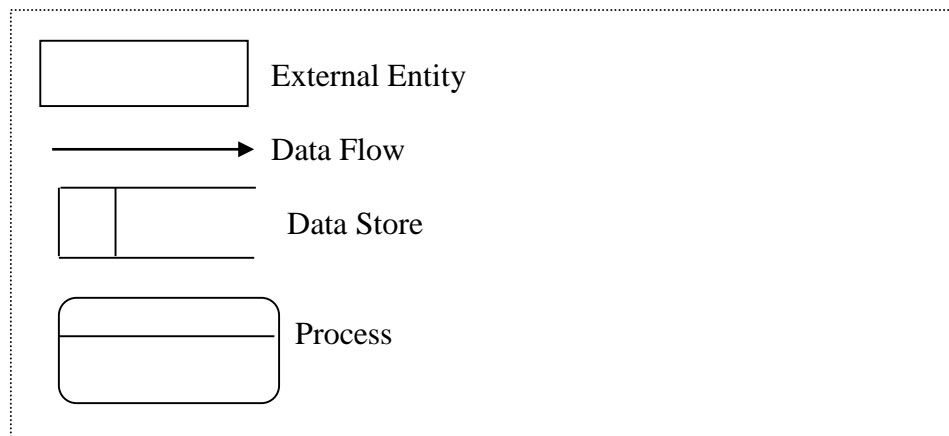


Figure 3.3: Key to Data Flow Diagram

3.6 WEAKNESSES OF THE CURRENT SYSTEM

The analysis of the current system has revealed a number of weaknesses with the system and hereunder are some of the weaknesses discovered;

- There is poor service delivery due to the manual systems low performance against a background of increasing applications for criminal vetting. The manual criminal records are also piling up on daily basis hence need for automated system.
- The current system cannot deter rampant forms of corruption currently being experienced by the organisation. Fake police clearance certificates end up being in circulation because it is very difficult to effect control measures in the current system.
- The system is not able to monitor and timeously take stock of well known criminals who end up roaming around the world committing more similar offences.
- Communication between the organisation and its client is not effective in the current system as it is mainly paper based, that is use of postal services and telephones has been overtaken by new technologies.
- There is lack of collaboration with other police international partners such as Interpol and SARPCCO including other stakeholders.
- The system does not supply top level management with timely information in form of reports for quick decision making. Delayed decisions can cost the organisation.

3.7 EVALUATION OF ALTERNATIVES

There are different alternatives which can be employed by the systems analyst in delivering an information system. The analyst should look at all possible means to deliver the product and then select the best option among the alternatives. It is important for the analyst to analyse the advantages and disadvantages of each option to enable the analyst to come up with the best solution. The researcher considered the following alternative methods;

- Outsourcing
- Improvements
- Development (Bespoke)

3.7.1 OUTSOURCING

Outsourcing is defined as being a way of allocating or reallocating business activities from an internal source to an external source (Schniederjans & Schniederjans, 2005). Information systems like any other business can be outsourced. In outsourcing the contracting organisation enters into a contract with an outside company to handle the task of system implementation partially or in totality. All or part of any unique activity in a functional area like IT which would have been previously in-sourced before can be outsourced today.

This method has some advantages over the other two methods but the researcher after analysing the methods it is concluded that its disadvantages outweigh the advantage.

3.7.1.1 ADVANTAGES

- It is cost saving
- It takes less time to implement
- It helps the organisation to gain outside expertise and technologies
- It improves service as focus is on the core competences

3.7.1.2 DISADVANTAGES

- There is no security to organisation's confidential information
- There is no flexibility
- There are high chances that the outsourced system does not fully meet the requirements.

3.7.2 IMPROVEMENTS OF THE EXISTING SYSTEM

It is usual ideal as a first alternative to improve the existing system in order to solve problems currently being faced by the system. This can be done for example by putting some additional changes to the existing system. The current system would not be abandoned completely but improvements are made to it to enhance its performance. Such improvements are difficult to make in a manual system like the current criminal vetting system. It can only be enhanced by continuously recruiting more staff at the CCB which is not feasible taking into consideration limited funding the organisation is getting from the fiscus as the government is already contemplating downsizing its workforce. Although this method also has few advantages the researcher did not opt for it due to many problems associated with the method.

3.7.2.1 ADVANTAGES

- Level of management control is very high
- It is easy and cheap to implement and maintain.

3.7.2.2 DISADVANTAGES

- It is very complex to improve an old system which has already developed some problems.
- The efficiency of the improved system will remain compromised as same platform still exist.

3.7.3 INHOUSE DEVELOPMENT

An organisation can opt to establish its own software development capability by considering ways of organising the development personnel. If there is no appropriate already made software on the market or if the organisation cannot buy the software off shelf for whatever reasons then the organisation can consider building it in-house. The organisation will be using its own staff to develop and maintain the system.

3.7.3.1 ADVANTAGES

- The resultant software product will solve user problems and hence easily pass user acceptance test as it fully address user requirements.
- This method is less expensive in terms of development, implementation and maintenance.
- Security and confidential requirements of an organisation are supported and guaranteed.
- It is possible to deal with existing problems as they are precisely known.

3.7.3.2 DISADVANTAGES

- It takes time to deliver the software since it takes time for good quality software to be delivered through this method.
- The organisation might require extra skills and resources which might not be available within the organisation.

3.7.4 RECOMMENDED ALTERNATIVE

All the above three implementation alternatives were analysed by this researcher and it has been realised that in house development supersedes all others in this research. Although it is cost effective to improve the current system it is difficult to completely address the existing problems because the operating platform remains the same. Outsourcing takes less time to implement with less technical skilled staff but the method does not guarantee the fulfilment of user requirements. . ZRP is a security organisation and outsourcing this critical system will compromise the security of the country. The researcher is therefore opting for the in house developments which guarantee fulfillment of user requirements under a secure environment.

3.7.5 COST SUMMARY OF THE ALTERNATIVE

| Alternative | Cost |
|-------------|------------|
| Outsourcing | 500 000.00 |
| Development | 300 000.00 |
| Improvement | 90 000.00 |

3.8 REQUIREMENTS ANALYSIS

Many systems' failure has been attributed to failure in the requirements analysis phase. The analyst according to Mall (2004) starts the requirements gathering and analysis activity by collecting all information from the client which would then be used to develop the requirements of the system. He then analyses the collected information to obtain a clear and thorough understanding of the product to be developed with a view of removing ambiguities and inconsistency from the initial customer perception. A client seldom gives a comprehensive document containing a description of what is required but normally gives vague requirements.

The main purpose of this activity is to clearly understand the exact requirements of the customer. It is up to the analyst to extract the full information from the customer. There are two categories of requirements analysis; functional and non functional.

3.8.1 FUNCTIONAL REQUIREMENTS

According to Mall (2009) the functional requirement part has to discuss the functionalities required from the system. Each function of the system can be considered as a transformation of a set of input data to the set of corresponding output data through the system processes. It simply focus on the inputs to the system, its processes and finally the outputs and thus highlighting what the system is capable of doing. This researcher has identified the following functional requirements for the Criminal Vetting System;

- The system must be able to create a register of users
- It should enable the capturing, storage and update of records
- The system should also facilitate search or records and making of queries.

3.8.1.1 THE USE OF CASE DIAGRAMS

The purpose of the use case diagrams in UML (Unified Modeling Language) is to demonstrate the different ways that a user might interact with a system (Mall, 2009). Use cases are used during the analysis phase of a project to identify and partition system functionality. They separate the system into *actors* and *use cases*.

- **Actors**

Actors represent roles that can be played by users of the system. Those users can be humans, other computers, pieces of hardware, or even other software systems. The only criterion is that they must be external to the part of the system being partitioned into use cases. They must supply stimuli to that part of the system, and they must receive outputs from it.

- **Use**

Use cases describe the behavior of the system when one of these actors sends one particular stimulus. This behavior is described textually. It describes the nature of the stimulus that triggers the use case; the inputs from and outputs to other actors, and the behaviors that convert the inputs to the outputs.

The text of the use case also usually describes everything that can go wrong during the course of the specified behavior, and what remedial action the system will take.

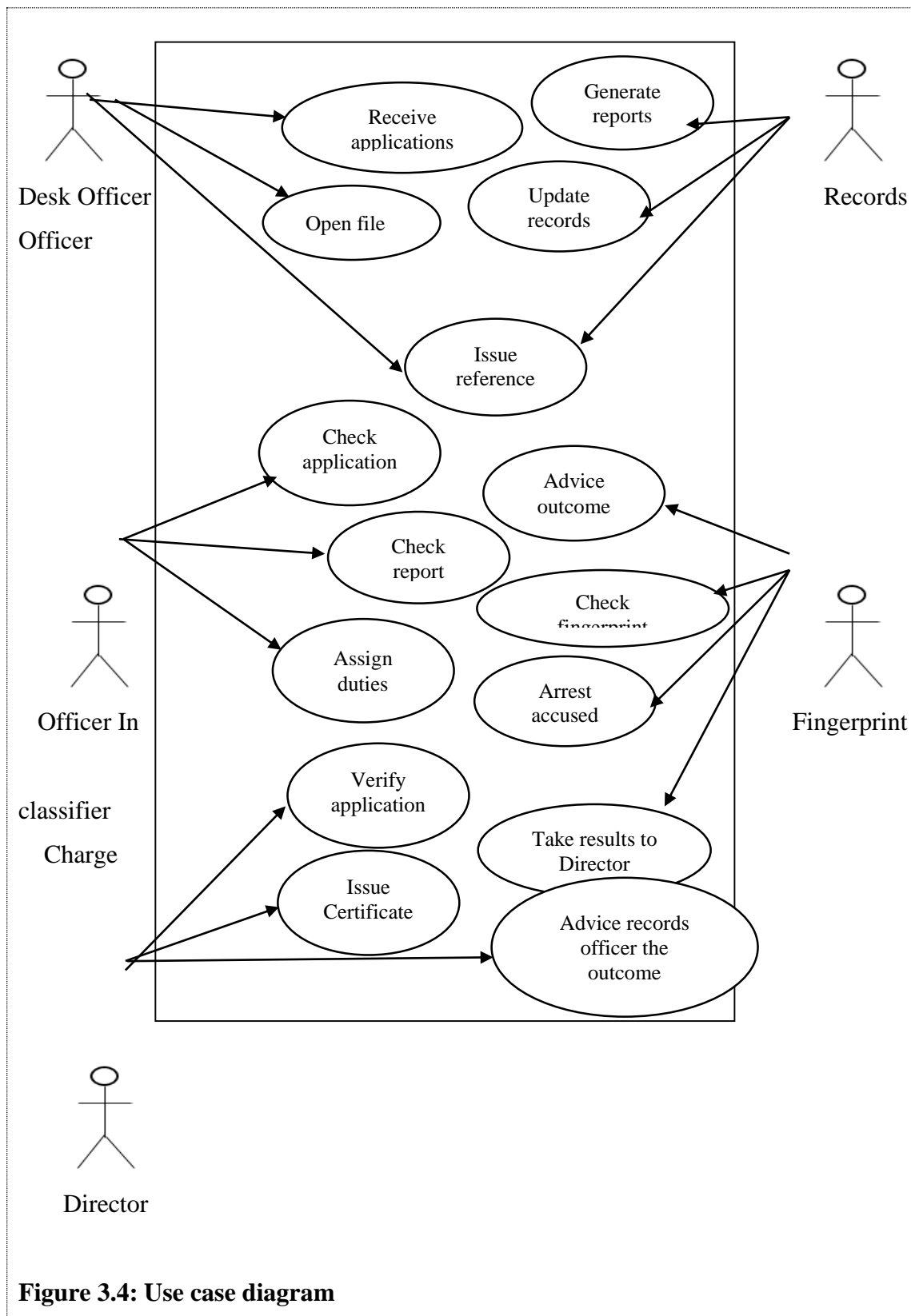


Figure 3.4: Use case diagram

3.8.2 NON FUNCTIONAL REQUIREMENTS

The non functional requirements according to Mall (2009) deal with the characteristics of the system that cannot be expressed as a function. Unlike functional requirements the non functional requirements are not about what the system can do, but how it is going to do it. Such aspects include examples such as portability, maintainability and usability. They may also reliability issues, accuracy of results, human computer interface issues and constraints on the system implementation.

3.9 CONCLUSION

After fully studying the current system and gathering the required information about the system from the users through use of different data gathering techniques, the research concludes that it is appropriate to implement this project. A unique application can only be achieved through the in house development method which can solve all the problems thereby meeting all requirements of the clients. So with requirements understood and the system defined, the researcher is now ready to move into design stage.

CHAPTER 4: DESIGN PHASE

4.1 INTRODUCTION

The design phase is initiated once the deliverables of the analysis phase have been reviewed and accepted by all stakeholders (Schwalbe, 2010). This process involves converting user requirements into designs after being clearly designed during analysis phase. A description is going to be made at this stage on how the intended solution to the project will be achieved.

4.2 SOFTWARE DESIGN

According to Saleh (2009) software design activities include the high level architectural, database, interface and detailed designs. It is a software engineering activity where software requirements are analysed in order to produce a description of the internal structure and organisation of the system that serves as a basis for its construction (coding). During the software design phase many critical and strategic decisions are made to meet the required functional and quality requirements of a system. These decisions are taken into account to successfully develop the software and carry out its maintenance in a systematic manner to improve the quality of the product.

Software designs serves as a blueprint for the solution of software system. The proposed system should be in a position to address the functional requirements of users in an efficient, effective and reliable manner and the system should be maintainable.

- **Efficiency**

The system should be capable of completing all the required processes by the user at a minimal time.

- **Effectiveness**

The Criminal Vetting system must be well designed in such a way that it is capable of doing all the tasks for which it was designed.

- **Reliability**

Reliability is a very crucial functional requirement factor and most project fail in this area. A reliable system is the one that is well designed in order to be able to produce expected correct

results. Unforeseen circumstances such as constant power cuts, load shading and other factors should be dealt with by the design of the system.

- **Maintainability**

A well designed system should be easy to maintain during its entire life cycle.

- **User friendly**

The system should be easy to use by the users with minimal support and assistance from systems administrators.

4.2.1 DESCRIPTION OF THE PROPOSED SYSTEM

This new Criminal Vetting Management System has been necessitated by the shortcomings of the current manual vetting system at CCB. The proposed system will be an automated application that will enable the ZRP to efficiently and effectively vet its citizens for criminal history. The system is a client-server based application linking various police establishments throughout the country through a Wide Area Network to a central database at CCB. To accomplish the required results the system will have the following functionalities;

- The system will enable the organisation to electronically register records of individuals who have been convicted in Zimbabwe of any criminal offences.
- The system will also electronically capture and store fingerprints of the above convicted individuals.
- Law enforcement agents will also be able through the system to access relevant and updated criminal records so as to vet clients sent to CCB for vetting.
- The proposed system will create a secure centralised storage of criminal records for easy access by all stakeholders.
- The ZRP will also be in a position to easily share criminal records with its partners and communicate effectively with its customers.

4.2.2 CONTEXT DIAGRAM OF THE PROPOSED SYSTEM

The Context Diagram of the proposed system will outline the system boundaries in a same way as block diagrams thus forming the highest level of the system. This will show the whole system indicating inputs plus outputs from internal to external. It will also reflect the degree to which the

system relates to the external environment and also show that the system is an open ended one rather than closed one.

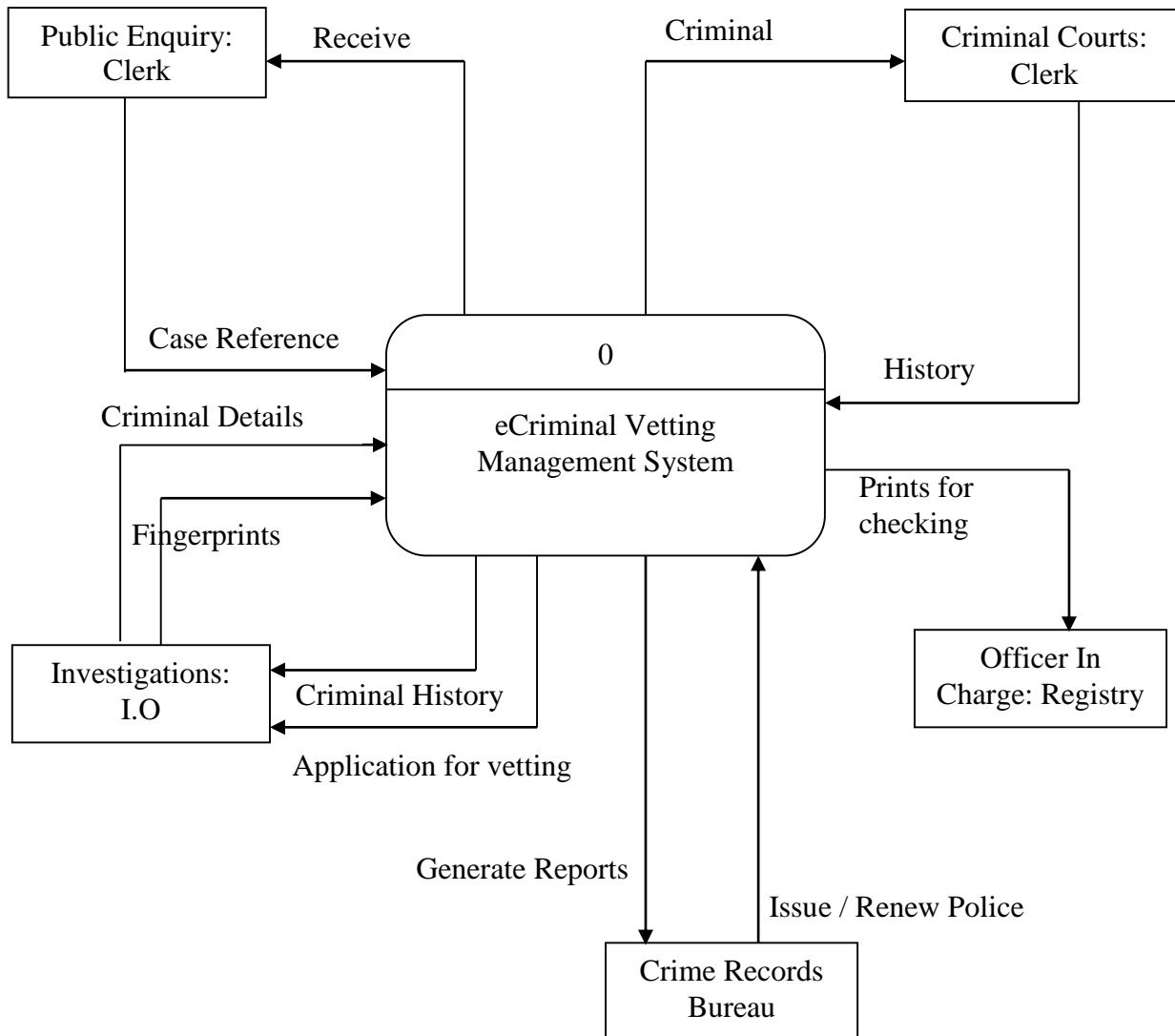


Figure 4.1: Context Diagram of the proposed system

4.2.3 DATA FLOW OF THE PROPOSED SYSTEM

The system's components processes and the data that flows between them is represented in a Data Flow Diagram. Rosenblatt (2004) states that DFDs only show external entities providing data into the system or vice-versa (retrieving output from the system). The diagram below is a DFD showing flow showing flow of data to, from and within the system.

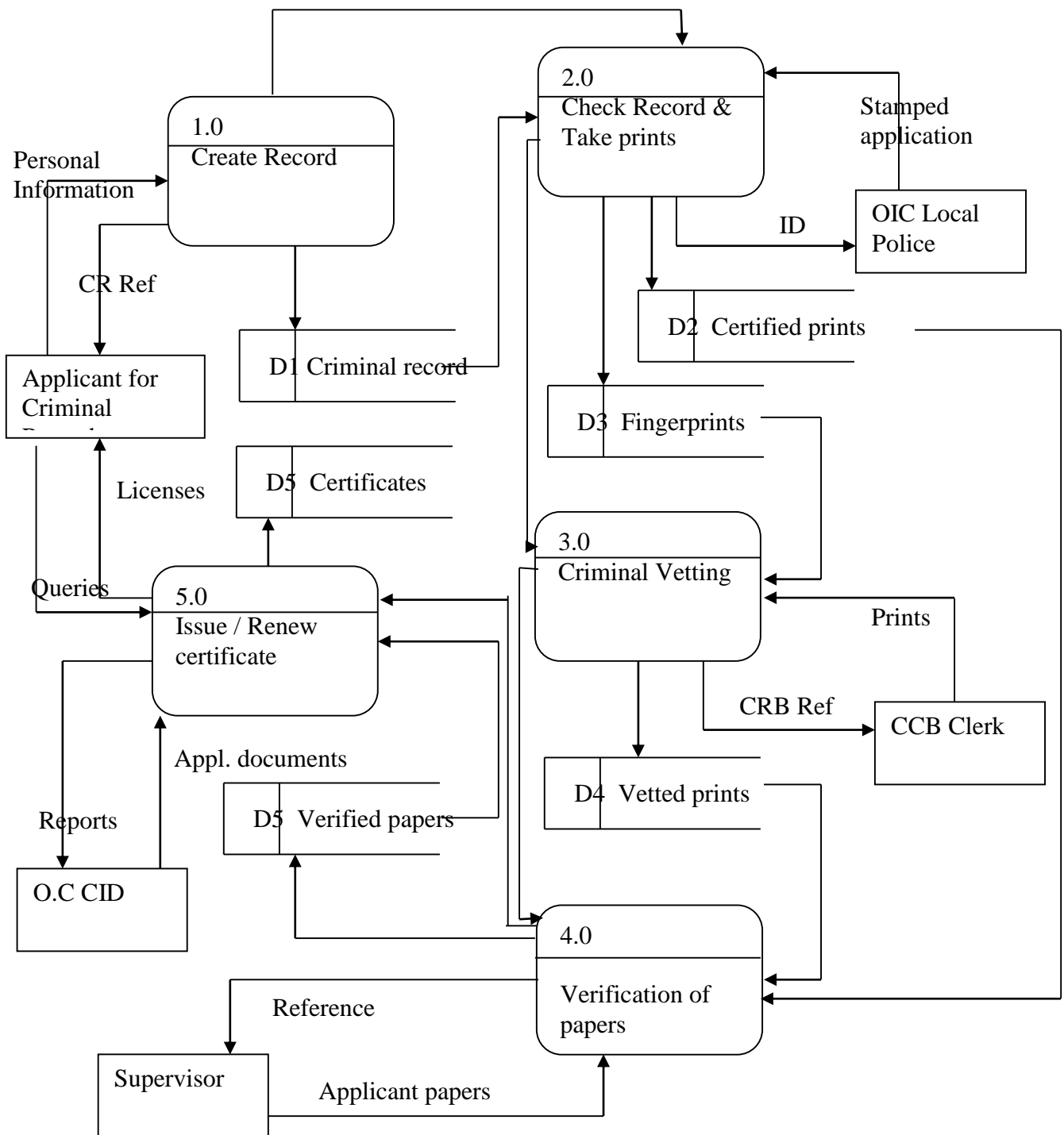


Figure 4.2: Data Flow Diagram for the current system

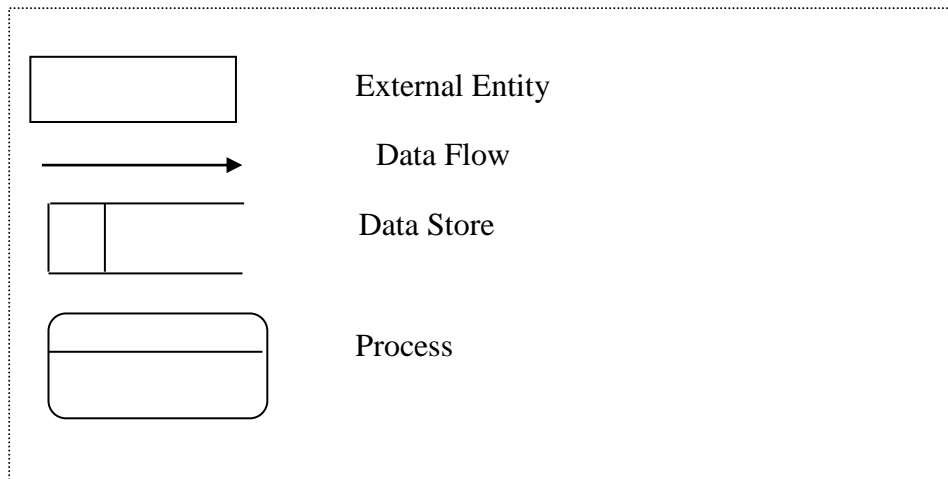


Figure 4.3: Key for Data Flow Diagram

4.3 ARCHITECTURAL DESIGN

Large systems such as the Criminal Vetting System are always decomposed into sub-systems that provide some related set of services. According to Agarwal & Tayal (2009) the initial design process of identifying these sub-systems and establishing a framework for sub-system control is called architectural design. Architectural design represents the structure of data and program components that are required to build a computer based system. It considers the architectural style that the system will take the structure and properties of the components that constitutes the system and the interrelationship that occur among all architectural components of a system.

Architectural design methods have a look into various alternates' architectural style of designing a system. These are;

- Data centric architecture
- Data flow architecture
- Object oriented architecture
- Layered architecture

Data centric architecture approach involves the use of a central database with operations of inserting, updating it in the form of a table. Data flow architecture is applied when input data takes the form of output after passing through various phases of transformations. The transformations can be via manipulations or various computations done on the data. In object oriented architecture the software design moves around the classes and object of the system. The layered architecture defines a number of layers and each layer performs some tasks with outer layer handling functionalities of the user interface while inner mainly handles interaction with hardware.

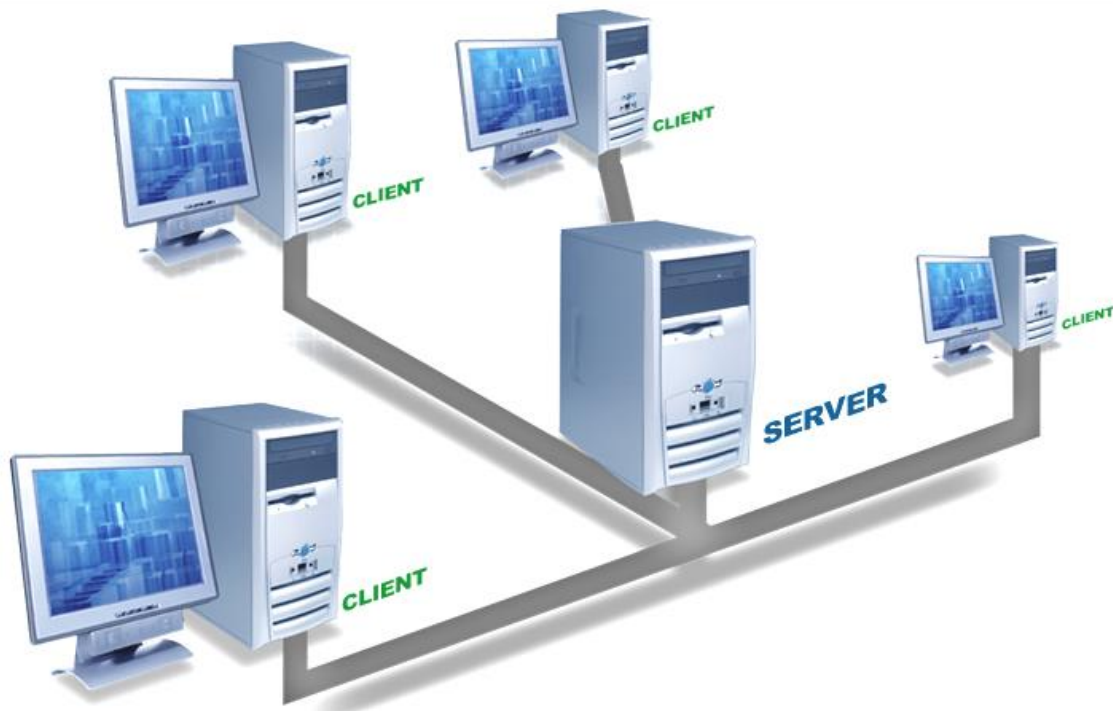


Figure 4.4: Architectural design for the proposed system

4.4 PHYSICAL DESIGN

The physical design according to Stair and Reynolds (2014) refers to how a computer system accomplishes tasks, including what each component does and how the components work together. In order to put functional requirements (logical design) into action there is need to have a physical design that will specify the characteristics of the needed systems components. In this proposed Criminal Vetting System the characteristics of hardware, database, telecommunications, personnel and procedure and control specifications will be detailed. To ensure successful implementation of the Criminal Vetting Management System on this client server based platform, a good design and secure configuration has to done by the analyst. Request are sent by the client to the application server which then processes the received request through querying the SQL server and later send back the request with results.

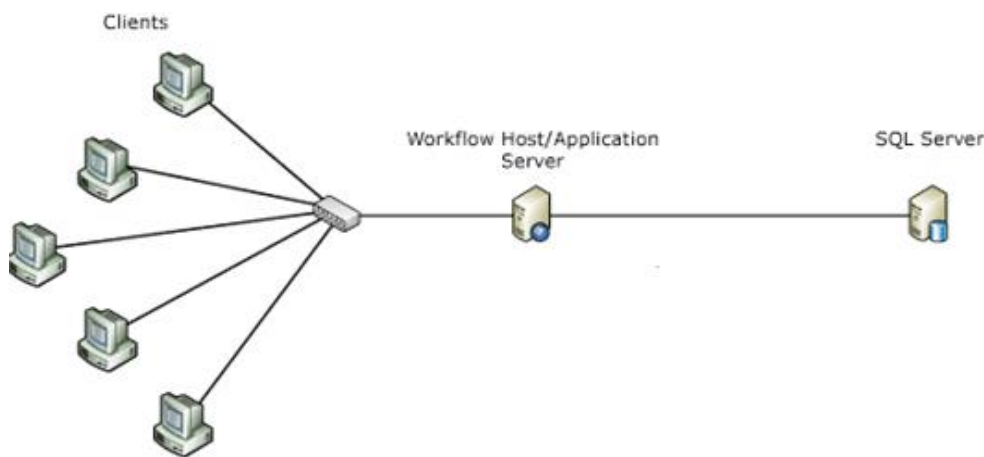


Figure 4.5: Model of client server architecture.

4.4.1 SOFTWARE ARCHITECTURE

Systems analysts do agree that software architecture is a critical success factor especially in large systems such as Criminal Vetting System. The software architecture needs to be independent of any programming language and is the vehicle for satisfying requirements and can be essential for any project, big or small. There are many definitions for software architecture. Bass (1998) defines software architecture for a system as the structure or structures of the system which comprise components, they externally visible behaviour and the relationships among them. The researcher cannot hope to deliver an acceptable product unless the architecture is appropriate, suitable and effectively communicated.

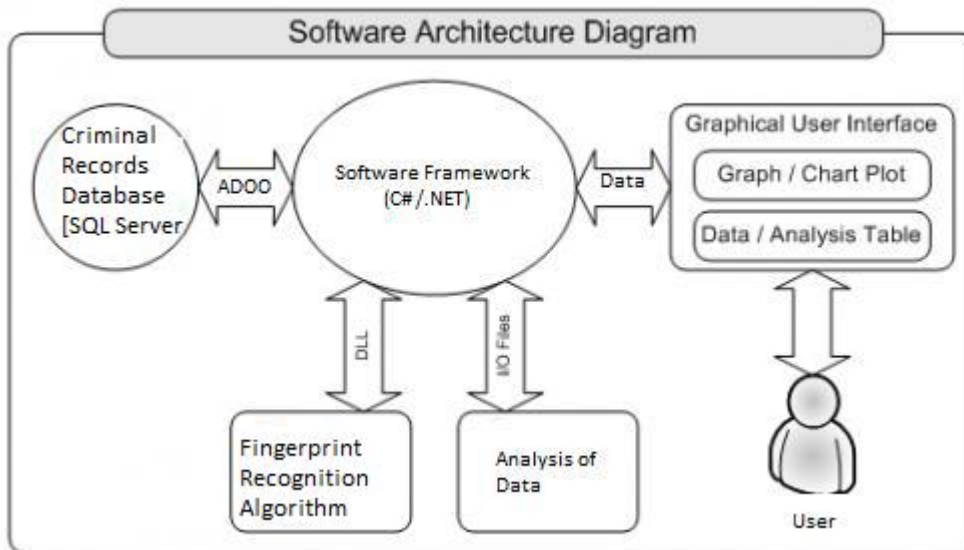


Figure 4.6: Software Architectural Design

4.5 DATABASE DESIGN

A database is the backbone of any computerised system. When the database is designed to meet the information needs of an organisation, plans (or scheme) of the database and actual data to be stored in it becomes the most important concern of the organisation (Singh, 2011). It is important to note that the data in a database changes frequently while the plans remains the same over long periods of time (although not forever). These database plans according to Singh (2011) consists of types of entities that a database deals with, the relationships among the entities and the way in which the entities and relationships are expressed from one level of abstraction to the next level for the users view. The user's view of the database should be in a form that is most convenient for the users and they should not be concerned about the way data is physically organised (abstraction).

The *eCVMS* will implement a client server based system architecture using Microsoft SQL Server 2012 as a Database Management System (DBMS). Using this type of architecture the majority of DBMS users are not stationed at the site at CCB offices in Harare where the database is resident but will be at various police stations around the country connected to the database through the network. Usually there are two types of architectures in database applications, a tow-tier or a three-tier architecture as shown below.

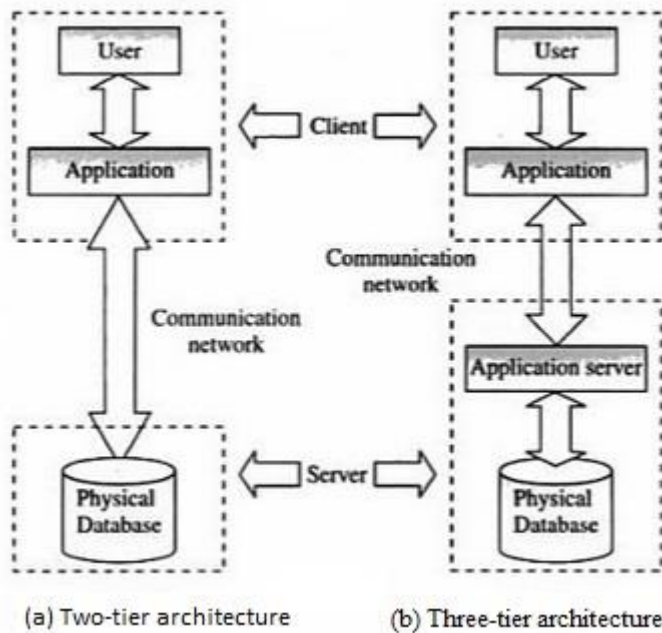


Figure 4.7: Database system architectures (Source: Singh(2011)).

In a two-tier architecture the architecture is partitioned into a component that resides at the client machines which interacts with the database systems functionality at the server side through query language statement. Three-tier architecture is whereby the client machine acts as merely a front end and does not contain any direct database calls, instead the client communicates with an application server through an interface. The application server in turn communicates with a database system to access data. The three-tier architectures are more suitable for large applications such as the CVMS.

4.5.1 ANSI-SPARC DATABASE ARCHITECTURE

In this architecture the overall database description can be defined at three levels, namely internal, conceptual and external levels. This architecture according to ITL Education Solutions (2007) was proposed by ANSI/SPARC (American National Standards Institute / Standards Planning Requirements Committee) and hence is also known as ANSI-SPARC architect. The objective of the three level architecture is to separate user's view of the database from the way that it is physically represented and this is desirable for the following reasons;

- It enables users to have a customised independent view of the database. Each user will be able to access the same data but have a different customized view of data. The views should be independent such that changes to one view will not affect other views.

- The physical storage details are hidden from the users in such a way that users do not have to deal with the physical database storage details, but simply work with data in the database without knowledge of how it is stored.
- It enables changes to be made by the Database Administrator to the database storage structure without affecting the user's views.
- Enables changes to be made to the physical aspects of the storage without affecting the internal structure.
- Changes can be made by Systems Administrators to the conceptual level of the database while users are not affected.

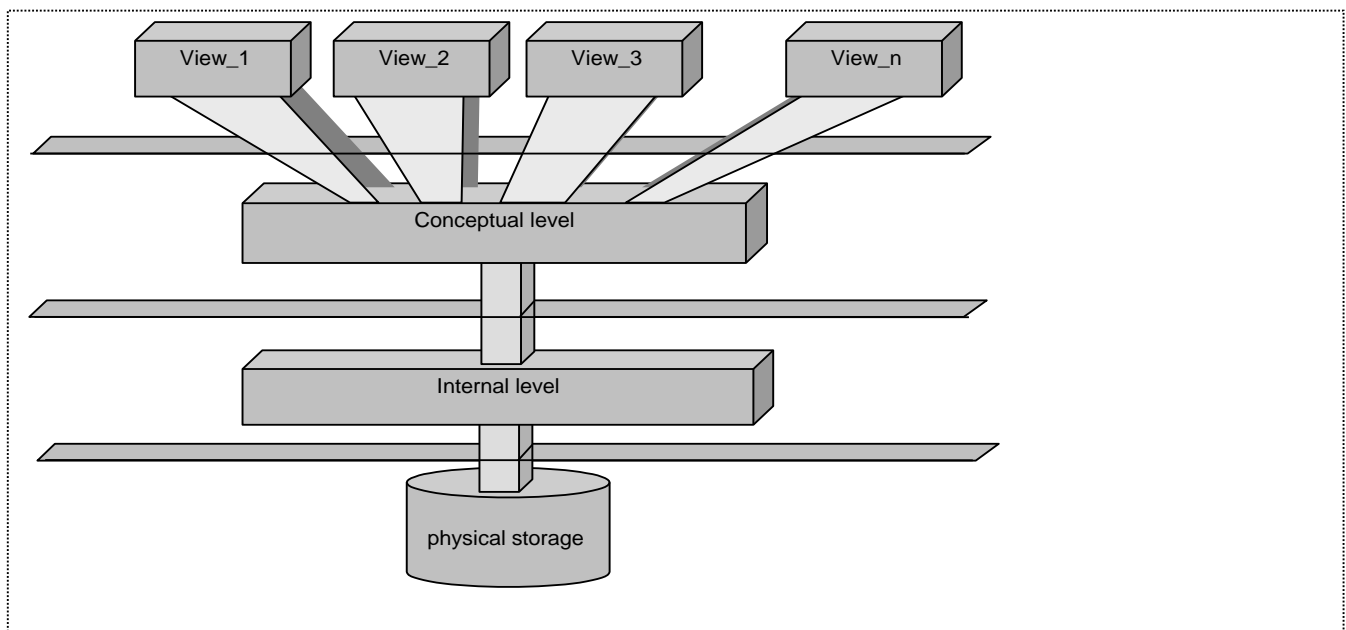


Figure 4.8: Ansi-Sparc Architecture

4.5.1.1 INTERNAL LEVEL

This is the lowest level of data abstraction that deals with the physical representation of the database on a computer and at times it is referred to as physical level. At this level description of how the data is physically stored and organized in the storage media is done. Various aspects are considered at this level to achieve optimal runtime performance and storage utilization.

4.5.1.2 CONCEPTUAL LEVEL

This level of abstraction deals with the user's view of the data base and thus it is also known as logical level. It describes what data is stored in the database, the relationships among the data and complete views of the user requirements without any concern for the physical implementation. This level hides the complexity of physical storage structures. It is the overall view of the data base and it includes all the information that is going to be represented in the database.

4.5.1.3 EXTERNAL LEVEL

This is the highest level of abstraction that deals with the users views of the database and thus also known as views level. Users in general do not require all or same data in the database for their transactions. The external level therefore describes part of the database for a particular group of users. It allows users to view data in a way that is customized depending on their needs so that the same data can be seen by different users in different ways at the same time

4.5.2 DATABASE TABLES

All records that are in the database are stored in the table forms. The tables should be in normal forms to avoid redundancy. Below are the following tables that will store data to be used.

Table 4.1: User log in

| Name | Data Type | Size | Null Vales | Primary Key |
|-----------|-----------|------|------------|-------------|
| User Name | Varchar | 20 | No | Yes |
| Password | text | 20 | No | No |
| Role | Text | 20 | No | No |

Table 4.2: Convict Details

| Name | Data Type | Size | Null Vales | Primary Key |
|-------------|-----------|------|------------|-------------|
| CCB No | Text | 20 | No | Yes |
| Name | Text | 50 | No | No |
| Surname | Text | 50 | No | No |
| Second Name | Text | 50 | Yes | No |
| Alias | Text | 50 | No | No |
| Race | Text | 20 | No | No |

| | | | | |
|---------------------|-----------|----|----|----|
| Date of Birth | Date/Time | 20 | No | No |
| Sex | Text | 20 | No | No |
| NR | Text | 20 | No | No |
| Race | Text | 50 | No | No |
| Country | Text | 50 | No | No |
| District | Text | 50 | No | No |
| Chief | Text | 50 | No | No |
| Headman | Text | 50 | No | No |
| Kraal / Village | Text | 50 | No | No |
| Business Address | Text | 50 | No | No |
| Residential Address | Text | 50 | No | No |

4.5.2 ENTITY RELATIONSHIP DIAGRAM (ERD)

An Entity-relation (ER) model according to Herbst (1997) is a high level conceptual model that describes data as entities, attributes and relation. They help designers create accurate and useful conceptual models by providing a visual, graphical model of the information content of a system.

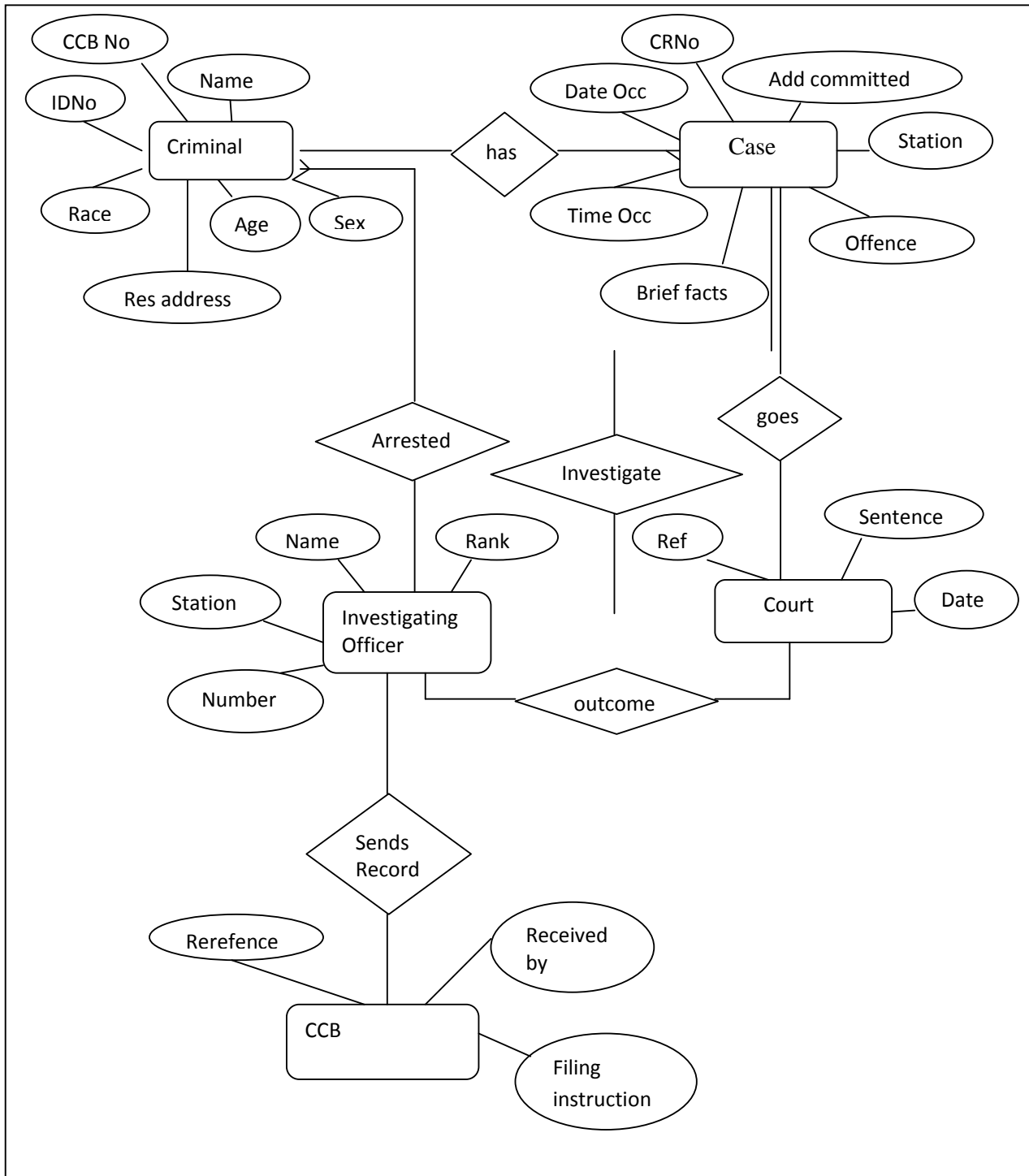


Figure 4.9: ERD

4.6 INTERFACE DESIGN

The end users of computer systems regard the interface as the system. According to Otero (2012) most of end users do not know, nor do they need to know about the under lying structure and implementation of the software system. Their concern is only the interface presented to them and capabilities provided

by that interface. IEEE (1990) defines the user interface as an interface that enables information to be passed between a human user and a hardware or software components of computer system. A poor interface can fell a most elegant and high quality architectural and detailed designed computer system. For most software this entails designing the graphic user interface. To be more specific the entails selecting appropriable information layouts, correct language, appropriate interface controls and trying the detailed design to the various input mechanism provided in the interface (Otero 2012).

4.6.1 MENU DESIGNS

Users often make a selection from a list of possibilities presented to them by the system through the use of menus (Somerville, 2000). In the eCVMS the menu designs were designed in a friendly manner in such a way that the selection may be done by pointing and clicking with a mouse, using cursor keys or by typing the name of the selection. Some menus in other systems can make use simple to use terminals such as touch screens.

4.6.1.1 MAIN MENU

Many multimedia software applications such as the eCVMS provide a top level menu that organises the software's contents and such a menu is commonly called the main menu (Silver, 2008). In such applications the means to access this menu has to be provided on every screen of the software. The main menu in the eCVMS will enable the users to access input forms for capturing criminal personal details and the other form for entering conviction details of convicted persons. An administrative module where the administrator manages users is also accessible via the main menu. The main menu also have capabilities of calling query modules and printing various reports.

| Electronic Criminal Vetting and Management System (eCVMS) | | | |
|-----------------------------------------------------------|-------------|----------------|------|
| File | Reports | Administration | Help |
| Users | Certificate | | |
| Input details | | | |
| Convictions | | | |
| Exit | | | |

Figure 4.10: Main menu design

4.6.2 SUB MENUS

Menus are further divided into a number of sub menus depending on the requirements (James, 2009). Separator bars were used by the researcher in the eCVMS to help group together sub menus of identical nature. Just like menus sub menus can be created for making a selection from a number of options. Usually the keyboard options are also provided while setting sub menus similarly the way it is done with menus.

4.6.2 INPUT DESIGNS

Forms are used generally to present or collect information on a single item such as personal details of client in case of CMVS. The forms can be used for both input and output. Reports on the other hand are used to convey information on a collection of items.

4.6.2.1 LOGIN FORM

This is the first form that is displayed when a user runs the application program and this form simply accepts the credentials of users and for authentication purposes. The user enters the username and a password and the system verifies from the DBMS whether the credentials are correct and if correct access to the main menu will be granted.

| Criminal Vetting Management System | |
|------------------------------------|---------------------------------------|
| User Name | <input type="text"/> |
| Password | <input type="password"/> |
| <input type="button" value="OK"/> | <input type="button" value="Cancel"/> |

Figure 4.11: LogIn Form

4.6.2.2 CRIMINAL DETAILS INPUT

After successful logging into the system the user will have access through the main menu described above to perform various task according to the access levels (rights) that are granted to the user by the administrator. The main input form will enable the user to input the personal details of a convicted individual but does not contain the details of the convictions.

| Electronic Criminal Vetting Management System (eCVMS) | |
|-------------------------------------------------------|--------------------------------------|
| <input type="button" value="Crime History"/> | <input type="button" value="Users"/> |
| Criminal Personal Details | |
| CCB No: | <input type="text"/> |
| Name | <input type="text"/> |
| Surname | <input type="text"/> |
| Second Name | <input type="text"/> |
| Alias | <input type="text"/> |
| Race | <input type="text"/> |
| Sex | <input type="text"/> |
| NR | <input type="text"/> |
| Country of Origin | <input type="text"/> |
| District | <input type="text"/> |
| Chief | <input type="text"/> |
| Headman | <input type="text"/> |
| Kraal | <input type="text"/> |
| DOB | <input type="text"/> |
| Place of Birth | <input type="text"/> |
| Residential Address | <input type="text"/> |
| Business Address | <input type="text"/> |

Figure 4.12: Criminal Personal details

4.6.2.3 CRIME DETAILS

After successfully capturing the personal details of convicted criminal the user will then enter crime details if any of the concerned individual.

| Electronic Criminal Vetting Management System (eCVMS) | |
|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: fit-content; margin: 0 auto;">Criminal Personal Details</div> | <div style="border: 1px solid black; border-radius: 10px; padding: 5px; width: fit-content; margin: 0 auto;">Users</div> |
| Criminal Personal Details | |
| CCB No: | <input type="text"/> |
| CR No | <input type="text"/> |
| PPs Ref | <input type="text"/> |
| Date Sentence | <input type="text"/> |
| Sentence | <input type="text"/> |
| Offence | <input type="text"/> |
| Date Of Offence | <input type="text"/> |
| Time Offence | <input type="text"/> |
| Place of Occurrence | <input type="text"/> |
| Other Relevant | <input type="text"/> |
| Investigating Officer Number | <input type="text"/> |
| Investigating Officer Rank | <input type="text"/> |
| Investigating Officer Name | <input type="text"/> |
| Court | <input type="text"/> |

Figure 4.13: Crime Details

4.6.3 OUTPUT DESIGNS

Outputs from computer system are necessary mainly to communicate the results of the processing by the system to the users and at times to the other system. They are also used to provide a permanent copy of these results for later consultation (Dexit, 2009), and can be in various formats such as the following;

- External outputs which are destined outside the organisation and therefore deserve specific attention because they project the image of the organisation.
- Internal outputs whose destination is within the organisation and these need careful design because they are user's main interface with the system.
- Operational outputs whose consumption is purely with the ICT departments.

- Interactive outputs which involve the user communication directly with the computer.
- Turnaround outputs which are re-entrant documents to which data will be added before they are returned to the computer for further reading.

Table 4.1: Criminal history view

| Criminal History view | | | | | |
|-----------------------------------|----------------|----------------------------|-----------------------|------------------|-----------------------|
| Personal Details of client | | | | | |
| First Name | Surname | ID | Sex | Address | |
| Wellington | Sibanda | 29-164110T29 | M | Farm 22 Silobela | |
| Offence(s) Details | | | | | |
| CR | Offence | Place of Occurrence | Place of Trial | Sentence | Date sentenced |
| 10/2015 | Theft | Gweru | Silobela | 3 months | 23/09/2010 |
| 34/2014 | Assault | Gwanda | Gwanda | \$2000 | 10/06/2014 |

4.6.3.1 REPORTS

After the records has been successfully entered into the system the user depending on the access level can make various queries and print Police Clearance Certificates. If the applicant has no convictions the certificate will indicate in bold capital letters that there are no convictions recorded against the applicant.

Zimbabwe Republic Police



SN: 0001

This is to certify that:

| | |
|---------------|--------------|
| Name | Wellington |
| Surname | Sibanda |
| ID | 29-164110T29 |
| Date Of Birth | 10/08/1973 |


was vetted by Zimbabwe Republic Police and the following are the result:

NO CRIMINAL RECORD FOUND

Figure 4.14: Police clearance certificate

If there are some recorded convictions against the applicant the system will print the certificate indicating full details of the crimes committed which attached to the report as annexure.

Zimbabwe Republic Police



This is to certify that:

| | |
|---------------|--------------|
| Name | Wellington |
| Surname | Sibanda |
| ID | 29-164110T29 |
| Date Of Birth | 10/08/1973 |

was vetted by Zimbabwe Republic Police and the following previous convictions are the recorded:

| CR | OFFENCE | DATE | SENTENCE | PLACE |
|-------|---------|---------|-------------|----------|
| 12/99 | Rape | 10/7/98 | 6 years IWL | Masvingo |

Figure 4.15: Certificate with previous convictions

4.7 CONCLUSION

The design process specified the required hardware and software for successful implementation of the system. A description of how the system will perform in the actual environment was also given in the design stage. The next phase of development which is the Development Phase will make use of the systems design document.

CHAPTER 5: IMPLEMENTATION

5.1 INTRODUCTION

The purpose of implementation, according to Vermat (2009), is to construct or build the new or modified system and then deliver it to the users. There a number of processes that still has to be undertaken before the electronic Criminal Vetting Management System is put to use. Members of the development team perform the following four major activities in this phase which are:-

- Develop programs (coding)
- Install and test the new system
- Train the users
- Convert to the new system
- Maintenance

5.2 CODING

If an organization opts to purchase packaged software and no modification are required then the development team may skip this activity. In the case of eCVMS the ZRP will develop an in house application that will solve its operational problems. According to Agarwal etal (2007) the goal of the coding stage is to translate the design of the system into code in a given programming language. The system will be comprised of various modules which will be later integrated into one working system.

5.2.1 PSEUDO CODE

The researcher first wrote the algorithm in pseudo code before attempting to code the algorithm of the eCVMS in a programming language. The term pseudo code according to Scragg (1997) implies that it is not real computer code but just English statements. This effort to many developers seems like a lot of extra work but to the researcher the effort paid more for itself as it made a complex program simpler. Writing pseudo code separates the task of developing the algorithm from the task of coding the application. Most developers are overwhelmed as they attempt to code an ambiguous or poorly thought step into a rigorous and exacting application (Scragg, 1997)

5.2.1 OPENING OF THE SYSTEM BY THE USER

Open the system

Pop-up user Login Form

5.2.3 LOGIN

Check database connection

Enter your credentials, i.e. username and password.

Check whether username and password correct

If username and password correct then

 Open the main menu (module)

Else

 Retype correct credentials

End if

End if

5.2.4 CAPTURING PERSONAL DETAILS OF CONVICTS

Check for database connectivity

Enter CCB record number

 Is entered number valid?

If entered number is valid then

 Enter the full names of convict

Is entered name valid?

If entered name is valid then

 Choose race

If correct race chosen then

 Enter the date of birth

If date of birth correct then

 Choose the sex of convict

If chosen sex is valid then

 Enter national registration

If entered NR is valid then

 Enter residential address and business address

If entered addressees are valid then

 Enter country and district of origin

If entered country valid then

 Enter place of birth

If all the above information is correct

Then

 Save and lock the record

Else

 Produce an error message

End If

5.2.5 UPDATING PERSONAL DETAILS OF CONVICTED PERSON

Find the record using a unique key

Does the record exist?

If the record is found then

 Unlock the record and validate the information

If information not valid

 Make error report

Else

 Save record using established correction

End If

End

5.2.6 ENTERING CRIMINAL HISTORY

Check if database connected

Find details of criminal using National Registration number

If record not found then

 Make a report that record does not exist

Else

 Select the record

 If correct record selected then

 Enter Criminal Reference (CR) number

 If valid crime reference then

 Enter Police station that investigated the case

 If correct station then

 Enter Investigating Officer details then

 If details of investigating are correct then

```
    Enter Court Reference
If correct Court Reference then
    Enter place of trial
If place of trial is valid then
    Enter date of sentence
If date of sentence is valid then
    Enter sentence
If sentence is valid then
    Enter offence
If offence is valid then
    Date and time of offence
If date and time of offence is valid then
    Enter full address where crime was committed
If address is valid then
    Enter full circumstances
If all above details correct and valid then
    Save the record
Else
    Produce error report
End If
END
```

5.2.7 USER MANAGEMENT

```
Check database connection
Check whether user exists in the database
If user does not exist ask whether to add the user or not
If the answer is yes then
    Enter credentials of the user
Is credentials successfully entered then
    Enter the role (admin, supervisor etc)
Else
    Cancel the operation
End
```

5.3 TESTING

Testing is the major quality control measure used during software development and its basic function according to Agarwal et al (2007) is to detect errors in the software. The goal of testing software is to uncover requirement, design and coding errors in a program (Agarwal et al 2009). Testing is an extremely critical and time consuming activity which should never be taken for granted. It therefore requires proper planning of the overall testing process. There are many different forms of testing namely:

- Unit testing
- Module testing
- Interaction testing
- System testing
- Subsystem testing
- Acceptance testing

5.3.1 TESTING STRATEGY

To perform testing in a planned and systematic manner, software testing strategy must be developed (Kurana, 2007). The researcher in his test strategy identified what levels of testing were to be applied, methods and techniques and tools to be used were also identified. The same strategy also decided test cases, test specifications; test decisions and finally put them together for execution. Developing a strategy which meets the requirements of an organisation was very critical to the success of the system.

The procedure in the testing software is indicated in the diagram below

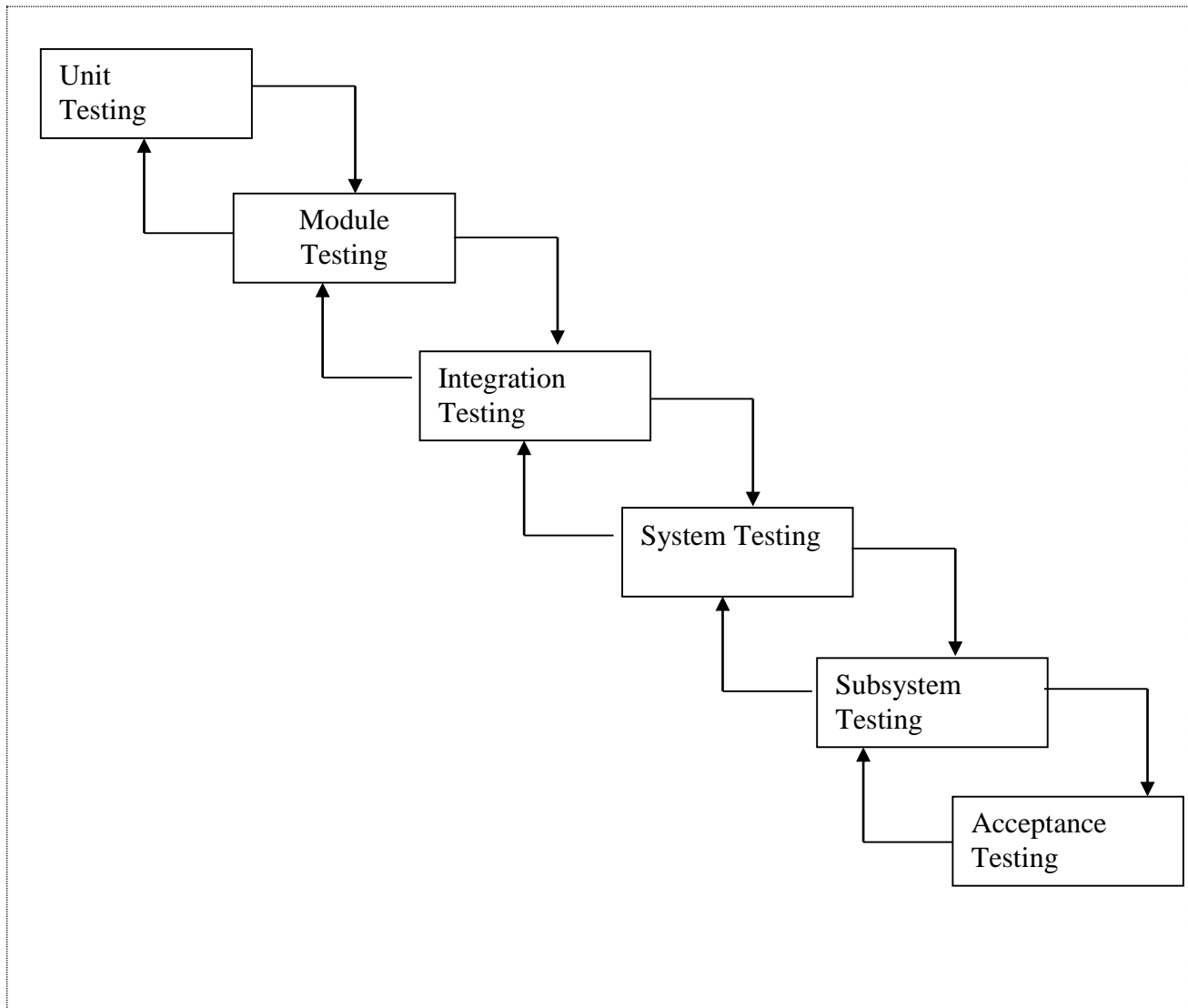


Figure 5.1 Procedures in Testing

5.3.1.1 UNIT TESTING

Large systems are usually broken into smaller parts or modules or functions that should be tested to see if they are performing as per required expectations. Unit testing according to Mall (2008) involves testing each module in isolation from other modules, then debugging and documenting it. The main objective of unit testing is to determine the correct working of the individual modules during unit testing. This is done by testing each module by the programmer in isolation since this is the most effective way to debug errors identified at this stage. The unit testing may also be ideal as in some cases other modules which are to interface the module being tested will not be ready.

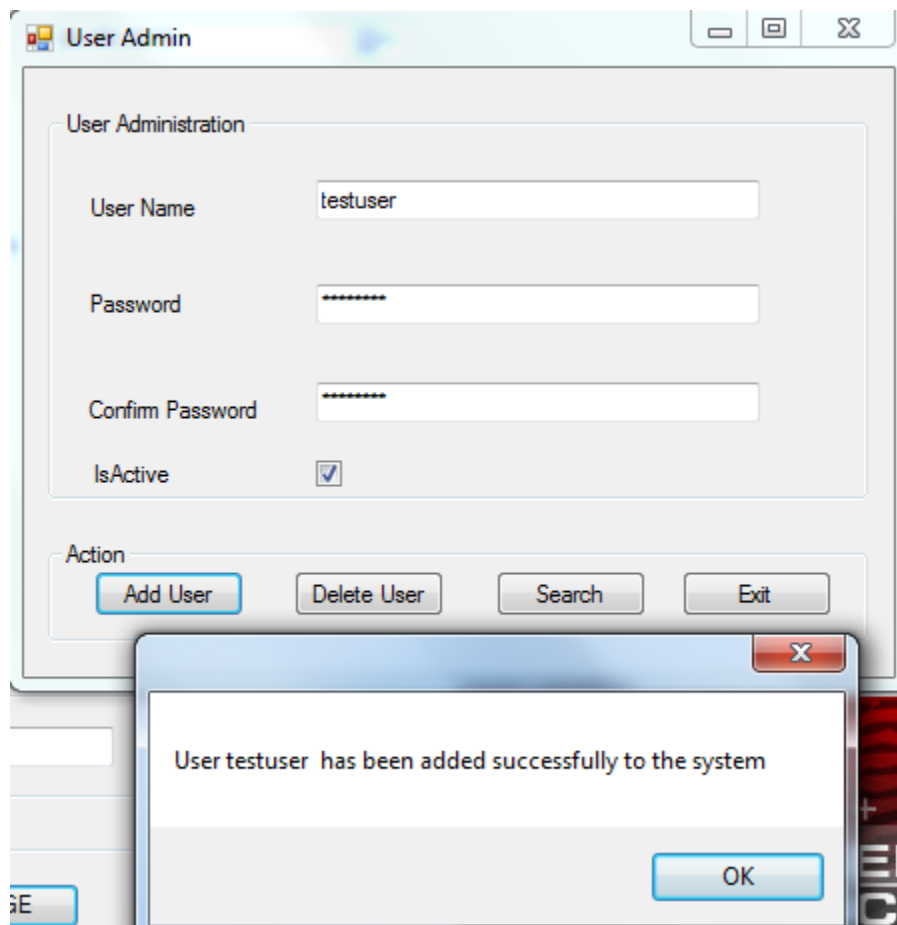


Figure 5.2: Testing User Administration unit

Unit testing for the Criminal Vetting and Management System was done in two ways;

- Logical testing (White box testing)
- Functional testing (Black box testing)

Functional testing (black box) is based on the data obtained from the user requirements specification document. Krishnamurthy and Saran (2008) suggest that the black box testing is behavioral in nature that is it is only concerned about testing whether specifications are met. This test does not guarantee that the source code is error free after testing it for errors.

On the other hand logical testing (white box) is concerned with the internals of the software application as noted by Krishna Murthy and Saran (2009), who further suggest that it is about the source code

making it structural in nature. Since logical testing is based on the source code it does not guarantee that non-functional specifications have been implemented.

5.3.1.2 INTEGRATION TESTING

Integration of different modules of CVMS was undertaken by the researcher after the modules had been coded and tested. According to Mall (2009) the integration of different modules is done in a planned manner during integration testing and it is normally carried out incrementally over a number of steps. During each integration step the previously planned modules were added to the partially integrated system and the resultant system tested. Finally after all modules were integrated and tested the system. The screen below shows is shown after the user successfully call this module from the main menu so that the user can start entering data.

The screenshot displays the 'Main' window of the eCVMS application. The interface is divided into several sections:

- CIF DETAILS:** Includes input fields for First Name, Surname, ID Number, Date Of Birth (06/05/2015), Cell NO, Gender, Tel No, Home Address, and Work Address.
- Origin Details:** Includes input fields for Place Of Birth, Chief, District Of Origin, Headman, Country Of Origin, and Village.
- Reference Details:** Includes a CCB no. input field.
- Generic Operations:** Contains buttons for SAVE, SEARCH, MANAGE, and EXIT.
- FingerPrint Operations:** Includes a Prompt field, Status field, Image Quality field, and buttons for Connect, Disconnect, ENROL, and VERIFY (1:N).
- Camera Operations:** Features a video feed area with 'FINGERPRINT SCANN' and 'LOAD' text, and buttons for Start and Stop.
- Image Operations:** Includes a Capture Image button.

At the bottom left, the status bar indicates 'Logged In User : SIBANDA'.

Figure 5.3: Main form after successful login

5.3.1.3 SUB-SYSTEM TESTING

After some components have been integrated to independent subsystems there is need to test if the subsystem cooperating. In subsystem test design the researcher specified the structure and behavior of subsystems each of which was intended to satisfy some functions in the overall system. Often subsystems are adaptations of previously developed software. The functions of all subsystems such as login password, user management and reports were successfully done.

5.3.1.4 SYSTEM TESTING

After successful integration testing the system testing was carried out. The goal of system testing according to Mall (2009) is to ensure that the developed system conforms to its requirements laid out in the SRS document. The system testing process was carried out in two different forms which are;

- **Alpha testing:-** This system testing was done by the researcher (developer).
- **Beta testing:-** This system testing was performed by a friendly set of clients.

System testing was also carried out in a planned manner according to a system test plan document that was produced by the researcher. The system test plan identified all testing related activities that were to be performed and also specified the schedule for testing and allocated the resources.

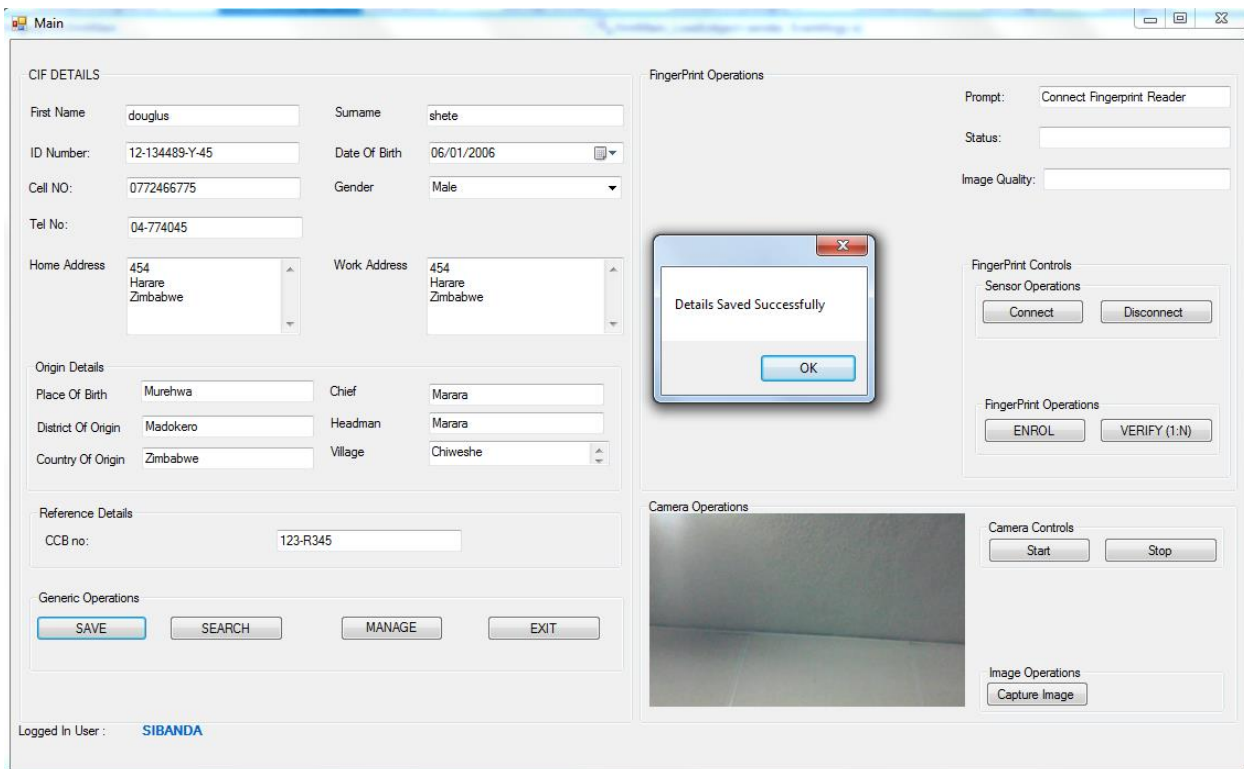


Figure 5.4: System testing and successfully saves a record

5.3.1.4 ACCEPTANCE TESTING

Only users can make the final decision about the content and scope of system. According Desai and Srivastava (2002), after a successful completion of the system testing the user is expected to take over the system for acceptance testing. The objective of the test being to test the system using live scenarios and also have an opportunity to train the end users on the proposed system. It is vital that the end users participate with great ownership and must show passion to accept or suggest improvements during the acceptance test in order for the system to be successfully implemented. There are two methods that were used to conduct acceptance test which are as follows;

- Beta testing, whereby the developer used actual data obtained from the users of the system rather than fake data created by the developer as test data for the purpose of testing the system
- Alpha testing was also used where the developer delivered the CVMS to the users and the organization had a feel of the system so as to unearth hidden errors.

5.3.2 VERIFICATION AND VALIDATION

It is essential that some verification and validation checks be carried out so as to determine whether the product is developed comply with the specifications given and is fit for intended use. The terms verification and validation are used almost interchangeably in our daily conversations but in the field of computer science they each have a specific meaning. According to Eduardo and Zapien (2008) verification and validation (V&V) are two similar terms which have been used to refer to all the activities that are performed to check that the software does what it is supposed to do. In order to achieve high degree of software reliability the developer must verify and validate it.

5.3.2.1 VERIFICATION

According to Kamrani and Azmil (2008) verification is the process of confirming that the system and its element meets its requirement. It ensures that the system performs its intended function and meets performance requirements allocated to it. Verification answers the simple question. “Are we building the product right”. In the verification process the developer (verifier) establishes whether the software faithfully implements all user requirements as stated in the requirements specification document. In case of the CVMS the researcher carried all verification checks and it was established that all specifications are being met that is whether the system was constructed as per specifications.

5.3.2.2 VALIDATION

Validation is a process of determining whether the system functions in the manner its stakeholders / customers expected when used on its intended environment (Hope et al. 2007). A system can be verified and meet all its requirements but this does not guarantee that the system is valid. It answers the question “Are we building the right product?”. Validation is extremely subjective as it involves making subjective assessment of how well the systems address the given problems in real world. The researcher carried out some validations to ensure that specifications for the CVMS correctly describe a system that is fit for its intended use. Different validation checks were made such as the following;

- **Logon validation**

The user must correctly enter carried user name and password otherwise the system will show error messages as shown in the test results below.

5.3.3 TEST RESULTS

All modules were first tested separately before integration and the following are the results. Detailed below are the test results that were done’

5.3.3.1 LOGIN

The user can only gain access to the system after correctly providing his/her credentials.

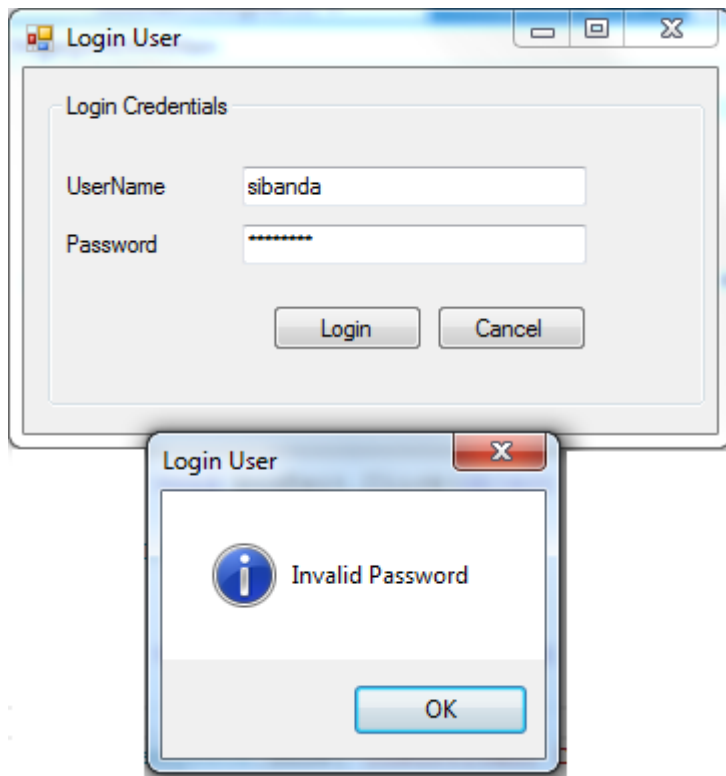


Figure 5.5: Logon form

5.3.3.2 INCOMPLETE INFORMATION

The user must provide complete information into the system and as such null values will be rejected in situation where it is mandatory to enter information such as name and date of birth.

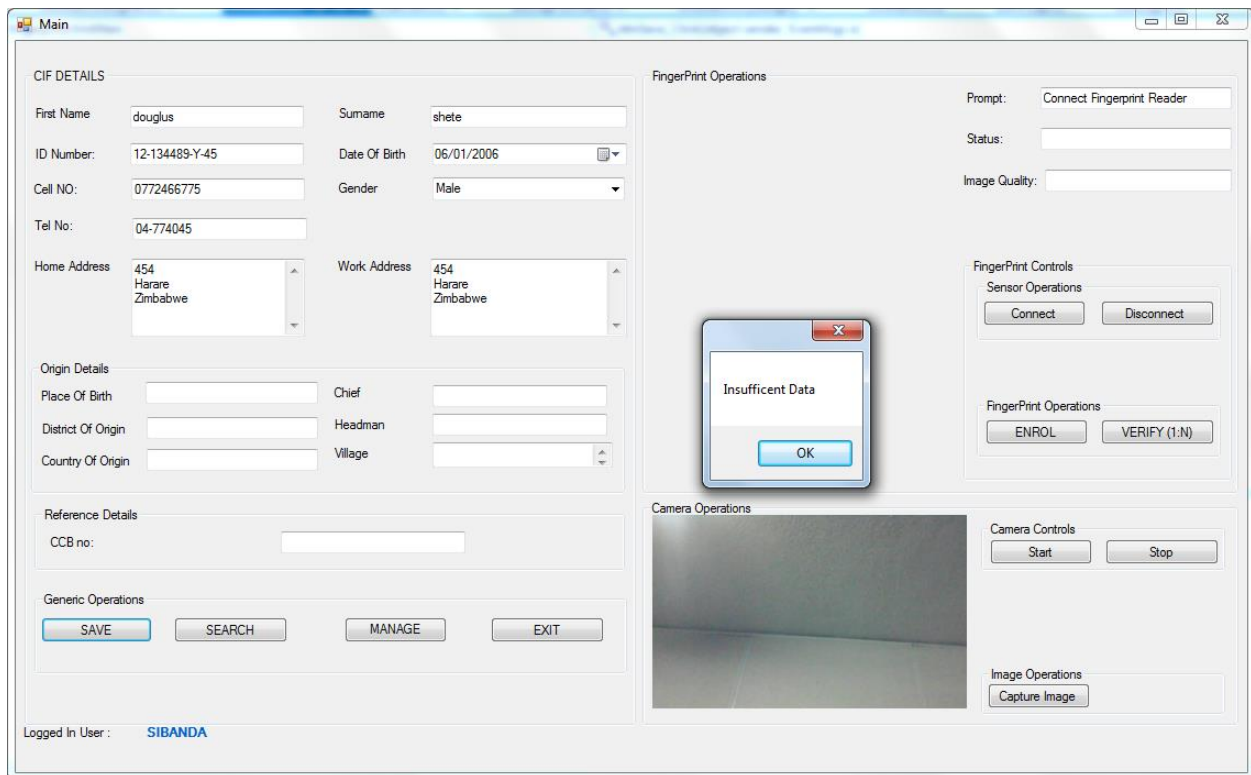


Figure 5.6: Incomplete information validation

5.3.3.4 ENTERING WRONG VALUES

Incorrect dates should not be accepted by the system such as an invalid date of birth or e-mail address.

5.3.3.5 OUT OF RANGE VALUES

The data to be stated in the database must be within registered ranch such as name of the command cannot be for example less than 2 characters.

5.3.4 OVERVIEW OF TEST RESULTS

- The system is able to execute all intended task as per client`s request.
- The system is storing only valid data and no redundant data will be stored.
- Security features of the system are excellent and the owners of the system are guaranteed that the system will securely carry out the task.
- The system has been accepted by the users as it functioning as anticipated.

5.4 INSTALLATION

After successful system testing the Criminal Vetting Management System was successfully installed at the Criminal Investigations Department (CID) headquarters in Harare. The database was created at the main server and the application server was used to install the application. During installation the following process was taken into account.

- Installation prerequisites
- Operational environment
- User training
- File conversation
- System conversation

5.4.1 OPERATIONAL ENVIRONMENT

The system will operate in an environment which is affected by different factors such as hardware, software configuration operating system, utilities and network resources. This operational environment should be tested before the system is installed. All suitable conditions for the operations of the system were made available.

5.4.2 INSTALLATION PREREQUISITES

The under listed are the hardware and software requirements in order for the CVMS to be successfully implemented;

- windows 8
- 4 GB RAM
- 500 GB HDD
- Windows 2008 server
- Microsoft Office 2010
- antivirus software
- Adobe Reader 9.0

5.4.3 USER TRAINING

There is need for intensive user training so as to enable users to have a detailed understanding of how the system operates. The training was targeted to all levels of management and it was carried out at the company premises. The training exercise was a success and all users are now conversant with the operations of the system.

5.4.4 FILE CONVERSION

After successful completion of the development process the system files are then transferred to the new system. The files such as the server database file are copied from the development site to the operational site by use of other software applications such as SQL restore or manual applications.

5.4.5 SYSTEM CONVERSION

Once the system is ready and tested it has to be implemented. System conversion according to Wang and Wang (2012) refers to the process that the new system to be starts up and the old system is shut down. The new system could be a replacement of an old completion system or of a set of manual procedure or a shifting of a system from another environment it could also be a system developed to perform a function not being performed previously (Gupta, 2005). There are four commonly used system conversion methods which are as follows;

- Parallel system
- Direct conversion
- Pilot system
- Phase-in method

5.4.5.1 PARALLEL CONVERSION

Using the parallel conversion method both the old system and the new system run simultaneously for a time period until the new system performs stably (Wang and Wang, 2012). People use both systems but increase the amount of time that they use the new system until it is in use the majority of the time. Then the old system is discontinued. If problems are discovered in the new system the system is simply turned off and fixed and then the conversion process starts again. However the problem with this approach is the added expense of operating two systems that perform same function. In the context of Criminal Vetting Management System (CVMS) this will involve running the new computerized system and manual paper based system and this approach was used to implement the system.

(i) ADVANTAGES

- With the help of this even minor errors can be detected.
- There is no risk if there does not occurs successful implementation of new system

- Allows comparison of the new system and old so that you can benchmark and quantify its effectiveness.

(ii) DISADVANTAGES

- It is very expensive conversion strategy as two systems has to run at the same time so it is a great expense in terms of power and support.
- There is duplication of efforts associated with running two systems thus creating managerial problems and extra cost.
- The old system is an optional some users will not use the new system if they continue to access old system thus delaying benefits of the new system.



Figure 5.7 Parallel conversion (Source Wang and Wang, 2010)

5.4.5.2 DIRECT CONVERSION

According to Dennis et al (2007) with direct conversion (sometimes recalled cold turkey, big bang or abrupt cutover) the new system instantly replaces the old system. The new system is turned on and the old one is immediately turned off. Users and management have a high interest in making the new system work because, by design, there is no turning back. A direct cutover conversion may be the only option if the old and new systems cannot co-exist in any form. However it is the most risk because only problems with the new system that have escaped detection during testing can seriously disrupt the organization. Thus direct conversion is applied to small and simple information systems (Wang and Wang 2010).

(i) ADVANTAGES

- It costs a less amount of money as everything has to just set up for once.
- It is very easy to make change over.

(ii) DISADVANTAGES

- It is more risky because it is not always that implementation of systems is successful. If there is any problem in the system then organization as a whole has to suffer.
- It is very difficult to detect minor errors as due to absence of parallel system. Errors may be there because testing data is not as big as there may be live data.
- Sometimes major errors can terminate the system so whole operation will be stopped and there will be difficulty of back up.

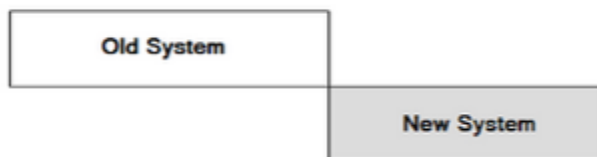


Figure 5.4 Direct conversion (Source Wang and Wang, 2010)

5.4.5.3 PILOT SYSTEM

With a pilot conversion one or more locations or work groups within a location are elected first for conversion as a pilot test (Dennis et al 2007). This will mean that part of an organization will implement the new system while the rest of it uses the old system. The location that participate in the pilot test are converted (using either direct or parallel conversion). If the system passes the pilot test then the system will be installed at all organization located. Pilot conversion has an advantage of providing an additional level of testing before fully deploying the system. However this type of conversion obviously requires more time before the system is installed at all different locations.

(i) ADVANTAGES:

- It is an economic conversion strategy.
- It reduces the risk.

(ii) DISADVANTAGES

- Sometimes some operations remain untested.
- Runs the risk of delaying the full implementation of a new system because the pilot is constantly being improved.

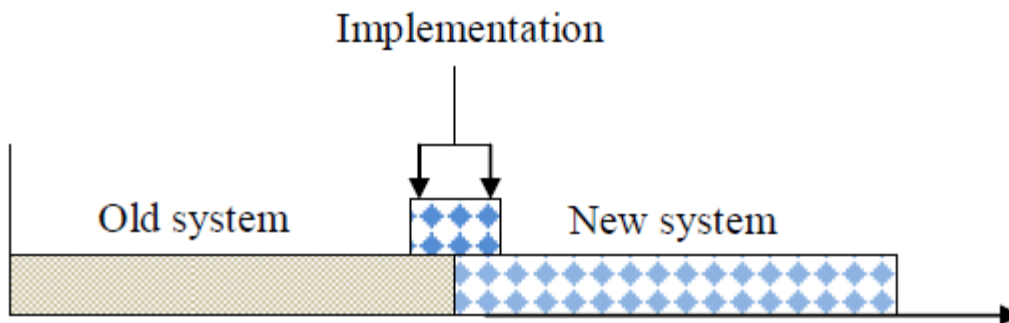


Figure 5.9: Pilot conversion (Source Wang and Wang, 2010)

5.4.5.4 PHASED-IN METHOD

According to Wang and Wang (2012) in a phased conversion the new system replaces the old system gradually in the phase out style. The phases can be physical location or part of the new system being introduced while the rest of the old one remains in use. This method has localized the problem to the new module so support resource can focus on it. However there can be interface problems if modules are made to share data. Although this methods can also reduce risks of failure it usually takes a relatively long time for the whole conversion process.

(i) ADVANTAGES

- There is a negligible chance of any type of problem in the system as it is tested on every stage.
- It is more user friendly.

(ii) DISADVANTAGES

- It needs a lot of time for full implementation of system.
- Completion point can be difficult to define because it takes place over such a long period.
- The old and new system must be able to work together seamlessly which may require additional programming and development.

- Can become never ending project, by the time all the components have been introduced it will be time to install new system



Figure 5.10: Phased in method (Source Wang and Wang, 2010)

5.4.5.5 RECOMMENDED CONVERSION METHODS

The researcher chose the parallel method for implementing the system because it has a relative low risk and it gives users enough time to test and evaluate the system. Although it is costly to run two systems simultaneously most of the cost will be minimized since the organization will be using internal staff for the development and implementation hence no need for additional staff.

5.4.6.6 POST IMPLEMENTATION

Every system needs to be reviewed periodically after implementation. According to ISRD Group (2007) a post implementation review aims at evaluating the system in terms of the extent to which a system succeeds in achieving stated objective and how far actual project cost exceeds initial estimates.

5.4.6.7. BACKUP SERVICE

A backup of the system needs to be done regularly to safeguard the data. The case with Criminal Vetting Management System (CVMS) it was done in two categories:

- Application backup
- Database backup

In application backup the researcher created a backup of the system application program will enable the re-installation of the system in case of system failure. The backup was done once and will be recreated only when there are changes done to the functionality of the system.

Database backup will be done periodically to ensure that the data is safe and can recover to a certain recovery point. The data in the database is not static hence the need to constantly create backup points

5.4.6.8 SYSTEM SECURITY

It is of paramount importance that the Criminal Management Vetting System (CVMS) has high level security features to enhance its integrity. There should be security measures to ensure that only authorized people gain access to criminal records by use of a password and user names. The users should also be given the access levels to ensure that each user who logs onto the system performs only actions that are limited to his access level. Information systems security according to Kim and Solaman (2012) can be easily defined by breaking the system into pieces consisting of hardware, operating systems and application software that work together to collect, process and store data for individuals and organizations. Thus information security becomes all the activities that protect information system and the data stored in it. The system security may be in two aspects which are;

(i) PHYSICAL SECURITY CONTROLS

The information system is composed of computer hardware such as CPU and its peripherals. In a networked system there are additional devices which include routers, bridges, gateways, switches, modems etc. The Criminal Vetting Management System (CVMS) was designed in such a way that all these pieces of equipment are adequately protected against physical damage resulting from natural disasters such as earthquakes, hurricanes, floods and other dangers such as bombings, fires, power sages, theft and vandalism and unauthorized tempering. Controls that protect against these threats are called physical security controls (Champlain 2003). These security controls can be in various forms that include locks such as convectional keys, electronic access badges, biometrics locks and cipher locks.

(ii) LOGICAL SECURITY CONTROLS

The Criminal Vetting Management System (CVMS) need to be adequately protected against unauthorized access and accidental or intentional destruction or alterations of the system software programs, application programs and data. Protecting against these threats is accomplished through the deployment of logical security controls (Champlain, 2003). These controls will restrict the access capabilities of users of the system and prevent unauthorized users from accessing the system. These security controls will be enforced within the operating system, the database management system and application program. Different types of such controls were designed and these will include user IDs and passwords with minimum requirements such as length required, number of digits or letters and suspension of user IDs after successive failed user attempts.

5.5 MAINTAINANCE

Software maintenance is an expensive process and is often acknowledged as a problem in the field of practice. It is thought that many problems in software maintenance in software maintenance are caused by inadequacies in the initial software design (Schneidewind, 1987). Poor choices in software development (such as database architecture), may result in low quality software that is difficult to modify. However the software architecture design for the CVMS was well designed in such a way that the maintenance process will not be an expensive activity. Also since the system was designed internally the same programmers will be used to maintain the system.

5.5.1 TYPES OF MAINTENANCE

It is generally acknowledged that organizations engage in four categories of software maintenance (Ramanujan et al 2000): corrective, adaptive, perfective and preventive maintenance. All the four types of maintenance will be engaged in the Criminal Vetting Management System.

5.5.1.1 CORRECTIVE MAINTENANCE

This maintenance contends with fixing errors delivered with software (Khan & Zheng, 2005). These faults and errors will continue to be discovered by the user as they were not detected during the testing stage thus necessitating the performance of corrective maintenance to rectify the identified faults in both the application software and hardware. The causes of error are numerous such as changes in hardware operating, operating systems and interrelated application packages. Regression errors which are errors included during the process of correcting existing error and these errors will be attended to.

5.5.1.2 ADAPTIVE MAINTENANCE

This process is primarily about preserving the systems utility and relevance in changing business environments (Khan & Zheng, 2005). All information systems are operating under certain different environment hence need for adaption to the environment to the systems in order for the system to effectively operate on the changed environment there is need for adaptive maintenance to take place

5.5.1.3 PERFECTIVE MAINTENANCE

According to Khan and Zheng (2005) perfective maintenance is concerned with enhancing system functionality (efficiency reliability or maintainability) user requirements may also change from time to

time and as such perfective maintenance can ensure that the system caters for such changes in user requirements.

5.5.1.4 PREVENTIVE MAINTENANCE

The preventive maintenance is the most common maintenance done on almost all systems and it refers preemptive changes to forestall future problems (Khan and Zheng, 2005). The functionality of the system is not increased by preventive maintenance yet it consumes large sums of money. It can be also referred to as proactive maintenance and Tumero (2000) further suggests that it may involve carrying out some periodic checks and system review in order to unearth unanticipated problems.

5.5 .2 EVALUATION OF THE OBJECTIVES

- **1st objective:** To facilitate electronic addition, storage and maintenance of criminal records.

The above objective was met. The systems are able to store electronic biographic data in database.

- **2nd objective:** To capture biometric data for all convicted criminals.

The above objective was also met. Fingerprints of convicted persons can be electronically captured and stored in the database.

- **3rd objective:** Instant retrieval and sharing of criminal records.

The above objective was met. The criminal records of clients if any can now be retrieved within a mouse click from the electronic database.

- **4th objective:** To provide a police clearance.

The above objective is being met. Police clearance with adequate security features can be printed out.

- **5th objective:** To produce report that will aid management in decision making.

The above objective is also being met. Various reports are being produced that will aid management in carrying out its mandate.

5.2.3 RECOMMENDATIONS

After successful implementation of the Criminal Vetting Management System the researcher made the following recommendations:

- The ZRP should with immediate effect adopt and commission the new computerized system.
- The organization should continue funding the system to ensure smooth running maintenance work to be done on time.
- The ICT department to periodically train the users to ensure that system will run smoothly.
- The security controls that were highlighted during the system implementation should be strictly followed.

5.6 CONCLUSIONS

The electronic Criminal Vetting and Management System has met all the objectives and was successfully implemented despite numerous challenges that were encountered. The aim of the research study was to automate the criminal vetting and management to enable police to efficient and effectively issue Clearance Certificate to its clients. The users greatly appreciated the new electronic system as it has improved operational efficiency of the Criminal Investigations Department. The risk analysis process was carefully done and appropriate measures were taken to counter the risks.

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APPENDICES

Appendix A: USER MANUAL

USER MANAGEMENT

The system administrators need to manage all users who are entitled to perform different task in this application. There are four types of users in the system; CLERK, LICENCE ADMIN, SUPERVISOR and ADMIN. The user are given user ID and passwords so that they can log into the system

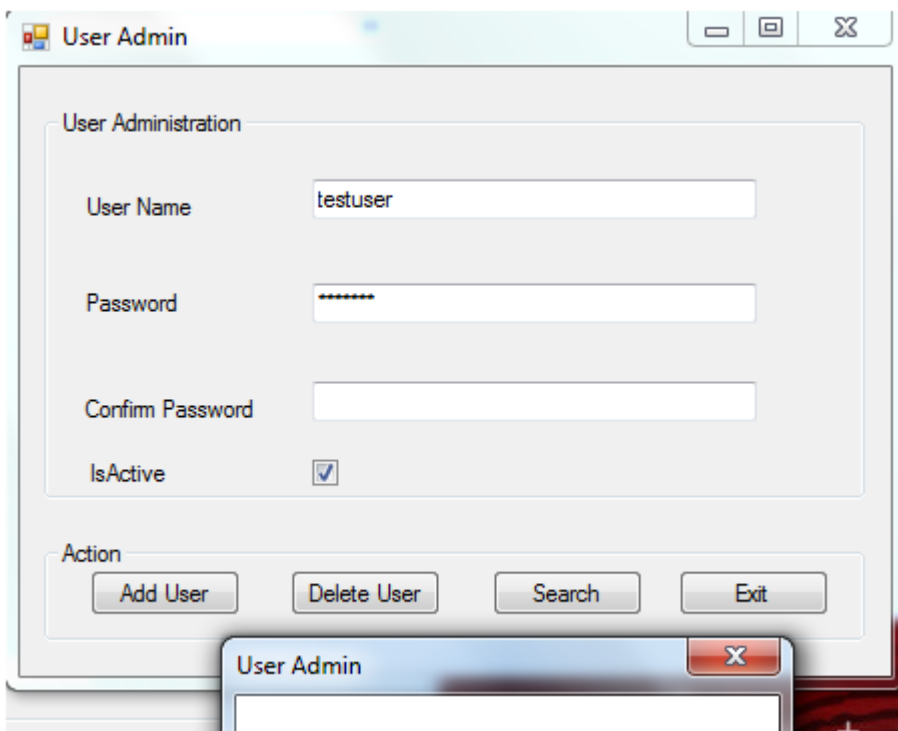


Fig A1: User management

LOGIN

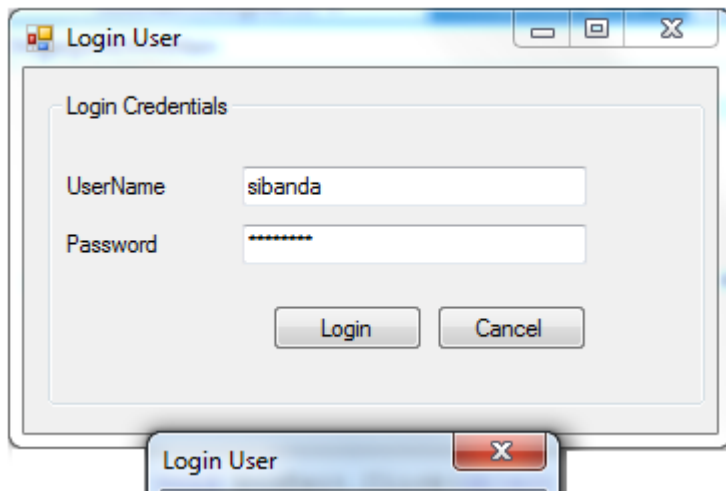
The user must first LOGIN to the system using a correct user the correct credentials (user name and password). All users have corresponding task as assigned by the admin.

Admin Login

Supervisor

Clerk Login

The application is case sensitive as shown below and the user will only be given three chances in case he enters a wrong password



MAIN MENU

After successful login the user will be directed to the main module where he/she can interface all other modules as shown below

Fig A2: Main menu

INPUT FORM FOR PERSONAL DETAILS

This is the main input form to enter the personal details of the convicted criminals. This form can easily be accessed from the main menu

Fig A3: Criminal details input form.

Once this form loads on the screen the user can perform various such as imputing, searching record etc. To input the record the record the user simply type in the correct details of the convicted criminal on the provided space and then use SAVE button to store the record. To search the record the user has to put the cursor at the ID number input box and then type the correct ID number for the client and the click button search.

CRIME HISTORY DETAILS

This form will help the user to input and navigate the crime details which relate to the criminal record(s) of the found criminal after a successful search. The user enters the national ID for the convict and search the personal details and the search the user type in the conviction details as indicated below. After complete data has be captured the user click load convictions button to show details on the grid.


Fig A4: Crime details Input form

GENERATING POLICE CERTIFICATE

After a successful search the user should click print button which will print the police clearance report will be displayed and a normal print will be done.

APPENDIX B: LETTER OF CONSENT

16/1/15 1645h



ZIMBABWE REPUBLIC POLICE
CRIMINAL INVESTIGATION DEPARTMENT HQ

P.O. BOX CY 683
CAUSEWAY,
HARARE, ZIMBABWE

TEL (263 4) 700171
FAX (263 4) 799456

7 January 2015

Commissioner General
POLICE GENERAL HEADQUARTERS

Attention: Director (ICT)


**RE: PERMISSION TO CARRYOUT A RESEARCH STUDY ON THE
COMPUTERISATION OF FINGERPRINT VETTING SYSTEM
BY SUPERINTENDENT SIBANDA W: PROVINCIAL ICT
OFFICER (MASVINGO PROVINCE)**

Reference is made to an application to carry out a research study by
Superintendent Sibanda W, Provincial ICT Officer Masvingo Province and
your covering letter dated 5 January 2015.

Please be advised that the application was approved.

May the Senior Officer be advised accordingly.

Respectfully referred, please.


(G. MUNYONGA) Senior Assistant Commissioner
Director
CRIMINAL INVESTIGATION DEPARTMENT

/gc

APPENDIX C: INTERVIEW CHECKLIST

Interview sheet

Interviewee _____ Date _____

Title of Interview _____ Time _____

Interviewer _____ Location of interview _____

Interview title _____

1. Describe the current system in use?

.....

2. What difficulties do you face when using the current system?

.....

.....

3. How efficient and secure is the current system in management of records?

.....

.....

4. How does the current system work when capturing details and producing reports?

.....

.....

5. What do you suggest be done to improve the current system?

.....

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6. If we are to computerize the new system what do you expect from the new system

.....
.....
.....
.....
.....

7. Do you think that members of staff embrace the change from the old system to the new system?

.....:

APPENDIX D: QUESTIONNAIRE

Appendix C: Questionnaire checklist

Questionnaire for Police Officers who use the system (Central Criminal Bureau)

1. May you answer all the questions in spaces provided below?
2. Do not write your name unless you choose to do so. Please return your completed questionnaire, to the person who gave it to you within 5 days from the day on which you receive it. Thanks for your assistance.
3. Please tick your answers where ever necessary

Section A

1 Indicate your rank/title

D/Sgt

2 For how long have you been with the organization?

- Less than 1 year
- 1-2 years
- years and above



3 Can you give a description of the current system in your own view?

The system needs to be updated. The manual system is time consuming and hazardous to health since dust accumulate in parts and milk ration is given.

4 How do you rate the current system as compared to current trends?

Backwards therefore needs to be updated to move with current trends.

5 What do you think should be done to the system if there is need?

Computerised.

6 What challenges are you facing as a department?

Lack of finance to supply to purchase more cabinets since trays are full hence late filling is being affected. Lack of remunerations e.g. milk since operators are likely free TP due to dust.

7 How do you think the problems you highlighted can be rectified?

Organization needs to prioritise the CCB as it used to be since its a part to crime management, detection,

8 Do you manage to meet your deadlines on time with the current system?

YES NO

If NO give reasons below

.....
.....
.....

9 Approximately how long do you take to search for a CBD holders' file?

Less than 10 minutes

At least 20 minutes

More than 30 minutes

10 Do you find difficulties in searching for Criminal Records?

Yes No Sometimes

11 What do you recommend as solutions to the problems?

Continue with manual system and increase personal

Implementation of a new computerized system

APPENDIX E: OBSERVATION SCORE SHEET

Observation Guide Schedule

Date:

Time:

Venue:

Name of observer:

Brief description of session:

.....
.....
.....
.....

Observation.....

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Areas for development:

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.....

Recommendations.....

.....
.....
.....

APPENDIX F: DOCUMENT REVIEW REPORT

| | |
|--------------------------------|--|
| Review Name | |
| Department Under Review | |

| Criteria | Documents Reviewed | Remarks |
|-----------------|-------------------------------------------------------------------------------|----------------|
| | <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p> | |

APPENDIX G: CODE SNIPPET

Main Form

```

using System;
using System.IO;
using System.Linq;
using System.Text;
using System.Collections.Generic;
using System.Drawing;
using System.Windows.Forms;
using System.Data.SqlClient;
using System.Data;
namespace WinFormCharpWebCam
{
    class Helper
    {
        //string filename;
        static SqlDataAdapter empadap1;
        static DataSet dset;
        public static string IDNumber;
        const string connstr = "Data Source=PSDT02\\SQLEXPRESS;Initial
Catalog=Sibanda;Integrated Security=True;";
        public static void SaveImageCapture(System.Drawing.Image image , int typeId )
        {
            SaveFileDialog s = new SaveFileDialog();
            if (typeId == 1) { s.FileName = "Face"; }
            else
            { s.FileName = "FingerPrint"; }

            // Default file name
            s.DefaultExt = ".Jpg"; // Default file extension
            s.Filter = "Image (.jpg)|*.jpg"; // Filter files by extension
            if (s.ShowDialog() == DialogResult.OK)
            {
                if (typeId == 1)
                { // Save Image face
                    string filename = s.FileName;
                    FileStream fstream = new FileStream(filename, FileMode.Create);
                    image.Save(fstream, System.Drawing.Imaging.ImageFormat.Jpeg);
                    fstream.Close();
                    SaveImageToDatabase(filename, IDNumber, 1);
                }
                else
                { //now save fingerPint
                    string filename_fingerprint = s.FileName + "_fingerPrint";
                    FileStream _fstream = new FileStream(filename_fingerprint, FileMode.Create);
                    image.Save(_fstream, System.Drawing.Imaging.ImageFormat.Jpeg);
                    _fstream.Close();
                }
            }
        }
    }
}

```

```

        SaveImageToDatabase(filename_fingerprint, IDNumber, 2);
    }
}
}
public static void SaveImageToDatabase(string imagename , string IdNumber, int imageType)
{
try
{
    //proceed only when the image has a valid path
    if (imagename != "")
    {
FileStream fs;
        fs = new FileStream(@imagename, FileMode.Open, FileAccess.Read);
        //a byte array to read the image
        byte[] picbyte = new byte[fs.Length];
        fs.Read(picbyte, 0, System.Convert.ToInt32(fs.Length));
        fs.Close();
        //open the database using odp.net and insert the data
        SqlConnection conn = new SqlConnection(connstr);
        conn.Open();
        string query;
        if (imageType == 1)
        { query = "insert into face_image(IDNumber,pic) values( " + IdNumber + " ," + " @pic)";
}
        else
        {
            query = "insert into finger_image(IDNumber,pic_fingerprint) values( " + IdNumber + "
," + " @pic)";
        }
        SqlParameter picparameter = new SqlParameter();
        picparameter.SqlDbType = SqlDbType.Image;
        picparameter.ParameterName = "pic";
        picparameter.Value = picbyte;
        SqlCommand cmd = new SqlCommand(query, conn);
        cmd.Parameters.Add(picparameter);
        cmd.ExecuteNonQuery();
        MessageBox.Show("Image Added");
        cmd.Dispose();
        conn.Close();
        conn.Dispose();
        //Connection();
    }
}
catch (Exception ex)
{
    MessageBox.Show(ex.Message);
}
}
private static void Connection()

```

```
{
    //connect to the database and table
    //selecting all the columns
    //adding the name column alone to the combobox
    try
    {
        string connstr = @"Data Source=.;Initial Catalog=TestImage;
Persist Security Info=True;User ID=sa";
        SqlConnection conn = new SqlConnection(connstr);
        conn.Open();
        empadap1 = new SqlDataAdapter();
        empadap1.SelectCommand = new SqlCommand("SELECT * FROM test_table" , conn);

        dset = new DataSet("dset");
        empadap1.Fill(dset);
        DataTable dtable;
        dtable = dset.Tables[0];
        //comboBox1.Items.Clear();
        foreach (DataRow drow in dtable.Rows)
        {
            // comboBox1.Items.Add(drow[0].ToString());
            // comboBox1.SelectedIndex = 0;
        }

    }

    catch (Exception ex)
    {
        MessageBox.Show(ex.Message);
    }
}
}
```