A FRAMEWORK FOR BIOMETRICS FOR SOCIAL GRANTS IN SOUTH AFRICA

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A FRAMEWORK FOR BIOMETRICS FOR SOCIAL GRANTS IN SOUTH AFRICA

By

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DECLARATION:

I hereby declare that the above-mentioned thesis is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another University or for another qualification.

SIGNATURE: 

DATE: 12th March 2014

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- My precious children, André, Paul and Louise to whom I dedicate this work.

ABSTRACT

In the South African Social Security Agency (SASSA) Annual Report of 2011/2012 it is stated that there were more than 15 million social grants paid out to needy beneficiaries of which 10 927 731 were Child Support Grants. A major challenge that is continually being addressed is the management and administration of these grants. In particular, the focus is on service delivery and zero tolerance to fraud and corruption. SASSA has made various attempts to address these issues, such as the rollout of biometric smart cards in 2012.

This research endeavour attempts to discover whether a framework can be designed where necessary factors are taken into consideration to provide for an efficient social grant application and delivery process that uses biometrics. The framework aims to suggest improvements in the use of biometrics for the social grants.

Seeing that biometrics in this case is used as a technology to improve a system involving humans, this study followed a Design Science approach and made use of a case study to collect the data required for the study. Literature studies reviewed the fields of social grants and biometrics. The challenges and lessons learnt from current implementations of social grants and biometrics within the South African context and further abroad were also relevant for the study.

The framework that resulted from the above was evaluated for validity and applicability after which a modified framework is presented. The research concludes with specific implementation guidelines as well as areas for future research.

Keywords: Biometrics, Social Grants, South Africa, Framework.

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ACRONYMS

ACRONYM	DESCRIPTION
ATM	Automated Teller Machine
BSGSA	Biometrics for Social Grants in South Africa
CDW	Community Development Worker
CPSI	Centre for Public Service Innovation
CSG	Child Support Grant
DNA	Deoxyribonucleic Acid
DPSA	Department of Public Service and Administration
DHA	Department of Home Affairs
EER	Equal Error Rate
FAR	False Acceptance Rate
FRR	False Reject Rate
FTE	Failure To Enrol
GO	Government Official
HCI	Human-Computer Interaction
HDSS	Health and Demographic Surveillance System
HMIS	Health Management Information System
ICT	Information and Communication Technology
ISO	International Standards Organisation
MDG	Millennium Development Goal
MP	Members of the Public
MPSA	Ministry of Public Service and Administration
PALAMA	Public Administration Leadership and Management Academy
PASA	Payments Association of South Africa
PIN	Personal Identification Number
PSC	Public Service Commission
PSETA	Public Service Sector Education and Training Authority
SASSA	South African Social Security Agency
SITA	State Information Technology Agency

PUBLICATIONS BY AUTHOR

The author presented a peer-reviewed paper at a conference. This paper was a direct result of the literature studies done on biometrics for the purposes of this research report.

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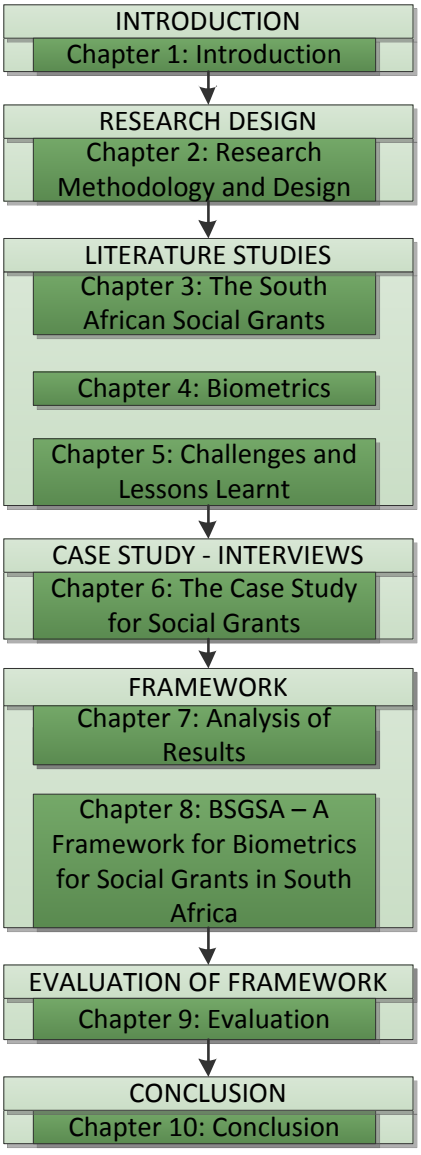
CHAPTER 1: INTRODUCTION

LAYOUT OF CHAPTER 1



CHAPTER MAP

1.1 INTRODUCTION

This first chapter introduces the research topic briefly, beginning with the background to the research in Section 1.2. This is followed by the description of the problem and the rationale behind it in Section 1.3. Section 1.4 presents the research question. Section 1.5 discusses the objectives. The scope and context of the research is defined in Section 1.6. Section 1.7 reveals the research process. Finally Section 1.8 covers the ethical considerations and the chapter ends with the layout of the thesis in Section 1.9.

1.2 BACKGROUND

The background to this research study begins with describing the global attempts at solving the problems of the poor as required by the Millennium Development Goals (MDGs) which were produced by the United Nations (UN) in order to suggest solutions for the world's problems. South Africa is a member of the United Nations and the government of the day is therefore also committed to these goals. The first MDG goal is the most relevant for the purposes of this research. This Goal 1 reads as follows: "Eradicate extreme poverty and hunger" ("Millennium Development Goals Country Report [MDG Country Report]", 2010). Jacob Zuma, in his first term of office as the President of the Republic of South Africa, reiterated South Africa's commitment to the eight MDGs, and indicated that Goal 1 was South Africa's first priority ("MDG Country Report", 2010).

When outlining a Medium Term Strategic Framework to follow MDG Goal 1 by improving conditions of the poor in South Africa, a five-year plan was adopted of which one of the main objectives was to "Halve poverty and unemployment by 2014" ("MDG Country Report", 2010). Ten priority areas were also outlined and Strategic Priority 10 described the building of a developmental state, which would also include improvement of public services. The Department of Public Service and Administration (DPSA) therefore signed a performance agreement, committing themselves to outcomes that were identified by the South African Government. In

turn, the DPSA also defined strategic priorities that would assist in accomplishing their mission (DPSA, 2011a).

The DPSA is particularly responsible for public services of which one of these is the provision of social grants for the poor in South Africa. The social grants that are available currently in South Africa are the following: Child Support Grant, Grant for Older Persons, War Veterans' Grant, Disability Grant, Foster Child Grant, Care Dependency Grant, Grant-in-Aid and Social Relief of Distress ("South African Social Security Agency [SASSA]", 2013a). Over the years this has become a major project and therefore an agency gained control of the management and administration of these grants from 2002. This agency is SASSA. Since their takeover, there has been much improvement in the control of the processes involved in applications and delivery of social grants for eligible South Africans (Dlamini, 2011; SASSA, 2010, "Grant increases," 2010). Their motto is NJALO ("paying the right social grant, to the right person, at the right time and place").

The growth in the number of social grant recipients continues to escalate. In 1998 there were only 2.5 million beneficiaries but it was estimated that by the end of the fiscal year 2012/2013, around 16 million South Africans would be receiving social grants (Clark, 2013). This shows a major increase in the number of grant recipients and the magnitude of this project implies the need to facilitate or improve implementations attached to the social grants. Some suggestions of problems in the social grant implementations are mentioned in the next section of this chapter.

This chapter outlines the aim of this study and describes the flow of the research.

In particular, this study investigated the current situation regarding providing relief to the poor in the form of social grants in South Africa, as well as similar welfare grant situations in other countries. From a technical point of view, the study looked at the biometric details that are used for identification of eligible grant recipients in the social grant system.

The next section will discuss the problems to be addressed by this research in the area of biometrics for social grants.

1.3 PROBLEM DESCRIPTION AND RATIONALE

1.3.1 Problem Description

In the South African Social Security Agency (SASSA) Annual Report of 2011/2012 it is stated that there were more than 15 million social grants being paid out to needy beneficiaries of which 10 927 731 were Child Support Grants (South African Social Security Agency [SASSA], 2012a). A major challenge that is continually being addressed is the management and administration of these grants. In particular, their focus is on service delivery and zero tolerance to fraud and corruption. SASSA has made various attempts to address these issues, such as the rollout of biometric smart cards in 2012.

Table 1.1 lists some problems that are experienced in the social grant system in South Africa where biometrics are used for identification.

1.3.2 Rationale

Actions taken to improve efficiency of the biometrics for social grants in South Africa may lessen the severity of the problems listed in Table 1.1. A suitable artifact is required to guide the implementation and use of biometrics in social grants in order to bring about improvements. A typical artifact may be a model or a framework.

Models can assist in developing theories and can be implemented in many ways. A model is not reality but is usually something that is in the place of the original and therefore explains how something operates, perhaps in a simpler form (“Difference between”, 2013).

A framework can be used as a guide to build something or solve a problem and can be useful when one is trying to learn more about something. A framework has variables, either independent or dependent, and the overall structure can show the connectivity and dependencies between the components (“Difference between”, 2013).

Table 1.1: Problems experienced in social grant system

NO.	PROBLEM	REFERENCES
1	Fraud and corruption resulting in unlawful issue of grants.	"7 arrested", 2004; "Child Support probe", 2006; Earl, 2013; "Enrol on new grant payment system", 2013; "Getting SASSA", 2013; Jacobs, 2013; Magubane, 2010; Masemola, 2008; Mashabane, 2011; Mphande, 2006; Ndaliso, 2010; Nini, 2011; Phakathi, 2012; Venter, 2005.
2	Delays in application process where biometrics are extracted.	Islam & Grönlund, 2010; Lewis, 2010; Makinana, 2007; Pahmeier, 2011; Seanego & Manyathela, 2012).
3	Lost or missing identification documents, especially in the case of children.	Carlisle, 2008; Makinana, 2007; Phakathi, 2012.
4	Difficulty in conducting periodic reviews for the purpose of confirming continued relevancy of the grant.	Khumalo, 2012; Ntuku, 2012; Ntuli, 2013.
5	Security problems with single-mode biometric mechanisms.	Argyropoulos *et al.*, 2010; Bhatnagar *et al.*, 2010; Elumalai & Kannan, 2011; Marcel, 2013; Mordini & Massari, 2008; Sağiroğlu & Őzkaya, 2009; Venkataraman, 2010.
6	Lack of sufficient procedural methods to supplement the biometric technology.	Islam & Grönlund, 2010; Lewis, 2010; Magubane, 2009b; Makinana, 2007; Mvenya, 2010; Pahmeier, 2011; Rehfuess & Akl, 2013; Verma, 2000; Warren & Mavroudi, 2011.
7	Limited proof of efficiency of the new system implemented in 2012, due to the fact that it is still in the early stages of execution.	It is assumed that the effectiveness of the new biometrics system should be regularly verified by SASSA and that the results of such verification would be made public.
8	Vulnerability of grant reci-pients.	DPSA, 2010a; Earl, 2013; MPSA, 2011; SASSA, 2010; SASSA, 2013a.

Jabareen (2009) also describes some features that should be part of a conceptual framework:

- The collection of concepts form part of the framework and each concept is important;
- The framework interprets social reality and provides understanding rather than theories;
- The framework does not predict an outcome and is developed using qualitative analysis;
- The synthesis of findings from the qualitative studies helps to provide new interpretations within a field of study.

The method for building the conceptual framework should be to group interpreted data into concepts which are related (Jabareen, 2009). The data chosen for the framework should represent the phenomenon under study and should come from many sources such as books, newspapers, articles, interviews and practices. The concepts should be allowed to emerge from the literature and they should be refined in further iterations so that fewer concepts are necessary for the final framework. Finally the framework should be evaluated by independent outsiders.

Latham (2013) explains that the framework could be either graphical or in narrative form and should include key factors, variables and relationships (Miles & Huberman, 1984). Figure 1.1 reveals an extraction of this idea (Latham, 2013).

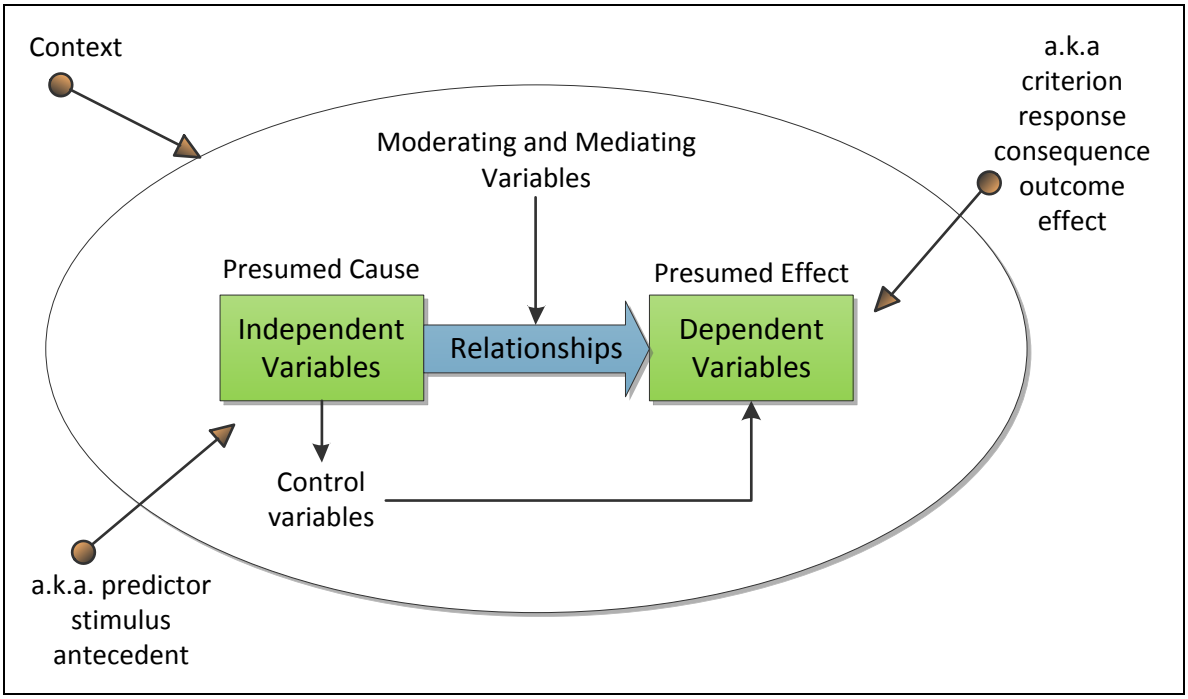


Figure 1.1: Conceptual framework elements (Redrawn from "Developing a conceptual framework" by Latham, 2013, Retrieved from http://www.johnlatham.info/researcher/methods/conceptual_framework/conceptual_framework.html)

To summarise, a model is a representation of an existing real world issue or situation and therefore is not suitable for this research, while a framework will be useful to provide for a set of steps to show how something should operate and therefore is best suited for the problem at hand.

Reviewing the problems mentioned in the previous sub-section, it would be advantageous if a set of actions or steps are suggested for providing solutions to the problems. These steps can be presented in a framework artifact and can suggest more secure biometrics, more efficiency, more controls to secure continuing eligibility for grants, alternatives when biometrics are unreadable and proper structures to support such an implementation. It will be explained in Section 1.7 that the Design Science research process is best suited when developing a framework such as is required in this research.

Before developing the framework, an initial literature review was required. The focus of this particular research is very specific: building a framework that includes the suggested areas of interest has not been done before.

Literature mentions some artifacts such as frameworks and models, but these are not complete with respect to the plan intended by this research effort.

Some of the frameworks found in the literature are technical in nature with respect to biometrics, such as the one in Figure 1.2 (Poh, Bengio & Korczak, 2002). Others are procedural frameworks such as the one in Figure 1.3 which is about the decision-making process that occurs when an application is received for a pension grant (Ojo & Twinomurinzi, 2010).

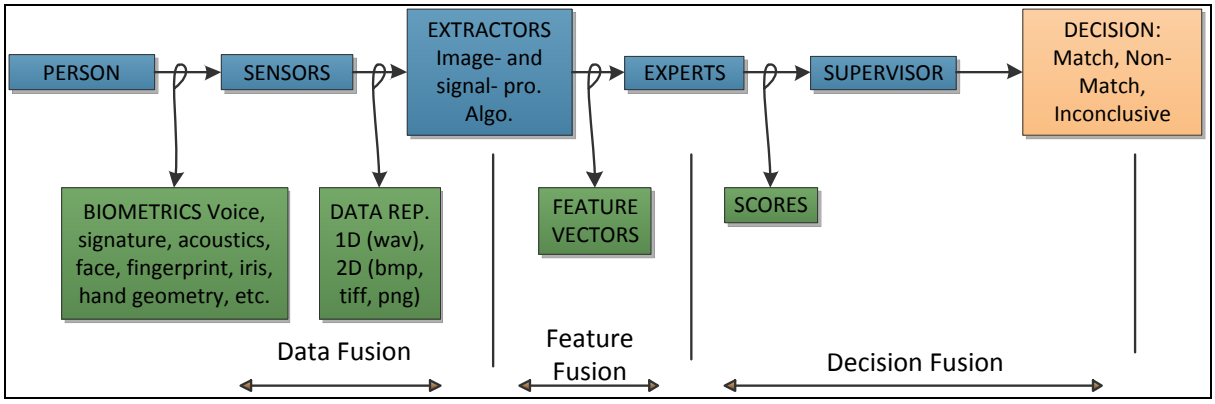


Figure 1.2: Framework for biometrics (Redrawn from "M-Government and service delivery: A case study on the pension system in South Africa" by Ojo and Twinomurinzi, 2010, Retrieved from http://www.ibimapublishing.com/journals/JEGSBP/2010/886842/886842.pdf)

The literature review has also revealed that some academic research was done on various other areas relevant to this intended study. For example, Davids (2011)

prepared a thesis on assessing e-readiness of SASSA which is a valuable read in the area of the technology used in South Africa. Ranga (2007) prepared a model for the South African social grant application process. Again the latter is a technical model and does not take the aspects into account as are expected to be included in the framework proposed by this research endeavour.

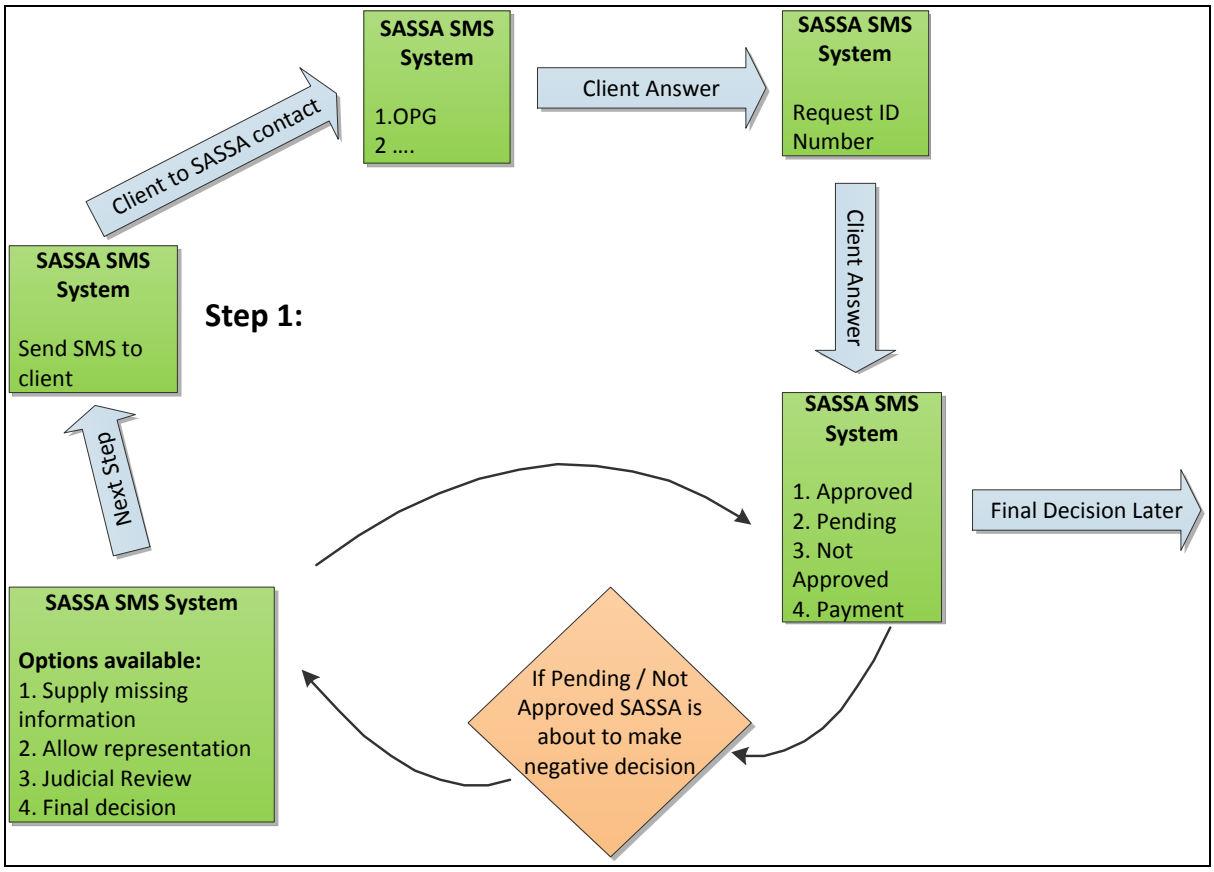


Figure 1.3: Framework to support decision-making process in pension applications (Redrawn from "Towards an identity and access management model for the South African social grant distribution process" by Ranga, 2007, Retrieved from http://ufh.netd.ac.za/bitstream/10353/93/1/Ranga%20thesis.pdf)

1.3.3 Problem Statement

There is thus no comprehensive framework which includes aspects of social grants as well as biometrics. This resulted in the following problem statement:

There is a lack of a suitable framework to describe implementation of biometrics used for social grants in South Africa.

The next section will describe the research objectives which are necessary in order to arrive at suggestions for solving this problem.

1.4 RESEARCH QUESTION

The main research question for this study is the following:

What are the components of a framework for biometrics for social grants in South Africa?

The sub-research questions are outlined as follows:

1. What are suitable biometric methods that can be used for social grants in South Africa?
2. What challenges exist and what lessons can be learnt from current applications where biometric features are used in government sectors both in South Africa and abroad?
3. How can the key factors required for an implementation of Biometrics for Social Grants in South Africa (BSGSA) be constituted into a framework?

1.5 RESEARCH OBJECTIVE

The primary objective for this research study is to develop a framework for using biometrics for social grants in South Africa. The sub-objectives that therefore follow from the research questions are listed in Table 1.2.

1.6 SCOPE AND CONTEXT OF RESEARCH

1.6.1 Scope of Study

The research endeavour requires investigation into the structures that support the social grants in South Africa as well as the perceptions of the role-players that are involved with the social grants. All social grant recipients within the South African

context are applicable to this study but the sampling is limited to the recipients in the Eastern Cape region and includes both rural and urban areas in the province.

From a technical point of view, it is also required to investigate biometrics and its implementation details. The biometric features currently used for social grants in South Africa are investigated, as well as typical biometric implementations abroad.

The framework that is designed in this document after completing the necessary exploratory research is suggested as a possible benchmark with which to measure the implementation of biometrics and social grants in South Africa.

Table 1.2: Research questions and objectives

NO.	QUESTION	OBJECTIVE
1	What are suitable biometric methods that can be used for social grants in South Africa?	To investigate biometrics to relevant detail and determine suitability for stated purpose.
2	What challenges exist and what lessons can be learnt from current applications where biometric features are used in government sectors both in South Africa and abroad?	To investigate the current usage of biometrics in appropriate areas as well as experiences and perceptions when using biometrics for stated purposes in order to determine key factors that should be taken into account for biometrics for social grants in South Africa.
3	How can the key factors required for an implementation of Biometrics for Social Grants in South Africa (BSGSA) be constituted into a framework?	To connect the key factors into a framework for biometrics for social grants in South Africa.

1.6.2 Delineation

The following detailed outline presents what are included in this research endeavour:

- Research and analysis of structures which support the implementation of social grants in South Africa;
- Research and analysis of perceptions of officials who are involved with biometrics for social grants in the Eastern Cape region as well as grant recipients from the region;
- Research and analysis of biometrics used in welfare services in other countries;

- Research and analysis of general biometric issues as found in academic literature in recent years;
- Development and presentation of a framework for biometrics for social grants in South Africa, taking the above research into account;
- Evaluation of the framework by experts;
- Refinement of the framework after feedback from experts;
- Suggested steps for implementation of the framework.

The following are not included in this research endeavour:

- There is no implementation of the framework within this research process;
- The results of the case study are not generalised to the population i.e. it is assumed that the perceptions of the officials and grant recipients in the Eastern Cape region do not necessarily imply the general perceptions of all the regions in South Africa;
- The framework is developed following the research done in this study. This implies that there may still be other aspects that would typically form part of such a framework but because these aspects did not come to the fore during this research process, they are not included in the framework.

1.7 RESEARCH PROCESS

In recent years, the discipline of Human-Computer Interaction (HCI) as part of computer science has been coming to the fore. It is concerned with tasks performed by humans and machines (machines being anything from computers to embedded technology) (Hewett *et al*., 1996).

Figure 1.4 reveals the interrelated topics of HCI (Hewett *et al*., 1996). At the top of the image, one may see the context where humans and machines are linked in application areas. In the middle of the image from left to right, the human processes information and uses communication governed by ergonomics to interface with the machine via input and output devices. Finally at the bottom of the image one sees the development process.

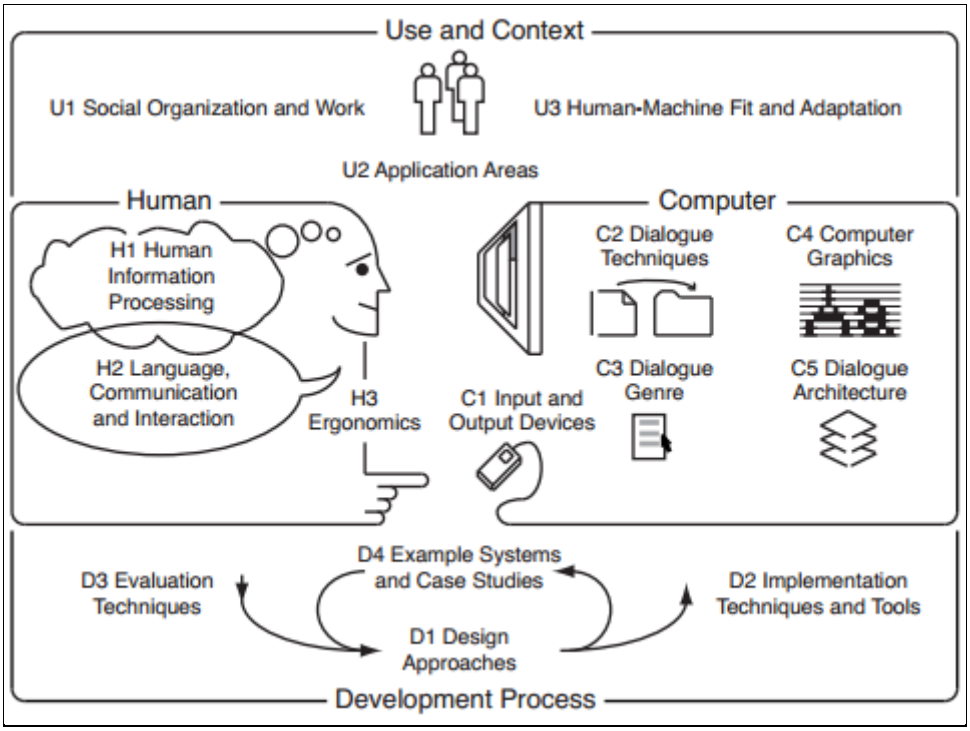


Figure 1.4: The interrelated topics of HCI (Reprinted from "ACM SIGCHI Curricula for Human-Computer Interaction" by Hewett *et al.*, 1996, Retrieved from http://old.sigchi.org/cdg/cdg2.html)

According to Baranauskas and Bonacin (2008), HCI has also been used in Information Systems, Software Engineering, Behavioural and Social Sciences and also as a Design Science paradigm. One needs systematic design methods, such as one uses when designing Information Systems. One can also use mathematics, systems theory and drawing techniques. There should be progress from the requirement specifications through to the resulting interactive computer system which in turn should represent individuality and be aesthetically pleasing. The final product should help the user carry out the required functions in such a way that the user feels positive and is comfortable with the interface.

When discussing HCI one may look at the typical paradigms of traditional science, design science and the engineering approach as mentioned briefly below (McCrickard, Chewar & Somervell, 2004):

- HCI is relevant for *traditional science* problems. For example, one can gather knowledge to form theory, and arrive at hypotheses after doing some observation of interfaces;

- In the *engineering discipline* it is important to have efficient and reliable systems. Interfaces must therefore be built quickly and consistently. Typically best practices are used;
- HCI researchers involved in *design science* can provide for good experiences when using interfaces. This is carried out by combining or balancing communication, user interaction and other principles of design.

Hevner and Chatterjee (2010) discuss using Design Science in Information Systems research areas, particularly because of the nature of an artifact supporting the hardware, software and human interface deliverables within Information Systems. Design Science focuses on solving a problem therefore Information Systems can be developed under this paradigm. Hevner, March, Park and Ram (2004) report that the problems in Information Systems that are addressed by Design Science may be those that depend on human abilities to provide for effectiveness in the solution, or where the environment is not well-defined and the requirements are not specific.

This research endeavour fits into an environment where both humans and technology are involved hence HCI is relevant and Design Science in particular is relevant for the Information Systems flavour of the research (Hewett *et al*., 1996). The Design Science research guidelines that are adopted in this report are shown in Table 1.3 (Hevner *et al*., 2004).

Table 1.3: Guidelines for Design Science

NO.	GUIDELINE	DESCRIPTION
1	Design as an artifact	An artifact can be developed. This may take the form of a construct, model, method or instantiation.
2	Problem relevance	One must be able to solve business problems using technological solutions.
3	Design evaluation	The design artifact must be evaluated for utility, quality and efficacy.
4	Research contribution	Contributions must be evident, such as artifacts, foundations or methodologies.
5	Research rigour	When constructing and evaluating the artifact, rigorous methods must be applied.
6	Design as a search process	An effective artifact must be achieved within the problem environment.
7	Communicate the research	The research done during this process must be presented to appropriate audiences, typically technological and management audiences.

The primary goal of this research is to produce a framework for biometrics for social grants in South Africa. Figure 1.5 maps the Design Science process suggested by Vaishnavi and Kuechler (2004) to the research process used in this document. The artifact produced in this research is the framework for Biometrics for Social Grants in South Africa (BSGSA).

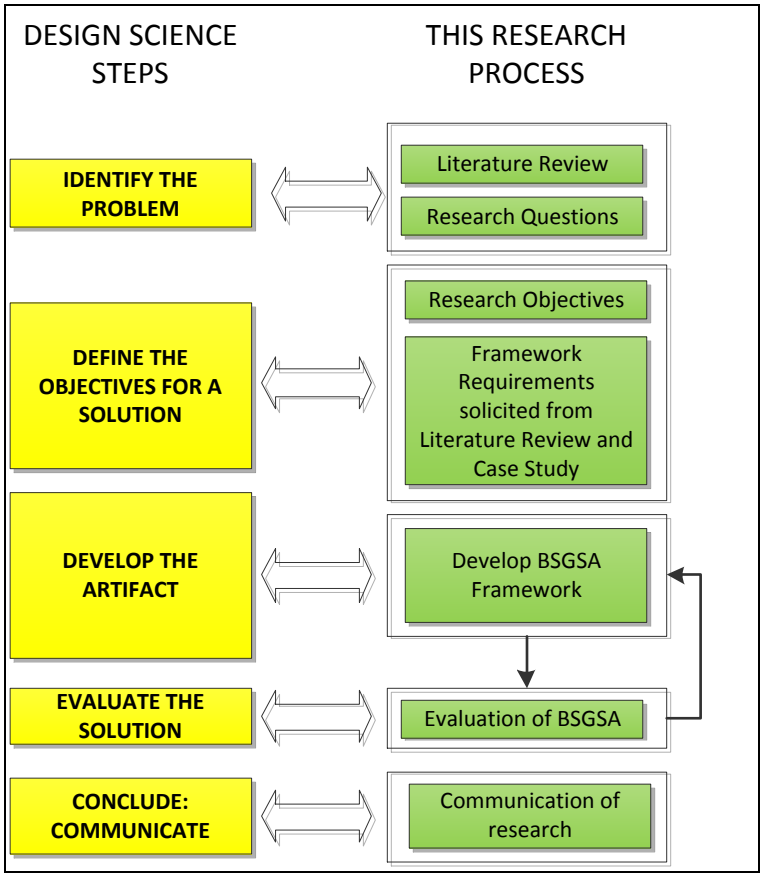


Figure 1.5: Design Science steps mapped to research process

1.8 ETHICAL CONSIDERATIONS

An application was submitted to assure that due care would be taken to accomplish the work in an ethical manner. The Faculty Research Technology and Innovation Committee of the Faculty of Engineering, the Built Environment and Information Technology from the Nelson Mandela Metropolitan University approved the application and the approval letter is attached to this report in Appendix A.

1.9 LAYOUT OF THESIS

Figure 1.3 depicts the graphical view of the chapters for the final report and how they fit with the research questions. Information from Chapter 3 and Chapter 4 are gathered to search for answers to Question 1. Information from Chapter 5 and Chapter 6 are used to search for answers to Question 2. The output from these four chapters is analysed in Chapter 7. To answer Question 3, one must also take into consideration, the feedback from the expert review as presented in Chapter 9, hence the loop in Figure 1.6.

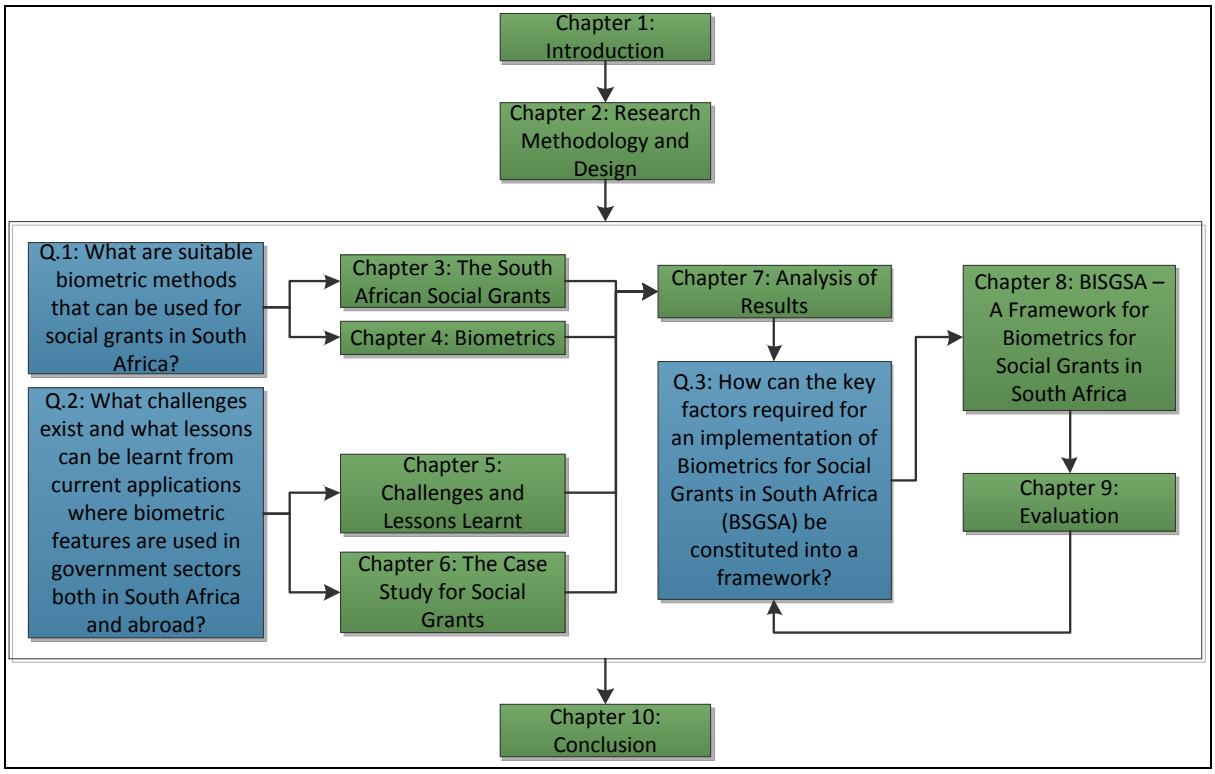


Figure 1.6: Graphical view of chapters and their link to research questions

A brief description of the contents of the chapters in this research study is given in Table 1.4. Chapter 1 introduces the topic of the research. Chapter 2 details the research methodology that is followed. Chapter 3 contains a discussion on the social grants in South Africa. Chapter 4 is a literature study on biometrics. Chapter 5 looks at the challenges and lessons learnt from using biometrics both in South Africa and abroad. Chapter 6 presents the case study in detail and Chapter 7

provides an explanation of the analysis done in this research. Chapter 8 introduces the suggested framework for biometrics for social grants in South Africa. Chapter 9 describes the evaluation of the framework by experts and presents the new refined framework after their feedback. Finally a conclusion and summary is provided in Chapter 10.

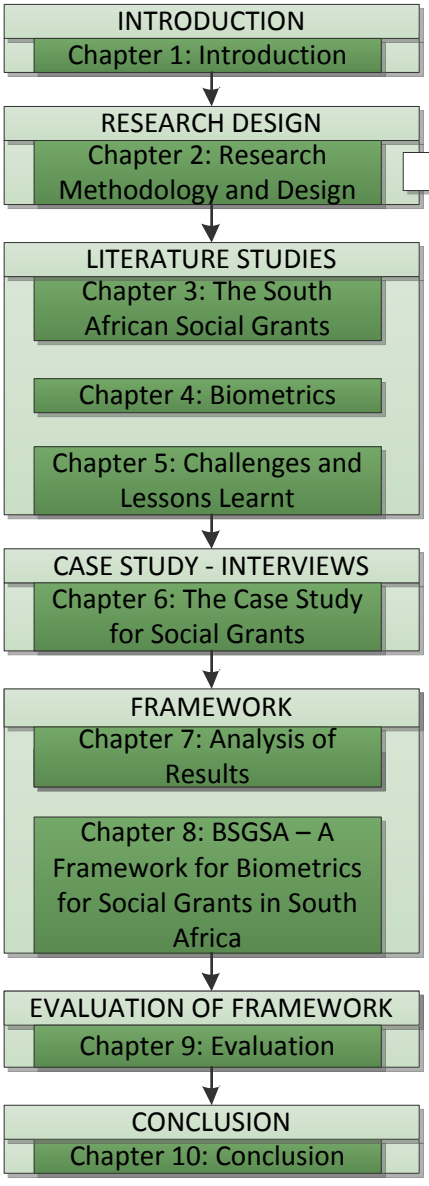
Table 1.4: The outline of the chapters

CHAPTER	TITLE	CHAPTER DESCRIPTION
1	Introduction	The background
2	Research Methodology and Design	The research process revealed
3	The South African Social Grants	An outline of the structures necessary for the Social Grants in South Africa
4	Biometrics	Literature study on biometrics used for identification, both locally and abroad.
5	Challenges and Lessons learnt	Literature study to find out the experiences when using biometrics in government systems, both in South Africa and abroad.
6	The Case Study for Social Grants	Findings and results from the interviews on biometrics currently being used for social grants in South Africa
7	Analysis of Results	Analysis of the results of the qualitative and quantitative data
8	BSGSA – A Framework for Biometrics for Social Grants in South Africa	Presenting the designed framework for BSGSA
9	Evaluation	Examination of the results from the expert evaluation questionnaires in order to test the applicability of the framework and to refine it as a result of the feedback
10	Conclusion	Summary and conclusion

The next chapter presents the research methodology and process followed in this study.

CHAPTER 2: RESEARCH METHODOLOGY AND DESIGN

LAYOUT OF CHAPTER 2



CHAPTER MAP

2.1 INTRODUCTION

This chapter presents the methodology used for this research effort. Section 2.2 introduces Design Science. Section 2.3 describes research design in general. Section 2.4 reveals the chosen research options for this research endeavour. Section 2.5 describes the case study and finally a summary is presented in Section 2.6.

2.2 DESIGN SCIENCE

Section 1.7 from Chapter 1 introduced Design Science as an appropriate research process for this study, as the intention was to produce an artifact in the form of a framework. Design Science research lends itself to information technology projects where there is intention to add value to a system (March & Storey, 2008). Carlsson suggests that information systems are like socio-technical systems and that Design Science research for information systems should solve human and organisational problems (Carlsson, 2007).

Vaishnavi & Kuechler (2007) suggest a Design Science research process that includes the following steps:

1. Identify a problem (awareness of problem);
2. Define the objectives for a solution (suggest a solution);
3. Develop the artifact which may be one of the following:
    a. C*onstruct* - such as a conceptual vocabulary;
    b. *Model* - which may be a set of statements to express constructs and relationships;
    c. *Method* - with a set of steps for performance of tasks;
    d. *Instantiation* - which is the realisation of the artifact in its environment;
4. Evaluate how the problem is solved by the solution;
5. Conclude by communicating the artifact and the problem that it solves, to appropriate audiences.

The most important issue according to Peffers, Tuunanen, Rothenberger and Chatterjee (2007) is that the artifact must solve a problem and contribute to the area of research which means that appropriate rigour must be applied in the research process and the artifact must be evaluated.

According to Hevner *et al*. (2004) there are various ways in which the artifact developed during the Design Science research process can be evaluated to ensure applicability. Table 2.1 describes these evaluation mechanisms briefly.

Table 2.1: Evaluation methods for artifacts in Design Science

EVALUATION METHOD	DESCRIPTION
Observational	**Case studies** or **field studies** can be carried out to examine the artifact in its environment.
Analytical	**Static analysis** can be used to examine an artifact statically such as to check its complexity; **Architecture analysis** – where the artifact must fit into an Information System architecture; **Optimisation** – look for optimal properties; **Dynamic analysis** can be used to examine an artifact dynamically so as to examine its performance.
Experimental	**Controlled experiment** – where the artifact is studied for qualities such as usability; **Simulation** – where the artifact is executed with test data.
Testing	**Functional (black box) testing** where the interfaces are checked to find errors; **Structural (white box) testing** such as testing implementation.
Descriptive	**Informed argument** which can convince a reader about the usefulness of the artifact for the research done; **Scenarios** are constructed around the artifact to reveal its usefulness.

The evaluation of the artifact from a Design Science research process is necessary to ensure internal and external validity. Internal validity can be done during triangulation in the data analysis phase. An expert review can ensure external validity. The expert has to examine the product or artifact and check its validity or applicability for the intended use.

The framework from this research effort was not implemented and therefore it could not be tested in an environment as suggested in Table 2.1. Rather static analysis was conducted on the framework by means of an expert review in order to confirm the relevance, validity and applicability of the framework steps, thus providing external validity. (Internal validity was done during triangulation.)

2.3 RESEARCH DESIGN

This section looks at general issues for research design in order to make appropriate choices later for this particular study. The full details for the actual research design adopted in this study are presented later in Section 2.4.

2.3.1 Research questions

This sub-section presents some comments regarding the appropriateness of research questions.

As suggested by Mouton (2001), typically a non-empirical question asks questions about scientific meanings or trends and allows one to do theoretical analysis, whereas an empirical question is one that tries to solve a real-world problem.

The research problem should be stated well and may result in questions concerning the relationship between variables. Some ideas of questions are the following (Mouton, 2001):

- Exploratory questions such as “What are the key factors of something?”
- Descriptive questions such as “How many?” or “Are these related?”
- Causal questions asking “Why?” or “What were the causes?”
- Evaluative questions such as “Has this been successful?”
- Predictive questions such as “What effect will this have on something?”
- Historical questions such as “What happened?”

The research into these questions must be testable within the constraints of the researcher (i.e. time, budget, experience and other resources) and must result in something useful (Melville & Goddard, 1996). It must also be something of interest to the researcher.

Bhattacherjee (2012) suggests that the topic around which the questions are formulated should not be one that is destined to be short-lived i.e. the “fad of the moment” but rather should be long-lasting or provide direction for further research in

similar areas. It should be a solvable problem in that there should exist possible solutions and answers when collecting the evidence. The questions should not be chosen to fit a preferred research design, but rather the other way around. Finally, one should not first collect evidence and then design a problem around it.

The research questions for this study are presented in Sub-Section 2.4.1.

2.3.2 Research objectives

One needs to focus on what one wishes to achieve by doing research. The main issue is to be able to answer the research questions. Having formulated the research questions, therefore, it is necessary to outline the objectives which assist in answering each of the research questions. The objectives for this research endeavour are described in Sub-Section 2.4.2.

2.3.3 Research philosophy

This sub-section describes various research philosophies.

As described by Bhattacherjee (2012), *functionalism* works as a research philosophy if the world being studied is ordered (socially) and the subject (the researcher) has no part or influence in the study, such as in an independent (objective) survey. *Interpretivism* is also for an ordered world, but the researcher would be involved because the main goal may be to understand the study personally. *Radical structuralism* works for a constant changing environment using an objective approach and lends itself well to surveys. *Radical humanism* also works for constant changing environments where there is subjectivity.

Positivism according to Collis and Hussey (as cited in Neville, 2077) is a philosophy which attempts to rationally explain phenomena in a scientific way. With positivism, no matter how many scientists work on the topic, they always get the same results (Bhattacherjee, 2012; Myers, 1997; Olivier, 2009). De Villiers (2005) motivates that the positivist paradigm is suitable in the natural sciences and sometimes also in social sciences when knowledge is absolute and therefore scientific methods such

as experiments are appropriate. The results would be reliable and unbiased and mostly quantitative studies would be done.

De Villiers (2005) continues to say that *interpretivism* builds new meanings for research done in natural settings (not laboratories) and is not absolute. Usually this is for social sciences and educational research but is accepted recently for Information Systems (IS) as well. The results can be subjective depending on the researcher and is mostly using qualitative data. De Villiers advocates that the sub-discipline of Human-Computer Interaction (HCI) is prominent in IS research.

Other philosophies include the following (Bhattacherjee, 2012; Myers, 1997; Olivier, 2009):

- *Realism* – Which reveals an external world that can never be known totally;
- *Pragmatism* - Where a more practical approach in a real-world setting is useful.

Phenomenological philosophy lends itself to systems where human behaviour and motivation are relevant. The advantages of this philosophy is that one may use a relatively small sample, rich in personal insights but the results may be subjective because of this (Neville, 2007).

The research philosophy adopted in this study is presented in Sub-Section 2.4.3.

2.3.4 Research approach

A research approach may use inductive and/or deductive methods (Bhattacherjee, 2012; Mouton, 2001; Olivier, 2009). Using induction, one can build theories by observing patterns in the data. This is of particular value when there are not many theories yet for the observed discipline. When using *induction*, one can also generalise from the specific results of case samples, to the target population, assuming that the sample was representative of the population. The data would have thus been observed and the theoretical concepts and patterns gained. Induction may be therefore called “theory building research”.

Deduction on the other hand can take a theory and test it with new data (Bhattacherjee, 2012). When one is using *deduction*, one usually arrives at conclusions following other premises or statements. One can therefore end up with theories, models or hypotheses using deduction (Melville & Goddard, 1996; Olivier, 2009). While working through the testing of these theories, one can improve them or refine them. Deduction may therefore be called "theory testing research" (Bhattacherjee, 2012).

Another cycle that Bhattacherjee (2012) explains as being similar to an induction-deduction cycle is the observation-rationalisation-validation cycle. During the observation phase one becomes interested in a phenomenon. This is then rationalised by making sense of the various pieces of the puzzle, and deriving a theory. Then in the validation cycle the theories are tested.

The research approach appropriate for this study is presented in Sub-Section 2.4.4.

2.3.5 Research strategy

Table 2.2 briefly describes some strategies used for research.

Table 2.2: Research strategies

STRATEGY	DESCRIPTION
Survey strategy	Surveys may focus on contemporary events (Yin, 2014). Probabilistic sampling is usually used in market research. Surveys are also useful for public opinion polls and linked to positivist meta-theory (Mouton, 2001).
Grounded theory	Grounded theory discovers theory by analyzing data such as is collected by case studies (Mouton, 2001; Yin, 2014)
Experiments	Experimentation requires behaviour control (Yin, 2014). It is usually done in a highly controlled environment and can be used for basic experiments as well as applied clinical trials (Mouton, 2001).
Action research	Action research is typically useful in classroom situations and uses mainly qualitative methods in a low control environment (Mouton, 2001).
Case study	Case studies focus on contemporary events (Yin, 2014) and are usually done in a low control environment. They are also useful in social work research or political science and other organisations where phenomenological theories apply (Mouton, 2001).

De Villiers (2005) describes action research as a solution when real events cannot be investigated in a laboratory and it aims to improve practice and advance

knowledge as an ongoing event. Grounded theory takes contextual data and develops theory and models. Surveys are more useful in random sampling situations and experiments are used in highly controlled laboratories.

A case study is an attempt to find answers to specific research questions. The evidence must be extracted from the case and processed to arrive at the eventual answers (Gillham, 2000).

Bhattacherjee (2012) suggests that a case study is useful under the following conditions: when one is trying to build theory for studies that require participant experiences and actions, or for studying temporal processes. It is mentioned that case studies are suitable for large-scale technology implementation projects (such as is studied in this research effort).

Creswell (2013) suggests a single instrumental case study if the focus is on one issue or concern and one bounded case is selected for examination. Bhattacherjee (2012) suggests a single case study if the situation being studied is unique such as being previously inaccessible. Creswell (2013) suggests a collective case study where the focus is on one issue or concern but multiple case studies (perhaps from different sites) are selected for examination, and Bhattacherjee (2012) views the multiple-case design as preferable for theory testing.

Case studies can be used to measure many different aspects even where there are a lessor number of cases (Olivier, 2009). One can gather both quantitative and qualitative data while doing case studies using data gathering techniques such as interviews, observations, measurements and discussions (Bhattacherjee, 2012; Olivier, 2009).

The format that is suggested for a case study by Robert E. Stake, Helen Simons and Robert K. Yin takes the following form (“The Case Study,” 1997):

1. Define the research questions (plan);
2. Select the case and determine how the data is gathered and what analysis techniques are used (design);
3. Make preparations to do the data collection (prepare);

4. Collect the data (collect);
5. Analyse the data (analyse);
6. Prepare the report (share).

2.3.6 Data Collection and Analysis

2.3.6.1 Data collection

Once one has decided on the focus of one's research, then the target population may be ascertained. One cannot use the whole population due to feasibility and cost constraints but rather a carefully chosen unbiased representative sample thereof. One can use various sampling techniques. Some are random and some are not (Bhattacherjee, 2012).

Probability sampling is a random method where each member of the population has an equal chance of being selected in the sample. Random sampling includes systematic sampling, stratified sampling and cluster sampling among others (Bhattacherjee, 2012; Creswell, 2005; Gomm, 2004; Melville & Goddard, 1996; Struwig & Stead, 2001).

Some non-random sampling methods are also described below (Bhattacherjee, 2012; Creswell, 2005; Gomm, 2004; Struwig & Stead, 2001):

- *Nonprobability sampling* is not random and some members of the population have zero chance of being selected for this sample. This *purposive* sampling method is done for a specific purpose, taking into account various criteria as well as convenience and can therefore not be used to generalise back to the population because it is not representing the whole of the population from the outset;
- *Convenience sampling* may be such that respondents are chosen as they happen to be nearby at the time of collecting a sample e.g. at a shopping mall;
- Other sampling methods may be *quota* sampling, *expert* sampling, *snowball* sampling and *self-recruitment* sampling.

Setting the *sample size* is also something to be considered carefully. If the study is to be done in very fine detail, then the sample should be bigger. Sometimes one can collect data from the larger sample using a survey questionnaire, and then select some to be interviewed in more detail (Gomm, 2004).

A *pilot study* should be done once one has decided on who or what to study, what to measure and how to collect the data. Basically the measuring instruments must be tested so that potential problems can be discovered before doing the actual data collection (Bhattacherjee, 2012). A pilot study is similar to a feasibility study which is done before the main study, and can also be called a pretest of the research instrument.

Once the instruments are shown to the target individuals for the pilot study, it is important to identify items that should be dropped from the procedure (Bhattacherjee, 2012). Maybe it is a scale that should be altered by removing one of the choices, or maybe it is a complete question that must be changed on a questionnaire. It could involve interviews or focus groups using a questionnaire. The pilot study could also be a test to see how to distribute and collect the questionnaires. It may also uncover important extra data that had not yet been included in the study.

According to Van Teijlingen and Hundley (2001), to avoid contamination, one should not include the pilot study results or pilot participants in the main study. However, there are occasions particularly in progressive qualitative data collection, where subsequent interviews in a series, can yield better information. It is possible that the expense invested in the pilot study is wasted due to the possible halting of the research when the pilot study is deemed unsuccessful. Sometimes the reports from the pilot studies are not included in the research report. However, they should be included in order to share what lessons were learnt along the way. This can assist other researchers as well.

Some final comments from various authors regarding the pilot study are mentioned here (Creswell, 2005; Moser, 1958; Yin, 1994). The subjects' comments should reveal to the researcher whether there are problems with the questions so that the

researcher can improve the instruments. Alternatively, perhaps different data gathering methods should be adopted. One can also discover whether there are wider ranges of answers than originally expected, meaning that the sample size would have to be increased when doing the actual research. Finally, the pilot study should allow one to assess the expected non-response rate and thus there may be a requirement to include methods to reduce that rate where necessary.

The next three sub-sections will discuss data gathering techniques such as the interview, the questionnaire and literature review respectively.

The interview

The interview is a technique to gather information during a survey or a case study.

Interviews are more personalised and require the interviewer's time. Sometimes one has to use interviews if the respondent cannot read (Melville & Goddard, 1996). According to Bhattacherjee (2012) and Hofstee (2006), the questions posed during an interview may be structured or unstructured. The interviewer is also able to make extra notations during the interview and ask extra questions for further clarification. Some interviews are done telephonically. It is also possible to interview more than one person at the same time in a focus group where the interviewer is rather like a facilitator. The interviewer must be careful to avoid bias.

Some other recommendations for interviewing are the following (Babbie, 1992; Bhattacherjee, 2012; Creswell, 2005; Hofstee, 2006; Yin, 2007):

- The interviewer should prepare well, prior to the interview;
- He/she must get permission and book the respondents for the interview beforehand and remember that they sometimes need to be motivated to join in;
- The interviewer should dress in a similar fashion to the respondents being interviewed and be neat and clean;
- The interviewer must be pleasant and show interest in getting to know the respondent by being relaxed and friendly;

- The interviewer must be familiar with the questionnaire before beginning the interview and must be able to read fluently. If there is a group of interviewers, they should be trained together beforehand;
- Interviewers must not rephrase the questions but rather use them exactly as they are written on the questionnaire. In open-ended questions, the interviewer must record the exact response word for word without fixing bad grammar, but he/she may also add comments to record other gestures;
- The interviewer should not lead the interviewee in any direction, but remain unbiased, i.e. be a neutral medium through which the answers are channeled;
- Respondents may need to be encouraged by the interviewer to respond to questions by probing on the part of the interviewer who can elaborate or reflect on what is stated so far;
- Additional data sources may supplement the interview process (such as internal documents, reports, statements, articles and direct observations);
- Interviews can be electronically recorded if consent is obtained from the interviewee;
- After the interview is over, someone can transcribe it into a text document for analysis.

The questionnaire

The questionnaire is a technique for gathering information during a survey or a case study.

According to Creswell (2005), it is advisable to accompany the questionnaire with a covering letter that contains information such as the importance of the questionnaire, the purpose of the study, the assurance of confidentiality, the sponsorship or institution responsible for the study, the estimated completion time and the method that may be used to return the completed questionnaire.

Many authors have suggestions regarding the questionnaire (Bhattacherjee, 2012; Melville & Goddard, 1996; Mouton, 2001). The questionnaire itself should be short, attractive, legible and well designed. It must also be complete in that it collects all the information that one requires. Questions used in a questionnaire may be

structured where the respondent simply selects an answer from a set of choices or unstructured where the respondent may answer using his/her own words. Structured questionnaires make it easier to quantify the results later.

According to Babbie (2004), the order of questions is important. A question posed earlier may influence the respondent in such a way that the subsequent answers by the respondent may be aimed at being consistent with the first question. Some researchers randomise the questions to avoid this but that may lead to chaotic thoughts. In a questionnaire it is often best to ask the more interesting questions first so that the respondents are encouraged to begin answering the questionnaire. These initial questions should not be intimidating. The opposite is true for interviews where one should rather ask the boring routine questions first.

If the questionnaire is sent out by mail such as for self-administered studies, then the response may be quite low and those that do come back may be late (Babbie, 1992). Sometimes it is necessary to send reminders. A suggestion is that the researcher should monitor the questionnaires as they are returned with a return rate graph. Babbie (1992) suggests that a response rate of 50% is adequate, 60% is good and 70% is very good but this is simply a rough guideline.

Preparation of Questions

This sub-section discusses the questions that may be prepared for a questionnaire or interview which are used either for surveys or case studies and which may be aimed at either quantitative or qualitative data collection.

As mentioned further above, there should be an introduction to the questionnaire and some basic instructions for answering the questions, such as where and how to place their mark. If there are sub-sections then each of these needs its own introduction as well (Babbie, 2004).

If ranking is required in a question, one should list the choices from low to high. Hofstee (2006) suggests that one should not provide a middle “neutral” choice in the ranking. Babbie (2004) advises one to use ranking sparingly because it can be confusing for a respondent to answer questions that use this technique. The

respondent needs to be instructed in detail as to what each rank means. Melville & Goddard (1996) prefer a 4-point scale for a question which expects a choice from alternatives thereby removing the neutral option.

Some questions are not relevant to all respondents. Often there are subsequent groups of questions that should be answered depending on a prior answered question. These are called contingency questions and should be arranged in such a way that respondents do not accidentally start answering them, but are correctly instructed to leave them out when appropriate (Babbie, 2004). An alternative idea according to Babbie (2004) is to put an instruction above a set of contingency questions such as: “This section is only for respondents who answered YES on question 23”.

One can also use a matrix of answers to make efficient use of space (Babbie, 2004).

There are other good suggestions for questionnaires such as the following (Bhattacherjee, 2012; Melville & Goddard, 1996; Mouton, 2001):

- The questions must be relevant, unambiguous, non-biased and understandable and should not assume too much;
- Questions should not be combined but kept simple to avoid confusion when answering them. Short questions are better than long questions to avoid boredom and to obtain more trustworthy answers, and certainly a higher response rate. The wording must be clear else it can mislead the respondent;
- One should not make suggestions for answers;
- The earlier part of the questionnaire should typically contain the closed-ended questions, the general questions, the least-sensitive questions and the factual questions. This leaves the open-ended questions, specific questions, more sensitive questions and attitude questions for the end of the questionnaire.

Some examples of response choices are provided in Table 2.3 (Bhattacherjee, 2012; Gomm, 2004; Olivier, 2009).

Table 2.3: Types of responses to questions

RESPONSE TYPE	EXPLANATION
Dichotomous	Select one of two choices such as YES or NO
Multiple choice	Choose from a number of options
Nominal	Unordered choices such as "What is the nature of your employment?" where the respondent can choose specific answers from a range of choices
Ordinal	Ordered ranges of responses are provided so that one can choose a range when asked "What is your age?"
Interval-level	One can choose from a scale such as 0 to 10, or 11 to 19
Likert scale	One can specify the degree of suitability of an answer, such as an answer from one to five where five is very important
Least Preferred Co-worker	One may choose a number, for example, from one to nine with one being closest to the one alternative and nine being closest to the other alternative
Guttman scale	The statements are ranked in increasing order of intensity and each has a weight. The resulting choices made by the respondent are aggregated
Sentence completion	An example of an open-ended question such as "To me a successful day at work is…"
Unstructured open question	Any question that expects a loosely structured answer

It is suggested that at the end of the questions, there should be a question posed to the respondent to find out anything extra i.e. "What else can you tell me that I have not asked you yet?" (Patton, 2002)

Literature Review

According to Mouton (2001), the reasons for doing literature reviews are the following:

- To avoid duplicated research studies and/or results;
- To discover recent developments and findings in the research area;
- To discover different theories, models and hypotheses in the particular field;
- To use instrumentation that has proven to be valid and reliable and that has worked with similar research;
- To discover the definitions of key concepts in the research area.

A literature review should be done on various sources of data in order to discover the state of knowledge in a particular area. One must read from articles written by the key authors in each chosen research area and also identify gaps. The study should not be superficial, but cover a number of years and many journals. One may

summarise the read articles in tables. Perhaps one finds that the initial research questions have already been discussed in the literature or perhaps the questions have to be modified. It is convenient if one can identify some theories to assist in addressing the research questions (Bhattacherjee, 2012). One should also check whether the data that one needs has not already been collected (Hofstee, 2006).

There are many sources of information that can be used in a research project, such as textbooks, scientific journals, conferences, theses and dissertations, reports, magazines, newspapers and people themselves (Melville & Goddard, 1996). Mouton (2001) classifies data sources as observations, self-reporting (interviewing and surveys), archival/documentary sources (historical documents, diaries, letters, speeches, literary texts, narratives, memoranda, business plans, annual reports, medical records etc.) and physical sources such as blood samples.

2.3.6.2 Data Analysis

To analyse data, one can break up the data into meaningful themes, patterns, trends and relationships in order to understand it (Creswell, 2005). It has already been said that data may be either quantitative or qualitative. This implies different data analysis techniques for each. Quantitative techniques use statistics. Qualitative techniques include coding or content analysis (Bhattacherjee, 2012; Mouton, 2001).

The discussion continues in sub-sections for qualitative data analysis, quantitative data analysis and mixed methods analysis.

Qualitative Data Analysis

Creswell (2005) suggests that qualitative research takes more time and resources. The data collected is often textual, and may be collected through participant observation, case research, action research, ethnographic research or other techniques such as grounded theory. Qualitative data sources may be observations (such as in fieldwork), interviews, questionnaires, documents, texts and the researcher's own impressions. The questions are broad and general rather than specific and the manner in which the research is done tends to be subjective.

The data gathered using qualitative methods requires coding. The intention is to find out hidden meanings and perhaps discover new theories. One must ensure objectivity when doing qualitative research, as the researcher tends to be more "hands-on" in his/her approach (Bhattacherjee, 2012; Myers, 1997; Olivier, 2009).

The researcher needs to make sense of the collected data and this requires an investigative mindset especially for qualitative analysis. According to Miles & Huberman (1984), one part of data analysis is data reduction where one must select, simplify, abstract and transform the raw data from field notes. The second part is to display the information in some form. The third and final part is to draw conclusions and do verification.

When busy with analysis during data collection it is advisable to have a contact summary sheet available to take notes of pertinent things such as who was involved in the interview (if it was an interview); what were the main issues discussed; what research questions were mostly focused on in the interview by this respondent; what new ideas have come forward regarding the hypotheses for the research and whether there was a need for shifting of focus planned for the next interview (Miles and Huberman, 1984).

Content analysis is one way to simplify or translate the "many words" from the data, into specific categories or ideas that are relevant to the research study (Struwig & Stead, 2001). Patton calls this "identifying, coding, categorizing, classifying and labeling" (Patton, 2002). If it is an interview, one should reread the transcripts and check field notes and observations, until one can find ideas or concepts that are important. The next step is to code the ideas or themes that one has found in the data and try to minimise the number of these themes. For example, use MOT for "motivation" or CONF for "confidence" (Miles & Huberman, 1984). Various authors suggest that for each document (e.g. an interview), one should mark the codes in the relevant places (Creswell, 2005; Gillham, 2000; Moser, 1958; Patton, 2002). Make a final list of the codes and reduce them if some are similar. Go back to the documents to recode where necessary. The final themes become the important categories and it is a good idea if they are mutually exclusive. One can use a

spreadsheet or grid with category headings and respondents so that one can enter into the cells, what the respondent chose for that category.

It is useful to quantify the qualitative answers in this manner, in order to make it easier to do statistical analysis and to provide rigour similar to quantitative analysis (Creswell, 2005; Kvale, 1996).

Quantitative Data Analysis

Quantitative methods mean that the data being collected is quantifiable such as numerical scores (Bhattacherjee, 2012; Myers, 1997). Typically the questions are specific and focused and are often posed in an unbiased, objective manner (Creswell, 2005).

According to Bhattacherjee (2012) and Myers (1997), different research design philosophies lend themselves to different data collection techniques. Some examples of quantitative methods are experiments or research surveys which are useful in the positivism philosophy. Formal and numerical methods such as mathematical modeling also belong in quantitative research.

There are two main analysis techniques used for quantitative results: descriptive analysis uses statistics and inferential analysis tests hypotheses or theories (Bhattacherjee, 2012).

Various authors have described *descriptive analysis* ((Bhattacherjee, 2012; Melville & Goddard, 1996; Mouton, 2001). When doing descriptive analysis, one must first do data coding where one can use a codebook to describe each variable, its items and measures, the format of each item, the response scale of each item and how to code or transform each value into numeric format. This coded data can be entered into a spreadsheet or database. Statistics can then be used to discover the frequency distributions, means and dispersion for each variable.

During analysis one may also use arrays, matrices, flowcharts and tables to collect and display information (“The Case Study,” 1997).

Inferential analysis is useful when planning to generalise from the sample to the larger population (Struwig & Stead, 2001).

Mixed Methods Data Analysis

A mixed-mode design using both quantitative and qualitative methods can be used in any research philosophy and is usually desirable (Bhattacherjee, 2012; Creswell, 2005). There are many ways in which one can obtain data e.g. questionnaires, interviews, observations, documents and secondary data to name a few. One can also mix the methods on any single technique. One should be aware that the different components of the approach can be weighted differently, leading to subjectivity. When one is using a structured questionnaire for a survey that collects quantitative data, one can add qualitative questions at the end to gather more insight from the data.

According to Bhattacherjee (2012), the timing for these methods may differ. If one is using both quantitative and qualitative methods then the following options are available:

- *Concurrent* - Both are used at the same time in a particular phase;
- *Sequential* - The one method is used in a particular phase to collect and analyse the data and then the next method follows on.

There may also be a particular sequence in which one collects the quantitative and qualitative data which may or may not be kept together for the purposes of combined analysis. One may do this in one of three ways: *triangulation, explanatory* or *exploratory* (Creswell, 2005).

Jick (1979) shows how to use triangulation with these methods. His example includes data collected about the respondents' viewpoints and also reports and observations. The surveys were conducted randomly and the quantitative data supplemented the qualitative data.

One may find convergence in the various results which increase confidence in the research, but one may also find divergent results which expect more explanations (Jick, 1979). Triangulation can therefore assist in finding outliers or elements that do

not fit in the expected mold and this can result in more enriched explanations of the research problem. The researcher must build a complex puzzle into a coherent whole, according to Jick.

Triangulation is carried out to ensure *internal validity* and there are different triangulation methods as shown below (Krefting, 1991; Yin, 2007):

- Data triangulation is the gathering of data from different sources and perhaps even different sampling strategies;
- Investigator triangulation is the gathering of data which was acquired by different researchers or investigators;
- Theory triangulation is where different theories are used and the interpretations are brought together;
- Methodological triangulation is where more than one method is used to gather the data.

An *explanatory* mixed methods design is a two-phase model which first collects quantitative data and then uses collected qualitative data to further explain the quantitative results.

The *exploratory* mixed methods design collects the qualitative data first for some initial exploration, and follows this with quantitative data to explain relationships found.

The next section describes the research design used in this report.

2.4 RESEARCH DESIGN AND THIS STUDY

An artifact was produced in this research endeavour by following the Design Science research process. The artifact from this research is a framework for biometrics for social grants in South Africa. This section presents the research process that was conducted in order to produce the framework artifact which was subsequently validated.

In order to arrive at the intended framework, Figure 2.1 depicts the choices made for this research effort, having looked at various options in Section 2.3 of this chapter. The figure is presented in the order of the Design Science research process steps: problem identification, objectives, development, evaluation and conclusion.

The rest of this subsection will describe the choices in narrative detail.

2.4.1 Research questions

The chosen research questions in this study deal with real problems that prior research had not yet comprehensively answered. It was intended to discover some key factors and build towards a framework. The questions were therefore empirical in that they solve real world problems, and they may also be called exploratory.

The **research questions** are listed here for convenience so as to begin the discussion of the research design. The main research question for this study is the following:

What are the components of a framework for biometrics for social grants in South Africa?

The sub-research questions are outlined as follows:

1. What are suitable biometric methods that can be used for social grants in South Africa?
2. What challenges exist and what lessons can be learnt from current applications where biometric features are used in government sectors both in South Africa and abroad?
3. How can the key factors required for an implementation of Biometrics for Social Grants in South Africa (BSGSA) be constituted into a framework?

2.4.2 Research objectives

The **objectives** that follow from the research questions are the following:

- Investigate biometrics to relevant detail and determine suitability for biometrics for social grants in South Africa;
- Investigate the current usage of biometrics in appropriate areas as well as experiences and perceptions when using biometrics for social grants in South Africa and other welfare services abroad, in order to determine key factors that should be taken into account;
- Combine the key factors thus obtained into a framework for biometrics for social grants in South Africa.

2.4.3 Research philosophy

Various research philosophies were described in Sub-Section 2.3.3. The researcher is looking at real world issues and is attempting to interpret the phenomenon of biometrics and social grants in South Africa.

This study therefore lends itself to a **phenomenological philosophy** which in turn, suggests case studies and qualitative research (Babbie, 2005; Leedy & Ormrod, 2001; Neville, 2007; Trochim, 2006).

2.4.4 Research approach

Research approaches were described in Sub-section 2.3.4. In this study, the researcher uses an **inductive** approach while developing components for the framework. The intention is therefore to find reasonable results after examination of intended subject matter, such matter being both literary as well as results from field work. Once the components are put together into the framework, it is required to examine the applicability of the framework by gathering expert opinions for the purposes of evaluation of the components. This evaluation is necessary in order to improve the framework, requiring further induction.

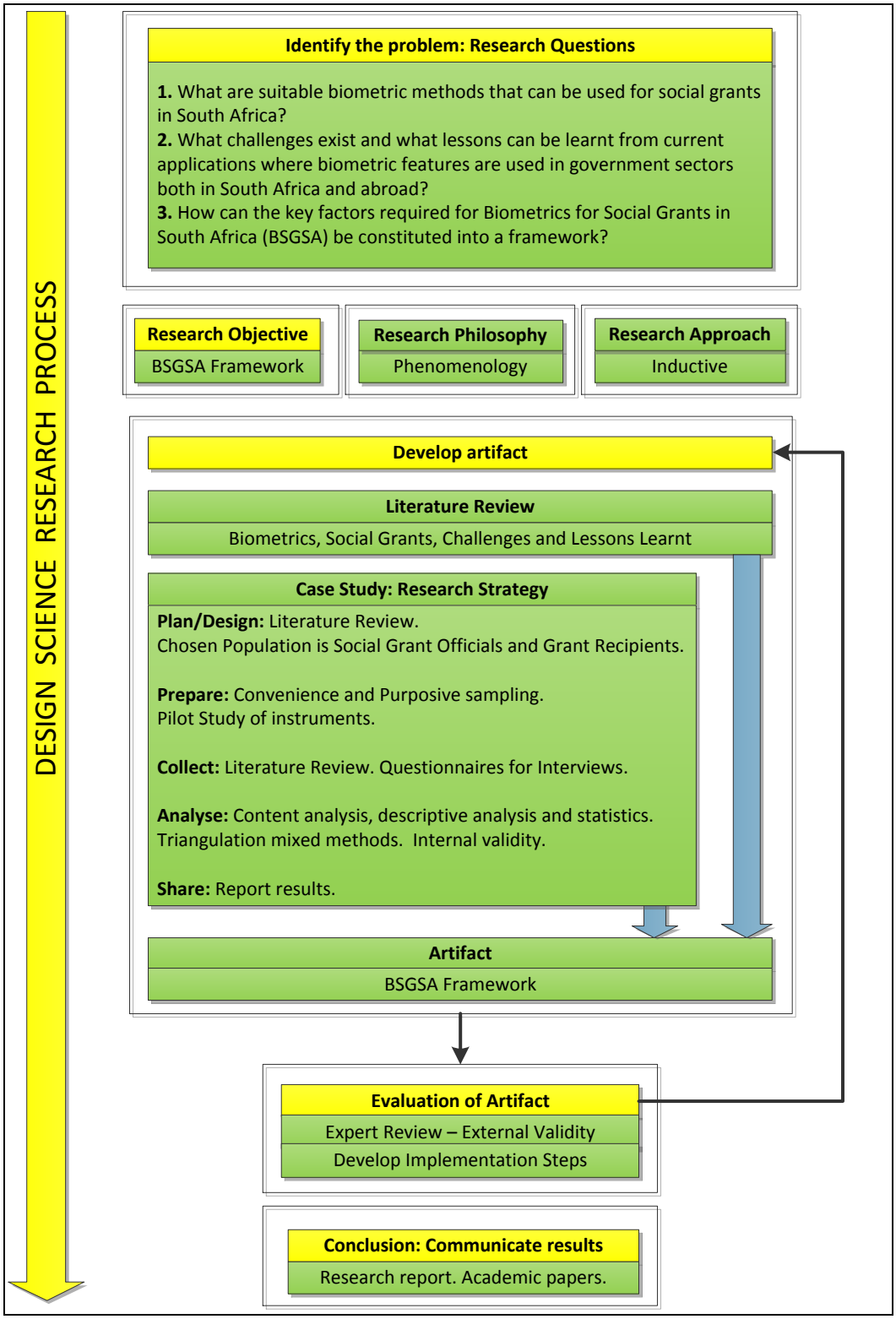


Figure 2.1: Choices made for this research

2.4.5 Research Strategy

Section 2.3.5 described various research strategies. Following through with the Design Science research process, it was decided to conduct a case study. The focus of the study was on the role-players that are involved with biometrics for social grants in South Africa. Where interviews were necessary, this was done locally in the Eastern Cape region. Literature reviews were also done on biometrics used internationally and on the South African social grants and accompanying policies and laws. In particular, this case study took the following into account as suggested in "The Case Study as a Research Method" (1997) which uses work from Robert E. Stake, Helen Simons and Robert K. Yin, as well as Creswell's suggestions ("The Case Study," 1997; Creswell, 2013):

- The case study was a useful approach because there was a need to find out about opinions and understanding from various individuals;
- The research question for the case study had been determined and defined;
- The case had been selected and the data gathering and analysis techniques had been determined. The choice of case study subjects comprised government officials and members of the public who are social grant recipients and who have already had biometrics extracted for this purpose;
- The data gathering was in the form of literature studies and interviews.

The case study is discussed further in Section 2.5.

2.4.6 Data collection and analysis

2.4.6.1 Data collection

The data collection techniques were chosen to suit the three research questions. Some discussion on various data collection techniques was presented in Sub-Section 2.3.6.1. The chosen techniques for this research are presented in Table 2.4.

Question 1: What are suitable biometric methods that can be used for social grants in South Africa?

To find answers for Question 1, a **literature review** was necessary on the use of biometrics for identification, both locally and abroad. The material was to be found in various academic papers, documents and reports both locally and internationally. It was also suitable for collecting data about the social grants. This includes laws, policies and strategic plans where these have relevance to social services (social grants in particular).

Table 2.4: Overview of research questions with their data collection and data analysis strategies

NO.	RESEARCH QUESTION	DATA COLLECTION TECHNIQUE	QUANTITATIVE AND/OR QUALITATIVE DATA
1	What are suitable biometric methods that can be used for social grants in South Africa?	Literature Review	Qualitative
2	What challenges exist and what lessons can be learnt from current applications where biometric features are used in government sectors both in South Africa and abroad?	Literature Review and Interviews with role-players	Qualitative and Quantitative
3	How can the key factors required for an implementation of Biometrics for Social Grants in South Africa (BSGSA) be constituted into a framework?	Literature Review, Interviews with role-players	Qualitative and Quantitative

Question 2: What challenges exist and what lessons can be learnt from current applications where biometric features are used in government sectors both in South Africa and abroad?

To find answers for question 2, a **literature review** was required on existing data to find out what challenges and lessons are learnt from using biometrics in South Africa and abroad, and in particular when using biometrics for social grants. Some questions were prepared and used in a set of **interviews** to discover facts and perceptions from various role-players such as government officials and the general public.

Question 3: How can the key factors required for an implementation of Biometrics for Social Grants in South Africa (BSGSA) be constituted into a framework?

All the information gathered from the first two questions was also relevant for incorporation into the framework to answer the third research question. The framework for BSGSA was to be built and then evaluated and subsequently refined.

Question 3 therefore used the data gathered from the techniques used in the first two questions in order to produce the **BSGSA framework**.

In this research the **interview** technique was used to collect information from the social grant role-players via researcher-controlled questionnaires.

The questionnaires had the relevant preamble material regarding the importance and purpose thereof. The questions were structured and ordered appropriately. On the day of their return, each questionnaire was immediately captured electronically.

Before going out to collect the data by means of the interviews, it was necessary to conduct focus groups with various individuals in order to understand the context of social grants in South Africa. Meetings were therefore held with head representatives from the South African Social Security Agency (SASSA) who had extensive experience in the social grants system. Another meeting was also held with experts from the Payments Association of South Africa (PASA) who are involved with interbank payments in South Africa and who are busy with a project for biometric standards for South Africa.

SASSA subsequently granted permission for the interviews to be conducted with SASSA staff as well as members of the public, and provided contact details for the SASSA departments in the Eastern Cape region. It was convenient for the researcher to do the data collection in the Eastern Cape. The total number of grants in the Eastern Cape region as at the end of October 2013 was over 2.5 million which was the second highest number of grants in provinces of South Africa, with KwaZulu-Natal being the highest (SASSA, 2013b).

The map in Figure 2.2 pinpoints the sites which were chosen for the interviews with the members of the public:

- Urban Site A (with 24 respondents) is Port Elizabeth in the Nelson Mandela Bay metropole area and included suburbs New Brighton, Walmer and Charlo;
- Urban Site B (with six respondents) is Uitenhage in the Nelson Mandela Bay metropole area;
- Rural Site C (with 10 respondents) is Joubertina in the Cacadu district;
- Rural Site D (with five respondents) is Kareedouw in the Cacadu district;
- Rural Site E (with 15 respondents) is Cofimvaba in the Chris Hani district.

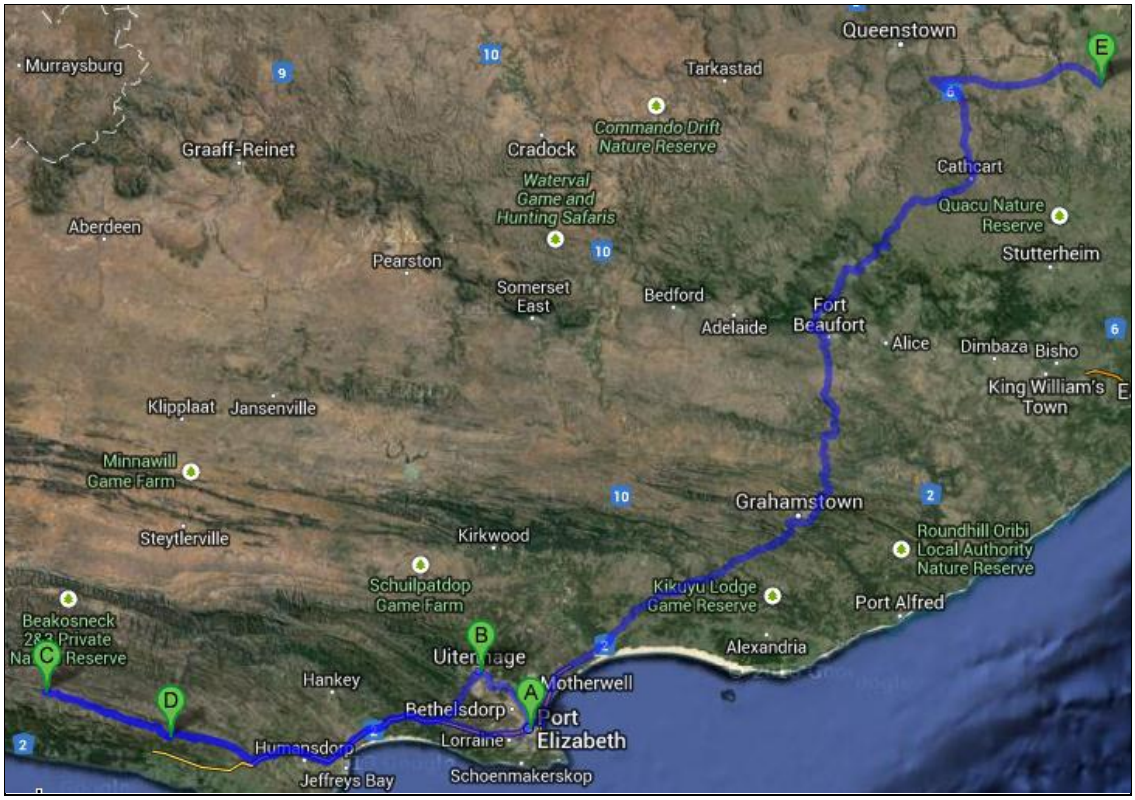


Figure 2.2: Sites used for the questionnaires for the Members of the Public

Data collection was also carried out by means of literature reviews. The **sources** used for the literature reviews in this research effort include the following: reports, newspaper articles, academic articles, journals, books, conference papers, websites, government documents, speeches and annual reports. The initial literature review revealed some frameworks that were discussed briefly in Chapter 1. The full

literature review that is presented in later chapters includes studies on the South African Social Grants and on biometrics.

2.4.6.2 Data Analysis

Some data analysis techniques were described in Sub-section 2.3.6.2. The **triangulation mixed methods** design is used for this research study. Using *methodological triangulation*, both quantitative and qualitative data were collected at the same time, using different data collection methods, and subsequently merged and analysed together. Table 2.4 depicts where the quantitative and/or qualitative methods were employed for the various questions. Content analysis was used on the qualitative data and descriptive analysis with statistics was used for the quantitative data.

2.5 THE CASE STUDY

This section will briefly discuss the case study for this research of which the detail is presented in Chapter 6.

The case study follows the format that is suggested for a case study by Robert E. Stake, Helen Simons and Robert K. Yin ("The Case Study," 1997):

1. The research questions were formulated and listed in Section 2.4.1;
2. A single case was used with exploratory questions to assist the gathering of appropriate data from role-players. These role-players were either social grant officials or members of the public;
3. In this study, convenience sampling and purposive sampling were used for the social grant role-players. Purposive sampling was carried out to find members of the public who had already had experience in having their biometric samples extracted. The respondents were conveniently at the sites when the visits were made. A pilot study was used to test the instruments before conducting the interviews with the role-players;
4. Both qualitative and quantitative data were collected by means of interviews, using semi-structured questionnaires;

5. Within-case analysis was used to analyse the data. The analysis was done using content and descriptive analyses with statistics;
6. Chapter 6 reveals the results of the case study.

2.6 SUMMARY

This chapter has laid out the research methodology. Some general issues were explained and specific choices were made for this research effort. In particular the Design Science research methodology was applied where an artifact was developed to solve the problem. The research problem fits into a *phenomenological philosophy*. The *research approach* used *induction* to observe the data and develop appropriate theory and components for the framework.

The chosen *research strategy* was a single *case study* and the sampling strategy used convenience and purposive sampling methods. It was decided to use the following *data collection techniques* for the research questions:

- Question 1: Literature review on biometrics and on social grants in South Africa;
- Question 2: Literature review and interviews to discover challenges and lessons learnt from applications using biometrics both locally and abroad;
- Question 3: All data gathered from the earlier data collection for Question 1 and Question 2 as well as questionnaires sent to experts were used to build and refine the framework.

A pilot study was carried out to test the instruments and will be discussed in more detail in Chapter 6 where the full case study is presented.

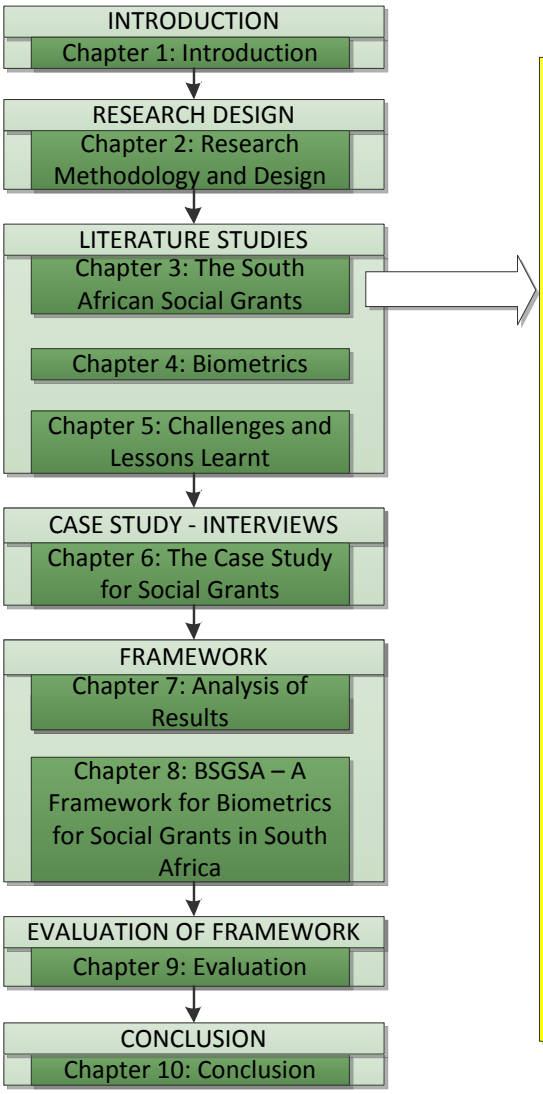
After collecting both qualitative and quantitative data using the data collection techniques, it was decided to use *methodological triangulation* during the data analysis process which involved *mixed methods data analysis*. The qualitative data was examined using *content analysis*. The quantitative data was analysed using *descriptive analysis* and *statistics*. The triangulation ensured the internal validity of the artifact.

As explained in Section 2.2 of this chapter, the evaluation of the artifact (the BSGSA framework) was in the form of *static analysis* where an *expert review* was conducted to ensure external validity. The feedback from the expert review was used to further refine the framework.

The next chapter heralds the start of the research report content and begins with a literature study that takes a closer look at the South African social grants.

CHAPTER 3: THE SOUTH AFRICAN SOCIAL GRANTS

LAYOUT OF CHAPTER 3



CHAPTER MAP

3.1 INTRODUCTION

This chapter describes the implementation of the South African Government's social grants which is a large social protection programme in South Africa (Patel & Hochfeld, 2011). The intention is to highlight those particular aspects of the implementation, which influence the outcome of this research endeavour.

Section 3.2 begins with the United Nations' Millennium Development Goals (MDGs). Section 3.3 will reveal how the South African Government has incorporated MDGs into its own home-grown policies in the country. Section 3.4 describes the Department of Public Service and Administration and Section 3.5 describes the South African Social Security Agency, both of which take responsibility for the social grants in the country. Section 3.6 details the social grants that are offered to needy South Africans. Section 3.7 and Section 3.8 present discussions on Batho Pele principles and Community Development Workers respectively and the chapter ends with concluding remarks in Section 3.9 and a summary in Section 3.10.

3.2 MILLENNIUM DEVELOPMENT GOALS

At the time of writing, the United Nations (UN) has 193 member states and South Africa is one of these. Being a forum for global collaboration, the UN produced valuable goals for suggesting solutions to the larger problems of the world, for example, poverty, diseases such as Acquired Immunodeficiency Syndrome, and human rights, among others. These goals are collectively referred to as the "Millennium Development Goals". There are eight goals, of which the first one is the most relevant for the purposes of this research. This Goal 1 reads as follows: "Eradicate extreme poverty and hunger" ("MDG Country Report", 2010).

In 2010, the third report on South Africa's progress on the implementation of the Millennium Development Goals was prepared ("MDG Country Report", 2010). Some of the findings in this report that are related to Goal 1 will be presented in the next section, starting with the Government's commitment to the MDGs.

3.3 SOUTH AFRICAN GOVERNMENT COMMITMENT TO MDGS

Jacob Zuma, the President of the Republic of South Africa, reiterated South Africa's commitment to the eight MDGs, and indicated that Goal 1 was South Africa's first priority ("MDG Country Report", 2010). In his Foreword of the 2010 MDG reporting document, Trevor Manuel, who was then the Minister in the Presidency: National Planning, reported that there had been increased expenditure to alleviate the plight of the poor, in order to reach the Goal 1 target of providing people with more than $1 per day. The 2010 Country Report showed that by 2006, South Africa had more than halved the population living with less than $1 per day. However, Mr Manuel added that further statistical evidence was required to prove this target realisation. There were still many severely malnourished children under the age of five, according to the Department of Health.

The South African government had therefore accepted and embraced the ideals of the MDGs, especially regarding policies for the needs of women and children. The intention was to speed up the implementation of the MDGs by 2014 ("MDG Country Report", 2010). Falling in line with the MDGs, the South African Government identified and outlined a Medium Term Strategic Framework to improve the living conditions of its people. This was intended to be a guideline for the three spheres of Government: National, Provincial and Local. It was a five-year plan and included five objectives, of which the first one fell in line with Goal 1 of the MDGs: "Halve poverty and unemployment by 2014". The objectives were further outlined as ten priority areas of which the following is relevant for this research study:

- Strategic Priority 10: Build a developmental state, including improvement of public services and strengthening democratic institutions.

On 30 April 2010, the President of the Republic of South Africa and the Minister of Public Service and Administration signed a performance agreement where they expressed commitment to twelve outcomes identified by the South African Government and listed by Lekgotla in Cabinet on 20 – 22 January 2010 (Baloyi & Zuma, 2010; Department of Public Service and Administration [DPSA], 2010a; "MDG

Country Report", 2010; Ministry of Public Service and Administration [MPSA], 2011). For the purposes of this study, outcome numbers nine and 12 are very relevant:

9. A responsive, accountable, effective and efficient local government system;
12. An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship.

The next section introduces the Department of Public Service and Administration which was made responsible for providing public services, including the social grants.

3.4 THE DEPARTMENT OF PUBLIC SERVICE AND ADMINISTRATION

The DPSA is responsible for maintaining good governance and sound administration in the public service (DPSA, 2011a).

The Minister for Public Service and Administration is responsible in particular for the 12th outcome which was introduced by government and referred to in Section 3.3 above and which reads as follows (DPSA, 2011a):

> Outcome 12: An efficient, effective and development oriented public service and empowered, fair and inclusive citizenship.

According to the DPSA Strategic Plan for 2011/12, if the above is the vision of the DPSA, then the mission is to empower fair and inclusive citizenship; to support the Ministry of Public Service and Administration (MPSA); and to provide advice and support for excellent public service and good governance, incorporating Batho Pele principles for service excellence (DPSA, 2011a). The Batho Pele principles will be discussed later in this chapter.

The DPSA therefore translated the Outcome 12 into 10 Strategic Priorities and those that are relevant for this study are listed in Table 3.1 (DPSA, 2011a).

Table 3.1: Strategic priorities relevant to this study

NO.	STRATEGIC PRIORITY	COMMENTS
1	Service delivery quality and access.	Requires increasing infusion of Batho Pele principles. The Khaedu project which does excellence training for public servants is also relevant here. Service delivery can be improved through revised Khaedu management, and assessments of the impact on the three spheres of government should be made.
2	Effective systems, structures and processes.	The DPSA planned to develop the Single Public Service.
3	Leverage information and communication technology (ICT) as a strategic resource (enabler).	The e-government is a critical ICT strategy to automate and modernise rendition of services. The Thusong Service Centres (One-stop service centre for services and information) must be connected to the State Information Technology Agency (SITA) and back-end systems.
7	Appropriate governance structure and decision-making.	Policies and guidelines should be developed for governance and management structures.
8	Citizen engagement and public participation.	Engage all stakeholders; conduct surveys to monitor awareness; devise strategies for Community Development Workers.
10	Contribution towards improved public service administration in Africa and international arena.	The Department should contribute to African Peer Review Mechanism by implementing the National Programme of Action.

There are various institutions under the MPSA portfolio which go a long way towards assisting with these strategic priorities. These institutions are very important for the full functioning of the DPSA (DPSA, 2010a; DPSA, 2011b; MPSA, 2011):

- DPSA develops policies and enforces them in the public service. The Public Service Commission (PSC) must develop and implement service delivery interventions. The PSC also monitors compliance with the values through annual reports on the state of the Public Service. This is carried out by investigating and assessing users' satisfaction with government services each year;
- PALAMA (Public Administration Leadership and Management Academy) is for training and development of public servants with the intention of mobilizing public servants who respect the citizens they serve. There was a plan to train 1700 frontline public servants in excellent customer care (Project Khaedu);
- SITA (State Information Technology Agency) looks after information technology in public service;

- CPSI (Centre for Public Service Innovation) promotes innovation in public service and transforms ideas into new improved products and services in order to enhance service delivery. They need resources to test solutions;
- PSETA (Public Service Sector Education and Training Authority) coordinates skills development in the public service and has plans to use resources for implementation of a rural youth development project.
- The Public Sector Charter defined the following for public servants:
  - 8 attributes of a public servant;
  - 9 commitments of a public servant to the people of South Africa;
  - 7 rules of engagement for public servants;
  - 12 commitments of a public servant to the Public Service;
  - Five ethical principles of a public cadre.

Everyone from the Directors-General to the drivers signed an agreement which listed deliverables or outputs which would be the focus of the DPSA. Some of the intended outputs were to improve the access to service delivery and the quality thereof (Baloyi & Zuma, 2010; DPSA, 2011a; MPSA, 2011). This was mainly due to low efficiency levels and corruption problems. The measurement shown in the performance agreement was that the current satisfaction level at that time (measured by the users for services rendered) was only 58%. The target was to reach 75% by 2014. One could measure user satisfaction in various ways such as the time spent waiting in hospital queues, or at the home affairs offices, or licensing offices. One could also measure the number of 16 year olds that were supplied with their identity documents within a particular time period. To measure access to service delivery, one could report on the maximum distance that residents travelled in order to acquire services from a government department.

The DPSA renders services in the following areas: Home Affairs, Human Settlements, Healthcare, Basic Needs, Social Development (which includes the social grants), Work and Education (DPSA, 2010b).

When the control of social grants became too large for the DPSA to manage, they established the South African Social Security Agency (SASSA) whose main purpose

was to provide for efficiency in the management and administration of grants in the face of the increasing numbers of grant beneficiaries (SASSA, n.d.; Triegaardt, 2005). SASSA is discussed in the next section.

3.5 THE SOUTH AFRICAN SOCIAL SECURITY AGENCY

The South African Social Security Agency (SASSA) was established to provide effectiveness in the management and administration of grants in the face of the increasing numbers of grant beneficiaries. Before SASSA, the provincial departments of Social Development had managed the social assistance (SASSA, 2010). SASSA gained control of social grant access facilities in 2002. It was intended to be a high performance institution with good governance principles.

Among others, SASSA adheres to the policies as listed in the Annual Report 2010/11 and presented in Table 3.2 (SASSA, 2011c; SASSA, 2010; SASSA, 2013a; "Social Development", 2012).

Table 3.2: Acts that facilitate implementation of social grant system

ACT	COMMENT
Constitution of the Republic of South Africa, 1996 (Act 108 of 1996).	Makes provision for social security rights for all citizens.
Public Finance Management Act, 1999 (Act 1 of 1999).	Regulates financial issues in government institutions.
Promotion of Access to Information Act, 2000 (Act 2 of 2000).	Provides right for public to have access to information.
Promotion of Administrative Justice Act, 2000 (Act 3 of 2000).	Promotes rights of public to lawful administrative action.
South African Social Security Agency Act, 2004 (Act 9 of 2004).	SASSA was established as an agent to administer and pay the social assistance transfers.
Social Assistance Act, 2004 (Act 13 of 2004).	Assists transfer of benefits to qualifying persons.
Children's Act, 2005. (Act 38 of 2005).	Ensures best interests of children, strengthens families, looks after constitutional rights of children who need care (social services, protection from maltreatment, neglect or abuse).
Older Person's Act, 2006.	Improves well-being and safety of older persons.
Children's Amendment Act, 2007.	Provides assistance to children in the form of child care, development and care centres.

SASSA intended to find out where the demand was for social grants, where the SASSA could meet the demand, and they could also utilise other suppliers (SASSA, n.d.). They looked at roads, rivers, and natural barriers in order to plan for networking. They studied the transaction volumes at the current infrastructure as well as the travel times (rather than distances) to measure the delivery of required services which were grant payments and helpdesk enquiries. Some standards accepted (among others) and reported in a presentation some time after the year 2007 by SASSA on the spatial optimisation of service infrastructure were as follows (SASSA, n.d.):

- It should take 30 seconds to pay a beneficiary;
- A beneficiary should not have had to wait in a queue for longer than two hours;
- The offices should be open from 8 am to 3pm;
- There should be one SASSA employee for every 800 beneficiaries at the mobile offices;
- There should be 1250 people able to be paid out in any one day at the pay points.

In 2011, the SASSA agency had been around for five years (SASSA, 2010). Their motto is NJALO ("paying the right social grant, to the right person, at the right time and place"). The agency has a Chief Executive Office and six branches which are listed in Table 3.3.

Table 3.3: Branches of SASSA

NO.	BRANCH	COMMENT
1	Strategy and Business Development.	Responsible for innovations for improvements to service delivery.
2	Internal Audit and Risk Management.	To reduce fraud and corruption in grants administration process.
3	Corporate Services.	To provide effective and efficient management and development of the human capital.
4	Office of the Chief Financial Officer.	To provide financial and accounting services such as budgeting and expenditure monitoring.
5	Information and Communication Technology	To look after special ICT projects and improve business solutions.
6	Grant Administration and Customer Services.	To provide guidance to ensure co-ordination of grant administration and payments.

Many checks and balances indicate that there is better control leading to efficiency and effectiveness (Dlamini, 2011; SASSA, 2010; “Grant Increases,” 2010). Social grants have contributed the most towards alleviating poverty according to reports by the Minister of Social Development. She also indicated that there was still a major challenge to be addressed in the management and administration of grants, and in particular, the service delivery itself and the zero tolerance to fraud and corruption. According to the SASSA Annual Report of 2010, many suspected fraudsters had signed acknowledgement of their debt, saving R51m and leading to 3345 convictions. There were also 26588 lapsed grants owing to non-responses to review requests, thereby also saving R312m for that year.

The SASSA 2010 Annual Report cited social grants as going a long way to improve the lives of beneficiaries and that the child recipients were better nourished and attended school more regularly (SASSA, 2010). At the time of writing this document, it is estimated that about 11 million of the 16 million South Africans who receive social assistance, are children (“Grant increases,” 2010; Mahlong, 2012; Ntuli, 2013; SASSA, 2011b).

Social welfare is not seen as an act of charity but an issue of social justice but the service has not been provided without its problems as well. There have been indications that some civil servants were not treating grant applicants correctly, or were making illegal demands on them and there was also complaint of corruption and political exclusion (Goebel, 2011; DPSA, 2010). This needs to be solved, and has been already tackled, because it is important to provide social welfare for the poor, and in particular to female headed households. There should be mutual respect between the state and the poverty-stricken citizens (Goebel, 2011).

There is much fraud and corruption in the grant delivery process, which results in SASSA needing to be increasingly productive in improving the management and administration. In 2012, a new vendor, Cash Paymaster Services had been appointed to assist with SASSA’s new implementation for social grant applications and pay-outs (Mahlong, 2012). A new SASSA-branded smart card using biometrics was handed out in the second half of 2012 to legally enrolled grant recipients

(Khumalo, 2012; Ntuku, 2012; Ntuli, 2013). The recipient would have provided fingerprint and voice recognition biometrics. This was part of a plan to reduce corruption, maladministration and fraudulent grant collections and would allow recipients to collect their grants from anywhere in the country. It would also allow for routine checks to verify continuing validity of a recipient each time he/she collected the grant).

SASSA has reported that the majority of the grant recipients have rather migrated from the previously crowded pay-points, to automated teller machines (ATMs) or other participating stores when collecting their money. The time taken to collect at these pay-points has also decreased to 30 seconds (Ntuli, 2013; SASSA, 2012b).

According to Earl (2013), SASSA had been looking for an alternative to using the Personal Identification Number (PIN), and a signature alone was not sufficient. Proof of Life was also required when payments were to be made. The re-registration process in 2012 took only nine months. The SASSA smart card included biometrics such as fingerprints and voice recognition. By June 2013, SASSA already had 9.8 million cards in the new system. Currently, although the voice has also been captured, there is a pilot study underway to see how to use the voice. There were, however, still half a million persons who had not yet re-registered on the new smart card system. 70% of the new registered recipients were using a PIN to access their money and 2.7 million were using biometrics at traditional pay-out points. SASSA indicated that an ideal world would be to have biometric readers at Automated Teller Machines (ATMs).

Earl (2013) also explained that SASSA are focused on two key areas: authentication and safer options for vulnerable people. SASSA were concerned that the grant recipients were being targeted by loan sharks who were taking ownership of SASSA cards to collect loan payments owed to them. It was common practice between 12 am and early morning 6 am, on pay days, that many transactions were recorded. The money lenders would collect all the money that they could during that time, using the SASSA cards that they had obtained. If biometrics were compulsory when

the respondent is withdrawing money, then this undesirable practice would be more challenging for the loan sharks.

The Department of Home Affairs (DHA) are also currently busy with the issuing of smart cards for identification to replace the current identification document (ID) for the 37.5 million persons who are 16 years or older (Jacobs, 2013). The intention was to first deliver to citizens older than 80 years as well as those first-time applicants. Thereafter the public would be invited to apply in stages depending on their birth dates. The main reason for introducing this smart card is for counteracting identity fraud as it is difficult to forge the specially fused, laser-engraved card which also contains a microchip and biometrics. The system does not use a database as the fingerprint is stored on the card. This involved the digitising of over 30 million fingerprint records. According to Jacobs (2013), many other countries also use this system, such as Belgium, Finland, India, Portugal, Sweden and the United States of America. It could also be used for many applications such as drivers' licenses, resident permits, census and voting among others. The DHA wishes to consider using it for state pensions as well as private uses such as banks and insurance. The financial implication of having the necessary equipment installed for these mechanisms, might be worthwhile in counteracting the loss associated with fraud.

SASSA are committed to using biometrics for the purposes of security, proof of life and avoiding fraud and therefore need a standard that works for them but they do not feel that they are responsible for developing the biometric standard (Earl, 2013). Net1 UEPS Technologies is a provider of payment systems and its unit Cash Paymaster Services was awarded the tender to distribute the social grants to the South African recipients from 2012.

SASSA had also referred the researcher to the Payments Association of South Africa (PASA) who manage and control interbank payments for the South African payment system. PASA were very interested in the results of this research and in particular they wanted to know the preferences of the grant recipients regarding biometrics and/or the usage of PINs for identification as they were involved in a project on the potential adoption of a fingerprint biometric standard in South Africa

(Ismail & Ramlall, 2013). The results of this project were not available at the time of completion of this document.

The next section looks at the various social grants that are administered by SASSA.

3.6 THE SOUTH AFRICAN SOCIAL GRANTS

There are various financial grants to alleviate poverty in South Africa such as the Older Persons Grant, the Child Support Grant, the Disability Grant, the Foster Child Grant, the Care Dependency Grant, the War Veterans Grant, Grant-In-Aid and Social Relief of Distress ("MDG Country Report", 2010; Petersen, 2011; SASSA, 2013a). A report by Clark (2013) shows a growth from reaching 2.5 million persons in 1998, to a projected 16 million persons in 2013. By October 2013, this figure dropped to 15.2 million (SASSA, 2013b). There is still a high unemployment rate and therefore there is a large number of non-working persons who rely on their grants. In the SASSA Annual Report of 2009/2010 it stated that 4.3 million people were still unemployed (SASSA, 2010).

Those who receive their payments at a pay-point or into their bank account are able to enrol for the new biometric system which was implemented in 2012 ("Enrol on new grant payment system," 2013). They apply for a new SASSA-branded Smart Master Card at the SASSA pay points, local offices or assigned sites. This allows the recipient to receive pay-outs at any point in the country and provide for life certification each month, thus minimizing fraud and corruption. The biometric features required for the new card are the ten fingerprints and a photograph. A voice sample is also collected. For the Child Support Grant, there is a requirement to also capture the fingerprints of the child (Rasool, 2012; Timm, 2012). According to Jacobs (2013), those children younger than three years have their two thumbprints captured, while the rest have all ten fingerprints captured.

Some details for each of the social grants are presented here.

3.6.1 Child Support Grant

The Child Support Grant (CSG) was introduced in 1998 and became an important grant to alleviate poverty. The principle behind this new CSG was to "follow the child" irrespective of the family structure (Goldblatt, 2005; Triegaardt, 2005).

Over the years, the age limit was extended so that, although it began and was projected to all children up to the age of six years, by the year 2011 the age limit was 18 years (DPSA, 2011c). The UN Convention on the Rights of the Child in 1995 has stated that a child means a person under the age of 18 years (Triegaardt, 2005).

The Child Support Grant is currently R300 per month. No carer may receive assistance for more than six children. The child must go to school if between seven and 18 years of age. He/she must have been born after 31st December 1993 and not be cared for in a State institution (DPSA, 2011c; SASSA, 2013a; "Child Support Grant," 2013).

The caregiver must also get permission from the child's parent to get the grant on behalf of the child and must prove that he/she is the primary caregiver and that the child is living with him/her. Proof may be in the form of an affidavit from the Police Station or parent, or a report from a Social Worker or a letter from the child's school principal. Home visits can be arranged where necessary (DPSA, 2011c; SASSA, 2011a; "Child Support Grant," 2013).

3.6.2 Grant for Older Persons

The Older Persons Grant which used to be called the old age pension is currently a maximum of R1270 per month for persons over 60 (unless the person is over 75 years of age in which case it is R1290 per month) ("Older Persons Grant", 2013; SASSA, 2013a). The recipient should be a South African citizen or permanent resident or refugee living in South Africa.

3.6.3 War Veterans' Grant

The War Veteran's Grant is currently R1290 per month for persons 60 years or more and who have served in the First World War, the Second World War, the Zulu uprising or the Korean War and cannot support him/herself (SASSA, 2013a; "War veterans' grant", 2013). Otherwise the person should be disabled in order to receive the grant. The recipient should be a South African citizen or permanent resident living in South Africa. The spouse should comply with the means test.

3.6.4 Disability Grant

The Disability Grant is currently R1270 per month for persons from 18 to 59 years of age and who have submitted a medical report confirming the disability (SASSA, 2013a). The medical report must not be older than three months at the date of application. The recipient should be a South African citizen or permanent resident or refugee living in South Africa. The person must not already be cared for in a State institution and must not be receiving another social grant for him/herself. The spouse should comply with the means test.

3.6.5 Foster Child Grant

A foster child is someone under the age of 18 and who is orphaned, neglected, abused or abandoned and is therefore at risk ("Foster Child Grant", 2013; SASSA, 2013a). The Foster Child Grant is currently R800 per month per child. Both the applicant and the child must be resident in South Africa. The foster parent must be a South African citizen, or permanent resident or refugee. The child must remain in the care of the foster parent and there should be a court order to indicate the foster care status.

3.6.6 Care Dependency Grant

This grant is for a child 18 years or less, and who is severely disabled from birth and needs special full-time care ("Care Dependency Grant", 2013; SASSA, 2013a). The

Care Dependency Grant is currently R1 270 per month. Both the applicant and the child must be resident in South Africa. The child must be under 18 years of age and there must be a medical report submitted to confirm the permanent, severe disability. The medical report must not be older than three months at the date of application. The applicant and spouse must pass the means test. In the case of a foster parent looking after the child, the foster parent need not pass the means test.

3.6.7 Grant-in-aid

The Grant-in-aid is currently R300 per person (SASSA, 2013a). If a person is receiving either a grant for Older Persons, a Disability Grant or a War Veteran's Grant, and is being cared for by another person due to his/her own mental or physical disabilities, then the applicant may apply for the Grant-in-aid. The person must not already be cared for in a State institution and must not be receiving another social grant for him/herself.

3.6.8 Social Relief of Distress

There is also a grant for Social Relief of Distress which can only be paid to South African citizens, permanent residents or refugees (SASSA, 2013a). It is a temporary grant which may be in the form of a food parcel or a voucher to buy food. There are various reasons for paying this grant. The applicant may be in need of funds but is still waiting for payment of another approved social grant. The applicant may also be someone who is not able to obtain maintenance or is left behind after a partner has passed on. Perhaps the bread winner is hospitalised or the applicant him/herself is affected by some disaster. This grant is very useful for those who would be suffering hardship if they were not receiving it.

These social grants have benefited many South Africans. Besides having influence on the achievement of the MDG Goal 1, at a meeting of the Department of Social Development, it was reported that the Child Social Grant also affected MDG Goal 2 which is about achieving universal primary education ("MDG: response", 2012).

Many more children under 18 had been able to attend school, and the number of people who were living below the $1 limit had substantially decreased.

The next section discusses the Batho Pele principles which are very relevant when services such as social grants are being delivered to the members of the public.

3.7 THE BATHO PELE PRINCIPLES

The Batho Pele was devised in a White Paper in 1997 and is about how to deliver services and improve managerial efficiencies and effectiveness. The Batho Pele principles are about "putting people first", thereby providing public service excellence and are listed below (DPSA, 2011b; DPSA, 2011e; Nelson Mandela Bay Municipality [NMBM] Annual Report, 2011):

- Courtesy and consideration i.e. a "people first" approach is expected. This is not only done with polite smiles but should reduce the negativity that citizens have regarding the delivery of services. Respect must be shown to the citizens at all times;
- Consultation with residents is necessary when making decisions regarding service levels and quality. There should be consultations with individuals, groups and/or other representative bodies such as non-government organisations;
- Service excellence i.e. one should know what to expect regarding level and quality of service. There should be benchmarks for service expectations so that one can measure customer satisfaction. The customers must be able to see for themselves whether the delivery is as promised;
- Access for all services should be equally available to all citizens. There are still many South Africans who may not have access to basic services and these inequalities must be rectified;
- Information about services should be accurate and comprehensive. Many people seek information about service deliveries and other issues, and this should be available no matter where the citizens live;

- Openness and transparency i.e. residents should know about government operations, budgets and other structures. They should understand the way that the three spheres of government work, and they should know what happens to all resources. Government employees must be held accountable when raising queries with them;
- Redress i.e. apologies and remedial action should be available to residents if services are not delivered and the residents should receive immediate sympathetic and positive response if they make complaints. There should be procedures in place to identify quickly when services are falling below a required level. Complaints must therefore be seen as an opportunity to improve service delivery;
- Value for money i.e. services should be provided for in an economical and efficient manner. If a public servant does not provide correct information to a consumer, that consumer may spend unnecessary time and money whereas a simple explanation from the public servant may have reduced the cost.

All provinces implemented the Batho Pele principles (MPSA, 2011). With reference to public service, this necessitated knowing where the people lived, and where the services were needed or had to be improved. There was provision for complaints to be voiced therefore organisations should be willing to make changes and personnel should be adaptable and well-informed. Public participation and volunteerism was vital in order to move to a developmental state rather than a welfare state (DPSA, 2009; DPSA, 2011a).

To evaluate the effectiveness of the application of Batho Pele principles, and to ensure the upholding of these principles, studies were conducted to see whether the agencies were bringing the public services closer to the citizens and whether there was effective and responsible rendition of the services (MPSA, 2011). For example, a report in 2011 showed that at least 815 new supervisors needed to be trained on the Batho Pele principles in order to provide for better responsiveness, and to transfer best practice, reduce waiting times and improve turnaround times for services rendered. These services may have been in hospitals, or in other

departments such as Home Affairs, Social Development, Health, Transport or Labour.

The introduction of Community Development Workers as described in the next section should further facilitate the outpouring of the Batho Pele principles.

3.8 THE COMMUNITY DEVELOPMENT WORKERS

In the State of the Nation address on 14 February 2003, President Thabo Mbeki explained the need for a new multi-skilled public servant, viz. the trained Community Development Worker (DPSA, 2011d). The Department of Public Service and Administration implemented the Community Development Worker (CDW) Programme to provide assistance and improved service delivery for the poor. There were policies for these workers, as well as a strategy on how to engage directly with the citizens and how to promote volunteerism. This was necessary because the poorer members of the population did not always have access to services, or they were not able to help themselves. The CDWs entered the communities and households to find out what the people needed. They were able to assist the people in getting access to aid, whatever the needs might be. Their mandate was as follows (DPSA, 2009):

- To assist in removal of bottlenecks which delay delivery of services to the citizens;
- To promote the democratic social contract between the community and the government;
- To link the community to the services and to take problems back to the government structures where applicable;
- To be a voice for the poor;
- To improve the networking of government and community.

The CDWs are committed to the War on Poverty campaign by identifying needy households, filling in questionnaires, encouraging communities to engage with government at events and helping to gain access to land for food production (MPSA, 2011). The CDWs also help the residents in rural communities to get their social

grants. They also identify children who should be in Early Childhood Development programmes. The CDWs are encouraged to help establish more of the crèches that are funded by the Department of Social Development.

CDWs could be seen as critical building blocks for building the developmental state that President Zuma was looking forward to (DPSA, 2009). There is an annual Grassroots Innovations booklet which includes some of the best case studies showing CDWs in action in the provinces (DPSA, 2011a).

3.9 CONCLUDING REMARKS

A short summary of contributions from this chapter is listed in Figure 3.1 and shows that this chapter is very relevant for finding information that would be applicable for insertion into a framework for biometrics for social grant systems in South Africa. The literature review was conducted in order to answer part of the research Question 1: *What are suitable biometric methods that can be used for social grants in South Africa?* In particular, the "social grants" portion of this question was investigated in this chapter.

Formal coding was used on the contents of this chapter in order to provide input to the framework as will be discussed in Chapter 7. The other half of Research Question 1 is the biometrics content, which will be reviewed in the next chapter.

3.10 SUMMARY

A number of issues have been presented in this chapter. Those issues that have an influence on this research effort are summarised here.

The MDG Goal 1 is to eradicate extreme poverty and hunger. As part of the commitment to this goal, South Africa wants to improve public services. This means that the local government system must be responsive, accountable, effective and efficient. It must also be empowered, fair and inclusive. The social grant systems

that target the needs of the poor must be done using effective identification mechanisms to ensure eligibility of recipients.

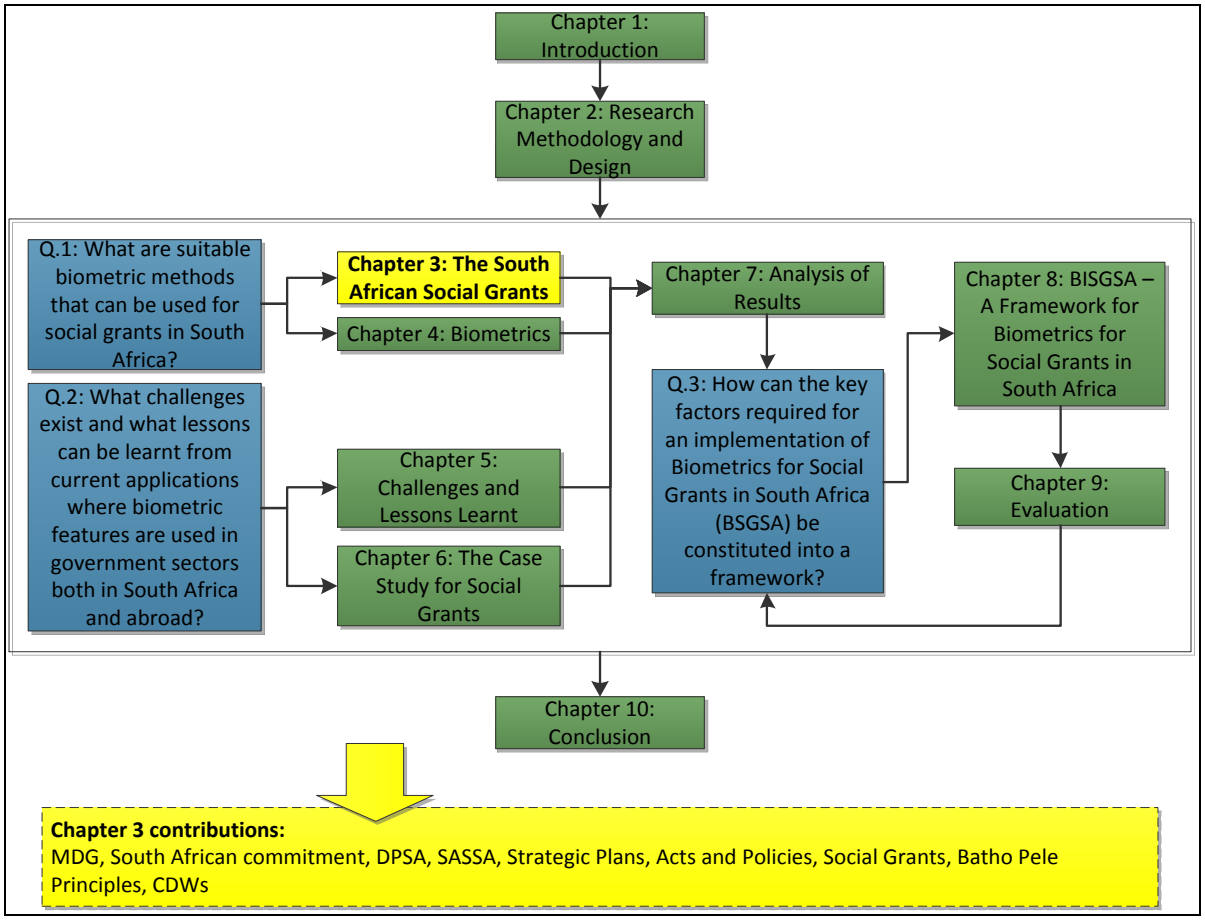


Figure 3.1: Contributions from the literature review on the South African Social Grants

The strategic priorities of the DPSA focus on Batho Pele principles to ensure quality and accessibility of public services. Information Technology must be used well according to the State Information Technology Agency to improve processes and business solutions. Public participation should be encouraged by using surveys to ensure their awareness of their rights. Community Development Workers can also assist in various ways.

The Public Service Commission should assess user satisfaction. The Public Administration Leadership and Management Academy should continue to train public servants in customer care. These public servants should apply the Batho Pele principles when dealing with the public.

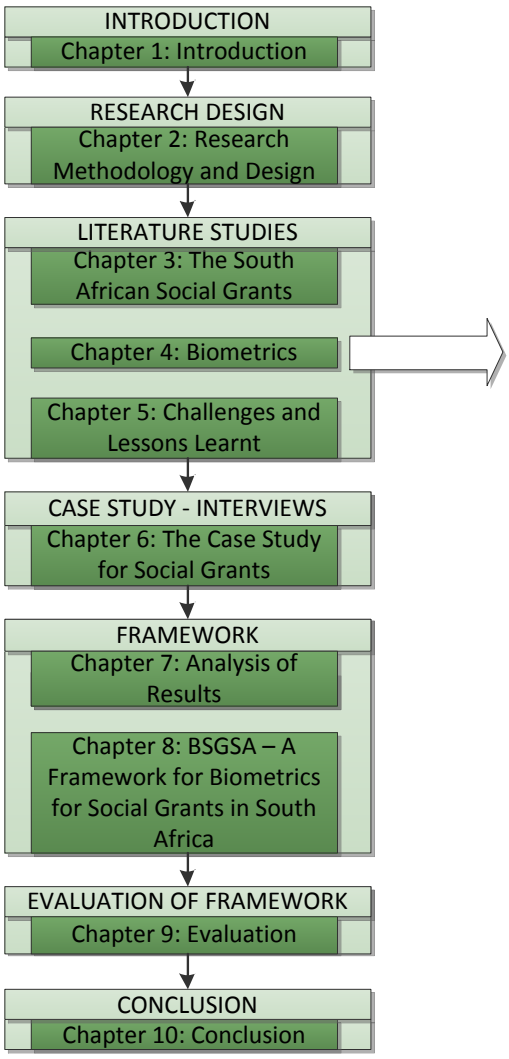
The South African Social Security Agency should continue to use the Social Assistance Act to provide benefits to qualifying individuals and should continue to uphold their motto of “Njalo”. They should continually look for new innovations for improvements to service delivery. The grants administration process should result in a reduction of fraud and corruption. There could be improvements made in the pay-out of grants.

The social grant applicants should be treated well by the staff where assistance is provided for their grant applications and pay-outs. The staff should be held accountable. The applicants, who are members of the public, need to be kept in consultation when changes are made to improve quality and service. The service itself should be excellent, accurate and reachable. The public should not spend undue amount of time and money to acquire the needed services, therefore there should also be sufficient staff to assist them.

The next chapter looks at the challenges and lessons that can be learnt from implementations of biometrics for social grants.

CHAPTER 4: BIOMETRICS

LAYOUT OF CHAPTER 4



CHAPTER MAP

4.1 INTRODUCTION

This chapter is an attempt to comprehensively present various topics related to biometrics in general. Section 4.2 begins with a general explanation of biometrics and lists the characteristics that are expected in a good biometric sample. Section 4.3 describes some uses of biometrics. Section 4.4 discusses various problems with biometrics such as function creep and ethical issues. Section 4.5 focuses on the chosen biometrics to be discussed. Section 4.6 looks at the various stages of using the biometrics for enrolment, verification and authentication. Ways of improving biometric security is discussed in Section 4.7. Section 4.8 discusses multi-modal biometrics. Finally some concluding remarks are presented in Section 4.9 and a summary ends the chapter in Section 4.10.

4.2 CHOOSING A GOOD BIOMETRIC SAMPLE

This section discusses biometrics as an advantage over traditional methods of authentication, and also describes the expected characteristics for labelling a biometric as a good one.

4.2.1 Problems with traditional passwords

The traditional means of authentication and identification have used knowledge such as passwords and Personal Identification Numbers (PINs), or token based security such as identification cards and keys, but these may be forgotten or lost thereby causing numerous requests to “help desk” to continually provide replacements (Ashok, Shivashankar & Mudiraj, 2010; Elumalai & Kannan, 2011; Gokulkumari & Lakshmi, 2011; Htwe & Htay, 2011).

Passwords may also be weak and susceptible to brute-force attacks (Allan, 2011). Passwords do also change over time or are substituted. When users struggle to remember passwords, they write them down or store them somewhere and this may cause breaches of security (Renaud & De Angeli, 2009). Therefore, it is certainly

beneficial if one can remove the necessity for remembering or storing a key or password (Lalithamani & Soman, 2009).

4.2.2 Preference for biometrics

Biometric techniques are seen as a solution to the password problems mentioned above (Renaud & De Angeli, 2009). Human mannerisms and characteristics are usually life-long, and have begun to emerge as a better solution for identification and authentication. Biometrics is a word that means “life” and “to measure” (Ashok *et al*., 2010). A biometric is a physiological or behavioural characteristic of an individual and can confirm his/her identity. A national biometric identification card can be used to identify someone, or to confirm someone’s identity by matching the biometric with an existing entry on a database (O’Neil, 2005).

A biometric has many advantages, including non-repudiation and convenience of use. It is eternally linked to the user, unlike a password or credit card that changes over time or is substituted (Lalithamani & Soman, 2009). Biometrics cannot be forgotten, lost or stolen (Gaddam & Lal, 2011; Manivannan & Padma, 2011; Sarbishaei & Khayat, 2009). Thus a biometric is more permanent and provides convenience and portability (Gokulkumari & Lakshmi, 2011). One can use a single biometric solution or a multi-modal biometric solution (Elumalai & Kannan, 2011).

Section 4.4 will, however, present some problems associated with biometrics.

4.2.3 Characteristics of biometrics

It must be realised that not all human characteristics are suitable for use as a biometric. Various authors have indicated what constitutes a good biometric, by listing required characteristics. Some of these have been tabled for convenience in Table 4.1 and will be discussed further below.

Table 4.1: Some characteristics of a biometric

AUTHORS	COLLECTABLE	UNIVERSAL	UNIQUE	PERMANENT	ACCEPTABLE	PERFORMS WELL
Ashok *et al.* (2010)	√	√	√	√	√	
Beynon-Davies (2007)	√	√	√	√		
Bhatnagar, Lall and Patney (2010)		√	√	√	√	
Birgale and Kokare (2009)	√	√	√	√		
Chandra, Durand and Weaver (2008)	√	√	√	√		
Deriche (2008)	√	√	√	√	√	√
Elumalai and Kannan (2011)	√	√	√	√	√	√
Gaddam and Lal (2011)			√			√
Gokulkumari and Lakshmi (2011)	√	√	√	√	√	√
Hosein (2004)					√	
Jain, Ross and Prabhakar (2004)	√	√		√	√	√
Lalithamani and Soman (2009)				√		√
Lyon (2008)						√
Mali and Bhattacharya (2011)			√	√		
Manivannan and Padma (2011)	√	√	√	√	√	√
Mordini and Massari (2008)	√	√	√	√		
Őzkaya and Sağiroğlu (2010)			√			√
Sağiroğlu and Őzkaya (2009)	√	√	√	√		

When one uses biometrics to identify a person, there are four basic requirements according to many authors (Birgale & Kokare, 2009; Chandra *et al*., 2008; Gokulkumari & Lakshmi, 2011; Mordini & Massari, 2008; Sağiroğlu & Őzkaya, 2009):

- *Collectability* - The ability to measure or extract the biometric element;
- *Universality* - All persons should have this element to measure from;
- *Uniqueness* - Each person has his/her own distinct version of this element which is not duplicated in another person;
- *Permanence* - This element remains the same over time i.e. is life-long.

Jain, Ross and Prabhakar (2004) replace the *uniqueness* above with *distinctiveness* which expects any two persons to have sufficient differences in their characteristics. Ashok *et al*. (2010) and Gokulkumari and Lakshmi (2011) add to the original four characteristics, by stating that a good biometric should be *acceptable* to the public who should therefore have no objection to providing their biometrics as samples.

There are also other characteristics that have been added by some authors. One of them is *performance* which means that the extraction of the biometric should be quick and accurate and the matching process should be efficient (Elumalai & Kannan, 2011; Gokulkumari & Lakshmi, 2011; Jain, Ross & Prabhakar, 2004; Manivannan & Padma, 2011). Another is *circumvention*, where one can use a different biometric if the first one is not able to be used (Elumalai & Kannan, 2011; Manivannan & Padma, 2011). Jain, Ross and Prabhakar (2004) describe *circumvention* in a different way, i.e. as the manner in which fraudulent attempts may be used to fool the system.

Beynon-Davies (2007) includes three of the main characteristics, i.e. *universality*, *uniqueness* and *permanence*, but replaces *collectability* with a similar description called *indispensability* meaning that the identifier is available when required. Added to this is *exclusivity* as well, which means that the particular identifier is sufficient for unique identification.

Bhatnagar *et al*. (2010) also dictate *universality, uniqueness (distinctiveness)* and *permanence* and add *acceptability* as a fourth characteristic. *Acceptability* is also added by Jain, Ross and Prabhakar (2004).

There is another characteristic or principle described by some authors, called *one-way transformation* or *non-invertible* meaning that one should not be able to invert the computation of the template (Gaddam & Lal, 2011; Lalithamani & Soman, 2009). They motivate therefore for the following characteristics: *diversity, reusability, performance* and *one-way transformation*.

The first idea of *cancelable* biometrics was proposed by Andrew Teoh *et al*. as suggested by Lalithamani and Soman (2009) so that biometric templates can be

cancelled and restored again after adding for example another authentication factor. This allows for principles of *diversity* (being able to use the biometric for more than one application, *reusability* (to be able to revoke and reissue the biometric), *one-way transformation* (so that the template computation is not inverted) and *performance* (the calculation methods used for the biometric should not influence its performance).

Finally, biometric authentication systems can also have *live detection* mechanisms to avoid illegal access attempts (Bayly, Castro, Arakala, Jeffers & Horadam, 2010; Marcel, 2013). It is very important to ensure live-ness detection when taking fingerprint images for the purposes of identification to circumvent fake fingertips made from silicon or other means (Manivanan, Memon & Balachandran, 2010). The human typically has sweat glands that end up at the pores on the surface of the skin. One way to detect live-ness is by detecting the pores in the skin using a high-resolution micro-capture camera.

The characteristics of a biometric that have been discussed above can be placed into various categories. One can describe them as being inherent, technical or procedural in nature (Van de Haar, Van Greunen & Pottas, 2013). The inherent category comprises those characteristics that are part of the biometric itself. The technical category contains characteristics that are added for the technical implementation of the biometric. The procedural category contains various choices for the actual application of the biometric. Table 4.2 shows some of the characteristics that fall into each of these categories.

Table 4.2: Categories of biometric characteristics

INHERENT	**TECHNICAL**	**PROCEDURAL**
Collectible	Cancelable	Circumvention
Universal	Live-ness	Diversity
Unique	One-Way Transformation	Reusability
Permanent	Performance	
Acceptable		

This sub-section described biometrics in general and looked at the characteristics for labelling a “good” biometric identifier. The next sub-section will list the biometrics that may be extracted from individuals.

4.2.4 General biometrics

Perhaps a nearly complete list of possible biometrics includes: fingerprints, iris scans, retina scans, hand geometry, palm print, facial recognition, facial thermography, jaw, ear shape, ear force fields, heart signals, brain signals, electroencephalogram, vein patterns, nail bed patterns, odour, signature dynamics, voice recognition, speech verification, computer keystroke dynamics, skin patterns, gait, gesture, deoxyribonucleic acid (DNA) matching, nail bed identification and foot dynamics (Al-Hijaili & AbdulAziz, 2011; Alandkar & Gengaje, 2010; Beynon-Davies, 2007; Birgale & Kokare, 2009; Ezhilarasan, Jacthish, Subramanian & Umapathy, 2010; Gaddam & Lal, 2011; Goranin & Cenys, 2010; Hosein, 2004; Htwe & Htay, 2011; Lahrash & Nordin, 2011; Manivannan & Padma, 2011; Mordini & Massari, 2008; O'Neil, 2005; Sağiroğlu & Őzkaya, 2009; Sarbishaei & Khayat, 2009; Serwaa-Bonsu *et al*., 2010; Shamsi, Kenari, Shadravan & Koropi, 2010; Shanthini & Swamynathan, 2011; Venkataraman, 2010).

Some of the identifiers mentioned in the previous paragraph are behavioural characteristics such as keystrokes or gait while others are physiological characteristics such as the fingerprint or iris. The identifiers or biometric features are measured and stored. Software is used to assist in capturing or measuring the biometric, and also for the identification or authorisation of an individual using the reference template that was captured or extracted. The storage of the encrypted biometric features can be done on smart identity cards, and/or entered into a database (Beynon-Davies, 2007; Goranin & Cenys, 2010).

Most of the biometric measurements require contact with the subject and are therefore often seen as intrusive methods. An intrusive biometric may be one that causes the subject to be annoyed when providing the measurement of the biometric. For example, the capturing of a fingerprint may be seen to be more intrusive due to the handling of the subject's fingers, whereas a photograph or facial image taken from a distance requires no contact with the subject and may therefore seem less intrusive. It may be a matter of opinion by the particular subject.

Some biometric methods have high error rates (Alandkar & Gengaje, 2010). All biometrics follow the plan of enrolment, comparison and identification (Al-Hijaili & AbdulAziz, 2011; "Biometrics security technical implementation guide", 2004; "Department of the Treasury", 2005; Mir, Rubab & Jhat, 2011; Podio, 2001; Rhodes, 2004; Ross & Jain, 2003).

4.3 USES OF BIOMETRICS

Having looked at the various biometrics that are available, the discussion in this section will turn to the many implementations of biometrics where they are being used as a means of identification. Some of the areas discussed are in the following fields: crime, law enforcement, intelligence, anti-terrorism, surveillance, passports, visas, identity, banking, commerce, government services, education, child protection and health.

4.3.1 Crime and law enforcement

Biometrics have been used extensively to reduce crime and fraud (Ashok *et al*., 2010; Beynon-Davies, 2010; Birgale & Kokare, 2009; Lyon, 2008; Mackey, 2006; O'Reilly, 2007; Penna, 2005). According to some authors, crime and law enforcement were the first areas where biometrics were introduced (Gokulkumari & Lakshmi, 2011; Őzkaya & Sağiroğlu, 2010; Sağiroğlu & Őzkaya, 2009).

Closed Circuit Television cameras (CCTVs) can be used to check facial images within shopping malls, stores, sports meetings, airports, streets and car parks in order to identify and convict known criminals (O'Neil, 2005; Tomkins, 2008; Wade, 2004).

In the United Kingdom (UK), as soon as someone was arrested, his/her fingerprints and DNA were extracted so that the record could be kept on the database (Wade, 2004). There was also a proposal to obtain this DNA at birth. The collection of these DNA profiles has been a contentious issue in the UK. In February 2011 it was reported that the UK government planned to delete the profiles of those persons who

had not actually been found guilty of crimes. However, in July of that same year, it was announced that the profiles would not be totally deleted, but rather anonymised (Hope & Winnett, 2011).

4.3.2 Counteracting terrorism and facilitating travel

This sub-section discusses biometrics used primarily for identification of terrorists and also focuses on surveillance biometrics for intelligence and anti-terrorism.

Surveillance can be carried out to watch for terrorists at airports and other places where passports are checked (O'Neil, 2005). Using biometrics for surveillance techniques can, however, result in concerns about privacy issues (Lyon, 2008; Őzkaya & Sağiroğlu, 2010; Penna, 2005; Sağiroğlu & Őzkaya, 2009). Passports, visas and identity documents can all use biometrics for more reliable identification of individuals that are immigrating, moving through airports or crossing borders (Lyon, 2008; Maguire, 2009).

Table 4.3 summarises a list of some countries where biometrics are used nationally for identification (Ashok *et al*., 2010; Beynon-Davies, 2007; Beynon-Davies, 2010; "Biometric Bytes", 2008b; Birgale & Kokare, 2009; Forte, 2003; Hosein, 2004; Lyon, 2008; Murray, 2007; Thomas, 2005; Tomkins, 2008).

4.3.3 Banking and commerce

There is some movement from traditional identity surveillance, to commercial biometrics but it is not so prevalent in the corporate world due to high costs, technical problems and user resistance (Breckenridge, 2010; Gokulkumari & Lakshmi, 2011).

The public are often the target of various surveillance attempts ("Biometric Bytes", 2008b). In Holland, the supermarket chain Albert Heijn did a pilot test by instituting fingerprint payment methods to see how it was received by consumers. It was found that 86% of customers had been willing to provide their fingertip biometrics in order to make payments for goods (Van Hooren, 2009). Gillette once used closed circuit

television cameras to track customers who picked up their packs of razors in supermarkets.

Table 4.3: Countries using biometrics for identification

COUNTRY	USAGE OF BIOMETRICS
Belgium	Digital signature for identification for government services.
European Union (EU)	Biometrics in visas and residence permits for outsiders of Member States.
France	Biometric passport system throughout the country. Their Automated Finger Identification System (AFIS) can process 5200 requests per hour using a database of 16 million records.
Greece	Compulsory identification for anyone over 14 years of age. Uses right thumb print. Used for passports, driving, entrance to public buildings, access to government services and European travel.
Hong Kong	Embedded chip with information and thumbprints for immigration and travel.
Malaysia	Biometric thumbprints for drivers' licences, passports, health cards and bank cards.
Portugal	Voluntary identification with information and fingerprints for passports, driving and marriage licences, employment and education purposes.
Singapore	Long Term Pass biometric-based card with photograph and fingerprints for foreigners in the country, in order to have control over national security.
Spain	Compulsory identification with information and developing biometrics for government, commerce and European travel.
Thailand	Identification cards with electronic fingerprints and face images that are linked to a population database.
United Arab Emirates (UAE)	Monitoring of persons who enter their region by comparing travellers against a watch-list.
United States of America (USA)	Enforced fingerprint biometrics at borders. Many countries have added fingerprints, iris scans or facial recognition since September 2001 terrorist attacks.
United Nations (UN)	Facial recognition biometric data in travel documents to improve identity checks for Member States.

4.3.4 Education and child protection

In the USA, iris recognition technology was installed at sheriffs' offices in order to positively identify missing children and adults (Garvey, 2005; O'Reilly, 2007). Children from schools as well as the aged were enrolled into the system. The national registry of child fingerprints allowed social services, law enforcement and other users to identify children in seconds. This project was called the Children's Identification and Location Database.

The biometric technology industry could also be used in canteens and libraries at schools and nurseries ("Biometric Bytes – It's all child's play", 2007). This would assist in the identification of food allergies and eating patterns as well as payments for school lunches. It could also be used for checking adult backgrounds to test suitability for becoming child-carers.

Education has its applicable uses for biometrics (Gonzalez-Agulla, Alba-Castro, Argones-Rua & Anido-Rifon, 2010). There are more and more e-learning environments providing virtual educational communities but insufficient controls as to how much time the trainees spend on the courses. One could monitor the logging in and logging out, but to confirm that the actions done on the computer were from the correct individual, one could use face recognition biometrics.

4.3.5 Health services

Health care systems are well suited to benefit from using biometrics (Betts, 2011; Chandra *et al*., 2008). One could use a physiological or behavioural characteristic of an individual to confirm identity when a patient is not coherent or unable to identify himself. This helps to speed up diagnosis and treatment by providing easy access to the correct medical information, thereby adding value to the health service. Using biometrics for identification will also further protect the health care system from misuse. Chandra *et al.* reported that there were many instances of false claims for health insurance (Chandra *et al.*, 2008). There is a trade-off between intrusion into patients' lives or benefiting them by being able to track their medical history.

One needs to have secure access to health-care information systems due to the sensitive information that is kept (Al-Hijaili & AbdulAziz, 2011). The Electronic Medical Record systems contain sensitive patient data which requires a secure authentication system. Traditional passwords and access cards can be easily lost or stolen but biometrics can ensure that only authorised persons gain access to the records.

The Health and Demographic Surveillance Systems (HDSSs) provide assistance for the tracking of demographic and health information in a region (Serwaa-Bonsu *et al*., 2010). They may work with Health Management Information Systems (HMIS) and help to estimate disease and incidence rates. Fingerprinting can be used in these systems (HDSS and HMIS) which can be combined to provide a platform for further analysis and subsequent health planning and policy formulation.

4.3.6 Government and services

Biometrics has also been used in government and other high security applications (Bayly *et al*., 2010). Looking at e-Government and its possible use of identity cards and remote access devices, one can see that it could ease service delivery on a 24-hour basis. An identity card or smart card could include biometric information such as a facial image, digitised signature, fingerprint and iris-scan, thereby producing a multi-modal biometric system (Beynon-Davies, 2007).

There are many benefits to be enjoyed in using a national Identification mechanism, such as better service delivery, less identity fraud and less terrorism (Penna, 2005). Discipline can be practised if populations are ordered, controlled, monitored and ranked, perhaps from the moment of birth to the moment of death. This results in surveillance of a controlled society. Such information can assist in providing rights (such as welfare), assessing needs and judging progress or actions. All citizens can be identified using biometrics.

Service delivery would improve because an individual would not need to authenticate across different systems but rather use the same identification mechanism to access all services, including passport, health, insurance, tax, travel, census, voting and proof of age (Beynon-Davies, 2007).

India is one example. The intention in India was to provide 600 million Indians with a Unique Identification Number by 2015 for the purposes of providing social benefits (Guha, 2010). This identification mechanism would include the person's fingerprints, iris scan and facial photograph.

Having discussed various applications where biometric features are being used for authentication, the discussion turns to problems with biometrics in the next section.

4.4 PROBLEMS WITH BIOMETRICS

This section of the chapter focuses on some problems that may be encountered when using biometrics. For example, while capturing a biometric one may introduce noise in the data. There are also ethical issues such as the subversive use of biometrics, privacy concerns and the use of biometrics with vulnerable subjects such as minor children or certain people groups. Error rates and matching thresholds are discussed as well.

4.4.1 Noise

One can use the term “noise” to refer to any kind of interference in the capturing of the biometric samples.

For example, fingerprints are usually life-long unless there are cuts or bruises on the fingertips (Mali & Bhattacharya, 2011). Finger-scan technologies cannot read fingerprints well if the person is elderly or is employed as a construction worker or artisan (Busselaar, 2010; Murray, 2007). Diseases of the skin can also affect fingerprints (Drahansky, Brezinova, Hejtmankova & Orsag, 2010).

It is a limitation if a fingerprint itself is sweaty or dry or has some skin defect. Sometimes the subject supplying the biometric may use an incorrect angle or exert too much pressure thereby causing distortion of the image (Busselaar, 2010; Kang & Park, 2009). In between uses, the fingerprint scanners need to be cleaned to ensure non-contaminated images.

Authors describe various problems when capturing iris images (Al-Hijaili & AbdulAziz, 2011; “Biometric bytes,” 2007a; “Biometric bytes,” 2008a; Harjoko, Hartati & Dwiyasa, 2009; Lee, Su, Tu & Chang, 2010). If iris images are captured under controlled circumstances then one can better ensure high quality iris images by

capturing a sequence of images and selecting the best one. The distance from the camera can affect the quality of the image. The discarded images usually are out of focus, or have blurring caused by motion, or have eyelid or eyelash occlusion caused by blinking during the capture of the iris image, thus introducing errors in the data collection.

Using the voice as a biometric also has problems that could be overcome (Morgen, 2012; Phillips, Martin, Wilson & Przybocki, 2000). Sometimes if a person is tired, ill, bored, irritated or otherwise vocally stressed then the speech recognition does not function well. Voices can also change over time as a result of changes in emotions, health or age. They can also be distorted depending on the quality of the device that is capturing the voice.

4.4.2 Function creep

According to Mordini and Massari (2008) and Penna (2005), "function creep" describes the action where data collected for one specific purpose is then used later for a different purpose which may have been unintended or unauthorised from the beginning. This can betray trust and destroy confidence in the original system and can be viewed as a serious ethical breach. If it was intended from the start that some information would be gained through hidden agendas, this is seen as "subversive" use of biometrics. This phenomenon has also been referred to as "data creep" or "mission creep" by other authors (Beynon-Davies, 2010; Guha, 2010; O'Neil, 2005).

4.4.3 Privacy concerns

Mackey (2006) lists personal data as comprising the following: demographic information, consumption habits, health information, interests, communications, movement, appearance, social behaviour and biometric information. The public are concerned about security and privacy of their own personal data. Privacy governs the right to protect homes, families, thoughts, emotions, expressions, personalities,

and communication and association choices, as ruled in 1975 by the California Supreme Court (Tomkins, 2008).

Perhaps the biometric identification technique is one that invades privacy or is a potential weapon for authoritarian governments (Mordini & Massari, 2008). Another concern is if a criminal obtained someone's identity card, would that not open that person's privileged access to various other systems? There are also questions regarding the correctness, maintenance and security of the central registry (Beynon-Davies, 2010; Guha, 2010).

The public should be willing to accept the biometric sensor device and find it easy to use and non-invasive (Manivannan & Padma, 2011). Face biometric features are non-invasive and therefore easily accepted by users and is becoming less costly. There is already software for handheld devices (such as cell phones) that can capture one's facial image and provide access to information from social networks as well as criminal records about that person (Kennemer, 2014). Facial recognition is therefore becoming prolific and affordable. A voice biometric feature is also non-invasive and takes up minimal space but there are problems with efficiency.

There may be other concerns about being "watched". Perhaps the public would prefer to be able to provide informed consent for having their biometric taken and used (Lyon, 2008).

There is a lack of legal frameworks for protecting consumer privacy and there is a trade-off between privacy and benefits. One can look at five basic principles for fair privacy policy (Wirtz, Lwin & Williams, 2007):

- Giving notice by telling the customers about the information that is collected and what the intention is i.e. for what reason the information is being collected;
- Allowing customers to choose whether their information may be shared with third parties or mailing lists;
- Securing the information from tampering, theft or misuse;
- Allowing customers to view and update or correct their information;
- Enforcing compliance by all companies that participate in the endeavour.

4.4.4 Error rates

Problems occur with biometrics when there are false acceptances and false rejections during the matching process. For example the system may accept a match for an incorrect person, or the correct person may be rejected. The thresholds that are used to tolerate these faults are not made known publically (Lyon, 2008). The threshold assists the decision making. Typically a threshold is 85% for a biometric identification system but a higher threshold can be set to improve security (Gams *et al*., 2009). To increase the threshold, one may extract more feature elements in order to do the authentication.

Many authors describe the various error rates (Alandkar & Gengaje, 2010; Beynon-Davies, 2007; Busselaar, 2010; Elumalai & Kannan, 2011; Gams *et al*., 2009; Manivannan & Padma, 2011; Sarbishaei & Khayat, 2009). One can use the False Acceptance Rate (FAR) to measure the rate at which an imposter can be seen as a valid user. This FAR is offered by the vendor. The False Reject Rate (FRR) is the rate at which an authorised user is rejected. One can perhaps reduce the false rejects in fingerprinting by storing prints from multiple fingers. The failure to enrol (FTE) is the probability that the enrolment is unable to take place. The equal error rate (EER) is the crossover point on a graph with both FAR and FRR curves where they become equal.

The following performance metrics may be used (Ashok *et al*., 2010):

- *Threshold based identification* – This looks at the query biometric and compares it to all entries in the database to see which matches reveal scores exceeding some threshold. The list of matches have the following possible situations:
    - There is either a “NO” implying that there is no match in the database at all, or a single “YES” for the correct match;
    - No definite identification because more than one match is found above the threshold;
    - A single match above the threshold may be a false match;

    - The threshold is not reached, although the real subject may be in the database, therefore yielding a false rejection;
- *Rank based identification* – This looks at similar candidates and then ranks them according to a secondary decision process.

The USA has passed a list of products according to a set of expectations, such as an FRR of less than 1%, an FAR of 1% and a transaction time of less than six seconds as well as an FTE of less than 3% (“Biometric bytes,” 2007b).

Regarding errors and biometrics, fingerprinting is seen as being more accurate than hair, blood type or ear prints because the fingerprint ridges and furrows develop already in the womb (Spinney, 2010). Voice biometric features take up minimal space and are also non-invasive but there are problems with the FAR and FRR (Manivannan & Padma, 2011). The iris is the best biometric for the most important data and has favourable FAR and FRR measures. However, it tends to be invasive.

4.5 A CLOSER LOOK AT SOME OF THE BIOMETRICS

It has already been mentioned that in this research endeavour, further attention is paid to certain biometrics. The reasons for this are presented in the first sub-section below, followed by the individual sub-sections for each of the chosen biometrics, i.e. iris, fingerprint and voice.

4.5.1 Reasons for including certain biometrics

Already in 2005 in the UK, the iris was seen to have the highest success rate (96%) while the fingerprint had 81% and face recognition was the next highest one with 69% (“Biometric bytes,” 2005a). Regarding acceptability by the public, the USA found fingerprinting to be most acceptable (80%), followed by iris recognition with 58%, hand geometry 50% and speaker verification with 48% (“Biometric bytes,” 2005b). The market share in 2005 revealed about 47-49% fingerprinting, 10-12% face recognition, hand geometry 10-12%, iris recognition 8-10% and voice recognition 5-6% (“Department of the Treasury”, 2005). Regarding mobile usage of

biometrics, again the fingerprint was most popular (80%), followed by voice (70%) and then the iris (53%) with other features being less popular (Furnell & Evangelatos, 2007). In 2011 it was forecast that the iris, fingerprint and face recognition systems would consume about 84% of the global market for biometrics by 2012 (RNCOS, 2012).

Looking carefully at these statistics it appears that the fingerprint and the iris are the more popular biometrics. Voice and face recognition are also well used. Hence the iris, fingerprint and voice recognition are studied further in this research.

4.5.2 The iris biometric

Iris patterns are often seen to be the most stable and reliable of the biometrics. One requires only part of the iris image for correct identification (Htwe & Htay, 2011; Shamsi *et al*., 2010). According to Dekking and Hansbergen (2009), the most prominent biometric system to use is the iris recognition system. However, it is also seen as technically complex and costly (Beynon-Davies, 2010).

Iris identification techniques have been used since 1997. The iris is the protected coloured part of the eye and has textural characteristics. No two persons have the same iris (Ashok *et al*., 2010; Lahrash & Nordin, 2011). The cornea and aqueous humour protect the iris which manifests itself permanently from the age of 8 months. It has a unique pattern, determined by the subject's DNA (Harjoko *et al*., 2009). There are embryonic factors that influence the human iris development such that even identical twins are distinguishable (Birgale & Kokare, 2009; Ezhilarasan, Jacthish *et al*., 2010). The unique patterns in the iris differ even between the left and the right eye of the same person and are constant throughout the lifetime of the person (Htwe & Htay, 2011).

When the eye is open normally, the eyelids and eyelashes occlude the lower and upper part of the iris (Strzelczyk, 2011). The intensity of the iris is higher than that of the pupil and lower than that of the sclera which surrounds the iris, thus allowing the iris to be separated from the other two (Harjoko *et al*., 2009). Iris localisation and

segmentation is a very important step where the boundary between the iris and the pupil is detected as well as the eyelid and eyelash occlusions (Roy & Bhattacharya, 2010).

The iris is a contactless method of identification as well as one with high confidence levels. The features of the iris are encoded into a 512 byte Iris Code at the enrolment stage (Alandkar & Gengaje, 2010). The scanning may be done without the subject's knowledge. If the iris image is gathered in a controlled environment then it performs very well and with high accuracy rate, but in a lesser controlled environment the iris images may not be a first choice (Roy & Bhattacharya, 2010).

The iris is described as the best biometric for the most important data and has favourable False Accept Rate (FAR) and False Reject Rate (FRR) measures. These error rates are lower in comparison to facial features, fingerprints, palm-prints, retina, hand-writing signature, DNA and gait. However, the extraction of irises is sometimes seen to be invasive (Lee *et al*., 2010; Manivannan & Padma, 2011).

Iris scanning is very reliable as there are more than 250 points of reference in the iris which is randomly freckled and ridged and able to be captured regardless of the subject wearing glasses or colour contacts, or having undergone laser surgery (Chandra *et al*., 2008). For a baby, however, iris identification is more problematic because usually a baby's eyes remain closed most of the time. The other issue is that the iris is not stable until the child is about two years old (Jia *et al*., 2012).

4.5.3 The fingerprint biometric

Fingerprinting was discovered to be useful for identifying criminals in the late 1800s by Henry Faulds (Wade, 2004). It has now been used for many more applications. Fingerprint recognition is also very popular because it is convenient and efficient and is widely used for access to welfare hand-outs (Serwaa-Bonsu *et al*., 2010).

Fingerprints are usually life-long and unique and are therefore a good biometric to use for identification (Manivannan & Padma, 2011; Omidiora, Fakolujo, Arulogun & Aborisade, 2011). They are available, reliable and highly accurate and the

technology is easy to implement. Their usage as an identification mechanism has been around for quite a long time, being the oldest used biometric, but they may be costly.

Fingerprinting is seen as being more accurate than hair, blood type or ear prints as the ridges and furrows develop already in the womb (Spinney, 2010). Fingerprints are too small on babies, however (Jia *et al*., 2012).

The fingertip itself has ridges and valleys so it depends on these ridge features and their relationships. There are ridge endings where a ridge comes to an abrupt end and ridge bifurcations where the ridge divides into multiple branches (Lalithamani & Soman, 2009). Since 400AD, fingerprint patterns were known as comprising loops, whorls and arches (Ezhilarasan, Kumar, Santhanakrishman, Dhanabalan & Vinod, 2010). Sir Francis Galton in 1890 identified fingerprint characteristics as minutiae points, and in particular one looks at the ridge termination and ridge bifurcation and the core points. A core point is the uppermost of the innermost curve as can be seen in Figure 4.1 ("Department of the Treasury", 2005).

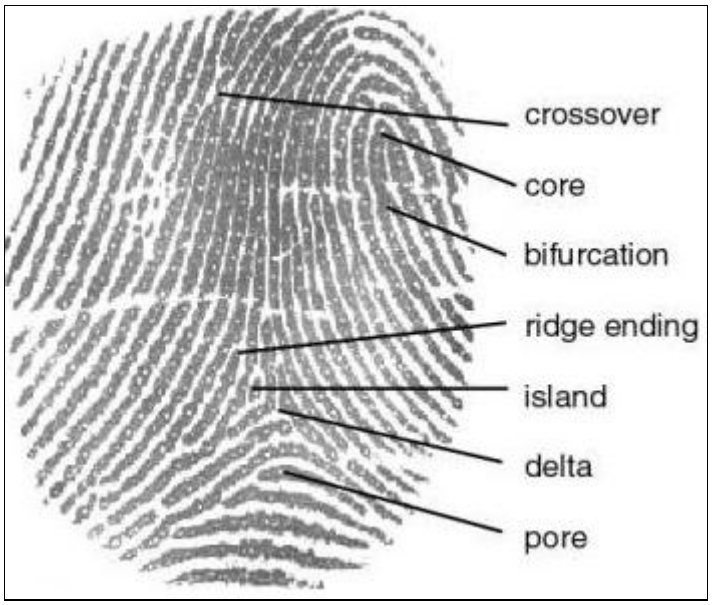


Figure 4.1: Fingerprint showing some minutiae points (Adapted from "The use of technology to combat identity theft" by The Department of the Treasury, 2005, Retrieved from http://communitybooks.worldebooklibrary.org/Members/Government_Library/United_States_Department_of_the_Treasury/biometrics_study.pdf)

All fingerprint recognition systems have feature extraction where these minutiae points are detected. Feature matching is where the extracted features are compared

with those from the database, stored for that individual (Elmir, Elberrichi & Adjoudj, 2011; Ezhilarasan, Kumar, *et al*., 2010). Sir Edward Henry among others, classified fingerprints into five categories as shown below so that the time taken to match against entries in the database is lessened by localising similar classes (Gams *et al*., 2009; Jampour, Yaghoobi & Ashourzadeh, 2010; Mali & Bhattacharya, 2011):

- *Right loop* – The loop forms a curve that ends on the same side of the finger from which it began;
- *Left loop* – As above;
- *Whorl* – The whorl is where circular patterns form around a central point on the finger;
- *Arch* – The arch is where the ridges rise from the one side of the finger to form an arc that leaves on the other side of the finger;
- *Tented arch*.

Automated Fingerprint Identification Systems help reduce the time taken to do fingerprint comparisons because the database groups similar fingerprints leading to faster searches (Gams *et al*., 2009).

Fingerprints can be taken in less than two minutes. Usually at least both index fingers are digitally scanned to improve the image (Chandra *et al*., 2008). It is said that any two persons would not have more than seven common minutiae (Singla & Arora, 2010). Even identical twins have different fingerprints (Lalithamani & Soman, 2009). On average each fingerprint has between 50 to 80 minutiae. The methods used to identify fingerprints may be one of two (Ashok *et al*., 2010; Jampour *et al*., 2010):

- Minutiae based algorithm prepares the fingerprint features after a pre-processing phase. The minutiae based matching would match the location and orientation of the minutiae points resulting in a template size of less than 400 bytes per finger. A sample recording process of the fingerprint is shown in Figure 4.2 (“Department of the Treasury”, 2005). Although the extraction of these minutiae points takes time, the matching is fast because of the small template size;

- Pattern based algorithm compares the patterns of the fingerprint samples. Pattern recognition is carried out by classifying sets of fingerprints that are similar (Elmir *et al*., 2011). When matching images the one image is placed over the other one and shifted to align as much as possible so that if enough areas are aligned, then it is deemed a match (Ashok *et al*., 2010).

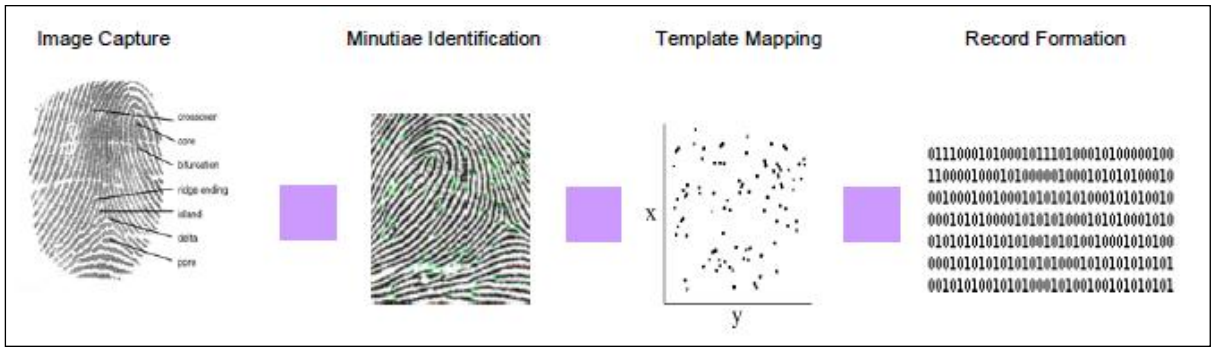


Figure 4.2: Fingerprint recording process (Reprinted from "The use of technology to combat identity theft" by The Department of the Treasury, 2005, Retrieved from http://communitybooks.worldebooklibrary.org/Members/Government_Library/United_States_Department_of_the_Treasury/biometrics_study.pdf)

There are various ways to extract fingerprints (Ashok *et al*., 2010):

- Optical sensors are cheap and reliable but bulky. They cannot test for liveness, however, and may be exposed to spoofing. They allow a visual image to be captured from a surface;
- Capacitive sensors are more expensive and need more power to scan the finger surface. The image quality is better but not if the fingers are dry;
- Thermal sensors measure the heat emissions between the ridges which are cooler and the valleys which are warmer. These sensors also use much power but are small and inexpensive. They do not work well on warm days;
- Radio frequency sensors can get to the subsurface of the finger and are therefore not affected by dirt on the surface. They are small, accurate and reliable.

There are other sensor mechanisms, such as e-field, electro-optical, solid state and pressure sensitive but the ultrasound technology is the best because it penetrates beneath the upper "damaged" skin layers (Busselaar, 2010; Drahansky *et al*., 2010).

4.5.4 The voice biometric

The voice is useful for securing access to applications. One can usually recognise a person on the other side of a phone instantly when that person begins to say “Hello”. This is the only biometric that uses acoustic data and can therefore work with public telephones. One can capture voice even with smart phones or Personal Digital Assistants as long as there is a microphone (Vielhauer & Scheidat, 2005). Mobile telephones are widely available and are therefore becoming a useful prolific device for use with biometric technology (Fauve, 2010; Morgen, 2012). One can use the phone to verify that a claimant is still eligible for payment of benefits by checking the voice biometric (Carroll, 2012).

Various authors have suggestions about using voice biometrics (Markowitz, 2000; Markowitz, 2001; Morgen, 2012). When using voice biometrics, some extractions are made from the speech stream and it is more efficient if there is a larger amount of speech recording data captured with a good microphone and accompanied by noise cancellation. One needs a “reference voiceprint”. A sample voiceprint is shown in Figure 4.3 (“Do we have a unique “voiceprint”?”, 2013). When a person wishes to claim identity then a new voiceprint is compared to the reference voiceprint and the usual acceptance/rejection threshold is used to accept or reject the identity claim. For example one can capture the speech of a person while he/she recites an account number or group of words or numbers. At a later instance, the person would recite the same account number or prescribed words and the two versions of the captured speech can be compared in order to ensure authorised access. This process involves speech recognition but also verifies the speaker. Speech recognition is where one analyses what the person is saying. Voice recognition is where a particular speaker may be identified.

There is a risk that someone’s speech can be captured without one being aware of the infiltration (Marcel, 2013; Markowitz, 2000). Therefore, in some high-risk systems, one may be expected to provide text as prompted by the system. This means that an intruder with a taped set of replies would not be able to get into the system if some challenge/response questions are presented in a random order.

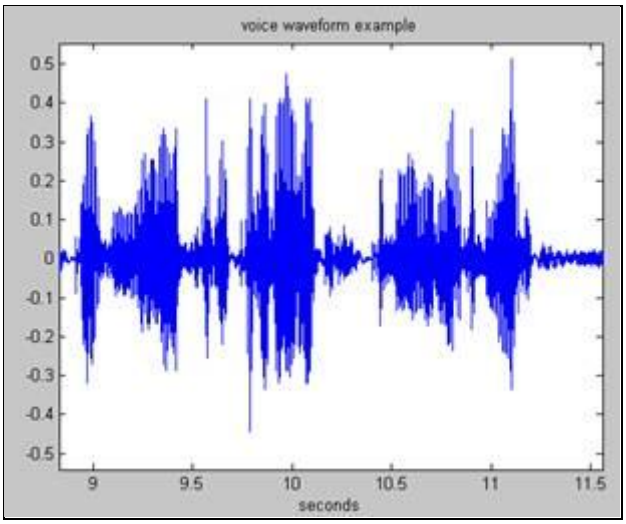


Figure 4.3: Voiceprint sample (Reprinted from "Do we have a unique "voiceprint"?", 2013, Retrieved from http://uknowwhatimsaying.com/do-we-have-a-unique-voiceprint/)

The Australians use voiceprints in their social security system (Golden, 2012). The Philippines also use voice biometrics to identify pensioners and other members of the Government Service Insurance System. For enrolment, they have to recite the numbers zero through nine three times. Even at a distance such as persons who are out of the country, the identification can still be done if the applicant provides his/her passport and two other identification items and shows them to the webcam. Later when the applicant wants to carry out a transaction, he/she would enter his membership number and be asked to recite the numbers zero through nine. Subsequent questions for random numbers to be recited would also be posed in order to confirm that the person is correctly identified.

An authentication solution is suggested where at least two of the following should be in place together to provide for strong authentication (Fauve, 2010):

- Something one knows – knowledge data;
- Something one has – mobile phone;
- Something one is – voice biometric;
- Somewhere one is – proximity or location.

It would not be sufficient to simply have a phone, as it could be easily stolen. One requires the other parts of the authentication solution as well. Conversational

biometrics is a term used to combine knowledge data with voice biometrics (Fauve, 2010). Voice biometrics certainly reduces time spent on identification procedures but there must be no excessive background noise. One risk is that if a fraudulent person tries to gain access and his/her biometric is rejected, the traditional method of verification should take over but not be dangerous in that personal information is revealed to the wrong person. The "real" client should be informed somehow of the result of the authentication. The "real" client would soon realise that someone was trying to impersonate him/her if he/she receives a call to indicate attempted verification. One can also find out whether the actual transaction being conducted is in close proximity to the mobile phone that is linked to the "real" client. This implies that cell phones support all four situations above. E-government is one area where this can work to make obtaining public services more convenient and affordable. One can certainly prevent a fraudster from obtaining a grant while outside the country.

A study done in the UK proved that there was better performance using speaker verification than all other biometrics except for the iris (Markowitz, 2001). Each person's voice is unique in that it has a pitch, a cadence and some inflection for its various phonemes (Fong, 2011). Voice biometric features do not need additional hardware and authentication can be done remotely. It is easy to use and is non-invasive. The voiceprint must, however, be strengthened to avoid security breaches (Fong, 2011). One must also remember that the voice may change over time as the person gets older (Myers, 2004).

This section has looked at particular biometrics that may be discussed during the presentation of the framework in this research. The next section looks at the biometric processes of enrolment, verification and authentication.

4.6 ENROLMENT, VERIFICATION AND AUTHENTICATION

For biometric identification one has to first collect the sample, process it into a template and store it in a database or on a biometric device such as a smartcard which is carried by the user (Thomas, 2005).

This digital authentication for biometrics has various processes for which authors used certain terms to describe them (Al-Hijaili & AbdulAziz, 2011; Bhatnagar *et al*., 2010; Birgale & Kokare, 2009; Elumalai & Kannan, 2011; Ezhilarasan, Jacthish *et al*., 2010; Lahrash & Nordin, 2011; Mali & Bhattacharya, 2011; Manivannan & Padma, 2011; Őzkaya & Sağiroğlu, 2010; Renaud & De Angeli, 2009; Sağiroğlu & Őzkaya, 2009; Spinney, 2010; Uludag, Ross & Jain, 2003; Wayman, 2001):

- *Feature Extraction/Segmentation* is the capturing of the unique collectible biometric from the source using a camera or sensor unit or other preferred device. One then extracts the feature set from the acquired data. This extraction of features is necessary because the complete image would require too much memory. Feature extraction preserves the required pattern and discards the non-relevant data. In particular one may want to keep the data that does not depend on environmental or other changes when the particular biometric is harvested again at a different time. One should check the extracted feature set (image) for quality before converting it into digital form in order to be saved as a template. If the check for quality revealed an unacceptable image, the biometric extraction should have been repeated to obtain a better sample. The template thus produced would be used later for future verification or authentication. Usually this feature extraction to produce the template is done before transmission to reduce the bandwidth required. Segmentation is another word to describe the procedure of getting the real iris image from the whole eye, for example. The segmentation itself must be reliable otherwise there would be an effect on the performance of the iris as an identification mechanism;
- *Transmission* – Sometimes the biometric is collected at one place and stored at another and this may involve transmission of compressed images which must be uncompressed again at the other end. One must be careful not to have data quality loss during the compression stage. One must complete the feature extraction before transmission to avoid unnecessary bandwidth;
- *Enrolment* is done after the acquisition and digitizing of the biometric template. When a person is enrolled, his/her biometric data is processed and the feature set template is put into the database with the person's identity or

onto a magnetic stripe card which is kept by the person. Sometimes multiple templates may be stored. The template may be processed into a value such as a long string of alphanumeric characters that is stored into the database. Some authors describe enrolment as involving feature extraction followed by registration into the database;

- *Verification* is when a person has provided a biometric and it is matched with a captured sample in order to confirm whether the person is indeed who he/she claims to be. The system would match the stored biometric with the new captured biometric in order to do the verification;
- *Identification* requests are made when it is required to find out who the person is i.e. to identify the person. The system would match the new captured biometric with all the stored data in order to see whether there is a match, and to subsequently identify the person. The smaller the "distance" between two matched biometrics, the better the match. If the match is successful, it may provide access to a protected system. *Screening* is when one is looking to identify many individuals on a watch list, for example at a sports game. In this case there are many comparisons being made against the database to find matching biometric templates in order to make identifications;
- *Authentication* happens when a user is challenged to provide a new live biometric template so that a comparison can be made against a template that already exists in a database in order to grant access to some system. One does this for the purposes of verification of a claimed identity. There are usually multiple templates for any particular user in order to cater for variations. Hopefully a successful match would result and the system verifies the claimed identity. One would authenticate the user if there is sufficient evidence of a match. *Decision* making or *matching* is where one arrives at a result of positive or negative depending on the strength of the similarity after comparing the newly generated template with the stored template. This comparison may be required at real-time when trying to verify an identity, or authenticate someone, or when screening for suspects. One usually uses predefined policies to make this decision;

- *Replacement* is necessary if the user needs to issue a new biometric template;
- *Evaluation* leads to one of three results: identification, exclusion or inconclusive evidence. A matcher function would have done the matching of the query template against the templates in the database and the result of this function is a score which is classified according to some threshold.

4.7 MAKING BIOMETRICS MORE SECURE

Passwords are regularly altered, stored, salted and encrypted to prevent their leakage, but biometric features are lifetime measures and are not subject to change, hence that feature's use as a biometric. One requires new methods to protect the biometric data. If the biometric key is supposed to be secret, then there should be no access to the original biometric features of the human from which the biometric was first created (Plaga, 2009). This is not always possible to prevent because one leaves fingerprints everywhere, or one walks past iris recognition or face recognition cameras. While being able to cover one's hand while typing a password with the purpose of preventing someone lurking "over-the-shoulder", it is not possible to totally prevent one's biometrics from being derived in the real world. Therefore one could rather use a biometric key to protect the security and privacy of the biometric information itself i.e. the protected templates such as in mobile devices, magnetic smart cards or databases.

4.7.1 Cryptographic biometric keys

Biometrics can change over time as a result of the patterns, the environmental conditions and the sensors. One requires newer encryption methods for biometrics due to the extra noise and variability. Argyropoulos *et al*. (2010) suggests binding the original biometric data template into a cryptographic key.

There is an increasing move to mixing biometrics and cryptography (Plaga, 2009). Various ways can be used to create cryptographic keys, including extraction from

biometrics, resulting in “biometric keys”. Looking at the processes of a biometric system in detail, some biometric information is extracted and stored digitally, usually called a template which signifies the enrolment of the subject into the biometric system. Later a new template is derived from a new biometric image of that same feature and the two templates are matched. The subject may be thus identified. If one maps this biometric template onto a unique numerical string, then there may be security applications using the string, because the biometric would result in the same string.

Various authors discuss using cryptography with biometrics (Argyropoulos *et al*., 2010; Chen & Chen, 2010; Gaddam & Lal, 2011; Lalithamani & Soman, 2009; Seshadri & Trivedi, 2010). Systems that use biometrics and cryptography may be called biometric cryptosystems, or crypto-biometric systems. Biometric cryptosystems use biometric features to generate a cryptographic key using some extra public information, called helper data. This is secure as it would be complicated to fabricate a cryptographic key generated using a biometric and certainly hard to memorise if one uses the Advanced Encryption Standard keys.

There is performance improvement when using cryptographic keys which are produced from biometrics. The problem arises, though, if the biometric feature is compromised, which results in infiltration for the applications that use the biometric. Therefore the idea of cancelable biometrics has become a preferred solution (Gaddam & Lal, 2011). For example, with fingerprints, there may be three phases in this approach. First, the minutiae points may be extracted. Then a cancelable biometric template is generated from that. Finally, the template is used to generate the cryptographic key, thus producing a key that is irrevocable, unique and effective. Argyropoulos *et al*. (2010) also suggests the use of irreversible stored templates so that the original biometric is not extracted using reverse engineering in order to produce false copies of the biometric.

4.7.2 Hashing and salting

One can hash and/or “salt” a traditional password for more security (Chen & Chen, 2010; Plaga, 2009). One can also protect biometric templates in the same way. Biometric templates are also subject to noise which would cause different hash values, so a better solution is to hash a biometric key rather than the original template. Salting can be used to protect the biometric key, by applying some transformation to the biometric data.

This section has looked at some protection mechanisms for biometric data. The next section discusses the use of multi-modal biometrics which adds further protection for various issues of concern.

4.8 MULTI-MODAL BIOMETRICS

As can be seen in an earlier section in this chapter, there are many problems that can arise when using biometrics. Single modal biometric techniques may mean less accuracy and higher FARs or FRRs. The use of multiple biometrics can help reduce or overcome these problems (Argyropoulos *et al*., 2010; Al-Hijaili & AbdulAziz, 2011; Elumalai & Kannan, 2011; Plaga, 2009).

There are various instances where a single biometric solution may result in non-enrolment or bad matching. Immigrants sometimes may not be able to prove their identity. Disabled persons are not always able to have the required biometric samples taken (“Biometric Bytes,” 2005a). Biometric data is also susceptible to changes over time or in different environments. For example fingerprints may be only partially captured, faces may change their pose and dry weather would affect fingerprints (Uludag *et al*., 2003). It may be that certain persons are prevented from participating in the biometric technology due to cultural and circumstantial issues, such as hard labour having an effect on fingerprints, or dark irises not being able to be read (Murray, 2007).

It is therefore becoming more acceptable to use multi-modal biometric systems because multiple sensors and biometric features improve the accuracy of a match,

thus providing performance advantage. A multi-modal system is also not so easy to compromise through forgery or fraudulent attacks (Argyropoulos *et al*., 2010; Bhatnagar *et al*., 2010; Elumalai & Kannan, 2011; Marcel, 2013; Mordini & Massari, 2008; Sağiroğlu & Őzkaya, 2009; Venkataraman, 2010). If one is using a low performance biometric, such as facial recognition, one can therefore improve overall performance when adding the iris recognition as a second biometric in a multi-modal system because the iris is considered to be the best in performance (Elumalai & Kannan, 2011).

Biometric systems that use multiple data sources must be aware of privacy concerns and multi-modal biometric fusion issues (Venkataraman, 2010). One would have to normalise the scores to bring the different biometrics into a common domain before applying the multi-modal fusion which provides higher performance than the individual single modal systems. Biometric fusion can happen at different levels (Al-Hijaili & AbdulAziz, 2011; Milovanović, Minović & Dušan, 2012):

- The sensor level fusion requires compatible data from the different biometric sensors;
- The feature level fusion is problematic in that the feature sets may be inaccessible or incompatible. The feature level means which biometric features are being put together, i.e. fingerprint and voice, for example;
- The matching score level fusion is preferred as there is enough information to combine the matching scores. The score level involves mathematics and statistics;
- The decision level fusion is too rigid with too little available information. This level uses statistics and business intelligence.

Therefore using fusion at the matching score level, one can set different tolerances for FAR and FRR (Al-Hijaili & AbdulAziz, 2011). For example, the FAR should be minimised in a high risk application such as health care. One must also be aware that face recognition is affected by light, pose and facial expression. Iris recognition is affected by occlusion, movement and poor focus. The effect of factors like these in the various biometrics must be reduced in order to get the best performance. Different weights may also be applied to the face and to the iris.

4.9 CONCLUDING REMARKS

Some biometric topics have been discussed in this chapter and are summarised in Figure 4.4 to indicate that they are used for the eventual preparation of the framework. This chapter presented a literature review on biometrics in order to answer the biometric portion of Question 1: *What are suitable biometric methods that can be used for social grants in South Africa?*

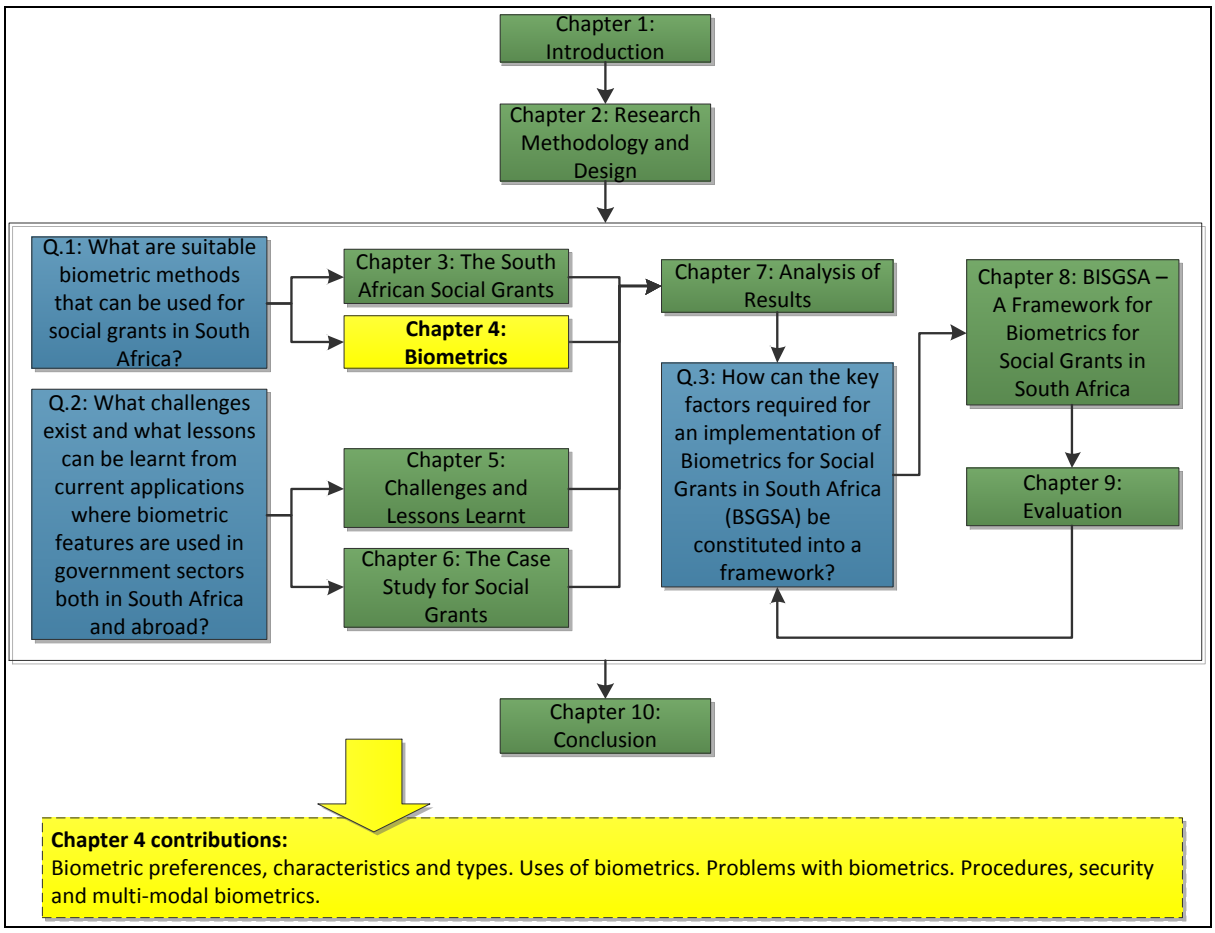


Figure 4.4: Contributions from the literature review on biometrics

Formal coding was used on the information found in this chapter in order to provide input to the framework as will be described in Chapter 7.

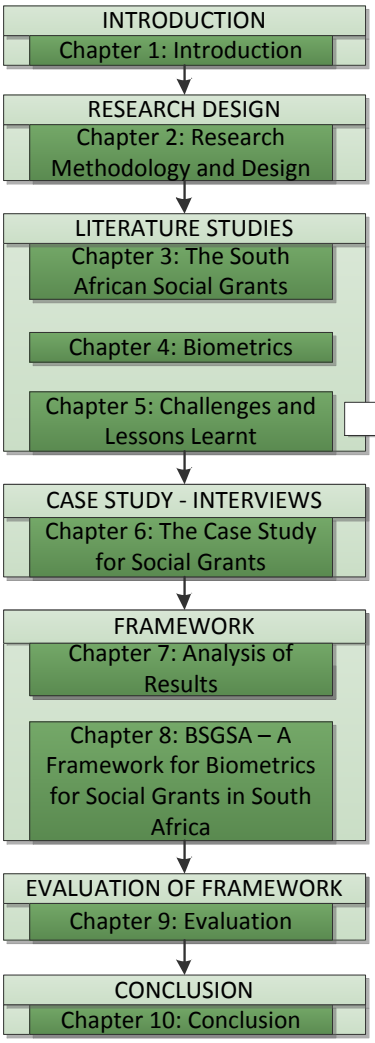
4.10 SUMMARY

This chapter has attempted to introduce various facets of biometrics. Various characteristics were described, the most obvious being that it should be unique for each individual. The types and applications of various biometrics were presented. Some problems were discussed, such as error rates, noise, function creep and security concerns. The idea of cryptographic biometric keys was proposed. Multi-modal biometrics was suggested as a preference over using only a single biometric.

A later chapter will present a framework which may include some of the contents discussed in this chapter.

CHAPTER 5: CHALLENGES AND LESSONS LEARNT

LAYOUT OF CHAPTER 5



CHAPTER MAP

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5.5 CONCLUDING REMARKS

5.6 SUMMARY

5.1 INTRODUCTION

This chapter attempts to discover challenges and lessons learnt where they have relevance to:

- social grants in South Africa;
- biometrics used for the social grants;
- National identity schemes where biometric features are used abroad.

This chapter therefore discusses a blend of social issues (welfare grants) and technical issues (biometrics). First in Section 5.2, some themes are identified to guide the order of the presentation of the challenges and lessons learnt. Thereafter the literature study is presented in Section 5.3 to reveal challenges and lessons learnt with regard to welfare schemes in South Africa, with particular reference to biometrics where applicable. This is followed by Section 5.4 on various countries abroad and their adoption of biometrics for the purposes of welfare systems. Some concluding remarks are presented in Section 5.5 and the chapter ends with a summary in Section 5.6.

5.2 THEMES IDENTIFIED

This research endeavour to create a framework for biometric implementation for social grants in South Africa suggests a blend of human issues and technology. One cannot add new technology and neglect the social implications thereof because there is interdependence and inseparability of the two (Liu, Nakata & Harty, 2010). The social system should support the technical improvements (Appelbaum, 1997).

According to Appelbaum (1997), one should look at the environment, goals, structures, officials, people and technology when implementing technology for people. Therefore these six themes are used to organise the challenges and lessons learnt in this chapter as follows:

- The *environment* examined in this chapter is the environment within which the social grant procedures are carried out;

- The *goals* discussed are those goals which would have been set for correct implementation of the social grants;
- The *structures* are the official forms, procedures, rules and/or regulations for the social grant processes;
- The *procedures* for *officials* are those issues that are relevant to the South African Social Security Agency (SASSA) or other government officials who handle the social grants for the recipients;
- The *people* relevant to the study are the members of the public who are recipients of social grants;
- The *technology* is that which is required for the biometric implementation for the social grants.

This next sub-section discusses challenges and lessons learnt in South Africa and the information gathered is organised within these themes.

5.3 THE SOUTH AFRICAN EXPERIENCE

Challenges and lessons learnt when using biometrics for social grants in South Africa are presented in this section. Included in the presentation of these challenges and lessons learnt, there may be some references to articles from abroad where the content applies to the South African experience.

5.3.1 Interaction with the environment around social grants

To identify challenges and lessons to be learnt from interactions with the environment, it is necessary to find out in this sub-section, which environmental factors influence the work and what problems arise from these factors. One should identify the strengths and weaknesses in the organisation with respect to the environment (Appelbaum, 1997). For the purposes of this research, the term “environment” describes the environmental circumstances at the various locations where the social grants are handled. The discussion begins with infrastructure,

remote offices and temporary locations, criminals found in the vicinity and finally community support or lack thereof.

Problems with environment may include the physical infrastructure such as the buildings and surroundings. In 2011 SASSA investigated pay-out points and found that only 13% of them met the required guidelines that had been set up (Nini, 2011). The environments were bad and particularly the aged grant recipients were suffering. The roads were also inaccessible in many areas.

Usually in a remote environment, where large distances separate a remote office from the main branch offices, one would have to control the remote office also as well as if it was nearby (Verma, 2000). New mobile units would have to be started up in remote areas where necessary to manage the growth and volume of the services that are required.

It was found that standards for providing basic humane facilities were not being met at many of the pay-points (SASSA, 2012b). It was reported that some temporary pay-point and/or application offices had been set up in open fields where there were no chairs, no ablution blocks and no electricity or water (Pressly, 2011). This invited crime and robbery. It caused slow processing and resulted in poor quality of service. It could also result in a lack of commitment on behalf of the workers as well as the public. In such environments, there were also complaints about lack of staffing and faulty technology. In 2012 it was reported that some officials were issuing cards outside in the heat of the day on top of rubbish bins, to accommodate long queues (Seanego & Manyathela, 2012). There were no chairs for the queues of applicants and there were dangerous electricity cables lying around.

There may also be undesirable elements in the environment in the form of criminals ("Getting SASSA," 2003; "Loan sharks," 2008). Bribery was often used to advance applicants to the front of the queues. Outside the offices there were many loan sharks who targeted the people waiting in the queues for pay-outs. The loan sharks confiscated payment cards and other identification documents as security for money borrowed from them. Holding such identification items is considered unscrupulous practice as these items belong to the state. Such occurrences can lead to criminal

investigations, if reported. There were also reports that some shops expected commission before cashing cheques for customers.

The environment includes the communities in the area. In 2003 religious leaders in KwaZulu-Natal wanted the Child Support Grants (CSGs) to be scrapped because they indicated that it affected the traditional way of life as practised by the Zulus (Mbatha, 2003). They argued that there were women who were herding cattle in the fields, which was traditionally taboo. They said that the people were hungry and needed to be given food rather than encouraged to collect identity documents for the purpose of the social grants. In 2006 the South African Students Congress also wanted the system scrapped, arguing that the mothers were not using the money correctly and that the money allocated for CSGs should rather have been spent on tertiary education (Muofhe, 2006). Some reports were that the mothers were neglecting their children and using the grant money to make loans to others in order to claim interest, thus abusing the CSG allocated to them (Matomela, 2007).

5.3.2 Goals for the social grants

This sub-section looks at the goals for the technology system. To identify goals for an organisation that wishes to embrace technology, one needs to find out what influences the attainment of the goals, both positively and negatively (Appelbaum, 1997). The goals discussed in this sub-section are those that should have been aimed at by the grant assistance programs. The discussion begins with the main goal being to relieve poverty and other associated problems, followed by solving migration issues and providing universal access to grant pay-outs. There is also discussion regarding the government's goals for re-using the information. Thereafter there are suggestions for handling peak times, unnecessary delays, increases in demand and changes to regulations. Finally there is discussion on the need for the technology, its efficiency, security and privacy requirements.

The Child Support Grant (CSG) was instituted to assist the poorer household. This could be seen as a major intended goal for this grant. It is proven that there is a link between positive child development and social grant assistance (Dlamini, 2010).

The grant was intended to supplement the household and could be used for school uniforms, books or transport. There was a provision for children who received CSGs to be exempted from school fees, but this is not automatic (Sitole, 2011; Tilley, 2009). There is increased school attendance because the parents are using the grants to feed their children and send them to school (Tilley, 2009). The grant therefore has put the power into the hands of the people and has encouraged them to secure a future for their children.

A study carried out by the Centre of Social Development in Africa found that 82% of residents who received the grant felt that it improved their quality of life (Sitole, 2011). It helped to shield their children from poverty during the recession (Khanyile, 2011; Sitole, 2011). In 2012 a study by the Department of Social Development, the United Nations children's fund, and SASSA showed that besides reducing poverty, the CSG resulted also in reduced sexual activity, pregnancies, alcohol and/or drug usage, criminal activity and gang membership (Phakathi, 2012). Despite suggestions by some individuals that teenagers were falling pregnant in order to be eligible for grant money, studies have shown that there is no link between the teenage pregnancies and the social grant applications (Dlamini, 2010; Skweyiya, 2007). Many of the teenage applicants were only applying for the grant much later when the child was already two or three years old.

Another goal for social grants in general is that the homeless should be able to move around and still receive their benefits legally and easily. They may not have a fixed abode but this should not prevent them from receiving welfare assistance (Krakovsky, 2011; Wickins, 2007). Usually a citizen would have to enrol in the system to receive the financial support. It is a pity that some officials expected bribes in countries abroad where millions of poor citizens were in dire need of access to welfare support and were not reached by controlled welfare programmes (Guha, 2010).

This paragraph borrows experiences from abroad which may be applicable to South Africa. The government goals should not only involve concern about the collection of the data, but should also involve decisions on how the data would eventually be

used, by whom, and how it would benefit the citizens (Martin, 2012). The identification and associated technology could assist the state to govern “from a distance”. It would ease the citizen’s life, defend his/her interests and provide trust and reassurance by providing mobility as a form of freedom such as the monitoring at borders, for example (Ajana, 2012). The collected information could also be used for census purposes and in times of natural disaster (Rao, 2011). It would be useful if one could use a national system for voting, licensing, insurance and national security as well (Owusu-Banahene, Nti & Sallis, 2010).

Performance goals should also be considered (Lewis, 2010; Magubane, 2009b; Makinana, 2007; Mvenya, 2010; Pahmeier, 2011; Rehfuess & Akl, 2013; Verma, 2000; Warren & Mavroudi, 2011). There are peak times where the demand for a well-functioning system is even higher than usual. Managing the processes at these times should be done as efficiently as when there are off-peak times. The methods for doing the work should be developed and controlled and the delivery of the services should be scheduled appropriately. Costs should be kept low and a high standard of quality should be maintained for all functions. The processes must not take too long before completion and there must not be too much “red tape”. Reports have been made of elderly women sleeping in the cold outside the perimeter of SASSA offices due to the slowness of the grant pay-outs. This was an unfavourable image according to the public.

A sudden rise in the number of applicants could cause delays. This rise in numbers could have been a result of regulation changes such as increases of age limits for Child Support Grants, or raised income levels for those who qualified for social grants (which is usually done annually). A report in 2010 showed that when six extra staff members were added to improve this situation by working overtime as well, the queues were quickly shortened and applicants could leave by mid-afternoon (Lewis, 2010). There should be sufficient assistance at the application points so that time is saved (Islam & Grönlund, 2010).

Whenever new regulations are released concerning the grants, the citizens should have been well-informed thereof (“Explanation about Child Support Grant,” 2010;

Nkomo, 2010). In 2010, there was much confusion when a report went out to state that all children up to 18 would be able to receive the CSG. However, the intention was only to introduce that situation by 2012. The Black Sash received numerous distress calls from parents who had not understood this delay and wondered whether their children were eligible.

Looking at the goals for using biometrics in particular, one should ensure that the need for using the technology is genuine, that a less secure control would not have sufficed, and that the implementation to meet that need does indicate effectiveness. If there is intrusion of privacy, it should be minimal, not more than is necessary to ensure required functionality (Greenleaf, 2010; Martin, 2012; Pavone & Esposti, 2010; Shade, 2013).

Regarding the database demands and the identification matching such as the checking of biometrics, the continuing growth of the system in size should not affect the performance of the system (Krakovsky, 2011).

An important goal is that of the security of the information. Attention should be paid to confidentiality such as what information is kept, where it is kept, how it is secured, who has access to the information and what criteria should be used when deciding to share the information with others such as across national borders. According to the literature from abroad, the information may have been collected for criminal identification but may perhaps be used for other purposes as well, such as politics, commerce, employment, banking, housing loans, credit rating, health care or social discrimination (Arteaga, 2011; Bunyan, 2010; Greenleaf, 2010; Islam & Grönlund, 2010; Laas-Mikko & Sutrop, 2012; Martin, 2012; Meints *et al*., 2008; Mok & Kumar, 2012; Pavone & Esposti, 2010; Rao, 2011; Shade, 2013; Wickins, 2007). The owner of the information should be able to authorise the dissemination of his/her information, unless it is for the purposes of law and order (Pavone & Esposti, 2010). The information should be deleted when no longer required (Meints *et al.*, 2008). There are also ethical issues related to sharing health data but this might be in the best interests of the patient to be able to have the data shared when necessary (Swartzman, 2010). Each person has the right to decide what happens to their

health data. The state is not a parent and does not have the right to decide what is in the best interests of adults. Moreover, many governments are simply not to be trusted to behave ethically.

The system should counteract fraud (Krakovsky, 2011; “Biometric ID,” 2012). The data itself should also be protected against forgery. The data that is extracted should be the absolute minimum that is required for the particular purpose and the public should be made aware of the extraction or surveillance. The public should also not be misled regarding the reliability of the system or the possible transference of their information to other databases or systems (Laas-Mikko & Sutrop, 2012; Meints *et al*., 2008). The collected information must be able to be continuously updated where appropriate for the sake of integrity, and must be protected against loss, unauthorised access, use or disclosure. Audit records should be kept when queries are made about an individual (Greenleaf, 2010).

5.3.3 Structures necessary for social grants

This sub-section looks at the structures required for an intended implementation of technology. Identifying the structures involves finding out whether the structures assist in the attainment of the goals and the performance of the tasks. It is important that the structures support the needs of the workers and the officials. The structures should allow for collaboration and reasonable use of the technology and other resources. It is also important to identify strengths and weaknesses in the structures and their interaction with other elements (Appelbaum, 1997). The structures discussed in this sub-section are those in place to provide facilities for the public to apply and receive social grants. These structures may be standard procedures and/or rules and regulations for the grant application and pay-out processes. The discussion begins with the reliability of the offices, schedules and controls required for the service and attempts to limit required traveling for the applicants. It continues with discussions about legible forms, unreasonable requirements placed on applicants, eligibility for the grants, problems with means tests and lack of identification.

One needs a reliable agency structure for managing the payment of grants and it must function consistently and provide user-friendly access to the applicants ("Getting SASSA," 2003). In the SASSA strategic plan, the importance of having structures such as standardised procedures and processes was mentioned as part of a baseline for the objective of improving the administration of social grants (SASSA, 2012b).

Plans would have been made as to how the enrolment would happen in both the rural and the urban areas, and how to issue the cards (if applicable). Estimates would be made regarding the number of citizens in the various regions so that one could recruit sufficient personnel for the various roles, as it would be unfair for the officials to work in conditions where there was slowness and delays due to lack of sufficient staff (Mvenya, 2010; Rao, 2011). Mobile units could assist with applications, especially in remote areas (Naki, 2003). When there was an expected rise in the number of applicants as a result of changes in the regulations, extra staff should be supplied to manage the queues at the offices.

Some locations may be too far for the applicants to travel in order to apply for grant assistance (Makinana, 2007). There should also not be a two-part process i.e. if one enrols at one location but issues the card at a different location, then the applicant would travel unnecessarily (Warren & Mavroudi, 2011). It would be useful if there were home visits for those who cannot travel at all.

The forms to be filled in must not have language that is too technical, and it must not take too long to fill in, as this may cause the public to lose interest (Makinana, 2007; Pahmeier, 2011). Using information from abroad, if the enrolment in a system is voluntary, perhaps cash incentives would encourage enrolment into the system (Greenleaf, 2010). It may of course be compulsory (necessary) to provide the biometrics for identification in order to gain access to the services. Another argument for compulsory voluntary participation would be to avoid discrimination against minority groups (Ajana, 2012).

There was some expectation that regular school attendance and health requirements would be monitored for those children who would receive the CSG (Tolsi, 2008). In

2009, the Finance Minister Trevor Manual again hinted at conditions which may be attached to grants. However, one should not deny a disability grant to a deaf child for example, when it is not his own fault that there are no schools nearby to accommodate him (Tilley, 2009).

The Department of Social Development has a responsibility to ensure that the beneficiaries do qualify for the grants that they receive (Hoo, 2004). One woman was reported to have been denied benefits three times by the same SASSA appointed doctor who refused to examine her and told her to "shut up" as she was "making a noise" (Magubane, 2009a). He simply turned down her application even though her own doctor had diagnosed that she was eligible for disability pension due to back injuries.

There were also concerns expressed in 2007 regarding the means test (Makinana, 2007). It was focussing on the caregiver's income, but neglected to look at the number of children in that person's care. The more children one has, the more money one should have available to look after them. When the carer has more income than the expectation of the means test, this should not necessarily deny him/her the facility of obtaining the CSG for the many children in his/her care, yet this was happening. Another problem was that the spouse's income was joined with the carer's income for the purposes of the means test, even when the spouse was not related to the child. The income level for the means test was also not increasing in line with inflation.

In 2007 it was reported that as many as a third of the children who were eligible for grants, were not covered due to the lack of the correct identification documentation but it is those same children who desperately need the assistance (Makinana, 2007). By 2012 it was reported that about two million children were not yet enrolled into the system (Phakathi, 2012). Some provinces had made extra efforts through innovation and proactive campaigns to reach the poorest children and those in remote regions ("SASSA explains," 2006; "SASSA officials," 2009; Makinana, 2007; Ngobese, 2009; Peters, 2004). In 2004 the poorest regions in the Western Cape were assisted by a door-to-door campaign to register CSGs and the Home Affairs department provided

free identity documents and birth certificates. SASSA continued these campaigns in 2006 by visiting towns and encouraging the usage of the grants to alleviate poverty. SASSA also wanted the public to notify them of persons who were housebound and who required home visits. In 2009 it was reported that an elderly woman had died while waiting in the queue. Some people applied for grants but died before they were able to be assisted after waiting for some months to get their grants. If SASSA was informed about these problems then they could get involved and assist the individuals.

5.3.4 Officials handling social grants

This sub-section looks at the procedures that are executed by the government officials for the purpose of the social grants. The procedures for officials should support the goals and tasks and should fit the organisation. The managers and officials must be well trained with respect to the procedures. Strengths and weaknesses should be identified (Appelbaum, 1997). For the purposes of the research, this section deals with both management and workers or officials that minister to the public who come to apply for their social grants. The discussion begins with the employees' acceptance of technology and their knowledge thereof. Thereafter the professionalism and training requirements are discussed. Finally some comments on their interaction with the public and their possible fraudulent actions are discussed.

A survey by Pooe and Labuschagne (2011) was carried out to find out how officials in the South African banking industry viewed biometric technology. In particular, it aimed to find out the facts, opinions and perceptions of the people who used the technology as this could affect the adoption of biometrics and the willingness to use them. Similar perceptions may be found in officials who handle social grant applications and pay-outs where biometric features are used.

This banking survey included questions to discover the general knowledge of biometrics among the officials in order to see whether the respondent was familiar

with the use thereof (Pooe & Labuschagne, 2011). The level of exposure to the technology usually had an effect on the acceptance of the technology.

The survey looked at seven key factors which may have influenced the adoption of biometric technology, viz. legacy systems, banking culture of South Africa (how they share information and cooperate), South African biometrics legislation, national standards for biometrics, culture of South African banking clients, culture within the banks and the maturity of the technology. For the purposes of this research, only some of these areas are referenced further.

Most respondents were neutral regarding the impact of legacy systems on the adoption of biometrics, but tended towards agreeing that there was an impact which affected compatibility (Pooe & Labuschagne, 2011). Regarding the national banking culture on the adoption of biometrics, the banks were willing to adopt biometrics. The bank culture and the culture of the bank users themselves were both seen to have an effect on the adoption of biometrics. Most of the respondents were neutral regarding whether the biometric technology was still immature for adoption by the banks but there was a tendency towards disagreeing on this point. Projecting these results on to the current research endeavour, one may expect that there would be an impact on compatibility when changes are made to the identification systems if different biometric technology is introduced. The culture of the users or officials working with social grants also has an effect on their willingness to adopt new biometric technology.

Another study (borrowed from abroad) was carried out to determine the managers' and employees' perceptions regarding the adoption of biometric technology for e-government in the Kingdom of Saudi Arabia (Alhussain & Drew, 2009). Some experts in various levels of management were identified for the purposes of sampling carried out by interviewing and recording thereof. Looking at the responses from management, there was a perception of a cultural gap between the employee's technological experience and the actual biometric technology being used. Some of the respondents accepted that it was their own responsibility to increase their knowledge of the technology. There had also been other difficulties experienced

when using the technology. Besides employee resistance there had been breakages (some deliberate) and system failures. The employees in this study were also given questionnaires which were filled in at their own convenience. The responses from the employees revealed that they viewed the biometric technology as being important but that they should have been made aware of the need for this technology before its implementation.

Projecting these results onto the social grants research, one can gather that there should be sufficient motivation and understanding of the need for the biometrics, and there should be extensive training. All of these help to avoid employee resistance to the new technology.

There should be standard operating procedures for all functions. The workers or officials should be managed well and encouraged to be loyal, and their welfare should be attended to (Appelbaum, 1997; Islam & Grönlund, 2010; Ndoni, 2009; Verma, 2000). Attention should be paid to their skills and knowledge for accomplishing their tasks involving technology. Training should be provided where appropriate and the officials should be scheduled according to the task needs. In 2009 many officials complained that they had not been paid for their overtime for the first three months of the year. There must also be opportunities where they may enhance their performance and be allowed to advance themselves.

It is also a problem when the officials are not themselves aware of the processes. In 2008 it was announced that the officials were allowed to accept other proof of identity instead of the identification documents and birth certificates (Carlisle, 2008). Not all officials were aware of this and there were many applicants who were denied grants due to the missing documents. Also in 2010, when it was announced that all eligible children up to 18 years of age would receive the grant, the officials themselves were not all aware that this would only come into existence in 2012 and were not able to inform the applicants correctly as to their eligibility for the grant ("Explanation about Child Support Grant," 2010).

The members of the public have also made some complaints about poor service at the application offices and about mistakes that were being made (Magubane, 2009b;

Makinana, 2007; “Getting SASSA,” 2003). There were complaints of neglect, rudeness and ignorance and of offices closing earlier than they should, and people being turned away. Some members of the public arrived at the offices on Monday but were only assisted on the Thursday. It was considered undesirable that school children who were already carers themselves had to stand in the queues in their school uniforms, waiting for their money and missing school at the same time (Pressly, 2011). These children should rather have received their money electronically.

Some officials were found to be committing fraud and were charged, dismissed and required to pay back the money that they had gained illegally (“Getting SASSA,” 2003; Magubane, 2010; Masemola, 2008; Nini, 2011). Some used spyware devices to gain passwords and identification information from unsuspecting officials. Many complaints of fraudulent activities were made against the management as well.

The Special Investigating Unit was introduced to root out the corruption and fraud among the officials by monitoring daily activities (Venter, 2005). In 2005 some 12 suspects were discovered. In 2008 there were 18 000 files awaiting disciplinary action against public servants and R22m had already been collected in repayments with legal agreements for another R99m (Gerardy, 2008). Some 300 000 grants were being removed from the social pensions’ database due to fraud. Fraudsters also cheated people of their disability grants and claimed for “ghost” beneficiaries (Ndaliso, 2010).

Other officials were demanding money from applicants (Khumalo, 2002). Social workers were also found to have demanded money when visiting homes and if the carers did not pay over the money to them, then the children were sometimes removed from their care because the social workers laid false complaints against the carers, accusing them of neglect. Corruption of this nature can lead to criminal investigation if reported.

5.3.5 Recipients of social grants

This sub-section looks at the people themselves who are involved in the technology. With regard to the public, one should know the attitude that they have towards the organisation and subsequently how that attitude affects the work done. Problems and obstacles should be identified. The public should adapt to the structures which should provide incentive and motivation to the employees as well (Appelbaum, 1997). This sub-section will discuss the members of the public who use the services i.e. those who make applications for social grants and who have to provide biometrics for identification purposes. The discussion begins with the public confidence in the system, their attitude towards invasive technology and continues with their ideas about being controlled by the government and other privacy issues. Finally there is a brief discussion on fraudulent activities by the public.

Sometimes the public may be unapproachable or unwilling to be involved in a new implementation involving biometrics. Rehfuess & Akl (2013) reported in a study abroad that the public complained about difficulties experienced when accessing services. They either did not know enough about it, or they did not understand it, or they had not been included yet in the system.

The public need to have confidence in the system (Rehfuess & Akl, 2013). If the members of the public understand and accept the technology then the implementation should be successful (Martin, 2012). One can be concerned as to the extent to which the public should be involved in the decision-making for the new technical security controls, and therefore they must first have the new technologies explained to them (Pavone & Esposti, 2010). One study abroad showed that the public simply wanted transparency but did not particularly want to be included in the decision-making process.

The public may have preferences for non-invasive security control methods (Deriche, 2008). The attitude of the public may shift if the technological implementation is marketed in a particular way and if the associated public service is also kept “alive” in the public’s eye to remind them about it. Some individuals may be against government control and manipulation, which problem would be reoccurring

whenever the government changes hands after elections. The public may be concerned that the government agencies abuse the security technologies or misuse and reuse their personal data (Arteaga, 2011; Guha, 2010; Islam & Grönlund, 2010; Pavone & Esposti, 2010). They are also concerned about the criminals doing the same thing (Pavone & Esposti, 2010).

People are concerned about the infringement of their privacy. It is a concern that the captured biometric may be used to attach to other databases containing information about them (Greenleaf, 2010; Pavone & Esposti, 2010). They are also concerned about being stigmatised because the services are provided for the underprivileged who may take offence that their sensitive information is being recorded (Greenleaf, 2010). It is often a concern that the public or their culture may influence the adoption of the new system. There is the risk of social exclusion when electronic identification mechanisms are used (Ajana, 2012; Greenleaf, 2010; Wickins, 2007).

It is an ethical concern when biometric data is collected where no information is provided to the citizen concerning the processing of that data (Laas-Mikko & Sutrop, 2012). The problem of "function creep" has already been discussed in Chapter 4.

There is also the problem of fraud ("7 arrested," 2004; "Child Support probe," 2006; Mashabane, 2011; Mphande, 2006). As early as in 2004, again in 2006 and still in 2011 there were cases of fraudulent activities by women who bought illegal green clinic cards to apply for CSGs for non-existing children. Some of these women had been doing this for many years such as the grandparent who claimed to the value of R85 758 between July 1997 and August 2004. In 2012 there were still cases of fraudulent claims mounting to more than R40m (Phakathi, 2012).

5.3.6 Technology (biometrics) needed for social grants

This sub-section looks at the technology implementation. Changes in technologies affect both the people and the structures and may result in resistance by the public. The structures and processes should adapt to suit the technology and the people should be trained to cope with the changes. It is important to find the strengths and

weaknesses when the technology interacts with the other elements (Appelbaum, 1997). The technology in this case is the biometrics and associated procedures that are used to identify social grant recipients and to make pay-outs.

In Chapter 4, the characteristics of a biometric have already been discussed as well as the required accuracy and performance. Chapter 4 also described the perceived invasiveness of some biometric features and problems with quality and other issues such as noise. It was suggested that multi-mode biometrics can solve many of these problems. This sub-section continues with brief discussion on timing and noisy data issues.

If there is a long queue, and it takes between 10 and 20 minutes to enrol one person then there are major time delays (Romero, 2012). Some reports described a process of enrolment that took between 30 minutes and three hours (Warren & Mavroudi, 2011). Sometimes the technology may have been implemented simply to witness that something was being done, whereas in real terms it may not have been effective (Islam & Grönlund, 2010; Pavone & Esposti, 2010).

The elderly need more time when capturing their biometrics and they are usually the people that need the services the most (Wickins, 2007). Issues such as weight loss and lack of cleanliness can affect the extraction of biometrics thus causing social exclusion. Disabled persons may not have fingerprints to be captured due to lack of forearms. By using multiple biometrics one can help reduce or overcome these problems, achieve universality and help prevent spoofing.

5.4 BIOMETRIC IMPLEMENTATIONS ABROAD

The previous sub-section investigated challenges and lessons learnt with respect to the social grants and biometrics in South Africa. This sub-section looks briefly at some national biometric implementations in welfare systems from other countries in order to discover what challenges have been experienced abroad and what lessons can be learnt from them.

5.4.1 India's Aadhaar project for welfare

The Unique Identification Authority of India (UIDAI) began a project, the Indian Unique Identification number system (Greenleaf, 2010; Guha, 2010; Islam & Grönlund, 2010; Jacobsen, 2012; Krakovsky, 2011; Rao, 2011). It is said to be the largest biometric implementation in the world. It is called the Aadhaar project (Aadhaar means 'foundation'). More than 1.2 billion citizen entries are entered into a large database for this national identification system. It was intended to be used for surveillance, welfare systems and cash transfers and could assist the government in managing the population and delivering services effectively. It would be particularly useful when including the poor in the banking systems for the purposes of welfare. It could also help in identifying the homeless in order to assist with food and shelter and provide welfare assistance which had not been there in the past due to their migration. The homeless could also be assisted in shelters once they swiped their card in micro-automated teller machines, and provided a thumbprint.

This Aadhaar project would provide each citizen over 18 with a unique 16-digit number for national identity purposes (Guha, 2010; Krakovsky, 2011). This would be linked to the biological data such as name, age, address and gender as well as all 10 fingerprints, a photograph and an iris scan. Of course this is a mammoth task because there are basically 12 images to be checked and the database is ever growing in size. In the beginning it was seen as a voluntary system, but at birth it would be compulsory to enrol into the system. The number given to a citizen at birth would be linked to that of the parent until the child was five years old. It would become necessary to enrol in order to gain access to a particular service (Greenleaf, 2010; Guha, 2010).

There was a concern that the information recorded would include the caste information (Greenleaf, 2010; Krakovsky, 2011). The problem is that there are no legal data protection laws in India. While there is no law, one may include criminal history or political affiliation. The information may change from time to time. India would probably not collect sensitive information such as ethnic, racial or religious affiliation, or caste, tribe, language, income or health.

Although the Unique Identification Authority of India did not intend to produce identification cards, there would be a letter containing the registered details including the identification number, name, photograph and barcode of the fingerprint (Greenleaf, 2010). Eventually some card could be produced. The intention was to use the identification number for access to everything.

5.4.2 The European Union's health card

More and more surveillance mechanisms are being instituted in everyday life in the European Union (EU) countries (Bunyan, 2010). There is therefore a massive collection of personal information which is shared among others. In 2005 the EU agreed to collect fingerprints for passports from all citizens six years and older. Driving licence rules also changed, such that where it was previously a licence for life, it would be replaced by five-year licences. Service providers for communication also kept details of consumers across the EU. Monitoring is done on travellers in and out of the EU. This sort of surveillance society is part of globalisation. The surveillance may be used against criminals but it can also be used to catch anti-social behaviour or to check if someone is employable, able to take out a loan or has a decent credit rating. This information can be passed around the EU and also sent outside the EU. All this information would be shared. Perhaps one could join the passport, driving licence and health record into one chip card that would also allow access to government services such as libraries.

5.4.3 The United Kingdom's national identity card

The National Identity Scheme (NIS) was intended to provide a national identity card for the United Kingdom (UK) but was abandoned (Martin, 2012; Sullivan, 2007). The National Identity Register (NIR) supports the NIS. It was the database that would be centralised and would contain information (name, address, gender, date and place of birth) as well as two iris scans, ten fingerprints, a handwritten signature and facial photographs.

It is important that a biometric system is accepted by the user groups else it is not successful (Martin, 2012; Sullivan, 2007). It was seen to be the case that the government was focussed on the collection of the biometrics without thinking further as to how the collected data would eventually be used and by whom, and whether there would be benefits for the citizens.

The UK government announced that the national identity cards and the National Identity Register were to be cancelled in 2010 (Warren & Mavroudi, 2011). There had been confusion about why the cards had been issued in the first place, and also about the cost thereof and the security of the biometric and other personal data that was collected. There had been fierce resistance to the project (Jacobs, 2013).

5.4.4 Ghana's system for social service delivery

The government of Ghana wanted to introduce a National Identification System that would include both national residents as well as foreigners using biometrics (Owusu-Banahene *et al*., 2010). This would assist the social service delivery and allow for accurate population figures. It could also be valuable for voting, insurance, licensing and national security. The biometric information to be captured would be the facial photograph, and the fingerprints.

It was also intended to have a geo-database linked to the National Identification System so that accurate geospatial information would be available (Owusu-Banahene *et al*., 2010). This sort of system could be valuable for many areas such as management of crime, development of business, flood mitigation, restoring of environments, administering land and public as well as disaster recovery. Governments had to provide for health and welfare services as well as safety to their citizens.

5.4.5 Gabon's citizen service

Gabon wanted to use biometric identification for their local elections in 2013 using desktops and mobile stations to capture demographic data as well as fingerprints

and digital photographs (“Biometric ID,” 2012). The database thus produced would be able to serve citizens and their birth certificates, national identity cards, passports and driving licences. Using biometrics would circumvent fraud in government benefit programmes.

5.5 CONCLUDING REMARKS

Various themes have been used in this chapter to discuss challenges and lessons learnt for biometric implementations and social grants. This chapter is very relevant for finding information that would be applicable for insertion into a framework for biometrics for social grant systems in South Africa.

The literature review in this chapter was conducted in order to answer the research Question 2: *What challenges exist and what lessons can be learnt from current applications where biometrics are used in government sectors both in South Africa and abroad?* Many items of interest for the intended framework have been discovered as a result of this literature review chapter.

Formal coding was used on the contents of this chapter in order to provide input to the framework as will be discussed in Chapter 7. The other half of the Research Question 2 is the content from the case study, which will be reviewed in the next chapter.

5.6 SUMMARY

This chapter has described challenges and lessons learnt from using biometrics for identification with particular relevance to social grants in South Africa and other welfare schemes abroad.

The challenges and lessons learnt from South Africa were listed under the following defined theme headings for the purposes of organisation: environment, goals, structures, officials, members of the public and technical aspects. The next chapter will describe the case study used in this research.

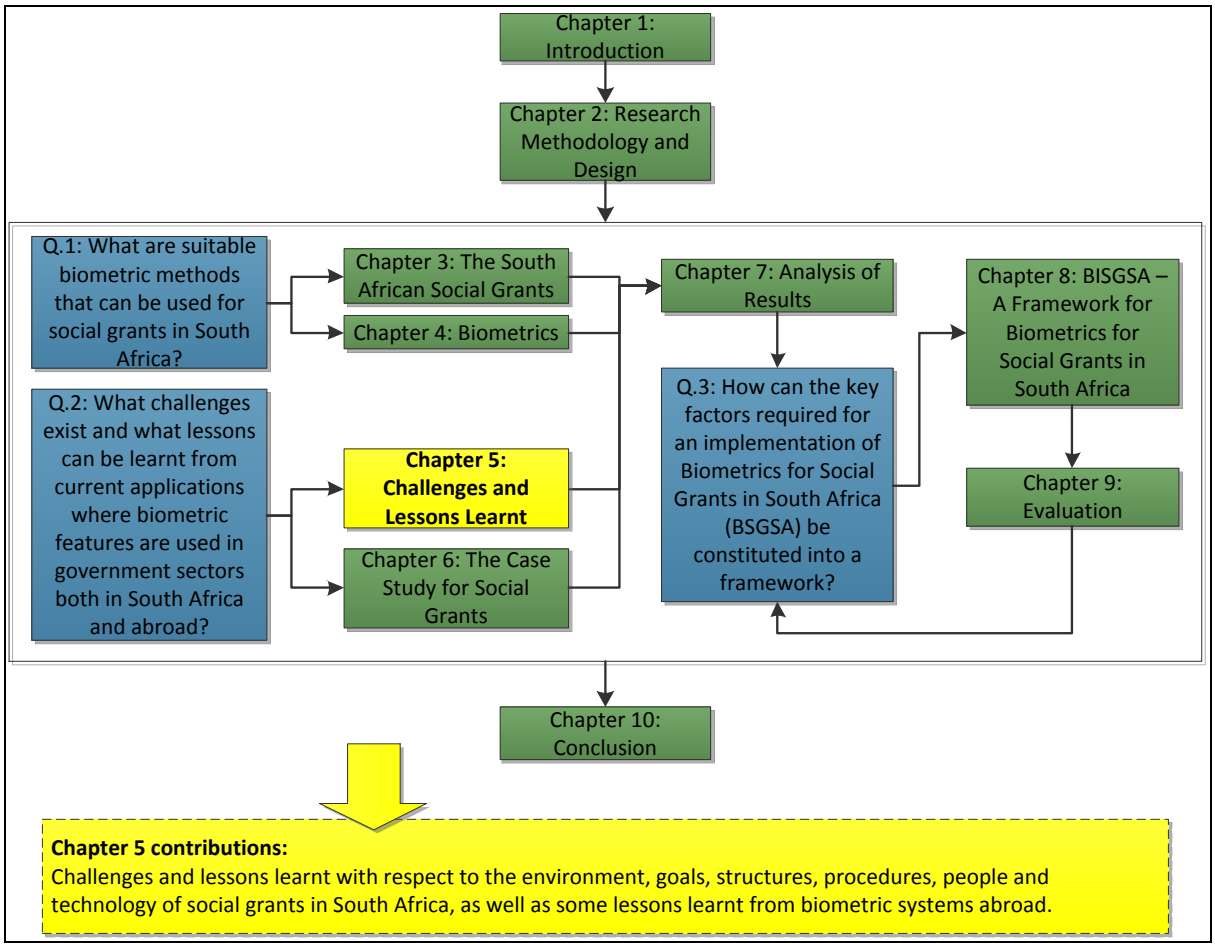
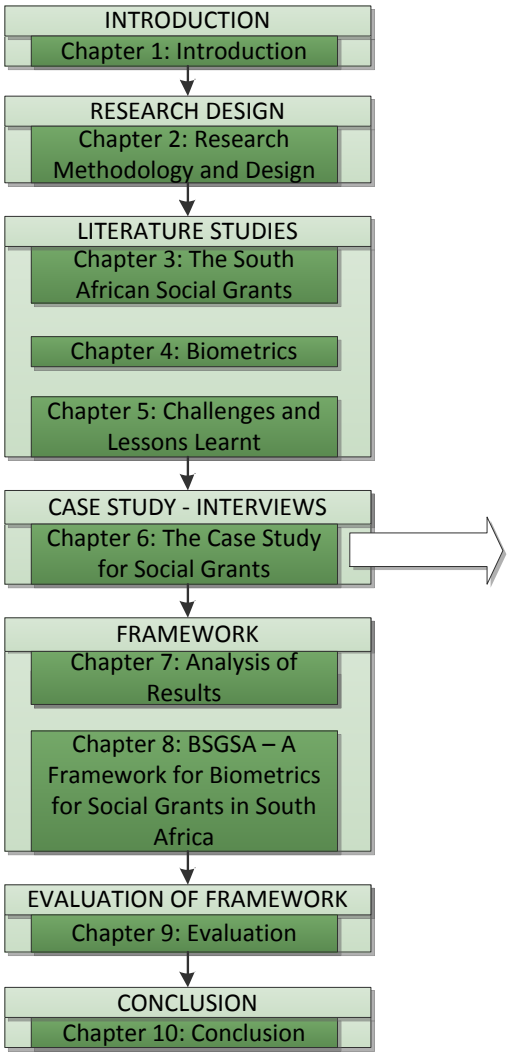


Figure 5.1: Contributions from the literature review on challenges and lessons learnt

CHAPTER 6: THE CASE STUDY FOR SOCIAL GRANTS

LAYOUT OF CHAPTER 6



CHAPTER MAP

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6.3 DESIGN

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6.8 SUMMARY

6.1 INTRODUCTION

This chapter presents the case study that was used in this research. The sections in the chapter follow the typical steps of a case study as follows:

- Plan – Section 6.2 describes the objectives of the case study and the information that is required;
- Design – Section 6.3 discusses the design of the instruments;
- Prepare – Section 6.4 shows the preparation of the interviewers and the pilot study of the instruments;
- Collect – Section 6.5 reveals where the data was collected.

Section 6.6 presents the results of the data that was collected. Some concluding remarks are presented in Section 6.7 and a summary closes the chapter in Section 6.8.

6.2 PLAN

Chapters 3, 4 and 5 presented literature studies on social grants, biometrics and challenges and lessons learnt when using biometrics respectively. These chapters revealed some information that is relevant for the final framework in this research effort and some of the information also prompted input to this case study. The intention for the case study was to find out information from the ground level by conducting interviews with relevant role-players in the area of biometrics for social grants.

A single case study was conducted. The stakeholders that were involved in this study were the government officials responsible for the social grants in South Africa as well as the members of the public who were recipients of social grants. Each of the groups required a different questionnaire to satisfy the different objectives which are listed for these groups in Table 6.1.

Table 6.1: Objectives for each group questionnaire

RESPONDENT GROUP	OBJECTIVE OF INTERVIEWS
Government Officials	The government officials were targeted as interviewees because the researcher wanted to find out about their training and experience regarding biometrics for social grants. Their attitude towards the grant recipients was also an item of interest as well as perceived problems that may cause inefficiency, such as faulty equipment or lack of staffing.
Members of the Public	It was required to interview grant recipients in order to find out their preferences with regard to biometrics, and their experiences at the social grant offices.

6.3 DESIGN

Two questionnaires were developed to suit the two interviewee groups and can be found in Appendices B.1 and B.2. Both of the questionnaires for the interviewees contained some structured questions (closed-ended) and some unstructured questions (open-ended). There were questions where a ranking was imposed as a Likert scale, i.e. five choices ranging from “Strongly Disagree” to “Strongly Agree”. Matrices of answers were used where appropriate. There were also contingency questions for when more information on a topic was required, depending on the respondent’s answer to a prior question (Bhattacherjee, 2012; Gomm, 2004; Olivier, 2009).

Attempts were made to keep the questions as short as possible and as specific as possible. No questions were written in the negative. There were options to choose “I am not sure of this” if a respondent did not know the answer to certain questions.

Some multiple choice questions were also used where appropriate. Ordinal questions were used where age ranges were required or other similar responses. There were also interval-level responses required for questions such as “How often are you required to collect biometrics from the members of the public?”

As recommended by various authors, the questions were treated as follows (Babbie, 2004; Bhattacherjee, 2012; Gomm, 2004; Hofstee, 2006; Melville & Goddard, 1996; Olivier, 2009):

- Where choices were desired, they were shown from low to high. A middle "neutral" option was provided;
- Matrices were used where possible to make efficient use of space;
- Simple questions were used and most of them were closed-ended;
- Where it was possible that a question may be difficult to answer, an option was included as follows: "I do not know about this";
- The following examples of response choices were used: dichotomous, multiple-choice, nominal, ordinal, interval-level and unstructured open questions.

Figure 6.1 shows an example extracted from a matrix of questions.

Where applicable, please respond by making an "X" in the appropriate space provided.

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
B.1	There are standard operating procedures that I must follow when collecting the biometrics					
B.2	There are sufficient biometric capture devices to meet the demand					
B.3	There are sufficient members of the technical staff to assist with problems at the biometric capture stations					

Figure 6.1: Example of a matrix used in the questionnaires

Figure 6.2 shows an example of a multiple-choice question where more than one choice is allowed.

A.4 Which of the following Social Grants do you currently receive? (You may choose more than one.)

1	Older persons grant	
2	Disability grant	
3	War Veterans grant	
4	Care dependency grant	
5	Foster child grant	
6	Child support grant	
7	Grant-in-aid	
8	Social relief of distress	

Figure 6.2: Example of a multiple-choice question

Figure 6.3 shows an example of an ordinal question.

A.1 To which age group do you belong?

1	Under 21	
2	21 to 30	
3	31 to 40	
4	41 to 50	
5	51 to 60	
6	Over 60	

Figure 6.3: Example of an ordinal question

Finally, Figure 6.4 shows an example of an unstructured open question.

B.26 Are you happy with the total service offered by the Social Grant offices where the biometrics are collected?

YES	
NO	

B.27 What is the reason for your answer to B.26?

_____

_____

_____

_____

Figure 6.4: Example of an open unstructured question

It was intended to obtain information about the respondents' experiences and opinions, and their level of knowledge about biometrics and associated requirements for social grants.

Each questionnaire comprised three sections:

- A preamble to explain the reason for the questionnaire and the assurance of anonymity as well as the option to cease the interview at any time;
- A section on background information which included biographical details;
- A section which included the questions aimed at satisfying the objectives for gathering information concerning the biometrics and social grants.

6.4 PREPARE

The pilot study to test the questionnaires was conducted once the research instruments were ready to be tested in the field. The intention of the pilot study was to determine the validity and applicability of the questions. The three subjects chosen for the pilot study were information technology specialists who had advanced experience in qualitative and quantitative data collection. The following alterations were suggested and improvements were subsequently made in an updated version of the questionnaires intended for the interviews with role-players:

- The terms "survey" and "questionnaire" had been used interchangeably in the preamble. This was corrected;
- "Length in years" was changed to "Duration in years";
- Some questions were moved to start on the following page so that they would not overlap on two pages;
- Comments were added where necessary to indicate that more than one option was allowed to be chosen;
- References to particular question numbers were added, i.e. "If you answered YES to this question (B.12), please explain the procedure" necessitated the presence of the actual question number (B.12);
- An option of "Other" was added to a set of choices;

- “Designation” was changed to “Job Title”;
- The statement “Please choose your gender” was changed to “What is your gender?”

The researcher was responsible for conducting most of the interviews but an assistant was trained to also take in responses from some of the members of the public. The training included the following:

- All the questions must be discussed together first to ensure equal understanding from both of the interviewers;
- All questions must be asked in the exact order and format as is written on the questionnaire;
- The respondents must be encouraged to respond to the questions by ensuring a safe, friendly, non-threatening environment where they feel comfortable;
- All responses by the respondents must be written down word for word in the case of open-ended questions.

6.5 COLLECT

When the questionnaires were ready, meetings were first held with various parties in order to acquire permission to do the interviews. Subsequent to a visit with the South African Social Security Agency (SASSA), official permission was obtained from the Chief Executive Officer of SASSA who indicated that the interviews could go ahead with full co-operation from SASSA staff.

The five government officials who participated in the interviews were from the Nelson Mandela Bay area. A sufficient number of government officials were found in this region to satisfy the criteria. They were in close proximity, were permanent officials in fixed locations, and had sufficient background and knowledge regarding the biometrics and the social grants. The 60 interviews for the members of the public respondents were conducted in urban areas in the Nelson Mandela Bay area as well as further afield in rural areas. This was done in order to see whether there would be a difference in the results from the different areas.

In particular, the following should be noted:

- The respondents were first approached and asked whether they would be willing to be interviewed;
- The respondents were not removed from their environment within which they were found. For example, if they were queuing at a clinic they were not taken out of the queue as it would have caused inconvenience to them;
- The preamble to the questionnaire was read to the respondent. This included the reason for the interview, and options to cancel the interview at any moment;
- To avoid confusion, the respondent was instructed carefully that the term biometrics referred to the fingerprints, voice data and iris images for example;
- Each questionnaire was numbered and the location of the interview was entered on the form;
- All questionnaires were returned to the researcher after the interview sessions and the researcher captured the results into a spread-sheet on the same day as each interview;
- Where necessary, the researcher engaged the services of a translator to assist with the questions and answers during the interviews. A translator was only found to be necessary in Cofimvaba.

The next section will present the data collected from the interviews.

6.6 RESULTS

This section presents the data gathered from the interviews. Most of the respondents were found at the various SASSA offices, while some of the members of the public were also found at local clinics. The members of the public were not questioned in the presence of the government officials so as to ensure unbiased responses. Descriptive analysis and statistics are used to present the information in this section. Some of the questions allowed the respondents to select multiple options. In these cases the graphs contain the comment “Multiple options allowed”

which should indicate to the reader that the results are not expected to add up to 100%.

6.6.1 Biographical information

This section details the biographical information of the respondents who participated in the interviews.

6.6.1.1 Biographical information for Government Officials

The Government Official (GO) questionnaire was answered by five respondents. The Government Officials were asked to provide their designation as well as the number of years that they had been in that position. They were also asked to list the duties that were related to the biometrics required for the social grants. The results for the biographical data for government officials are shown in Table 6.2.

Table 6.2: Biographical data for Government Officials

	GO 1	**GO 2**	**GO 3**	**GO 4**	**GO 5**
Designation	Vendor operator	Administra-tion Clerk	Enrolment Officer	Administra-tion Clerk	Enrolment Officer
No. of years in position	2	7	1	7	2
Typical duties	Enrolment, issuing of cards	Applications, home visits, reviews	Enrolment, issuing of cards	Applications, manage-ment, problems	Enrolment, issuing of cards
How often they collect biometrics	More than 20 in one day	Between 5 and 20 in one day	More than 20 in one day	More than 20 in one day	More than 20 in one day
Source of Training received	Line Manager	Outside vendor	Technician	Outside vendor	Line Manager

The number of years in service for each of the respondents implies sufficient time to have gained experience in the processing of social grant applications. According to their response as to how often they collected biometrics, there is an implication that they were suitably experienced.

Three out of five respondents had heard of the “Batho Pele” principles. All three of these respondents indicated that they were encouraged to adopt these principles in

their dealings with the public and that they could see the relevance of the “Batho Pele” principles when engaged in the task of collecting biometrics from the members of the public.

6.6.1.2 Biographical information for Members of the Public

There were 60 Members of the Public (MP) who were approached for this interviewee group. Two of the questionnaires were incomplete and therefore there were 58 in total that were taken into account for the results. The range of their ages is shown in Figure 6.5. The biggest group was the over 60’s and the smallest group was the under 21’s.

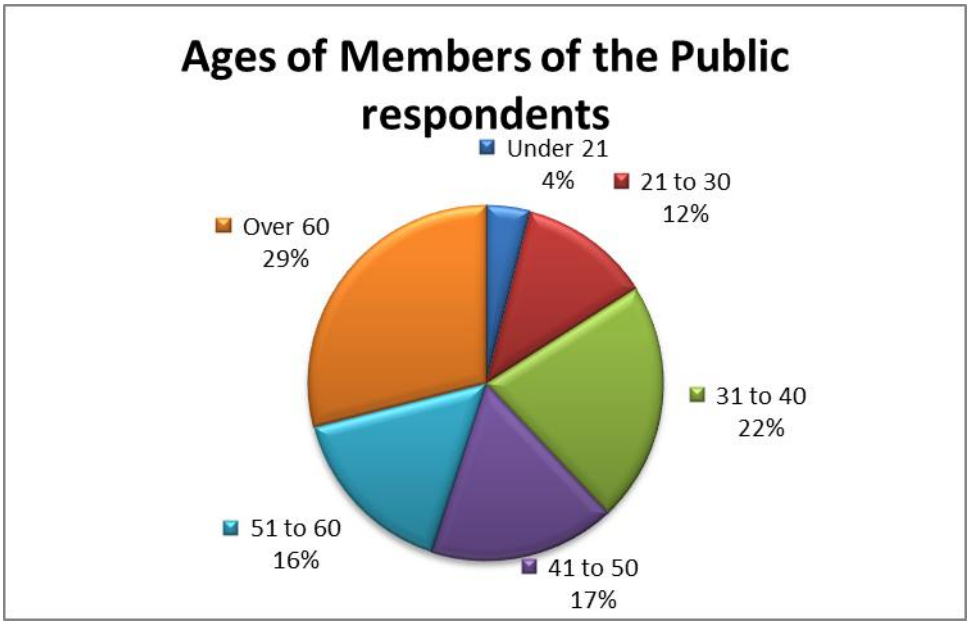

Figure 6.5: Members of the Public: Age of respondents

The number of years that the members of the public had been receiving one or more of the grants is shown in Figure 6.6. The largest group had been receiving their grants for more than five years and less than 10 years.

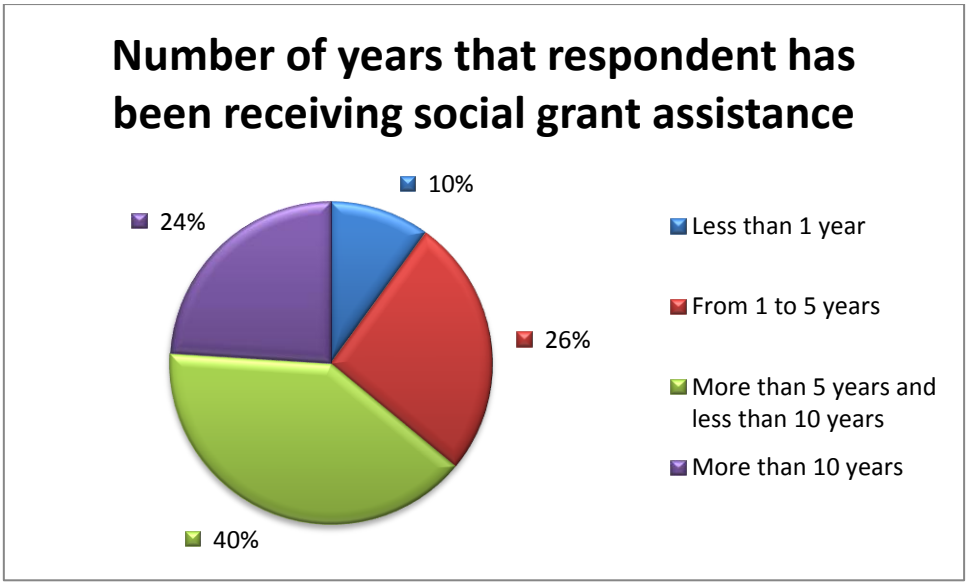

Figure 6.6: Members of the Public: Duration for receiving social grants

The respondents were also asked where they had first heard about social grants in order to gain some idea as to whether the grants are well advertised. This is shown in Figure 6.7. The figures appear to be evenly spread across the district. However, it was noticed regionally that in the Chris Hani district, 50% of the respondents from that region had first heard about social grants from the SASSA office itself. In the Cacadu district, 60% of the respondents from that region had heard about the social grants from the Community Development Workers. Those that chose the "Other" group were mostly from the Nelson Mandela Bay area and included information sources from clinics, police stations and doctors.

The respondents also had to indicate which of the social grants they were currently receiving as is shown in Figure 6.8. More than half of the respondents were receiving Child Support Grants. There were some individuals who were receiving more than one grant, such as an older person who was looking after a child or someone who had a Child Support Grant as well as a Care Dependency Grant.

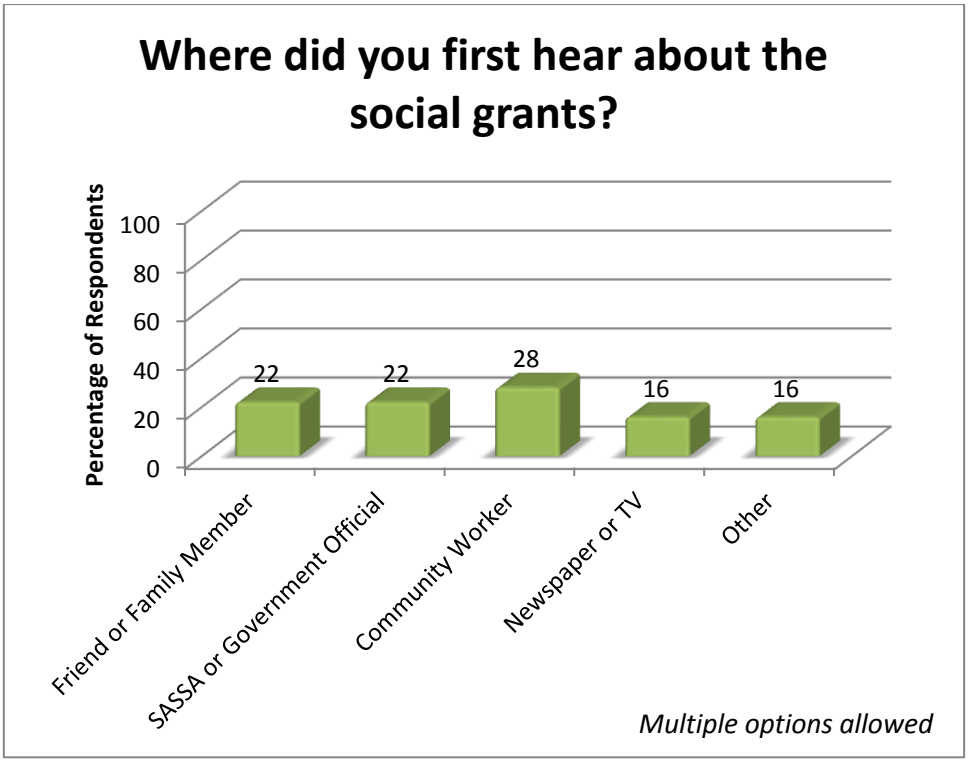

Figure 6.7: Members of the Public: Where they first heard of social grants

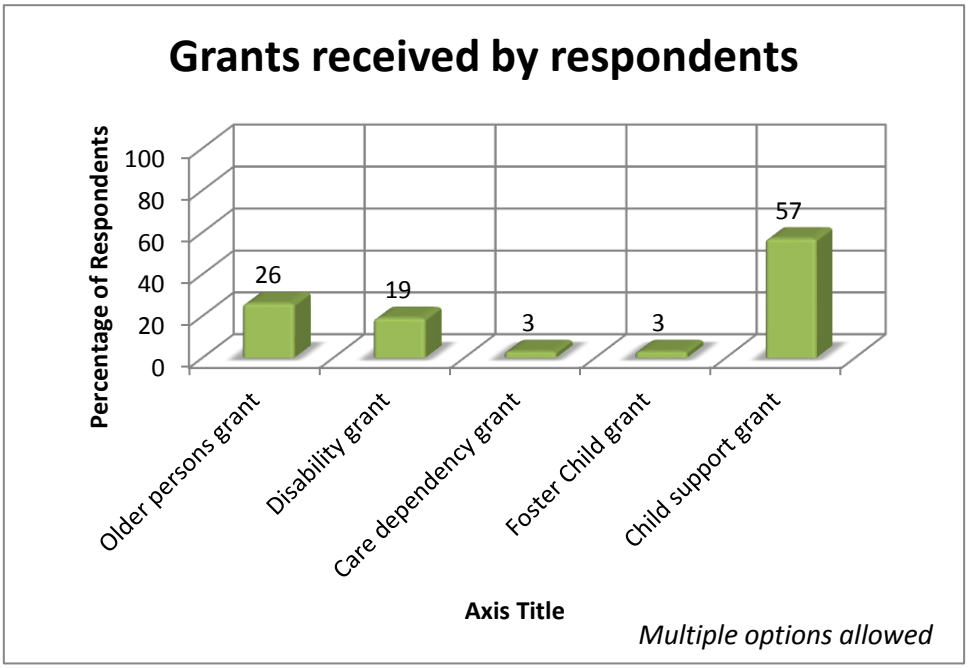

Figure 6.8: Members of the Public: Grants received

6.6.2 Biometric information

This section presents the findings and results of the biometric questions for each of the respondent groups. A full set of results for the questions can be found in Appendix C.

6.6.2.1 Organising questions within categories

The questions from the questionnaires were categorised as is shown in Table 6.3. The relevant question numbers from each questionnaire are listed against the applicable category. Some questions may apply to more than one category. The answers for these numbered questions within the categories therefore contain the information that is used to further describe the results for each category in Section 6.6.2.2. Once again, the questions are coded according to the group to which they belong, for example GO means Government Official and MP means Members of the Public. For the sake of brevity, Table 6.3 includes these acronyms only in the header rows. If the header of a column shows MP then all the questions below in that column are to be preceded by "MP-" to indicate the actual question number that is referred to. For example in the last column labelled "Members of the Public Questionnaire (MP)", the Infrastructure questions B1, B2 and B26 indicate questions MP-B1, MP-B2 and MP-B26. The next section will describe how to use Table 6.3.

Table 6.3: Organising questions within categories

CATEGORY	GOVERNMENT OFFICIAL QUESTIONNAIRE (GO)	MEMBERS OF THE PUBLIC QUESTIONNAIRE (MP)
Infrastructure	B2, B4, B5, B6, B24	B1, B2, B26
Assurance	A9, B10, B11	B3, B4, B5, B6, B7, B9, B10, B12, B13, B14, B17, B26, B27
Data usage and sharing		B5, B12, B13
Performance	B2, B3, B4, B5, B23, B24	B1, B2, B8, B11, B16, B26, B27
Defined procedures	A3, B1, B13, B14, B15, B18, B19, B20	B3, B18, B20, B23, B24, B31
Quality of service	B12, B14, B23, B24	B7, B9, B10, B11, B26, B27
Length of procedures	B2, B3, B23, B24	B8, B16, B26, B27
Intrusion of privacy		B6, B17, B21, B25, B28, B29
Advertising	B10	A2, B5, B15, B32
Training	A5, A6, A7, B7, B8, B14	B3, B7, B10
Accessibility	B16, B17, B24	B4, B30, B31, B32

6.6.2.2 Results within categories

Infrastructure

The *infrastructure* category questions according to Table 6.3 appear in both the GO and the MP questionnaire groups. The appropriate question numbers are therefore taken from Table 6.3 and are the following: GO-B2, GO-B4, GO-B5, GO-B6, GO-B24, MP-B1, MP-B2 and MP-B26. Looking at the results for these questions, one can report the following information about *infrastructure*:

- The government officials mostly strongly agreed that the biometric devices were sufficient, readily available and in working order to meet the demand. They also strongly agreed that the computers were in working order. Only one respondent indicated that network problems would cause delays which usually necessitated a call for assistance.
- There were 88% of the members of the public who were happy with the service at the offices. Another 76% agreed that there were sufficient biometric devices to meet the demand. There were also 93% who agreed that the biometric devices were in working order.

Assurance

The *assurance* category questions according to Table 6.3 appear in both of the questionnaire groups. Again, the appropriate question numbers are therefore taken from Table 6.3 and looking at the results for these questions, one can report the following information about *assurance*:

- From the point of view of the government officials, they indicated strongly that they informed the recipients as to why their biometric features are needed in order to provide assurance to the recipients. They all agreed that the recipients were willing to provide their biometrics. Those officials who had heard about the Batho Pele principles all agreed that they could see the relevance of these principles when dealing with the biometrics required from the members of the public.

- 88% of the members of the public were happy with the service at the offices which may imply that they are feeling assured. 97% of the members of the public agreed that the government officials spoke clearly to them and only three respondents disagreed that the officials assisted them throughout the process. 91% felt that the officials knew how to collect their biometrics and the same percentage found that it was easy to provide their biometrics. 93% agreed that they were willing to provide their biometrics. 64% agreed that any questions that they had were able to be answered by the officials while 31% were neutral regarding this issue and the rest disagreed. 48% disagreed that they were told why their biometrics were required and another 7% were neutral. 81% of the respondents were not at all concerned about how the government would use their information. Only 9% of the respondents thought that their information was unsafe but 5% were neutral. Regarding the perceived invasion of privacy which may also have an effect on the assurance of the recipients, Figure 6.9 shows the spread of the results. 76% of the respondents disagreed or strongly disagreed that collecting biometrics from them invades their privacy while 9% were neutral. The respondents from the rural districts were less concerned about their privacy, reaching confidence as high as 87% in the Cacadu district and 86% in the Chris Hani district.

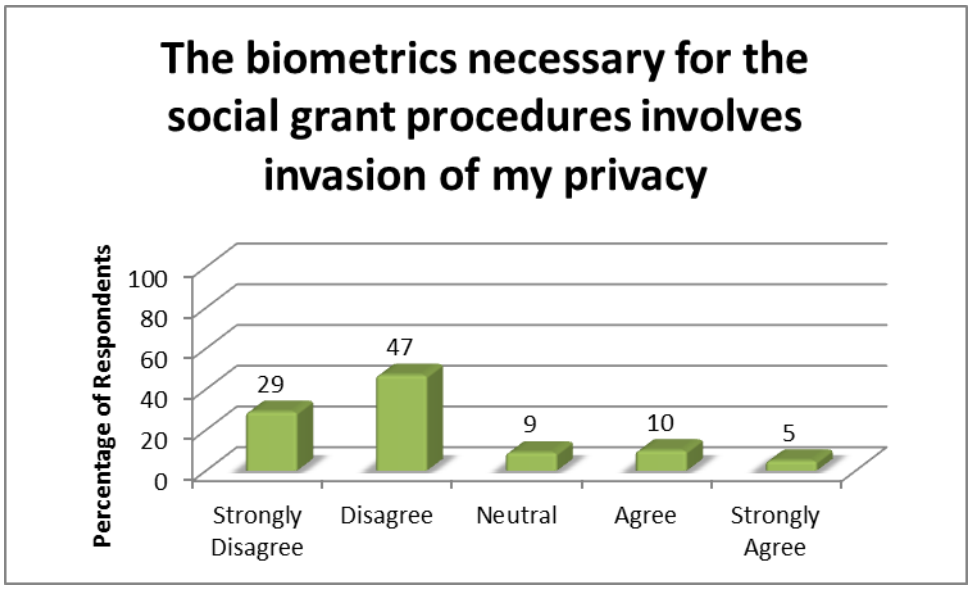

Figure 6.9: Members of the Public: Invasion of privacy

Data usage and sharing

The *data usage and sharing* category questions according to Table 6.3, appear in the MP questionnaire group. The appropriate question numbers are taken from Table 6.3 and are the following: MP-B5, MP-B12 and MP-B13. Looking at the results for these questions, one can report the following information about *data usage and sharing*:

- There was 48% of the members of the public who indicated that they were not told why their biometrics were required and another 7% were neutral. A total of 81% of the respondents were not at all concerned about how the government would use their biometric data. Figure 6.10 shows the spread of the results as to whether the respondents were concerned that their biometric information would be shared with other institutions. According to the results, 76% of the respondents were not concerned at all while 8% were neutral.

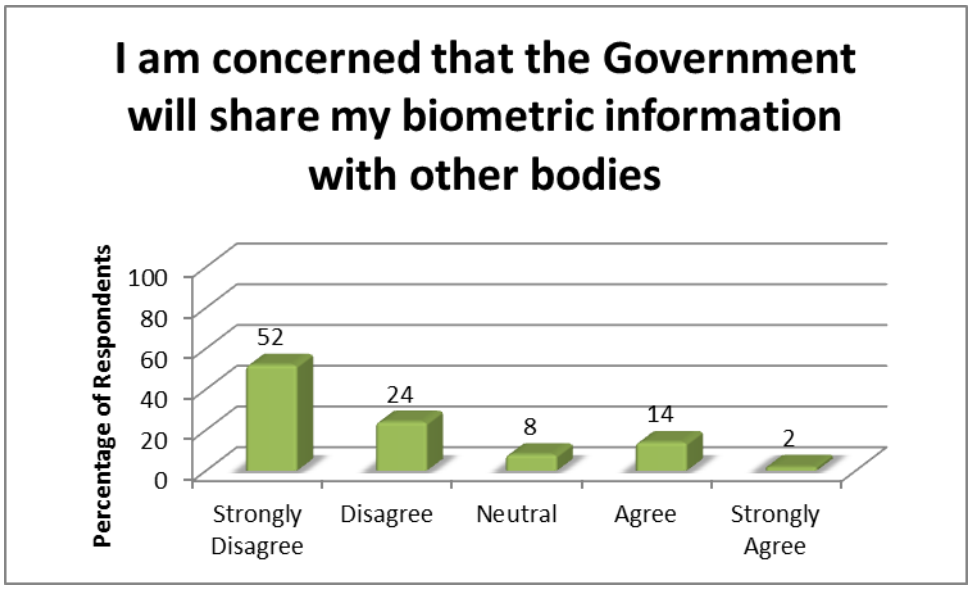

Figure 6.10: Members of the Public: Concern that biometric information is shared

Performance

The *performance* category questions according to Table 6.3 appear in both of the questionnaire groups. Again, the appropriate question numbers are therefore taken

from Table 6.3. Looking at the results for these questions, one can report the following information about *performance*:

- Under the *infrastructure* category, one has already seen that there were sufficient devices and that they were in working order which implies that there was no negative effect on performance due to the devices.
- The government officials all agreed that there were sufficient technical staff to deal with problems, thereby also ensuring continuing performance.
- Regarding the staff complement, 79% of the members of the public agreed that there were sufficient government officials to deal with the demand. 84% of the recipients agreed that they were assisted at one single site or office and were not sent on to different offices while the rest (in the minority) disagreed.

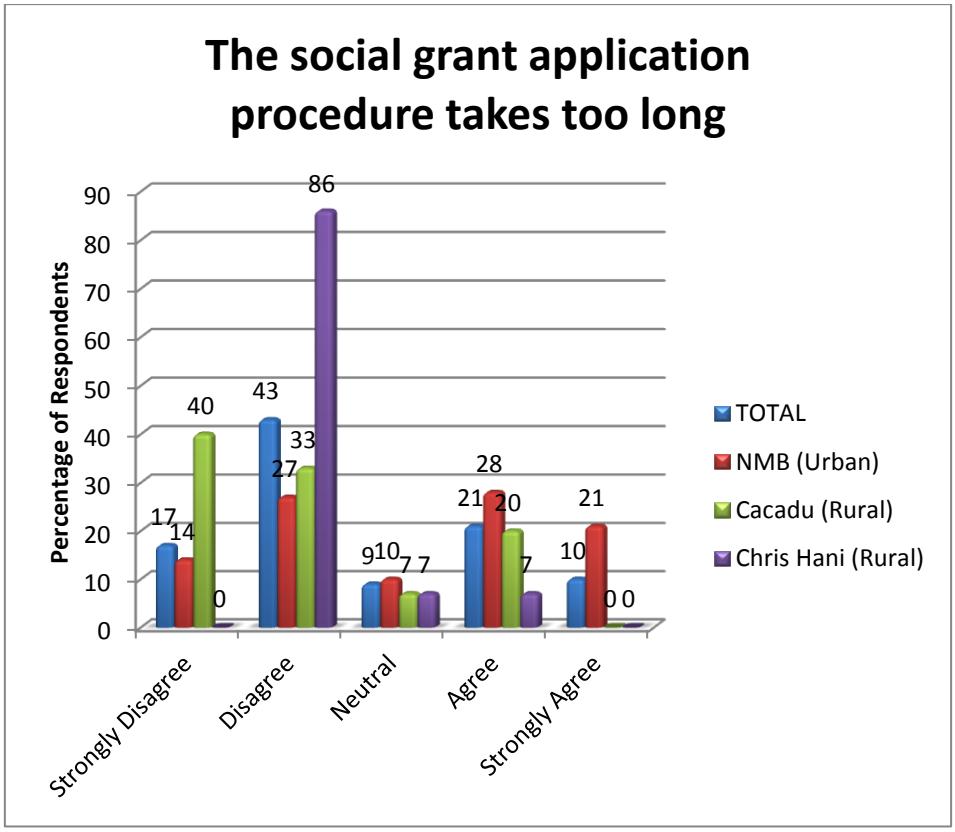

Figure 6.11: Members of the Public: Perceived length of the application procedure

- Figure 6.11 shows the results from a question which attempts to find out if the social grant application procedure is viewed as being too long. The

responses are more evenly spread in the urban area. In the rural areas, however, the majority of the respondents mostly disagree that the procedure takes too long. In particular, the Chris Hani district shows a large percentage (86%) of respondents who disagree that the procedures take too long.

- A question was asked from the government officials to find out what caused the most delays thereby having an effect on the performance level. Four out of five of the officials felt that waiting for computers to respond, caused the most delays.

Defined procedures

The *defined procedures* category questions according to Table 6.3 appear in both of the questionnaire groups. Again, the appropriate question numbers are therefore taken from Table 6.3 and looking at the results for these questions, one can report the following information about *defined procedures*:

- Three of the respondents from the government officials group were directly involved daily in the capturing of the biometrics while the other two were rather involved in dealing with grant applications and queries. All officials agreed that there were standard procedures to follow when collecting biometrics. Four of them answered “YES”, that there was a standard procedure to follow when capturing fingerprints and three of them answered the same for the capturing of voice samples. These three could also correctly describe the procedures for capturing the voice samples. One of the respondents indicated that there was a particular order to collect the fingerprints i.e. from left to right. Another respondent indicated that children younger than three months would only have their two thumbprints captured. Those respondents who were responsible for collecting fingerprints indicated that the finger is pressed onto the surface and not rolled. However, the respondents who were not engaged in collecting biometrics provided contradictory answers which indicated that they were not sure of the standard procedures for collecting fingerprints. Regarding the standard procedures for collecting voice samples, the results from three of the respondents were that

the subjects would provide voice samples of the following in the exact order: name, surname, identification number, address, telephone number and the grant for which he/she was applying. One of the respondents did not include the telephone number and it is assumed that this was an oversight.

- Those who did not answer "YES" regarding the standard procedures for fingerprint and voice indicated that they were not sure about the issue and on further investigation it is seen that these respondents were those who were not always involved in the capturing of biometrics. When asked whether the child accompanies the carer for the purposes of capturing the child's biometrics for the CSG, four of the five officials strongly agreed.
- Finally, for the government officials, a question was posed to find out what biometric features were being accepted by the offices for social grants. There was consensus that the four biometrics are the photograph, fingerprint, voice capture and child fingerprint where appropriate.
- From the point of view of the members of the public, Figure 6.12 reveals their perceptions about whether the officials know how to collect their biometric samples. 91% were confident that the officials were efficient in the collection of biometrics. From the rural districts, 100% of the respondents agreed that the officials knew the procedure.

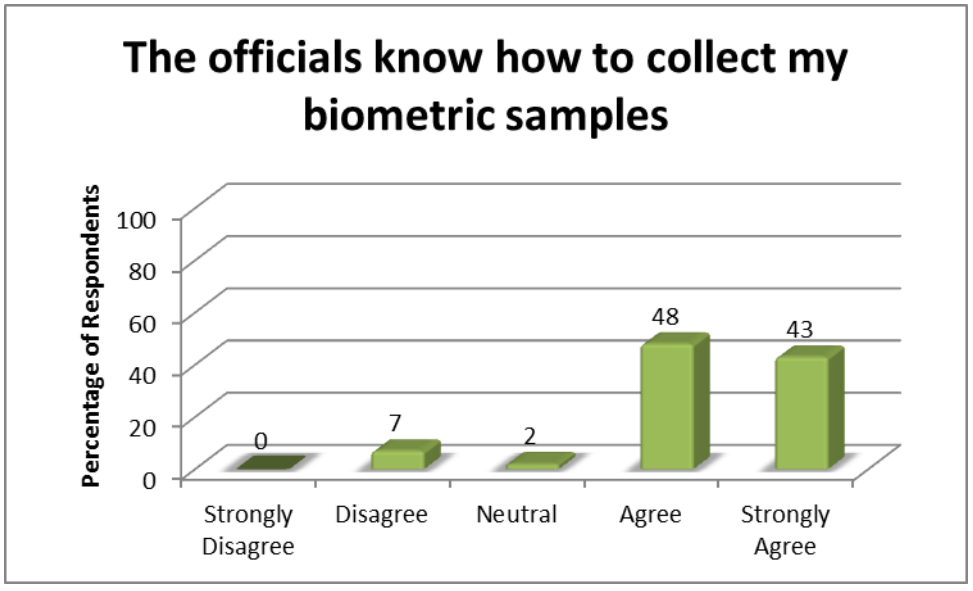

Figure 6.12: Members of the Public: Perceived efficiency of officials re biometric sampling

- 91% of those respondents who received Child Support Grants (CSGs) indicated that their children accompanied them so that their fingerprints would also be collected when applications are made for the CSG.
- It can be seen that the respondents were mostly not supplying their biometrics while collecting payments. Figure 6.13 reveals the results for the following three questions:
    - Which identification mechanisms have been accepted in your experience for social grants?
    - Which biometric features were extracted at the time of application for the social grant?
    - Which biometric features were extracted when collecting grant pay-outs?

The "photograph of applicant" included in the figure, is simply the traditional identification document photograph that is used i.e. it is not a new biometric facial image.

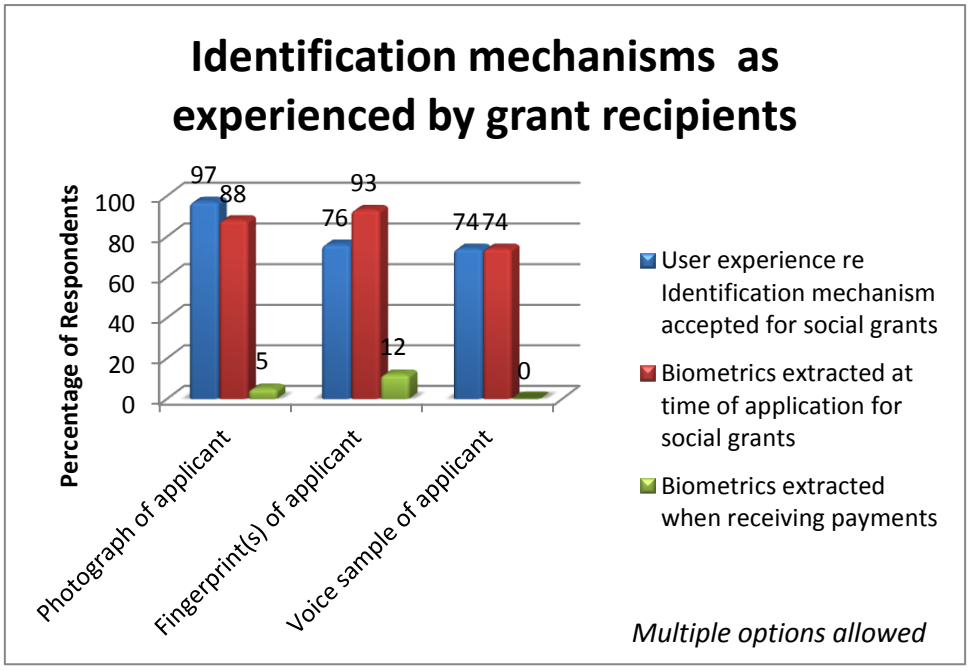

Figure 6.13: Members of the Public: Experience of biometrics for social grants

- The members of the public were also asked how often they would be willing to provide biometric samples for proof of life in order to remain grant recipients. These results are shown in Figure 6.14. 48% of the respondents felt that once a year was sufficient. 34% of respondents were willing to provide samples once a month or more.

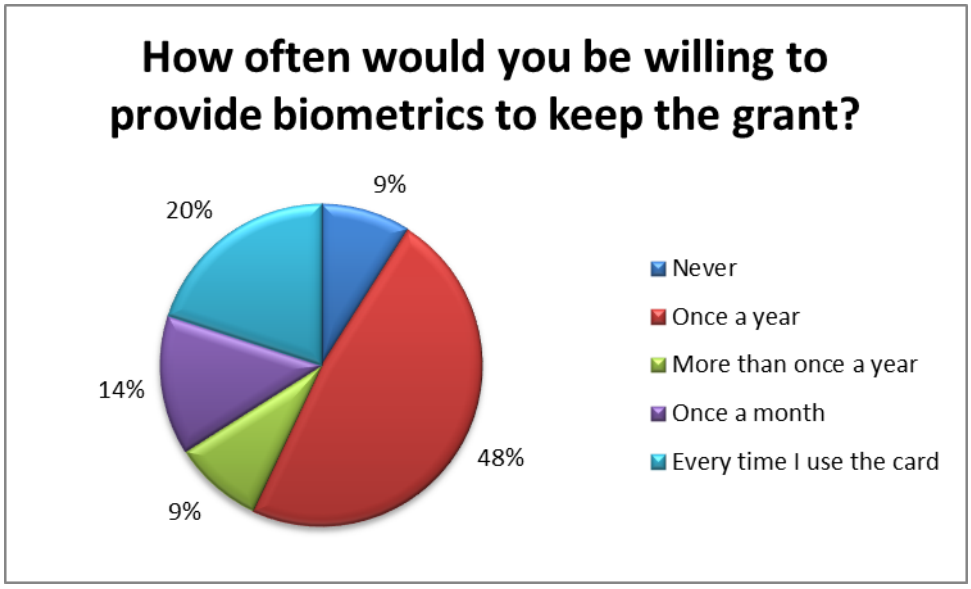

Figure 6.14: Members of the Public: Willingness to regularly provide biometrics

Quality of service

The *quality of service* category questions according to Table 6.3, appear in both of the questionnaire groups. Again, the appropriate question numbers are therefore taken from Table 6.3 and looking at the results for these questions, one can report the following information about *quality of service*:

- Earlier a question was discussed regarding what caused the most delays, thereby affecting the quality of service, and this was revealed to be the process of waiting for computer response. Regarding the procedures required for biometrics for social grants, all of the government officials claimed to know the procedures exceptionally well. They also all strongly agreed that they assisted the public to extract their biometrics.

- 95% of the members of the public agreed that the officials assisted them and also agreed that the quality of service was high, if one looks at Figure 6.15. It has already been reported earlier that 88% of recipients were happy with the service. One respondent was happy that the officials had come to her home. Another mentioned in particular that the officials spoke nicely. One individual appreciated that the state was providing assistance and another felt "lucky" to receive a grant because there were many who were not receiving grant assistance at all. There were, however, comments from two individuals that there was not enough staff or that the service was not acceptable. One indicator that may require further investigation is the 31% who chose neutral when asked whether they get answers to their questions.

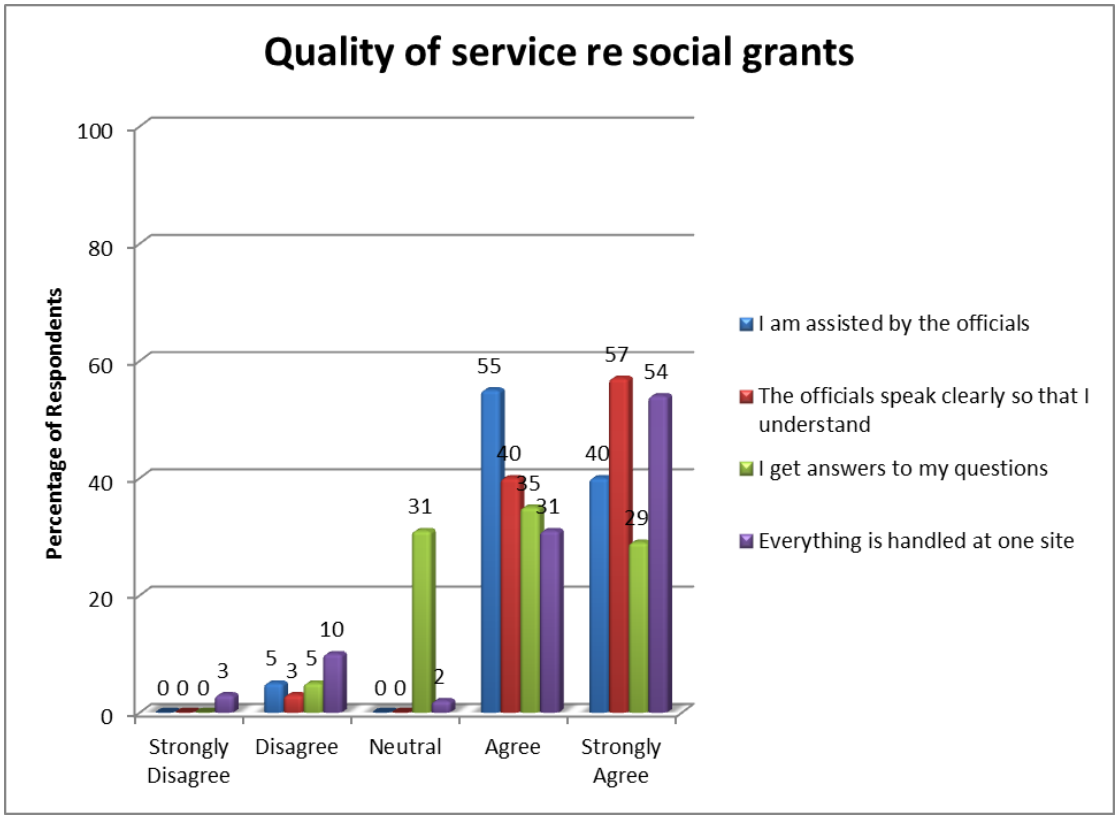

Figure 6.15: Members of the Public: View of quality of service

Length of procedures

The *length of procedures* category questions according to Table 6.3, appear in both of the questionnaire groups. Again, the appropriate question numbers are therefore taken from Table 6.3 and looking at the results for these questions, one can report the following information about *length of procedures*:

- Under both the *infrastructure* and the *performance* categories, it was reported by the government officials that there were seen to be sufficient devices and technical staff to cater for the demand. However, one has also seen that the time taken for the computers to respond is the biggest cause of delays. One of the respondents who had indicated that waiting for the computer system to respond caused the most delay, added a comment that the delay was sometimes as long as ten minutes. Another respondent said that she would usually fill in the application form first on paper but that capturing it later on the computer took a longer time as the computer was slow.
- 79% of the members of the public agreed or strongly agreed that there were sufficient government official staff to cater for the demand but their perceptions on whether the whole process is too long, are widespread as was shown in Figure 6.11. The rural areas found that the procedure did not take very long. One urban respondent said that the four or five hours wait was pleasant while another said that the wait was a bit long, but was happy in general.

Intrusion of privacy

The *intrusion of privacy* category questions according to Table 6.3, appear only in the Members of the Public group. Again, the appropriate question numbers are therefore taken from Table 6.3 and looking at the results for these questions, one can report the following information about *intrusion of privacy*:

- 93% of the members of the public were willing to provide their biometrics. Figure 6.16 reveals the results when they were asked whether they would prefer using a Personal Identification Number (PIN) or a biometric when collecting social grant money. The results mostly indicated that it was

preferred to use a PIN. One respondent preferred the biometric because it was difficult to type in a PIN when one has arthritis. Another respondent said that she forgets her PIN. There was also one respondent who had experienced that no money was forthcoming because the fingerprint system had not been working at the time.

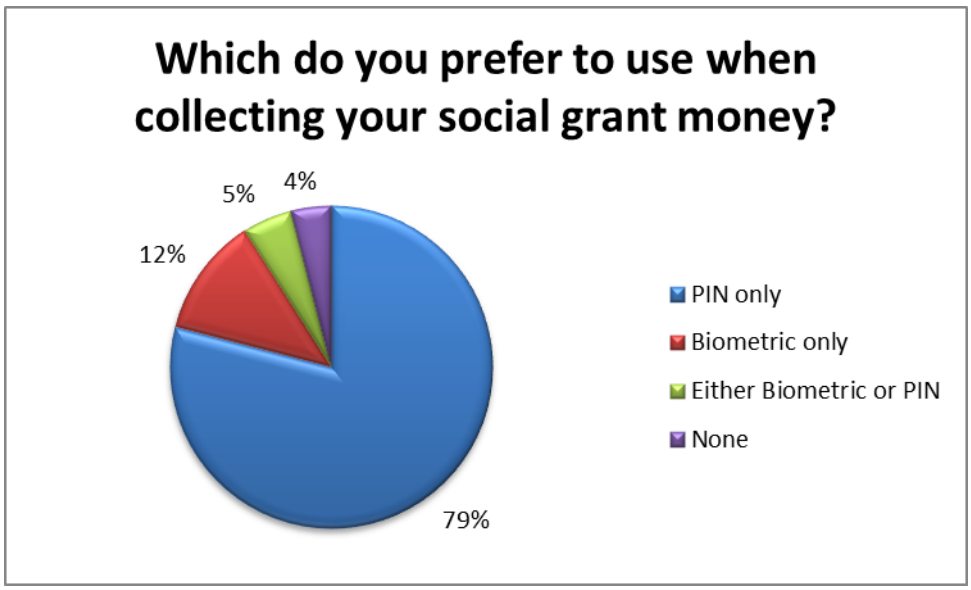

Figure 6.16: Members of the Public: Preference for PIN and/or biometric

- The members of the public expressed a preference for certain methods of identification as shown in Figure 6.17. 64% of the respondents like the photograph which again refers to an ID document printed photograph. This high preference for the printed photograph requires further investigation to determine the possibility of public preference for facial recognition as a biometric. There is a possibility that the members of the public chose the fingerprint and the voice simply because it is what they have had exposure to. They have not been exposed to the iris so as to make an informed decision as to whether they view it favourably.

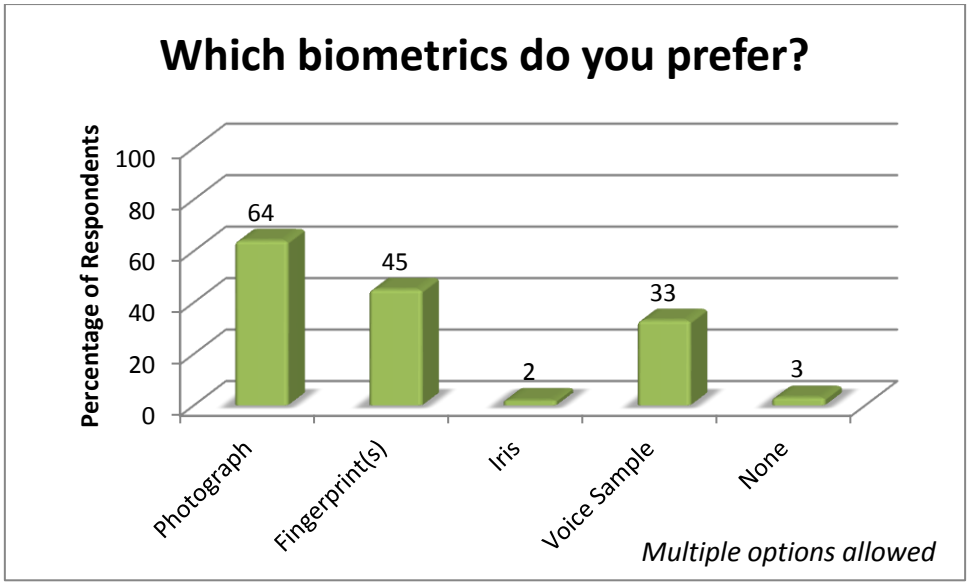

Figure 6.17: Members of the Public: Preference for certain biometrics

- Figure 6.18 reveals the results showing which biometrics were seen as invasive. It can be seen that from those biometrics that were provided on the choice list, 43% of respondents found none of them invasive. However, there is no data to suggest whether they were reporting on the features that were in use and which they had experienced.

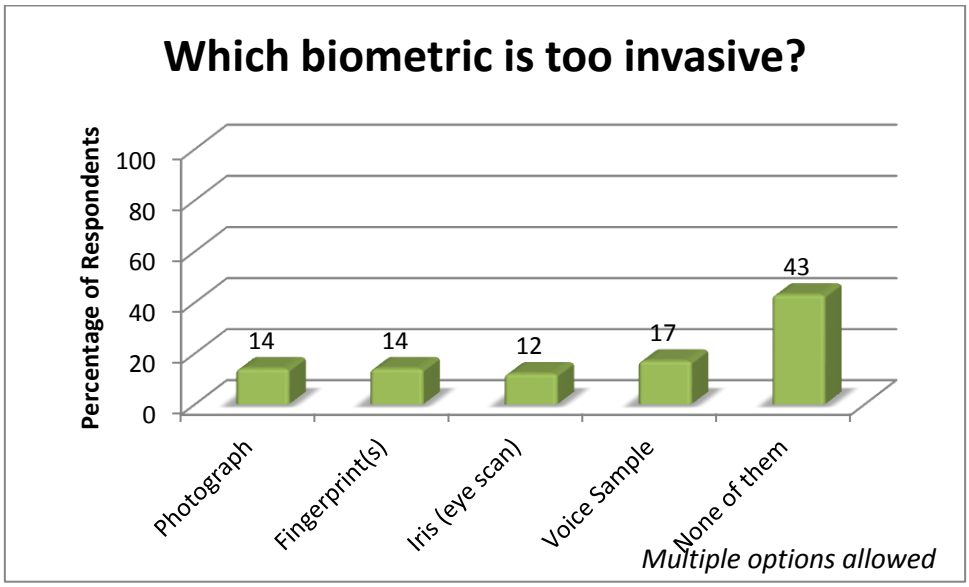

Figure 6.18: Members of the Public: Invasive biometrics

Advertising

The *advertising* category questions according to Table 6.3, appears in both of the groups. Again, the appropriate question numbers are therefore taken from Table 6.3 and looking at the results for these questions, one can report the following information about *advertising*:

- All government officials agreed that they informed the members of the public as to why their biometric features were required. However, many of the members of the public (48%) disagreed with this and 7% were neutral, leaving less than half of the members of the opinion that they were informed.
- Figure 6.7 revealed where the members of the public first heard about the social grants. Only 22% heard about it from friends or family members and the rest from public sources. The "other" range included the South African Police and clinics in some cases.
- Members of the public were asked whether they thought that the social grant requirements were well advertised. The results revealed that 83% mostly strongly agreed that they were well advertised, 14% disagreed and the rest were neutral. In the Cacadu district, 60% of the respondents reported having heard about the grants from the Community Development Workers. In the Chris Hani district, 50% of the respondents had heard about the grants from the SASSA offices.
- The members of the public were also asked where they would prefer to receive their grant money. Figure 6.19 shows the results. In the Nelson Mandela Bay area, only 7% were happy to collect from official pay-points, while in the outlying rural areas, this percentage was much higher. Overall, the favourite site was the banks or the ATMs.

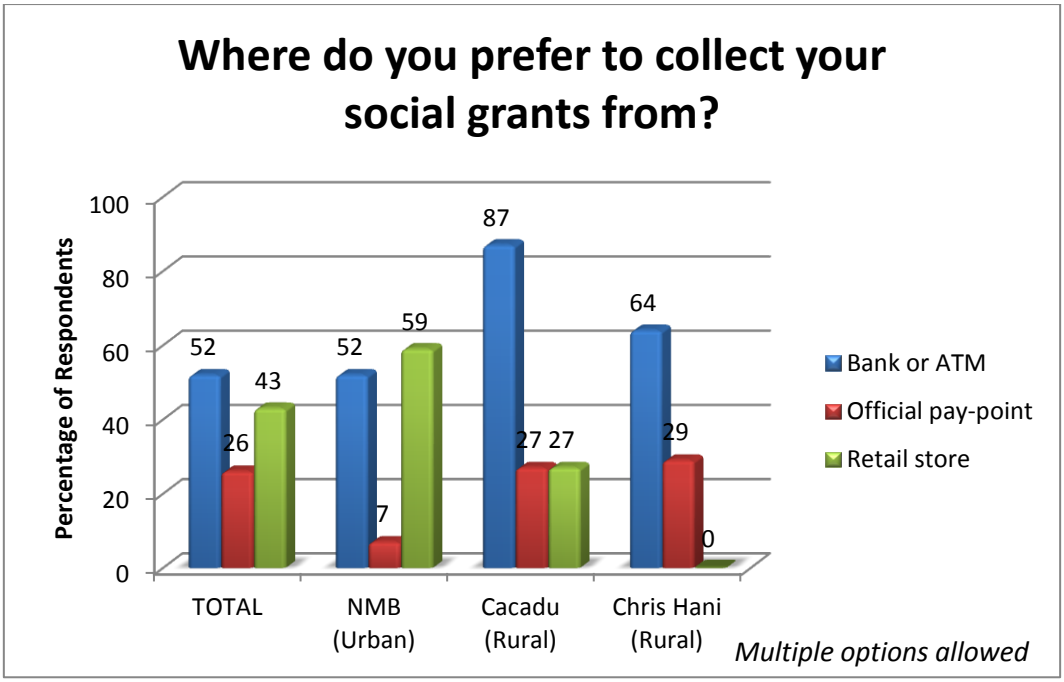

Figure 6.19: Members of the Public: Preference of site for collecting grants

Training

The *training* category questions according to Table 6.3, appears in both of the questionnaire groups. Again, the appropriate question numbers are therefore taken from Table 6.3 and looking at the results for these questions, one can report the following information about *training*:

- The *defined procedures* category and the *quality of service* category revealed that the government officials were all confident that they knew the required procedures exceptionally well. Figure 6.12 from the *defined procedures* category reveals that 91% of the members of the public agreed or strongly agreed regarding this issue. Figure 6.15 from the *quality of service* category reveals more positive results from the members of the public, suggesting well-trained officials.

Accessibility

The *accessibility* category questions according to Table 6.3, appears in the Government Officials and the Members of the Public groups. Again, the appropriate

question numbers are therefore taken from Table 6.3 and looking at the results for these questions, one can report the following information about *accessibility*:

- The government officials were asked whether they had experienced situations where a member of the public was not able to provide a required biometric for the social grants. If the answer was YES, then the respondent was asked to explain further. The results listed included problems with the elderly and claw hands due to strokes and other disabilities. There were also occasions where someone had no fingerprints or was missing some fingers. Mentally disturbed patients sometimes did not want to provide their fingerprints.
- Under the *assurance* category, it was seen that 91% of the members of the public found it easy to provide their biometrics. Under the *defined procedures* category, Figure 6.14 revealed how often the members of the public were willing to provide their biometrics in order to continue receiving their social grants. Figure 6.19 under the *advertising* category revealed from where the members of the public preferred to fetch their social grant money.
- A closer examination of Figures 6.13 and 6.19 reveals the following result:
    - Figure 6.13 has shown that a large percentage of the respondents reported that they had provided biometrics when applying for social grants while at the most only 12% reported providing biometrics when receiving payments. This correlates with the practice that grantees may collect grants at various outlets, not all of which require biometrics (e.g. Banks or ATMs as shown in Figure 6.19).

This section has presented the results from the interviews for the case study.

6.7 CONCLUDING REMARKS

The case study was conducted in order to answer part of the research Question 2: *What challenges exist and what lessons can be learnt from current applications where biometric features are used in government sectors both in South Africa and abroad?* Some parts of this Question 2 were answered in Chapter 5 which presented challenges and lessons learnt. This chapter looked at perceptions and

experiences from role-players involved with social grants and biometrics in South Africa and used interviews within a case study to do this.

An indication of the contribution from this chapter towards the research report is shown in Figure 6.20. The results from this case study are very relevant for insertion into a framework for biometrics for social grant systems in South Africa.

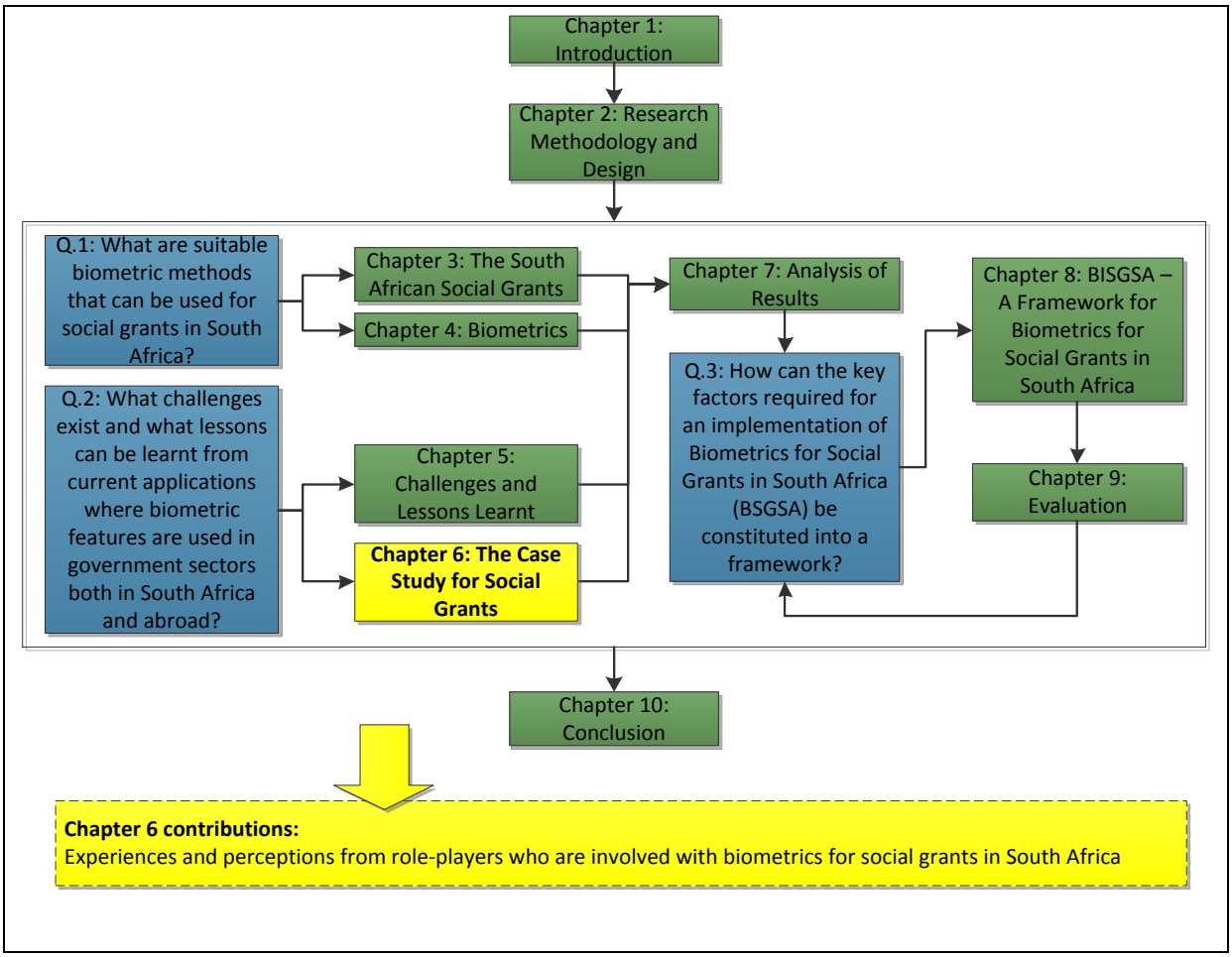

Figure 6.20: Contributions from the case study

Formal coding was used on the data gathered from this chapter in order to provide input to the framework as will be discussed in Chapter 7.

6.8 SUMMARY

This chapter presented the case study done in the Eastern Cape region of South Africa.

The government officials who participated in the interviews included five persons from the SASSA offices in the Nelson Mandela Bay area. The 60 questionnaires for the members of the public were taken to urban areas as well as some rural sites in the Eastern Cape region. Most of the respondents for the members of the public interviews were found at the various SASSA offices, while some were also found at local clinics. Where there may have been a slight difference found in the results between the rural and the urban area for any particular measure, these differences were indicated.

The chapter presented the results of the case study within various categories. Each category was therefore able to be described according to the interview results.

The next chapter will present the analysis done on the information gathered so far for the framework for Biometric Implementation for Social Grants in South Africa.

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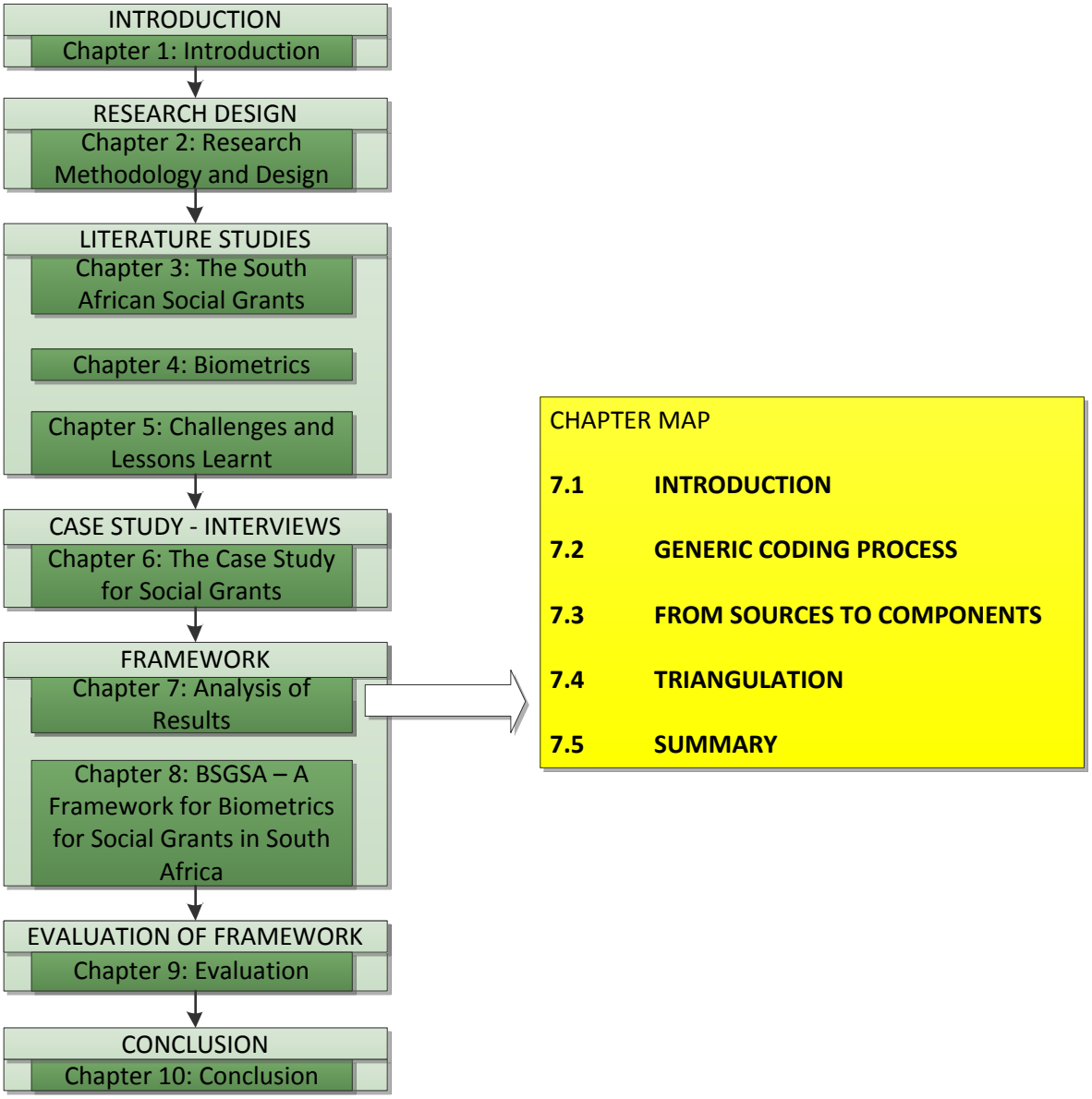
CHAPTER 7: ANALYSIS OF RESULTS

LAYOUT OF CHAPTER 7



7.1 INTRODUCTION

This chapter explains the processes used to do analysis on the various sources of data. As can be seen in Figure 7.1 there are four data sources used. All of the data that is gathered from Chapters 3, 4, 5 and 6 feed into the analysis of results.

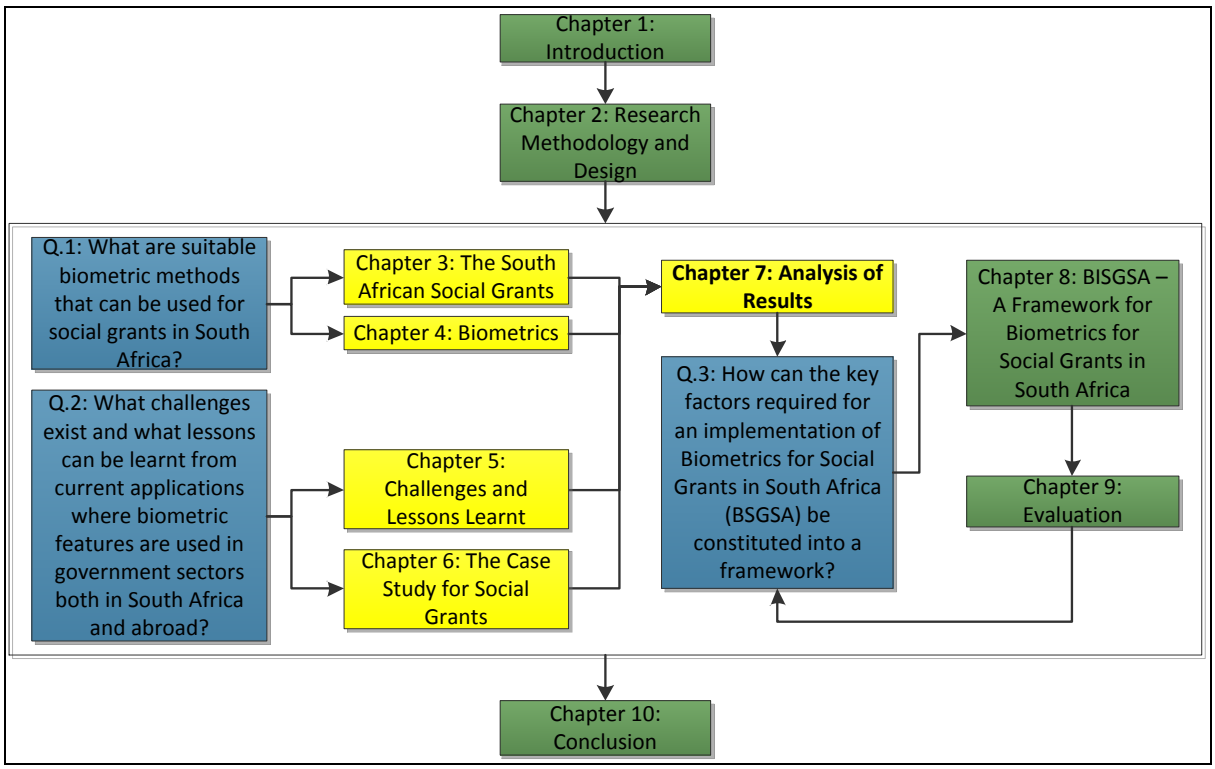


Figure 7.1: Literature and case study chapters feed into analysis chapter

Section 7.2 presents a generic coding process that was used to analyse the qualitative and quantitative data from the sources, these being the literature review chapters and the case study results. Section 7.3 presents the focus areas and components that are used for the framework and that resulted from the generic coding process. Section 7.4 summarises the triangulation of the data and the chapter ends with the summary in Section 7.5.

7.2 GENERIC CODING PROCESS

The purpose of the BSGSA framework is to suggest some important components that should be in place for an effective implementation of biometrics when used for social grants for South Africa.

In order to produce the BSGSA framework it was necessary to first develop a generic coding process as shown in Figure 7.2 for deriving components for the framework. This generic process was used for both the qualitative and the quantitative data. The process begins by looking at the various sources of the information and proceeds from there.

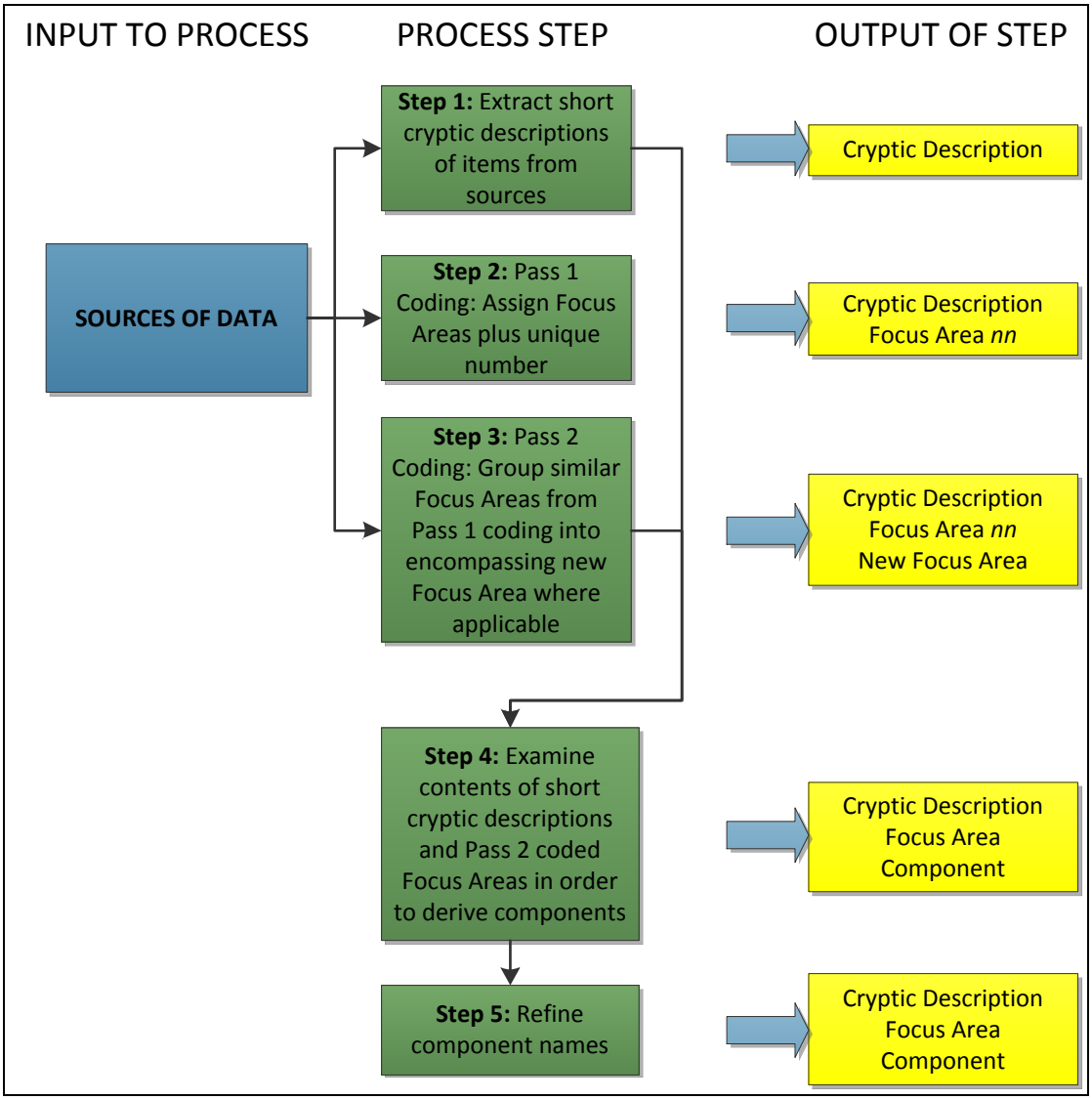


Figure 7.2: The generic coding process

The generic process involves the following steps using content analysis where appropriate:

1. Separately and methodically, from each source of information, gather items that are seen to be important at this stage for the BSGSA i.e. those items that could become entries in the framework. Write a short *cryptic description* for each of the items so gathered. This description is used as a temporary replacement for the detailed item that it refers to. If it is eventually decided to include this item in the framework, an appropriate full description can be used, and not the temporary short cryptic version. The output from this stage of the generic process is a list of cryptic descriptions from each source;
2. Perform a "pass one coding" on the short cryptic description items from point 1 above, by providing a coded description or name which implies a *focus area* that this item may fall into. For example if the item was something related to a security control then the code may become "Security" and must be appended with a number to distinguish this particular item from another one which may also be coded as a security control. The output from this stage of the generic process is the list of cryptic descriptions from each source, each coded with a "pass one coding" focus area together with a unique number;
3. Perform a "pass two coding" on the "pass one coding" names i.e. the items from point 2 above that are marked as "Security-nnn" fall under a pass two coding focus area called "Security". There may also be other codes such as "Privacy-nnn" which one also chooses to place under "Security" during this pass two coding process. The output from this stage of the generic process is the list of cryptic descriptions from each source, coded from the first pass coding, and including a code from the second pass coding stage which is a higher-level abstraction than the first pass coding;
4. Reflect on the unique focus areas from the pass two coding and study the nature thereof. This expects, however, that one must also look at the cryptic descriptions during this reflection. Therefore, for each entry that contains a cryptic description and a "pass two coding" focus area, one studies the nature of these two together in order to derive an area of application which is called a *component.* For the purpose of the framework, a component is an

encompassing entity that is necessary for appropriate implementation of biometrics for social grants in South Africa. These components chosen for the framework are derived from this intensive reflection process. This is best explained by means of examples:

a. For example, if one source (information gathered from challenges and lessons learnt) had a cryptic description entry about “Offices should be at accessible sites” and the focus area was coded in the second pass coding for this item as “Environment”, then looking at both of these pieces of information together, one sees that it may have an influence on providing for an effective environment which is a useful component and necessary for the BSGSA framework, entitled as a “Facilitating Environment”;
b. As a second example, if one source (e.g. information gathered from the South African social grants) had a cryptic description entry about “Connect all service centres to back end systems” and the focus area was coded in the second pass coding as “Goals”, then looking at both of these pieces of information together, one sees also that it would feed into the component entitled “Facilitating Environment” even though it was from a different source and featured a different focus area. The environment for BSGSA would be facilitated by the adoption of this item. In fact, this particular item was originally seen as a goal in the South African strategic plans as found in the earlier literature study;
c. A final example presented here may be a cryptic description about “Grassroots Innovation booklet showcases best case studies of Community Development Workers” and the focus area coded in the second pass was “Structures and Procedures”. This booklet is a structure in place to encourage best practices by Community Development Workers. Looking at these two pieces of information together, one sees that it could feed into a component entitled “Performance requirements” that should be in place for BSGSA as it is an encouragement for the Community Development Workers to enhance their performance;

To summarise, the components suggested in these examples are “Facilitating Environment” and “Performance Requirements” that should be in place for appropriate implementation of biometrics for social grants in South Africa. The output from this stage of the generic process is the list of cryptic descriptions from each source, coded from the first pass coding, and including a code from the second pass coding stage which is a higher-level abstraction than the first pass coding, and also including a suggested derived component;

5. Reflect on the derived components from the output of point 4 above and see if any of them can also be renamed in order to aim for fewer final encompassing components. For example if there were components called “Security”, “Privacy” and “Ethics”, then a new component name can be “Security, Privacy and Ethics” which would replace those individual component names. The output from this stage of the generic process is the list of cryptic descriptions from each source, coded from the first pass coding, the second pass coding, and the final smaller set of component names.

Some examples of the final output from this generic coding process used to derive components is extracted and depicted in Figure 7.3.

7.3 FROM SOURCES TO COMPONENTS

Table 7.1 describes the sources that were used to find information that were relevant for the framework and that fed into the generic process described in Section 7.2. These sources were presented in previous chapters in this document.

The information from the sources was examined according to the generic process. Within the sources, for the purposes of the framework, the information was coded into focus areas which are listed in Figure 7.2. These focus areas are the result after the “pass two coding” that was done in Step 3 of the generic coding process.

	SOCIAL GRANTS: Content Analysis			
Item No.	**Cryptic Description**	**First pass coding**	**Second pass coding – Focus areas**	**Component in initial framework**
SG-51	Grassroots innovation booklet showcases best case studies of CDWs	Structure SG-51	Structures and Procedures	Performance Requirements
SG-52	Connect all service centres to back end systems	Goal SG-52	Goals	Facilitating Environment
	BIOMETRICS: Content Analysis			
Item No.	**Cryptic Description**	**First pass coding**	**Second pass coding - Focus areas**	**Component in initial framework**
BIO-08	Function creep - subversive use of biometrics	Privacy BIO-08	Privacy and Security	Privacy, Security and Ethics
	CHALLENGES AND LESSONS LEARNT: Content Analysis			
Item No.	**Cryptic Description**	**First pass coding**	**Second pass coding - Focus areas**	**Component in initial framework**
CL-31	Offices should be at accessible sites	Environment CL-31	Environment	Facilitating Environment
	INTERVIEWS: Descriptive and Content Analysis			
Item No.	**Cryptic Description**	**First pass coding**	**Second pass coding - Focus areas**	**Component in initial framework**
MP-B25	Intrusion of Privacy: Biometrics seen as invasive	Public Acceptance MP-B25	Public Acceptance	Privacy, Security and Ethics

Figure 7.3: Examples of generic coding process to extract components

Each source therefore has a number of focus areas. Further derivation in Steps 4 and 5 according to the generic process led to the components. Table 7.3 shows the components that therefore form part of the framework, and gives a brief description of the contents within each component.

The contents for each component therefore naturally indicate which focus areas from which sources would be relevant for that component. This is presented in Chapter 8 together with the initial framework.

Table 7.1: Chapters used as sources of information for the BSGSA framework

SOURCE AND DESCRIPTION
Source 1 (S1): The South African Social Grants (Chapter 3) A comprehensive description of the social grants and the encompassing government structures and strategic plans were discussed in this chapter. These are necessary to facilitate the environment in which biometrics can be used for social grants and therefore feed into the framework.
Source 2 (S2): Biometrics (Chapter 4) This chapter focussed on biometrics under the following headings: characteristics of good biometrics; typical areas where biometric features are used; problems with biometrics; actions such as enrolment, verification and authentication; multi-modal biometrics and in particular: the fingerprint, iris and voice biometrics. This forms part of the framework.
Source 3 (S3): Challenges and Lessons Learnt (Chapter 5) The challenges and lessons learnt from past experiences in South Africa's grant procedures were tabled here. These challenges and lessons were looked at particularly in the following areas: environment, goals, structures, officials, members of the public and technical. All of the information discussed in this chapter was taken from publications and news articles and some of the information is fed into the framework.
Source 4 (S4): Interview Results (Chapter 6) Interviews were conducted with government officials who deal with social grant applications in the Eastern Cape region of South Africa, as well as with grant recipients in that region. The results of these interviews also revealed information which feeds into the framework.

Table 7.2: Focus Areas extracted from the Sources during analysis

SOURCE	FOCUS AREAS
Source 1: The South African Social Grants **(Chapter 3)**	Policies and Laws Strategic Plans Structures and Procedures Batho Pele Principles Goals
Source 2: Biometrics **(Chapter 4)**	Biometric Characteristics Privacy and Security Feature Extraction Matching Issues Popular Biometrics Multi-mode Biometrics
Source 3: Challenges and Lessons Learnt **(Chapter 5)**	Structured Procedures Security Privacy Environment Service Delivery Public Acceptance
Source 4: Interview Results **(Chapter 6)**	Structures and Procedures Staff Commitment Public Acceptance

Table 7.3: Components used for the BSGSA framework

COMPONENT AND DESCRIPTION
Component 1 (C1): Structures and Procedures For the success of an implementation of biometrics used for social grants in South Africa, there must be seen to be encompassing formal structures, procedures and possible actions in place to ensure the on-going correct application and delivery of the grants and to nurture a nature of caring for the recipients. There should also be protection in the form of policies and laws to facilitate all aspects of the social grants.
Component 2 (C2): Security, Privacy and Ethics *Security:* Biometric features are used to authenticate individuals for the purposes of applying and receiving social grants. This is personal information and should be kept secure. *Privacy:* Recipients of grants should have certain rights as to what is done with their biometric and other information. *Ethics:* There should be due care taken when dealing with biometrics and vulnerable recipients. There should also be certain controls in place to prevent misuse of personal information. The members of the public may have reservations about the use of their biometrics and therefore there should not be a breach of ethical behaviour.
Component 3 (C3): Suggested Biometrics Some suggestions for the choice of biometrics as well as for the implementation thereof are necessary.
Component 4 (C4): Performance Requirements Due to the large volumes of transactions required for the social grants for South Africa, there should be attempts made to improve performance in every way. Performance improvements should be applied in the area of the application processing and service delivery, as well as in all the biometric functions such as extraction of features and matching.
Component 5 (C5): Facilitating Environment There should be a favourable environment within which the members of the public apply for and receive grants. Various acts and policies may assist towards a good environment. There should also be accessibility to the grants, and good administration of the grant procedures.

7.4 TRIANGULATION

Having examined the various sources of data and the analysis thereof, one can see that the whole process involved methodological triangulation. There were also many instances where data from one source supported the data from a different source.

Figure 7.4 summarises the triangulation process. Literature reviews were carried out to investigate the structures that are applicable to social grants in South Africa. A literature study was also carried out to find out various aspects of biometrics in order to determine its suitability for social grants in South Africa. A further literature review was conducted to find out the challenges and lessons learnt when using biometrics

for social grants in order to find out the impact of the use of biometrics for social welfare systems. A case study was also used and interviews were conducted with various role-players who are involved with biometrics for social grants in South Africa. The objective was to investigate general perceptions regarding the social grant system in South Africa. The data collected from the literature reviews was qualitative and the interviews provided both qualitative and quantitative data. All of the data was empirical evidence and gathered in low control environments.

Those aspects that were relevant to a framework for biometrics for social grants in South Africa were extracted from the data and used in a generic coding process in order to derive components for the framework. Triangulation was conducted throughout this process. It became evident that the data from some of the sources supported data from other sources. This analysis finally resulted in the grouping of focus areas which then fed into the derived components for the framework.

7.5 SUMMARY

This chapter presented the details of the analysis that was done on the collected data. Chapters 3, 4 and 5 were literature reviews and the data collected from them was analysed by means of content analysis. After coding the data, some focus areas emerged and are used for the framework in the next chapter. Chapter 6 presented the case study. The data collected from the interviews in this case study was presented in Chapter 6. Focus areas were also extracted from this data and listed in this chapter and also form part of the framework.

Methodological triangulation was conducted. Many items of information from different sources supported one another, thereby adding confirmation that a particular issue is relevant.

The next chapter describes the development of the framework for biometrics for social grants in South Africa.

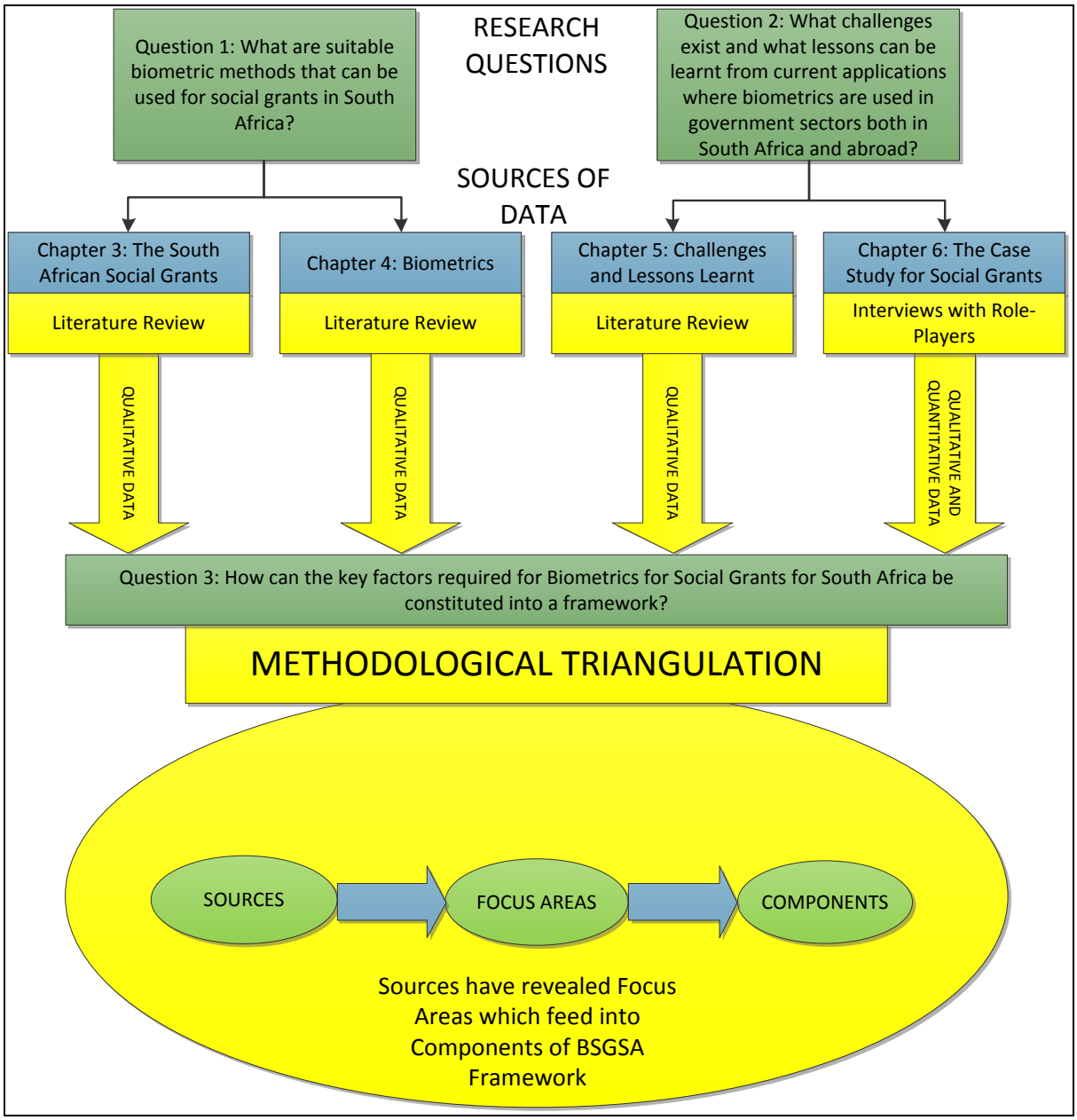
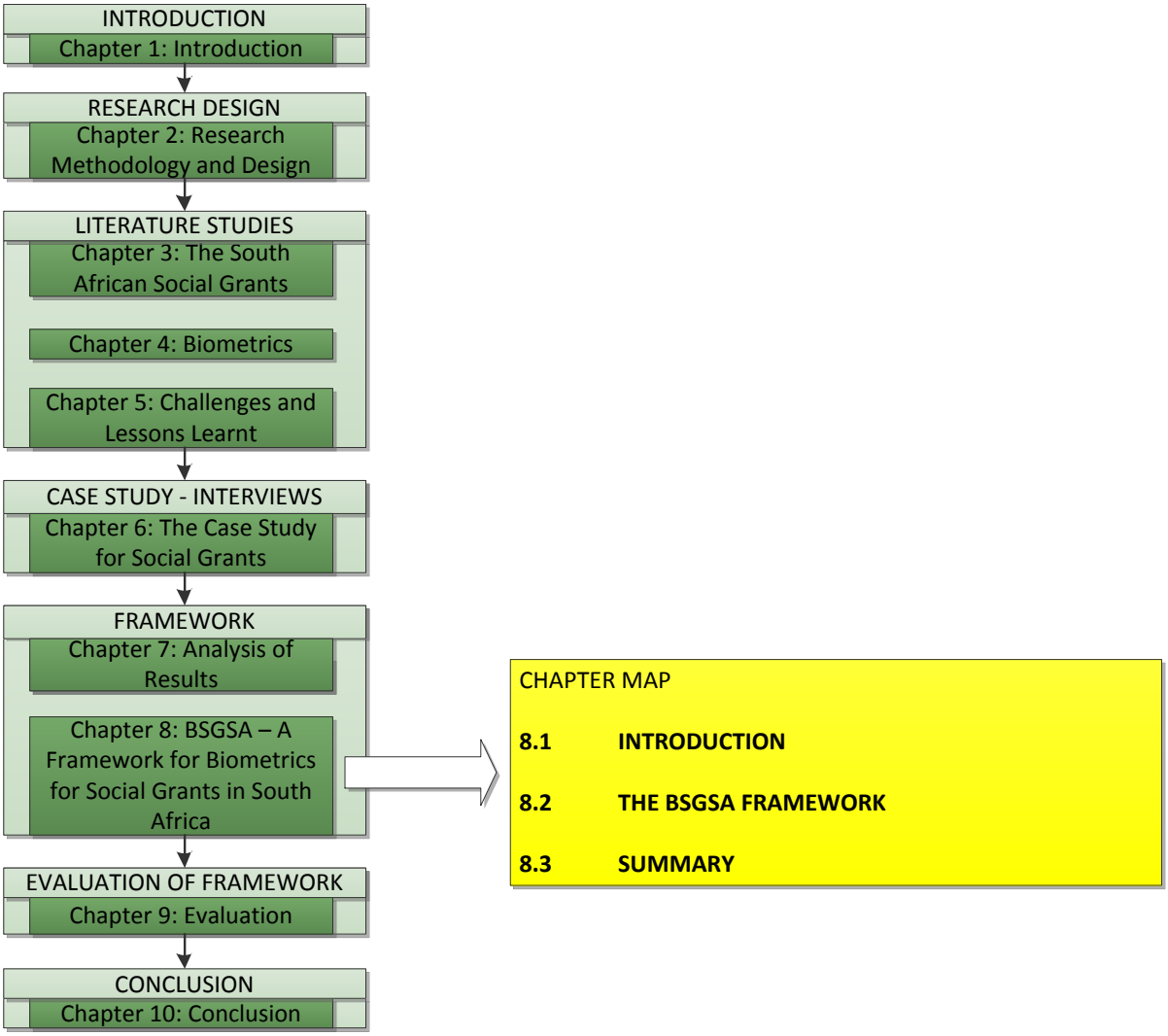


Figure 7.4: Methodological triangulation for this research

CHAPTER 8: BSGSA – A FRAMEWORK FOR BIOMETRICS FOR SOCIAL GRANTS IN SOUTH AFRICA

LAYOUT OF CHAPTER 8



8.1 INTRODUCTION

The previous chapter presented the analysis of the data and in particular, presented the focus areas and components that are used for the initial framework together with the sources from which all items for the framework were derived.

This chapter presents the initial framework for Biometrics for Social Grants for South Africa (BSGSA). The framework is presented in Section 8.2 and a summary closes the chapter in Section 8.3.

8.2 THE BSGSA FRAMEWORK

The contents for each component of the framework indicate which focus areas from which sources are relevant for that component. The components were derived according to the generic coding process described in Chapter 7. Before considering the focus areas in detail, a high-level view of the framework showing the link between the sources and the components is depicted in Figure 8.1. It can be seen in the figure that Source 1 (pink) feeds into all the components. This implies that there may be one or more focus areas in Source 1 which are applicable to one or more of the components, after analysis as described in Chapter 7. Source 2 (blue) feeds into components 2, 3 and 4. Source 3 (green) feeds into components 1, 2, 4 and 5. Source 4 (purple) feeds into components 1, 2, 3 and 5. The details of these links indicating the actual focus areas is shown later in this section. It is important to note that there are no relationships between the components in Figure 8.1 as they simply reside side by side. The only relationships in the diagram are those showing that the sources feed into the components by means of focus areas and this is indicated by the arrows.

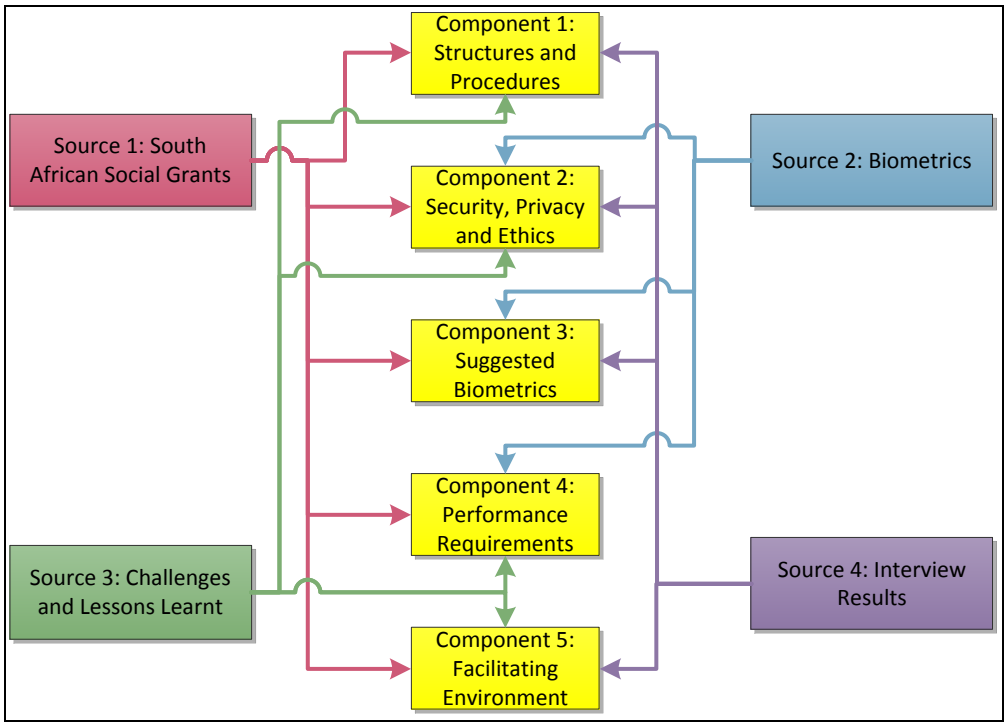


Figure 8.1: High level view of links between sources and components for BSGSA

The details of the links between the sources and the components (by means of focus areas) are shown in four figures. Source 1 (pink) and its focus areas are displayed in Figure 8.2 to indicate which focus areas from Source 1 feed into which components. All components are represented in this figure. The relationships in the figure are depicted by arrows to imply that the focus areas (which were extracted from the sources) feed into the components. For example, the focus area "Policies and Laws" feeds into Component 1: Structures and Procedures, Component 2: Security, Privacy and Ethics and Component 5: Facilitating Environment. There are thus one or more steps or details from "Policies and Laws" that may have relevance to one or more of these three components.

The steps or details referred to are the actual steps containing the original descriptions that become items in the intended framework. These steps are organised into focus areas within the components in the framework. The initial

version of the framework also shows the sources from where the steps were extracted.

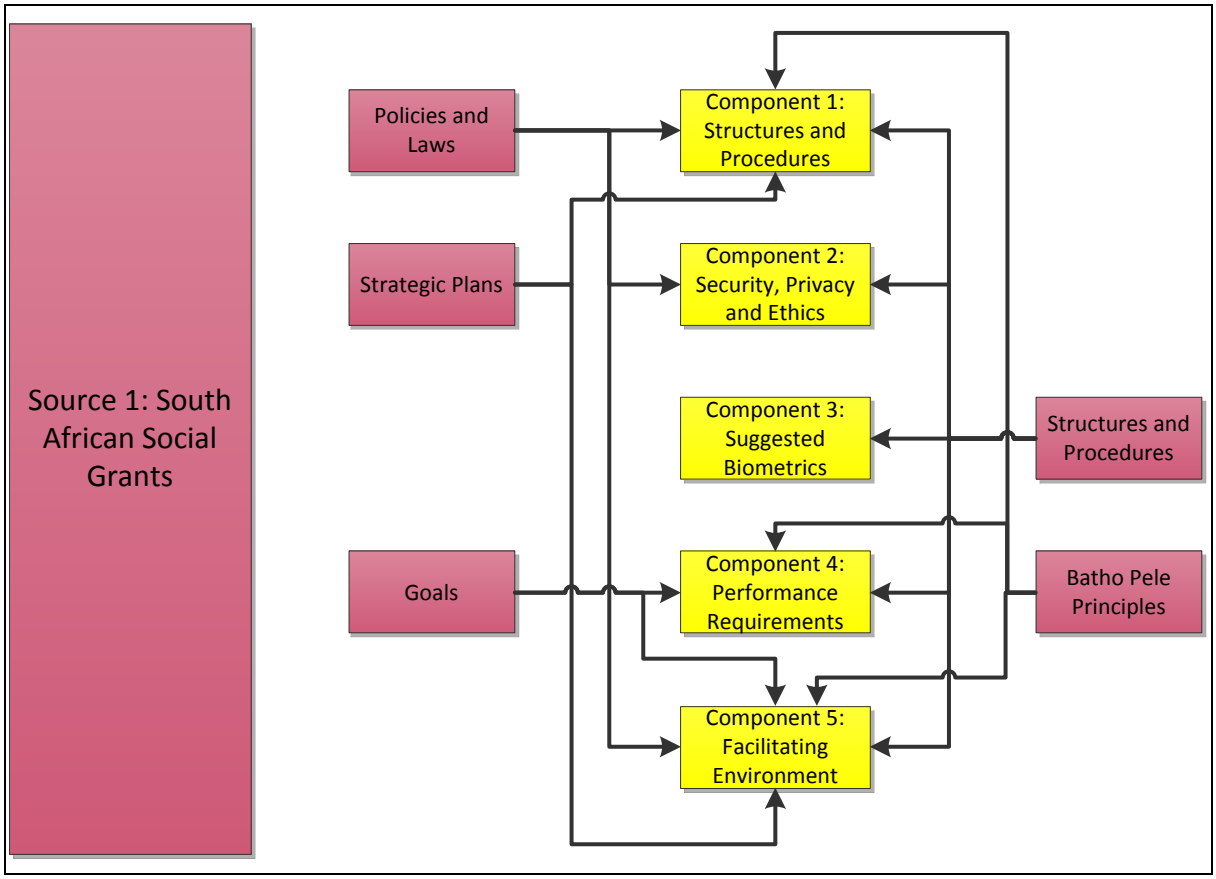


Figure 8.2: Source 1 Focus Areas feeding into Components

Source 2 (blue) and its focus areas are displayed in Figure 8.3 to indicate which focus areas feed into which components. Only Components 2, 3 and 4 are represented as there are no focus areas from Source 2 feeding into Component 1 or Component 5. The relationships (arrows) indicate the focus areas feeding into the components. For example, there are details extracted from the biometrics chapter in the focus area “Privacy and Security” which have relevance to the Component 2: Security, Privacy and Ethics.

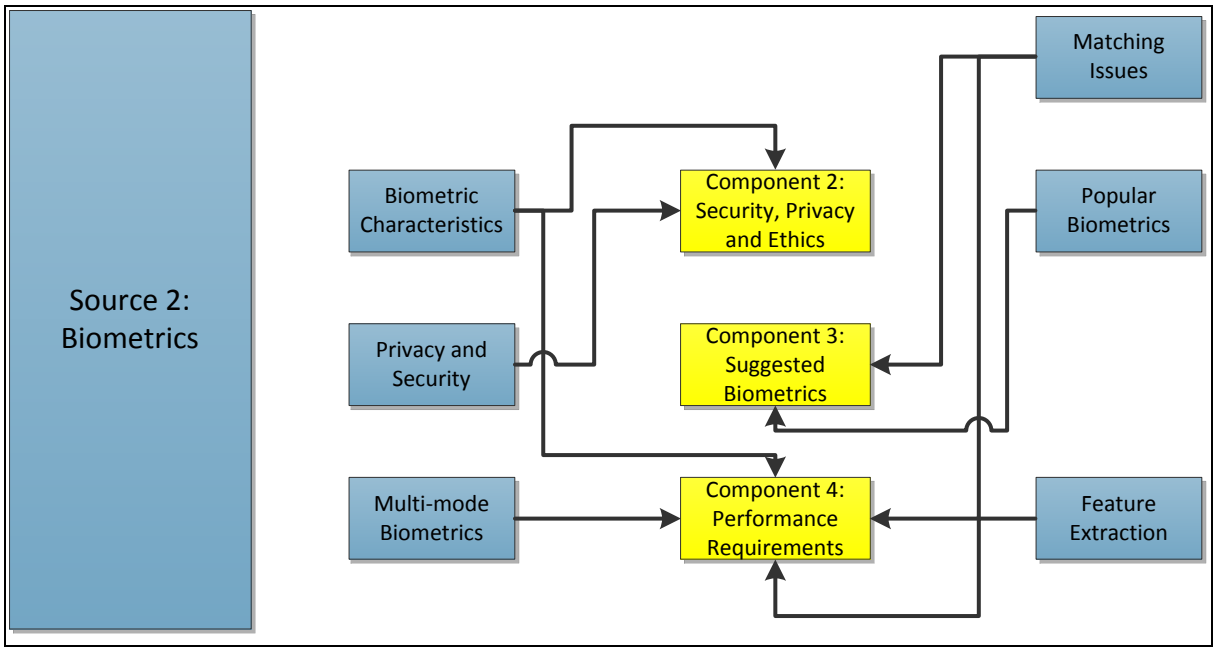


Figure 8.3: Source 2 Focus Areas feeding into Components

Source 3 (green) and its focus areas are displayed in Figure 8.4 to indicate which focus areas feed into which components. Only components 1, 2, 4 and 5 are represented as there are no focus areas from Source 3 feeding into Component 3. The relationships (arrows) indicate the focus areas feeding into the components. For example, the focus area “Public Acceptance” from the challenges and lessons learnt contain information that is relevant for Component 2: Security, Privacy and Ethics.

Source 4 (purple) and its focus areas are displayed in Figure 8.5 to indicate which focus areas feed into which components. Only components 1, 2, 3 and 5 are represented as there are no focus areas from Source 4 feeding into Component 4. The relationships (arrows) indicate the focus areas feeding into the components. As can be seen in the diagram, there is also a focus area within the interview results, called “Public Acceptance”, and this one feeds into Component 2: Security, Privacy and Ethics as well as Component 3: Suggested Biometrics.

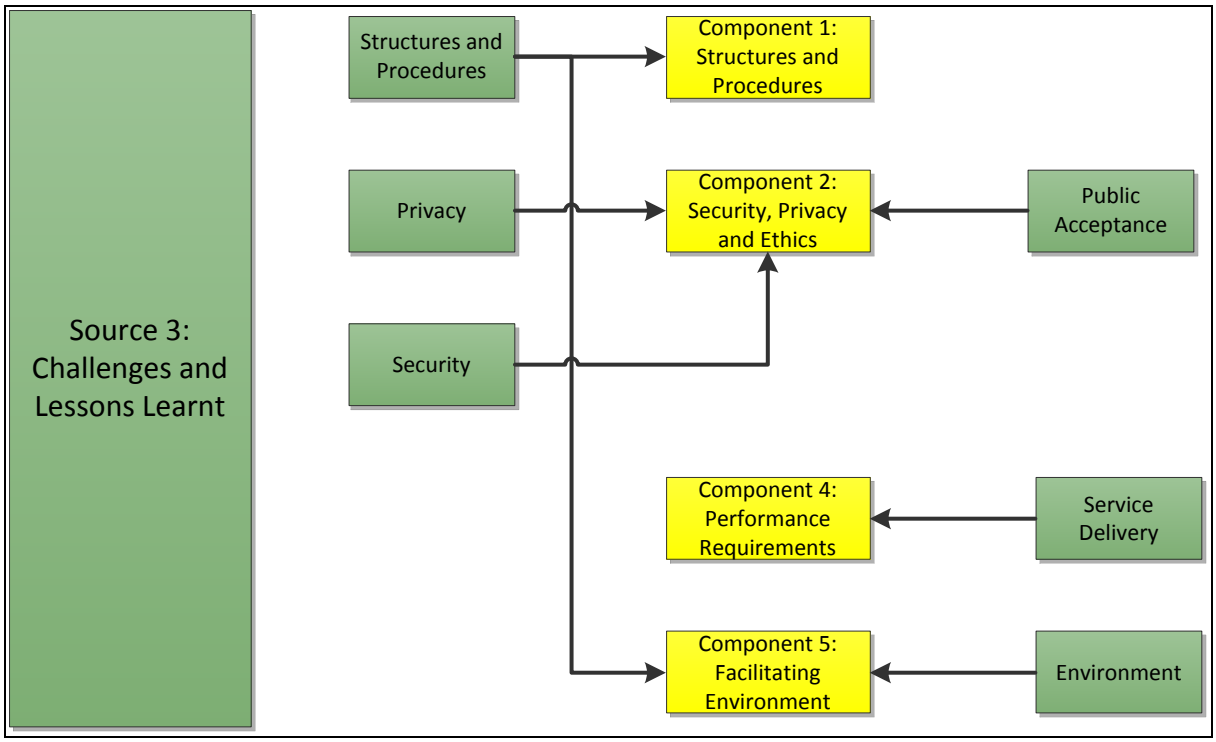


Figure 8.4: Source 3 Focus Areas feeding into Components

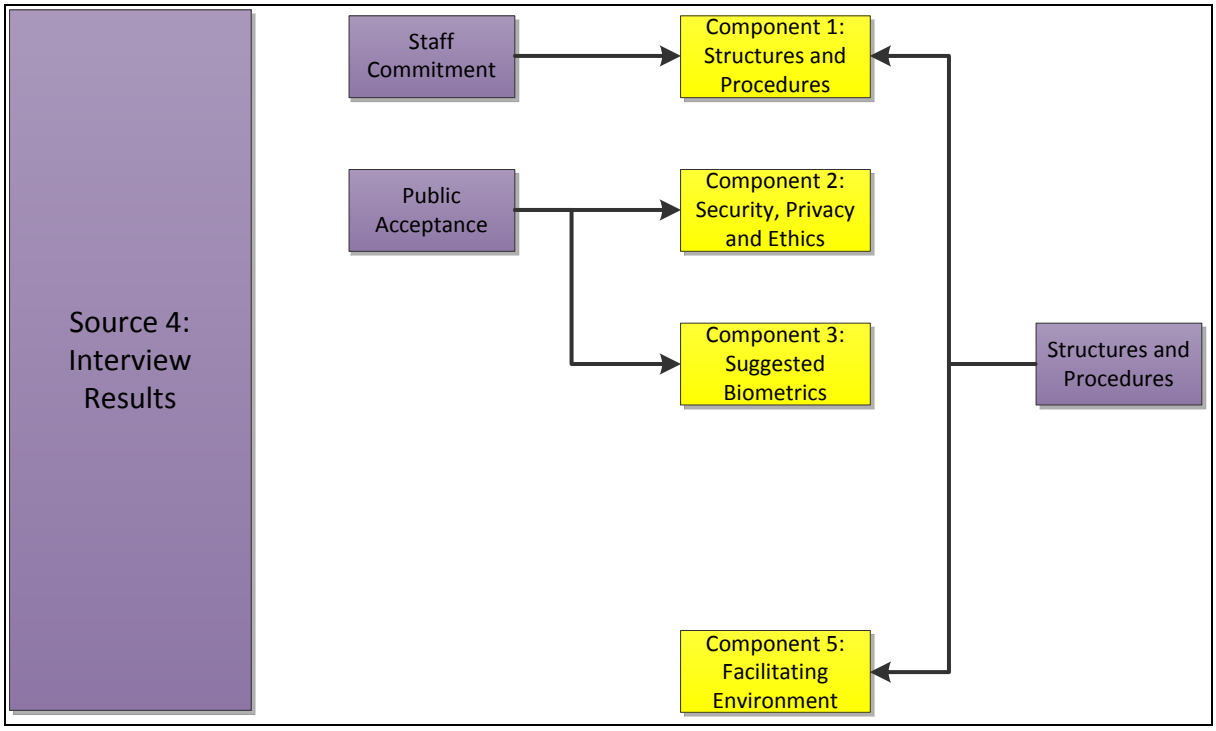


Figure 8.5: Source 4 Focus Areas feeding into Components

One can also look at an inverted view, as depicted in Figure 8.6. The relationships depicted by arrows, indicate that the focus areas, within their sources, feed into the components. For example, Component 3: Suggested Biometrics receives information from three sources. Source 1, for example, feeds into this component by means of its focus area "Structures and Procedures". There is a total of four relationships from various focus areas (within sources) feeding in to Component 3. The total number of relationships where all focus areas (within sources) feed into one or more components is 35.

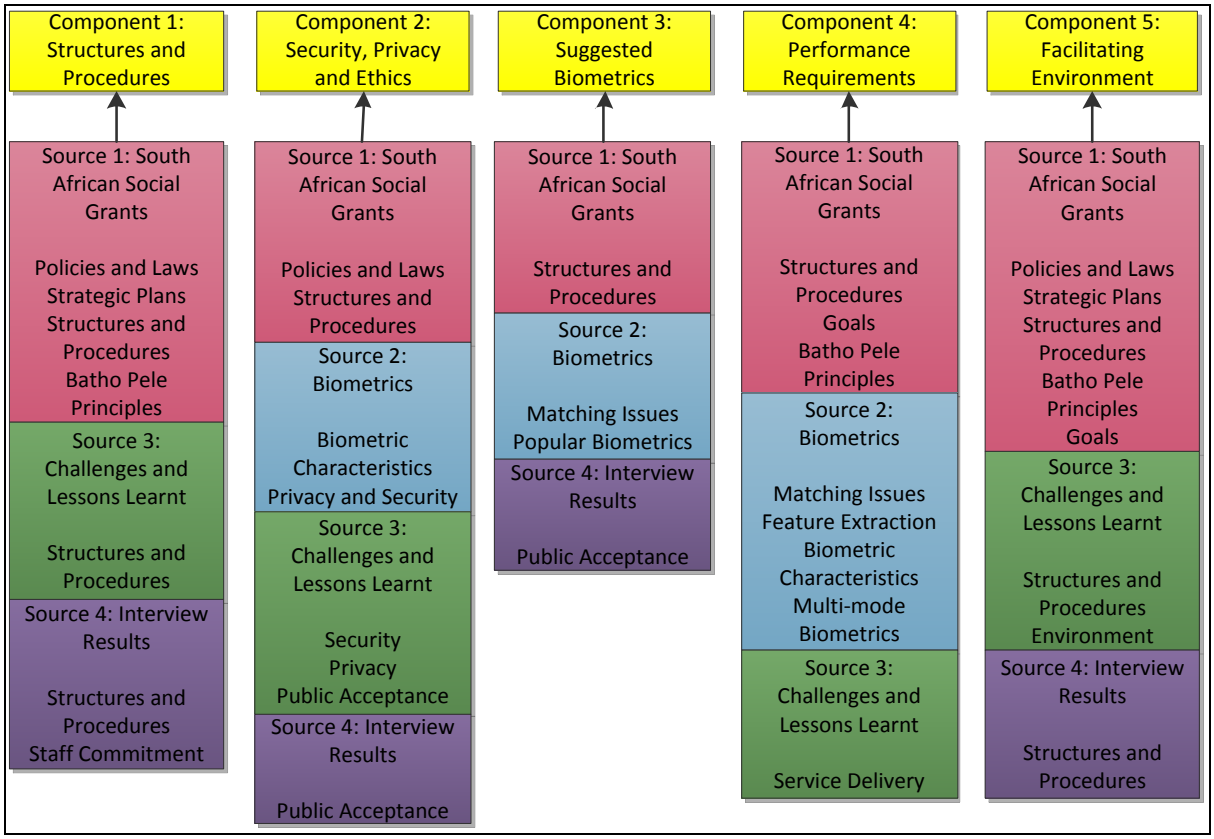


Figure 8.6: Inverted view showing Components and the Source Focus Areas that feed into them

The full pictorial framework is now presented in Figure 8.7, showing the detailed links between the focus areas and the components. For example, one can see that the Source 1 focus area of "Strategic Plans" is fed into the Component 1: Structures and Procedures and Component 5: Facilitating Environment. Again the relationships are depicted by arrows to indicate where there are focus areas (from within the sources) that feed into the relevant components.

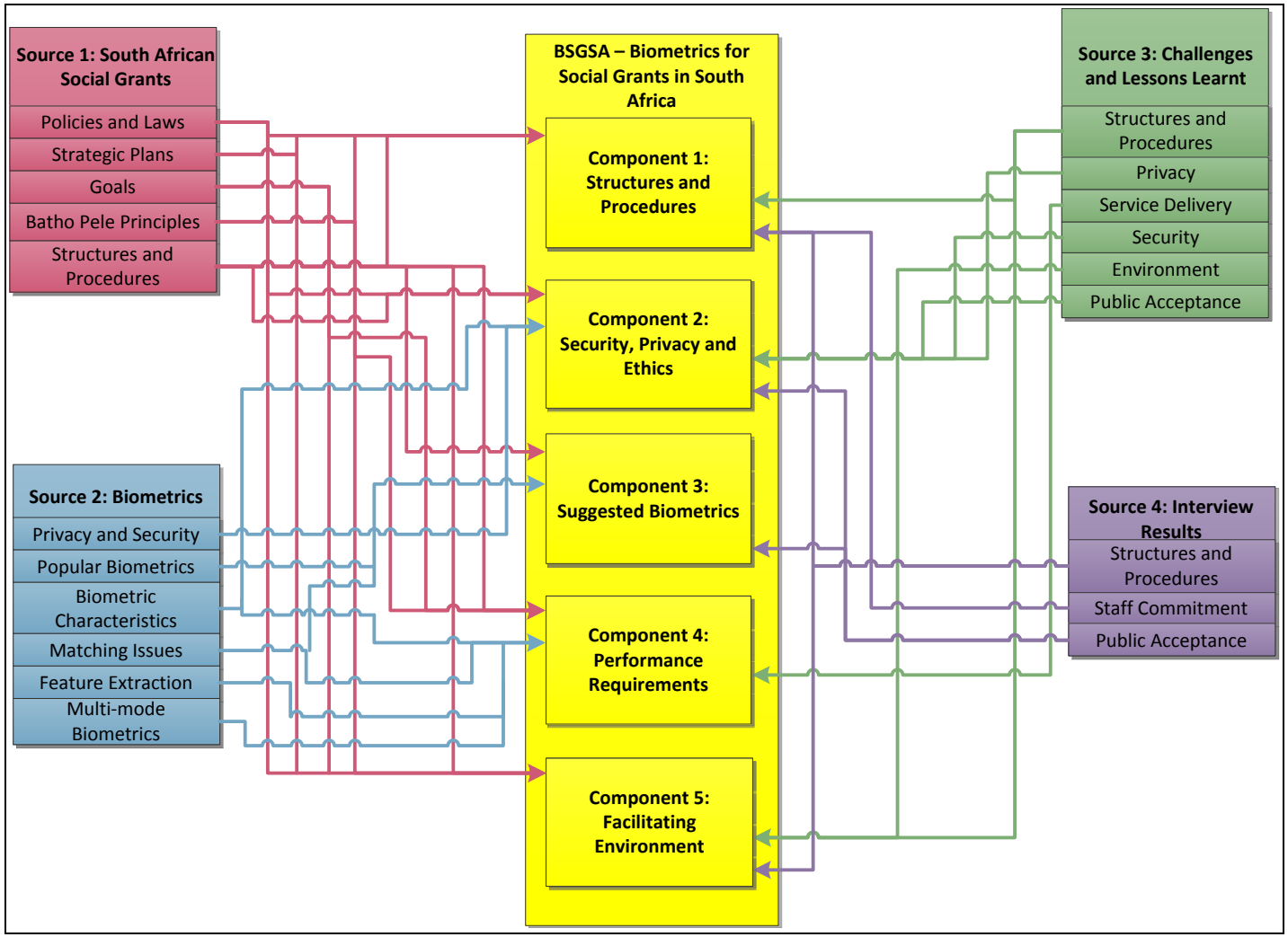


Figure 8.7: Low level view of links between Focus Areas of Sources and Components of BSGSA

The initial framework is now presented in full in Table 8.1. The same colour coding is used as was used in the figures above. Source 1 is pink, Source 2 is blue, Source 3 is green and Source 4 is purple. An example from the first row in the table shows that Source 1 which is South African Social Grants, feeds into Component 1: Structures and Procedures, by means of a focus area called “Batho Pele Principles”. The suggested action in this particular row indicates that “Staff should be courteous and considerate”. This is therefore suggested as being an important requirement within the umbrella of the structures and procedures associated with biometrics for social grants in South Africa. There are a total of 180 suggested actions in this initial framework.

Table 8.1: Initial framework for Biometrics for Social Grants in South Africa (BSGSA)

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
COMPONENT 1: STRUCTURES AND PROCEDURES		
Source 1: South African Social Grants	Batho Pele Principles	Staff should be courteous and considerate.
		There should be consultation with members of the public for decision making regarding service levels and quality.
		Service excellence should be measured with benchmarks to reveal customer satisfaction.
		Apologies and remedial action is necessary if services are not delivered.
		There should be value for money in that services should be provided in an economical and efficient manner.
	Pol., Laws	The Social Assistance Act, 2004 (Act 13 of 2004) assists transfer of benefits to qualifying persons and also describes minimum standards for grant delivery.
		The SASSA Act, 2004 allowed for the establishment of an agency to administer and pay the social assistance transfers.
	Strat. Plan	This DPSA Strategic Priority should be upheld: There should be effective systems, structures and processes.
		This planned outcome should be evident: An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship.
	Structures and Procedures	The SASSA Branch 6: Grant Administration and Public Services should continue to provide guidance for co-ordination of grant administration and payment.
		The Public Protector should continue to ensure that private citizens are served equitably and fair.
		The Public Administration Leadership and Management Academy (PALAMA) should continue to train and develop public servants to respect citizens.
		The Project Khaedu should continue to train public servants in excellent customer care.
		The Centre for Public Service Innovation (CPSI) should continue to promote and transform ideas into new products and services to enhance service delivery.
		The Public Service Sector Education and Training Authority (PSETA) should continue to coordinate skills development in public service.
		The Public Sector Charter has defined attributes, commitments, rules of engagement and ethical principles for public servants and these should be upheld.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
		The idea of the Single Public Service idea must continue to be developed and implemented by the DPSA.
		E-Government must be used to automate and modernise rendition of public services including registrations such as births or deaths.
		Batho Pele principles must continue to encourage mutual respect between state and the poverty stricken citizens.
		The SASSA Branch 2: Internal Audit and Risk Management must continue to reduce fraud and corruption in the grants administration process.
		The Mission of Department of Public Service and Administration (DPSA) is to empower fair and inclusive citizenship, to support MPSA, to provide advice and support for excellent public service and good governance, to incorporate Batho Pele principles for service excellence. This should continue to be upheld.
Source 3: Challenges and Lessons Learnt	Structures and Procedures	This goal should be maintained: migration issues should be solved by allowing the homeless to be able to move around and still be able to claim their money anywhere at any time.
		There should continue to be home visits for those persons who cannot travel to the grant offices.
		There should be awareness that the opinions of the officials who work with the technology may have an effect on their correct adoption and use thereof.
		The officials should be aware of the need for the technology before its implementation in order to proceed with the correct adoption and use thereof.
		There should be sufficient officials to meet the demand.
		The officials should be managed well.
		The officials need comprehensive knowledge of the standard operating procedures with regard to the biometrics and the grants.
		The officials should accept responsibility for knowledge of their tasks.
		The officials should be trained.
		The officials should be professional and friendly.
		The service should remain free of charge as the members of the public may not have resources to apply for the service.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
Source 4: Interview Results	Staff Commitment	The officials should see the relevance of using Batho Pele principles when collecting biometrics in order to provide assurance to the members of the public.
		The officials should be properly trained and should speak clearly when assisting the public and should answer questions carefully in order to provide assurance to the members of the public and to enhance the quality of service.
		The officials should be trained in the procedures and should know how to collect the biometric samples in order to provide assurance to the public and to enhance the quality of service.
		The officials should know and use the Batho Pele principles in order to provide for quality of service.
		The officials should be trained regarding the collection and use of the biometrics.
	Structures and Procedures	There should be sufficient officials to meet the demand.
		There should be standard procedures to follow when collecting biometrics.
		The process of collecting biometrics for the grants should not take too long.
		The computers involved in the procedure cause the most delays. This should be resolved in order to improve performance and service delivery and reduce the length of time taken for the procedure.
		There should be a requirement for the public to provide proof of life periodically, such as once a year or once a month.
COMPONENT 2: SECURITY, PRIVACY AND ETHICS		
Source 1: SA Social Grants	Policies and Laws	The Electronic Communication and Transactions Act, 2002 includes E-Government services and protection of personal information.
	Sruct. and Proc.	The Human Rights Commission should continue to protect human rights in areas including social security.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
Source 2: Biometrics	Biometric Characteristics	Acceptable characteristic of a biometric: The biometric feature(s) that are extracted should be acceptable to the public i.e. they should be willing to have those particular biometrics extracted and used for identification.
		One-way transformation characteristic of a biometric: There should be a one-way transformation characteristic i.e. the biometric template created for storage should be non-reversible.
		Cancelable characteristic of a biometric: When necessary, the template should be able to be cancelled and a new one recreated. For example, if an extra authentication factor is to be added for extra security then it would be necessary to replace the old one.
		Diversity characteristic of a biometric: It should be possible to use the biometric for more than one application.
		Live detection characteristic of a biometric: There should be a mechanism to test if the subject is alive.
	Privacy and Security	To provide for secure authentication, the original binary template should be bound into a cryptographic key.
		Hashing or “salting” may be used but one should not hash the original template which may be subject to noise, but rather hash the biometric key.
		There should be awareness of function creep, which is when a biometric is used for a different purpose than that which was originally intended. This should not happen as it betrays trust, destroys confidence and is an ethical breach. When intending to use a biometric for more than one purpose, this should be stated up front.
		Each time there is an attempt at verification, the real person should receive some notification (such as is done for bank transfers).
		The following personal data should be seen as private: consumption habits, health information, interests, communications, demographic information, appearance, social behaviour and biometrics.
		Biometric extraction may be seen as invasion of privacy which may cause resistance against adoption by the public. To counteract these perceptions, the public should be properly informed about the details of biometric extraction and there should be attempts to make it as non-intrusive as possible.
		The public should be given assurance if biometric features are seen by them to be a weapon for an authoritative government.
		Care should be taken to protect the biometrics that are used across more than one system, because if a criminal obtained access to a subject's biometric, then other systems which contain information for that subject may also be compromised.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
		The central registry should be correct, maintained and secured from tampering, theft and misuse.
		The public must be willing to adopt the biometric scanning, find it easy and non-invasive.
		The public should be told what is being collected and why.
		The public must provide informed consent for having their biometric taken and used.
		The public may be concerned about “big brother” watching? Their concerns should be set at rest.
		There should be a trade-off between privacy and benefits.
		It is advisable that the public should be allowed to choose whether their biometrics may be used for other applications as well.
		The public should be allowed to view and update their information.
		All companies that participate (other applications that want to use the biometrics) must ensure compliance with security and sharing of information.
		There should be no discrimination against vulnerable groups such as children or disabled persons, among others.
		One should seek consent of both carer and child when collecting child biometrics.
		When a biometric is no longer required it should be destroyed.
Source 3: Challenges and Lessons Learnt	Privacy	There may be a need to give assurance to the public if they are concerned about government control and manipulation. Alternatively, if the government is intending to use the biometrics to control and manipulate the public then this goal should be stated upfront.
		There may be a need to give assurance to the public if they are concerned about abuse of their personal data by the government.
		There may be a need to give assurance to the public if they are concerned that their data may be used in other systems as well (function creep). Alternatively, if the intention is to use the biometrics for other systems as well, then this should be stated upfront.
	Public Accept-ance	The members of the public need to have confidence in the service.
		The members of the public need to be involved in decision making.
		Some people may have reservations about invasive methods of collecting biometrics. Education and awareness programmes may counteract these viewpoints.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
	Security	Criminal elements operating around the environment where social grants are processed or paid out should be removed.
		Decisions should be made on the following aspects of security: what information, where would it be stored, how would it be secured, who would have access, what criteria would be used when sharing the information with others, how would the intrusion of privacy be reduced, how would the data be used, when would the data be deleted, would it be deleted when no longer required, would the public remain informed and not misled, would the data be continuously updated when appropriate, would it be protected against loss, access, use or disclosure, would audit records be kept?
		There should be awareness that the public may be concerned about abuse of their personal data by criminal elements. Due care should be taken with the public's data and biometrics.
		There should be awareness that some members of the public may be committing fraud themselves. Controls are required.
Source 4: Interview Results	Public Acceptance	There should be measurements taken to see if the public are happy with the quality of service and infrastructure.
		The public should be informed as to why their biometric features are needed. This should be relayed to them both at the offices as well as through advertising.
		The public should be willing to provide their biometrics.
		The public should find it easy to provide their biometric samples.
		The public may be concerned about how the government uses or shares their information. This needs to be relayed to the public.
		The public should not find the biometric extraction to be invasive.
		When making decisions on which biometrics to use for social grants, one should be aware that the statistics taken from interviews with the public to indicate which features they like are as follows: photo (72%), fingerprint (41%) and voice (34%).
		When making decisions on which biometrics to use for social grants, one should be aware that the statistics taken from the public reveal that they find the following biometrics to be invasive or intrusion of their privacy: Fingerprint (7%), Voice (7%) and Iris (17%). The percentage of persons who did not find any of the biometrics invasive was 48%.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
COMPONENT 3: SUGGESTED BIOMETRICS		
Source 1	Struct. And Proc.	It must be remembered that the Department of Home Affairs (DHA) is issuing new smart cards with biometrics for identification purposes. There may be intentions to use it also for drivers' licences, residence permits, census, voting, insurance, pensions and banks. It may also be possible to use it for the social grants.
Source 2: Biometrics	Matching issues	If a biometric is not able to be extracted and there is no alternative, then traditional methods of identification should be used.
	Popular biometrics	When choosing appropriate biometrics to be used for social grants, one should be aware that fingerprinting is the oldest and easiest technology, and is very accurate.
		When using fingerprints one should remember that it should not be used for very young children i.e. babies are too small.
		When using fingerprints one should cater for the following "noise" issues: cuts and bruises, erased fingerprints due to construction work, skin affected by diseases, dryness or sweating, incorrect angles, too much pressure..
		When using fingerprints one should reduce the time to match fingerprints by localising similar classes of fingerprints.
		When using fingerprints, all 10 fingerprints should be able to be taken in less than two minutes.
		When using fingerprints one should choose appropriate sensors: Optical sensors are cheap and reliable. Capacitive sensors are more expensive and need more power, but better image quality if fingers are not too dry. Thermal sensors need much power but are inexpensive and do not work well on warm days. Radio frequency sensors get to subsurface of finger and are small, accurate and reliable.
		When choosing appropriate biometrics to be used for social grants, one should remember that the iris is the most stable and reliable biometric with the highest success rate and the best one for the most important data.
		When using the iris, one should remember that it is unique and has embryonic factors but is not stable until 2 years old and is problematic when collecting from babies as their eyes are usually closed.
		When using the iris one should remember that it is sometimes considered invasive.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
		When using the iris one should remember that it can be captured regardless of glasses, contacts or laser surgery.
		When using the iris one should cater for the following "noise" issues: One requires an appropriate distance when capturing the iris and one must be aware of eyelash and eyelid occlusion.
		When using the voice as a biometric one should be aware that it takes up minimal space and is non-invasive but has efficiency problems therefore must be strengthened to avoid security breaches.
		When using the voice one should be aware that there is better performance with speaker verification than with other biometrics, except the iris.
		When using the voice as a biometric one should remember that mobile telephones are readily available and can be used to verify live persons.
		When using the voice biometric, one should cater for these "noise" issues: One needs noise cancellation, a good microphone, preferably a larger amount of speech is better, and remember also that tired, bored, irritated or ill persons can cause changes in the voice.
		When using the voice biometric, one must be aware that there is a risk of unintentional speech capture.
		When using the voice biometric, one needs challenge/response questions in random order, to avoid infiltrators using previously taped replies.
		When using the voice biometric, cell phones can provide authentication solutions as it contains the four requirements: something one knows (knowledge data), something one has (phone), something one is (biometric), somewhere one is (location or proximity).
		When using face biometrics, one should be aware that it is non-invasive, easily accepted by users, and is becoming less costly.
		When using face biometrics, one should cater for "noise" issues: images affected by light, pose and facial expression.
		When choosing biometrics for social grants, one should know that the public acceptability statistics reveal the following preferences in order from most preferred to least preferred: fingerprint, iris, hand and voice.
		When choosing biometrics for social grants, one should be aware that market share shows fingerprint, face, hand, iris, voice in that order from biggest market share to smallest market share.
		When choosing biometrics for social grants, one should be aware that the mobile use preference shows fingerprint, then voice and then iris.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
		When choosing biometrics for social grants, one should be aware that the forecast for 2012 was that 84% of the total usage of biometrics was with iris, fingerprint and face..
		Taking statistics into account, one must be aware that the most popular biometric features are fingerprint and iris, but voice and face are also well used.
		If a biometric is to be used for more than one purpose, this must be stated up front. Besides government services, one may also want to use it for crime and law enforcement, passports, drivers' licences, building entrances, travelling, immigration, health cards, bank cards, marriage licences, employment, education, commerce, taxation, voting, terrorist watch, visas, residence permits, consumer preferences, child protection, e-learning and/or population control.
Source 4	Public Accept-ance	It must be noted that statistics from interviews indicated that the majority of the respondents did not use biometrics when collecting their money.
		It must be noted that statistics from interviews indicated that the public prefer to use a Personal Identification Number (PIN) rather than a biometric.
		It must be noted that statistics indicated that only a small portion of the public collect their money from pay points.
COMPONENT 4: PERFORMANCE REQUIREMENTS		
Source 1: SA Social Grants	BP Principle	There should be openness and transparency so that the public can see how the government works.
	Goals	One should cultivate and uphold standards. For example one standard says that it should take 30 seconds to pay a beneficiary.
		One should have standards for waiting times for the members of the public, such as: A beneficiary should not wait longer than two hours.
		One should have standards for office hours, such as: Offices should be open at least from 8am to 3pm.
		When planning for delivery of services re social grants, one must continue to plan for networking, study the transaction volumes, take note of travel times, and anything else required for the delivery of services.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
		One should have standards such as: There should be at least one Community Development Worker in each municipal ward in the country.
	Struct. And Proc.	The Public Service Commission (PSC) must continue to develop and implement service delivery interventions and monitor compliance through annual reports on state of public service by assessing user satisfaction.
		The Grassroots Innovation booklet should continue to showcase the best case studies of Community Development Workers in action in the provinces.
Source 2: Biometrics	Bio. Chars.	Performance characteristic of a biometric: The biometric feature should be able to be extracted quickly and accurately and the matching process should be done efficiently.
		Circumvention characteristic of a biometric: If a biometric feature is not able to be extracted there should be an alternative feature that may also be used in the application.
	Feature Extraction	When extracting features for a biometric, the application should extract an appropriate feature set of the biometric (called segmentation) because the complete image would take up too much memory. This process is meant to discard non-relevant data. The data being discarded may be that which is dependent on the environment and therefore liable to change each time the feature is extracted.
		The feature set that is extracted must be checked for quality before converting to digital form.
		If the intention is to transmit the biometric via a communication medium, the feature extraction of the biometric must be done before the transmission to reduce the bandwidth that may be required.
		The feature extraction must be reliable else there would be an effect on performance.
		If compression is done, there must be due care taken to prevent data quality loss.
		Accepted biometric standards should be used wherever possible.
	Matching issues	An appropriate False Acceptance Rate (FAR) should be chosen and the implementation must support it. Less than 1% may be suitable.
		An appropriate False Rejection Rate (FRR) should be chosen and the implementation must support it. Less than 1% may be suitable.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
		An appropriate Threshold should be used to measure whether there is a match or not. 85% is suitable but can be higher if more security is required.
		An appropriate Failure to Enrol rate should be chosen and the implementation must support it. Less than 3% may be suitable.
		One should choose to design either for false negatives or false positives. If one designs the implementation more in favour of false negatives then more valid recipients would be denied their grants. If one designs more in favour of false positives then more fraudulent individuals may gain access to funds unlawfully.
		One should consider appropriate options such as these for matching: Either no match (failure), or one single match (success), or more than one match (failure), or rank those that match and choose the best match (success).
		The matching process in the implementation should adhere to a standard such as: the transaction time using biometrics should be less than six seconds.
	Multi-modal biometrics	One should rather use multi-modal biometrics which is better for many reasons.
		When using multi-modal biometrics, if biometric fusion is done at sensor level, one needs compatible data from the different sensors.
		When using multi-modal biometrics, it is preferred to do the biometric fusion at the matching score level, because there is enough information to combine the scores and one can set different tolerances for FAR and FRR.
Source 3: Challenges and Lessons Learnt	Service Delivery	One should strive for a high standard of quality in service.
		One should manage increases in demand for service such as changes in regulations which cause congestion.
		One should be confident that the biometric solution is necessary and that no lessor control would have sufficed.
		There must be sufficient offices for both urban and rural areas.
		There must be a facility to recruit extra staff for peak times.
		The procedures necessary to apply for and acquire a social grant must be done at a single site to avoid unnecessary travel and expense.
		Any complaints of poor service, mistakes, neglect, rudeness, corruption and fraud should be attended to.
		One should be able to prove the effectiveness of having introduced the biometric system.

SOURCE	FOCUS AREA	SUGGESTED ACTIONS
COMPONENT 5: FACILITATING ENVIRONMENT		
Source 1: The South African Social Grants	BP	Access for all services should be made equally available to all citizens.
		Information about services should be accurate and comprehensive.
	Goals	There should be a continuing commitment to connect Thusong service centres to the State Information Technology Agency (SITA) and government back end systems.
	Policies and Laws	The Constitution of the Republic of South Africa 1996 (Act 108 of 1996) provides for the right to social security for all citizens.
		The Public Finance Management Act, 1999 stands for transparency, accountability and sound financial management in public and private sectors.
		The Public Service Act, 1994 provides for the organisation and administration of the public service.
		The Public Service Regulation, 2001 presides.
		The SITA Act, 1998 allowed the establishment of a company to provide Information Technology and associated services.
		The Promotion of Access to Information Act, 2000 (Act 2 of 2000) provides the public with the right to have access to information by promoting transparency and accountability.
		The Promotion of Administrative Justice Act, 2000 (Act 3 of 2000) provides the public with the right to lawful administrative action by promoting efficient administration.
	Strategic Plans	This planned outcome should be evident: A responsive, accountable, effective and efficient local government system.
		This DPSA Strategic Priority should be upheld: Service delivery quality and access – with increased infusion of Batho Pele principles.
		This DPSA Strategic Priority should be upheld: Leverage Information and Communication Technology as strategic resource (enabler).
		This DPSA Strategic Priority should be upheld: Contribution towards improved public service and administration in Africa and international arena.

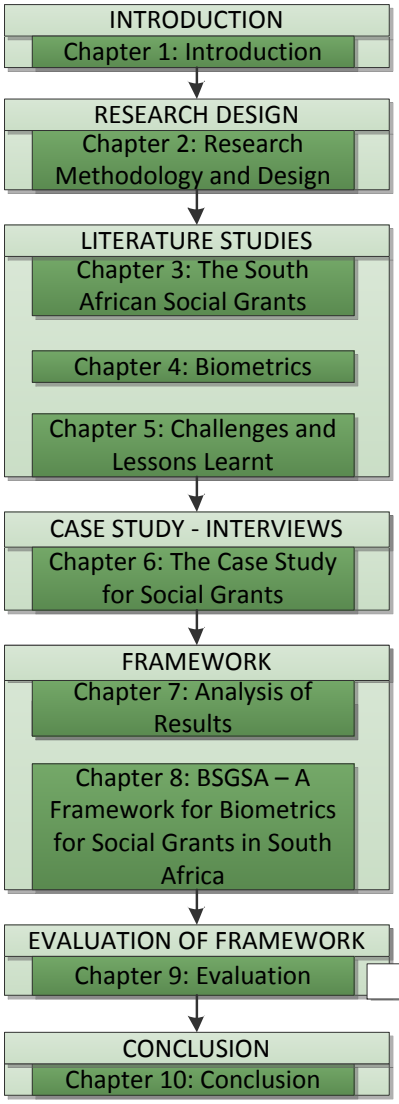
SOURCE	FOCUS AREA	SUGGESTED ACTIONS
	Structures and Procedures	The SASSA Branch 1: Strategy and Business Development should continue to be responsible for innovations for improvements to service delivery.
		The SASSA Branch 5: Information and Communication Technology should continue to look after special ICT projects and improve business solutions.
		Community Development Workers should continue to provide assistance to the poor by improving delivery of services to them.
		The Community Development Workers should continue to remove bottlenecks which delay delivery of services.
		The Community Development Workers should continue to link community to services and take problems back to government structures.
		Community Development Workers should continue to be a voice for the poor by identifying needy households and children, assisting them to get their grants.
Source 3: Challenges and Lessons Learnt	Env.	At the social grant offices there should be acceptable infrastructure (chairs, ablution blocks, electricity and technical equipment that works).
		The offices should be at sites accessible to the public.
	Struct. and Proc.	There should be a goal to keep costs low.
		There should always be a reliable agency for managing the payment of grants.
		The public may complain of difficulty to access the service in which case some response is required to improve the situation.
		The public may not know about the service or understand it in which case education and awareness programmes should be used.
Source 4	Struct. and Proc.	There should be sufficient available working devices for the capturing of biometrics.
		The public should be able to find out about the grants through advertising.

8.3 SUMMARY

This concludes the presentation of the framework. It was shown in Chapter 7 how the output from the sources which was presented in previous chapters, were further processed into various focus areas. These focus areas were then linked to suggested components for the framework. In this chapter, the framework was presented graphically and by means of tables. The next chapter will reveal how this framework was submitted to experts in order to answer the question: “Does an implementation of the BSGSA framework indicate plausibility?”

CHAPTER 9: EVALUATION

LAYOUT OF CHAPTER 9



CHAPTER MAP

9.1 INTRODUCTION

This chapter presents the evaluation of the framework for Biometrics for Social Grants in South Africa (BSGSA). The chapter first discusses the expert review in Section 9.2. Thereafter the new refined framework is presented in Section 9.3 and some steps to implement the framework are described in Section 9.4. A summary closes the chapter in Section 9.5.

9.2 EXPERT REVIEW

The framework was examined for external validity. This was done in the form of an expert review in order to test the validity, applicability and relevance of the framework. The experts were intentionally chosen, either because the person was a social grant expert from the South African Social Security Agency (SASSA) or an expert on biometrics. Meetings were held with other representatives of SASSA and other biometric experts before the case study was conducted, in order to validate the requirement of the case study which was an inductive action. Due to the nature of this approach, it was not necessary to have multiple experts. The experts were independent from the original meetings that were conducted and were not involved in the research study at all. The details of the experts are given in Table 9.1.

Table 9.1: Expert scope

REVIEWER	DESIGNATION AND EXPERTISE	INDUSTRY
Social Grant Expert	Public Servant 20 years Intermediate experience in Social Grants Beginner experience in Biometrics	Public Sector
Biometric Expert	Information Security Technical Specialist 11 years Beginner experience in Social Grants Expert experience in Biometrics	Consulting which expands across all industry operating groups/sectors

It was necessary to interrogate the framework in order to examine more closely, the items that were derived from the extensive research on the subjects of interest.

Evaluation in the form of an expert review can reveal whether the work been done is valid and reliable (Simon, 2011). One should provide the expert with some form of

instrument to assist with the evaluation. He/she can then observe the elements and examine the relevance and characteristics thereof. If changes are made as a result of the evaluation, these changes should be clearly stated.

An evaluation tool was therefore developed to assist with the expert reviews. The expert evaluation tool as presented in Appendix C was sent to the experts via e-mail. They were invited to examine the framework steps as listed in the original framework presented in Chapter 8. The following question was posed: "Does an implementation of the BSGSA framework indicate plausibility?"

The experts were required to mark the entries in the framework according to their choices for *Relevance,* or *Suggested Action.* The *Relevance* was a range of five choices: Not Relevant, Neutral, Somewhat Relevant, Relevant and Very Relevant. The *Suggested Action* that the expert could choose was from the following: Retain, Undecided or Remove. There was also place for *Comments* for each of the items.

The completed evaluation tools from the experts were summarised and the following issues were considered to be *Very Relevant*:

- Batho Pele Principles;
- Service excellence, trained officials, sufficient devices and standard procedures;
- Management of increases in demand, attention to complaints of service and proof of effectiveness of service;
- Accurate dissemination of information to the public;
- Public assurance, confidence and non-discrimination of vulnerable groups, and protection of human rights;
- Assurance of non-manipulation by government and stated intention of use in Policy;
- Principles of the Protection of Personal Information Bill which include the following:
    - Public being allowed to view and update biometric and decide if it can be used elsewhere;
    - Destruction of biometric once it is no longer used;

- Equal access for all citizens and home visits where necessary;
- Periodic reviews to ensure eligibility;
- Preference of public for using Personal Identification Numbers (PINs);
- Live-ness of biometrics and use of traditional methods if biometric features are missing;
- Department of Health card;
- Appropriate policies and acts (sound financial management, organisation and administration of public service);
- Auditing, security and protection of biometrics and removal of criminal elements and fraud, including use of cryptography and other options such as hashing or salting;
- Biometric characteristics such as acceptability, one-way transformation, live-ness detection, cancel-ability, performance, circumvention and diversity;
- Invasiveness of iris;
- Extra security measures required when using voice biometrics;
- Catering for noise when capturing biometrics, extraction of appropriate feature set, checking for quality, prevention of data quality loss;
- Use of accepted standards for biometrics;
- Appropriate False Acceptance Rate (FAR), False Rejection Rate (FRR), Equal Error Rate (EER) and Failure To Enrol (FTE) rate;
- Threshold should be higher than 85%;
- Use of multi-modal biometrics;
- Short transaction time to facilitate enrolment of population.

As a result of the comments and feedback from the experts, the researcher chose to treat the items as follows:

- *Comment only*: The feedback from the expert suggested no further change to the item within the framework. The researcher therefore did not change the framework item;
- *Alter*: The expert provided extra information that is also relevant else there was some misunderstanding about the item. The researcher made changes

to the information in the framework item to provide further clarification or to incorporate suggestions from the expert;

- *Delete*: The researcher removed this item, having received recommendation from an expert to do so.

A full analysis of the expert feedback resulted in alterations and deletions of some of the steps. It must be mentioned that once this feedback analysis was applied to the original framework, it resulted in an intermediate framework which is attached as Appendix D. This was then further analysed and a final refined framework was derived and is presented in the next section of this chapter. Table 9.2 presents a short summary of transition from the original components to the final components of the final framework.

Table 9.2: Summary of transition from original to final framework

ORIGINAL FRAMEWORK		**INTER-MEDIATE FRAMEWORK**	**FINAL FRAMEWORK**	
COMPONENT	**No. of STEPS**	**No. of STEPS**	**NEW COMPONENT**	**No. of STEPS**
C1: Structures and Procedures	42	40	C1: Structures and Procedures	79
C2: Security, Privacy and Ethics	45	39	C2: Security, Privacy and Ethics	28
C3: Suggested Biometrics	31	31	C3: Suggested Biometrics	45
C4: Performance Requirements	34	31		
C5: Facilitating Environment	28	28		
TOTAL:	**180**	**169**		**152**

In total, there were 180 steps or entries in the original framework. After some information was altered by the researcher and other steps deleted, there were 152 steps left in the final framework. This was as a result of the expert feedback and the final re-arrangement. The next sub-section will present the refined framework.

9.3 THE REFINED BSGSA FRAMEWORK

The final refined framework is presented in this section and represents a completely re-organised version of the framework. The sources of the data were removed from the framework as they are relevant to the research process but are not required in the final framework that may be presented to an organisation wishing to adopt the framework. For the purposes of clarity, the framework items were re-organised. During this re-organisation the original focus areas were re-grouped and the original components were also consolidated. Instead of five components, the new refined framework has three main components which incorporates the contents of the original framework. These **new components** are listed here together with their new *higher-level focus areas* within each component. The list also reveals the original focus areas from which the items were extracted as well as the original components which includes those focus area items:

- **Component 1: Structures and Procedures**
    - *Formal Structures* containing extracted items from:
        - Original focus areas: Policies and Laws, Structures and Procedures;
        - Original components: 1, 2, 4 and 5.
    - *Procedures for Efficiency* containing extracted items from:
        - Original focus areas: Structures and Procedures, Staff Commitment, Goals, Service Delivery;
        - Original components 1 and 4.
    - *Nurturing Environment* containing extracted items from:
        - Original focus areas: Batho Pele principles, Strategic Plans, Goals, Structures and Procedures, Environment;
        - Original components: 1, 4 and 5.
- **Component 2: Security, Privacy and Ethics**
    - *Biometric Technical Security* containing extracted items from:
        - Original focus areas: Biometric Characteristics, Privacy and Security;
        - Original component 2.

- *Personal Data Privacy* containing extracted items from:
  - Original focus area: Privacy and Security;
  - Original component 2.
- *Public Concern and Ethics* containing extracted items from:
  - Original focus areas: Public Acceptance, Biometric characteristics, Privacy and Security;
  - Original component 2.

- **Component 3: Suggested Biometrics**
  - *Popular Biometrics* containing extracted items from:
    - Original focus areas: Popular Biometrics, Public Acceptance;
    - Original component 3.
  - *Biometric Efficiency* containing extracted items from:
    - Original focus areas: Feature Extraction, Matching Issues, Multi-modal biometrics, Biometric characteristics;
    - Original component 3 and 4.

The final refined framework presented in Table 9.3 has 152 steps or suggested actions. The suggested items are listed within their new focus areas and numbered within the new components.

Table 9.3: Refined framework for BSGSA

BSGSA FRAMEWORK
COMPONENT 1: STRUCTURES AND PROCEDURES
FORMAL STRUCTURES
1.1 The Social Assistance Act, 2004 (Act 13 of 2004) assists transfer of benefits to qualifying persons and also describes minimum standards for grant delivery.
1.2 The SASSA Act, 2004 allowed for the establishment of an agency to administer and pay the social assistance transfers.
1.3 The Mission of Department of Public Service and Administration (DPSA) is to empower fair and inclusive citizenship, to support MPSA, to provide advice and support for excellent public service and good governance, to incorporate Batho Pele principles for service excellence. This should continue to be upheld.
1.4 The SASSA Branch 2: Internal Audit and Risk Management must continue to reduce fraud and corruption in the grants administration process.
1.5 The SASSA Branch 6: Grant Administration and Public Services should continue to provide guidance for co-ordination of grant administration and payment.
1.6 The Public Protector should continue to ensure that private citizens are served equitably and fair.
1.7 The Public Administration Leadership and Management Academy (PALAMA) should continue to train and develop public servants to respect citizens.
1.8 The Project Khaedu should continue to train public servants in excellent customer care.
1.9 The Centre for Public Service Innovation (CPSI) should continue to promote and transform ideas into new products and services to enhance service delivery.
1.10 The Public Service Sector Education and Training Authority (PSETA) should continue to coordinate skills development in public service.
1.11 The Public Sector Charter has defined attributes, commitments, rules of engagement and ethical principles for public servants and these should be upheld.
1.12 The idea of the Single Public Service idea must continue to be developed and implemented by the DPSA.
1.13 E-Government must be used to automate and modernise rendition of public services including registrations such as births or deaths.
1.14 The Electronic Communication and Transactions Act, 2002 includes E-Government services and protection of personal

BSGSA FRAMEWORK
information. Attention must also be paid to the Protection Of Personal Information Bill approved by the South African Parliament on 22nd August 2013 soon to be signed into law by the President.
1.15 The Human Rights Commission should continue to protect human rights in areas including social security.
1.16 It must be remembered that the Department of Home Affairs (DHA) is issuing new smart cards with biometrics for identification purposes. There may be intentions to use it also for drivers' licences, residence permits, census, voting, insurance, pensions and banks. It may also be used for the social grants.
1.17 The Public Service Commission (PSC) must continue to develop and implement service delivery interventions and monitor compliance through annual reports on state of public service by assessing user satisfaction.
1.18 The Grassroots Innovation booklet should continue to showcase the best case studies of Community Development Workers in action in the provinces.
1.19 The Constitution of the Republic of South Africa 1996 (Act 108 of 1996) provides for the right to social security for all citizens who qualify.
1.20 The Public Finance Management Act, 1999 stands for transparency, accountability and sound financial management in public and private sectors.
1.21 The Public Service Act, 1994 provides for the organisation and administration of the public service.
1.22 The Public Service Regulation, 2001 presides.
1.23 The SITA Act, 1998 allowed the establishment of a company to provide Information Technology and associated services.
1.24 The Promotion of Access to Information Act, 2000 (Act 2 of 2000) provides the public with the right to have access to information by promoting transparency and accountability.
1.25 The Promotion of Administrative Justice Act, 2000 (Act 3 of 2000) provides the public with the right to lawful administrative action by promoting efficient administration.

PROCEDURES FOR EFFICIENCY

1.26 Batho Pele principles must continue to encourage mutual respect between state and the poverty stricken citizens.
1.27 This goal should be maintained: migration issues should be solved by allowing the grant recipients to be able to move around and still be able to claim their money anywhere at any time.
1.28 There should continue to be home visits for those persons who cannot travel to the grant offices.
1.29 There should be awareness that the opinions of the officials who work with the technology may have an effect on their correct adoption and use thereof.

BSGSA FRAMEWORK
1.30 The officials should be aware of the need for the technology before its implementation in order to proceed with the correct adoption and use thereof.
1.31 There should be sufficient officials to meet the demand.
1.32 The officials should be managed well.
1.33 The officials need to be trained and have comprehensive knowledge of the standard operating procedures with regard to the biometrics and the grants.
1.34 The officials should accept responsibility for knowledge of their tasks.
1.35 The officials should be professional and friendly.
1.36 The service should remain free of charge as the members of the public may not have resources to apply for the service.
1.37 There should be standard procedures to follow when collecting biometrics.
1.38 The process of collecting biometrics for the grants should not take too long but one must not hasten the process at the expense of quality.
1.39 The computers involved in the procedure cause the most delays. This should be resolved in order to improve performance and service delivery and reduce the length of time taken for the procedure.
1.40 There should be a requirement for the public to provide proof of life periodically, such as once a year or once a month.
1.41 The officials should know and use the Batho Pele principles in order to provide for quality of service and to provide assurance to the members of the public.
1.42 The officials should be properly trained and should speak clearly and should answer questions carefully when assisting the members of the public.
1.43 One should cultivate and uphold standards. For example one standard says that it should take 30 seconds to pay a beneficiary. However, this should not have an adverse impact on quality.
1.44 One should have standards for waiting times for the members of the public, such as: A beneficiary should not wait longer than two hours.
1.45 One should have standards for office hours, such as: Offices should be open at least from 8am to 3pm.
1.46 One should have standards such as: There should be at least one Community Development Worker in each municipal ward in the country.
1.47 When planning for delivery of services re social grants, one must continue to plan for networking, study the transaction volumes, take note of travel times, and anything else required for the delivery of services.
1.48 One should strive for a high standard of quality in service and measurements should be taken to see if the public are happy with the quality of service and the infrastructure.

BSGSA FRAMEWORK
1.49 One should manage increases in demand for service such as changes in regulations which cause congestion.
1.50 One should be confident that the biometric solution is necessary and that no lessor control would have sufficed.
1.51 There must be sufficient offices for both urban and rural areas, using mobile services where there is no infrastructure.
1.52 Complaints of poor service, mistakes, neglect, rudeness, corruption and fraud should be attended to.
1.53 One should be able to prove the effectiveness of having introduced the biometric system.
NURTURING ENVIRONMENT
1.54 Staff should be courteous and considerate.
1.55 There should be consultation with members of the public for decision making regarding service levels and quality.
1.56 Service excellence should be measured with benchmarks to indicate customer satisfaction.
1.57 Apologies and remedial action is necessary if services are not delivered.
1.58 There should be value for money in that services should be provided in an economical and efficient manner.
1.59 This DPSA Strategic Priority should be upheld: There should be effective systems, structures and processes.
1.60 This planned outcome should be evident: An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship.
1.61 This planned outcome should be evident: A responsive, accountable, effective and efficient local government system.
1.62 Opinions of community leaders should also be considered.
1.63 There should be openness and transparency so that the public can see how the government works.
1.64 Access for all services should be made equally available to all citizens.
1.65 Information about services should be accurate and comprehensive.
1.66 There should be a continuing commitment to connect Thusong service centres to the State Information Technology Agency (SITA) and government back end systems.
1.67 This DPSA Strategic Priority should be upheld: Service delivery quality and access – with increased infusion of Batho Pele principles.
1.68 This DPSA Strategic Priority should be upheld: Leverage Information and Communication Technology as strategic resource (enabler).
1.69 This DPSA Strategic Priority should be upheld: Contribution towards improved public service and administration in Africa and international arena.
1.70 The SASSA Branch 1: Strategy and Business Development should continue to be responsible for innovations for

BSGSA FRAMEWORK
improvements to service delivery and there should be a collective effort from all branches.
1.71 The SASSA Branch 5: Information and Communication Technology should continue to look after special ICT projects and improve business solutions.
1.72 Community Development Workers should continue to provide assistance to the poor by improving delivery of services to them.
1.73 The Community Development Workers should continue to link community to services and take problems back to government structures and remove bottlenecks which delay delivery of services.
1.74 Community Development Workers should continue to be a voice for the poor by identifying needy households and children, assisting them to get their grants.
1.75 There should always be a reliable agency for managing the payment of grants.
1.76 The public may not know about the service or understand it in which case education and awareness programmes should be used as well as advertising.
1.77 There should be sufficient available working devices for the capturing of biometrics.
1.78 At the social grant offices there should be acceptable infrastructure (chairs, ablution blocks, electricity and technical equipment that works).
1.79 The offices should be at viable sites accessible to the public.

BSGSA FRAMEWORK
COMPONENT 2: SECURITY, PRIVACY AND ETHICS

BIOMETRIC TECHNICAL SECURITY

2.1 One-way transformation characteristic of a biometric: There should be a one-way transformation characteristic i.e. the biometric template created for storage should be non-reversible. This can be carried out by one-way hashing or appropriate cryptographic mechanisms in order to retain Confidentiality and Integrity.
2.2 Cancelable characteristic of a biometric: When necessary, the template should be able to be cancelled and a new one recreated. For example, if an extra authentication factor is to be added for extra security then it would be necessary to replace the old one. Another reason may be that some features evolve over time such as a finger injury.
2.3 Live detection characteristic of a biometric: There should be a mechanism to test if the subject is alive. This also improves the accuracy (False Rejection / False Acceptance rates) for the biometric.
2.4 To provide for secure authentication, the original binary template should be bound into a cryptographic key.
2.5 Hashing or “salting” may be used but one should not hash the original template which may be subject to noise, but rather hash the biometric key. One should also remember that full-on symmetric cryptography is more secure than hashing.
2.6 Care should be taken to protect the biometrics that are used across more than one system, because if a criminal obtained access to a subject's biometric, then other systems which contain information for that subject may also be compromised. Some level of segregation needs to be applied between systems.
2.7 The central registry should be correct, maintained and secured from tampering, theft and misuse.
2.8 All government departments that participate (other applications that want to use the biometrics) must ensure compliance with security and sharing of information. There should also be compliance with information security best practices such as ISO 27000.
2.9 Criminal elements operating around the environment where social grants are processed or paid out should be removed.
2.10 Decisions should be made on the following aspects of security: what information, where would it be stored, how would it be secured, who would have access, what criteria would be used when sharing the information with others, how would the intrusion of privacy be reduced, how would the data be used, when would the data be deleted, would it be deleted when no longer required, would the public remain informed and not misled, would the data be continuously updated when appropriate, would it be protected against loss, access, use or disclosure, would audit records be kept?
2.11 There should be awareness that some members of the public may be committing fraud themselves. Proactive biometric and general information security controls are required.

BSGSA FRAMEWORK
PERSONAL DATA PRIVACY
2.12 Each time there is an attempt at verification, the real person should receive some notification (such as is done for bank transfers).
2.13 The following personal data should be seen as private: consumption habits, health information, interests, communications, demographic information, social behaviour and biometrics. The Protection of Personal Information Bill defines more about what personal data is.
2.14 The public must provide informed consent for having their biometric taken and used where the collection of a biometric feature is seen to be invasive. This is included in the Protection of Personal Information Bill. There may be religious or physiological reasons for objections.
2.15 When a biometric is no longer required it should be destroyed. The Protection of Personal Information Bill states that the information must only be kept as long as it is required for the intended purpose.
2.16 There should be awareness that the public may be concerned about abuse of their personal data by criminal elements. Due care should be taken with the public's data and biometrics. The Protection of Personal Information Bill would cover this.
PUBLIC CONCERN AND ETHICS
2.17 Acceptable characteristic of a biometric: The biometric feature(s) that are extracted should be acceptable to the public i.e. they should be willing to have those particular biometric features extracted and used for identification. Certain biometric features are more acceptable to the public than others.
2.18 There should be awareness of function creep, which is when a biometric is used for a different purpose than that which was originally intended. This should not happen as it betrays trust, destroys confidence and is an ethical breach. When intending to use a biometric for more than one purpose, this should be stated up front and included in a Policy statement. The Protection of Personal Information Bill has various principles that apply here.
2.19 Biometric extraction using certain human features or characteristics may be seen as invasion of privacy which may cause resistance against adoption by the public. To counteract these perceptions, the public should be properly informed about the details of biometric extraction and there should be attempts to make it as non-intrusive as possible. They should be told what is being collected and why.
2.20 The public may be concerned about "big brother" watching? Their concerns should be set at rest.
2.21 The public should be allowed to view and update their information.
2.22 Care should be taken that there is no discrimination against vulnerable groups such as children or disabled persons, among

BSGSA FRAMEWORK
others. The biometric(s) chosen must be suitable for the particular individual.
2.23 One should seek consent of both carer and child when collecting child biometrics.
2.24 There may be a need to give assurance to the public if they are concerned about government control and manipulation and abuse of their personal data. However, government should not be involved with manipulation of the public. Transparency from a governmental perspective is crucial.
2.25 The members of the public need to have confidence in the service.
2.26 The public should find it easy to provide their biometric samples but this may depend on the biometric.
2.27 When making decisions on which biometrics to use for social grants, one should be aware that the statistics taken from recent interviews with a sample of the social grant recipients in the Eastern Cape Region indicated that the features they like are as follows: photo (72%), fingerprint (41%) and voice (34%).
2.28 When making decisions on which biometrics to use for social grants, one should be aware that the statistics taken from recent interviews with a sample of the social grant recipients in the Eastern Cape Region indicated that they would find the following biometrics to be invasive or intrusion of their privacy: Fingerprint (7%), Voice (7%) and Iris (17%). The percentage of persons who did not find any of the biometrics invasive was 48%.

COMPONENT 3: SUGGESTED BIOMETRICS

POPULAR BIOMETRICS

3.1 When choosing biometrics for social grants, one should know that the public acceptability statistics indicate the following preferences in order from most preferred to least preferred: fingerprint, iris, hand and voice.
3.2 When choosing biometrics for social grants, one should be aware that market share shows fingerprint, face, hand, iris, voice in that order from biggest market share to smallest market share.
3.3 When choosing biometrics for social grants, one should be aware that the forecast for 2012 was that 84% of the total usage of biometrics was with iris, fingerprint and face. The preference for mobile use shows fingerprint, then voice and then iris.
3.4 Taking all statistics into account, one must be aware that the most popular biometric features are fingerprint and iris, but voice and face are also well used.
3.5 It must be noted that statistics from a recent interview sample in the Eastern Cape Region revealed that the majority of the respondents did not use biometrics when collecting their grant money but rather received their money via Banks or Shops.

BSGSA FRAMEWORK
3.6 It must be noted that statistics from a recent interview sample in the Eastern Cape Region revealed that the majority of the respondents still prefer to use a PIN rather than a biometric.
3.7 It must be noted that statistics from a recent interview sample in the Eastern Cape Region showed that only a small portion of the respondents collected their money from the pay points. However, a South African Social Security Agency official indicated that the correct percentage was 35% of the public.
3.8 When choosing appropriate biometrics to be used for social grants, one should look for ease of use and accuracy. The fingerprint, among others, is very suitable and is the oldest feature used as a biometric.
3.9 When using fingerprints one should remember that it should not be used for very young children i.e. babies are too small.
3.10 When using fingerprints one should cater for the following "noise" issues: cuts and bruises, erased fingerprints due to construction work, skin affected by diseases, dryness or sweating, incorrect angles, too much pressure.
3.11 When using fingerprints one should reduce the time to match fingerprints by localising similar classes of fingerprints.
3.12 When using fingerprints, all 10 fingerprints should be able to be taken in less than two minutes in order to make it practical to enrol a population.
3.13 When using fingerprints one should choose appropriate sensors having taken various factors into account such as robustness etc.: Optical sensors are cheap and reliable. Capacitive sensors are more expensive and need more power, but better image quality if fingers are not too dry. Thermal sensors need much power but are inexpensive and do not work well on warm days. Radio frequency sensors get to subsurface of finger and are small, accurate and reliable.
3.14 When choosing appropriate biometrics to be used for social grants, one should remember that the iris is the most stable and reliable biometric with the highest success rate and the best one for the most important data.
3.15 When using the iris, one should remember that it is unique and has embryonic factors but is not stable until two years old and is problematic when collecting from babies as their eyes are usually closed.
3.16 When using the iris one should remember that it is sometimes considered invasive.
3.17 When using the iris one should remember that it can be captured regardless of glasses, contacts or laser surgery.
3.18 When using the iris one should cater for the following "noise" issues: One requires an appropriate distance when capturing the iris and one must be aware of eyelash and eyelid occlusion.
3.19 When using the voice as a biometric one should be aware that it takes up minimal space and is non-invasive but has efficiency problems therefore must be strengthened to avoid security breaches. One could, for example, add another biometric.
3.20 When using the voice one should be aware that there is better performance with speaker verification than with other biometrics, except the iris.
3.21 When using the voice as a biometric one should remember that mobile telephones are readily available and can be used to

verify live persons.

3.22 When using the voice biometric, one should cater for these "noise" issues: One needs noise cancellation, a good microphone, preferably a larger amount of speech is better, and remember also that tired, bored, irritated or ill persons can cause changes in the voice.

3.23 When using the voice biometric, one must be aware that there is a risk of unintentional speech capture.

3.24 When using the voice biometric, one needs challenge/response questions in random order, to avoid infiltrators using previously taped replies.

3.25 When using the voice biometric, cell-phones can provide authentication solutions as they contain the four requirements: something one knows (knowledge data), something one has (phone), something one is (biometric), somewhere one is (location or proximity).

3.26 When using face biometrics, one should be aware that it is non-invasive, easily accepted by users, and is becoming less costly.

3.27 When using face biometrics, one should cater for "noise" issues: images affected by light, pose and facial expression. Eigen faces should assist with image feature extraction quality.

BIOMETRIC EFFICIENCY

3.28 If a biometric is not able to be extracted and there is no alternative, then traditional methods of identification should be used.

3.29 When extracting features for a biometric, the application should extract an appropriate feature set of the biometric (called segmentation) because the complete image would take up too much memory. This process is meant to discard non-relevant data. The data being discarded may be that which is dependent on the environment and therefore liable to change each time the feature is extracted.

3.30 The feature set that is extracted must be checked for quality before converting to digital form.

3.31 If the intention is to transmit the biometric via a communication medium, the feature extraction of the biometric must be done before the transmission to reduce the bandwidth that may be required.

3.32 If compression is done, there must be due care taken to prevent data quality loss.

3.33 Accepted biometric standards should be used wherever possible e.g. ISO 19784.

3.34 An appropriate False Acceptance Rate (FAR) should be chosen and the implementation must support it. Less than 1% may be suitable.

3.35 An appropriate False Rejection Rate (FRR) should be chosen and the implementation must support it. Less than 1% may be

suitable.
3.36 An appropriate Threshold should be used to measure whether there is a match or not. The suggestion is that it should be higher than 85%.
3.37 An appropriate Failure to Enrol rate should be chosen and the implementation must support it. Less than 3% may be suitable.
3.38 One should choose to design either for false negatives or false positives. If one designs the implementation more in favour of false negatives then more valid recipients would be denied their grants. If one designs more in favour of false positives then more fraudulent individuals may gain access to funds unlawfully. One could have an appropriate balance that gives the least Equal Error Rate (the intersection of FAR and FRR).
3.39 One should consider appropriate options such as these for matching: Either no match (failure), or one single match (success), or more than one match (failure), or rank those that match and choose the best match (success).
3.40 The matching process in the implementation should adhere to a standard such as: the transaction time using biometrics should be less than six seconds, but this should not have an adverse impact on quality.
3.41 One should rather use multi-modal biometrics which is better for many reasons.
3.42 When using multi-modal biometrics, if biometric fusion is done at sensor level, one needs compatible data from the different sensors.
3.43 When using multi-modal biometrics, it is preferred to do the biometric fusion at the matching score level, because there is enough information to combine the scores and one can set different tolerances for FAR and FRR.
3.44 Performance characteristic of a biometric: The biometric feature should be able to be extracted quickly and accurately and the matching process should be done efficiently so that it becomes practical to use it for the population.
3.45 Circumvention characteristic of a biometric: If a biometric feature is not able to be extracted there should be an alternative feature that may also be used in the application.

It remains to discuss a suggested implementation of the framework in the next section.

9.4 STEPS FOR IMPLEMENTATION OF BSGSA

Now that the framework has been presented, some steps are suggested as to the way forward if the framework is to be implemented. Figure 9.1 represents a summary of the implementation procedure. Table 9.4 presents the implementation steps and includes a summary of the resources needed for these steps as well as the deliverables expected to result from the execution thereof.

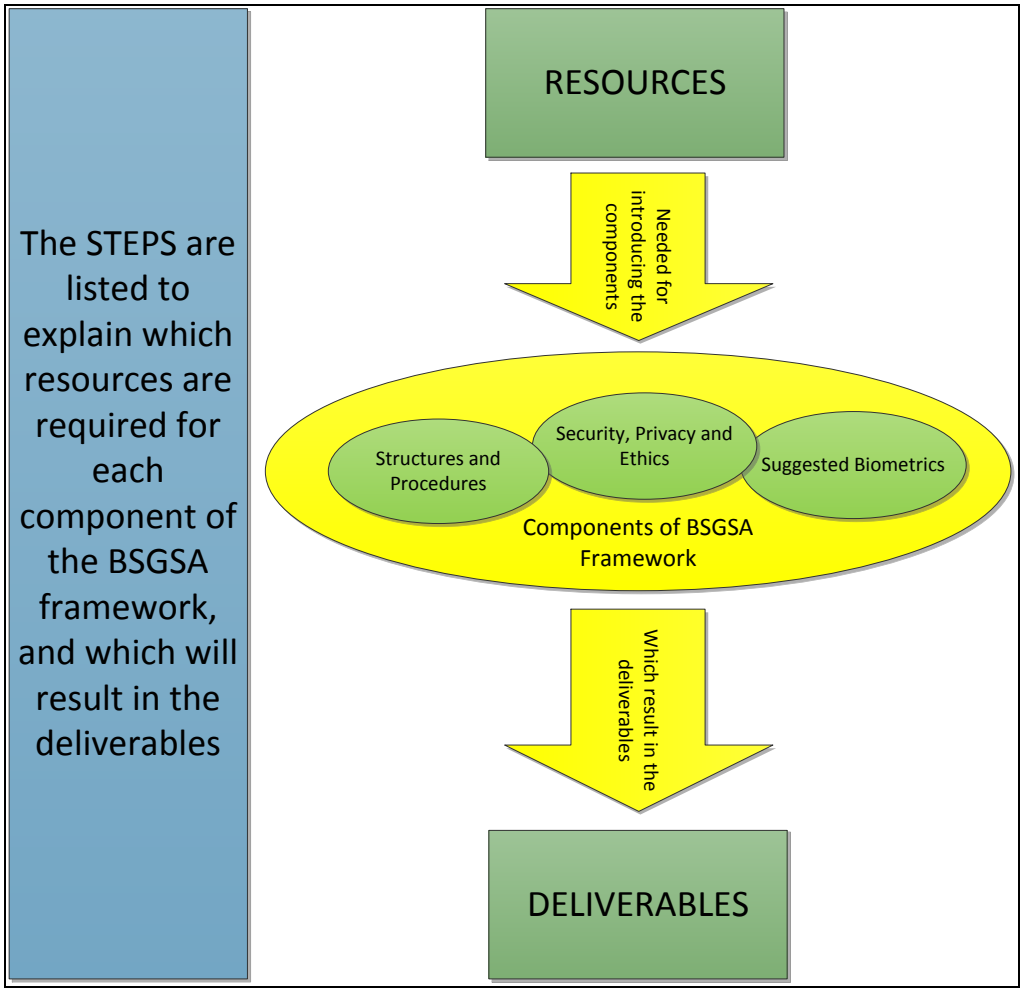


Figure 9.1: Summary of procedure to implement BSGSA

Table 9.4: A summarised set of steps for implementation of BSGSA

STEPS	COMPO-NENTS	RESOURCES NEEDED FOR COMPONENTS	DELIVERABLES
• Set up appropriate structures and procedures for social grants. This includes strategic plans, and introduction of policies and laws as well as training to staff to encourage appropriate delivery of services. • Adopt practices that provide for efficiency in all areas of the implementation as well as behaviour of role-players. • Provide for a facilitating environment where environment includes structures, strategic plans, policies and principles.	Structures and Proce-dures	• Appropriate strategic plans to uphold the delivery of the service. • Policies and laws that allow for an appropriate agency for social grants which nurtures efficient and sound practices. • Appropriate and accountable structures to govern the social welfare grants. • Appropriate adopted procedures throughout the delivery of the service to ensure efficiency and professionalism. • Goals and standards for maintaining efficiency and high standard of service delivery. • Applied Batho Pele principles when dealing with the members of the public. • Commitment of staff. • Staff training.	• A social grant governing agency that facilitates the application and delivery of social grants to eligible members of the public where appropriate execution of procedures are performed with due care and respect for the grant recipients. • An environment surrounding the social grant systems that continues to nurture and improve processes and encourage efficient and well-delivered services.

STEPS	COMPO-NENTS	RESOURCES NEEDED FOR COMPONENTS	DELIVERABLES
• Introduce appropriate security measures. This may include security measures for the implementation as well as appropriate treatment of personal data and vulnerable citizens.	Security, Privacy and Ethics	• Upholding of human rights and non-discrimination. • Policies and laws that protect private information. • Appropriate security features throughout the implementation. • Disclosure of intended procedures to the members of the public. • Prevention of criminal abuse by any or all parties concerned. • Easy access to services.	• A secure biometric implementation for social grants. • Suitable privacy controls for protecting personal information. • Ethical treatment of persons and their data.
• Choose appropriate biometric features for intended use and according to preferences and ensure suitable implementation thereof.	Suggested Biometrics	• Multi-purpose biometric plans. • Choice of appropriate biometric features. • Appropriate implementation of said biometric features. • Intended biometric characteristics that are deemed relevant. • Known preferences by the members of the public for certain biometric features. • Biometric implementation specifics that are geared to performance objectives. • Appropriate decisions made for the matching of the biometrics used for the implementation.	• Efficient biometric implementation that is suitable for the intended use(s) and is acceptable to everyone.

9.5 SUMMARY

This concludes the presentation of the results from the expert evaluation and the refined framework. There were two experts who validated the framework: one is an expert on the social grants and another an expert on biometrics. Their suggestions were taken into account for the final refined BSGSA.

Figure 9.2 summarises the process that was followed in evaluating the framework and subsequently producing the final version of BSGSA. The original version of the framework contained 5 components, 17 focus areas and 35 relationships which comprised the total number of focus areas feeding into the components. It also included 180 suggested steps. It is evident in Figure 9.2 that the refined framework has only 3 components, 8 focus areas feeding into those components which are the 8 relationships, with a total of 152 steps in the final framework.

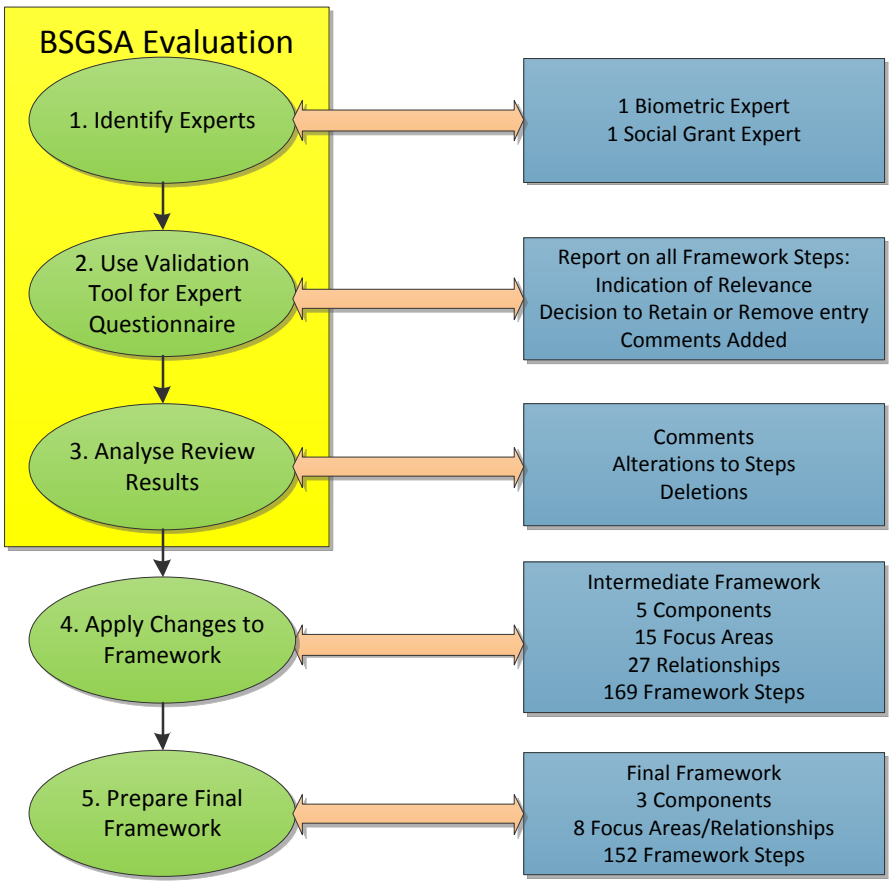


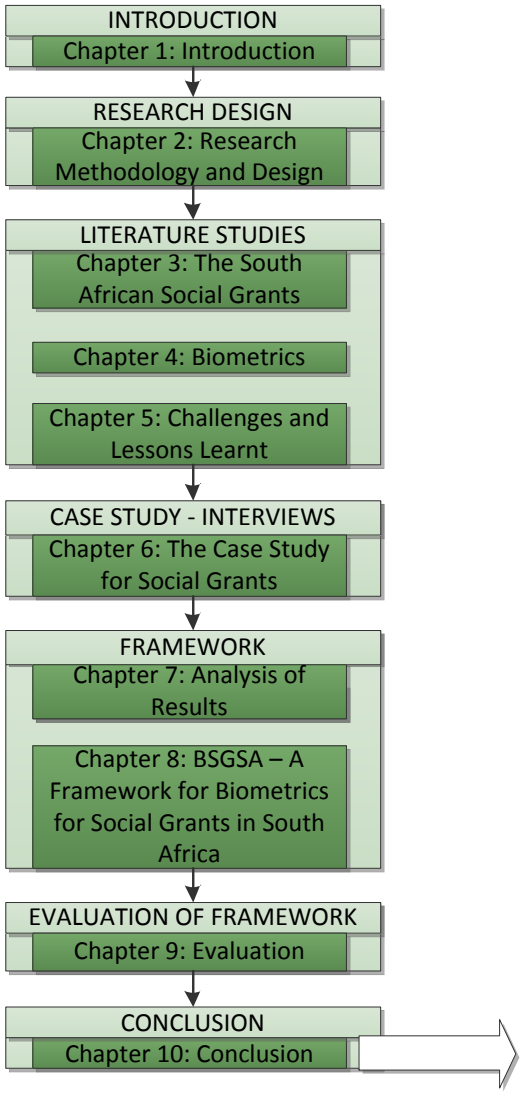
Figure 9.2: Process followed for BSGSA evaluation and framework refinement

The refined framework was presented in this chapter and some steps for implementing the framework were suggested in a summary format.

The next chapter provides the conclusion for this research endeavour and discusses the possibilities for further research in the area of biometrics for social grants.

CHAPTER 10: CONCLUSION

LAYOUT OF CHAPTER 10



CHAPTER MAP

10.1 INTRODUCTION

This chapter summarises this document. Section 10.2 summarises the research conducted and reported in this thesis. Section 10.3 describes the significance of the research and lists contributions from the research. Some reflection on the work is provided in Section 10.4. Section 10.5 describes lessons learnt along the way and Section 10.6 discusses limitations. Section 10.7 suggests further research ideas and the chapter ends with a final summary in Section 10.8.

10.2 RESEARCH OVERVIEW

The purpose of this research study was to develop a framework for Biometrics for Social Grants in South Africa (BSGSA). The initial problem presented was the following:

There is a lack of a suitable framework to describe implementation of biometrics used for social grants in South Africa.

The study lent itself to a phenomenological research philosophy and the research was done in accordance with the principles of Design Science as presented in Chapter 2. The researcher followed an inductive approach using a case study strategy, the results of which were presented in Chapter 6. The case study took the form of interviews which were conducted to collect information on perceptions of the social grant recipients as well as the government officials who deal with the social grants and the capturing of biometrics in the Eastern Cape region.

Appropriate ethical approval was obtained from the Nelson Mandela Metropolitan University. Also reflecting on ethics, permission was obtained from the SASSA head office, before the interviews were done. The respondents themselves were assured of anonymity and were asked first if they were willing to answer the questionnaires. They were informed of their right to stop the interview at any time. Due care was taken when dealing with the interview respondents who were assumed to be

vulnerable persons by the researcher. In one of the rural areas, it was found necessary to use an interpreter to ensure correct responses for the questions.

Regarding the interviews, questionnaires were answered by five officials who work with biometrics for social grants as well as 60 members of the public who were grant recipients. Two of the questionnaires from the members of the public were scrapped due to incompletion. The number of correct questionnaires accepted from each site is shown in Table 10.1. The visited sites included South African Social Security Agency (SASSA) offices and clinics.

Table 10.1: Interview scope

URBAN OR RURAL	SITE NAME	NO OF GRANT RECIPIENTS	NO OF OFFICIALS	TOTAL
URBAN (Nelson Mandela Bay)	Ibhayi (New Brighton)	5	5	34
	Greenbushes	7		
	Uitenhage	6		
	Walmer	11		
RURAL	Kareedouw	5	0	29
	Joubertina	10		
	Cofimvaba	14		
TOTAL		58	5	**63**

The results of the case study for this research involved both quantitative and qualitative data. The analysis of the case study data was discussed in Chapter 7. Content analysis was used on the qualitative data in Section 7.2 to arrange the ideas during the formulation of the contents for the framework. Descriptive analysis was also used in Section 6.6 for the quantitative data. A methodological triangulation mixed methods design was used to combine the data as was shown in Section 7.4.

The study commenced with detailed literature reviews. The South African social grants were reviewed in Chapter 3. Chapter 4 included a review on biometrics. Chapter 5 presented a literature review to discover challenges and lessons learnt when using biometrics for social grants in South Africa and other welfare schemes abroad.

All the data collected from Chapters 3, 4, 5 and 6 were necessary for the development of the framework which was presented in Chapter 8.

An expert review was conducted on the framework once it was ready. An evaluation tool was prepared for the expert review where the experts could choose answers to questions regarding the framework details. These respondents were chosen because they had expertise either in the field of biometrics or social grants in South Africa. The expert review was necessary to discover the validity, relevance and applicability of the framework. The tool was sent and returned via e-mail. The results and analysis of the expert review were presented in Chapter 9. The feedback from the experts was used to develop an intermediate version of the framework. Subsequently some re-organisation and refinement was carried out to produce a final version of the framework which was presented in Chapter 9.

To summarise, the research questions were answered in different sections of this report as is shown in various tables in this section. The primary research question was exploratory in nature, in that it asked the question:

What are the components of a framework for biometrics for social grants in South Africa?

In Tables 10.2, 10.3 and 10.4, the actual procedure that was adopted to find the answer to each of the research questions is summarised respectively for Research Questions 1, 2 and 3. The answer to each question is accompanied by various items of information, including the following:

- The source of the information used to answer the question is supplied. The sources are the chapters that were listed in Table 7.1 and again in Table 7.2;
- The answer in the tables also provides section references such as applicable chapter numbers and tables or figures. Further information can therefore be obtained by looking at those references elsewhere within this document;

For example, Table 10.2 indicates that the Question 1 made use of Source 1 from Chapter 3 and Source 2 from Chapter 4. It also indicates that further information about the sources and the focus areas that were derived from these sources can be found in Table 7.1 and Table 7.2 respectively.

Table 10.2: Research Question 1 with answers

QTN NO.	RESEARCH QUESTION	PROCEDURE ADOPTED TO FIND ANSWER TO QUESTION	ANSWER TO QUESTION	SECTION REFERENCES
1	What are suitable biometric methods that can be used for social grants in South Africa?	Literature Study was done on Biometrics and on Social Grants in South Africa as well as welfare systems abroad where biometric features are used.	Analysis of **Source 1:** South African Social Grants resulted in **Focus Areas:** *Policies and Laws, Strategic Plans, Structures and Procedures, Batho Pele Principles* and *Goals* Analysis of **Source 2:** Biometrics included **Focus Areas:** *Biometric Characteristics, Privacy and Security*, *Matching Issues*, *Popular Biometrics*, *Feature Extraction* and *Multi-mode Biometrics*	**Chapter 3** (Source 1) **Chapter 4** (Source 2) **Table 7.1** (Source Descriptions) **Table 7.2** (Focus Areas within Sources)

Table 10.3: Research Question 2 with answers

QTN NO.	RESEARCH QUESTION	PROCEDURE ADOPTED TO FIND ANSWER TO QUESTION	ANSWER TO QUESTION	SECTION REFERENCES
2	What challenges exist and what lessons can be learnt from current applications where biometric features are used in government sectors both in South Africa and abroad?	A literature study was carried out to find challenges and lessons learnt both in South Africa as well as abroad. Questionnaires were prepared for interviewing Government and Official Staff as well as for Members of the Public who had provided biometrics at least once for the purpose of receiving Social Grants.	Analysis of **Source 3:** Challenges and Lessons Learnt resulted in **Focus Areas:** *Structured Procedures, Security, Privacy, Environment, Service Delivery and Public Acceptance.* Analysis of **Source 4**: Interviews with role-players resulted in **Focus Areas:** *Structures and Procedures, Staff Commitment* and *Public Acceptance*.	**Chapter 5** (Source 3) **Chapter 6** (Source 4) **Table 7.1** (Source Descriptions) **Table 7.2** (Focus Areas within Sources)

Table 10.4: Research Question 3 with answers

QTN NO.	RESEARCH QUESTION	PROCEDURE ADOPTED TO FIND ANSWER TO QUESTION	ANSWER TO QUESTION	SECTION REFERENCES
3	How can the key factors required for an imple-mentation of Biometrics for Social Grants in South Africa (BSGSA) be constituted into a framework?	A generic coding process was used to derive components for the framework using the information gained from the sources as primary input. Various focus areas were found to exist within the sources. These focus areas (within their sources) were naturally rearranged under encompassing headings which became the components of the initial framework. After evaluation of the framework by experts, some refinement was carried out to produce an intermediate framework. Finally a new framework was presented after re-organisation and further refinement.	The original BSGSA Framework includes the following which have been defined: • 4 Sources; • 5 Components; • 17 Focus Areas; • 35 Relationships; • 180 Steps. The intermediate BSGSA Framework includes the following: • 5 Components; • 15 Focus Areas; • 27 Relationships; • 169 Steps. The final refined BSGSA Framework includes the following: • 3 **Components;** • 8 **Focus Areas**; • 8 **Relationships;** • 152 **Steps.**	**Chapter 7 and 8** **Figure 7.2** (Generic coding process) **Table 7.2** (Focus Areas within Sources) **Table 7.3** (Components) **Figure 8.1** (Framework high-level image) **Figure 8.7** (Framework low-level image) **Table 8.1** (Initial Framework) **Appendix D** (Intermediate Framework) **Table 9.3** (Final Refined Framework)

10.3 SIGNIFICANCE AND CONTRIBUTION OF RESEARCH

This section lists the artifacts that resulted from the research process and contributed to the body of knowledge and also describes the significance of the research and suggestions for solving the problems that were listed at the beginning of the research report.

10.3.1 Theoretical contributions

Various artifacts were developed during the research process and have thus contributed to the body of knowledge:

- A questionnaire was developed for social grant officials who deal with applications and pay-outs for social grants in South Africa and can be found in Appendix B1. The purpose of the questionnaire was to find out whether the officials were trained and experienced regarding the biometrics for social grants. It was also intended to understand the attitude of the officials towards the social grant recipients. Other questions posed were to find out their point of view regarding perceived problems around the social grants and the capturing of biometrics;
- A questionnaire was also developed for collecting preferences and perceptions from the members of the public who are grant recipients and who have experience in supplying biometrics for the purposes of social grants. This is attached in Appendix B2;
- A generic coding process was developed and presented. It was used to derive the components for the framework from the sources of data and comprised a number of steps which were followed. This process was used for both the qualitative and the quantitative data;
- The framework for BSGSA was developed and refined. The final refined framework is presented in Chapter 9. The framework is a unique artifact which can be used by the South African Social Security Agency (SASSA) as a benchmark for checking their implementations and procedures used for social

grant applications and pay-outs. It also contains reminders of various structures that are in place and should remain in place in order to ensure continuing effective control of social grants in South Africa. A copy of this report will be handed over to the Chief Executive Officer of the South African Social Security Agency;

- An evaluation tool was prepared in a spread-sheet format and contained the items that were part of the original framework. This tool is attached in Appendix C. It was set up to facilitate the acquisition of feedback from the experts who were chosen to validate the framework;
- A set of steps were formulated and presented in Chapter 9 to describe how to implement the framework artifact.

The research topic is not temporary but is one that can invest into the current and future implementations of social grants in South Africa. The results found were typically focussed on the South African context and involved recent research.

10.3.2 Significance of research

SASSA would find the results of this research to be valuable, as there is no framework currently that suggests appropriate implementation of biometrics for social grants in South Africa. The proposed framework includes a list of the various acts and policies in South Africa that are necessary for maintaining an appropriate and facilitating environment for social grants where biometrics are used. It also includes suggestions on the actual implementation of the biometrics. A large portion of the framework also includes a variety of standard procedures that have been seen to be important during the research endeavour.

The results of the survey done for this study may also benefit the Payments Association of South Africa (PASA) who manages and controls interbank payments for the South African payment system in the following ways:

- PASA manages and controls the payment system for the social grants in South Africa and would therefore benefit from the results of the survey used in this research;

- In particular the preferences of the grant recipients regarding biometrics and/or the usage of Personal Identification Numbers (PINs) for identification would benefit PASA's project related to the adoption of a biometric standard in South Africa.

The problems that may exist in the current social grant system were listed in Chapter 1 and led to the problem statement shown at the beginning of Section 10.2. These solutions may be extracted from the final BSGSA framework. Table 10.5 presents each of these problems, together with suggested components and individual focus areas which contain solutions. A narrative is also added to the table for each problem.

The framework therefore comprehensively makes provision for requirements to address the identified problems. Its success, however, would depend on its implementation.

Table 10.5: Suggested solutions for current problems highlighted in this research

PROBLEM NO.	PROBLEM DESCRIPTION	SOLUTION: COMPONENT	SOLUTION: FOCUS AREA	SOLUTION: NARRATIVE
1	Fraud and corruption result-ing in unlawful issue of grants.	Structures and Procedures	Formal Structures	Acts and Policies and various administrative structures are suggested to be in place to minimise fraud and corruption. Appropriate biometric techniques for strengthening security are included in the framework.
		Security, Privacy and Ethics	Biometric Technical Security	
			Personal Data Privacy	
2	Delays in application process where biometrics are extracted.	Structures and Procedures	Procedures for Efficiency	Suggestions are made for using efficient biometric features and implementations, as well as sufficient, well-trained staff, in order to improve the timing for the grant application process.
		Suggested Biometrics	Popular Biometrics	
			Biometric Efficiency	
3	Lost or missing identification documents, especially in the case of children.	Structures and Procedures	Nurturing Environment	To alleviate problems caused by lost or missing documents, the framework includes items on technology implementations and suggests the use of multi-modal biometrics.
		Suggested Biometrics	Popular Biometrics	
			Biometric Efficiency	
4	Difficulty in conducting periodic reviews for the purpose of confirming continued relevancy of the grant.	Structures and Procedures	Procedures for Efficiency	Securing continuing eligibility for grants requires suggestions for live-ness checking using voice and challenge/response questions as well as taking advantage of multi-modal biometrics.
		Suggested Biometrics	Popular Biometrics	
			Biometric Efficiency	
5	Security problems with single-mode biometric mechanisms.	Suggested Biometrics	Popular Biometrics	The framework suggests multi-modal biometrics as a solution to problems when certain features are not able to be extracted, and it also presents statistics regarding the preference by the public for certain biometric features.
			Biometric Efficiency	

PROBLEM NO.	PROBLEM DESCRIPTION	SOLUTION: COMPONENT	SOLUTION: FOCUS AREA	SOLUTION: NARRATIVE
6	Lack of sufficient procedural methods to supplement the biometric technology.	Structures and Procedures	Formal Structures Procedures for Efficiency Nurturing Environment	Procedural methods are suggested to supplement the biometric technology, such as appropriate facilitating structures and organisations as well as training and Batho Pele principles.
7	Limited proof of efficiency of the new system implemented in 2012, due to the fact that it is still in the early stages of execution.	Structures and Procedures	Formal Structures Procedures for Efficiency Nurturing Environment	Suggestions such as consultations, standards and benchmark measures are made in the framework to assist in the evaluation of the social grant service.
8	Vulnerability of grant recipients.	Security, Privacy and Ethics	Public Concern and Ethics	Due to the vulnerability of the grant recipients, various ethical suggestions are included in the framework.

10.4 REFLECTION

Reflection on scientific, methodological and substantive topics is done in this section.

10.4.1 Scientific reflection

The literature studies were important so that one could prevent doing research that would be duplicated. Most of the literature sources for biometrics were academic articles from journals. The literature sources for social grants in South Africa were mostly government documents, newspaper articles, dissertations and theses, as well as personal communication with prominent officials. There were also a limited number of journal articles for information from welfare systems and biometrics used abroad. The dates chosen for the document searches were from the year 2000 onwards.

The scope of the study was to provide a framework for using biometrics for social grants in South Africa. In order to do this, it was necessary to study the social grant system in South Africa. The field of biometrics was studied from a national as well as an international perspective. However, to refine the scope for using biometrics for South Africa, focus for the case study was directed to the current use of biometrics for the social grant system. The case study involved a set of interviews with role-players.

10.4.2 Methodological reflection

This study touched on different research areas, such as is implied by the very nature of Human-Computer Interaction (HCI). It therefore necessitated the choice of Design Science for the purpose of the research process. An intermediate approach accommodating both the qualitative and quantitative approaches was adopted. The inclusion of such an approach helps to strike a balance between a social science perspective and that of pure science. The social scientist may find the methodology used in this study to be inadequate with respect to data collection and practical use

of the framework, and may find that the data analysis employed is not comprehensive enough. The pure scientists may argue that the methodology lacks in statistical presentation and empirical/experimental aspects. However, the rationale behind following the research process that was employed is motivated in the study. Various approaches were analysed and the approach that best satisfied the objective of the study was chosen. Reflecting on the methodology, the limitations encountered during the study are discussed in Section 10.6.

In order to reflect on the Design Science research process used in this report, Table 10.5 reveals how the guidelines were applied to this research effort (Hevner *et al*., 2004). The artifact produced by the Design Science research process is the framework for Biometrics for Social Grants in South Africa (BSGSA). The research process guidelines as applied in this research effort are summarised in Table 10.6.

Table 10.6: Guidelines used in this Design Science Research

NO.	GUIDELINE	GUIDELINE APPLIED TO THIS RESEARCH
1	Design as an artifact	The framework for Biometrics for Social Grants in South Africa (BSGSA) that was developed in this research study is a valid artifact. It is a framework which suggests certain steps for the implementation of biometrics for social grants in South Africa.
2	Problem relevance	There was a need to solve the suggested research problem: *There is a lack of a suitable framework to describe implementation of biometrics used for social grants in South Africa.* Having done an initial literature review it was found that no suitable framework already existed, therefore the problem was relevant.
3	Design evaluation	The static artifact (framework) was evaluated by experts and their feedback was used to refine the framework.
4	Research contribution	The framework contributed to the area of social grants where biometric features are used and may be presented to the South African government for possible contribution to future plans for using biometrics in government sectors. Various artifacts were created during the research process.
5	Research rigour	Chapter 2 revealed the rigorous methods used throughout the systematic research process as described in this document.
6	Design as a search process	The final refined framework was the result of a two-year long process.
7	Communi-cate the research	This research report was a means of communicating the framework to the academic fraternity. The framework is also to be presented to the South African Social Security Agency who is responsible for administration of the social grants. Some academic papers will be written on topics that have relevance to this research. The implementation of the framework is beyond the scope of this research but steps for implementation were presented in Chapter 9.

10.4.3 Substantive reflection

Reflecting on this research and comparing it to other studies in the field of Human-Computer Interaction (HCI), the researcher realises that the scope was very wide. The research combined the research areas of biometrics, human computer interaction and to an extent aspects of information security and governance. However, the wide scope made it possible to capture more factors and their interactions, which makes the contribution unique. The implementation of biometrics is subject to changes in technology, costing, infrastructure and policies. Therefore, a repeat of this study at a later date would probably produce an additional set of critical factors; however, the critical factors, mediating factors and design fundamentals identified in the BSGSA should still be valid. Capturing and describing the situation at this point in time should also have reference value at a later stage.

10.5 LESSONS LEARNT

Various lessons were learnt along the way:

- The researcher focuses on real world problems and has realised that technology can be used to assist with real world problems in many ways;
- While conducting the literature studies, it was found to be a difficult task to collect detailed information from biometric implementations abroad. It may be that because of the security controls expected around identification and biometrics, much of the implementation details are kept hidden, which is understandable;
- The social grant applications and pay-outs are seen to be covered by a myriad of structures and policies which have been put in place to facilitate good governance. The commitment to principles and values with respect to the treatment of needy citizens is commendable;
- When approaching citizens with the purpose of interviewing them, it was found easy to do this, as the citizens themselves were already waiting in a queue for something to happen. This meant that they did not feel that the researcher was encroaching on their free time or delaying their usual

activities. All persons who were approached were very willing to sit and be interviewed by the researcher. This may be because the environments within which the interviews were conducted were of a positive nature, being that it was either a social grant office or a clinic, both of which are in place to provide care to the citizens;

- Some difficulty was experienced with accessibility and availability when attempts were made to engage with knowledgeable participants for the research;
- In hindsight, the researcher feels that the questionnaires were a bit too long and some of the questions may have asked the same question in a different way. Of course this is useful for verifiability but where there are already many questions, this may be unnecessary;
- Also regarding the questionnaires, the researcher feels that there were too many open-ended questions which may have been too difficult for the respondents to answer. Not all of these questions were crucial for the study and could have been left out of the questionnaire;
- The questionnaires were coded into a spread-sheet on the same day that they were used in the interviews. This helped to save time and sped up the process in order to prepare for the analysis of the case study data. Upon perusal of the questionnaires, it also resulted in awareness that the responses were similar among the respondents and therefore it was decided to extend the interviews to rural areas as well in order to see if there were different responses to those from the urban areas. Not much difference was found;
- Many sources of information were used to prepare for the input to the framework and many of the results from the case study that fed into the framework confirmed the data from the other literature sources;
- When looking for experts to review and evaluate the framework, there was some difficulty in identifying the correct people to do the review. The researcher was able, however, to get access to a social grant expert as well as a biometrics expert who has written a book and various academic papers on biometrics.

10.6 LIMITATIONS OF RESEARCH

Although the social grants are used nationally, the interviews were only done in the Eastern Cape region, at various urban and rural sites. Having conducted the interviews in the Eastern Cape region, it is not intended to assume that the perceptions of the general public in this region are the same as the rest of South Africa. The researcher is confident, however, that the interview results reveal a true reflection of the perceptions of the respondents that were targeted in the Eastern Cape region. It should be mentioned, that there was not much difference between the urban and the rural results within the Eastern Cape region, thus suggesting content validity. Convenience sampling was used for the respondents i.e. the researcher approached various members of the public who were already social grant recipients and who happened to be present at the visited sites at the time of the interviews.

10.7 FURTHER RESEARCH

This research may be taken further in various ways as discussed below:

- Academic papers need to be written on this research including but not limited to the following topics:
  - Suggested solutions for the recognised problems in this research;
  - Findings of the interviews on biometrics for social grant recipients;
  - Method used to develop the framework in this thesis;
- There may be other components that are also necessary for a framework such as BSGSA, else there may be new items that should become part of the current components of BSGSA as is revealed in some of the items below;
- Studies should be made to discover what biometric technology providers are using with regards to internal implementation measures when providing biometric services for social grants. Academic research reveals many suggested measures. One must bear in mind, however, that these providers will also have security concerns about releasing such information;

- Information may be added to the framework to provide for the eventuality when intentions are to use the same biometric(s) for more than one implementation. Many countries are already using their collected biometrics for more than one purpose. Ethical issues and concerns which would have to be investigated and put to rest as well. Countries that use biometrics in this way would at least have a controlled population and a great reduction of crime;
- From a technical hardware point of view and in the more distant future, affordable technology stations are required where total biometric identification procedures are possible. This may include multi-modal biometrics such as facial recognition, iris scans, fingerprinting and voice data capture and so on. These stations could be at each access point where identification is necessary for whatever reason, including shopping malls. This system should be affordable and convenient and could revolutionise the way that the world's inhabitants are identified;
- Due to the magnitude of an exercise (and database) where biometric features are used for more than one implementation in a country, one may use distributed systems for management. New ideas may be required for managing such an implementation where many parties are involved and are using the system;
- The Protection of Personal Information Bill that will soon come into effect in South Africa must be analysed and the BSGSA framework must be updated accordingly;
- Additional identification evidence using the internet, computer cameras or electronic tattoos can be investigated;
- Ethical issues should be investigated more fully, as well as religious beliefs, in the case of suggestions for chip implants which have begun to emerge in some societies.

10.8 FINAL WORD

It remains to close this report with the following quote from Steve Jobs (1955-2011) which is borrowed as a reference to the framework artifact produced by this research: “A lot of times, people don’t know what they want until you show it to them.”

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APPENDICES

Appendix A: Ethics approval document

Appendix B1: Questionnaire for Government Officials

Appendix B2: Questionnaire for Members of Public

Appendix C: Evaluation tool

Appendix D: Intermediate BSGSA Framework

Appendix A: Ethics approval document

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Ref: H13-Eng-ITe-001
7th August 2013

Mrs H van de Haar
Student No 9006656
School of ICT

Dear Helen

A BIOMETRIC IDENTIFICATION FRAMEWORK FOR CHILD SUPPORT GRANTS IN SOUTH AFRICA

Your above-entitled application for ethics approval served at the Faculty RTI Committee of the Faculty of Engineering, the Built Environment and Information Technology.

We take pleasure in informing you that the application was approved by the Committee.

The ethical clearance number is H13-Eng-ITe-001 and is valid for three years, from 7th August 2013 – 7th August 2016. Please inform the RTI-HDC, via your promoter, if any changes (particularly in the methodology) occur during this time. An annual affirmation to the effect that the protocols in use are still those, for which approval was granted, will be required from you. You will be reminded timeously of this responsibility.

We wish you well with the project.

DR M GERBER
CHAIRPERSON: FRTI-RECH

Appendix B1: Questionnaire for Government Officials

This questionnaire is for a survey for a Doctoral thesis entitled: A BIOMETRIC IDENTIFICATION FRAMEWORK FOR SOCIAL GRANTS IN SOUTH AFRICA. The questions have relevance to biometrics used for identification for Social Grants. It will take about 10 minutes to complete the questionnaire.

Completion of this questionnaire is completely voluntary. You may decide at any time to discontinue answering further questions and then you may withdraw from the survey.

It is also completely anonymous. Your personal details are not collected at any time.

I thank you for your valuable time and effort that you will spend in answering this questionnaire. I will value your opinions and comments.

SECTION A: BACKGROUND INFORMATION

This set of questions is intended to find out some background information.

Where applicable, please respond by making an "X" in the appropriate space provided.

A.1 What is your designation (job title)?

A.2 How long have you been in this position? (Duration in YEARS)

A.3 What are your typical duties with respect to the required biometrics for Social Grants?

_____

_____

_____

_____

_____

A.4 How often do you have to collect biometric samples from the public?

1	Never	
2	Daily (but less than 5 in one day)	
3	Daily (5 to 20 samples in one day)	
4	Daily (More than 20 samples in one day)	

A.5 Have you received training on how to capture biometric samples?

YES	
NO	

A.6 If you answered YES to question A.5, who provided the training? (You may choose more than one).

1	Line Manager	
2	Outside vendor	
3	Fellow employee	
4	Self-taught	
5	Other (explain)	

A.7 Have you heard of the “Batho Pele” principles?

YES	
NO	

A.8 Have you been encouraged to adopt the “Batho Pele” principles when dealing with the public?

YES	
NO	

A.9 Can you see the relevance of the “Batho Pele” principles when engaged in the task of collecting biometrics from the public?

YES	
NO	

SECTION B: BIOMETRIC QUESTIONS

This section of questions intends to find out more about the feelings of the officials that work with biometrics that are required for the Social Grants. According to your own experience and to the best of your knowledge, you may indicate your level of agreement with the statements.

Where applicable, please respond by making an "X" in the appropriate space provided.

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
B.1	There are standard operating procedures that I must follow when collecting the biometrics					
B.2	There are sufficient biometric capture devices to meet the demand					
B.3	There are sufficient members of the technical staff to assist with problems at the biometric capture stations					
B.4	The biometric capture devices are readily available					
B.5	The biometric capturing devices are in working order					
B.6	The computers used for the Social Grant procedures are in working order					
B.7	I have been trained to use the biometric sensors					
B.8	I know how to collect the biometric samples					
B.9	It is an easy task to extract the biometric sample from the members of the public					
B.10	I inform the members of the public as to why their biometrics are needed					
B.11	The members of the public are willing to submit their biometric samples					
B.12	I assist the members of the public through the biometric collection process					
B.13	In my experience, the child accompanies the carer and also provides biometric identification when an application is made for the Child Support Grant					

B.14 How well do you know the procedures that you need to know for dealing with the collection of biometrics for the Social Grants?

Where applicable, please respond by making an "X" in the appropriate space provided. You may select only ONE option.

1	It is not my responsibility to remain up to date with the procedure for collecting biometrics	
2	I do not know the procedures myself but I know where to find them or who to ask if I need them	
3	I know them a little	
4	I know them reasonably well	
5	I know them exceptionally well and ensure that I keep my knowledge up to date	

B.15 In your experience over the years, which of the following identification mechanisms have sometimes been accepted by the offices for the Social Grants? (You may choose more than one).

1	Photograph of applicant	
2	Photograph of child	
3	Fingerprint(s) of applicant	
4	Fingerprint(s) of child	
5	Iris scan of applicant	
6	Iris scan of child	
7	Footprint of applicant	
8	Footprint of child	
9	Voice sample of applicant	
10	Voice sample of child	
11	Other (please provide)	
12	I AM NOT SURE OF THIS	

B.16 Have you ever seen that a member of the public was not able to provide a required biometric for the Social Grants (perhaps due to disability or other reason)?

YES	
NO	

B.17 If you answered “YES” to the previous question B.16, please explain further.

_____

_____

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_____

_____

B.18 Is there a suggested standard procedure for collecting the fingerprint sample for the Social Grants?

YES	
NO	
I AM NOT SURE OF THIS	

If you answered “YES” to this question B.18, please explain the procedure.

_____

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B.19 Is there a suggested standard procedure for collecting the voice sample for the Social Grants?

YES	
NO	
I AM NOT SURE OF THIS	

If you answered “YES” to this question B.19, please explain the procedure.

_____

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_____

_____

_____

B.20 When a voice sample is captured for the Social Grants, is there a prescribed list of words or responses that the subject should provide?

YES	
NO	
I AM NOT SURE OF THIS	

If you answered “YES” to this question B.20, please explain the procedure.

_____

_____

_____

_____

_____

B.21 Is there a suggested standard capture process for collecting the footprint sample for the Social Grants?

YES	
NO	
I AM NOT SURE OF THIS	

If you answered “YES” to this question B.21, please explain the procedure.

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B.22 To your knowledge, why is the footprint captured as a biometric for the purposes of the Social Grants?

_____

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B.23 When dealing with the members of the public at the offices, which of the following stages in the application process causes the most delays in the whole procedure for Social Grants? You may only select the one option that causes the most delays.

1	Checking or filling in the application form together with the applicant	
2	Capturing the biometrics from the members of the public using a biometric capture device	
3	Typing the details into the computer system	
4	Waiting for the computer system to respond	
5	I AM NOT SURE OF THIS	

(If desired, you may explain further)

_____

_____

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B.24 What other difficulties (if any) have you experienced when capturing biometrics from an individual for the Social Grants?

_____

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Thank you for your time!

Appendix B2: Questionnaire for Members of Public

This questionnaire is for a survey for a Doctoral thesis entitled: A BIOMETRIC IDENTIFICATION FRAMEWORK FOR SOCIAL GRANTS IN SOUTH AFRICA. The questions have relevance to biometrics used for identification for Support Grants. It will take about 10 minutes to complete the questionnaire.

Completion of the questionnaire is completely voluntary. You may decide at any time to discontinue answering further questions and then you may withdraw from the survey. It is also completely anonymous. No personal details are collected.

Some background about biometrics: Biometric means “life” and “to measure”, therefore a biometric is used to “measure life”. For example, your fingerprint is unique and therefore by taking your fingerprint sample, you can be uniquely identified for your own protection. Using biometrics will ensure that no-one else can use your own identity illegally.

Fingerprint biometrics are unique, and may be captured by placing one’s finger on a sensor. Sometimes the finger must be swiped or rolled in order to take the reading.

The iris biometric is taken by a camera which makes a photographic image of your eye. The iris is the coloured portion of your eye, but the colour is not important. It is the different patterns in the iris that are captured by the scan. Each person’s iris is unique, even between the left and the right eye.

A voice sample can be taken by a telephone or a microphone but can be affected by background noise. Sometimes a predefined set of words or phrase must be spoken when the voice sample is captured. Footprints may also be captured by a sensor.

I thank you for your valuable time and effort that you will spend in answering this questionnaire. I will value your opinions and comments.

SECTION A: BACKGROUND INFORMATION

This set of questions is intended to find out some background information.

Where applicable, please respond by making an "X" in the appropriate space provided.

A.1 To which age group do you belong?

1	Under 21	
2	21 to 30	
3	31 to 40	
4	41 to 50	
5	51 to 60	
6	Over 60	

A.2 Where did you first hear about the Social Grants?

1	Friend or family member	
2	SASSA or Government official	
3	Community Worker	
4	Newspaper or TV	
5	Other	

A.3 What is your gender?

MALE	
FEMALE	

A.4 Which of the following Social Grants do you currently receive? (You may choose more than one.)

1	Older persons grant	
2	Disability grant	
3	War Veterans grant	
4	Care dependency grant	
5	Foster child grant	
6	Child support grant	
7	Grant-in-aid	
8	Social relief of distress	

A.5 For how many years have you been receiving support from one or other Social Grant?

1	Less than 1 year	
2	From 1 to 5 years	
3	More than 5 years and less than 10 years	
4	More than 10 years	

A.6 Please choose your race.

1	Black	
2	White	
3	Coloured	
4	Indian/Asian	
5	Other	

SECTION B: BIOMETRIC QUESTIONS

This section of questions intends to find out more about your experiences when providing biometrics for Social Grant applications or when collecting pay-outs.

Where applicable, please respond by making an "X" in the appropriate spaces provided.

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
B.1	There are sufficient biometric capturing devices available					
B.2	The biometric capturing devices are in working order					
B.3	The officials know how to collect my biometric samples					
B.4	It is an easy task for me to provide my biometric samples					
B.5	I was told why my biometrics are needed					
B.6	I am willing to submit my biometric samples					
B.7	I am assisted by the officials through the biometric collection process					
B.8	There is sufficient staff to capture my biometrics					
B.9	The officials that work with the biometrics speak clearly so that I can understand					
B.10	I am able to get answers for any questions that I have about the biometric sampling procedure					
B.11	The whole process is completed at a single site/place/office and there is no need for me to run					

		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
	from one site/place/office to the next					
B.12	I am concerned about how the Government will use my biometric information					
B.13	I am concerned that the Government will share my biometric information with other bodies					
B.14	I am satisfied that my information is safe					
B.15	The Social Grant requirements are well advertised					
B.16	The Social Grant application procedure takes too long					
B.17	The biometrics necessary for the Social Grant procedures involves invasion of my privacy					

B.18 If you receive a Child Support Grant, does your child accompany you and also have to provide a biometric sample?

1	YES	
2	NO	
3	Not applicable	

B.19 How many times in your life have you been required to submit a biometric sample for any reason?

1	Never	
2	Less than 5 times	
3	5 to 10 times	
4	More than 10 times	

B.20 In your experience over the years, which of the following identification mechanisms have sometimes been accepted by the offices for the Social Grants? (You may choose more than one).

1	Photograph of applicant	
2	Photograph of child	
3	Fingerprint(s) of applicant	
4	Fingerprint(s) of child	
5	Iris (eye scan) of applicant	
6	Iris (eye scan) of child	
7	Footprint of applicant	
8	Footprint of child	
9	Voice sample of applicant	
10	Voice sample of child	
11	Other (please provide)	

12	I AM NOT SURE OF THIS	

B.21 Which of the following biometric sampling methods do you prefer? You may choose more than one.

1	Photograph	
2	Fingerprint(s)	
3	Iris (eye scan)	
4	Footprint	
5	Voice sample	
6	NONE OF THE ABOVE	

B.22 Which of the following biometric samples have already been extracted from you during your lifetime? You may choose more than one.

1	Photograph	
2	Fingerprint(s)	
3	Iris (eye scan)	
4	Footprint	
5	Voice sample	
6	NONE OF THE ABOVE	

B.23 Which of the following biometric samples was extracted at the time of your application for the Social Grants? You may choose more than one.

1	Photograph	
2	Fingerprint(s)	
3	Iris (eye scan)	
4	Footprint	
5	Voice sample	
6	NONE OF THE ABOVE	

B.24 Which of the following biometric samples was extracted when you needed to collect your pay-outs? You may choose more than one.

1	Photograph	
2	Fingerprint(s)	
3	Iris (eye scan)	
4	Footprint	
5	Voice sample	
6	NONE OF THE ABOVE	

B.25 Which of the following biometric samples do you think is too invasive? You may choose more than one.

1	Photograph	
2	Fingerprint(s)	
3	Iris (eye scan)	
4	Footprint	
5	Voice sample	
6	NONE OF THE ABOVE	

B.26 Are you happy with the total service offered by the Social Grant offices where the biometrics are collected?

YES	
NO	

B.27 What is the reason for your answer to B.26?

_____

_____

_____

_____

B.28 Which do you prefer to use when collecting your Social Grant money?

1	PIN	
2	Biometric	
3	Either Biometric or PIN	
4	NONE of the above	

B.29 What is the reason for your answer to B.28?

_____

_____

_____

_____

_____

_____

B.30 How often would you be willing to provide biometrics in order to continue receiving your Social Grant?

1	Never	
2	Once a year	
3	More than once a year	
4	Once a month	
5	More than once a month, i.e. every time that I use my Social Grant card to purchase goods or to draw money	

B.31 How often would you be willing to provide biometrics to prove your identity so that you can continue receiving your Social Grant?

1	Never	
2	Once a year	
3	More than once a year	
4	Once a month	
5	More than once a month, i.e. every time that I use my Social Grant card to purchase goods or to draw money	

B.32 Where do you prefer to collect your Social Grant funds from? (You may choose more than one.)

1	Bank or ATM	
2	Official pay-point	
3	Retail store (e.g. Checkers)	
4	Other (Please explain)	

B.33 Do you use a cell phone? This question and those questions that follow are posed in order to find out whether the respondent is familiar with the use of a PIN for access to services.

YES	
NO	

B.34 If you use a cell phone, do you use a PIN to access the phone?

1	YES	
2	NO	
3	Not applicable	

B.35 If you use a PIN to access your cell phone, was the PIN provided when you received the phone, or did you select your own PIN?

1	The PIN was provided for me	
2	I selected my own PIN	
3	Not applicable	

Thank you for your time!

Appendix C: Evaluation tool

Biometrics for Social Grants for South Africa (BSGSA) Framework Validation Tool

This is a tool that can be used by experts to establish the plausibility of implementing the BSGSA framework on biometrics for social grants in South Africa. There are various questions posed and it would be most appreciated if you could answer all of them. I greatly value your time and commitment in answering these as I deem it to be very necessary for my research to test this framework with experts. If there are any questions please contact me at helen.vandehaar@nmmu.ac.za.

Instructions

There are three parts to this tool, each part being on a different worksheet. The current worksheet that you are looking at is an "Introduction" where the purpose of the tool is described as well as an indication of the possible responses that you may give and what they mean. The second worksheet asks for some "Biographical Information". The third worksheet is the "Framework Evaluation" where the details of the framework are presented with a view to obtaining your comments about them.

In the third worksheet, you will therefore find the steps or details of the framework components. For each step or detail, you will see a list of possible responses regarding the relevance of that step or detail. You may choose a rating ranging from "Not relevant" to "Very relevant". You will also be asked whether you think the step or detail should be "Removed", "Retained" or whether you are "Undecided" on that issue. The details of these responses are described below.

Relevance

Not relevant	I strongly feel that this step or detail is **not at all** relevant for the social grants implementation which uses biometrics
Neutral	I have **neutral** feelings regarding the relevance thereof else I do not have any comments on this step or detail
Somewhat relevant	I think that this step or detail has a **small amount of relevance** for the social grants implementation which uses biometrics
Relevant	I feel that this step or detail is **important and relevant** for the social grants implementation which uses biometrics
Very relevant	I strongly agree that this step or detail is of **great importance and relevance** for the social grants implementation which uses biometrics

Suggested Action

Retain	I feel that this step or detail is important and relevant and therefore I suggest that it should be **retained** in the framework
Undecided	I have neutral feelings regarding the relevance thereof and am **undecided** as to whether this step or detail should be removed or not
Remove	Based on my feelings regarding the relevance I think this step or detail should be **removed** from the framework

You are invited to make any comments relating to the specific step or detail and how it relates to the social grants implementation which uses biometrics. You may also make suggestions for improving on the proposed step or detail.

Additional instructions are provided on the other two worksheets where necessary.

EXPERT BIOGRAPHICAL INFORMATION

1. Name and surname	
7. Gender:	
2: Home language	
3. Country	
4. Occupation:	
5. Years of experience:	
6. Industry:	
7. Experience: Social Grants for South Africa	
8. Experience: Biometrics	

BSGSA Framework Evaluation

This first set of 5 statements contains the overall components for the framework. You may prefer to respond to these after completing the whole procedure from Row 12 onwards. Please rate the overall relevance of the components to the framework for Biometrics for Social Grants in South Africa (BSGSA). You may also choose a Suggested Action and add Comments where appropriate.

Framework Components	Relevance	Suggested Action	Comments
There should be **Structures and Procedures** in place to effect the proper application and delivery of grants			
Security, Privacy and Ethics should be attended to in order to protect personal			
Suggested Biometrics based on public acceptance and general popularity should be used			
Performance Requirements in all areas must be focussed on to enhance service delivery			
There should be a **Faciliating Environment** to nurture and support application and			

These Framework Components listed above will now be presented separately together with various steps or detailed actions that should be taken. Please rate the extent to which you believe each proposed step or detail is relevant for the BSGSA framework.

Component 1: STRUCTURES AND PROCEDURES

For the success of an implementation of biometrics used for social grants in South Africa, there must be seen to be encompassing formal **structures, procedures** and possible actions in place to ensure the on-going correct application and delivery of the grants and to nurture a nature of caring for the grant recipients. There should also be protection in the form of policies and laws to facilitate all aspects of social grants.

Focus Area	Step to be taken or Detail described	Relevance	Suggested Action	Comments
Batho Pele Principles	Staff should be courteous and considerate			
	There should be consultation with members of the public for decision making regarding service levels and quality			
	Service excellence should be measured with benchmarks to show customer satisfaction			
	Apologies and remedial action is necessary if services are not delivered			
	There should be value for money in that services should be provided in an economical and efficient manner			
Policies and Laws	The Social Assistance Act, 2004 (Act 13 of 2004) assists transfer of benefits to qualifying persons and also describes minimum standards for grant delivery			
	The SASSA Act, 2004 allowed for the establishment of an agency to administer and pay the social assistance transfers			
Staff Commitment	The officials should see the relevance of using Batho Pele principles when collecting biometrics in order to assure the members of the public			
	The officials should be properly trained and should speak clearly when assisting the public and should answer questions carefully in order to provide assurance to the members of the public and to enhance the quality of service			
	The officials should be trained in the procedures and should			

	know how to collect the biometric samples in order to provide assurance to the public and to enhance the quality of service			
	The officials should know and use the Batho Pele principles in order to provide for quality of service			
	The officials should be trained regarding the collection and use of the biometrics			
Strategic Plans	This DPSA Strategic Priority should be upheld: There should be effective systems, structures and processes			
	This planned outcome should be evident: An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship			
Structures and Procedures	The SASSA branch 6: Grant Administration and Public Services should continue to provide guidance for co-ordination of grant administration and payment			
	The Public Protector should continue to ensure that private citizens are served equitably and fair			
	The Public Administration Leadership and Management Academy (PALAMA) should continue to train and develop public servants to respect citizens			
	The Project Khaedu should continue to train public servants in excellent customer care			
	The Centre for Public Service Innovation (CPSI) should continue to promote and transform ideas into new products and services to enhance service delivery			
	The Public Service Sector Education and Training Authority (PSETA) should continue to coordinate skills development in public service			
	The Public Sector Charter has defined attributes, commitments, rules of engagement and ethical principles for public servants			

	and these should be upheld			
	The idea of the Single Public Service idea must continue to be developed and implemented by the DPSA			
	E-Government must be used to automate and modernize rendition of public services including registrations such as births or deaths			
	Batho Pele principles must continue to encourage mutual respect between state and members of the poor			
	The SASSA Branch 2: Internal Audit and Risk Management must continue to reduce fraud and corruption in the grants administration process			
	The Mission of the Department of Public Service and Administration (DPSA) is to empower fair and inclusive citizenship, to support MPSA, to provide advice and support for excellent public service and good governance, to incorporate Batho Pele principles for service excellence. This should continue to be upheld.			
	This goal should be maintained: migration issues should be solved by allowing the homeless to be able to move around and still be able to claim their money anywhere at any time			
	There should continue to be home visits for those persons who cannot travel to the grant offices			
	There should be awareness that the opinions of the officials who work with the technology may have an effect on their current adoption and use thereof			
	The officials should be aware of the need for the technology before its implementation in order to have the correct adoption and use thereof			
	There should be sufficient officials to meet the demand			

	The officials should be managed well			
	The officials need comprehensive knowledge of the standard operating procedures with regard to the biometrics and the grants			
	The officials should accept responsibility for knowledge of their tasks			
	The officials should be trained			
	The officials should be professional and friendly			
	There should be standard procedures to follow when collecting biometrics			
	The process of collecting biometrics for the grants should not take too long			
	The computers involved in the procedure cause the most delays. This should be resolved in order to improve performance and service delivery and reduce the length of time taken for the procedure.			
	The service should remain free of charge as the members of the public may not have resources to apply for the service			
	There should be a requirement for the public to provide proof of life periodically, such as once a year or once a month			

Component 2: SECURITY, PRIVACY AND ETHICS

Security: Biometrics are used to authenticate individuals for the purposes of applying and receiving social grants. This is personal information and should be kept secure. **Privacy**: Recipients of grants should have certain rights as to what is done with their biometric and other information. **Ethics**: There should be due care taken when dealing with biometrics and vulnerable subjects. There should also be certain controls in place to prevent misuse of personal information. The members of the public may have reservations about the use of their biometrics and therefore there should not be a breach of ethical behaviour.

Focus Area	Step to be taken or Detail described	Relevance	Suggested Action	Comments
Biometric Characteristics	Acceptable characteristic of a biometric: The biometric feature(s) that are extracted should be acceptable to the public i.e. they should be willing to have those particular biometrics extracted and used for identification			
	One-way transformation characteristic of a biometric: There should be a one-way transformation characteristic i.e. the biometric template created for storage should be non-reversible			
	Cancelable characteristic of a biometric: When necessary, the template should be able to be cancelled and a new one recreated. For example, if perhaps an extra authentification factor is to be added for extra security then it will be necessary to replace the old one.			
	Diversity characteristic of a biometric: It should be possible to use the biometric for more than one application			
	Live detection characteristic of a biometric: There should be a mechanism to test if the subject is alive			
Policies and Laws	The Electronic Communication and Transactions Act, 2002 includes E-Government services and protection of personal information			
Privacy	There may be a need to give assurance to the public if they are concerned about government control and manipulation.			

	Alternatively, if the government is intending to use the biometrics to control and manipulate the public then this goal should be stated upfront.			
	There may be a need to give assurance to the public if they are concerned about abuse of their personal data by the government.			
	There may be a need to give assurance to the public if they are concerned that their data may be used in other systems as well (function creep). Alternatively, if the intention is to use the biometrics for other systems as well, then this should be stated upfront.			
Privacy and Security	To provide for secure authentication, the original binary template should be bound into a cryptographic key			
	Hashing or "salting" may be used but one should not hash the original template which may be subject to noise, but rather hash the biometric key			
	There should be awareness of Function Creep, which is when a biometric is used for a different purpose than that which was originally intended. This should not happen as it betrays trust, destroys confidence and is an ethical breach. When intending to use a biometric for more than one purpose, this should be stated up front.			
	Each time there is an attempt at verification, the real person should receive some notification (such as is done for bank transfers)			
	The following personal data should be seen as private: consumption habits, health information, interests, communications, demographic information, appearance, social behaviour and biometrics			
	Biometric extraction may be seen as invasion of privacy which			

	may cause resistance against adoption by the public. To counteract these feelings, the public should be properly informed about the details of biometric extraction and there should be attempts to make it as non-intrusive as possible.			
	The public should be given assurance if biometrics are seen by them to be a weapon for an authoritative government			
	Care should be taken to protect the biometrics that are used across more than one system, because if a criminal obtained access to a subject's biometric, then other systems which contain information for that subject may also be compromised.			
	The central registry should be correct, maintained and secured from tampering, theft and misuse			
	The public must be willing to adopt the biometric scanning, find it easy and non-invasive			
	The public should be told what is being collected and why			
	The public must provide informed consent for having their biometric taken and used			
	The public may be concerned about "big brother" watching? Their concerns should be set at rest.			
	There should be a tradeoff between privacy and benefits			
	It is advisable that the public should be allowed to choose whether their biometrics may be used for other applications as well			
	The public should be allowed to view and update their information			
	All companies that participate (other applications that want to use the biometric) must ensure compliance with security and sharing of information			
	There should be no discrimination against vulnerable groups such			

	as children or disabled persons, among others.			
	One should seek consent of both carer and child when collecting child biometrics			
	When a biometric is no longer required it should be destroyed			
Public Acceptance	The members of the public need to have confidence in the service			
	The members of the public need to be involved in decision making			
	Some people may have reservations about invasive methods of collecting biometrics. Education and awareness programmes may counteract these viewpoints.			
	There should be measurements taken to see if the public are happy with the quality of service and infrastructure			
	The public should be informed as to why their biometrics are needed. This should be relayed to them both at the offices as well as through advertising.			
	The public should be willing to provide their biometrics			
	The public should find it easy to provide their biometric samples			
	The public may be concerned about how the government will use or share their information. This needs to be relayed to the public.			
	The public should not find the biometric extraction to be invasive			
	When making decisions on which biometrics to use for social grants, one should be aware that the statistics taken from the public to indicate which features they like are as follows: photo (72%), fingerprint (41%), voice (34%)			
	When making decisions on which biometrics to use for social grants, one should be aware that the statistics taken from a survey with the public show that they find the following biometrics to be invasive or intrusion of their privacy: Fingerprint (7%), Voice (7%), Iris (17%). The percentage of persons who did			

	not find any of the biometrics invasive was 48%.			
Security	Criminal elements operating around the environment where social grants are processed or paid out should be removed			
	Decisions should be made on the following aspects of security: what type of information, where will it be stored, how will it be secured, who will have access, what criteria will be used when sharing the information with others, how will the intrusion of privacy be reduced, how will the data be used, when will the data be deleted, will it be deleted when no longer required, will the public remain informed and not misled, will the data be continuously updated when appropriate, will it be protected against loss, access, use or disclosure, will audit records be kept?			
	There should be awareness that the public may be concerned about abuse of their personal data by criminal elements. Due care should be taken with the public's data and biometrics.			
	There should be awareness that some members of the public may be committing fraud themselves. Controls are required.			
Structures and Procedures	The Human Rights Commission should continue to protect human rights in areas including social security			

Component 3: SUGGESTED BIOMETRICS

Some suggestions for the choice of biometrics as well as for the implementation thereof are presented in this component.

Focus Area	Step to be taken or Detail described	Relevance	Suggested Action	Comments
Matching Issues	If a biometric is not able to be extracted and there is no alternative, then traditional methods of identification should be used			
Popular Biometrics	When choosing appropriate biometrics to be used for social grants, one should be aware that fingerprinting is the oldest and easiest technology, and is very accurate			
	When using fingerprints one should remember that it should not be used for very young children i.e. babies are too small			
	When using fingerprints one should cater for the following "noise" issues: cuts and bruises, erased fingerprints due to construction work, skin affected by diseases, dryness or sweating, incorrect angles, too much pressure			
	When using fingerprints one should reduce the time to match fingerprints by localising similar classes of fingerprints			
	When using fingerprints, all 10 fingerprints should be able to be taken in less than 2 minutes			
	When using fingerprints one should choose appropriate sensors: Optical sensors are cheap and reliable. Capacitive sensors are more expensive and need more power, but better image quality if fingers are not too dry. Thermal sensors need much power but are inexpensive and do not work well on warm days. Radio frequency sensors get to subsurface of finger and are small, accurate and reliable.			
	When choosing appropriate biometrics to be used for social grants, one should remember that the iris is the most stable and reliable biometric			

	with the highest success rate and the best one for the most important data			
	When using the iris, one should remember that it is unique and has embryonic factors but is not stable until 2 years old and is problematic when collecting from babies as their eyes are usually closed			
	When using the iris one should remember that it is sometimes considered invasive			
	When using the iris one should remember that it can be captured regardless of glasses, contacts or laser surgery			
	When using the iris one should cater for the following "noise" issues: One requires an appropriate distance when capturing the iris and one must be aware of eyelash and eyelid occlusion.			
	When using the voice as a biometric one should be aware that it takes up minimal space and is non-invasive but has efficiency problems therefore must be strengthened to avoid security breaches			
	When using the voice one should be aware that there is better performance with speaker verification than with other biometrics, except the iris			
	When using the voice as a biometric one should remember that mobile telephones are readily available and can be used to verify live persons			
	When using the voice biometric, one should cater for these "noise" issues: One needs noise cancellation, a good microphone, preferably a larger amount of speech is better, and remember also that tired, bored, irritated or ill persons can cause changes in the voice			
	When using the voice biometric, one must be aware that there is a risk of unintentional speech capture			
	When using the voice biometric, one needs challenge/response questions in random order, to avoid infiltrators using previously taped replies			

	When using the voice biometric, cellphones can provide authentication solutions as it contains the four requirements: something one knows (knowledge data), something one has (phone); something one is (biometric), somewhere one is (location or proximity).			
	When using face biometrics, one should be aware that it is non-invasive, easily accepted by users, but is costly.			
	When using face biometrics, one should cater for "noise" issues: images affected by light, pose and facial expression			
	When choosing biometrics for social grants, one should know that the public acceptability statistics show the following preferences in order from most preferred to least preferred: fingerprint, iris, hand and voice			
	When choosing biometrics for social grants, one should be aware that market share shows fingerprint, face, hand, iris, voice in that order from biggest market share to smallest market share			
	When choosing biometrics for social grants, one should be aware that the mobile use preference shows fingerprint, then voice, and then iris			
	When choosing biomerics for social grants, one should be aware that the forecast for 2012 was that 84% of the total usage of biometrics was with iris, fingerprint and face			
	Taking all statistics into account, one must be aware that the most popular biometrics are fingerprint and iris, but voice and face are also well used			
	If a biometric is to be used for more than one purpose, this must be stated up front. Besides government services, perhaps one also wants to use it for crime and law enforcement, passports, drivers licences, building entrances, travelling, immigration, health cards, bank cards, marriage licences, employment, education, commerce, taxation, voting, terrorist watch, visas, residence permits, consumer preferences, child protection, e-learning and/or population control.			

Structures and Procedures	It must be remembered that the Department of Home Affairs (DHA) is issuing new smart cards with biometrics for identification purposes. There may be possibly intentions to use it also for drivers licences, residence permits, census, voting, insurance, pensions and banks. Perhaps it can also be used for the social grants.			
Public Acceptance	It must be noted that statistics in a survey show that the majority of the respondents did not use biometrics when collecting their grant money			
	It must be noted that statistics in a survey show that the public prefer to use a PIN rather than a biometric			
	It must be noted that statistics show that only a small portion of the public collect their money from pay points			

Component 4: PERFORMANCE REQUIREMENTS

Due to the large volumes of transactions required for the social grants for South Africa, there should be attempts made to improve performance in every way. Performance improvements should be applied in the area of the application processing and service delivery, as well as in all the biometric functions such as extraction of features and matching.

Focus Area	Step to be taken or Detail described	Relevance	Suggested Action	Comments
Batho Pele Principles	There should be openness and transparency so that the public can see how the government works			
Biometric Characteristics	Performance characteristic of a biometric: The biometric feature should be able to be extracted quickly and accurately and the matching process should be done efficiently			
	Circumvention characteristic of a biometric: If a biometric feature is not able to be extracted there should be an alternative feature that may also be used in the application			
Feature Extraction	When extracting features for a biometric, the application should extract an appropriate feature set of the biometric (called segmentation) because the complete image will take up too much memory. This process is meant to discard non-relevant data. Perhaps the data being discarded can be that which is dependent on the environment and therefore liable to change each time the feature is extracted.			
	The feature set that is extracted must be checked for quality before converting to digital form			
	If the intention is to transmit the biometric via a communication medium, the feature extraction of the biometric must be done before the transmission to reduce the bandwidth that may be required			
	The feature extraction must be reliable else there will be an effect on performance			

	If compression is done, there must be due care taken to prevent data quality loss			
	Accepted biometric standards should be used wherever possible			
Goals	One should cultivate and uphold standards. For example one standard says that it should take 30 seconds to pay a beneficiary			
	One should have standards for waiting times for the members of the public, such as: A beneficiary should not wait longer than 2 hours			
	One should have standards for office hours, such as: Offices should be open at least from 8am to 3pm			
	When planning for delivery of services re social grants, one must continue to plan for networking, study the transaction volumes, take note of travel times, and anything else required for the delivery of services			
	One should have standards such as: There should be at least one Community Development Worker in each municipal ward in the country			
Matching Issues	An appropriate False Acceptance Rate (FAR) should be chosen and the implementation must support it. Less than 1% may be suitable.			
	An appropriate False Rejection Rate (FRR) should be chosen and the implementation must support it. Less than 1% may be suitable.			
	An appropriate Threshold should be used to measure whether there is a match or not. 85% is suitable but can be higher if more security is required.			
	An appropriate Failure to Enrol rate should be chosen and the implementation must support it. Less than 3% may be suitable.			
	One should choose to design either for false negatives or false			

	positives. If one designs the implementation more in favour of false negatives then more valid recipients will be denied their grants. If one designs more in favour of false positives then more fraudulent individuals may gain access to funds unlawfully.			
	One should consider appropriate options such as these for matching: Either no match (failure), or one single match (success), or more than one match (failure), or rank all those that match and choose the best match (success)			
	The matching process in the implementation should adhere to a standard such as: the transaction time using biometrics should be less than 6 seconds			
Multi-modal Biometrics	One should rather use multi-modal biometrics which is better for many reasons			
	When using multi-modal biometrics, if biometric fusion is done at sensor level, one needs compatible data from the different sensors			
	When using multi-modal biometrics, it is preferred to do the biometric fusion at the matching score level, because there is enough information to combine the scores and one can set different tolerances for FAR and FRR			
Service Delivery	One should strive for a high standard of quality in service			
	One should manage increases in demand for service such as changes in regulations which cause congestion			
	One should be confident that the biometric solution is necessary and that no lessor control would have sufficed			
	There must be sufficient offices for both urban and rural areas			
	There must be a facility to recruit extra staff for peak times			
	The procedures necessary to apply for and acquire a social grant must be done at a single site to avoid unnecessary travel and expense			

	Any complaints of poor service, mistakes, neglect, rudeness, corruption and fraud should be attended to			
	One should be able to prove the effectiveness of having introduced the biometric system			
Structures and Procedures	The Public Service Commission (PSC) must continue to develop and implement service delivery interventions and monitor compliance through annual reports on state of public service by assessing user satisfaction			
	The Grassroots Innovation booklet should continue to showcase the best case studies of Community Development Workers in action in the provinces			

Component 5: FACILITATING ENVIRONMENT

There should be a favourable environment within which the members of the public apply for and receive grants. Various acts and policies may assist towards a good environment. There should also be accessibility to the grants, and good administration of the grant procedures.

Focus Area	Step to be taken or Detail described	Relevance	Suggested Action	Comments
Batho Pele Principles	Access for all services should be made equally available to all citizens			
	Information about services should be accurate and comprehensive			
Environment	At the social grant offices there should be acceptable infrastructure (chairs, ablution blocks, electricity and technical equipment that works)			
	The offices should be at sites accessible to the public			
Goals	There should be a continuing commitment to connect all Thusong service centres to the SITA and government back end systems			
Policies and Laws	The Constitution of the Republic of South Africa 1996 (Act 108 of 1996) provides for the right to social security for all citizens			
	The Public Finance Management Act, 1999 stands for transparency, accountability and sound financial management in public and private sectors			
	The Public Service Act, 1994 provides for the organisation and administration of the public service			
	The Public Service Regulation, 2001 presides			
	The SITA Act, 1998 allowed the establishment of a company to provide Information Technology and associated services			
	The Promotion of Access to Information Act, 2000 (Act 2 of 2000) provides the public with the right to have access to			

	information by promoting transparency and accountability			
	The Promotion of Administrative Justice Act, 2000 (Act 3 of 2000) provides the public with the right to lawful administrative action by promoting efficient administration			
Strategic Plans	This planned outcome should be evident: A responsive, accountable, effective and efficient local government system			
	This DPSA Strategic Priority should be upheld: Service delivery quality and access - with increased infusion of Batho Pele principles			
	This DPSA Strategic Priority should be upheld: Leverage Information and Communication Technology as strategic resource (enabler)			
	This DPSA Strategic Priority should be upheld: Contribution towards improved public service and adminstration in Africa and international arena			
Structures and Procedures	The SASSA Branch 1: Strategy and Business Development should continue to be responsible for innovations for improvements to service delivery			
	The SASSA Branch 5: Information and Communication Technology should continue to look after special ICT projects and improve business solutions			
	Community Development Workers should continue to provide assistance to the poor by improving delivery of services to them			
	The Community Development Workers should continue to remove bottlenecks which delay delivery of services			
	The Community Development Workers should continue to link community to services and take problems back to government structures			
	Community Development Workers should continue to be a			

	voice for the poor by identifying needy households and children, assisting them to get their grants			
	There should be a goal to keep costs low			
	There should always be a reliable agency for managing the payment of grants			
	The public may complain of difficulty to access the service in which case some response is required to improve the situation			
	The public may not know about the service or understand it in which case education and awareness programmes should be used			
	There should be sufficient available working devices for the capturing of biometrics			
	The public should be able to find out about the grants through advertising			

Appendix D: Intermediate BSGSA Framework

BSGSA FRAMEWORK (INTERMEDIATE)
COMPONENT 1: STRUCTURES AND PROCEDURES

BATHO PELE PRINCIPLES

1.1 Staff should be courteous and considerate.
1.2 There should be consultation with members of the public for decision making regarding service levels and quality.
1.3 Service excellence should be measured with benchmarks to show customer satisfaction.
1.4 Apologies and remedial action is necessary if services are not delivered.
1.5 There should be value for money in that services should be provided in an economical and efficient manner.

POLICIES AND LAWS

1.6 The Social Assistance Act, 2004 (Act 13 of 2004) assists transfer of benefits to qualifying persons and also describes minimum standards for grant delivery.
1.7 The SASSA Act, 2004 allowed for the establishment of an agency to administer and pay the social assistance transfers.

STRATEGIC PLANS

1.8 This DPSA Strategic Priority should be upheld: There should be effective systems, structures and processes.
1.9 This planned outcome should be evident: An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship. Opinions of community leaders should also be considered.

STRUCTURES AND PROCEDURES

1.10 The Mission of Department of Public Service and Administration (DPSA) is to empower fair and inclusive citizenship, to support MPSA, to provide advice and support for excellent public service and good governance, to incorporate Batho Pele principles for service excellence. This should continue to be upheld.

BSGSA FRAMEWORK (INTERMEDIATE)
1.11 The SASSA Branch 2: Internal Audit and Risk Management must continue to reduce fraud and corruption in the grants administration process.
1.12 The SASSA Branch 6: Grant Administration and Public Services should continue to provide guidance for co-ordination of grant administration and payment.
1.13 The Public Protector should continue to ensure that private citizens are served equitably and fair.
1.14 The Public Administration Leadership and Management Academy (PALAMA) should continue to train and develop public servants to respect citizens.
1.15 The Project Khaedu should continue to train public servants in excellent customer care.
1.16 The Centre for Public Service Innovation (CPSI) should continue to promote and transform ideas into new products and services to enhance service delivery.
1.17 The Public Service Sector Education and Training Authority (PSETA) should continue to coordinate skills development in public service.
1.18 The Public Sector Charter has defined attributes, commitments, rules of engagement and ethical principles for public servants and these should be upheld.
1.19 The idea of the Single Public Service idea must continue to be developed and implemented by the DPSA.
1.20 E-Government must be used to automate and modernise rendition of public services including registrations such as births or deaths.
1.21 Batho Pele principles must continue to encourage mutual respect between state and members of the poor.
1.22 This goal should be maintained: migration issues should be solved by allowing the homeless to be able to move around and still be able to claim their money anywhere at any time.
1.23 There should continue to be home visits for those persons who cannot travel to the grant offices.
1.24 There should be awareness that the opinions of the officials who work with the technology may have an effect on their correct adoption and use thereof.
1.25 The officials should be aware of the need for the technology before its implementation in order to proceed with the correct adoption and use thereof.
1.26 There should be sufficient officials to meet the demand.
1.27 The officials should be managed well.
1.28 The officials need comprehensive knowledge of the standard operating procedures with regard to the biometrics and the grants.

BSGSA FRAMEWORK (INTERMEDIATE)
1.29 The officials should accept responsibility for knowledge of their tasks.
1.30 The officials should be trained.
1.31 The officials should be professional and friendly.
1.32 The service should remain free of charge as the members of the public may not have resources to apply for the service.
1.33 There should be standard procedures to follow when collecting biometrics.
1.34 The process of collecting biometrics for the grants should not take too long but one must not hasten the process at the expense of quality.
1.35 The computers involved in the procedure cause the most delays. This should be resolved in order to improve performance and service delivery and reduce the length of time taken for the procedure.
1.36 There should be a requirement for the public to provide proof of life periodically, such as once a year or once a month.
STAFF COMMITMENT
1.37 The officials should know and use the Batho Pele principles in order to provide for quality of service.
1.38 The officials should see the relevance of using Batho Pele principles when collecting biometrics in order to provide assurance to the members of the public.
1.39 The officials should be properly trained and should speak clearly when assisting the public and should answer questions carefully in order to provide assurance to the members of the public and to enhance the quality of service.
1.40 The officials should be trained in the procedures and should know how to collect the biometric samples in order to provide assurance to the public and to enhance the quality of service.
COMPONENT 2: SECURITY, PRIVACY AND ETHICS
POLICIES AND LAWS
2.1 The Electronic Communication and Transactions Act, 2002 includes E-Government services and protection of personal information. Attention must also be paid to the Protection Of Personal Information Bill approved by the South African Parliament on 22nd August 2013 soon to be signed into law by the President.

BSGSA FRAMEWORK (INTERMEDIATE)
STRUCTURES AND PROCEDURES
2.2 The Human Rights Commission should continue to protect human rights in areas including social security.
BIOMETRIC CHARACTERISTICS
2.3 Acceptable characteristic of a biometric: The biometric feature(s) that are extracted should be acceptable to the public i.e. they should be willing to have those particular biometric features extracted and used for identification. Certain biometric features are more acceptable to the public than others.
2.4 One-way transformation characteristic of a biometric: There should be a one-way transformation characteristic i.e. the biometric template created for storage should be non-reversible. This can be done by one-way hashing or appropriate cryptographic mechanisms in order to retain Confidentiality and Integrity.
2.5 Cancelable characteristic of a biometric: When necessary, the template should be able to be cancelled and a new one recreated. For example, if an extra authentication factor is to be added for extra security then it will be necessary to replace the old one. Another reason may be that some features evolve over time such as a finger injury.
2.6 Diversity characteristic of a biometric: It should be possible to use the biometric for more than one application.
2.7 Live detection characteristic of a biometric: There should be a mechanism to test if the subject is alive. This also improves the accuracy (False Rejection / False Acceptance rates) for the biometric.
PRIVACY AND SECURITY
2.8 To provide for secure authentication, the original binary template should be bound into a cryptographic key.
2.9 Hashing or “salting” may be used but one should not hash the original template which may be subject to noise, but rather hash the biometric key. One should also remember that full-on symmetric cryptography is more secure than hashing.
2.10 There should be awareness of function creep, which is when a biometric is used for a different purpose than that which was originally intended. This should not happen as it betrays trust, destroys confidence and is an ethical breach. When intending to use a biometric for more than one purpose, this should be stated up front and included in a Policy statement. One should be aware that a holistic approach is needed, however, when social security is linked to births, hospital benefits, UIF etc.
2.11 There may be a need to give assurance to the public if they are concerned that their data may be used in other systems as well (function creep). Alternatively, if the intention is to use the biometrics for other systems as well, then this should be stated upfront. The Protection of Personal Information Bill has various principles that apply here.

BSGSA FRAMEWORK (INTERMEDIATE)	
	2.12 Each time there is an attempt at verification, the real person should receive some notification (such as is done for bank transfers).
	2.13 The following personal data should be seen as private: consumption habits, health information, interests, communications, demographic information, appearance, social behaviour and biometrics. The Protection of Personal Information Bill defines more about what personal data is.
	2.14 Biometric extraction using certain human features or characteristics may be seen as invasion of privacy which may cause resistance against adoption by the public. To counteract these feelings, the public should be properly informed about the details of biometric extraction and there should be attempts to make it as non-intrusive as possible.
	2.15 Care should be taken to protect the biometrics that are used across more than one system, because if a criminal obtained access to a subject's biometric, then other systems which contain information for that subject may also be compromised. Some level of segregation needs to be applied between systems.
	2.16 The central registry should be correct, maintained and secured from tampering, theft and misuse.
	2.17 The public must be willing to adopt the biometric scanning, find it easy and non-invasive. This may depend on the type of feature used for the biometric. Behavioural biometric features are more widely accepted.
	2.18 The public should be told what is being collected and why.
	2.19 The public must provide informed consent for having their biometric taken and used. This is included in the Protection of Personal Information Bill. There may be religious or physiological reasons for objections.
	2.20 The public may be concerned about “big brother” watching? Their concerns should be set at rest.
	2.21 The public should be allowed to view and update their information.
	2.22 All government departments that participate (other applications that want to use the biometrics) must ensure compliance with security and sharing of information. There should also be compliance with information security best practices such as ISO 27000.
	2.23 There should be no discrimination against vulnerable groups such as children or disabled persons, among others. The biometric(s) chosen must be suitable for all individuals.
	2.24 One should seek consent of both carer and child when collecting child biometrics.
	2.25 When a biometric is no longer required it should be destroyed. The Protection of Personal Information Bill clearly states that the information must only be kept as long as it is required for the intended purpose.
	2.26 There may be a need to give assurance to the public if they are concerned about government control and manipulation. However, ideally, government should not be involved with manipulation of the public. Transparency from a governmental perspective is crucial.

BSGSA FRAMEWORK (INTERMEDIATE)
2.27 There may be a need to give assurance to the public if they are concerned about abuse of their personal data by the government.
2.28 Criminal elements operating around the environment where social grants are processed or paid out should be removed.
2.29 Decisions should be made on the following aspects of security: what type of information, where will it be stored, how will it be secured, who will have access, what criteria will be used when sharing the information with others, how will the intrusion of privacy be reduced, how will the data be used, when will the data be deleted, will it be deleted when no longer required, will the public remain informed and not misled, will the data be continuously updated when appropriate, will it be protected against loss, access, use or disclosure, will audit records be kept?
2.30 There should be awareness that the public may be concerned about abuse of their personal data by criminal elements. Due care should be taken with the public's data and biometrics. The Protection of Personal Information Bill will cover this.
2.31 There should be awareness that some members of the public may be committing fraud themselves. Proactive biometric and general information security controls are required.
PUBLIC ACCEPTANCE
2.32 The members of the public need to have confidence in the service.
2.33 Some people may have reservations about invasive methods of collecting biometrics. Education and awareness programmes may counteract these viewpoints.
2.34 There should be measurements taken to see if the public are happy with the quality of service and infrastructure.
2.35 The public should be informed as to why their biometric features are needed. This should be relayed to them both at the offices as well as through advertising.
2.36 The public should be willing to provide their biometrics but this may depend on the type of biometric.
2.37 The public should find it easy to provide their biometric samples but this may depend on the type of biometric.
2.38 When making decisions on which biometrics to use for social grants, one should be aware that the statistics taken from recent interviews with a sample of the social grant recipients in the Eastern Cape Region indicated that the features they like are as follows: photo (72%), fingerprint (41%) and voice (34%). However, the government needs to determine standards of control.
2.39 When making decisions on which biometrics to use for social grants, one should be aware that the statistics taken from recent interviews with a sample of the social grant recipients in the Eastern Cape Region indicated that they would find the following biometrics to be invasive or intrusion of their privacy: Fingerprint (7%), Voice (7%) and Iris (17%). The percentage of persons who did not find any of the biometrics invasive was 48%.

BSGSA FRAMEWORK (INTERMEDIATE)
COMPONENT 3: SUGGESTED BIOMETRICS

STRUCTURES AND PROCEDURES

3.1 It must be remembered that the Department of Home Affairs (DHA) is issuing new smart cards with biometrics for identification purposes. There may be possibly intentions to use it also for drivers' licences, residence permits, census, voting, insurance, pensions and banks. It may also be used for the social grants.

MATCHING ISSUES

3.2 If a biometric is not able to be extracted and there is no alternative, then traditional methods of identification should be used.

POPULAR BIOMETRICS

3.3 When choosing appropriate biometrics to be used for social grants, one should look for ease of use and accuracy. The fingerprint, among others, is very suitable and is the oldest feature used as a biometric.
3.4 When using fingerprints one should remember that it should not be used for very young children i.e. babies are too small.
3.5 When using fingerprints one should cater for the following "noise" issues: cuts and bruises, erased fingerprints due to construction work, skin affected by diseases, dryness or sweating, incorrect angles, too much pressure.
3.6 When using fingerprints one should reduce the time to match fingerprints by localising similar classes of fingerprints.
3.7 When using fingerprints, all 10 fingerprints should be able to be taken in less than two minutes in order to make it practical to enrol the population.
3.8 When using fingerprints one should choose appropriate sensors having taken various factors into account such as robustness etc.: Optical sensors are cheap and reliable. Capacitive sensors are more expensive and need more power, but better image quality if fingers are not too dry. Thermal sensors need much power but are inexpensive and do not work well on warm days. Radio frequency sensors get to subsurface of finger and are small, accurate and reliable.
3.9 When choosing appropriate biometrics to be used for social grants, one should remember that the iris is the most stable and reliable biometric with the highest success rate and the best one for the most important data.

BSGSA FRAMEWORK (INTERMEDIATE)	
	3.10 When using the iris, one should remember that it is unique and has embryonic factors but is not stable until two years old and is problematic when collecting from babies as their eyes are usually closed.
	3.11 When using the iris one should remember that it is sometimes considered invasive.
	3.12 When using the iris one should remember that it can be captured regardless of glasses, contacts or laser surgery.
	3.13 When using the iris one should cater for the following "noise" issues: One requires an appropriate distance when capturing the iris and one must be aware of eyelash and eyelid occlusion.
	3.14 When using the voice as a biometric one should be aware that it takes up minimal space and is non-invasive but has efficiency problems therefore must be strengthened to avoid security breaches. One could, for example, add a password or another biometric.
	3.15 When using the voice one should be aware that there is better performance with speaker verification than with other biometrics, except the iris.
	3.16 When using the voice as a biometric one should remember that mobile telephones are readily available and can be used to verify live persons.
	3.17 When using the voice biometric, one should cater for these "noise" issues: One needs noise cancellation, a good microphone, preferably a larger amount of speech is better, and remember also that tired, bored, irritated or ill persons can cause changes in the voice.
	3.18 When using the voice biometric, one must be aware that there is a risk of unintentional speech capture.
	3.19 When using the voice biometric, one needs challenge/response questions in random order, to avoid infiltrators using previously taped replies.
	3.20 When using the voice biometric, cell-phones can provide authentication solutions as it contains the four requirements: something one knows (knowledge data), something one has (phone), something one is (biometric), somewhere one is (location or proximity).
	3.21 When using face biometrics, one should be aware that it is non-invasive, easily accepted by users, but is costly.
	3.22 When using face biometrics, one should cater for "noise" issues: images affected by light, pose and facial expression. Eigen faces should assist with image feature extraction quality.
	3.23 When choosing biometrics for social grants, one should know that the public acceptability statistics show the following preferences in order from most preferred to least preferred: fingerprint, iris, hand and voice.
	3.24 When choosing biometrics for social grants, one should be aware that market share shows fingerprint, face, hand, iris, voice in that order from biggest market share to smallest market share.

BSGSA FRAMEWORK (INTERMEDIATE)
3.25 When choosing biometrics for social grants, one should be aware that the mobile use preference shows fingerprint, then voice and then iris.
3.26 When choosing biometrics for social grants, one should be aware that the forecast for 2012 was that 84% of the total usage of biometrics was with iris, fingerprint and face.
3.27 Taking all statistics into account, one must be aware that the most popular biometric features are fingerprint and iris, but voice and face are also well used.
3.28 If a biometric is to be used for more than one purpose, this must be stated up front. Besides government services, one may want to use it for crime and law enforcement, passports, drivers' licences, building entrances, travelling, immigration, health cards, bank cards, marriage licences, employment, education, commerce, taxation, voting, terrorist watch, visas, residence permits, consumer preferences, child protection, e-learning and/or population control. Standards should be set by government.
PUBLIC ACCEPTANCE
3.29 It must be noted that statistics from a recent interview sample in the Eastern Cape Region revealed that the majority of the respondents did not use biometrics when collecting their grant money but rather received their money via Banks or Shops.
3.30 It must be noted that statistics from a recent interview sample in the Eastern Cape Region revealed that the majority of the respondents still prefer to use a PIN rather than a biometric.
3.31 It must be noted that statistics from a recent interview sample in the Eastern Cape Region showed that only a small portion of the respondents collected their money from the pay points. However, a South African Social Security Agency official indicated that the correct percentage was 35% of the public.
COMPONENT 4: PERFORMANCE REQUIREMENTS
BATHO PELE PRINCIPLES
4.1 There should be openness and transparency so that the public can see how the government works.

BSGSA FRAMEWORK (INTERMEDIATE)

GOALS

4.2 One should cultivate and uphold standards. For example one standard says that it should take 30 seconds to pay a beneficiary. However, this should not have an adverse impact on quality.
4.3 One should have standards for waiting times for the members of the public, such as: A beneficiary should not wait longer than two hours.
4.4 One should have standards for office hours, such as: Offices should be open at least from 8am to 3pm.
4.5 One should have standards such as: There should be at least one Community Development Worker in each municipal ward in the country.
4.6 When planning for delivery of services re social grants, one must continue to plan for networking, study the transaction volumes, take note of travel times, and anything else required for the delivery of services.

STRUCTURES AND PROCEDURES

4.7 The Public Service Commission (PSC) must continue to develop and implement service delivery interventions and monitor compliance through annual reports on state of public service by assessing user satisfaction.
4.8 The Grassroots Innovation booklet should continue to showcase the best case studies of Community Development Workers in action in the provinces.

BIOMETRIC CHARACTERISTICS

4.9 Performance characteristic of a biometric: The biometric feature should be able to be extracted quickly and accurately and the matching process should be done efficiently so that it becomes practical to use it for the population.
4.10 Circumvention characteristic of a biometric: If a biometric feature is not able to be extracted there should be an alternative feature that may also be used in the application.

FEATURE EXTRACTION

4.11 When extracting features for a biometric, the application should extract an appropriate feature set of the biometric (called segmentation) because the complete image will take up too much memory. This process is meant to discard non-relevant data. The data being discarded may be that which is dependent on the environment and therefore liable to change each time the

feature is extracted.
4.12 The feature set that is extracted must be checked for quality before converting to digital form.
4.13 If the intention is to transmit the biometric via a communication medium, the feature extraction of the biometric must be done before the transmission to reduce the bandwidth that may be required.
4.14 If compression is done, there must be due care taken to prevent data quality loss.
4.15 Accepted biometric standards should be used wherever possible e.g. ISO 19784.

MATCHING ISSUES

4.16 An appropriate False Acceptance Rate (FAR) should be chosen and the implementation must support it. Less than 1% may be suitable.
4.17 An appropriate False Rejection Rate (FRR) should be chosen and the implementation must support it. Less than 1% may be suitable.
4.18 An appropriate Threshold should be used to measure whether there is a match or not. The suggestion is that it should be higher than 85%.
4.19 An appropriate Failure to Enrol rate should be chosen and the implementation must support it. Less than 3% may be suitable.
4.20 One should choose to design either for false negatives or false positives. If one designs the implementation more in favour of false negatives then more valid recipients will be denied their grants. If one designs more in favour of false positives then more fraudulent individuals may gain access to funds unlawfully. One could have an appropriate balance that gives the least Equal Error Rate (the intersection of FAR and FRR).
4.21 One should consider appropriate options such as these for matching: Either no match (failure), or one single match (success), or more than one match (failure), or rank all those that match and choose the best match (success).
4.22 The matching process in the implementation should adhere to a standard such as: the transaction time using biometrics should be less than six seconds, but this should not have an adverse impact on quality.

MULTI-MODAL BIOMETRICS

4.23 One should rather use multi-modal biometrics which is better for many reasons.
4.24 When using multi-modal biometrics, if biometric fusion is done at sensor level, one needs compatible data from the different sensors.

BSGSA FRAMEWORK (INTERMEDIATE)
4.25 When using multi-modal biometrics, it is preferred to do the biometric fusion at the matching score level, because there is enough information to combine the scores and one can set different tolerances for FAR and FRR.

SERVICE DELIVERY

4.26 One should strive for a high standard of quality in service.
4.27 One should manage increases in demand for service such as changes in regulations which cause congestion.
4.28 One should be confident that the biometric solution is necessary and that no lessor control would have sufficed.
4.29 There must be sufficient offices for both urban and rural areas, using mobile services where there is no infrastructure.
4.30 Any complaints of poor service, mistakes, neglect, rudeness, corruption and fraud should be attended to..
4.31 One should be able to prove the effectiveness of having introduced the biometric system.

COMPONENT 5: FACILITATING ENVIRONMENT

BATHO PELE PRINCIPLES

5.1 Access for all services should be made equally available to all citizens.
5.2 Information about services should be accurate and comprehensive.

GOALS

5.3 There should be a continuing commitment to connect all Thusong service centres to the State Information Technology Agency (SITA) and government back end systems.

POLICIES AND LAWS

5.4 The Constitution of the Republic of South Africa 1996 (Act 108 of 1996) provides for the right to social security for all citizens who qualify.
5.5 The Public Finance Management Act, 1999 stands for transparency, accountability and sound financial management in public and private sectors.

BSGSA FRAMEWORK (INTERMEDIATE)
5.6 The Public Service Act, 1994 provides for the organisation and administration of the public service.
5.7 The Public Service Regulation, 2001 presides.
5.8 The SITA Act, 1998 allowed the establishment of a company to provide Information Technology and associated services.
5.9 The Promotion of Access to Information Act, 2000 (Act 2 of 2000) provides the public with the right to have access to information by promoting transparency and accountability.
5.10 The Promotion of Administrative Justice Act, 2000 (Act 3 of 2000) provides the public with the right to lawful administrative action by promoting efficient administration.
STRATEGIC PLANS
5.11 This planned outcome should be evident: A responsive, accountable, effective and efficient local government system.
5.12 This DPSA Strategic Priority should be upheld: Service delivery quality and access – with increased infusion of Batho Pele principles.
5.13 This DPSA Strategic Priority should be upheld: Leverage Information and Communication Technology as strategic resource (enabler).
5.14 This DPSA Strategic Priority should be upheld: Contribution towards improved public service and administration in Africa and international arena.
STRUCTURES AND PROCEDURES
5.15 The SASSA Branch 1: Strategy and Business Development should continue to be responsible for innovations for improvements to service delivery but there should be a collective effort from all branches.
5.16 The SASSA Branch 5: Information and Communication Technology should continue to look after special ICT projects and improve business solutions.
5.17 Community Development Workers should continue to provide assistance to the poor by improving delivery of services to them.
5.18 The Community Development Workers should continue to remove bottlenecks which delay delivery of services.
5.19 The Community Development Workers should continue to link community to services and take problems back to government structures.
5.20 Community Development Workers should continue to be a voice for the poor by identifying needy households and children, assisting them to get their grants.

BSGSA FRAMEWORK (INTERMEDIATE)
5.21 There should be a goal to keep costs low but not at the expense of service delivery.
5.22 There should always be a reliable agency for managing the payment of grants.
5.23 The public may complain of difficulty to access the service in which case some response is required to improve the situation.
5.24 The public may not know about the service or understand it in which case education and awareness programmes should be used.
5.25 There should be sufficient available working devices for the capturing of biometrics.
5.26 The public should be able to find out about the grants through advertising.

ENVIRONMENT

5.27 At the social grant offices there should be acceptable infrastructure (chairs, ablution blocks, electricity and technical equipment that works).
5.28 The offices should be at viable sites accessible to the public.