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THE ROLE OF SECONDARY EDUCATION IN OPERATOR EMPLOYABILITY IN THE AUTOMOTIVE INDUSTRY

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Abstract

This study was designed to assess the role of secondary education in the employability of operators in the South African automotive industry. Five types of secondary education are referred to, namely, a secondary education including Mathematics and Science as subjects; a matriculation with Mathematics as a subject; a secondary education inclusive of Science as a subject; a technical type Grade 12 qualification and a general form of secondary education. A two-phase aptitude testing selection process, employing three sub-tests from the Differential Aptitude Test (DAT-K) and five from the Trade Aptitude Test (TRAT) batteries, was utilised to assess whether there were significant differences in aptitude test scores of applicants with different types of secondary education. These aptitude measures were administered to 2 463 preselected respondents. Descriptive statistics such as median, mode and frequency distribution graphs were used. Statistical analysis was also carried out, using the Chi-square test of independence, to determine the differences in aptitude test results obtained by the groups in the study. The study's findings revealed that the type of Grade 12 qualification held by applicants is an important criterion to be considered in the selection of automotive operators. The findings specifically indicated that a secondary education that included Mathematics and/or Science as subjects resulted in notable performance in the aptitude instruments employed in this study. The findings are broadly relevant to the South African automotive industry and are of value to human resource practitioners, educators, social scientists and other researchers.

Keywords: Operators, selection, secondary education, aptitude, automotive industry

Declaration

I, Juliet Ingrid Puchert, declare that this research report on "The role of secondary education in operator employability in the automotive industry" is the author's original work and has never been submitted by the author or anyone else at any university for a degree. All the sources that I have used and/or quoted have been indicated and acknowledged by means of complete references. This dissertation is submitted in fulfilment of the requirements for the degree: Master of Commerce (Industrial Psychology) at the University of Fort Hare, East London campus.

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Language editing declaration

I hereby confirm that I have proofread and edited the following master's thesis using the Windows "Tracking" system to reflect my comments and suggested corrections for the student to action:

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Dedication

This research project is dedicated to my daughter, Joy. Thank you for your patience with my after-hours work and your smile when I come home.

Abbreviations

APDP	Automotive Production and Development Programme
CPP	Cognitive Process Profile
DAT	Differential Aptitude Test
DHET	Department of Higher Education and Training
ECDC	Eastern Cape Development Corporation
ECSECC	Eastern Cape Socio Economic Consultative Council
EEA	Employment Equity Act
FET	Further Education and Training
GCA	General cognitive ability
HPCSA	Health Professions Council of South Africa
K-R	Kuder-Richardson
LRA	Labour Relations Act
merSETA	Manufacturing, Engineering and Related Services SETA
MIDP	Motor Industry Development Programme
NSC	National Senior Certificate
OEM	Original Equipment Manufacturers
OFO	Organising Framework for Occupations
SETA	Sector Education and Training Authority
SIOPSA	Society for Industrial and Organisational Psychology of South Africa
SPSS	Statistical Package for the Social Sciences
TRAT	Trade Aptitude Test

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The South African automotive industry is widely regarded as the biggest and foremost manufacturing sector in the domestic economy (Barnes & Meadows, 2008; Davies, 2010a; Deloitte, 2013; Mashilo, 2010; Maxwell, 2012; Naude & O'Neill, 2011; Piro, 2011). Furthermore, the South African government has identified the automotive industry as a vital area of growth (Bronkhorst, 2010). This industry is therefore in a positive position to make a significant contribution to the manufacturing output in South Africa (Davies, 2010a; Vermeulen, 2013c).

Over the past decade, the South African automobile industry has been placed under considerable pressure to align with international trends adequately. The continual introduction of improved technology by international competitors has posed the local industry with the challenge of keeping abreast with innovation whilst dealing with the on-going skills shortages in key areas (De Kock, 2012; Deloitte, 2009; Meyer, 2013). Specifically, these skills shortages lie in areas that require technical skills such as Mathematics and Science (De Kock, 2012; Peo, 2013).

In this chapter, the study is introduced by providing the background to the research problem. The problem statement, research objectives and hypotheses are thereafter explained and a brief literature review is offered. The key terms and concepts are defined and a discussion on the research methodology follows. The limitations and delimitations of the study, the importance thereof, as well as the ethical considerations and thesis structure, are also provided in this chapter. Section 1.2 commences chapter one with an outline of the background to the study's research problem.

1.2 Background to the research problem

This section is divided into four parts. The section is initiated with an overview of the South African automotive industry with section 1.2.2 outlining the employment situation within the South African automobile industry. In section 1.2.3, the role of and the skill requirements of

automotive operators are summarised while the final part explains the education requirements of automotive operators.

1.2.1 Overview of the South African automotive industry

Globally, the automotive industry is regarded as "the industry of industries" (Drucker, 1946, p. 149). In South Africa, the automobile manufacturing sector contributes at least six to seven percent to the country's gross domestic profit and accounts for almost 12% of the country's manufacturing exports, resulting in it being South Africa's leading manufacturing sector (Barnes & Meadows, 2008; Davies, 2010b, 2012; Deloitte, 2013; Maxwell, 2012; Naude & O'Neill, 2011; Vermeulen, 2013b). According to a 2013 automotive survey, the South African automobile manufacturing sector is aiming to make South Africa the destination of choice for automotive investment. In this survey, global vehicle manufacturers ranked South Africa as the fifth-best choice in terms of investment with some manufacturers from the Brics (Brazil, Russia, India, China and South Africa) bloc indicating intentions to expand their production facilities into South Africa (Meyer, 2013).

There are currently seven large original equipment manufacturers (OEMs) in South Africa, namely, BMW South Africa, Ford Motor Company South Africa, General Motors South Africa, Mercedes-Benz South Africa, Nissan South Africa, Toyota South Africa and Volkswagen South Africa. These OEMs have assembly plants in various provinces of South Africa, assembling vehicles for both the national and international markets (Gaskin, 2010; Naude & O'Neill, 2011; Nzimande & Patel, 2012).

The South African automotive industry enjoyed the security and benefits offered by the Motor Industry Development Programme (MIDP) during 1995 to 2012. The objectives of the MIDP were to invest significant tax revenues into the industry to assist it to become globally competitive thus leading to increased productivity, employment and economic growth in the country (Barnes & Meadows, 2008; Bronkhorst, 2010; Kaggwa, Pouris & Steyn, 2007; Ramatla, Scholtz & October, 2012). Despite the MIDP initiatives, manufacturing organisations that had archaic machinery and equipment were most affected by the 2008 recession (Davies, 2012).

The Automotive Production and Development Programme (APDP) replaced the MIDP in January 2013, continuing until 2020. The objectives of the APDP are very similar to those of the MIDP (Gaskin, 2010; Bronkhorst, 2010; Mashilo, 2010; Maxwell, 2012; Patel, 2012a; Warrington, 2009). The policy instruments to implement the APDP are: stabilised import tariffs to discourage vehicle importation; a value added allowance that allows assemblers to import a percentage of their components duty free; the automotive investment scheme which offers annual taxable cash grants thus supporting OEM investments in new plant and machinery, training, technology and research and development; and the local manufacturing production incentives (Bronkhorst, 2010; Maxwell, 2012; Warrington, 2009). The APDP should, therefore, assist the automobile industry cope with the deep pressures and the major transformations, such as increased expansion, employment levels and the workforce skills deficit, currently being demanded of the industry (Bronkhorst, 2010; Mashilo, 2010; Maxwell, 2012; Patel, 2012a; Warrington, 2009).

Notwithstanding the APDP initiatives, international competition in the automotive industry, following various international trade agreements, has intensified over the past decade (Naude & O'Neill, 2011). South African automobile firms are presently not regarded as competing on an equal basis with international competitors such as China, Eastern Europe and South America (Deloitte, 2009; Naude & O'Neill, 2006; Peo, 2013). The current South African automotive industry is further challenged by the impact of modern technology (such as greener engine technologies) being introduced in the global automobile industry (Deloitte, 2009; Meyer, 2013; Naude & O'Neill, 2011; Peo, 2013; Vermeulen, 2013b). It is predicted that automotive consumer buying preferences will undergo a radical shift by 2020 (Barnes & Meadows, 2008; Deloitte, 2009; Mashilo, 2010; Meyer, 2013).

In the present global stage, the main South African automotive role-players have had to undergo a significant shift in the way they conduct their business in order to survive (Barnes & Meadows, 2008; Deloitte, 2009; Mashilo, 2010; Naude & O'Neill, 2011; Piro, 2011). The economic recession, the rise of emerging markets and alternative technology advancements will result in significant changes in the automotive industry. OEMs will need to make substantial investments into developing their capabilities in order to be able to profitably and flexibly deal

with these trends (Barnes, 2000; Barnes & Meadows, 2008; Deloitte, 2009; Mashilo, 2010; Meyer, 2013). Improved efficiency is, therefore, required to remain competitive within the global automobile industry (Barnes, 2000; Deloitte, 2009; Naude & O'Neill, 2006; Peo, 2013). Competitive influence is so fierce that it is estimated that production output per annum must increase from 600 000 units to 1.2 million units if the South African automotive industry is to survive (De Kock, 2012). Researchers have accordingly recommended that South African OEMs improve on production costs and efficiencies to remain competitive in the global environment (Barnes, 2000; Deloitte, 2009; Naude & O'Neill, 2006).

Due to these challenges, and the attractive incentives offered by the APDP, the majority of the OEMs are currently investing heavily in the South African automotive industry. To facilitate the projected increase in local vehicle production volumes, the overall investment by OEMs between 2010 and 2012 was R7 billion (Eastern Cape Development Corporation, 2013). Industry capital expenditure is close to record levels with an excess of R5-billion being invested in the industry during 2013 (Bronkhorst, 2010; Maxwell, 2012; Vermeulen, 2013a). Ford Motor Company South Africa completed a R3.4 billion transformation of its manufacturing and assembly plants in 2011 resulting in 800 new jobs (Davies, 2010a, 2010b). Mercedes-Benz South Africa invested R2.5 billion into the local assembly plant in preparation for the launch of the new C-class in 2014. This plant also plans to add an additional 800 staff to its workforce (Deloitte, 2009; Maxwell, 2012).

Given the provided synopsis of the South African automobile industry, the following section discusses the implications thereof in terms of the current and proposed future employment within the industry.

1.2.2 Employment in the South African automotive industry

The South African automotive industry employed 30 344 employees as at the end of September 2013 (Vermeulen, 2013a). However, an additional 65 000 people are employed within the related component manufacturing industry; 200 000 in the retail and aftermarket services and 6 600 in the tyre manufacturing industry (Bronkhorst, 2010). Through backward and forward linkages, the automotive industry is also clearly linked to other industries ranging from steel,

leather and plastic manufacturing to financial and advertising services (Davies, 2010a, 2010b; Ramatla et al., 2012).

The automobile industry's employment levels have been steadily increasing since retrenchments in the post-2008 economic recession (Bronkhorst, 2010; Gaskin, 2010; Vermeulen, 2012a, 2012b). This increase reached its highest employment level in the third quarter of 2013 with an increase of 441 jobs to reach 30 344 (Vermeulen, 2013a). Furthermore, there is a realistic expectation that the employment levels will further increase as various OEMs upgrade and expand their production and assembly facilities from 2013 to 2015 (Barnes & Meadows, 2008; Bronkhorst, 2010; Peo, 2013; Vermeulen, 2013a, 2013b).

Specifically, the main employment growth will be in the semi-skilled and skilled categories of production workers (Barnes & Meadows, 2008; Gaskin, 2010; Nzimande & Patel, 2012). These categories of production workers - also known as plant and machine operators, assemblers or blue collar workers - are the largest portion of the workforce, being an estimated 69% of the automobile manufacturing industry's workforce (Barnes & Meadows, 2008; Mashilo, 2010; merSETA, 2009). This group of workers has a direct link to the technology and equipment used in the sector with the result that the South African automotive assembly plants' demand for skilled and highly skilled operators and assemblers has rapidly increased since 2005 (Barnes & Meadows, 2008; Davies, 2010b; Deloitte, 2009; Mashilo, 2010; Maxwell, 2012; merSETA, 2009; Nzimande & Patel, 2012). The industry, therefore, needs to ensure that their workforces' skills sets are aligned with the enhanced production requirements (Barnes & Meadows, 2008; De Kock, 2012; Deloitte, 2009).

With an understanding of the current and projected employment requirements within the automotive industry, section 1.2.3 provides details of the consequent skills demands and highlights the important role that operators and assemblers play in the automobile industry.

1.2.3 Role and skill requirements of automotive operators

The Organising Framework for Occupations (OFO) offers a national framework for the identification and classification of occupations in South Africa. According to the OFO, the major

group category of plant and machine operators and assemblers (major group seven) comprises occupations that need knowledge, experience and understanding of industrial machinery and equipment in order to complete their main tasks (Department: Higher Education and Training (DHET), 2012). These workers "operate and monitor industrial and agricultural machinery and equipment on the spot or by remote control, drive and operate trains, motor vehicles and mobile machinery and equipment, or assemble products from component parts according to strict specifications and procedures" (DHET, 2012, p. 500). Within the automotive industry, the completion of these workers' tasks is usually done on an automated assembly line (S. de Klerk, personal communication, May 9, 2013).

In order to fulfil these tasks, operators need a mix of job-specific skills and personal attributes. The European Commission (2013) has indicated three categories of skills and traits required of automotive operators. Firstly, job-specific skills, such as know-how of machinery and equipment; skills in handling machine-paced operations; the capacity to adjust to technological innovations as well as knowledge and understanding of health and safety issues, are essential. Secondly, operators are expected to demonstrate dexterity skills, attention to detail and accuracy in the completion of machine operation and assembling tasks. Finally, personal attributes such as punctuality, flexibility and teamwork skills are advantageous.

Having outlined the important role that operators fulfil and the skills this workforce requires within the automotive industry, the next section discusses the educational profile of these workers.

1.2.4 Educational requirements of automotive operators

Section 1.2.2 highlighted that global advances in the automobile manufacturing industry have seen an increase in the demand for skilled and highly skilled workers, with the amount of unskilled and semi-skilled workers that are needed dropping proportionately. The required qualifications in the industry are therefore also increasing. The quality of the Grade 12 qualifications, specifically with regard to Mathematics and Science, is of high importance to the South African automotive sector (Barnes & Meadows, 2008; Nzimande & Patel, 2012; Patel, 2013; Peo, 2013).

In particular, the South African automotive industry relies on employees with a first-rate technical education to sustain its competitive drive (Schafmeister, 2013). The projected career path for automotive plant operators and assemblers is mostly towards obtaining an apprenticeship qualification and becoming an artisan. Due to this, the automotive industry has, historically, focused on a technical type of secondary educational qualification in the recruitment and selection of the production worker category (S. de Klerk, personal communication, May 9, 2013).

Section 1.2 discussed the background to the research problem, specifically outlining the role as well as the skill and educational requirements of automotive operators. With this context in mind the main scope of the research study is addressed in the following section.

1.3 Problem statement, objectives and hypotheses

This section comprises of three parts. Initially the study's problem statement is outlined, with the second and third parts elucidating the objectives and hypotheses of the study.

1.3.1 Problem statement

As indicated in section 1.2.1, the South African automotive industry is currently facing growing international competitive pressure. Increased customer quality demands, as well as the upcoming launch of new vehicle models by a number of OEMs, have added additional pressure to the industry. International partner-owners of most of the South African OEMs have, therefore, recently invested significant capital expenditure through the APDP incentives with the expectation of improved efficiencies and an increased average number of vehicles produced per employee (Barnes & Meadows, 2008; Davies, 2012; Deloitte, 2009; Vermeulen, 2013a, 2013b).

In any manufacturing environment, a certain level of technical knowledge and skill is required, even at the level of machine operators (Nzimande & Patel, 2012). The factors mentioned in the previous paragraph will result in increased skills demands being placed on the South African automotive industry's production employees. The industry, therefore, needs to ensure that it proactively expands and develops its employee skills base (Deloitte, 2009; Peo, 2013). A shortage of critical technical skills has, however, been found within the South African

manufacturing sector (Barnes & Meadows, 2008; Nzimande & Patel, 2012; Piro, 2011). Scarce skills within the production operator category were found to be within the fields of arc welders, brake press operators, furnace operators, metal rolling mill operators, sheet work operators and tool setters (Barnes & Meadows, 2008; merSETA, 2009; Nzimande & Patel, 2012). The lack of core technical skills, particularly at the level of technician and artisan, also urgently needs to be addressed within the manufacturing sector (Patel, 2008; Peo, 2013).

This situation is further compounded by a deficiency in educational attainments within South Africa (Lehohla, 2010). The South African 2013 National Senior Certificate (NSC) results reveal that 78.2% of the students matriculated with a Grade 12 certificate. However, only 59.1% achieved a passing grade in Mathematics (30% or above) and only 67.4% achieved a passing grade in Physical Sciences (30% or above) in the same year (Motshekga, 2014). While there has been some improvement in the Mathematics and Science results since 2008, there is considerable criticism of the current NSC. Specifically, criticism is directed at the low 30% pass mark requisite as it is not in line with national human resource requirements, particularly within the automotive industry (Motshekga, 2014; Nzimande & Patel, 2012).

Despite the raised educational requirements of operators described in section 1.2.4, the numbers of students that are graduating with qualifications that support entry and success at higher educational levels are not increasing proportionately to the increased demand for these skills (Rauner, Heinemann, Hauschildt & Piening, 2012). An estimated 59% of the South African employed workforce has less than a matriculation certificate as an educational achievement, with at least 3.6% having no education at all. Moreover, a paltry 18.5% of those currently employed in South Africa hold a higher education qualification (Lehohla, 2010). Only 53% of the employees in the auto manufacturing chamber of the merSETA have a Grade 9 or higher qualification (merSETA, 2009). As a result of this current educational profile, at least 50 000 technical vacancies in the South African automotive industry could not be filled because there were not sufficient individuals with the minimum educational requirements (De Kock, 2012).

This problem statement has elucidated an important issue for consideration within the South African automotive industry. That is, determining which type of secondary education

provides an optimum fit in the selection of automotive operators. In the next section the study's research objectives are offered as a means to address this fundamental issue.

1.3.2 Objectives

Within the context of the problem statement outlined in section 1.3.1, the primary objective of this study was to explore the relationship between the type of secondary education obtained and operator employability within the automotive industry.

Following on from the primary objective, the two secondary objectives are as follows:

- To establish whether the type of secondary education obtained affects the success of applicants in the general aptitude sub-tests that form part of the employability selection process of operators in the automotive industry.
- To establish whether the type of secondary education obtained affects the success of applicants in the technical aptitude sub-tests that form part of the employability selection process of operators in the automotive industry.

With the primary and secondary objectives having been briefly discussed, the study's hypotheses are outlined in section 1.3.3.

1.3.3 Hypotheses

This research study's nine hypotheses are presented in this section with the null hypothesis stated first, followed by the alternate hypothesis.

H_{01} The type of secondary education obtained will not have an influence on verbal reasoning test scores.

H_1 The type of secondary education obtained will have an influence on verbal reasoning test scores.

H_{02} The type of secondary education obtained will not have an influence on non-verbal reasoning test scores.

H_2 The type of secondary education obtained will have an influence on non-verbal reasoning test scores.

H_{03} The type of secondary education obtained will not have an influence on comparison test scores.

H_3 The type of secondary education obtained will have an influence on comparison test scores.

H_{04} The type of secondary education obtained will not have an influence on dexterity test scores.

H_4 The type of secondary education obtained will have an influence on dexterity test scores.

H_{05} The type of secondary education obtained will not have an influence on co-ordination test scores.

H_5 The type of secondary education obtained will have an influence on co-ordination test scores.

H_{06} The type of secondary education obtained will not have an influence on assembly test scores.

H_6 The type of secondary education obtained will have an influence on assembly test scores.

H_{07} The type of secondary education obtained will not have an influence on spatial perception 2-D test scores obtained.

H_7 The type of secondary education obtained will have an influence on spatial perception 2-D test scores obtained.

H_{08} The type of secondary education obtained will not have an influence on spatial perception 3-D test scores.

H_8 The type of secondary education obtained will have an influence on spatial perception 3-D test scores.

H_{09} The type of secondary education obtained will not influence the employability of operator applicants.

H_9 The type of secondary education obtained will influence the employability of operator applicants.

Section 1.3 outlined the problem statement, research objectives and hypotheses of this research study. Section 1.4 that follows provides a literature review of the theoretical frameworks and empirical research underpinning the study.

1.4 Literature review

Section 1.4 consists of four parts. Initially, the first two sections provide a brief overview of two theoretical frameworks, namely, talent management and human capital, supporting the study area. Section 1.4.3 offers a précis of the empirical research in the field of study while section 1.4.4 concisely critically appraises the offered literature review. Section 1.4.1 initiates the section with a succinct summary of the talent management theory.

1.4.1 Talent management theory

The talent management approach regards the top 10-20% of employees in an organisation as being the focus of human resource practices. Proponents of this theory believe that these individuals' talent, or the total of their abilities, skills, knowledge, attitude, character, motivation and experience, is the most important resource for any firm and they should, therefore, be treated differently to the rest of the workforce (Beechler & Woodward, 2009; Hughes & Rog, 2008; Tarique & Schuler, 2012). An alternative theoretical framework, namely, the human capital theory, is discussed in the next section.

1.4.2 Human capital theory

The human capital theory deems the entire workforce, not just a select grouping, to be the key factor in production. This theory rests on a cause and effect principle: the regular infusion of education and development into a person has an accumulative influence on the person's capability, performance and efficiency. According to this framework, education and the implementation of developmental initiatives will result in an increase in employee capacity and

productivity (Akinyemi & Abiddin, 2013; Jacobs & Roodt, 2011). The foundation of a global economy, based on knowledge, is therefore education. As a result, in order for organisations to be able to remain competitive in the turbulent global markets prevalent in the twenty-first century, they would need continuously to invest in the education of their workforce (Akinyemi & Abiddin, 2013; Gilead, 2009).

Having offered a brief overview of the two theoretical frameworks considered in this research study, section 1.4.3 provides a laconic literature review of the empirical research undertaken in the study area.

1.4.3 Empirical research literature review

A wide variety of human resource selection methods are available for use within the automotive industry. The review of applicants' curricula vitae and application forms are commonly used as initial screening devices with the conducting of interviews, assessments, medical and reference checks being done thereafter (Chan & Kuok, 2011; Noe, Hollenbeck, Gerhart & Wright, 2011).

The automobile industry has recently been challenged to implement novel and proactive recruitment and selection tactics in order to attract and successfully identify the high potential talent required within the industry (Car industry still draw for talent, 2009; Piro, 2011; Van Hampton, 2007). Automotive industry firms are also required to align their human resource practices strategically in order to remain competitive. Human resource management initiatives within the industry need to focus on selecting employees that match the organisation's culture as well as ensuring that employees are developed in the skills required within the industry (Shatouri, Omar & Igusa, 2012).

International research investigating the preferred selection methods used for technical staff identified that a high value was placed on above average academic attainments, specifically a solid fundamental knowledge of engineering and Science (Gaus, 1999; Phillips, 2003). This was supported by a local automotive firm which emphasised the possession of a reliable technical qualification in its selection practices (Schafmeister, 2013).

Notwithstanding the importance of key practical and technical skills, other qualities such as flexibility and teamwork have also been stressed by the automobile industry. Effective communication and problem solving skills, ingenuity, business insight and a zeal for working in the automotive industry have all been considered as key selection criterion by the automotive organisations surveyed (Gaus, 1999; Gump 2006; Hutton, 2000; Lee, 2011; Mottram, Clarke & Downs, 1980; Phillips, 2003; Rothstein, 2010). Furthermore, the use of job descriptions and position benchmarking of high performing workers have been supported as a means to assess accurately the key behaviours and attributes of candidates in the selection processes utilised within the automotive industry (Mehok, 2009).

Psychological assessment is more commonly being used in the automotive industry's selection practices (Piro, 2011; Van der Merwe, 2005). International research investigating the selection of operator level employees has revealed the use of a variety of assessments and tests. These included the testing of Mathematics, reading comprehension, group problem-solving exercises and simulated work assessments (Gump, 2006). Out-dated, but relevant, international research into the selection processes of apprentices has revealed that assessing the candidates' abilities and aptitudes has been able to predict successful candidates in their first year of studying (Mottram et al., 1980). There is currently no specific research on the operator selection processes used in the South African automobile industry.

Taking cognisance of the aforementioned review of the theoretical and empirical literature, section 1.4.4 that follows provides a critical appraisal thereof.

1.4.4 Critical appraisal of the literature

The talent management framework's primary focus is the segmentation of the workforce into groupings that receive different management practices. Segments that fall into pivotal positions within the organisation or include high performing potentials are hence the worthy recipients of preferential treatment within this framework (Boudreau & Ramstad, 2005; Church, 2013; McDonnell, 2011; Morgan & Jardin, 2010; Tarique & Schuler, 2012). As discussed in the problem statement, section 1.3.1, automotive operators are regarded as a vital cog in leveraging the automotive industry's competitive advantage. The talent management framework has hence

informed this study in terms of the manner in which this vital segment of the workforce should be treated with regard to recruitment and selection.

Considering the global economic changes and business environments being in constant flux, as well as the increased mobility and diversity of the workforce, the talent management theory has come under significant criticism. Focusing only on the top sub-set of employees is no longer an adequate workforce planning approach in this complex and competitive context (Beechler & Woodward, 2009; Lewis & Heckman, 2006; Piansoongnern, Anurit & Kuiyawattananonta, 2011). Furthermore, the international shortage of talent has resulted in organisations needing to be more creative and aggressive in their talent management strategies (Berenson & Smith, 2009; Tarique & Schuler, 2012). For survival and success, organisations are going to need to look at a more inclusive and comprehensive human resource planning approach (Beechler & Woodward, 2009). Given the problem statement outlined in section 1.3.1, it is clear that the automotive industry cannot afford to focus exclusively on a select group of individuals (namely, a technical Grade 12 qualification) in their recruitment and selection processes. Rather, more inclusive human resource practices focussing on educational attainments, as outlined in the human capital theory, are appropriate for this industry.

While there is some, mostly out-dated, international empirical research on the broad processes utilised in the selection of operators and artisans, there is scant similar South African research in this study area. Furthermore, there is modest national and international research on the profile of a successful operator and/or artisan applicant. There is, therefore, the need for specific research on the profiling and selection of operators and artisans in the South African automobile industry.

A literature review of both the theoretical frameworks and empirical research underpinning this research study was offered in section 1.4. An explanation of the key concepts and terms employed in this thesis are outlined in the section that follows.

1.5 Definitions of key terms and concepts

Where the concept is explicit, a definition has been provided directly from secondary literature. However, the meanings of other concepts have been manipulated to suit the study's purposes.

Applicant: within the thesis this term denotes an individual that has applied for an automotive operator position and has obtained a minimum of a Grade 12 qualification. Thereafter, this term indicates a person who has undergone either or both phase one and two of the assessment phases within the research study. In this thesis the terminology 'applicant', 'candidate' and 'respondent' are used interchangeably.

Aptitude: is defined as the potential within a person to obtain a specific level of skill or ability, following a certain amount of training and/or practice (Coetzee & Vosloo, 2000; Van der Merwe, 2005).

Employable applicant: an applicant is deemed 'employable' if he/she achieves the minimum criteria set for each aptitude sub-test.

General aptitude: for the purposes of the study, this collectively refers to verbal reasoning, non-verbal reasoning and visual perceptual speed (that is, attention to detail).

Operators: this concept refers to workers involved in the operation and monitoring of production equipment, driving vehicles, driving and operating mobile plants, or assembling products from component parts according to specifications and procedures (DHET, 2012).

Secondary education: for the study's purposes this refers collectively to technical high schools, academic high schools and Further Education and Training (FET) institutions. In this thesis the terminology 'secondary education', 'Grade 12 qualification' and 'matriculation' are used interchangeably. Specifically, this study denotes five types of secondary education named and defined as follows:

- A secondary education with Mathematics and Science as subjects is a Grade 12 qualification obtained through an academic high school
- A secondary education inclusive of Mathematics as a subject is a matriculation qualification achieved at an academic high school
- A secondary education with Science as a subject is a Grade 12 qualification acquired at an academic high school
- A technical type secondary education, inclusive of Mathematics and Science as subjects, is obtained through a technical high school or a FET institution
- A general type secondary education does not include Mathematics and Science as Grade 12 subjects and is acquired at an academic high school.

Sub-tests: within the thesis this term is predominately used to denote the aptitude instruments employed in the research study. However, where appropriate, the terminology 'tools', 'measures', 'instruments' and 'techniques' are used interchangeably.

Technical aptitude: for the purposes of the study this collectively refers to dexterity, co-ordination, assembly, spatial perception 2-D and 3-D.

Section 1.5 has delineated the key terms and concepts employed in this study whilst section 1.6 that follows clarifies the study's research method.

1.6 Research method

This section is divided into five parts. The selected research paradigm and design is initially outlined, followed by an indication of the research population and sample in section 1.6.2. The two selected aptitude testing tools applied in this study are briefly explained in section

1.6.3 with section 1.6.4 summarising the study's data collection process. The data analysis methods are then indicated in the final section.

1.6.1 Research design

This study sought to identify and explain the relationship between two variables, namely, the type of secondary education and employability as an automotive operator. A positivist paradigm was therefore adopted. Furthermore, a quantitative research design was utilised as the study's variables and data collected lended themselves to this type of research approach (Bless, Higson-Smith & Sithole, 2013; Collis & Hussey, 2009; Neuman, 2012). The subsequent section outlines details pertaining to the study's population.

1.6.2 Population

The population for this research study is broadly defined as work-seekers, whilst the target population is work-seeking applicants for an automotive operator position in South Africa. The sampling frame for this study was a database of pre-screened potential operators. A non-probability convenience and quota sampling technique was used to obtain the sample of 2 463 potential operators.

This study's research design, population and sample have been briefly elucidated in the previous sections. This has set the stage for a concise outline of the selected instruments employed in this study.

1.6.3 Instruments

This section succinctly outlines the details of the two aptitude assessment instruments, namely, the Differential and Trade Aptitude Test batteries, selected to be applied in this study. The section commences with a summary of the Differential Aptitude Test battery.

1.6.3.1 The Differential Aptitude Test (DAT)

The DAT battery is designed for counselling purposes or to assist in appropriately matching individuals to specific jobs or post-school training (Coetzee & Vosloo, 2000). The reason for the purposive selection of the DAT-K version of this test is detailed in section 3.4.2.

Three measures from the test battery were utilised in this study, namely, the verbal reasoning, non-verbal reasoning and comparison sub-tests. There are 25 multiple-choice type questions in each sub-test. Scoring of the tools was done manually with a scoring mask and the obtained raw scores were converted to stanines, according to standard psychometric testing protocol. The details of the second assessment battery, the Trade Aptitude Test, used in this study are discussed in the next section.

1.6.3.2 The Trade Aptitude Test (TRAT)

The TRAT battery aims to support the selection of potential students for access into technical institutes and colleges. The test battery also indicates the candidate's potential to progress and successfully finish training in a specific technical field (Taljaard, 1983). Five measures from the test battery were utilised in this study, namely, the dexterity, co-ordination, assembly, spatial perception 2-D and 3-D sub-tests. The dexterity sub-test consists of 72 items, the co-ordination sub-test 127 items with the other tools each having 25 multiple-choice type questions. Scoring of the instruments was conducted manually (with a scoring mask used in the latter three sub-tests) and the obtained raw scores were converted to stanines, according to standard psychometric testing protocol.

Having outlined the two instruments employed in this study within section 1.6.3, the data collection methods utilised are explained in section 1.6.4.

1.6.4 Data collection methods

This study's data collection formed part of a large recruitment process completed by a South African automotive assembly plant. Respondents who made the initial internal selection criteria specified in a recruitment advertisement were invited to complete the phase one (specifically, the DAT-K measures) assessment process. Candidates that qualified (that is, those that met the specified minimum cut-off requirements for the three phase one instruments) were requested to complete the second phase (namely, the TRAT sub-tests) of the assessment process. The tools of both assessment phases were administered and scored by a trained psychometrist (independent/private practice).

With the data collection process précised in section 1.6.4, the data analysis procedure used in this study is elucidated in the subsequent section.

1.6.5 Data analysis

Following the scoring and converting of the raw scores into stanines, the data was coded and captured into Microsoft Excel. Thereafter, cleansing occurred before the information was imported into the Statistical Package for the Social Sciences. Descriptive statistics such as the median, mode and frequency distribution graphs were used. Statistical analysis was done, using the Chi-square test of independence to ascertain the relationship between the variables for hypotheses one to nine, where the statistical significance level was set at .05.

Section 1.6 has described five vital aspects of the research method selected for this study, whilst section 1.7 outlines the limitations of the research.

1.7 Limitations

The results from this research study will not be able to be generalised beyond the identified sample. The main shortcoming of this research, therefore, is that the results cannot be generalised to either the South African or global automotive industry. However, the results will still be valuable for the automotive industry and the field of human resource management.

Having summarised the limitations of this study in section 1.7, the delimitations of the study are indicated in the next section.

1.8 Delimitations

Due to practical constraints, the following selection criteria were beyond the scope of this study: consideration of the applicants' demography, subject percentage accomplishments achieved at secondary educational level; other qualifications obtained and/or work experience. Furthermore, this study did not consider all of the aptitudes tested in the larger recruitment process but was delineated by the selected eight aptitude sub-tests. As indicated in section 5.7 of this thesis these aspects should be investigated in further research or an alternative study.

Section 1.8 précised the delimitations of this research study, whilst the following section provides a succinct summary of the study's significance.

1.9 Justification for the study

As outlined in section 1.2 of this chapter, the automobile industry is a leading manufacturing sector in South Africa. A close study of the automotive industry is, therefore, warranted. It was established in the problem statement (specifically, section 1.3) that the application of technical skills is a vital component for the success of the South African automotive industry. However, research has shown that technical apprentices and artisans, whilst a key ingredient to the optimal success of a manufacturing concern, are a scarce and critical skill. Furthermore, the empirical literature review (that is, in section 1.4.3) revealed that there is scarce updated South African research on the optimum profile and selection process of operators and/or artisans in the automotive industry. This research, therefore, aimed to highlight the need for the automotive industry to focus on the impact of the type of Grade 12 qualification potential employees possess as well as the value of aptitude testing in the operator selection process.

Having justified the research study, the ethical considerations of the study are highlighted in section 1.10 that follows.

1.10 Ethical considerations

Ethical clearance for this research study was obtained from the University of Fort Hare (Annexure A). There was no risk of physical harm and informed consent was obtained from each candidate for each assessment phase. Respondents' personal details were recorded and respected. Psychometric assessment protocol was employed so results were objective, standardised and accurately reported. No data was manipulated, with the exception of standard scoring and transformation. The data will be stored for five years to enable other researchers to interrogate such data to ensure its veracity. The Turnitin report (Annexure B) indicates an acceptable level of original writing in this thesis.

Before concluding this chapter, an outline of the thesis' structure is provided in the following section.

1.11 Structure of thesis

In this thesis chapter two offers a literature review of the theoretical frameworks underpinning the study, incorporating a review of the empirical literature in the research field. As indicated in Table 1.1, the research design and methodology employed in this study are then explained in chapter three. Chapter four follows on by presenting the findings of the study with chapter five outlining the conclusions, recommendations and limitations realised by the research study.

Table 1.1

Chapter Outline

Chapter	Title
One	Introduction and background
Two	Literature review
Three	Research design and methodology
Four	Empirical findings
Five	Conclusions, recommendations and limitations

Note. The table was developed for this study.

Section 1.12 concludes the chapter by summarising the content offered in chapter one and provides an indication of the literature to be reviewed in chapter two.

1.12 Summary

This chapter has established the significant role the automotive industry plays within the national economy and the South African manufacturing sector. Due to various factors highlighted in this chapter, the industry has been placed under severe competitive strain resulting in increased skills demands. This chapter has also provided a brief overview of the empirical research conducted on the automotive industry's selection processes and highlighted the need for South African research in this area. Moreover, chapter one has concisely explained the research methodology and assessment instruments applied in this study. The key concepts, limitations, delimitations, justification for and overall structure of this thesis were also outlined.

The subsequent chapter highlights the importance of and defines the human resource selection practice. Chapter two also discusses the human resource selection practices and challenges in the automotive industry. Following a theoretical literature review, solutions to the selection challenges are then offered.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The purpose of chapter one was to establish the background and context to this research study. The automotive industry's skill requirements were outlined highlighting the significant role of human resources as an asset, competitive advantage and a means to increasing productivity. The human resource challenges within this industry were also briefly revealed. Chapter one has, therefore, provided a prelude to a detailed discussion on the importance of the human resource selection processes used within the automotive industry in order to meet these challenges.

Chapter two commences with defining the human resource selection process. The current broad selection processes used in organisations are then summarised, followed by a review of selection practices utilised within the automobile industry. Chapter two goes on to explore the specific difficulties experienced in the selection of automotive operators. Two theoretical models, namely, the talent management and human capital theories, are provided as a means to understand these selection challenges. The final part of chapter two discusses a potential solution to these problems through the use of psychological testing, specifically employing aptitude tools. Section 2.2 commences the chapter with an outline of the theoretical and empirical literature within the context of human resource selection.

2.2 Human resource selection

This section is divided into four parts. Section 2.2.1 discusses the significant role humans fulfil in organisations while the subsequent section defines the human resource selection activity. The importance of the human resource selection process is then deliberated in section 2.2.3, with the final part summarising the main human resource selection methods. Section 2.2.1 initiates the section by creating an awareness of the importance of people in firms.

2.2.1 Importance of human resources

People constitute the competitive edge for a country and are the most important asset in an organisation (Grobler, Wärnich, Carrell, Elbert & Hatfield, 2011; Mehok, 2009; Nel, Werner,

Poisat, Sono, Du Plessis & Ngalo, 2011). A number of concurrent elements are required to make a firm successful; however, the human resource aspect is regarded as a vital input in an organisation's production process. Certain assets and processes, such as operational technology and product design, can be replicated by the firm's competition but the human resource asset remains unique. It is within this inimitable quality that the ultimate competitiveness of an organisation lies (Breaugh, 2013; Naude & O'Neill, 2011; Shatouri, Omar & Igusa, 2012).

Firms cannot function effectively without the necessary human component for various reasons (Grobler et al., 2011; Nel et al., 2011; Noe, Hollenbeck, Gerhart & Wright, 2011). Through the consistent application of their knowledge, skills and wisdom the workforce increases the quality and quantity of labour output. This multi-fold increase ultimately results in lower unit and marginal costs for the organisation (Kleynhans, 2006; Moore, 2006). Furthermore, employees play a vital role in achieving the firm's vision, mission and associated objectives. Through the appropriate downward delegation of responsibility and work allocation it is the human resource factor that transforms these aspirations into reality (Grobler et al., 2011; Nel et al., 2011; Noe et al., 2011).

This section has highlighted the importance of human resources within a business. With this awareness, the section that follows develops an understanding of the nature of human resource selection.

2.2.2 Defining human resource selection

Human resources are essential in achieving the overall strategic business objectives. The selection of the workforce is, therefore, a fundamental aspect of an organisation's strategic planning initiatives. Firms need to engineer a methodology tactically to match talent supply with the current and future talent demand. Selection can be regarded as the last step in the workforce or talent planning process embarked upon by organisations as part of their strategic planning (Grobler et al., 2011; Nel et al., 2011; Noe et al., 2011).

In order to both optimise the workforce's potential competitive edge and match the labour force supply and demand already outlined, a firm needs to select the right person for the correct

position (Byars & Rue, 2011; Grobler et al., 2011; Nel et al., 2011; Noe et al., 2011). Selection can be defined as the decision-making process followed to establish which individuals will and will not be eligible to work in the organisation. The process thus aims to choose from a group of candidates the individual best suited for a specific job (Byars & Rue, 2011; Grobler et al., 2011; Noe et al., 2011). In human resource selection judgements the firm needs to give due consideration to the differences between individuals, job requirements and the organisation's micro, market and macro environments. Ultimately, however, decisions made should provide the best match to specific jobs in a specific firm's context (Byars & Rue, 2011; Nel et al., 2011).

Having broadly defined human resource selection, section 2.2.3 indicates the importance of the human resource selection task for an organisation.

2.2.3 Significance of human resource selection

Effective selection decisions are vital for a business to optimise the competitive advantage of its human resources and achieve the firm's objectives (Grobler et al., 2011; Noe et al., 2011). Research indicates that an investment in human resource management activities, namely, recruitment and selection, training and development, and compensation, results in better organisational performance (Ghebregiorgis & Karsten, 2007).

On the other hand, poor selection decisions can be a significant cost for a business (Grobler et al., 2011; Lough & Ryan, 2010; Paterson & Uys, 2005). There are major costs involved in re-training individuals following an ill-fit or match of an incumbent to a job (Moore, 2006; Piro, 2011). Depending on employee level, the hard costs of an ineffective selection decision can range from 50 to 200% of the first year salary. Soft costs of substandard selection decisions include aspects such as the possible destabilisation of the workforce, morale issues and an impact on customer relationships (Moore, 2006).

There is a need for selection processes to indicate the incumbents that have a realistic possibility to be successful. Failure to do so can have dire consequences for the organisation (Grigoryev, 2006; Lough & Ryan, 2010; Piro, 2011). An empirical research study indicated that approximately half of newly hired employees did not meet the specified job requirements and

failed within the first 18 months of employment. Of these failures, 11% were due to the newly-hired incumbent lacking the technical or professional competence required for the position. In addition, the study determined that one of the root causes of this problem was that the minority of the hiring managers were actually trained or formally prepared in best selection practices (Grigoryev, 2006).

Section 2.2.3 has established the importance of the selection process, thereby setting the stage for a discussion on the diverse human resource selection methods used by firms in the subsequent section.

2.2.4 Overview of human resource selection methods

Having understood the value of the human resource selection process, this section commences an overview of human resource selection methods by elucidating two selection models utilised by organisations, namely, the multiple-hurdle and the compensatory models.

In the multiple-hurdle (or successive-hurdle) model, the selection process consists of various stages, with each stage needed to be overcome to successfully progress through the process. This widely used technique results in the pool of candidates becoming increasingly smaller after each stage in the selection process (Grobler et al., 2011; Nel et al., 2011; Noe et al., 2011). In contrast, the compensatory model requires the total pool of applicants to complete all the selection stages. The final selection decision is then made by taking all the information into account (Grobler et al., 2011; Noe et al., 2011). In this research study, the multiple-hurdle selection model has been used.

Regardless of the selection model implemented by an organisation, selection criteria are required to facilitate the decision-making process adequately on whether a candidate possesses the qualities required to be successful in the position (Breaugh, 2013; Byars & Rue, 2011; Grobler et al., 2011). A thorough job analysis should be conducted, resulting in a job description and job specification documentation. The job description summarises the main duties and responsibilities of the position, while the job specification outlines the preferred knowledge, skills and abilities required of a successful incumbent for the position (Grobler et al., 2011; Nel

et al., 2011). Adhering to these requirements will assist in obtaining an effective match or fit between position requirements and incumbent abilities (Giberson & Miklos, 2012; Mehok, 2009; Noe et al., 2011). A comprehensive job analysis was conducted prior to the selection of the research instruments used in this study.

Firms use an array of selection procedures and methods and no two organisations conduct selection in the same manner. There is, therefore, no set, typical and/or generally accepted human resource selection process (Van der Merwe, 2002). Based on the selection criteria specified in the job description and job specification, a variety of selection methods can be used. These include the initial screening of candidates' curricula vitae, reviewing application forms, conducting interviews, carrying out assessment and testing as well as doing medical and reference checks (Chan & Kuok, 2011; Grobler et al., 2011; Nel et al., 2011; Noe et al., 2011). Some organisations use a singular method (namely, using just the curricula vitae, interviewing or testing) in order to make their selection decision (Chan & Kuok, 2011). However, a systematic selection approach can improve the success rates obtained (Grigoryev, 2006). A national survey established that, from the 20 businesses sampled, 70% had a clear selection procedure; 85% made use of application blanks or curricula vitae; 95% conducted interviews and utilised psychological testing, while 60% checked the references of the respondents (Van der Merwe, 2002).

An overview of human resource selection methods has been offered in section 2.2.4. The following section presents a plethora of information on the specific selection modes available to firms.

2.2.4.1 Types of human resource selection methods

In this section four forms of selection techniques are discussed. Initially the use of secondary educational qualifications is presented, followed by curricula vitae, interviews and, finally, psychological assessment as human resource selection methods.

- *Educational qualifications*

Educational attainments are regularly used by organisations to determine whether the potential incumbent has the necessary requirements to be successful in the position (Grobler et

al., 2011; Nel et al., 2011). Empirical research into the role of education in labour market outcomes used students' secondary school grade point averages to identify their competence levels at the commencement of their post-school studies. This quantified the students' competencies separate to those developed during their post-school education. The research found that students who had higher grade point averages performed better in the post-test instruments. Competence levels at the end of the students' post-school education were, at least partly, predicted by the students' competence levels obtained at secondary school (Semeijn, Van der Velden, Heijke, Van der Vleuten & Boshuizen, 2005). This selection method is of specific importance to this research study as the relationship between the candidates' type of Grade 12 qualification and employability within the automotive industry is explored. The next section summarises another selection practice used by organisations, which is the use of curricula vitae.

- *Curricula vitae*

The use of curricula vitae has priority as an initial screening tool. In a study on the usage of various selection methods, a review of curricula vitae was ranked of highest importance, with reference checking and the covering letter ranking second and third respectively. The applicant's academic attainments were only ranked fourth in importance (Chan & Kuok, 2011).

However, curricula vitae are becoming more difficult to verify (Grobler et al., 2011; Van Steenwyk, 2008). In an international survey, 42.7% of curricula vitae contained errors and/or misrepresentations pertaining to previous job titles, employment dates and education obtained (Van Steenwyk, 2008).

- *Interviewing*

The third selection technique discussed in this section is interviewing. Core competency modelling was offered as a proven means for significantly improving the hiring process in a research study. The core competencies required for success in a position were identified and job applicants were evaluated for their attained level of these competencies (Grigoryev, 2006). This was supported by other researchers who stated that a competence-based structured interview can provide a distinctive contribution to human resource selection practices. Their research findings revealed that this type of interview was the only selection method tested that yielded positive

correlations with annual performance reviews, the job performance criterion. This type of interview consequently provided vital information to predict work performance (Nzama, De Beer & Visser, 2008).

International research found that the preliminary interview was the most important initial selection tool used for 92% of the employers sampled. The face-to-face contact was regarded as significantly more informative than what was provided in curricula vitae (Chan & Kuok, 2011). In contrast, research by Motowidlo, Brownlee and Schmit (2008) excluded the possibility that interviewing can accurately predict job performance as on-the-job behaviour cannot be genuinely measured in an interview. The subsequent section discusses the fourth selection technique, namely, psychological assessments.

- *Psychological assessment*

A wide variety of psychological measurements exist that can be used to gauge psychological constructs. Psychological techniques have, therefore become an increasingly used aid in selection processes (Domino, 2002; Foxcroft & Roodt, 2013; Lough & Ryan, 2010; Paterson & Uys, 2005; Van der Merwe, 2005). The subsequent paragraphs briefly discuss the various psychological measures used in selection. The assessment of general cognitive functioning, specific aptitudes, personality, interest and value testing as well as the assessment of emotional intelligence are covered.

In the assessment of cognitive functioning, tools can measure general cognitive functioning (that is, individual intelligence measures) or specific abilities or aptitudes (namely, verbal or non-verbal reasoning and spatial abilities) (Domino, 2002; Foxcroft & Roodt, 2013). There are several cognitive ability measures that are commonly used in the selection process, such as the Learning Potential Computerised Adaptive Test and Cognitive Process Profile (Foxcroft & Roodt, 2013). Empirical research indicates that the use of cognitive ability assessments in selection processes have amplified (Piro, 2011; Van der Merwe, 2005). The assessment of specific abilities or aptitudes is discussed in detail in section 2.7.3 as this is the identified selection technique employed in this research study.

In South Africa, several personality tests are popular selection instruments. These include the Occupational Personality Profile, Myers-Briggs Type Indicator® and Occupational Personality Questionnaire® (Foxcroft & Roodt, 2013). A certain set of personality variables, such as extraversion, agreeableness and neuroticism, were found to predict better on-the-job knowledge performance (Motowidlo et al., 2008). An incremental relationship between locus of control and job performance has also been empirically established (Hattrup, O'Connell & Labrador, 2005).

A myriad of value and interest questionnaires are available for career counselling and selection purposes (Domino, 2002; Foxcroft & Roodt, 2013). The significance of these measures has been highlighted in empirical research which concluded that attitude, interest and value testing are more important than ability and personality testing (Chan & Kuok, 2011; Lough & Ryan, 2010). However, in Du Toit and De Bruin's (2002) study they did not establish support for the structural validity of the Self-Directed Search interest inventory. Specifically, these researchers concluded that this instrument was not valid for Black South African high school students.

A further element within psychological assessment is that of emotional intelligence testing. This is regarded as a fair selection tool and has confirmed to be predictive of job performance in selection processes, specifically at senior managerial levels (Giberson & Miklos, 2012; Iliescu, Ilie, Ispas & Ion, 2012). The Consortium for Research on Emotional Intelligence in Organisations has been collating research submissions in order to build a business case for emotional intelligence. According to this Consortium, emotional intelligence has a significant impact on a wide variety of firms' objectives (Cherniss, 1999).

However, a caution is raised against using psychological instruments as the primary or sole decision-making step in a selection process. Psychological assessment should rather be an aid and one of the potential steps in the selection process. Several authors are of the view that other selection aids, such as interviews and reference checking, should be used simultaneously with psychological testing (Foxcroft & Roodt, 2013; Paterson & Uys, 2005; Van der Merwe, 2002).

Section 2.2 has highlighted the importance of the human resource element in an organisation, defined human resource selection and indicated the import of selection methods. A summary of the various techniques used in the selection process was also provided. In order to contextualise the selection process for this study, section 2.3 discusses the selection processes used within the automobile industry.

2.3 Human resource selection in the automotive industry

There are two parts within this section. Initially a synopsis is provided of the background to selection practices within the automobile industry, whilst section 2.3.2 outlines the empirical research within this area. Section 2.3.1 commences the section by establishing a milieu to human resource selection within the automotive industry.

2.3.1 Overview of selection approaches in the automotive industry

The automobile industry's rapid growth, increased technological change and globalisation have meant that the selection and development of appropriate human resources has become a high priority (Deloitte, 2009; Mashilo, 2010; merSETA, 2009; Nzimande & Patel, 2012). Furthermore, South Africa's labour costs are regarded as being high in comparison with overseas competitors in the automotive industry. This is mostly due to the high regulation of the labour environment and a prominent level of unionisation in South Africa. In order for there to be the required increase in competiveness and profit margins in the automobile industry, there needs to be improvement in the quality of its human capital (Kleyhans, 2006; Van Zyl, 2011).

As a means of adjusting to significant economic and business transformations, the amendment of human resource practices plays a pivotal role (Barnes & Meadows, 2008; Piro, 2011; Van der Merwe, 2005). Strategically aligning its human resource selection practices has become a necessity to maintain the automotive industry's competitiveness. The selection practices in the industry need to concentrate on matching potential employees to organisational culture and the industry's skill requirements (Gump, 2006; Shatouri et al., 2012). This is particularly vital due to the industry requiring greater flexibility from its workforce given the substantial level of change the sector is undergoing (Piro, 2011).

The average recruitment and selection lead times for core technical positions, such as artisans, within the automobile industry is regularly more than four months. A further complication is that many of these positions also require extensive on-the-job training thereby further lengthening the lead time before these individuals are deemed competent in their positions (Barnes & Meadows, 2008). Only recruits that have a reasonable chance to succeed should, then, be identified through the selection process. This would alleviate additional post-employment costs as well as mitigate the disadvantages of a poor fit to job requirements. The automotive industry has, accordingly, been encouraged to focus intently on its selection processes (Piro, 2011).

Having provided an introduction to the human resource selection practices in the automobile industry, the section that follows charts the empirical research on the selection methods used both nationally and globally within the automotive industry.

2.3.2 Empirical research on selection in the automotive industry

Hiring within the automobile field has become substantially more difficult as the conventions within the industry are constantly shifting (Deloitte, 2009; Mashilo, 2010; merSETA, 2009; Nzimande & Patel, 2012). Traditionally, automotive firms have primarily recruited through their internship programmes, although career fairs and campus recruitment were also done (Phillips, 2003). Novel proactive recruitment and selection tactics are, however, recommended to entice young men and women with technical skills into the industry (Car industry still draw for talent, 2009; Van Hampton, 2007).

Automobile firms are focusing on sourcing talented individuals who possess a sound technical qualification in order to sustain their growth and competitive edge into the future (Schafmeister, 2013). Above average academic standards are also commonly sought in the automotive industry's selection process (Phillips, 2003). However, in an automobile survey, 25% of the firms stated that the bulk of respondents were not qualified for the position for which an application was submitted. In several cases the applicants were not able to adequately answer the questions put forward at the interviews (Barnes & Meadows, 2008). South African automotive firms are, therefore, advised that they cannot rely on either secondary or higher education results

as a predictor of strong cognitive capability or potential. Rather, the industry is advised to identify individuals with high learning potential for talent management purposes (Piro, 2011).

Well-developed practical and technical skills are acknowledged as being crucial in artisan recruitment (Phillips, 2003). Empirical research conducted by the merSETA revealed that 76% of this sector's employers regarded these skills as principal in their recruitment of artisans (Peo, 2013). These skills are specifically required within the automobile industry as it operates according to lean manufacturing practices (Shatouri et al., 2012).

Specific skill sets, beyond technical skills, are also commonly sought in the automotive industry's selection processes (Phillips, 2003). Practical team work skills need to be correctly identified and considered in the selection of employees in the automobile industry (Fucini & Fucini, 1990, as cited in Gump, 2006; Gaus, 1999; Hutton, 2000). Having well-developed simulation and computing skills are additionally regarded as vital (Gaus, 1999). Furthermore, effective communication skills, creativity, business acumen and a passion for working in the automotive industry are valued (Phillips, 2003). Strong personal attributes, such as an internal locus of control, conscientiousness, extraversion and a high need for inclusion, control and affection, are often required in the automobile industry's selection processes (Gaus, 1999; Phillips, 2003). Automobile firms are additionally focused on selecting a workforce that fits with the organisational culture. Due to the introduction of innovative manufacturing systems and technologies within the automotive industry, their human resources are also increasingly required to be creative and comfortable operating according to shared responsibility principles (Shatouri et al., 2012).

The use of job descriptions in the selection process used by automotive firms is encouraged as it concisely documents the organisation's expectations of the job incumbent. Furthermore, position benchmarking of the high performing workers in the automobile industry assists in the selection process as key behaviours and attributes of a particular position are identified and sought in prospective employees (Mehok, 2009).

Section 2.3 accounted for the broad human resource selection processes used within the national and global automotive industry and also provided an overview of relevant research conducted within selection in this industry. With this in mind, it is imperative to explore the empirical research on human resource selection practices used for automobile operators. Hence, the following section seeks to elucidate the specific selection techniques employed for this type of employee within the industry.

2.4 Empirical research on selection practices for automotive operators

Section 1.2.2 highlighted that the vast majority of the automobile industry's workforce, namely, plant, machine operators and assemblers, have increasingly a direct link to the technology and equipment used in the sector. So the skill requirements of this employee grouping have significantly amplified. This research study aims to elucidate the optimum educational profile and selection process of these automotive operators. Hence, a review of the empirical research on selection practices used for automotive operators is imperative.

Operators and assemblers are required to be accustomed to working on multiple workstations as job rotation and multi-skilling are common practices within the automobile manufacturing industry. Flexibility is, therefore, regarded as a key selection attribute (Gaudart, 2000; Gump, 2006). The ability to work in a team and demonstrate effective problem-solving skills are also highly prized in the selection of automotive operators as lean production strategies are increasingly being adopted (Lee, 2011; Rothstein, 2010). Some automobile firms have focused on ascertaining commitment and loyalty (as evidenced in the person having a stable work history rather than continuously job-hopping); willingness to work after hours and do shift-work, as well as personality and organisational fit in their selection of operators (Gump, 2006).

Similar to the findings established in 2.3.2, researchers have established that on-the-job training is not sufficient for acquiring the knowledge and skills required of an operator or technician. Rather, the automotive industry tends to source candidates from technical high schools and college training programmes. These school-leavers are then given opportunities to increase their skills base with post-secondary school training (Automotive Service Technician, 2005). However, an analysis of the skills supply to the South African automobile industry has

highlighted that despite a sizeable portion of graduates exiting the various Further Education and Training institutions, these qualifications are not of a sufficiently high technical standard to meet the automotive industry's technical requirements (Barnes & Meadows, 2008).

In the selection of operator level employees, a thorough multi-faceted selection process was used within a global automobile plant. Application forms were reviewed, followed by preliminary telephonic screening interviews. A general aptitude test battery was also implemented, covering basic Mathematics and reading skills which the firm believed were important for statistical process control. Medical testing was then conducted after the individual had been hired. It is noteworthy that only brief consideration was given to specific technical skills such as machining experience within this selection process (Gump, 2006). This international empirical research is significant for this research study as a successive-hurdle selection model was also employed.

Whilst there is currently no specific research on the operator selection processes used in the South African automobile industry, section 2.4 has outlined the available global empirical research related to this area. Section 2.5 explains the challenges associated with the selection of these types of employees.

2.5 Selection challenges of automotive operators

This section is divided into two parts which highlight two specific problems encountered in operator selection in the South African automobile industry. Section 2.5.1 outlines the conundrum posed by secondary education, whilst section 2.5.2 discusses the lack of skill proficiency issue. These selection challenges are worthy of inclusion in this literature review as both have had a direct impact on this research study, specifically in terms of the choice of research instruments and data collection processes. Section 2.5.1 commences the section by establishing appreciation of the significant problem posed by the quality of South African Grade 12 qualifications in the selection of automotive operators.

2.5.1 Educational profile

The selection hindrance created by the current efficacy of the South African secondary education system is worthy of comment in a literature review as the growth of an employable workforce rests on the education system (Deloitte, 2009). This research study seeks to establish the optimum educational profile of the automotive operator workforce category and thus understanding the national educational profile is of significant import. This section is further broken down into three parts: the initial section outlines the national and automobile sector educational needs; section 2.5.1.2 delineates the nature of the country's educational profile, whilst the final section 2.5.1.3 summarises the implications of this educational profile.

2.5.1.1 National educational requirements

The South African economy and specifically the manufacturing industry requires high-level skills in order to keep abreast of global competitiveness and the associated technological advancements (Altman, 2007; Mahembe, 2012; Nzimande & Patel, 2012; Rauner, Heinemann, Hauschildt & Piening, 2012). Education is increasingly acknowledged as the main determinant of elevated skills and, hence, improved performance and productivity within a knowledge economy (Akinyemi & Abiddin, 2013). This aspect was highlighted in a national survey where seven percent of the South African respondents stated that an insufficiently educated workforce significantly limited the success of a business (Nzimande & Patel, 2012).

The South African National Treasury (2011) has acknowledged that the country's education system needs to cultivate an environment that fosters academic, technical and vocational skills. Specifically, foundational skills, such as Mathematics and Science, are vital mechanisms of an effective education system. Adequate achievements in these subjects encourage technology shifts and innovation which is crucial for South Africa's social and economic future (Manuel, 2011; National Treasury, 2011; White Paper on Science and Technology, 1996). The efficiency and applicability of the South African education curricula can therefore be regarded as vital in achieving an effective flow of skilled individuals into the workforce (Patel, 2008).

The educational requirements within the automotive industry had been steadily increasing proportionate to the intensified demand for skilled and highly skilled workers. Particularly, the industry crucially needs Grade 12 qualifications, including Mathematics and Science as subjects (Barnes & Meadows, 2008; Nzimande & Patel, 2012; Patel, 2013; Peo, 2013). This is due to the improved technology and innovation being introduced into the industry as a means of coping with competitive challenges (De Kock, 2012; Deloitte, 2009; Meyer, 2013).

The South African automobile industry has centred its recruitment and selection of employees on individuals with high quality technical education (Schafmeister, 2013). Due to the majority of automotive operators progressing to an artisan profession, a technical type of Grade 12 qualification has been a recruitment and selection preference within the automobile industry (S. de Klerk, personal communication, May 9, 2013). With an understanding of the national and the automotive sector's educational requirements, the subsequent section describes the current South African educational profile.

2.5.1.2 National educational profile

South Africa, in comparison to international trends, has a significant rate of public investment in education. The educational sector accounts for approximately 20% of total state expenditure thus obtaining more government spending than any other sector in South Africa (Statistics South Africa, 2012). Despite this substantial investment, the World Economic Forum's 2013 Global Information Technology Report ranked South Africa fourth-last out of 144 countries for its overall educational system. The same Report rated South Africa second last for its Mathematics and Science education. In terms of secondary education gross enrolment South Africa ranked fifty-sixth and ninety-third for its adult literacy rate out of the 144 countries surveyed (Bilbao-Osorio, Dutta & Lanvin, 2013).

Significant improvement in National Senior Certificate (NSC) pass rates has been observed over the past two decades. The matriculation pass rate in the late 1990s was only 40%, whilst in 2013, 78.2% of the students who sat the matriculation examinations passed. There has been a 17.6% increase in pass rates since 2009 when the NSC was implemented (Motshekga, 2014; Statistics South Africa, 2012). Some improvement in NSC pass rates within the

Mathematics and Physical Sciences subjects has also been noted. In terms of pass rates in Mathematics, 59.1% passed with 30% and above in 2013 in comparison to 47.4% in the same percentile category in 2010 and 54% in 2012. In 2013, 40.5% of learners passed Mathematics with 40% and above while 30.9% passed with the same percentage in 2010 and 35.7% in 2012. A similar improvement in pass rates was found in Physical Sciences. In 2013 67.4% passed Physical Sciences with 30% and above, with 47.8% achieving the same percentage in 2010 and 61.3% in 2012. The 40% and more pass rate in Physical Sciences was achieved by 29.7% in 2010, 39.1% in 2012 and 42.7% in 2013 (Motshekga, 2014).

Despite these improvements, research indicates that the South African educational and training system is not adequately responding to the labour market's identified skills needs and that it is the root cause of the skills shortage problem in South Africa (De Kock, 2012; Eastern Cape Socio Economic Consultative Council (ECSECC), 2012; Manuel, 2011; Motshekga, 2014; National Treasury, 2011). The South African government has acknowledged the severity of this problem. The government has thus made one of its ten strategic priorities the development of a skilful and competent workforce through the improved quality of education to sustain a comprehensive growth path (Lehohla, 2010; National Treasury, 2011).

There is a currently a significant deficit in educational attainments within the employed South African workforce. A national survey revealed that an estimated 3.6% of the employed workforce had no education and approximately 59% had less than a matriculation certificate with only 18.5% holding a higher education qualification (Lehohla, 2010). Furthermore, only 53% of automotive employees have a National Qualifications Framework level one (the equivalent of Standard seven or Grade nine) or higher qualification (merSETA, 2009).

Sourcing candidates with the appropriate educational and skill profile is not a unique problem to South Africa. An international automobile organisation was not able to fill 100 technical vacancies from within the United Kingdom, particularly the skilled positions below graduate level. Due to Poland's solid educational system, the automotive firm was able to source highly skilled employees from this country (Evans, 2005). Section 2.5.1.2 has portrayed the

present South African educational profile. The implications of this edification situation are discussed in the section which directly follows.

2.5.1.3 Implications of the national educational profile

Whereas educational achievement can be regarded as a useful gauge for the measurement of skill levels in a country, it has been concluded that the South African schooling system may be a deficient preparation base for employment. Furthermore, the national educational approach may not be a dependable indication of learning capability (Cosser & Sehlola, 2009; Lehohla, 2010; National Treasury, 2011). Whilst employers are requiring skill and experience, the youth are ill-equipped for the workplace and in some situations even lack fundamental skills (ECSECC, 2012; National Treasury, 2011). The deficiencies in the education system are hence significantly constraining the prospects of the South African youth (National Treasury, 2011).

The South African Department of Basic Education has been criticised for the structure and low promotional requirements of the NSC, introduced in 2005. Learners seeking a NSC need to pass three subjects with 40% (one must be a home language) and a further three subjects at 30% (Motshekga, 2014; Nzimande & Patel, 2012). These low promotional rates are significant given that a better educated and more highly skilled labour force is the most critical long-term priority for the South African economy (Manuel, 2011; National Treasury, 2011). Specifically, the current low promotional rates for subjects such as Mathematics and Science are a major concern as these subjects engender primary skills. As indicated in section 2.5.1.1, these subjects enhance the necessary technological innovations critical for optimising the South African economy. It is upheld that these low promotional marks are not in line with national human resource requirements, specifically in the automotive industry (Motshekga, 2014; Nzimande & Patel, 2012).

Poor educational levels are clearly regarded as a major problem within the South African automobile industry (Patel, 2008; Piro, 2011). The number of learners that are graduating with qualifications that support entry and success at the higher educational level is not increasing proportionate to the increased demand for these skills (Mahembe, 2012; Nzimande & Patel, 2012; Rauner et al., 2012). High quality Grade 12 qualifications, specifically with Mathematics

and Science, are of high importance to the automotive industry (S. de Klerk, personal communication, May 9, 2013). The merSETA has, therefore, recommended a 50% or more pass in both Mathematics and Science for apprenticeship selection (Brown, 2013). To facilitate this, the merSETA has launched a project which aims to improve the Grade 12 Mathematics and Science performance. It is envisaged that this will improve the supply of learners to higher educational institutions, specifically in the engineering field (Patel, 2012c; Peo, 2013).

Moreover, the transition of the South African youth from school to the labour market is problematic (Cosser & Sehlola, 2009; Evans-Klock, 2012). A national survey revealed that school-leavers have a unique perception concerning the importance of achieving a NSC. In the ranking of variables perceived as influential in acquiring employment, personality and English communication variables were ranked as being more important than the possession of a Grade 12 qualification. Furthermore, the learners perceived the acquisition of a Grade 12 qualification as being a more influential variable in acquiring employment than the actual subjects completed or the marks obtained in their secondary education (Cosser & Sehlola, 2009).

Section 2.5.1 has comprehensively outlined the secondary education challenge in the selection of automotive operators in the South African context. The second selection dilemma, skill adeptness, is discussed in the next section.

2.5.2 Skill proficiency

Section 2.5.2, comprised of four parts, deliberates the second challenge experienced in the selection of automotive operators in the South African context. The section opens with an outline of the national skill requirements within the automobile context with section 2.5.2.2 explaining the current skill profile. Section 2.5.2.3 demarcates potential reasons for the skills shortfall, whilst the concluding section describes the implications of the South African skills profile. The section that follows initiates the debate on this selection challenge by specifying the South African automotive industry's skill requirements.

2.5.2.1 National skill requirements

The main drivers of change within the automobile industry have been the persistent introduction of new technology, innovative methods of organising production and the impact of globalisation. These have resulted in work intensification and task diversification, without the necessary official upgrading of skills set requirements (Gaudart, 2000; Rothstein, 2010; Van Hampton, 2007). Workforce specialisation has become more prevalent as the automobiles being manufactured become more complex (Automotive Service Technician, 2005). In a national automotive industry survey, 69% of the respondents agreed or strongly agreed that production automation had resulted in an enhanced need for skilled workers (Gaskin, 2010). The magnitude of these changes is so vast that after three years new skills will be required within the industry (Phillips, 2003).

Artisans are regarded as vital facilitators of competiveness within the South African manufacturing sector (Brown, 2013). An artisan is someone who works in the categories of "millwright, electrician, plumber, boilermaker, mechanic, fitter and turner, pattern maker or injection moulders" (Van Rooyen, Du Toit, Botha & Rothmann, 2010, p. 1). An artisan has successfully completed a formal or informal trade internship or apprenticeship and has passed the requisite trade test (Evans-Klock, 2012; Mahembe, 2012; Rauner et al., 2012). A portion of the plant operator and assembler workforce category vertically progresses into the artisan profession through completing an apprenticeship qualification. The adequate selection of the operator labour force can, therefore, have a direct impact on the quality of potential artisans for an automobile plant (S. de Klerk, personal communication, May 9, 2013).

Sections 2.3.2 and 2.3.3 of this chapter described the various practical and technical skills sought within the automotive sector, specifically for the operator category. Amongst other skill requirements, teamwork, problem solving and flexibility are prized as these assist the operators cope with the technological improvements and lean manufacturing practices prevalent within the industry. Having highlighted the skills required within the automobile industry, the section that follows describes the current South African skills profile.

2.5.2.2 National skills profile

A large pool of productive workers will enable organisations to grow and develop as fruitful labour is available (Hodge, 2006; Kleyhans, 2006). However, one of the main restraints to improvement within the manufacturing sector is a weak skills system that does not adequately match the sector's needs (Ramatla, Scholtz & October, 2012). The human capital within the manufacturing sector was recently rated as between poor and fair, with low productivity, motivation and work ethic regarded as key challenges (Van Zyl, 2011).

Technical skill shortages are a major limitation to growth within the South African manufacturing sector (merSETA, 2008). A key discrepancy is found within disciplines that require technical skills, such as Mathematics and Science (De Kock, 2012; Peo, 2013; White Paper on Science and Technology, 1996). Specifically, there is a shortage of transitional professional skills at the National Qualifications Framework levels two (the equivalent of Grade 10) and three (the equivalent of Grade 11) in the market (Patel, 2008).

The limited supply of artisans has negatively impacted on the ability of the South African automotive industry to compete internationally due to its limited talent to embrace new technology and innovation (Nzimande & Patel, 2012). There is also a significant shortage of prospective candidates for artisan training in South Africa (Kleynhans, 2006). This lack of core technical skills in the South African labour pool needs to be urgently addressed (DeSimone & Werner, 2012; Patel, 2008; Peo, 2013). Artisans and technicians are currently regarded as scarce and critical skills in the South African automobile sector (merSETA, 2009; Peo, 2013; Tarique & Schuler, 2012). A scarce skill is one that has inadequate supply and a critical skill is regarded as being core to the sector (merSETA, 2008, 2009).

There is an alarming gap between industry requirements and artisan training (Patel, 2012b; Peo, 2013). South Africa needs 12 500 artisans each year, yet, current statistics revealed that only 3 000 learners are passing the trade test each year (Van Rooyen et al., 2010). The recent rapid exodus of artisans out of the country and the aging profile of the existing South African artisan population have made the education and retention of artisans in the country a significant problem (Moore, 2006; Peo, 2013; Van Rooyen et al., 2010). The situation is further

complicated by an overall lack of interest and understanding of the importance of technical training amongst the South African youth (Patel, 2008). Furthermore, the current quality of South African graduate technicians and artisans is regarded as poor and variable (Nzimande & Patel, 2012). In a merSETA survey, 36% of employers stated that their artisans were deficient in the vital skills required (Peo, 2013).

There is a pressing need to increase the throughput rate of engineering qualifications in South Africa (Patel, 2012c). China has an engineer for every 130 population members while South Africa, in comparison, has one engineer for every 3 166 population members (De Kock, 2012; Patel, 2012b). South Africa is also significantly behind other countries such as the United Kingdom, Australia and Chile in terms of the number of engineers per population (Patel, 2012c). The three most difficult positions to fill in South Africa are that of skilled trade workers, technicians and engineers. A similar situation is found in the Americas, Asia-Pacific, Europe and in the Middle East (Tarique & Schuler, 2012).

The global automotive industry has also identified a scarcity of adequately skilled talent. There are not sufficient individuals with technical skills to meet the global demand and this scarcity has been experienced for several years. A moderate to critical shortage of skilled production workers was identified by 31% of the international automobile firms surveyed and it was anticipated that this shortage would become as difficult or worse in the future (Evans, 2005; Gaus, 1999; Hodge, 2006).

Section 2.5.2.1 provided an understanding of the national skills requirements within the automotive industry with section 2.5.2.2 highlighting the current shortfall in the South African context. In the subsequent section several potential reasons for this skills gap within the industry are uncovered and discussed.

2.5.2.3 Basis for the national skills profile

There are several reasons for the current lack of high-level technical skills (merSETA, 2008, 2009; Patel, 2008, 2012c). The apartheid period's destructive educational policies resulted in a reduced supply of these skills as teachers in the technical field were regarded as poor

(merSETA, 2008). Furthermore, as mentioned in section 2.5.1, South Africa's education and skills development establishments have been experiencing problems in their ability to adequately supply the manufacturing industry with suitably qualified individuals (Cosser & Sehlola, 2009; ECSECC, 2012; merSETA, 2008; National Treasury, 2011).

The automotive industry has historically and persistently been guilty of an under-investment in the skills development of its workforce. In a comparison of training expenditure between South African and global automobile industries, the international average was almost double that of its South African counterparts. This has significantly reduced the automotive industry's ability to be legitimately competitive (Barnes & Meadows, 2008).

Despite the dire need for qualified artisans the manufacturing sector has not successfully instilled the value of a technical career path (Patel, 2008, 2012c). In terms of skills priorities, technical training is ranked as a third priority and apprenticeship training as seventh. In terms of frequency, only 18% of the workforce participated in technical training and 1.5% in apprenticeship training (merSETA, 2009).

This section clarified possible grounds for the current skills shortage and lack of an adequate artisan labour pool within the automobile industry. The implications of these factors in the South African context are explored in the proceeding section.

2.5.2.4 Implications of the national skills profile

A constrained skills supply plus a widening skills gap within the South African manufacturing sector are significant challenges (Barnes & Meadows, 2008; De Kock, 2012; Manuel, 2011, merSETA, 2008). This sector skills problem is particularly dire given that the automotive industry operates within a knowledge economy (Lingham, 2011; Patel, 2012b). In order for the South African automobile industry to be able to produce technologically superior motor vehicles, employees will need to be correctly training and cross-trained to ensure they can deal with the latest technologies being introduced in the industry (Deloitte, 2009; DeSimone & Werner, 2012). The skills upgrading of the plant and machine operator and assembler occupational category is, therefore, required (Arslan & Kus, 2012; Kleynhans, 2006).

Scientific and technical education and training within the broad South African workforce needs to be encouraged in order to maximise overall competiveness (Arslan & Kus, 2012; Evans-Klock, 2012; White Paper on Science and Technology, 1996). Furthermore, linkages between the formal South African educational system and apprenticeships needs to be supported in order to increase the access to these required skills in the country (Evans-Klock, 2012). There is a link between the secondary educational level obtained before starting an apprenticeship and the time taken to successfully pass the test (Brown, 2013). In researching how many times it took students to pass the apprenticeship trade test, no significant difference was found in the percentage of students passing at first sitting between the N3 (the equivalent to a Grade 12), N4 (the first theoretical phase of a National Diploma), N5 (the second theoretical phase of a National Diploma), N6 (the last theoretical phase of a National Diploma) qualifications and those with a Grade 12 (that is, either technical or academic) qualification. Between 70 to 73% of the students with these educational attainments passed the trade test at first sitting. However, only 39% of the N2 (the equivalent to a Grade 11) graduates passed their trade test at the first sitting (Mahembe, 2012).

The solution to the lack of technical professional skills in South Africa lies with apprenticeships. It is in this training programme that learners gain practical technical skills to assuage shortages in artisan skills. There is also a need for a specialist technical career path that enables employees to progress as technical practitioners without the need to redirect into a management career (Manuel, 2011).

In section 2.5, two challenges in the selection of operators within the South African automotive industry were described. Section 2.5.1 outlined the lack of quality Grade 12 qualifications with section 2.5.2 highlighting the shortage of an adequate skills supply within the applicant pool in comparison to the labour market demands, specifically the lack of artisans in the country. The aforementioned literature review added significant value to this research study by underscoring these two dilemmas integral to the selection of automotive operators. Section 2.6 provides a literature review of theoretical frameworks as a means to identify potential solutions to these selection challenges.

2.6 Theoretical framework literature review

This section consists of two parts each providing a review of a theoretical model. Section 2.6.1 discusses the talent management theory while section 2.6.2 outlines the human capital philosophy. Both theoretical frameworks informed various stages of the research process adopted in this study.

2.6.1 Talent management theory

The section commences with a review of the talent management framework. This section is divided into three parts. Section 2.6.1.1 defines the talent management theory; section 2.6.1.2 details the criticisms of the framework, whilst the third part of the section highlights the contribution of the philosophy to this research study. Section 2.6.1.1 commences the discussion of the talent management framework by providing a précis of the definitions offered by advocates of the theory.

2.6.1.1 Defining the talent management theory

Proponents of the talent management theory view human resource activities as constituting a "war for talent" (Beechler & Woodward, 2009: p. 274). A small exclusive group of individuals are regarded as being the focus of talent management approaches, thus providing the competitive edge for organisations (Beechler & Woodward, 2009; Hughes & Rog, 2008; Tarique & Schuler, 2012; Van Dijk, 2008).

Talent management is concerned with strategic jobs, that is, the core and critical positions impacting on organisational competiveness (Boudreau & Ramstad, 2005; Morgan & Jardin, 2010; Tarique & Schuler, 2012). Promoters of this definition of talent management believe that there is a distinction between pivotal and important positions. Human resource practitioners need to evaluate where changes in talent management would have the maximum influence on organisational success (Boudreau & Ramstad, 2005).

Another branch of the talent management theory supports the notion that high performing workers or high potentials should be the focal point of talent management initiatives (Church, 2013; Lewis & Heckman, 2006; McDonnell, 2011; Morgan & Jardin, 2010; Piansoongnern,

Anurit & Kuiyawattananonta, 2011; Tarique & Schuler, 2012). The workforce needs to be segmented into distinctive groups based on their current skills set and development resources need to be allocated accordingly. This talent management approach therefore advocates the differential treatment of workforce segments (Boudreau & Ramstad, 2005; Church, 2013; McCauley & Wakefield, 2006; Morgan & Jardin, 2010). Incurring costs for non-pivotal talent is regarded as the equivalent of squandering firm resources (Boudreau & Ramstad, 2005). Organisational talent is, therefore, the employees who are ranked as the top ten to twenty percent in terms of performance (Beechler & Woodward, 2009).

Other authors point out that the essence of talent management involves human resource planning and the projecting of required skills and capabilities. These authors concur that it is primarily focused on the prediction of future workforce requirements (Lewis & Heckman, 2006; Morgan & Jardin, 2010; Tarique & Schuler, 2012). However, there is a call within the talent management framework for more creative approaches to talent scarcity problems. Firms need to focus on improving their human resource capabilities rather than focusing on skill supply shortages (Beechler & Woodward, 2009; Morgan & Jardin, 2010; Van Dijk, 2008).

This section has outlined the various definitions of talent within the talent management model. This section has thus highlighted that whilst some authors concur there is nevertheless also differing opinions on the exact nature of the talent concept. This specific criticism and several others levelled against this philosophy are discussed in the next section.

2.6.1.2 Criticism of the talent management framework

While being prevalent, talent management has not been consistently defined and is still a vague concept within human resource management (Hughes & Rog, 2008; Lewis & Heckman, 2006; McDonnell, 2011; Morgan & Jardin, 2010; Piansoongnern et al., 2011). It is acknowledged that talent management is an emerging topic; however, the theory has been criticised for its lack of agreement on the exact definition of talent and the parameters for the management thereof (Beechler & Woodward, 2009; Tarique & Schuler, 2012).

The talent management philosophy is further criticised for its lack of grounding in academic research (Boudreau & Ramstad, 2005; Hughes & Rog, 2008; Lewis & Heckman, 2006; Tarique & Schuler, 2012). Specifically, it lacks rigorous statistical analysis and robust longitudinal data (Tarique & Schuler, 2012). There is hence the need for more rigorous measurement and analytical systems within talent management decisions (Boudreau & Ramstad, 2005; Hughes & Rog, 2008).

The predominant focus on a certain portion of employees, whilst ignoring other capable and consistent players in the workforce, is a fundamental criticism levelled at the talent management theory (Beechler & Woodward, 2009; Berenson & Smith, 2009; DeLong & Vijayaraghavan, 2003; McDonnell, 2011; Pfeffer, 2001). The foundational assumption that talent strategies solely focus on an exclusive group has been questioned given the fundamental change in work trends and the volatile global economic situation (Beechler & Woodward, 2009). Human resource talent management thus needs to integrate and align itself with the business' strategies (Lewis & Heckman, 2006; McCauley & Wakefield, 2006; McDonnell, 2011; Tarique & Schuler; 2012; Vermeulen, 2008). Technological advancements and the change in the skills set required of the workforce in a global market is forcing firms to look at their workforce strategically in terms of skills gaps and future skill needs (Altman, 2007). Positioning talent management as a strategic activity is crucial to the creation and continuation of competitive advantage (Hughes & Rog, 2008; Morgan & Jardin, 2010; Van Dijk, 2008; Vermeulen, 2008).

This section provided a concise critique of the talent management framework by underscoring three broad reproaches. The subsequent section comments on the bearing of the philosophy to this research study, taking into account these criticisms and the context of the automobile industry.

2.6.1.3 Relevance of the talent management theory

Plant and machine operators or assemblers comprise the vast majority of the automobile workforce and a significant increase in the employment of this category of workers is anticipated (Barnes & Meadows, 2008; Gaskin, 2010; Mashilo, 2010; merSETA, 2009; Nzimande & Patel, 2012). Automotive operators also have a direct association with the advanced technology and

equipment introduced within the automobile sector to optimise its competitive edge (Davies, 2010b; Deloitte, 2009; Mashilo, 2010; Maxwell, 2012; Nzimande & Patel, 2012). Furthermore, section 2.5.2.1 of this chapter highlighted the skill requirements of the national automotive industry with section 2.5.2.2 emphasising the current shortfall in the current national skills profile.

The automotive operator category of workers can, therefore, be regarded as both pivotal and strategic in terms of the South African automobile industry's future success. Automotive operators are classified as the talent segment worthy of differential treatment as outlined in the talent management framework. Automobile firms need to identify high potential candidates for the operator position that can be further developed to address the current skill supply shortage. Notwithstanding the criticisms provided in section 2.6.1.2, the talent management philosophy thus has some relevance for this research study. However, the talent management framework makes no commentary on the role of education in identifying and dealing with the talent within an organisation. It follows that it is pertinent to interrogate an alternative viewpoint, the human capital model, which is discussed in the section that follows.

2.6.2 Human capital theory

Section 2.6.2 is comprised of three parts. Section 2.6.2.1 delineates the human capital framework; section 2.6.2.2 outlines the criticisms of the theory, whilst section 2.6.2.3 highlights the significance of the human capital philosophy to this research study. The first part of the section provides the overview of the human capital theory by concisely defining the central principles of the model.

2.6.2.1 Defining the human capital theory

The concept of human capital originated in the economics field when Becker (1975) viewed labour as another input into the production process in the same way as factories and machines (as cited in Akinyemi & Abiddin, 2013). This theory instigated a shift from tangible to intangible assets, known as human capital, as the key drivers within twenty-first century organisations. Given that firms, over the past few decades, have become more knowledge based, the intangible human capital resource has become a vital strategic resource (Todericiu &

Muscalu, 2008). Unlike tangible commodities, which depreciate in value with use, knowledge increases with application and only shows signs of depreciation when not exploited (Sveiby, 2001).

The human capital approach centres on the principle that investment in an organisation's human resources, or capital, will result in a return on that investment (Akinyemi & Abiddin, 2013; Coff, 1997; Gamerschlag, 2013; Gilead, 2009; Wright, McMahan & McWilliams, 1994). Specifically, human capital is developed through education and training (Abhayawansa & Abeysekera, 2008; Coff, 1997; Nerdrum & Erikson, 2001). In order for firms to be able to remain competitive in the prevalent turbulent global markets, they would need to invest in the education of their workforce continuously. The foundation of a global economy, based on knowledge, is therefore education (Akinyemi & Abiddin, 2013; Gilead, 2009).

The relationship between human capital and education or development is both antecedent and consequential. Human capital is significantly influenced by the educational level attained by employees (Bontis & Fitz-enz, 2002; Gamerschlag, 2013; Ng & Feldman, 2010). Furthermore, investment in the education and training of the labour force results in increased ability, performance and productivity which, in turn, brings a return of investment (Akinyemi & Abiddin, 2013).

However, in order for human capital to be regarded as part of an organisation's competitive advantage, they must be regarded as valuable, rare, and inimitable and there should be no substitutes for the resource (Abhayawansa & Abeysekera, 2008; Coff, 1997). There is hence a distinction drawn between employees as a resource and human capital. According to these authors not all employees are a source of competitive advantage. Furthermore, the value of employees is only optimised when they are perceived as having firm-specific, unique or rare competencies and create a positive value for a firm through their inability to be substituted by another source (Abhayawansa & Abeysekera, 2008).

According to proponents of the human capital framework, human resource management techniques and systems need to influence the optimisation of the human capital value and

potential of the workforce. Without this being in place even highly competent individuals will not be able to generate value (Abhayawansa & Abeysekera, 2008; Coff, 1997). More specifically, the recruitment and selection processes used by a firm can ensure enhanced competitive advantage through the adequate matching of the required skills for a position with individuals who have these skills (Abhayawansa & Abeysekera, 2008; Wright et al., 1994).

The central tenets of the human capital theory have been summarised in this section. A comprehensive outline of the criticisms of this philosophy is, however, also necessary in this study's literature review.

2.6.2.2 Criticism of the human capital framework

The human capital theory has been criticised given that knowledge is a difficult concept to delineate clearly and cannot be regarded as capital in the traditional economic sense (Andriessen & Van den Boom, 2007; Dean & Kretschmer, 2007). Specifically, human capital has been regarded as an elusive concept as human assets can range from a group of highly specialised professionals to a single person. However, the confusion and disagreement surrounding the human capital concept is understandable as it is still relatively new within management research (Pearse, 2009).

According to some authors there is scant empirical research providing an understanding of the value of human capital on organisational performance (Abhayawansa & Abeysekera, 2008; Bontis & Fitz-enz, 2002; Moon & Kym, 2006; Nerdrum & Erikson, 2001). Furthermore, it has been identified that existing research has only focussed on the impact of top management's human capital on organisational performance (Abhayawansa & Abeysekera, 2008; Wright et al., 1994). Additional empirical research is, therefore, required into the use of human capital in different types of organisations as each have specific requirements and management dilemmas (Bontis & Fitz-enz, 2002; Coff, 1997).

This section has succinctly outlined the criticisms directed at the human capital theory. These critiques fundamentally informed the recommendations made in chapter five of this thesis.

The subsequent section moves forward by noting other elements of significance for the research study drawn from this framework.

2.6.2.3 Relevance of the human capital framework

Given the technological advances within the automotive industry, the required educational qualifications of the workforce have increased (Barnes & Meadows, 2008; Nzimande & Patel, 2012; Patel, 2013; Peo, 2013). Furthermore, a significant portion of automotive operators vertically progress into becoming artisans (S. de Klerk, personal communication, May 9, 2013). It is consistently documented that a Grade 12 qualification, specifically with Mathematics and Science, is of high importance to the manufacturing sector (Barnes & Meadows, 2008; Nzimande & Patel, 2012; Patel, 2013; Peo, 2013). Therefore, automobile firms have traditionally focused on a technical type of secondary education in the recruitment and selection of the production worker category (Schafmeister, 2013; S. de Klerk, personal communication, May 9, 2013). The recruitment and selection of automotive operators can thus be regarded as the search for valuable and exceptional human capital.

The primary aim of this study was to explore the relationship between the type of matriculation obtained and operator employability in the automobile industry. This is in alignment with the human capital theory which regards education as a vital component to optimising the competitive advantage of human resources.

Given the limited national and global research in the field, this study commenced research into the profiling and optimum selection process for operators and artisans in the South African automobile industry. Therefore, this study's findings address certain criticisms of the human capital framework by providing an understanding of the specific educational requirements needed for a successful automotive operator.

Section 2.6 provided a literature review on two theoretical frameworks underpinning human resource selection practices. The subsequent section outlines the empirical research on the use of psychological assessment, charting a potential solution to the selection challenges delineated in this chapter.

2.7 Psychological assessment

This section consists of three parts. In the first part an overview of the development of psychological assessment in the South African context is provided. A summary of the functionality of psychological testing in the workplace follows in the second part of the section, with section 2.7.3 describing a specific psychological measure, namely, aptitude tools. Section 2.7.1 initiates the section by defining psychological assessment and outlines the legislation governing the use thereof.

2.7.1 Psychological assessment in South Africa

The Health Professions Act (No. 56 of 1974) defines a psychological act with reference to assessment as being "the use of measures to assess mental, cognitive, or behavioural processes and functioning, intellectual or cognitive ability or functioning, aptitude, interest, emotions, personality, psychophysiological functioning, or psychopathology (abnormal functioning)" (p. 39). In light of psychological tests and other assessments being regarded as a psychological act, their main purpose is to discover more about particular individuals in order to report to others on how they currently function or to foretell how they may behave in the future (SIOPSA), 2006).

Psychological assessment in South Africa has come under close scrutiny over the past few decades, specifically, with regard to their alleged inability to incorporate the norms of the entire South African population. National labour legislation and regulations passed by various stakeholder bodies after the 1994 elections resulted in an intensified focus on psychological assessment (Nel et al., 2011; Nzama et al., 2008; Paterson & Uys, 2005; Piro, 2011). The national legislation impacting on psychological testing includes the Employment Equity Act (No. 55 of 1998) (EEA) and the Labour Relations Act (No. 66 of 1995) (LRA). Both Acts will be briefly discussed in the proceeding paragraphs in order to underscore the bearing they have on psychological assessment.

The EEA (1998) unambiguously highlights the responsible use of psychological testing and other psychological assessment procedures (Foxcroft & Roodt, 2013; Nel et al., 2011; Nzama et al., 2008). The EEA (1998) indicates the following with regard to psychological testing:

Psychometric testing and other similar assessments of an employee are prohibited unless the test or assessment being used-

a) has been scientifically shown to be valid and reliable;
b) can be applied fairly to all employees; and
c) is not biased against any employee or group. (p. 7)

Furthermore, the LRA (1995) has compelled organisations to make certain their employment procedures and activities are fair. Prior to the introduction of this Act, employers could employ without due consideration of criteria or method employed and applicants were not able to challenge the decision. The LRA (1995) has necessitated making these criteria precise and tangible as well as proactively informing the respondents of these criteria when applying for a position (Grobler et al., 2011; Nzama et al., 2008). The LRA (1995) has a particular impact on recruitment and selection methods as it includes employment applicants in its definition of an employee, thus bestowing all the Act's rights and benefits on these candidates (Grobler et al., 2011; Nel et al., 2011).

Applicants undergoing psychological assessments are also protected by specific regulations governing the administration thereof. All assessment practitioners using psychological and other similar assessment procedures in the place of work are required to adhere to a code of practice (SIOPSA, 2006). In addition, only a psychologist or psychometrist (with certain restrictions), registered with the Professional Board of Psychology, may use psychological tests and other assessment instruments that are classified with the Board (Health Professions Council of South Africa, 2010b; Mauer, 2000; SIOPSA, 2006).

Section 2.7.1 has provided vital background information on the milieu of psychological assessment in South Africa. This has set the stage for a discussion on the practical role of this type of assessment in the workplace within the next section.

2.7.2 Functionality of workplace psychological assessment

Employees are an essential component of an organisation's production process and directly affect its competiveness (Grobler et al., 2011; Nel et al., 2011; Noe et al., 2011). Human resource selection methods can be vital in optimising a firm's competitive edge by attaining the most favourable fit between person and position (Ghebregiorgis & Karsten, 2007). However, ineffective human resource selection can be a costly affair (Grobler et al., 2011; Lough & Ryan, 2010; Paterson & Uys, 2005). These factors, plus the legislated requirement to engage staff from previously disadvantaged groups, highlights the significant contribution that psychological testing can provide to South African human resource management (Piro, 2011).

Psychological testing is regarded as a commonly used aid in a variety of employment decisions and for a range of occupational levels. It is used for selection, promotion, placement, transfers as well as training and development (Foxcroft & Roodt, 2013; Giumetti & Sinar, 2012). Personality testing has also been used as a team-building tool (Van Steenwyk, 2008). A wide variety of psychological assessments are utilised in human resource selection (Grobler et al., 2011; Nel et al., 2011). Specifically, psychological testing is viewed as a more objective selection technique in comparison to other methods, specifically an interview (Paterson & Uys, 2005). Furthermore, the use of psychological testing in selection processes is particularly valuable as the test scores provide a common comparison metric, especially when dealing with both internal and external job respondents (Giumetti & Sinar, 2012; Murphy & Maree, 2006; Paterson & Uys, 2005). In addition, psychological testing is a way of ensuring the implementation of the LRA (1995) and EEA (1998) requirements in selection situations (Nzama et al., 2008).

Despite these potential advantages, the use of psychological testing in the selection process has come under intense analysis, as alluded to in section 2.7.1. The section that follows outlines the criticism and negative perceptions of the field as well as the responses to these.

2.7.2.1 Criticism and responses on workplace psychological testing

The use of psychological testing in selection processes has been scrutinised with a high degree of mistrust, specifically if the respondent pool constitutes a diverse group. This is primarily due to the complexity of developing tests that can be adequately utilised across the

various linguistic and cultural backgrounds found in South Africa (Paterson & Uys, 2005; Piro, 2011; Theron, 2007; Van der Merwe, 2002). Psychological tests have been accused of cultural bias if they take for granted certain experiences that are inherent in testing that the candidates may not have been exposed to previously (Murphy & Maree, 2006). A test can also be regarded as discriminatory if the construct being assessed is dissimilar across cultures (Paterson & Uys, 2005).

The EEA (1998) particularly indicates that employers may not reject candidates on the basis of a lack of skills or experience. Educationally disadvantaged learners are not a homogeneous group and psychological testing, therefore, needs to assist in identifying accurately between those who have potential but have been disadvantaged and those who do not have potential although disadvantaged (Murphy & Maree, 2006; Piro, 2011). Potential, the ability to acquire the required skills and experience within a reasonable time period, is required by the EEA (1998) to be acknowledged in selection practices. Psychological testing has, however, recently made significant inroads into measuring potential, especially in the cognitive sphere (Nzama et al., 2008; Piro, 2011).

Rather than using an either-or mind-set, organisations are encouraged to approach psychological testing from a multi-dimensional or integrated assessment framework. Through using more than one instrument, assessment practices will be less vulnerable to criticism and will be better positioned to counter any legislative challenges (Lough & Ryan, 2010; Piro, 2011; Van der Merwe, 2002).

The provision of the aforementioned criticisms and responses are pertinent in the context of this research study as they have significantly informed the choice of psychological testing measures used in this research study. Following the broad outline of psychological assessment usage in section 2.7.2, a discussion on a particular type of psychological technique, namely the testing of aptitude, is provided in the subsequent section.

2.7.3 Aptitude testing

There are three parts to this section. Initially, the aptitude construct is delineated, in section 2.7.3.2 the use of aptitude testing in selection practices is reviewed and the final part outlines the criticisms of this type of testing. Section 2.7.3.1 that follows elaborates on the meaning of aptitude testing.

2.7.3.1 Aptitude defined

Aptitude is broadly defined as the potential within a person to obtain a specific level of skill or ability, following a certain amount of training and/or practice (Byars & Rue, 2011; Coetzee & Volsoo, 2000; Noe et al., 2011; Taljaard, 1983; Van der Merwe, 2005). The three terms 'ability', 'potential' and 'aptitude 'are often used synonymously. However, they do signify very different facets of cognitive functioning (Murphy & Maree, 2006; Schmidt, 2002). A thorough understanding of this difference is vital within the context of this study as the ability, potential and specific aptitudes of the respondents involved in this study were assessed.

Walsh, Lok and Jones (2006), as cited in Nel et al. (2011), summarised employment tests into two categories, namely, those that measure current or short-term capabilities and those that measure future or long-term capabilities. Psychomotor tests that determine aspects such as dexterity, co-ordination and strength are in the former category, whilst cognitive ability tests, which assess a person's ability to learn and perform a job, fall into the latter category.

Another point to be clarified is the distinction between general mental ability and specific cognitive aptitude measures (namely, verbal, quantitative or spatial ability tests) (Bertua, Anderson & Salgado, 2005; Brown, Le & Schmidt, 2006). In order to elucidate the differing features of these two psychological tests, general mental ability will first be explained, followed by specific aptitudes.

General mental ability is regarded as the most validated individual differentiating construct in psychology (Bertua et al., 2005; Giberson & Miklos, 2012; Lubinski, 2000; Schmidt, 2002). Given the thorough and robust empirical research supporting the link between general mental ability and job performance, there is no foundation for doubting its validity as the most

powerful and central predictor of job performance (Brown et al., 2006; Denis & Gilbert, 2012; Domino, 2002; Kuncel, Hezlett & Ones, 2004; Schmidt, 2002). General mental ability, also known as intelligence, is the common aspect underpinning achievement on all mental ability tests (Brown et al., 2006; Carretta & Ree, 2000). It can, however, be regarded as unfortunate that psychologists refer to general mental ability as intelligence since this tends to confuse laymen who are inclined to refer to intelligence as genetic potential. The term *g* or general intelligence refers to developed general cognitive ability and, therefore, reflects more than just genetic potential (Schmidt, 2002).

Specific cognitive aptitudes, often simply called aptitudes, are narrower in focus than general mental ability and aim to provide a unitary assessment of a specific aptitude (Foxcroft & Roodt, 2013; Schmidt, 2002). Cognitive ability tests measure specific mental abilities such as verbal skills (that is, vocal and written skills in a particular language), quantitative or numerical skills, as well as reasoning ability (namely, the ability to think through to obtain a problem's solution) (Foxcroft & Roodt, 2013; Noe et al., 2011). Perceptual speed (the ability to recognise similarities and differences) and spatial ability tests (the ability to perceive items in space and establish their relationships) are also commonly used as aptitude techniques. In addition, finger dexterity, wrist-finger speed and manual dexterity are examples of the abilities analysed in psychomotor aptitude instruments (Byars & Rue, 2011).

Whilst often tested individually, it is noteworthy that a combination of two or more specific aptitudes is in actual fact a measure of general cognitive ability (Brown et al., 2006; Domino, 2002; Foxcroft & Roodt, 2013; Schmidt, 2002). In this study the respondents were assessed on eight specific aptitudes. I have therefore decided to refer to the assessment of their ability/potential/aptitude as 'general cognitive ability' (GCA) in this thesis (specifically within chapter five), except where reference is made to a specific aptitude or aptitude testing in general terms. Empirical research on the use of GCA and other specific aptitude measures within selection practices is explored in the proceeding section.

2.7.3.2 Aptitude testing in selection practices

Given their usefulness in making employment decisions, GCA tests have been used in human resource selection for over eighty years (Outtz, 2002). There is also voluminous literature supporting the extensive importance of GCA testing (Kuncel et al., 2004). The validity of these statements will be explored through a review of empirical literature in this section.

Aptitude testing can denote the future performance of job applicants accurately. Through the use of a multi-intelligence aptitude test battery, Tao, Chen and Chen (2009) concluded that an organisation can evaluate whether a job respondent has the required aptitude rapidly and effectively and use this as an important selection technique.

General cognitive ability is also regarded as a valid predictor of both educational and vocational performance, providing valuable appraisals of creativity and career potential (Kuncel et al., 2004; Ng & Feldman, 2010). In a meta-analysis into the validity of general mental ability and specific cognitive abilities for predicting job performance and training success, both were found to be valid predictors of the two criterions across a wide variety of occupational groups. Verbal, numerical, perceptual and spatial specific cognitive abilities were measured in this study (Bertua et al., 2005). A study researching the effectiveness and fairness of using matriculation and aptitude test results as predictors of further academic performance found that both have predictive validity. All ten of the aptitude-styled instruments consistently revealed moderate to high significance for predictive validity of future performance (Van der Flier, Thijs & Zaaiman, 2003). This finding was supported by international research where the Clinical Aptitude Test was found to be a significant predictor of performance in first and second year medical school examinations (Wright & Bradley, 2010).

There is a significant relationship between cognitive ability test results and performance for a wide variety of jobs (Carretta & Ree, 2000; Hattrup et al., 2005; Outtz, 2002). In a postgraduate selection centre, cognitive ability tests (namely, measuring verbal, numerical and diagrammatical reasoning) had predictive validity and significantly added to predicting performance on job simulations (Koczwara, Patterson, Zibarras, Kerrin, Irish & Wilkinson, 2012). Research conducted by McHenry, Hough, Toquam, Hanson and Ashworth (1990), as cited

in Outtz (2002), used a variety of psychological tests, namely, cognitive ability, perceptual ability, interest, temperament, personality and job outcome preference measures to predict job accomplishment. Their research established that cognitive and perceptual ability tests were the best predictors of task performance, specifically core technical skills.

The Technical Test Battery was found to have statistically significant results indicating that the aptitudes measured were useful in predicting work performance. The five measures of the battery, namely, verbal comprehension, visual estimation, technical understanding, numerical reasoning and fault diagnosis were found to be useful for diagnostic, developmental and selection purposes (Barnard & Schaap, 2005). However, despite these noted advantages of aptitude testing, other research studies have critically appraised this psychological instrument. These censures are outlined in the next section.

2.7.3.3 Criticisms of aptitude testing in selection practices

The use of specific cognitive aptitude tools has been disparaged for their inability to provide evidence of predictive validity on performance (Brown et al., 2006; Nzama et al., 2008; Outtz, 2002; Schmidt, 2002; Turner & Nicholson, 2011). Specifically, one study found no correlation between aptitude test scores (namely, visuo-spatial awareness, information processing, decision making, concentration and working memory) and measures of trainee skill ratings (Paisley, Balwin & Paterson-Brown, 2003). In another study, the Cognitive Process Profile (CPP) was used in selecting more than 100 middle to senior level retail managers. The CPP measures twelve aspects of cognitive functioning, such as, logical reasoning, verbal abstraction, memory, learning ability and judgement. The results from the CPP were compared with ratings from the organisations' performance management system. An unexpected finding was that only verbal abstraction significantly correlated with work performance. The researchers also indicated that given the robust intercorrelations between the cognitive variables measured there were overlapping variances resulting in a significant degree of superfluous measurement (Nzama et al., 2008).

Further criticism of aptitude testing centres on the fact that the use of cognitive ability tests in selection processes yields sizeable differences in scores obtained by racial groups (Brown

et al., 2006; Domino, 2002; Outtz, 2002; Schmidt, 2002). Research into cultural variation has identified that facets regarded as intelligent in one culture may not be the same in another (Murphy & Maree, 2006). Citing research done by Sackett and Ellingson (1997), Outtz (2002) states that, based on cognitive ability test scores, an employer would employ 10 out of every 100 White candidates, but only one African American applicant.

The time constraints under which general mental ability tests are assessed can have a negative impact on test results and respondents may, therefore, be mistakenly eliminated in the selection process. Applicants with certain personality characteristics find time constraint conditions of testing problematic which limit their ability to perform adequately in these time-based general mental ability tests (Denis & Gilbert, 2012). Koczwara et al. (2012) also caution against the use of off-the-shelf cognitive ability tests due to the coaching effects that can be gained if candidates directly access the tests from test publishers.

According to Outtz (2002) these criticisms do not render cognitive ability tests unfair. Assessment batteries that include non-cognitive measures, such as personality and interest tests, will provide information pertaining to contextual performance and not just task performance. These specific assessment batteries should, therefore, be used in conjunction with cognitive ability tests to predict job success (Outtz, 2002). Furthermore, cognitive ability tests should be used for diagnostic purposes to assist in training needs analysis, rather than just for classification (Piro, 2011).

This literature review chapter has thus far provided a plethora of information on both the theoretical and empirical research in the field of study. The ensuing discussion can be considered to be the pinnacle of the literature review. Section 2.8 outlines a critical appraisal of the literature review thereby synthesising the most relevant elements elucidated in this chapter.

2.8 Critical appraisal of the literature review

From the literature review it has been established that human resource selection practices are a vital method to improve the competitiveness and productivity of an organisation. This is especially true within the South African automotive industry as it faces several key

transformations in its organisational structure, modus operandi and the skill requirements of its workforce.

The empirical literature review on the selection techniques used within the South African automobile industry revealed a lack of research in the area of operator selection. This is unsatisfactory given the importance of this group of workers within the industry. These employees come in direct contact with the improved technology and they fulfil a significant role in the automobile sector as a pipeline to the artisan labour pool requirement within the industry.

The role of education as a predictor of work performance was also highlighted in the literature review. In the automotive industry a technical Grade 12 qualification, specifically with Mathematics and Science, has been the traditional education type preferred. Given the technical requirements within the industry, this preference is understandable. However, in light of the selection challenges exposed in the literature review, this narrow focus on one type of education is questioned.

The two challenges to the selection of automotive operators, outlined in the empirical literature review, have made clear that the automotive industry cannot adopt, from a practical point of view, an exclusive selection approach as theorised by the talent management framework. The human capital approach, focusing on education and development, is a more appropriate theoretical base from which the industry can operate.

While the literature review indicated the criticisms of the use of psychological and aptitude testing, the empirical research also indicates substantial benefits. Furthermore, the use thereof could provide the essential selection technique needed to address the challenges of operator selection in the South African automobile industry.

2.9 Summary and conclusions

This chapter defined the human resource selection practice and summarised the main selection methods used by organisations. An empirical literature review of the selection methodologies used both nationally and internationally was provided. Two challenges implicit in

the selection of automotive operators were also exposed. In an attempt to understand these challenges, a theoretical framework literature review on the talent management and human capital theories was presented. Psychological testing, specifically aptitude measures, was then offered as a potential solution to the challenges posed in the selection of operators in the automobile industry.

The next chapter serves to outline the nine steps of the research process which have been followed throughout the study. Chapter three, therefore, presents the research paradigm, the research design and the research methodology employed in this study. The methodology takes into account the population, sampling plan and the instruments used, as well as data collection methods and data analysis techniques implemented.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The preceding two chapters have established a basis for this research study. Chapter one highlighted the significant role of human resources within organisations as well as the skills deficiencies found within the automotive industry. Chapter two, the literature review, referred to the human resource selection practices used within the automobile industry, thus drawing attention to specific challenges experienced in the selection of automotive operators in the industry. The literature review also outlined two theoretical frameworks with the use of aptitude testing being offered as a possible solution to the identified selection challenges.

Chapter three charts the research process used throughout the study. The research paradigm and research design are delineated. The latter section indicates the research approach, methods and measurements as well as the sampling plan employed in this study. The research instruments used are explained in addition to the data collection and analysis strategies utilised. The reporting styles employed in chapter four are described with the final aspect of this chapter taking into account the ethical considerations of the research study. Section 3.2 commences chapter three with an outline of the research process applied in this study.

3.2 The research process

A research process can be understood as a highly structured step-by-step procedure that is followed in order to collect and analyse data (Collis & Hussey, 2009; Neuman, 2012). The ten research steps offered by Quinlan (2011) have been adapted into nine steps for this study as graphically illustrated in Figure 3.1. An overview of these nine steps is provided in the paragraph that follows this figure.

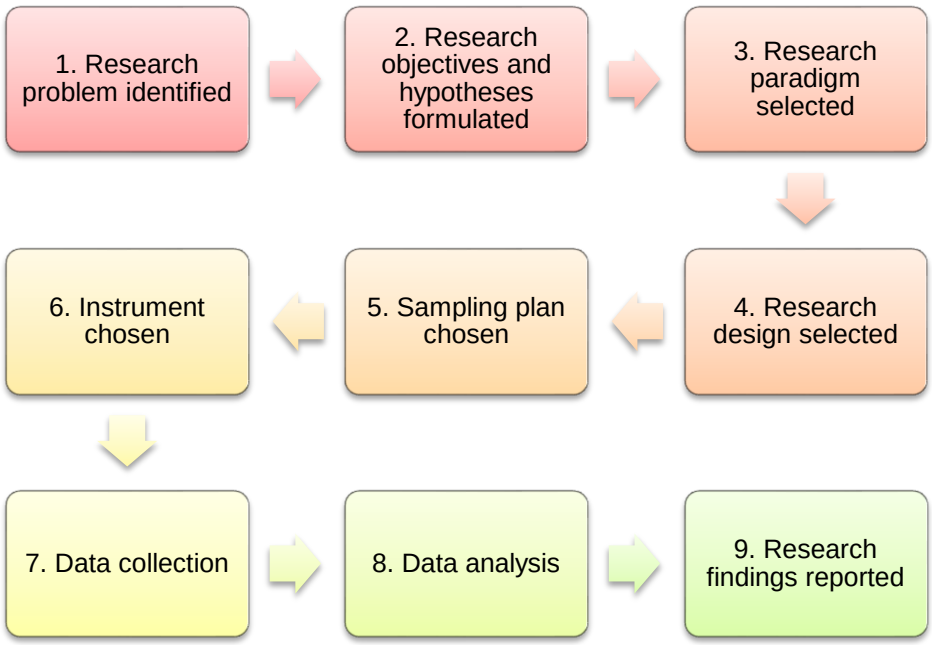

Figure 3.1. The research process, adapted from Quinlan (2011, p. 205).

The research process for this study commenced with the selection of the automobile industry as a general area of study and the identification of human resource selection as a research problem. Given that the research area stated in the first step was too broad, the crucial next step was the formulation of research objectives and hypotheses which narrowed down the research area to a specific focus on the selection of automotive operators. In step three, a positivist research paradigm was chosen, which informed step four, the overall quantitative research design of the study. A convenience and quota non-probability sampling plan was decided upon in step five with the appropriate measurement instruments being determined in step six. Data collection was completed in the seventh step of the research process, with step eight concerned with the analysis of this data. Finally, step nine concluded the research process with the reporting on the research findings.

Having explained the overall research process used in this study, the following section, section 3.2.1, directs the reader through the research problem, which is the first step of the research process.

3.2.1 Step one: the identified research problem

As discussed in section 1.3, the South African automobile industry is experiencing increased global competitive pressure resulting in the need to improve production costs and operational efficiencies significantly (Deloitte, 2009; Meyer, 2013; Naude & O'Neill, 2011; Peo, 2013; Vermeulen, 2013b). The introduction of advanced technology has resulted in a shift in the skills required of the workers, specifically the production employees, within the automobile industry. Unfortunately, there is a shortage of the required technical skills within the broad South African manufacturing sector in general. This skill deficiency is particularly dire at the level of technician and artisan (Barnes & Meadows, 2008; merSETA, 2009; Nzimande & Patel, 2012; Piro, 2011). Furthermore, the educational profile of the South African manufacturing workforce is not very high. An insufficient number of students are matriculating with Mathematics and/or Physical Science resulting in the workforce's educational attainments not being aligned to the manufacturing sector's requirements. This is creating a dichotomy within the automotive industry as it struggles to remain competitive through optimising the use of newly introduced modern technology (De Kock, 2012; Lehohla, 2010; merSETA, 2009; Nzimande & Patel, 2012; Rauner, Heinemann, Hauschildt & Piening, 2012).

The fundamental question this research study sought to answer is: does the type of secondary education obtained have an impact on operator employability in the automotive industry? Specifically, the two most important issues investigated were whether the choice of subjects in Grade 12 had an impact on operator employability and whether an academic or technical type Grade 12 qualification had an influence on the applicants' success in the selection process for automotive operators.

Section 3.2.1 has provided a brief précis of the research problem thus completing step one of the research process. The subsequent section further unpacks this research problem into the objectives and hypotheses of the study, thus commencing step two of the research process.

3.2.2 Step two: the objectives and hypotheses

Taking into account the succinct outline of the research problem, the aim and primary objective of this research study was to examine the impact of secondary education on operator employability in the automobile industry.

Following on this, the two secondary objectives of this study are:

- To establish whether the type of secondary education obtained affects the success of applicants in the general aptitude tests that form part of the selection process of operators in the automotive industry.
- To establish whether the type of secondary education obtained affects the success of applicants in the technical aptitude tests that form part of the selection process of operators in the automotive industry.

The nine hypotheses stemming from the above objectives can be articulated as follows:

H_{01} The type of secondary education obtained will not have an influence on verbal reasoning test scores.
H_1 The type of secondary education obtained will have an influence on verbal reasoning test scores.

H_{02} The type of secondary education obtained will not have an influence on non-verbal reasoning test scores.
H_2 The type of secondary education obtained will have an influence on non-verbal reasoning test scores.

H_{03} The type of secondary education obtained will not have an influence on comparison test scores.
H_3 The type of secondary education obtained will have an influence on comparison test scores.

H_{04} The type of secondary education obtained will not have an influence on dexterity test scores.
H_4 The type of secondary education obtained will have an influence on dexterity test scores.

H_{05} The type of secondary education obtained will not have an influence on co-ordination test scores.
H_5 The type of secondary education obtained will have an influence on co-ordination test scores.

H_{06} The type of secondary education obtained will not have an influence on assembly test scores.
H_6 The type of secondary education obtained will have an influence on assembly test scores.

H_{07} The type of secondary education obtained will not have an influence on spatial perception 2-D test scores obtained.
H_7 The type of secondary education obtained will have an influence on spatial perception 2-D test scores obtained.

H_{08} The type of secondary education obtained will not have an influence on spatial perception 3-D test scores.
H_8 The type of secondary education obtained will have an influence on spatial perception 3-D test scores.

H_{09} The type of secondary education obtained will not influence the employability of operator applicants.
H_9 The type of secondary education obtained will influence the employability of operator applicants.

After having briefly considered the research problem and concomitant aim, objectives and hypotheses, the next section explains how these elucidations have been reached. The concept of research paradigms is explored in step three of the research process. The subsequent section furthermore illuminates the specific research paradigm selected for this study.

3.2.3 Step three: the research paradigm - positivistic

The selection of an appropriate research paradigm is the third step of the research process. A paradigm is held to be a "cluster of beliefs and dictates which for scientists in a particular discipline influence what should be studied, how research should be done and how results should be interpreted" (Bryman, 1988 as cited in Bryman & Bell, 2011, p. 24). In contrast to the interpretive and critical research paradigms, the positivist approach presupposes that social reality consists of objective facts. This line of inquiry advocates that a broad causal theoretical principle be tested via deductive logic to understand how it functions in the social world (Hallebone & Priest, 2009; Neuman, 2012). In line with this understanding, this study espoused a positivist perspective as its underpinning research philosophy.

Section 3.2.2 indicated that the primary objective of this research study was to examine the impact of secondary education on operator employability in the automotive industry. The study therefore aimed to test whether a relationship exists between these two variables in order to expand knowledge within human resource selection theory. In line with positivist thinking this study also endeavoured to produce generalisable findings on the use of specific aptitude tests in human selection practices by either confirming or rejecting the nine hypotheses outlined in section 3.2.2.

The preceeding section has provided an overview of the research process, specified the problem statement, research objectives and hypotheses as well as the positivist research paradigm employed in this study. Section 3.2.4 clarifies the fourth step of the research process, outlined in Figure 3.1, by indicating the research design selected for the study.

3.2.4 Step four: the research design – descriptive/quantitative

Researchers advocating a quantitative research approach assume an absolute truth can be discovered through the discovering and uncovering of pre-existing laws (Bless, Higson-Smith & Sithole, 2013; Bryman & Bell, 2011). The precise measurement of variables and hypotheses are therefore emphasised in this research approach. Hard data, in the form of numbers, are collected and statistically analysed in this approach (Blanche, Durrheim & Painter, 2006; Neuman, 2012).

This study's variables, type of secondary education and operator employability, yielded measurable numerical data and the relationship between these variables was sought to be explained. A quantitative research approach was accordingly selected for this study. Furthermore, this is in line with the positivistic research paradigm described in section 3.2.3.

Research designs are traditionally categorised into three types, namely, exploratory, descriptive and causal (Burns & Bush, 2014). Exploratory research is applied in situations where there is a limited amount of knowledge or where further understanding on an area is required, most likely in preparation for a more systematic and broad secondary study (Bless et al., 2013). In contrast with other research design types, causal research seeks to discover the basis of beliefs, behaviours, events and conditions through testing theories, providing reasons and documenting the causes of these phenomena (Bless et al., 2013; Neuman, 2012).

Descriptive type research seeks to provide answers to questions such as who, what, where, when and how. The aim of this type of research is to provide a more detailed understanding of the identified research problem (Burns & Bush, 2014). The central aim of this research study was to describe and understand which applicants were successful in being employed as automotive operators. Specifically, the study sought to provide specific details of 'who' these successful applicants were in terms of their type of Grade 12 qualification.

Two of the vital decisions, selection of a research approach and type, needed to be taken during the fourth step of the research process, have been elucidated. The subsequent section further elaborates on the fourth research process step by summarising the research methods and measurements used in this study.

3.2.4.1 Research methods and measurement

As outlined in the previous section a quantitative research approach has been selected for this study. A wide variety of quantitative research methods are operationalised in empirical research and no simple rule exists to facilitate the decision-making process regarding which method to use for any set of circumstances (Iacobucci & Churchill, 2010; Jankowicz, 2005).

Of the four available quantitative research methods, the survey method was regarded as most suitable for this research study. This decision was based on the fact that the survey method is particularly useful in situations where information is sought to be obtained from a large pool of people on a similar topic or topics (Jankowicz, 2005). Furthermore, the survey research technique seeks to establish relational patterns between two or more variables at a specific point in time on a wide range of cases (Bryman & Bell, 2011; Shiu, Hair, Bush & Ortinau, 2009). The survey method is also particularly advantageous as the results can be generalised to the broader population (Collis & Hussey, 2009).

Having established the research method used in this study, the next critical decision to be made in the fourth step of the research process pertains to the scale of measurement utilised. This decision is significant given the implications for the types of statistics that can be computed in the data analysis step (Burns & Bush, 2014). This study's independent variable, type of secondary education, was nominal in nature as there is no zero point and all Grade 12 qualification possibilities were numerically classified. For hypotheses one to eight, the dependent variables were the stanine scores obtained for each of the aptitude sub-tests. These stanine scores are ordinal as the scores are ranked according to a particular aptitude with a higher number indicating a higher intensity of the aptitude being measured. The dependent variable in hypothesis nine, the employability of operator candidates, was nominal in nature as only two options, either recommended or not recommended, existed (Collis & Hussey, 2009; Iacobucci & Churchill, 2010). Therefore, these scales of measurement were applied in the data analysis step of the research process, outlined in section 3.6.

Thus far, section 3.2.4 has been concerned with this study's research design with regard to primary data collection. This was the direct source of evidence collected for this study. However, secondary sources of information informed this study at various stages in the research process. Secondary sources used in this study included textbooks, government reports, trade and academic journals, academic theses and syndicated data. Specifically, the secondary data was used to identify and define the problem statement, formulate the objectives and hypotheses, devise the research design and interpret the empirical research findings.

Section 3.2.4 has completed the fourth research process step outlined in Figure 3.1 by providing the details of the research design selected for this study. Section 3.2.5 that follows outlines the sampling plan used in the study, thus proceeding to the fifth step of the research process.

3.2.5 Step five: the sampling plan

At this point in the research process, the research problem has been specified with its related research objectives and hypotheses have been formulated, the research paradigm has been selected and an appropriate research design has been developed. Next, the elements from which the information will be collected needs to be identified. This requires the compilation of a sample plan (Iacobucci & Churchill, 2010). The five stages involved in assembling a sampling plan for this research study are tabulated in Table 3.1 and explained further in the proceeding paragraphs.

Table 3.1

Sampling Plan for the Study

No.	Stage	Description
1	Determining the target population	Work-seekers
	• Elements	Job applicants
	• Sampling unit	An automotive operator position
	• Extent	South Africa
2	Determine the sampling frame	Pre-selected applicant database
3	Select sampling techniques	Non-probability convenience and quota sampling
4	Determine the sample size	2 463 candidates
5	Execute the data collection	Follow the sampling plan

Note. The table was adapted from Burns and Bush (2014, p. 259) and Iacobucci and Churchill (2010, p. 283).

Firstly, the population for this study was defined as work-seekers, whilst the target population were work-seeking respondents for an automotive operator position in South Africa. The second stage in developing a sample plan is identifying the sampling frame. For this study

the sampling frame was generated as part of a large recruitment process at a South African automobile plant. The target population was reviewed based on minimum criteria set by the automotive organisation resulting in the sampling frame which is a database of pre-screened potential operators.

A sample procedure in stage three of the sampling plan needed to be selected. Given that the sampling frame was predetermined by the automobile firm, based on the type of Grade 12 qualification obtained, this study made use of a non-probability sampling technique. Stage three also neccesitated the selection of a sampling technique. This study employed a convenience sample as the sampling frame was readily available to the researcher. The sample can also be regarded as a quota sample given that the pre-screening was based on the secondary education breakdown as already defined.

Determining the sample size is the fourth stage of the sampling plan process. In non-probability sampling the sample size is determined on the basis of the researcher's judgment, weighing the value of the information obtained against the cost of obtaining that information (Burns & Bush, 2014). As already mentioned, a pre-screened sampling frame was provided to the researcher. In order to improve the accuracy of the study's findings, it was decided that the complete sampling frame would consitute the sample size. Therefore, the sample size of this research study was 2 463 pre-screened work-seeking candidates for an automotive operator position in South Africa. The execution of the sample plan, stage five of the research process, is covered in detail in section 3.2.7 of this chapter.

Thus far the fourth and fifth steps of the research process have been delineated. Section 3.2.6 moves on to the sixth step of the research process provided in Figure 3.1 by describing the research instruments chosen for this study.

3.2.6 Step six: the research instruments

Three parts constitute section 3.2.6. Initially, an overview of the process employed in the selection of the study's quantitative research instruments is presented. Thereafter, the two

research instruments used in this study are outlined. Section 3.2.6.1 commences the section with a review of the process undertaken to accurately identify the research instruments for this study.

3.2.6.1 Overview of instrument selection process

Prior to designing or selecting a research instrument, substantial subject matter knowledge is required in order to formulate a sound theoretical framework and develop the hypotheses to be tested (Collis & Hussey, 2009). Chapters two and three of this thesis provide satisfactory evidence to support the research instruments adopted in this study.

In addition, the importance of conducting a thorough job analysis prior to starting a human resource selection process was highlighted in section 2.2.2. In accordance with this recommendation, a job analysis of the operator position was conducted at a particular automobile assembly plant. This job analysis elucidated that three general aptitude skills, namely, verbal reasoning, non-verbal reasoning and attention to detail, were potentially predictive of operator job performance. Furthermore, five technical aptitudes were found to be in the same potentially predictive category, namely, psychomotor dexterity and co-ordination, the ability to mentally assemble representations as well as two and three-dimensional spatial perceptual ability.

For this study, the Differential Aptitude Test (DAT) battery was selected to ascertain the identified general aptitudes and the Trade Aptitude Test (TRAT) battery for the specific techical aptitudes required for the automotive operator postion. Both of these psychological test batteries meet the requirements of the Employment Equity Act (No. 55 of 1998) and the Labour Relations Act No. 66 (1995) and are, furthermore, registered and approved psychological tests by the Health Professions Council of South Africa (HPCSA, 2006; 2010a). Given the status of the research instruments selected for this research study, a pilot study was not deemed necessary. Details of these two selected research instruments are provided in the subsequent two sections, with the DAT being discussed first.

3.2.6.2 The Differential Aptitude Test (DAT)

The aim of the DAT battery is to offer information on the “differential aptitudes of Grade 10, 11 and 12 learners as well as of adults who wish to undergo post-school training or who wish

to enter a particular occupation" (Coetzee & Vosloo, 2000, p. 2). The overall purpose of the test battery is for counselling or to assist in producing the best match between individuals in certain jobs or in any post-school training centre (Coetzee & Vosloo, 2000).

There are a number of versions of the DAT to cater specifically for the entire South African population. The advanced form is explicitly for use on a population that has received six to seven years of education in the language of testing (namely, English) and that has had experienced advantageous growth prospects. The standard forms are appropriate for a population that has not benefitted from these favourable experiences (Coetzee & Vosloo, 2000). In this research study the DAT-K version was used, which is the standard form applicable to individuals who have completed Grades 10 to 12.

Table 3.2

Key Differences between the DAT-K Sub-tests

DAT-K sub-tests	Purpose of sub-test	Items per sub-test	Time (in mins) for test completion
Verbal reasoning	Aspect of general reasoning	25	25
Non-verbal reasoning	Aspect of general reasoning	25	25
Comparison	Visual perceptual speed	25	4

Note. The table was adapted from Coetzee and Vosloo (2000, p. 4-11).

The key differences with regard to purpose, items per instrument and timing of the DAT-K sub-tests used are indicated in Table 3.2. These aspects are explained in detail in the subsequent paragraphs.

- *The verbal reasoning sub-test*

The intention of this instrument is to establish an aspect of general reasoning on the basis of verbal material. The tool is based on the supposition that the skill of identifying relationships, being able to conduct word similarities and to decipher broad problems utilising rational thought, as well as a person's vocabulary experience, is a valid indication of an aspect of general

reasoning. The sub-test consists of 25 multiple-choice type questions with a 25 minute test completion time (Coetzee & Vosloo, 2000).

- *The non-verbal reasoning sub-test*

The aim of this tool is to determine an aspect of general reasoning on the basis of non-verbal items. The instrument comprises of two sections. The first section rests on the postulation that the capacity to identify the association between figures and thereby select the correct matching missing figure is a valid sign of an aspect of non-verbal reasoning ability. In the second section a series of modified figures is presented. The correct identification and application of the underlying principle informing the modification is regarded as a valid sign of an aspect of non-verbal reasoning ability. The sub-test has a 25 minute completion time in which 25 multiple-choice type questions need to be attempted (Coetzee & Vosloo, 2000).

- *The comparison sub-test*

This instrument seeks to ascertain the candidate's visual perceptual speed, which is the ability to make swift and precise discernments of the similarities and dissimilarities between visual arrangements. The rationale of this technique is that the ability to identify the one grouping of characters (numerical, alphabetical or diagrammatical) that is not consistent with the other four groupings is a valid indication of visual perceptual speed. In this sub-test 25 multiple-choice type questions need to be done within four minutes (Coetzee & Vosloo, 2000).

The preceeding section has outlined the DAT-K measures used in this research. The next section delineates the details of the second assessment battery used in this study, namely, the TRAT battery.

3.2.6.3 The Trade Aptitude Test (TRAT)

The aim of the TRAT battery is to assist in the selection of potential students for admittance into technical institutes and colleges. The test battery also indicates the candidate's potential to progress and successfully finish training in a specific technical field (Taljaard, 1983).

The key differences with regard to purpose, items per instrument and timing of the TRAT sub-tests used in this study are indicated in Table 3.3. The specifics of these five TRAT measures are then explained in detail in the ensuing paragraphs.

Table 3.3

Key Differences between the TRAT Sub-tests

TRAT sub-tests	Purpose of sub-test	Items per sub-test	Test completion time (in mins)
Dexterity	Two-hand eye co-ordination	72	2
Co-ordination	Hand eye co-ordination	127	2
Assembly	Ability to mentally assemble representations	25	25
Spatial perception 2-D	Two-dimensional spatial perceptual ability	25	17
Spatial perception 3-D	Three-dimensional spatial perceptual ability.	13 12	7 9

Note. The table was adapted from Taljaard (1983, p.16-44).

- *The dexterity sub-test*

This tool determines an aspect of the candidate's two-hand eye co-ordination, a facet of psychomotor co-ordination. The sub-test is based on the postulation that the capacity to simultaneously, rapidly and accurately pencil in circles, by employing a pencil in each hand, between the provided pairs of concentric circles, is a valid indicator of two-hand eye co-ordination. The instrument consists of 72 items with a two minute test completion time (Taljaard, 1983).

- *The co-ordination sub-test*

The intention of this technique is to establish the candidate's hand-eye co-ordination, another facet of psychomotor ability. The test rests on the hypothesis that the skill required to pencil in an unbroken line rapidly and precisely, by hand, between circular zones by going above one and below the other, without contacting the zones or picking up one's pencil, is regarded as a

valid gauge of hand-eye co-ordination. Within two minutes, 127 items need to be attempted in this instrument (Taljaard, 1983).

- *The assembly sub-test*

The aim of this tool is to reveal the candidate's ability to build illustrations mentally of mechanical parts to shape a provided mechanical object. The test's rationale indicates that the candidate's ability to assemble mentally representations of parts of a mechanical nature on the basis of fixed regulations is regarded to be a valid measurement of his/her ability to assemble mechanical components. In this instrument 25 multiple-choice type questions are required to be finished within 25 minutes (Taljaard, 1983).

- *The spatial perception 2-D sub-test*

This measure seeks to disclose the candidate's two-dimensional spatial perceptual ability. The test rests on the assumption that the degree to which a candidate sees two-dimensional geometrical shapes and is able to mentally rotate them on a flat surface, is regarded to be a valid measurement of two-dimensional spatial perceptual ability. Within 17 minutes, 25 multiple-choice type questions are required to be accomplished (Taljaard, 1983).

- *The spatial perception 3-D sub-test*

The intention of this instrument is to determine the candidate's three-dimensional spatial perceptual ability. This test rests on the assumption that the degree to which a candidate is able to visualise mentally, turn and merge three-dimensional figures, in order to formulate them to appear similar to a given representation and to shape mentally a three-dimensional composition from a two-dimensional plan, is a valid measurement of his/her three-dimensional spatial perceptual ability. This tool consists of two sections: section (a) comprises 13 multiple-choice type questions to be attempted in seven minutes while section (b) has 12 multiple-choice type questions to be completed in nine minutes (Taljaard, 1983).

The sixth step of the research process, the selection of the research instrument, was accounted for in section 3.2.6. A detailed account of the identified psychological instruments and

the sub-tests used from each instrument were also provided. Section 3.2.7 progresses to the seventh step of the research process, the data collection methods used in this study.

3.2.7 Step seven: data collection

There are two parts within section 3.2.7. Firstly, an overview of the data collection process used in this study is provided followed by an explanation of the sample realisation rate. In this section the seventh step of the research process, as indicated in Figure 3.1, is discussed. Section 3.2.7.1 initiates the section by giving an overview of the data collection process used in this research study.

3.2.7.1 Overview of the data collection process

As indicated in section 3.2.5, this research study forms part of a large recruitment process completed by a South African automotive assembly plant. Following an in-house initial pre-screening process, candidates were required to participate in a multiple-hurdle selection model. This model was explained in section 2.2.2.1 of the preceding chapter of this thesis.

In this selection process, respondents had to complete two assessment hurdles. Those successful in phase one, the general aptitude tools, were requested to complete phase two, the technical aptitude sub-tests. Based on a previously conducted job analysis, a stanine three cut-off requirement was set for each of the three general aptitude measures as qualifying screening criterion to progress to the second phase. Phase two of the psychological testing process involved the assessment of five technical aptitudes. Based on the previously mentioned job analysis, a stanine four cut-off requirement was set for each of these technical aptitude instruments as a requirement to progress to the next internal selection phase. However, an additional corollary was that either dexterity (a phase two sub-test) or comparison (a phase one sub-test) should be a minimum of a four stanine score in order to be regarded as successful in phase two.

The administration and communication of this research study was conducted by an internal Human Resource project team. The assessment process was conducted over several months during working hours. Two groups were assessed per week day of scheduled assessment,

commencing at either 08h00 or 12h00. Details of the data gathering procedure followed in this study is provided in section 3.2.7.2 where the sample realisation rate is discussed.

A registered psychometrist (independent/private practice) administered the entire assessment process. Testing was conducted in accordance with the recommendations made in the selected psychological test manuals. An explanation of the manner in which research ethics were accommodated in this assessment process is provided in section 3.2.9 of this chapter. Having outlined the data collection process utilised in this study, the subsequent section provides details of the sample realisation rate.

3.2.7.2 Sample realisation rate

Due to the nature of the data-gathering method used in this study, a number of the disadvantages associated with the survey method were minimised. There can be limited power over timeliness in the survey method. However, in this study this potential disadvantage was addressed through a personal assessment process that meant no delay between administration and completion of the survey instrument. Given that the research study was part of a recruitment and selection drive, the respondents had a personal incentive, namely the upliftment of skills and potential employment, in adequately completing the survey instrument. This minimised another possible disadvantage of the survey method, namely, a low response rate (Shiu et al., 2009). Therefore, the data-gathering method used in this study assisted in improving the actual sample realisation rate. The sample realisation rate for this research study is indicated in Table 3.4 and explained in the paragraphs that follow.

Table 3.4

Sample Realisation Rate

Data gathering session	No. of applicants	Phase of testing	Totals
Session 1	602		
Session 2	451		
Session 3	918	1	2 463
Session 4	487		
Session 5	5		
Session 6	391		
Session 7	296		
Session 8	551		
Session 9	309	2	1 566
Session 10	15		
Session 11	4		

Note. The table was developed for this study.

For phase one, the general aptitude testing hurdle, 2 465 candidates were invited but only 2 463 adequately completed this assessment phase. One candidate was asked to leave due to not adequately adhering to the prescribed assessment protocol and another candidate left before completing the entire assessment process due to a prior interview commitment. As a result, a total of 2 463 candidates were assessed during five assessment sessions in phase one of this research study.

Of the 2 463 respondents that completed phase one, 1 618 were successful in meeting the qualifying screening criterion (as explained in section 3.2.7.1) set for this phase and were therefore invited to attend phase two of the selection process. A total of 49 candidates, evenly spread across all groups, were lost due to attrition for a variety of reasons prior to the commencement of phase two of the assessment process. Twenty respondents did not answer their phones or it went to voicemail with no subsequent response; five of the cell phone numbers were no longer available or it was the wrong number; 12 candidates were no longer interested in the process and a further 12 did not present themselves at the confirmed scheduled assessment

session for unknown reasons. It is possible that these candidates may have found alternative employment or enrolled in alterate training programmes since the recruitment advertisement was placed.

Therefore, a total of 1 569 applicants were expected to complete phase two of the assessment process. However, three candidates were requested to exit the assessment process due to not acknowledging the prescribed assessment regulations. Consequently, a total number of 1 566 respondents were actually assessed in phase two of the assessment process. This was conducted over six assessment sessions.

Section 3.2.7 provided a review of the data collection methods and sample realisation rate of this study, thereby concluding the seventh step of the research process. In the following section the data analysis process implemented for this research study is discussed.

3.2.8 Step eight: data analysis

Following on from the data collection is the analysis of the raw data, the eighth research process step. Data analysis implies interpreting or giving meaning to the data collected through a process of examination and searching for patterns (Neuman, 2012). The six stages of the data analysis strategy adopted in this research study are briefly explained below and tabulated in Table 3.5. The six sections that follow clarify each stage in detail.

In stage one of the data analysis strategy, data preparation was conducted. In section 3.2.8.1 the five aspects of this, namely, scoring, converting, coding, cleansing and importing are discussed in detail. Stage two involves the describing of the data via the use of various descriptive statistics. The specific statistics used in this study are particularised in section 3.2.8.2. Stage three involves determining how the data is distributed and this is discussed in section 3.2.8.3, whilst the fourth stage, confirming the reliability of the measuring instruments, is covered in section 3.2.8.4. The fifth stage of the data analysis strategy, substantiating the validity of the instruments, is discussed in section 3.2.8.5, with the last stage, the assessment of the research hypotheses, being considered in section 3.2.8.6.

Table 3.5

Data Analysis Strategy

Stage	Description	Statistical procedures used	Brief summary & rationalisation of procedures
1	Data preparation	Not applicable	Scoring, converting, coding, cleansing and importing
2	Describing the data	Descriptive statistics	Frequency distributions and cumulative percentages
3	Distribution of data	Descriptive statistics	Measures of central tendency, specifically modes and medians
4	Reliability testing	Inferential analysis	Kuder-Richardson formula 14 and 21
5	Validity testing	Inferential analysis	Pearson product moment correlation co-efficient and confirmatory factor analysis
6	Hypotheses testing	Inferential statistics	Chi-square test of independence

Note. The table was developed for this study.

Before the data can be analysed, data preparation is required. Section 3.2.8.1. commences with a discussion of the data preparation stage of this strategy.

3.2.8.1 Data preparation

All the previous steps in the research process outlined in Figure 3.1 were undertaken in order to obtain data to be analysed. To improve the integrity and currency of the data's meaning, substantial rigour was employed in the preparation of the numerical data collected in this research study (Iacobucci & Churchill, 2010). The specific activities used in this study to adequately prepare the data for analysis are discussed in the following paragraphs.

Answer sheets were manually scored using a scoring stencil, except for the dexterity and co-ordination measures which were scored according to the psychological test manuals' scoring

instructions. In adherence to standard psychometric assessment practice, raw scores were converted to stanines, using the appropriate norm table. The stanine or nine-point standard scale is regarded as a normalised scale with standard scores ranging from one to nine (Coetzee & Vosloo, 2000; Taljaard, 1983). The stanine scores were then captured onto a Microsoft Excel spreadsheet.

Prior to the coding and editing of the data collected, the qualifying screening criterion had to be implemented with regard to whether the candidate was successful or not in each phase of the psychological testing. The details of these qualifying screening criterions were explained in section 3.2.7.1.

Given that the dataset was ready to be numerically coded, a data code book was generated to accurately identify and assign values to responses obtained in the data collection step (Burns & Bush, 2014). The Statistical Package for the Social Sciences (SPSS) naming regulations for preparing a codebook were followed as specified in the technical manual (Pallant, 2013).

The cleansing of the database followed with missing data and/or no responses being eliminated from the dataset as indicated in section 3.2.7.2. In preparation for the execution of the inferential statistics, the aptitude sub-tests' results were tabulated into three categories, namely, a low, moderate and high scoring category. The low category included stanine scores ranging from one to three, the moderate category comprised the fourth to sixth stanine scores whilst the seventh through to ninth stanine scores were designated to the high scoring category. Subsequently, the information was imported into SPSS, version 20, as this powerful software package can successfully analyse large quantitative datasets (Quinlan, 2011). Following the coding, editing and cleansing of the data is the first step of statistical analysis of the data, namely, the descriptive statistics. Section 3.2.8.2 provides an overview of the descriptive statistics employed in this study.

3.2.8.2 Descriptive statistics

Descriptive statistics were used in this study to describe in detail the gathered data (Quinlan, 2011). The specific descriptive statistics used in this study are described in the following paragraph.

Frequency tables should be used to depict the number of people and percentage that belonged to each category of the variable discussed (Bryman & Bell, 2011). The applicants' demography details (namely, age, race and gender) are provided in this format, along with the type of matriculation obtained by the 2 463 candidates. Additionally, the percentage marks obtained by respondents that completed the Mathematics and Science subjects are provided in frequency tables. Furthermore, analysis according to descriptive means is appropriate with regard to the number of respondents that made the cut-off requirement for each of the eight aptitude tools. As with the type of Grade 12 qualification obtained, these frequencies are also presented in tables containing the cumulative percentages. Furthermore, frequency tables are provided of the number of applicants who were recommended after phase one and two of the psychological testing process.

This section has elucidated the second stage of the data analysis strategy by outlining the descriptive statistics used to describe the demographic and educational data in this study. The third stage, the distribution of the data, is discussed in the subsequent section. Given the measures used in the distribution of this study's data it is noted that the proceeding section is an extension of the descriptive statistics.

3.2.8.3 Distribution of data

This section clarifies the techniques used to understand the distribution of the data. Particularly, measures of central tendency were used to summarise and compress the detailed information in order to establish its essential meaning. Two types of central tendency measures were used to discover the centre of the distribution, namely, the median and mode (Shiu et al., 2009).

In this study the medians and modes are provided in tabular format for the stanine results obtained for each of the three general phase one aptitude measures, that is, verbal reasoning, non-verbal reasoning and comparison. Similarly, the medians and modes of the technical phase two aptitude sub-tests are depicted in tabular format. The medians and modes of the stanine results obtained for these five tools, being dexterity, co-ordination, assembly, 2-D and 3-D spatial perception, are presented in one table.

Following on from the discussion of the data distribution in the study, the next section directs the reader towards the inferential statistics, which involves assessing reliability and validity. Section 3.2.8.4 specifically addresses the reliability of the research instruments whilst section 3.2.8.5 focuses on the validity of the research instruments.

3.2.8.4 Reliability of measuring instruments

The fourth stage of the data analysis strategy employed in this research study requires that the reliability of the selected measuring instruments be established. This section explains how this aspect of the strategy was fulfilled for both the Differential Aptitude Test (DAT) and Trade Aptitude Test (TRAT) instruments used in this study.

Section 3.2.6.1 has indicated that the two selected aptitude instruments used in this study complied with the requirements of both the Employment Equity Act (No. 55 of 1998) (EEA) and the Labour Relations Act (No. 66 of 1995) (LRA). These two aptitude measures are also registered and approved psychological tests by the Health Professions Council of South Africa (HPCSA, 2010a) (Annexure C).

The established reliability status of both of the selected aptitude instruments used in this study is outlined in the subsequent paragraphs. Initially, the reliability of the DAT-K sub-tests are provided in Table 3.6 and then explained, with the reliability of the TRAT measures indicated thereafter.

Table 3.6

Reliability of the DAT-K Sub-tests

DAT-K sub-tests	Purpose of sub-test	Reliability coefficient (Kuder-Richardson formula 14)
Verbal reasoning	Aspect of general reasoning	0.75
Non-verbal reasoning	Aspect of general reasoning	0.85
Comparison	Visual perceptual speed	*

Note. The table was adapted from Coetzee and Vosloo (2000, p. 35).

The * indicates a speed test and the Kuder-Richardson formula 14 formula is therefore not applicable.

The reliability of the three DAT-K tools used in this study were established with the aid of the Kuder-Richardson formula 14. The reliability coefficients of the three DAT-K measures in respect of Grade 12 candidates are indicated in Table 3.6. These coefficients are moderately consistent with those obtained for the Grade 10 and 11 groups. While the reliability coefficient for the verbal reasoning sub-test is on the low side, the reliability of the DAT-K is still assumed to be of an acceptable standard (Coetzee & Vosloo, 2000).

Having explicated the reliability of the DAT-K instruments, the reliability of the TRAT sub-tests are explained and tabulated in Table 3.7 which follows. The reliability of the various measures within the TRAT battery were determined by the Kuder-Richardson formula 21 (K-R 21). Table 3.7 provides the reliability coefficients of three of the TRAT sub-tests used in this study. The coefficients range from 0.72 to 0.92 and are regarded as being satisfactory (Taljaard, 1983).

Table 3.7

Reliability of the TRAT Sub-tests

TRAT sub-tests	Purpose of sub-test	Reliability coefficient (K-R 21)
Dexterity	Two-hand eye co-ordination (facet of psychomotor co-ordination)	*
Co-ordination	Hand eye co-ordination (facet of psychomotor co-ordination)	*
Assembly	Ability to mentally assemble representations	0.81
Spatial perception 2-D	Two-dimensional spatial perceptual ability	0.92
Spatial perception 3-D	Three-dimensional spatial perceptual ability	0.72

Note. The table was adapted from Taljaard (1983, p. 69).

The * indicates speed tests and the K-R 21 formula is therefore not applicable.

With the reliability requirements of the two instruments having being met as per section 3.2.8.4, the second aspect of inferential statistics, namely, the validity of these measures, needs to be explicated. This aspect is clarified in the subsequent section.

3.2.8.5 Validity of measuring instruments

In the preceding section it was established that the two aptitude tools used in this study are registered and approved psychological tests by the HPCSA given that they complied with the EEA and LRA requirements. This presupposes that both the reliability and validity of these aptitude tests are acceptable. The established validity of the DAT-K tools are indicated in Table 3.8 and thereafter explained.

Table 3.8

Validity of the DAT-K Sub-tests

DAT-K sub-tests	Purpose of sub-test	*M*	*SD*	Pearson product moment correlation coefficient with school subjects	
				English	Mathematics
Verbal reasoning	Aspect of general reasoning	16.00	4.22	0.66	0.39
Non-verbal reasoning	Aspect of general reasoning	13.87	4.90	0.43	0.51
Comparison	Visual perceptual speed	23.36	3.15	0.25	0.28

Note. The table was adapted from Coetzee and Vosloo (2000, p. 38 - 39).

Looking at the psychometric data in Table 3.8, the predictive validity of the DAT-K instruments is confirmed. This was ascertained by the significant Pearson product moment correlation coefficients obtained between the sub-tests and year-end school subject results obtained. For the verbal and non-verbal reasoning measures, correlations with a p-value $\leq .01$ were established for both English and Mathematics school subjects, while p-values of $\leq .05$ were obtained for the comparison tool (Coetzee & Vosloo, 2000).

Furthermore, the content validity of the DAT-K battery was established by a committee of specialists, independent of the test developers. The construct validity of the sub-tests was examined through subjecting the norm group's data to confirmatory factor analysis. Given that the sub-tests correlate highly with one another, two meaningful factors were established and hence construct validity was confirmed (Coetzee & Vosloo, 2000).

With regards to the validity of the TRAT battery, the test manual indicates that no validity data was available at the time of printing. However, a comprehensive validity investigation was

planned and the results would be provided as a supplement to the manual in due course (Taljaard, 1983). I made contact with the test distributors, Mindmuzik Media, to obtain this validity data. However, after reviewing their archives from the Human Sciences Research Council, I was informed that the validation had not been performed (T. Kriek, personal communication, November 19, 2013). However, the TRAT battery is a registered and approved psychological test by the HPCSA and on this basis it was decided to continue using this instrument within the research study.

Section 3.2.8.5 has been concerned with the fifth stage of the data analysis strategy, indicating the validity of the two measuring instruments used in this study. Stage six of the data analysis strategy, the evaluation of the research hypotheses, is discussed in section 3.2.8.6 that follows, thereby concluding the inferential statistics employed in this study.

3.2.8.6 Analysis of research hypotheses

The nine hypotheses for this study were provided in section 3.2.2, with both the null hypothesis and an alternative hypothesis being presented. To analyse these research hypotheses, inferential statistics were used to draw inferences and make predictions about the population from the sample's data (Quinlan, 2011).

As indicated in section 3.2.8.1, the aptitude sub-tests' results were converted into three categories, namely, a low, moderate and high scoring category. Inferential statistics were then performed on these three scoring categories. Bivariate statistical analysis was carried out on the two variables within each hypothesis to establish either covariance or independence between the dependent and independent variables (Bryman & Bell, 2011). To test the significance of the relationship between the variables for hypotheses one to nine, the Chi-square test of independence was used. An alpha level of .05 was used for each of these statistical tests. The null hypotheses were accepted if there was independence between the variables, whilst the alternate hypotheses were acknowledged if there was co-variation between the dependent and independent variables.

In order to elucidate the magnitude of the relationship between the variables, effect size statistics were employed and interpreted. Informed judgements of the study's practical significance were hence made possible (Sun, Pan & Wang, 2010). The Cramér's *V* statistic was reported in the analyses of the hypotheses and interpreted according to the eta squared guidelines, provided in Table 3.9. Three distinct effect sizes are classified in these guidelines based on the proportion of the dependent variable's variance that is explicated by the independent variable (Pallant, 2013).

Table 3.9

Interpretation Guidelines for Effect Size

Effect size	Eta squared (% of variance explained)	Cohen's d (standard deviation units)
Small	.01 or 1%	.2
Medium	.06 or 6%	.5
Large	.138 or 13.8%	.8

Note. The table was adapted from Pallant (2013, p. 218).

In section 3.2.8.6, the sixth and last stage of the data analysis strategy, the assessment of the research hypotheses has been explained and contextualised for this research study. Therefore, this section concludes the eighth step of the research process as depicted in Figure 3.1 at the start of this chapter. Section 3.2.9 that follows explains the specific reporting techniques used within chapter four and five of this thesis.

3.2.9 Step nine: reporting of findings

The reporting on research findings, the ninth step of the research process, is clarified and operationalised in chapter four and chapter five of this thesis. However, this section details three practices employed in the reporting of the empirical findings obtained from the data.

For each of the study's two assessment phases, specific qualifying screening criterions were set for each of the aptitude measures. These were explained in section 3.2.7.1. These minimum cut-off requirements are raised in chapters four and five to facilitate an understanding

of the empirical findings. Specifically, these criterions are referred to in the discussions on the outcomes obtained for each of the assessment phases (specifically, in section 4.2.3); the sub-test results (that is, in section 4.2.4) and in the analysis of the research hypotheses (namely, in section 4.3). In chapter five's conclusions and recommendations (that is, sections 5.2 and 5.3 respectively), these sub-test qualifying conditions are also mentioned.

In section 3.2.8.1 the three stanine score categories utilised in this study were explained. These are the low (stanine one to three), moderate (stanine four to six) and high (stanine seven to nine) scoring categories. Within chapter four, these three categories are referred to in the reporting on the descriptive statistics, specifically in the account of the sub-test results (that is, in section 4.2.4). These categories are also operationalised in the commentary on the inferential statistics, namely the assessment of the hypotheses in section 4.3. Furthermore, these categories are also referred to in the conclusions and recommendations (namely, sections 5.3 and 5.4 respectively) offered in chapter five.

In the interpretation of and reporting on norm-referenced tests, it is common practice to use percentile ranks. These indicate the "percentage of people in a normative standardisation sample who fall below a given raw score" (Foxcroft & Roodt, 2013, p. 41). In chapter four, the obtained stanine scores are described according to this representation. Specifically, this reporting style is adopted in section 4.2.4, the reporting on the sub-test results. Table 3.10 depicts the theoretical percentile ranges for the nine stanine scores.

Table 3.10

Percentile Range and Description of Stanine Scale

Percentage (approximate)	Stanine	Description
Lowest 4%	1	Far below average
Next 7%	2	Far below average
Next 12%	3	Below average
Next 17%	4	Low average
Next 20%	5	Average
Next 17%	6	High average
Next 12%	7	Above average
Next 7%	8	Superior
Highest 4%	9	Superior

Note. The table was adapted from Coetzee and Vosloo (2000, p. 27) and Taljaard (1983, p. 51).

Before concluding this chapter, section 3.3 outlines the ethical considerations implemented in this study.

3.3 Ethical considerations

Chapter three has thus far been concerned with the research design and methodologies used in this study. However, a major factor in conducting research, from step one to nine of the research process, is the consideration of research ethics (Neuman, 2012). The manner in which these ethics were accommodated in this study is explained in the next paragraphs.

Care was taken in the selection of the instruments used in this study in order to eliminate possible bias in terms of race and gender. To support this, both instruments were scientifically shown to be valid and reliable as discussed in sections 3.2.8.4 and 3.2.8.5. Furthermore, both instruments are registered and approved psychological tests according to the HPCSA as discussed in section 3.2.6.1.

Due to the nature of this study, the research candidates were not at risk of physical harm. Furthermore, physically disabled candidates were specifically catered for in separate assessment sessions thus protecting them from psychological abuse, stress and a loss of self-esteem. All research respondents were also thoroughly informed of the assessment process. Each participant voluntarily completed a specifically designed informed consent form (Annexure D and E) for each phase in the assessment process. Moreover, as mentioned in section 3.2.7.1, testing in this study was conducted in accordance with the recommendations made in the applicable test manuals. In this section the ethical considerations applied in the instrument selection and data collection for this study have been explained. The section which directly follows summarises and concludes chapter three, the research design and methodology employed in this study.

3.4 Summary and conclusions

Chapter three initially identified the nine steps of the research process used in this study. These nine steps were then explicated in detail as the chapter progressed. The problem statement was highlighted, followed by the further elucidation of the objectives and hypotheses of this research study. The selection of a positivist research paradigm was provided with the selection of an exploratory and explanatory survey research design being indicated. This chapter also outlined how secondary research was used to inform various aspects of the study. The sampling plan was then explained with the two quantitative research instruments employed in this study being outlined. Information pertaining to the data collection approach, including sample realisation rate, was provided as well as an indication of the data analysis strategy implemented in this study. The reporting techniques implemented in chapters four and five were described with the final section of chapter three discussing the ethical aspects considered in the process of conducting this research study.

Chapter four, which directly follows, details the findings derived from the quantitative survey, thereby partially fulfilling step nine of the research process. The biographical and educational profile of the applicants is discussed as well as the distribution of the stanine data. The results from the eight sub-tests employed in the study are also explored which leads to the analysis of the nine hypotheses.

CHAPTER 4: EMPIRICAL FINDINGS

4.1 Introduction

Chapter three explained the nine steps in the research process undertaken in this study. This ranged from the identification of the research problem to the reporting of the research findings. Within the research process, a positivistic paradigm was employed resulting in a quantitative research approach. Two psychological aptitude tests were then administrated to the selected sample. The data analysis strategy used for this study incorporated both descriptive and inferential statistical techniques.

Chapter four is concerned with the analysis and interpretation of the empirical findings. Initially, this chapter considers the findings obtained from the descriptive statistics, including the biographical and educational profile of the candidates. The distributions of the data for the eight aptitude measures, according to the assessment phase, are also discussed. The chapter then outlines the recommendation results for the two assessment phases as well as the eight instruments' results. The final section contains an analysis of the nine hypotheses. Section 4.2 commences chapter four with the presentation and explanation of the study's descriptive statistics using frequency and data distribution tables.

4.2 Descriptive statistics

This section is divided into four parts with section 4.2.1 initiating the section by providing particulars on the respondents' biographical and educational profile. The second part outlines the distribution of the stanine data results obtained with section 4.2.3 indicating the recommendation outcomes realised in the two assessment phases of this study. Section 4.2.4 then concludes the section by delineating the findings from the eight sub-tests' results.

4.2.1 Biographical and educational profile of applicants

In this section details and frequency tables are provided of the respondents' age, race, gender and secondary education type. Additionally, analysis is provided on the Mathematics and Science marks obtained for those respondents who completed these subjects. The main findings

of the biographical and educational profiling are then summarised in the final section. Section 4.2.1.1 commences the profiling of the study's sample by indicating the age distribution.

4.2.1.1 Age distribution

As can be determined from Table 4.1, the majority (45.3%) of the sample (N = 2 463) were between 25 to 29 years old. The second largest age distribution category (22.8%) was found in the 30 to 34 year old category, whilst candidates who were between 20 and 24 years old occupied the third largest age distribution category (22.1%). The remaining respondents (9.8%) were between the ages of 15 to 19 years (0.2%); 35 to 39 years (7.7%); 40 to 44 years (1.6%); 45 to 49 years (0.2%) and 50 to 54 years (0.1%).

Table 4.1

Frequency Distribution of Applicants' Age

	Age	*f*	%	Valid %	Cumulative %
Valid	15-19	6	0.2	0.2	0.2
	20-24	554	22.1	22.1	22.3
	25-29	1 115	45.3	45.3	67.6
	30-34	562	22.8	22.8	90.4
	35-39	189	7.7	7.7	98.1
	40-44	40	1.6	1.6	99.7
	45-49	5	0.2	0.2	99.9
	50-54	2	0.1	0.1	100.0
	Total	2 463	100.0	100.0	-

Following the age discussion, section 4.2.1.2 that follows provides information on the race distribution of the candidates.

4.2.1.2 Race distribution

In terms of race distribution a noteworthy proportion (81.8%) of the sample (N = 2 463) were Black. The second highest race distribution category was the Coloured category at 16.8%.

As depicted in Table 4.2, the remainder of the sample consisted of Indians (0.5%) and Whites (0.9%).

Table 4.2

Frequency Distribution of Applicants' Race

	Race	*f*	%	Valid %	Cumulative %
Valid	Black	2 015	81.8	81.8	81.8
	Coloured	413	16.8	16.8	98.6
	Indian	12	0.5	0.5	99.1
	White	23	0.9	0.9	100.0
	Total	2 463	100.0	100.0	-

Having explicated the sample's race allotment, the section that follows indicates the gender distribution of the study's respondents.

4.2.1.3 Gender distribution

Table 4.3 highlights that the considerable majority (65.7%) of the sample (N = 2 463) were revealed to be male, whilst 34. 3% were female.

Table 4.3

Frequency Distribution of Applicants' Gender

	Gender	*f*	%	Valid %	Cumulative %
Valid	Male	1 619	65.7	65.7	65.7
	Female	844	34.3	34.3	100.0
	Total	2 463	100.0	100.0	-

A designation of the type of Grade 12 qualification obtained by the candidate pool is outlined in the subsequent section.

4.2.1.4 Secondary education type distribution

As can be noted in Table 4.4, a large portion (44.4%) of the sample (N = 2 463) achieved a secondary education with Mathematics and Science as subjects. The second highest category (25.1%) was the general type of matriculation, with neither Mathematics nor Science as subjects in Grade 12. Respondents who completed their Grade 12 qualification with Mathematics as a Grade 12 subject were the third highest category at 19.2%. A technical N3, a Grade 12 equivalent, was completed by 7.3% of the sample. The remaining 3.9% of the candidates had completed a Grade 12 with Science as a subject.

Table 4.4

Frequency Distribution of Applicants' Type of Secondary Education

	Secondary education type	*f*	%	Valid %	Cumulative %
Valid	Mathematics and Science	1 094	44.4	44.4	44.4
	Mathematics	474	19.2	19.2	63.7
	Science	96	3.9	3.9	67.6
	Technical	180	7.3	7.3	74.9
	General	619	25.1	25.1	100.0
	Total	2 463	100.0	100.0	-

Following this discussion on the matriculation type obtained, the pass mark obtained by the respondents who completed Mathematics as a Grade 12 subject is summarised in the section that follows.

4.2.1.5 Mathematics mark distribution

A total of 1 748 candidates (71% of the sample) completed Mathematics as a Grade 12 subject. Of this total, however, 0.2% did not pass the subject at the minimum 30% promotional requirement. Just over 10% passed the subject with a 30 to 39 percentage mark, whilst 25.6% passed with a percentage mark ranging from 40 to 49. Table 4.5 highlights that the largest grouping of candidates (28.3%) obtained percentage marks from 50 to 59, with 21.8% obtaining percentage marks ranging from 60 to 69. The residual 13.5% achieved over 70% for Mathematics, 8.2% scoring between 70 to 79% and 5.3% achieving over 80% for this subject.

Table 4.5

Frequency Distribution of Applicants' Mathematics Marks

	Mathematics mark	*f*	%	Valid %	Cumulative %
	20-29	4	0.2	0.2	0.2
	30-39	184	7.5	10.5	10.7
	40-49	447	18.1	25.6	36.3
Valid	50-59	495	20.1	28.3	64.6
	60-69	381	15.5	21.8	86.4
	70-79	144	5.8	8.2	94.6
	80-100	93	3.8	5.3	100.0
	Total	1 748	71.0	100.0	-
Missing[a]	System	715	29.0	-	-
Total		2 463	100.0	-	-

Note. [a] These applicants did not complete Grade 12 with Mathematics as a subject.

Having presented the range distribution of Mathematics marks obtained by a portion of the sample in section 4.2.1.5, the Science marks obtained are outlined in the next section.

4.2.1.6 Science mark distribution

As depicted in Table 4.6, over half (55.6%) of the total respondent pool completed their Grade 12 qualification with Science as one of the subjects. However, 0.4% of this portion of the sample (n = 1 370) did not achieve the minimum 30% promotional requirement. Slightly more than a quarter (25.2%) passed the subject with percentage scores between 30 to 39, 43.7% with scores ranging from 40 to 49% and 19.3% with scores varying from 50 to 59%. Less than ten percent (9.1%) obtained scores between 60 to 69% for the subject and 1.6% passed with marks from 70 to 79%. The final group of 0.7% passed the subject with a mark in the 80 to 100 percentage category.

Table 4.6

Frequency Distribution of Applicants' Science Mark

	Science mark	*f*	%	Valid %	Cumulative %
Valid	20-29	6	0.2	0.4	0.4
	30-39	345	14.0	25.2	25.6
	40-49	599	24.3	43.7	69.3
	50-59	264	10.7	19.3	88.6
	60-69	125	5.1	9.1	97.7
	70-79	22	0.9	1.6	99.3
	80-100	9	0.4	0.7	100.0
	Total	1 370	55.6	100.0	-
Missing[a]	System	1 093	44.4	-	-
Total		2 463	100.0	-	-

Note. [a] These applicants did not complete Grade 12 with Science as a subject.

The subsequent section summarises the key findings stemming from the respondents' biographical and educational profiles.

4.2.1.7 Main findings

The central findings related to the descriptive statistics are:

- The majority (45.3%) of the respondents who participated in this study are between 25 and 29 years old. The second largest group (22.8%) of applicants was found within the 30 to 34 year age category.
- Over 80% of the respondents surveyed in this study are Black, with the second largest group (16.8%) being Coloured.
- It was established that the preponderance (65.7%) of this study's sample are male.
- A Grade 12 qualification, including Mathematics and Science as subjects, was attained by the greater part (44.4%) of the study's candidates. Slightly over a quarter of the sample obtained a general type of secondary education.

- The largest distribution grouping (28.3%) for Mathematics Grade 12 marks was in the 50 to 59 percentage category, with the second largest distribution grouping (25.6%) attaining marks ranging from 40 to 49%.
- The majority (43.7%) of those with Science as a Grade 12 subject obtained a 40 to 49 percentage mark, with just over a quarter realising between 30 to 39% for the subject.

This summary concludes the findings pertaining to the candidates' biographical and educational profiles. Section 4.2.2 that follows outlines the distribution of the stanine data.

4.2.2 Distribution of stanine data

This section comprises of three parts. Initially, the distribution of the phase one general aptitude measures, namely, verbal reasoning, non-verbal reasoning and comparison, is outlined. Section 4.2.2.2 continues by elucidating the distribution of the phase two technical aptitude tools, being dexterity, co-ordination, assembly, spatial perception 2-D and 3-D. The final part of this section then provides a summation of the section's main findings.

4.2.2.1 Distribution of the phase one sub-tests

Table 4.7 indicates the medians and modes calculated for the three aptitude measures employed in phase one. The medians for these tools were in the moderate (stanine four to six) range with the verbal reasoning sub-test's median being slighter higher than that obtained for both the non-verbal reasoning and comparison instruments. Table 4.7 also depicts that modes of seven, in the high range, were achieved for each of the three phase one sub-tests.

Table 4.7

Medians and Modes of Phase One Sub-tests

Phase one sub-tests	*Mdn*	*Mo*
Verbal reasoning	6	7
Non-verbal reasoning	5	7
Comparison	5	7

Note. The distribution of the data is recorded in stanine format.

In order to further understand the data distribution, section 4.2.2.2 offers details pertaining to the distribution of the five phase two aptitude techniques.

4.2.2.2 Distribution of the phase two sub-tests

The medians and modes determined for the five technical aptitude instruments are presented in Table 4.8. The 2-D and 3-D spatial perception tools recorded the highest medians at seven, being in the high range. The medians for the assembly and co-ordination sub-tests were within the moderate range, being six and five respectively. The lowest median, three, was found for the dexterity measure.

The highest mode, nine, was established for the spatial perception 2-D sub-test, with the second highest mode, being seven, recorded for the spatial perception 3-D instrument. The mode for the assembly sub-test was six, while a mode of five was documented for the co-ordination tool. The mode for the dexterity sub-test was the lowest at three.

Table 4.8

Medians and Modes of Phase Two Sub-tests

Phase two sub-tests	*Mdn*	*Mo*
Dexterity	3	3
Co-ordination	5	5
Assembly	6	6
Spatial perception 2-D	7	9
Spatial perception 3-D	7	7

Note. The distribution of the data is recorded in stanine format.

The distribution of the stanine data for the two assessment phases has been documented. This section is concluded with the main findings documented in section 4.2.2.3.

4.2.2.3 Main findings

The main findings related to the distribution of the eight sub-tests' data are:

- In phase one, the median was at the sixth stanine score for the verbal reasoning measure, whilst a lower median (fifth stanine) was attained for the non-verbal reasoning and comparison instruments.
- A stanine score of seven was the most frequent score achieved for each of the three sub-tests in phase one of this study.
- With reference to phase two, it is evident that the dexterity measure, given the low median and mode achieved, was the most challenging technical tool.
- The spatial perception 2-D tool was the highest scoring sub-test of phase two, with a stanine score of nine commonly being achieved by the sample.

Section 4.2.2 has detailed the distribution of the stanine data's findings in the two assessment phases employed in this study. Following on from this discussion is an analysis of the number of candidates recommended following each of these assessment phases. Section 4.2.3 explores the findings pertaining to these descriptive statistics.

4.2.3 Assessment phase results

Section 4.2.3 consists of three parts. Section 4.2.3.1 provides details of the respondents who were successful in phase one, the general aptitude testing phase. Section 4.2.3.2 then specifies the outcomes of the technical aptitude testing, phase two of the study. This section is concluded with a synopsis of the focal results.

4.2.3.1 Phase one assessment results

In order to be recommended to the second assessment phase, a minimum of a stanine three was required for each instrument in the first phase. As depicted in Table 4.9, the majority (65.6%) of the sample (N = 2 463) were recommended to proceed to phase two of the assessment process. Over a third (34.4%) of the respondents were not recommended for the next phase in the selection process.

Table 4.9

Frequency Distribution of Applicants' Phase One Assessment Results

	Assessment judgement	*f*	%	Valid %	Cumulative %
Valid	Recommended	1 615	65.6	65.6	65.6
	Not recommended	848	34.4	34.4	100.0
	Total	2 463	100.0	100.0	-

Section 4.2.3.2 that follows details the consequences of the second phase of aptitude testing.

4.2.3.2 Phase two assessment results

A minimum stanine four score was required for each of the sub-tests in this phase to qualify for recommendation to the subsequent stage of the automobile operator selection process. However, if a stanine four score had been attained for the first phase comparison tool, a lower stanine score for the dexterity sub-test still resulted in a recommendation from the second assessment phase. Table 4.10 highlights that, in terms of phase two, 70.1% of the candidate pool (n = 1 566) were recommended, whilst 29.9% were not.

Table 4.10

Frequency Distribution of Applicants' Phase Two Assessment Results

	Assessment judgement	*f*	%	Valid %	Cumulative %
Valid	Recommended	1 098	44.6	70.1	70.1
	Not recommended	468	19.0	29.9	100.0
	Total	1 566	63.6	100.0	-
Missing[a]	System	897	36.4	-	-
Total		2 463	100.0	-	-

Note. [a] These applicants were not successful in phase one of the assessment process and therefore did not complete the phase two sub-tests.

The frequency distribution of the results obtained in the two assessment phases has been explained. A précis of the section's central findings is provided in the subsequent section.

4.2.3.3 Main findings

The main findings related to the two assessment phase results are:

- The majority (65.6%) of the respondents who were involved in this study were recommended to phase two of the selection process.
- Just under a third (29.9%) of the phase two candidates were not recommended as potential automotive operators.

With regard to the descriptive statistics employed in this study, this section has thus far explicated the applicants' biographical and educational profile through the use of frequency tables. The distribution of the stanine data and the frequency distribution of the two assessment phases have also been elucidated. Section 4.2.4 that follows concludes the descriptive statistics employed in this study through describing the results achieved in each of the eight aptitude techniques used in this study.

4.2.4 Sub-test results

This section provides details of the sample's results in each of the eight aptitude instruments employed in this study, namely, verbal reasoning, non-verbal reasoning, comparison, dexterity, co-ordination, assembly, spatial perception 2-D and 3-D. The initial three sub-tests form part of the first assessment phase, with the latter five measures constituting the second phase of the study. An explanation of the stanine scores achieved by the respondents is initially provided followed by the frequency distribution table for each sub-test. As clarified in section 3.7, the stanine scores were sorted into three categories, namely, low, moderate and high. In the discussion of the results obtained for each measure these categories are referred to as well as the percentile ranks and minimum qualifying criterion, also explained in section 3.7. The main findings of this section are presented in section 4.2.4.9. The section commences with a synopsis of the results obtained for the verbal reasoning technique.

4.2.4.1 Verbal reasoning sub-test results

For this measure, 8.3% of the sample (N = 2 463) obtained low scores ranging from the first to the third stanine. However, only 3.7% of the candidates that attempted this sub-test did not realise the minimum cut-off requirement stipulated for the instrument. In comparison, 45.1%

of the respondents attained moderate stanine scores in this sub-test. As can be determined from Table 4.11, the largest frequency distribution grouping (46.7%), however, was found in the high stanine scoring category, between the seventh and ninth stanine. The latter finding means that almost half of the study's respondents are regarded as above average to superior, outperforming at least 77% of the South African population, in this aptitude (Coetzee & Vosloo, 2000).

In terms of specific stanine score categories, the largest frequency distribution (19.9%) was achieved at the seventh stanine, placing this segment of the sample in the above average category mentioned in the previous paragraph. Table 4.11 also elucidates that a further 19.2% of the sample realised a sixth stanine score, the second most frequent stanine score in this sub-test. These candidates are deemed high average in this aptitude, being capable of outdoing at least 60% of the South African population (Coetzee & Vosloo, 2000).

Table 4.11

Frequency Distribution of Applicants' Verbal Reasoning Scores

	Stanine score	*f*	%	Valid %	Cumulative %
Valid	1	39	1.6	1.6	1.6
	2	51	2.1	2.1	3.7
	3	114	4.6	4.6	8.3
	4	216	8.8	8.8	17.1
	5	421	17.1	17.1	34.1
	6	473	19.2	19.2	53.3
	7	489	19.9	19.9	73.2
	8	440	17.9	17.9	91.1
	9	220	8.9	8.9	100.0
	Total	2 463	100.0	100.0	-

The second aptitude tool was applied, that of non-verbal reasoning, and the results are reported in section 4.2.4.2 that follows.

4.2.4.2 Non-verbal reasoning sub-test results

Table 4.12 depicts the wide frequency distribution of the stanine scores realised in the non-verbal reasoning measure. Over 80% of the sample (N = 2 463) obtained stanine scores between two and seven. The largest frequency distribution (39%) was attained within the moderate scoring range. High category stanine scores were acquired by 29.1% of the applicants, the majority (14.9%) being realised at the seventh stanine. Just under a third (31.9%) of the sample achieved results within the low stanine scoring category. Furthermore, in this sub-test, 19.5% of the candidates did not attain the qualifying screening criterion determined for the measure.

With regard to the frequency distributions realised for the singular stanine categories, the second largest grouping (14.7%) of candidates achieved a stanine score of two, placing them in the far below average cluster. Being in this low scoring category, this grouping would probably be outperformed by 90% of the South African population in terms of their non-verbal reasoning abilities (Coetzee & Vosloo, 2000). Conversely, the largest particular stanine frequency distribution (14.9%) was found at the seventh stanine score. In this case, these respondents are likely to surpass at least 77% of the South African population in this aptitude (Coetzee & Vosloo, 2000).

Table 4.12

Frequency Distribution of Applicants' Non-verbal Reasoning Scores

	Stanine score	*f*	%	Valid %	Cumulative %
Valid	1	118	4.8	4.8	4.8
	2	362	14.7	14.7	19.5
	3	305	12.4	12.4	31.9
	4	311	12.6	12.6	44.5
	5	339	13.8	13.8	58.3
	6	310	12.6	12.6	70.8
	7	367	14.9	14.9	85.7
	8	215	8.7	8.7	94.5
	9	136	5.5	5.5	100.0
	Total	2 463	100.0	100.0	-

Having outlined the second instrument's results, the next section discusses the stanine frequency distribution results of the third aptitude measure employed in this study.

4.2.4.3 Comparison sub-test results

For this tool there was a broad frequency dispersal of stanine scores attained by the sample (N = 2 463). Low scores were achieved by 29.8% of the respondents, whilst 38.2% accomplished scores within the moderate stanine category. The residual 31.9% of the sample realised high scores. In terms of fulfilling the minimum cut-off requirement for this instrument, 18.1% were not able to accomplish this benchmark. However, it is noteworthy that 70.2% of the sample obtained stanine scores of four and above thereby increasing the likelihood of this portion of the sample being recommended in the second phase should their dexterity scores not attain the minimum cut-off set for this sub-test.

Table 4.13 also illustrates that the largest frequency distribution (15.5%) achieved for a singular stanine grouping was at the seventh stanine score. This faction is regarded as above average, expected to do better than 77 to 90% of the South African population in terms of their visual perceptual speed (Coetzee & Vosloo, 2000). The second highest specific stanine frequency

distribution (14.6%) was found at the fifth stanine within the moderate category. This segment of applicants would, hence, be considered as average and is likely to outperform between 40 to 60% of the South African population in this aptitude.

Table 4.13

Frequency Distribution of Applicants' Comparison Scores

	Stanine score	*f*	%	Valid %	Cumulative %
	1	137	5.6	5.6	5.6
	2	310	12.6	12.6	18.1
	3	288	11.7	11.7	29.8
	4	282	11.4	11.4	41.3
Valid	5	359	14.6	14.6	55.9
	6	301	12.2	12.2	68.1
	7	381	15.5	15.5	83.6
	8	252	10.2	10.2	93.8
	9	153	6.2	6.2	100.0
	Total	2 463	100.0	100.0	-

Section 4.2.4.4 that follows depicts the results achieved for the dexterity sub-test, the first technical aptitude instrument utilised in the study.

4.2.4.4 Dexterity sub-test results

Of the portion of the sample (n = 1 566) that completed this tool, the majority (54.1%) attained low scores. Being far below average to below average, these respondents are predicted to be outdone by 77 to 96% of the South African population in their two-hand eye co-ordination (Taljaard, 1983). Furthermore, these candidates would not have achieved the qualifying screening requirement stipulated for this sub-test, unless they had realised a stanine four or higher score in the comparison instrument (that is, within the first assessment phase). Moderate category scores were achieved by 44.9% of the sample with only one percent realising high scores. However, Table 4.14 indicates that no scores were tabulated for the ninth stanine score

within this measure. Given this distribution, it is noted that there was an accumulation of results (92.2%) between the second and fifth stanines for this instrument.

The largest particular stanine frequency distribution grouping (33.3%) was at the third stanine. As indicated in the previous paragraph, this portion of the sample, being below average, would be expected to be outperformed by at least 77% of the South African population in this aptitude (Taljaard, 1983). The second highest frequency distribution (26.8%) realised for a singular stanine category was at the fourth stanine. In this case, these candidates are deemed low average and are hence likely to be outperformed by approximately 60% of the South African population in their two-hand eye co-ordination ability.

Table 4.14

Frequency Distribution of Applicants' Dexterity Scores

	Stanine score	*f*	%	Valid %	Cumulative %
Valid	1	36	1.5	2.3	2.3
	2	290	11.8	18.5	20.8
	3	521	21.2	33.3	54.1
	4	420	17.1	26.8	80.9
	5	213	8.6	13.6	94.5
	6	70	2.8	4.5	99.0
	7	14	.6	0.9	99.9
	8	2	.1	0.1	100.0
	Total	1 566	63.6	100.0	-
Missing[a]	System	897	36.4	-	-
Total		2 463	100.0	-	-

Note. [a] These applicants were not successful in phase one of the assessment process and therefore did not complete the phase two sub-tests.

The frequency distributions of the stanine scores achieved for the co-ordination instrument are discussed in the subsequent section.

4.2.4.5 Co-ordination sub-test results

As portrayed in Table 4.15 the majority (69.5%) of the sample (n = 1 566) that fulfilled this sub-test obtained moderate scores, ranging from the fourth to the sixth stanine. High category scores were achieved by 19.9% of the sample, the majority (15.3%) stemming from the seventh stanine. With regard to the low scoring category, 10.6% of the applicants' results were within this classification. Therefore, almost 90% of the applicants that attempted this instrument achieved the stipulated minimum cut-off requirement. It is noteworthy that within this measure there was a clustering (84.8%) of scores between the fourth and seventh stanines.

The second largest specific stanine frequency distribution grouping (20.5%) was realised at the sixth stanine, whilst the largest frequency grouping (29.1%) was accomplished at the fifth stanine score. Being considered as average in their hand-eye co-ordination, this latter grouping could be expected to surpass 40 to 60% of the South African population in this aptitude (Taljaard, 1983).

Table 4.15

Frequency Distribution of Applicants' Co-ordination Scores

	Stanine score	*f*	%	Valid %	Cumulative %
	1	5	0.2	0.3	0.3
	2	31	1.3	2.0	2.3
	3	130	5.3	8.3	10.6
	4	312	12.7	19.9	30.5
Valid	5	456	18.5	29.1	59.6
	6	321	13.0	20.5	80.1
	7	239	9.7	15.3	95.4
	8	56	2.3	3.6	99.0
	9	16	0.6	1.0	100.0
	Total	1 566	63.6	100.0	-
Missing[a]	System	897	36.4	-	-
Total		2 463	100.0	-	-

Note. [a] These applicants were not successful in phase one of the assessment process and therefore did not complete the phase two sub-tests.

The next section discusses the stanine frequency distribution results achieved for the third technical aptitude technique employed in this study.

4.2.4.6 Assembly sub-test results

In this instrument, low category scores were realised by 5.8% of the sample (n = 1 566), the preponderance (3.4%) arising from the third stanine score. Therefore, almost 95% of the sample attained the predetermined qualifying screening criterion for this instrument. Whilst 48% of the candidates achieved moderate scores, the remaining 46.2% of the respondents realised high category scores, being between the seventh and ninth stanine.

Table 4.16 highlights that the largest singular stanine frequency distribution grouping (22.7%) of scores was attained at the sixth stanine. This elucidates that this portion would

probably outperform at least 60% of the South African population in their ability to mentally assemble illustrations of mechanical parts to form a given mechanical object (Taljaard, 1983).

Table 4.16

Frequency Distribution of Applicants' Assembly Scores

	Stanine score	*f*	%	Valid %	Cumulative %
	1	15	0.6	1.0	1.0
	2	23	0.9	1.5	2.4
	3	53	2.2	3.4	5.8
	4	82	3.3	5.2	11.0
Valid	5	315	12.8	20.1	31.2
	6	355	14.4	22.7	53.8
	7	261	10.6	16.7	70.5
	8	234	9.5	14.9	85.4
	9	228	9.3	14.6	100.0
	Total	1 566	63.6	100.0	-
Missing[a]	System	897	36.4	-	-
Total		2 463	100.0	-	-

Note. [a] These applicants were not successful in phase one of the assessment process and therefore did not complete the phase two sub-tests.

The fourth instrument was applied, that of spatial perception 2-D, and the results are reported in the following section.

4.2.4.7 Spatial perception 2-D sub-test results

It is noteworthy that the majority (52.9%) of the sample (n = 1 566) attained high category scores in this tool, between stanines seven to nine. Being above average to superior, this segment of the respondents is likely to surpass between 77 to 96% of the South African population in this aptitude (Taljaard, 1983). Moderate scores were achieved by 36.3% of the candidates and, as illustrated in Table 4.17, low stanine scores were realised by 10.9% of the

sample. Therefore, almost 90% of the sample achieved the minimum cut-off requirement stipulated for this measure.

The largest specific stanine frequency distribution group (27.5%) was at the ninth stanine score. As mentioned in the previous paragraph, these applicants realised a superior rating in their two-dimensional spatial perception ability (Taljaard, 1983). Within the moderate scoring category the second largest particular stanine frequency distribution group (18.9%) was located at the fifth stanine. Rated average in their ability to accurately perceive two-dimensional geometric shapes, this faction of respondents is expected to outperform between 40 to 60% of the South African population in this regard (Taljaard, 1983).

Table 4.17

Frequency Distribution of Applicants' Spatial Perception 2-D Scores

	Stanine score	*f*	%	Valid %	Cumulative %
	1	47	1.9	3.0	3.0
	2	66	2.7	4.2	7.2
	3	57	2.3	3.6	10.9
	4	139	5.6	8.9	19.7
Valid	5	296	12.0	18.9	38.6
	6	133	5.4	8.5	47.1
	7	202	8.2	12.9	60.0
	8	196	8.0	12.5	72.5
	9	430	17.5	27.5	100.0
	Total	1 566	63.6	100.0	-
Missing[a]	System	897	36.4	-	-
Total		2 463	100.0	-	-

Note. [a] These applicants were not successful in phase one of the assessment process and therefore did not complete the phase two sub-tests.

The results of the final technical aptitude tool, namely, spatial perception 3-D, will be acknowledged in section 4.2.4.8 that follows.

4.2.4.8 Spatial perception 3-D sub-test results

Table 4.18 indicates that in this measure, 5.7% of the sample (n = 1 566) obtained low category scores, whilst 38.3% realised moderate scores. However, the majority (55.9%) of the candidates accomplished high category scores. Whilst almost 95% of the applicants achieved the predetermined qualifying criterion for this tool, a significant portion (45.8%) thereof was realised at the sixth and seventh stanine.

As alluded to in the previous paragraph, the second largest specific stanine frequency distribution (20.5%) was established at the sixth stanine. This faction would probably outperform 60% of the South African population in terms of their three-dimensional spatial perceptual ability (Taljaard, 1983). Furthermore, the largest frequency distribution noted for a singular stanine was achieved by 25.3% of the respondents at the seventh stanine. This group is expected to surpass between 77 to 89% of the South African population in this aptitude (Taljaard, 1983).

Table 4.18

Frequency Distribution of Applicants' Spatial Perception 3-D Scores

	Stanine score	*f*	%	Valid %	Cumulative %
	1	11	0.4	0.7	0.7
	2	25	1.0	1.6	2.3
	3	54	2.2	3.4	5.7
	4	117	4.8	7.5	13.2
Valid	5	162	6.6	10.3	23.6
	6	321	13.0	20.5	44.1
	7	396	16.1	25.3	69.3
	8	215	8.7	13.7	83.1
	9	265	10.8	16.9	100.0
	Total	1 566	63.6	100.0	-
Missing[a]	System	897	36.4	-	-
Total		2 463	100.0	-	-

Note. [a] These applicants were not successful in phase one of the assessment process and therefore did not complete the phase two sub-tests.

The final part of this section condenses the focal findings from a review of the eight aptitude instruments' results.

4.2.4.9 Main findings

The central findings related to the eight sub-tests' results are:

- The vast majority (96.3%) of the study's respondents achieved the stanine three minimum score requirement for the verbal reasoning tool. Furthermore, 65.9% of the sample accomplished a high average to superior rating (scoring at the sixth and above stanine scores) placing them in the top 40% of the South African population in this aptitude (Coetzee & Vosloo, 2000).
- Almost twenty percent (19.5%) of the candidates involved in this study did not achieve stanine three, the minimum score required for the non-verbal reasoning measure. In addition, almost half (44.5%) the sample attained scores in this sub-test that categorises them as far below average to low average (scoring at the fourth and below stanine scores) in this aptitude, as compared to the South African population (Coetzee & Vosloo, 2000).
- Over eighty percent (81.9%) of the study's candidates achieved a stanine of three and above for the comparison tool, thus achieving the requisite recommendation condition. There was a wide distribution of scores noted in this sub-test ranging from a far below average to superior rating in relation to the South African population for this aptitude (Coetzee & Vosloo, 2000).
- It was established that over half (54.1%) of the respondents surveyed in this study scored a stanine three or less on the dexterity instrument thus not meeting one of the minimum requirements set for this sub-test. This means that the majority of the study's respondents are rated as below average to far below average (scoring at the third and below stanine scores) in this aptitude in comparison to the South African population (Taljaard, 1983).
- For the co-ordination measure, the bulk (89.4%) of the study's sample accomplished the stanine four minimum score requirement. However, only 19.9% of this portion of the respondents attained scores rating them above average (scoring at the seventh and

above stanine scores) on this aptitude with respect to the South African population (Taljaard, 1983).

- Over ninety percent (94.2%) of the sample achieved the stanine four minimum condition predetermined for the assembly tool. Just below seventy percent (68.9%) of this portion of the sample realised scores higher than the average rating (between the sixth and ninth stanine scores) in contrast to the South African population (Taljaard, 1983).
- With regard to the spatial perception 2-D sub-test, just over ten percent (10.9%) of the candidates did not attain a stanine score of four thereby not accomplishing the minimum selection cut-off requirement. However, over fifty percent (52.9%) of the sample achieved above average to superior scores (scoring at the seventh and above stanine scores), placing them in the top 20% in comparison to the South African population for this aptitude (Taljaard, 1983).
- For the spatial perception 3-D instrument, the vast majority (94.3%) of the respondents who were involved in this study accomplished the stanine four minimum score requirement. Furthermore, 76.4% of the sample realised a high average to superior rating (scoring between the sixth and ninth stanine scores) denoting them as part of the best 40% of the South African population in this aptitude (Taljaard, 1983).

Section 4.2.2.9 has abridged the main findings realised from the sub-tests' results thereby concluding the descriptive statistics section for this chapter. The evaluation of the study's hypotheses is discussed in section 4.3 that follows.

4.3 Analysis of hypotheses

Section 4.3 consists of ten parts. The first eight sections, namely 4.3.1 to 4.3.8, provide the results of the hypotheses pertaining to the eight aptitude techniques employed in this study. For these eight hypotheses a Chi-square test of independence was performed to examine the relationship between the type of secondary education and the stanine scores attained, grouped according to low, moderate and high scores. As indicated in section 3.7, a low scoring category included stanine scores one to three, the moderate category related to the fourth to sixth stanines and a high scoring category pertained to the seventh to ninth stanines. An alpha level of .05 was

used for these tests of statistical significance. Furthermore, the practical significance of the hypotheses' findings were interpreted and evaluated according to the guidelines specified in section 3.6.6.

Section 4.3.9 continues with a summarisation of the results obtained from the ninth hypothesis. For this hypothesis a Chi-square test of independence was also executed to study whether a relationship existed between the type of secondary education and employability as an automobile operator. Once again the alpha level was set at .05 for this statistical test. The findings in this section are also discussed in relation to the three stanine scoring categories explained in section 3.7. For the ninth hypothesis the strength of the association between the two variables is described according to the interpretation guidelines provided in section 3.6.6. The final part of this section, namely, section 4.3.10, offers a précis of the section's main findings. Section 4.3.1 commences the section with a depiction of the results for hypothesis one.

4.3.1 Hypothesis one results

The null hypothesis stated that the type of matriculation obtained would not have an influence on the verbal reasoning sub-test scores. However, the results revealed that the relationship between the type of secondary education and the verbal reasoning stanine scores was statistically significant, $X^2(8, N = 2\ 463) = 44.08$, $p < .001$, $V = 0.08$. The relationship between these two variables was exposed as being both statistically significant ($p = .0001$) and practically significant ($V = 0.08$). The effect size between the dependent and independent variables in this hypothesis was regarded as large and hence contextualises the importance of this hypothesis' findings (Pallant, 2013). The alternate hypothesis for hypothesis one was, therefore, accepted as this type of Grade 12 qualification obtained by the applicants had an affect on the verbal reasoning sub-test scores achieved.

Table 4.19 highlights that respondents (52%) with Mathematics as a subject in their Grade 12 qualification obtained higher scores in this sub-test than applicants with the other four types of secondary education. High scores were also acquired by candidates with Mathematics and Science as matriculation subjects, although at a lower percentage level (48%) than those who only had Mathematics as a subject. A technical matriculation type was associated with moderate

stanine scores (57%); however, this group also achieved a significantly large percentage (16%) in the low scoring category. Respondents with Science as a Grade 12 qualification subject and those with a general type secondary education also realised scores in the moderate stanine category (52% and 46% respectively). Nevertheless, the group with a technical Grade 12 qualification outperformed both these groupings in the moderate stanine category.

The group with a secondary education that included Science as a subject was ranked as the top performer in this instrument as at least 98% of its candidates obtained the stipulated stanine three minimum cut-off requirement. A Grade 12 qualification inclusive of Mathematics and one with Mathematics and Science were rated second and third respectively as no less than 93% and 92%, in that order, attained the sub-test's qualifying criterion. The general type secondary education was ranked fourth with at least 91% obtaining the minimum prerequisite whilst no less than 85% of the technical matriculation group achieved the same qualifying condition.

Table 4.19

Contingency Table of Observed Frequencies for the Verbal Reasoning Sub-test

	Type of secondary education		Stanine Scores Low (1-3)	Moderate (4-6)	High (7-9)	Totals
Group	Mathematics and Science	Count	86	481	527	1 094
		% within group	8	44	48	100
	Mathematics	Count	33	193	248	474
		% within group	7	41	52	100
	Science	Count	2	50	44	96
		% within group	2	52	46	100
	Technical	Count	28	102	50	180
		% within group	16	57	28	100
	General	Count	55	284	280	619
		% within group	9	46	45	100
Total		Count	204	1 110	1 149	2 463
		% within group	8	45	47	100

Note. $X^2(8, N = 2\ 463) = 44.08, p < .001, V = 0.08$

Having outlined hypothesis one's results, section 4.3.2 presents the findings for hypothesis two.

4.3.2 Hypothesis two results

The study's second null hypothesis was that the type of Grade 12 qualification obtained will not have an influence on the non-verbal reasoning sub-test scores. However, the alternate hypothesis was accepted for hypothesis two as the non-verbal reasoning scores attained were affected by the type of secondary education held by the candidates. A significant relationship, $X^2(8, N = 2\ 463) = 145.83, p < .001, V = 0.14$, was established between the type of matriculation and the non-verbal reasoning sub-test stanine scores. Specifically, the alternate hypothesis was accepted on the basis of there being a statistically significant ($p = .0001$) relationship between the

variables. Furthermore, the strength of the association between the variables was large ($V = 0.14$) highlighting the considerable practical significance of this hypothesis' findings (Pallant, 2013).

A significant portion (47%) of the candidates with a general type of education performed in the low stanine category and, hence, did not fare as well as applicants with the other four types of secondary education in this aptitude instrument. As depicted in Table 4.20 respondents with Science as a subject in their Grade 12 qualification also under-performed in this instrument as over 40% of the group obtained low stanine scores. Almost half (49%) the candidates with a technical type secondary education realised moderate stanine scores. Over forty percent of the candidates with Mathematics as a matriculation subject also achieved moderate scores in this measure; however, this group also achieved the largest percentage (37%) of candidates scoring in the high category. A secondary education with Mathematics and Science as subjects was linked to both moderate and high stanine scores.

In terms of achieving the stanine three cut-off requirement, at least 80% of the group with Mathematics in their Grade 12 qualification were successful resulting in this group being ranked the top performer in this tool. No less than 72% of the technical secondary education type and the matriculation inclusive of the Mathematics and Science subjects achieved this minimum prerequisite and both groups were thus ranked as the second best executors of this aptitude. The secondary education type with Science as a subject was ranked third, with at least 59% achieving the qualifying condition, and the general Grade 12 qualification being rated fourth with no less than 53% obtaining the cut-off requirement.

Table 4.20

Contingency Table of Observed Frequencies for the Non-verbal Reasoning Sub-test

	Type of secondary education		Stanine Scores Low (1-3)	Moderate (4-6)	High (7-9)	Totals
Group	Mathematics and Science	Count	310	403	381	1 094
		% within group	28	37	35	100
	Mathematics	Count	96	202	176	474
		% within group	20	43	37	100
	Science	Count	39	32	25	96
		% within group	41	33	26	100
	Technical	Count	50	88	42	180
		% within group	28	49	23	100
	General	Count	290	235	94	619
		% within group	47	38	15	100
Total		Count	785	960	718	2 463
		% within group	32	39	29	100

Note. $X^2(8, N = 2\ 463) = 145.83, p < .001, V = 0.14$

Hypothesis three's findings, the last phase one aptitude instrument, are expounded in the section that follows.

4.3.3 Hypothesis three results

The study's third null hypothesis, the type of Grade 12 qualification obtained will not have an influence on the comparison sub-test scores, was rejected. The alternate hypothesis was accepted as the type of secondary education obtained by the respondents did have an effect on the comparison scores attained. The association between the type of matriculation and the comparison sub-test stanine scores realised was significant, $X^2(8, N = 2\ 463) = 36.19, p < .001, V = 0.07$. A statistically significant p-value of .0001 was found to exist between the types of secondary education and the comparison sub-test scores, thereby indicating a low probability of this hypothesis' outcome being due to chance. Furthermore, the effect size for this finding,

Cramér's *V*, was medium at 0.07. The degree to which the two variables are associated with one another, therefore, reveals moderate practical significance for this hypothesis' findings (Pallant, 2013).

The technical Grade 12 qualification group had the largest percentage (37%) of respondents scoring in the low stanine score category for this instrument. Conversely, candidates with Mathematics and Science or just Mathematics as a secondary education subject achieved the largest (36% and 35% respectively) percentage of scores in the high stanine category. Table 4.21 also highlights that 44% of the applicants with a general type of matriculation and almost half (47%) with a secondary education including Science as a subject realised moderate stanine scores in this sub-test.

At least 73% of the candidates with Grade 12 qualifications including Mathematics or Science as subjects attained the qualifying stanine three requirement for this tool. Therefore, these two groups were rated as the top performers in this aptitude. The secondary education type inclusive of both Mathematics and Science was ranked second as no less than 71% of the respondents in this group attained this prerequisite. The general and technical matriculation types were ranked third and fourth respectively, with at least 68% and 63%, in that order, realising the minimum cut-off requirement specified for this measure.

Table 4.21

Contingency Table of Observed Frequencies for the Comparison Sub-test

	Type of secondary education		Stanine Scores Low (1-3)	Moderate (4-6)	High (7-9)	Totals
Group	Mathematics and Science	Count	315	386	393	1 094
		% within group	29	35	36	100
	Mathematics	Count	129	179	166	474
		% within group	27	38	35	100
	Science	Count	26	45	25	96
		% within group	27	47	26	100
	Technical	Count	67	61	52	180
		% within group	37	34	29	100
	General	Count	198	271	150	619
		% within group	32	44	24	100
Total		Count	735	942	786	2 463
		% within group	30	38	32	100

Note. $X^2(8, N = 2\ 463) = 36.19, p < .001, V = 0.07$

Section 4.3.4 portrays the results for hypothesis four, based on the first technical aptitude instrument of phase two.

4.3.4 Hypothesis four results

The fourth null hypothesis declared that the type of matriculation obtained would not have an influence on the dexterity sub-test scores. However, the alternate hypothesis was accepted as the relationship between the type of secondary education and the dexterity sub-test stanine scores was statistically significant, $X^2(8, n = 1\ 566) = 17.94, p < .001$. The p-value was .022 which is less than the significance level of .05; consequently, the null hypothesis was rejected on the basis that the two variables were statistically related.

Table 4.22 illustrates that low stanine scores on the dexterity tool were associated with the technical and general Grade 12 qualifications. Therefore, these two groups had the highest percentages of candidates (62% and 60% respectively) that did not achieve the recommended stanine four minimum requirement for this aptitude. On the other hand, moderate scores were mostly realised by candidates with Mathematics (51%) or Science (54%) as a subject in their secondary education. Respondents with Mathematics and Science as subjects in their matriculation were associated with low (54%) to moderate (45%) scores in this sub-test. High scores in this measure were only achieved by 1% of the total sample of applicants.

The secondary education type inclusive of the Science subject was ranked as the top performer in this instrument as 54% of this group's candidates obtained the stipulated stanine four minimum cut-off requirement. A Grade 12 qualification inclusive of Mathematics and one with Mathematics and Science were rated second and third respectively as 51% and 45%, in that order attained the sub-test's qualifying criterion. The general type secondary education was ranked fourth with 40% obtaining the minimum prerequisite whilst only 38% of the technical matriculation group achieved the same qualifying condition.

Table 4.22

Contingency Table of Observed Frequencies for the Dexterity Sub-test

	Type of secondary education		Stanine Scores			
			Low (1-3)	Moderate (4-6)	High (7-9)	Totals
Group	Mathematics and Science	Count	389	329	8	726
		% within group	54	45	1	100
	Mathematics	Count	162	170	1	333
		% within group	49	51	0	100
	Science	Count	27	32	0	59
		% within group	46	54	0	100
	Technical	Count	64	39	1	104
		% within group	62	38	0	100
	General	Count	205	133	6	344
		% within group	60	39	1	100
Total		Count	847	703	16	1 566
		% within group	54	45	1	100

Note. $X^2(8, n = 1\ 566) = 17.943^a$, $p < .001$

[a] Four cells (26.7%) have expected count less than 5. The minimum expected count is .60.

The findings for hypothesis five pertaining to the relationship between type of secondary education and the co-ordination sub-test are documented in the subsequent section.

4.3.5 Hypothesis five results

The study's fifth null hypothesis stated that the type of Grade 12 qualification obtained would not have an influence on the co-ordination sub-test scores. However, the relationship between the type of secondary education and the co-ordination stanine scores was statistically significant, $X^2(8, n = 1\ 566) = 16.02$, $p < .001$, $V = 0.06$. This resulted in the acceptance of the alternate hypothesis for hypothesis five. The significant correlation co-efficient for this relationship was found to be 16.02 and its significant *p*-value .042. The moderate practical significance of this hypothesis was established through the Cramér's *V* statistic. The effect size

for this finding (0.06) was medium thereby elucidating the judicious strength of association between the two variables in this hypothesis (Pallant, 2013).

Seventy percent of the respondents with Mathematics and Science as subjects in their matriculation and a general type of secondary education obtained moderate scores in this instrument. Candidates with Mathematics as a Grade 12 qualification subject achieved the largest percentage (23%) in the high scoring category. However, Table 4.23 also highlights that the majority (69%) of applicants with this type of Grade 12 qualification realised moderate scores. Similarly, applicants with Science as a subject in their secondary education mostly (69%) achieved moderate scores. A technical type matriculation obtained the highest percentage (19%) in the low stanine score category.

In terms of achieving the stanine four cut-off requirement, 92% of the group with Mathematics in their Grade 12 qualification were successful in this regard resulting in this group being ranked the top performer in this tool. Ninety-one percent of the secondary education type inclusive of the Science subject achieved this minimum prerequisite and this group was, therefore, ranked as the second best executor of this aptitude. The secondary education type with both the Mathematics and Science subjects as well as the general Grade 12 qualification were ranked third as 89% of both groups achieved the qualifying condition. The technical matriculation type was rated fourth as only 80% of this group’s candidates obtained the specified cut-off requirement.

Table 4.23

Contingency Table of Observed Frequencies for the Co-ordination Sub-test

	Type of secondary education		Stanine Scores Low (1-3)	Moderate (4-6)	High (7-9)	Totals
Group	Mathematics and Science	Count	80	507	139	726
		% within group	11	70	19	100
	Mathematics	Count	24	231	78	333
		% within group	7	69	23	100
	Science	Count	5	41	13	59
		% within group	8	69	22	100
	Technical	Count	20	70	14	104
		% within group	19	67	13	100
	General	Count	37	240	67	344
		% within group	11	70	19	100
Total		Count	166	1 089	311	1 566
		% within group	11	70	20	100

Note. $X^2(8, n = 1\ 566) = 16.02$, $p = .042$, $V = 0.06$

Section 4.3.6 that follows explains hypothesis six's results, the relationship between type of Grade 12 qualification and the assembly sub-test stanine results.

4.3.6 Hypothesis six results

The sixth null hypothesis declared that the type of secondary education obtained would not have an influence on the assembly tool scores. Nevertheless, a significant relationship, $X^2(8, n = 1\ 566) = 44.59$, $p < .001$, $V = 0.10$, was established between the type of Grade 12 qualification held and the assembly sub-test stanine scores. Thus, the alternate hypothesis was accepted and the null hypothesis rejected. The relationship between type of secondary education and the assembly stanine scores was characterised by a high, significant correlation co-efficient of 44.59 and a *p*-value of .0001 at a 95% confidence interval. Consequently, there was sufficient evidence of a statistically significant relationship between the dependent and independent

variables. Furthermore, the strength of the association between the variables was large ($V = 0.10$) highlighting the sizeable practical significance of this hypothesis' findings (Pallant, 2013).

High stanine scores were associated with candidates that had attained a matriculation with either Mathematics and Science or just Mathematics as subjects. For both of these types of secondary education, more than half (51%) of the applicants realised high stanine scores. Moderate to high scores were obtained by respondents (49% in each stanine scoring category) with Science as a secondary education subject. However, as depicted in Table 4.24, candidates who held a technical or general Grade 12 qualification achieved a higher percentage (56% and 60% respectively) in the moderate stanine category than candidates with the other types of secondary education.

Ninety-eight percent of the candidates with a Grade 12 qualification inclusive of the Science subject attained the qualifying stanine four requirement for this tool. Therefore, this group was rated as the top performer in this aptitude. The secondary education type inclusive of both Mathematics and Science and the technical Grade 12 qualification were both ranked second as 95% of the respondents in these two groups attained this prerequisite. The matriculation type inclusive of Mathematics was rated the third best executor of this measure as 94% achieved the minimum screening requirement. The general secondary education type was ranked fourth with 92% realising the minimum cut-off requirement specified for this measure.

Table 4.24 *Contingency Table of Observed Frequencies for the Assembly Sub-test*

	Type of secondary education		Stanine Scores Low (1-3)	Moderate (4-6)	High (7-9)	Totals
Group	Mathematics and Science	Count	36	317	373	726
		% within group	5	44	51	100
	Mathematics	Count	20	143	170	333
		% within group	6	43	51	100
	Science	Count	1	29	29	59
		% within group	2	49	49	100
	Technical	Count	5	58	41	104
		% within group	5	56	39	100
	General	Count	29	205	110	344
		% within group	8	60	32	100
Total		Count	91	752	723	1 566
		% within group	6	48	46	100

Note. $X^2(8, n = 1\ 566) = 44.59, p < .001, V = 0.10$

The results for hypothesis seven, referring to the relationship between type of secondary education and the spatial perception 2-D instrument, are depicted in the next section.

4.3.7 Hypothesis seven results

The study's seventh null hypothesis is that the type of matriculation obtained would not have an influence on the spatial perception 2-D sub-test scores obtained. However, there was a significant relationship between the type of secondary education and the spatial perception 2-D sub-test stanine scores, $X^2(8, n = 1\ 566) = 39.83, p < .001, V = 0.09$. The *p*-value (.0001) was less than the significance level of .05 hence the null hypothesis was rejected on the basis that the two variables are statistically related. Furthermore, the Cramér's *V* statistic ($V = 0.09$) revealed a large effect size highlighting the considerable practical significance of this hypothesis' findings (Pallant, 2013).

Table 4.25 highlights that applicants with either Mathematics and Science or just Mathematics as subjects in their Grade 12 qualification obtained higher scores (57% and 56% respectively) in this tool than candidates with the other types of secondary education. Slightly less than half (46%) of the respondents with Science as a Grade 12 subject achieved high stanine scores. The general type of matriculation group attained the largest percentage (19%) in the low stanine score category, whilst respondents with Science as a Grade 12 qualification subject obtained the largest percentage (41%) in the moderate stanine category.

The secondary education types inclusive of both Mathematics and Science and only Mathematics were ranked the top performers in this instrument as 92% of their candidates obtained the stipulated stanine four minimum cut-off requirement. A technical Grade 12 qualification was rated second as 90% attained this qualifying criterion. The type of secondary education inclusive of the Science subject was ranked third with 87% obtaining the minimum prerequisite whilst only 82% of the general matriculation group achieved the same qualifying condition.

Table 4.25

Contingency Table of Observed Frequencies for the Spatial Perception 2-D Sub-test

	Type of secondary education		Stanine Scores Low (1-3)	Moderate (4-6)	High (7-9)	Totals
Group	Mathematics and Science	Count	60	251	415	726
		% within group	8	35	57	100
	Mathematics	Count	27	119	187	333
		% within group	8	36	56	100
	Science	Count	8	24	27	59
		% within group	14	41	46	100
	Technical	Count	11	38	55	104
		% within group	11	37	53	100
	General	Count	64	136	144	344
		% within group	19	40	42	100
Total		Count	170	568	828	1 566
		% within group	11	36	53	100

Note. $X^2(8, n = 1\ 566) = 39.83, p < .001, V = 0.09$

The outcomes for hypothesis eight, gleaned from the final technical aptitude technique, are outlined in section 4.3.8 that follows.

4.3.8 Hypothesis eight results

The study's eighth null hypothesis declared that the type of secondary education obtained would not have an influence on the spatial perception 3-D sub-test scores. However, the relationship between the type of Grade 12 qualification and the spatial perception 3-D sub-test stanine scores was statistically significant, $X^2(8, n = 1\ 566) = 46.96, p < .001, V = 0.10$. The relationship between the two variables within this hypothesis was exposed as being both statistically significant ($p = .0001$) and practically significant ($V = 0.10$). The effect size between the dependent and independent variables in this hypothesis was regarded as large and hence contextualises the importance of this hypothesis' findings (Pallant, 2013). The alternate

hypothesis for hypothesis eight was, therefore, accepted as the type of secondary education obtained by the candidates did have an effect on the spatial perception 3-D sub-test scores achieved.

Respondents with Mathematics as a subject in their matriculation realised higher scores (65%) in this instrument than candidates with the other types of secondary education. The second highest percentage (59%) of high stanine category scores was obtained by candidates with Mathematics and Science as subjects in their secondary education. Table 4.26 also highlights that a Grade 12 qualification with Science as a subject achieved a larger percentage (49%) of moderate stanine category results in comparison to the other types of secondary education. Just under half of the respondents with this type of matriculation also realised high stanine scores in this measure. The technical and general types of secondary education were also associated with moderate to high stanine scores, but these two groups did not fare as well as the other three types of Grade 12 qualifications.

In terms of achieving the stanine four cut-off requirement, 98% of the group with Science in their Grade 12 qualification were successful resulting in this group being ranked the top performer in this tool. Ninety-seven percent of the secondary education type inclusive of the Mathematics subject achieved this minimum prerequisite and this group was thus ranked as the second best executor of this aptitude. The secondary education type with both the Mathematics and Science as subjects was ranked third as 95% of the group achieved the qualifying condition. Ninety-one percent of the candidates with a technical matriculation type obtained the specified qualifying criterion resulting in this group being rated fourth. The general Grade 12 qualification was ranked the worst executor of this measure as only 90% of this group’s respondents obtained the specified cut-off requirement.

Table 4.26

Contingency Table of Observed Frequencies for the Spatial Perception 3-D Sub-test

	Type of secondary education		Stanine Scores Low (1-3)	Moderate (4-6)	High (7-9)	Totals
Group	Mathematics and Science	Count	37	258	431	726
		% within group	5	36	59	100
	Mathematics	Count	11	106	216	333
		% within group	3	32	65	100
	Science	Count	1	29	29	59
		% within group	2	49	49	100
	Technical	Count	9	44	51	104
		% within group	9	42	49	100
	General	Count	32	169	149	344
		% within group	9	47	43	100
Total		Count	90	600	876	1 566
		% within group	6	38	56	100

Note. $X^2(8, n = 1\ 566) = 46.96, p < .001, V = 0.10$

Section 4.3.9 that directly follows describes the results for hypothesis nine, the study's last hypothesis, relating to employability as an automotive operator.

4.3.9 Hypothesis nine results

It was hypothesised that the type of secondary education obtained would not influence the employability of operator applicants. However, the opposite was revealed to be correct in that a significant relationship between the type of Grade 12 qualification and the employability of the applicants as automotive operators, $X^2(4, n = 1\ 566) = 23.93, p < .001, V = 0.09$, was established. A significant correlation co-efficient (23.93) for the relationship between the variables was found with a statistically significant *p*-value at .0001. Furthermore, the Cramér *V* statistic ($V = 0.09$) revealed a large effect size highlighting the sizeable practical significance of this hypothesis'

findings (Pallant, 2013). This resulted in the acceptance of the alternate hypothesis for hypothesis nine.

A larger portion (75%) of candidates who achieved a matriculation with Science as a subject was recommended for employability as automobile operators than those with the other types of secondary education. Seventy-three percent of the applicants with Mathematics and Science as matriculation subjects were recommended, whilst 74% of the respondents with Mathematics as a secondary education subject were recommended. As illustrated in Table 4.27, a technical Grade 12 qualification obtained the highest percentage (42%) of respondents who were not recommended for employability as an automobile operator. The second largest group (38%) that was not recommended were from the general type of secondary education.

Table 4.27

Contingency Table of Observed Frequencies for Employability

	Type of secondary education		Employability		
			Recommended	Not recommended	Totals
Group	Mathematics and Science	Count	531	195	726
		% within group	73	27	100
	Mathematics	Count	248	85	333
		% within group	74	26	100
	Science	Count	44	15	59
		% within group	75	25	100
	Technical	Count	60	44	104
		% within group	58	42	100
	General	Count	215	129	344
		% within group	63	38	100
Total		Count	1 098	468	1 566
		% within group	70	30	100

Note. $X^2(4, n = 1\ 566) = 23.93, p < .001, V = 0.09$

Section 4.3.10 concludes the section by précising the main findings from the assessment of the study's nine hypotheses.

4.3.10 Main findings

The main findings related to the assessment of the nine hypotheses are:

- There was a statistically significant relationship between the applicants' type of secondary education and the eight aptitudes assessed in this study.
- Employability as an automobile operator was influenced by the type of Grade 12 qualification held by the candidates.
- The alternate hypotheses for all nine hypotheses of this study were accepted with the null hypotheses being rejected.
- The strength of the association between the dependent and independent variables in the nine hypotheses ranged between moderate to considerable practical significance.

Table 4.28 provides a synopsis of the main findings pertaining to the rankings attained by the candidates in the three sub-tests of the first assessment phase. These rankings were utilised in the analyses of the three relevant hypotheses in sections 4.3.1 through to 4.3.3. In the discussion of the conclusions within chapter five reference is also made to these phase one rankings.

Table 4.28

Synopsis of Phase One Rankings

Type of secondary education	Verbal reasoning sub-test ranking	Non-verbal reasoning sub-test ranking	Comparison sub-test ranking
Mathematics and science	3	2	2
Mathematics	2	1	1
Science	1	3	1
Technical	5	2	4
General	4	4	3

A précis of the main findings relating to the rankings achieved by the applicants in the five sub-tests of the second assessment phase are reflected in Table 4.29. In sections 4.3.4 through to section 4.3.9 these rankings were reported in detail. These rankings are also employed in the discussion of the conclusions within chapter five.

Table 4.29

Synopsis of Phase Two Rankings

Type of secondary education	Dexterity sub-test ranking	Co-ordination sub-test ranking	Assembly sub-test ranking	Spatial perception 2-D sub-test ranking	Spatial perception 3-D sub-test ranking
Mathematics and science	3	3	2	1	3
Mathematics	2	1	3	1	2
Science	1	2	1	3	1
Technical	5	4	2	2	4
General	4	3	4	4	5

Section 4.3 outlined the results from the assessment of the nine hypotheses with section 4.3.10 concluding with the section's main findings. The summary of chapter four, as well as the concluding remarks, is provided in section 4.4 that follows.

4.4 Summary and conclusions

Chapter four has been concerned with presenting and interpreting the descriptive and inferential results obtained in the research study. The biographical and educational profile, assessment phase results and the aptitude sub-test results have been portrayed. The distribution of the data for the two assessment phases have also been discussed. Furthermore, this chapter has established the results of the nine hypotheses where the alternate hypotheses for each were accepted and the null hypotheses rejected.

Chapter five, which concludes this study, offers a synopsis of the entire study as well as conclusions attained for each of the research objectives. The contributions and limitations of the study as well as suggested areas for future research are also discussed in the final chapter.

CHAPTER 5: CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS

5.1 Introduction

The previous chapter presented the empirical findings of the research study. The descriptive statistics, recommendation results from the two assessment phases and the eight aptitude sub-test results were displayed and considered. The inferential statistics for the nine hypotheses were also analysed and interpreted.

Following on from the preceding chapter, chapter five provides a culmination of the study's research process. Initially, the main findings from chapter four are recapitulated, followed by the provision of the conclusions for the secondary and primary objectives. Recommendations stemming from these conclusions are then offered. Subsequently, the contributions and limitations of the study are discussed with the final section outlining suggestions for future research. As indicated in section 2.7.3.1, a combination of two or more specific aptitudes is regarded as a measure of general cognitive ability. Given that this study's applicants were assessed on eight specific aptitudes I have decided to refer to the assessment of their ability/potential/aptitude as general cognitive ability (GCA) in this chapter, except where reference is made to a specific aptitude or aptitude testing in general terms. Section 5.2 initiates the chapter by offering an overview of the main findings established in chapter four.

5.2 Summary of findings

This section précis's the results concerning the respondent's biographical and educational profile, outcomes from the two assessment phases as well as the results realised in the eight aptitude sub-tests.

The key findings are:

- The preponderance of the study's sample was Black males between 25 to 29 years old.
- In terms of secondary education type, almost half the applicants had both Mathematics and Science as subjects in their Grade 12 qualification.

- Of the sample's portion that completed Mathematics at Grade 12 level, marks within the 50 to 59 percentage category were attained by just over a quarter of the sample for this subject. In contrast, almost half of those with Science as a Grade 12 subject realised a 40 to 49 percentage mark for this subject.
- Just over a third of the total sample were not successful in the first phase of the assessment process, whilst there was a higher percentage of candidates recommended following phase two.
- With regard to the phase one general aptitude measures, the majority (ranging from 80.5% to 96.3% according to sub-test) attained the stanine three minimum score requirement for the three instruments. However, a larger percentage of applicants did not achieve this requirement for the non-verbal reasoning and comparison tools in contrast to the verbal reasoning sub-test.
- The bulk (ranging from 89.4% to 94.3%) of the study's respondents achieved the stanine four minimum score requirement for four of the technical aptitude instruments that form part of the second assessment phase. These scores were achieved in the co-ordination, assembly, spatial perception 2-D and 3-D sub-tests. For the dexterity measure, though, more than half of the sample did not achieve a stanine score of four.

Having summarised the main findings derived from the descriptive statistics, the next section offers deductions based on the inferential statistics.

5.3 Conclusions related to objectives

This section comprises of three parts. Initially the conclusions pertaining to the first secondary objective are discussed, with section 5.3.2 outlining the deductions offered for secondary objective two. In the final part of this section the conclusions relating to the study's primary objective are documented. In these sections reference is made to the ranked accomplishments of the five types of secondary education in the eight sub-tests, as indicated in Table 4.28 and Table 4.29 within section 4.3.10.

5.3.1 Secondary objective one

The study's first secondary objective sought to determine whether the type of Grade 12 qualification obtained by candidates had an influence on their accomplishments in the general aptitude sub-tests that formed part of the employability selection process. The results from the assessment of hypotheses one to three were, therefore, integral to the first secondary objective. These hypotheses pertained to the scores obtained by the respondents in the verbal reasoning, non-verbal reasoning and comparison tools. The findings from these three hypotheses led to the generation of three conclusions. The first conclusion relates to the comparative level of difficulty between the three sub-tests of the first assessment phase, whilst the second and third conclusions pertain to the differing accomplishments realised by the five types of secondary education. These three conclusions are explained in the three sections that follow.

5.3.1.1 Conclusion one: use of general aptitude sub-tests

As indicated in section 4.2.2.1, which summarised the distribution of the three phase one aptitude tools, the median for the verbal reasoning instrument was slightly higher than that obtained for the non-verbal reasoning and comparison sub-tests. Furthermore, as depicted in sections 4.2.4.1 through to 4.2.4.3, a wider frequency distribution of stanine scores was realised for the non-verbal reasoning and comparison measures in contrast to the verbal reasoning sub-test. It is therefore concluded that the study's candidates found these two tools more challenging than the verbal reasoning technique.

5.3.1.2 Conclusion two: endorsed types of secondary education

Overall, respondents with Grade 12 qualifications which included Mathematics and/or Science performed consistently better in the three phase one sub-tests in comparison to the other two types of secondary education. Specifically, the Grade 12 qualification inclusive of Mathematics as a subject was ranked the top performer in the non-verbal reasoning tool and the shared highest executor of the comparison measure. Furthermore, this group achieved the second best rating in the verbal reasoning sub-test. The secondary education type with Mathematics and Science as subjects was consistently ranked as the second best performer in the non-verbal reasoning and comparison instruments, being rated as third only in the verbal reasoning sub-test. The Grade 12 qualification type with Science as a subject was rated as the top executor in both

the verbal reasoning and comparison tools, being ranked third in the non-verbal reasoning sub-test. These three forms of secondary education are concluded to have positively influenced the applicants' accomplishments in the GCA measures of phase one. Therefore, the results realised by these three types of Grade 12 qualifications engenders confidence in their likelihood of becoming successful automotive operators.

5.3.1.3 Conclusion three: inadvisable types of secondary education

The technical type secondary education achieved the highest distribution of low category scores for the verbal reasoning and comparison instruments and was, therefore, rated as the worst performer in these two sub-tests. Furthermore, the general Grade 12 qualification type achieved the highest distribution of scores in the low category for the non-verbal reasoning tool and was rated the second worst executor of the other two measures constituting the phase one assessment process. It is concluded that these two forms of matriculation are not able to reliably provide the GCA required of automobile operators.

With the deductions for the first secondary objective having been documented, the section that follows details the inferences drawn from the findings related to secondary objective two.

5.3.2 Secondary objective two

The study's last secondary objective aimed to ascertain whether the type of secondary education obtained influenced the applicants' abilities in the technical aptitude sub-tests that formed part of the employability selection process. This objective pertained to the outcomes of the fourth through to eighth hypotheses. The results obtained for the dexterity, co-ordination, assembly, spatial perception 2-D and 3-D technical instruments were, therefore, relevant to this objective. Five conclusions were drawn from these five hypotheses' findings. The initial conclusion is concerned with the relative degree of difficulty between the five phase two technical sub-tests. The subsequent four conclusions pertain to the differing achievements realised by the five types of secondary education. In the proceeding section these five deductions are documented in detail.

5.3.2.1 Conclusion four: use of technical aptitude sub-tests

All five types of secondary education consistently revealed varying scores across the five aptitude measures that constituted the second phase of the study's assessment process. Whilst the majority of the respondents from all five types of Grade 12 qualifications performed well in the assembly, spatial perception 2-D and 3-D tools, overall lower scores were established for the dexterity and co-ordination sub-tests. The dexterity sub-test's results were predominantly in the low scoring category with the co-ordination measure revealing mostly moderate stanine scores. The conclusion derived from this is that these two sub-tests were significantly more demanding for all respondents in comparison to the previously mentioned three instruments.

5.3.2.2 Conclusion five: primarily endorsed type of secondary education

The secondary education type with Science as a subject consistently performed adequately in the five sub-tests of the study's second assessment phase. In comparison to the other four types of secondary education, this form of matriculation qualification was revealed as the top executor of the dexterity, assembly and spatial perception 3-D tools. Furthermore, this kind of secondary education was ranked as the second best performer in the co-ordination instrument. With regard to the spatial perception 2-D sub-test, this group was ranked third in comparison to the other four types of secondary education. Whilst this kind of Grade 12 qualification was most likely to produce moderate category scores in the five technical aptitude measures, the group was nevertheless ranked between first and third place in these aptitudes. It is therefore concluded that a Grade 12 qualification that includes Science as a subject can dependably lead to the level of GCA required of automotive operators.

5.3.2.3 Conclusion six: auxiliary endorsed type of secondary education

The matriculation type inclusive of Mathematics as a subject also consistently performed satisfactorily in the five sub-tests of the study's second assessment phase. In comparison to the other four types of secondary education, this form of Grade 12 qualification realised a first place ranking in the co-ordination instrument, with a shared first place position in the spatial perception 2-D sub-test. Furthermore, this kind of secondary education was rated the second best executor of the dexterity and spatial perception 3-D measures. A third place ranking was obtained for the assembly sub-test by this matriculation type. It is therefore concluded that a

Grade 12 qualification that includes Mathematics as a subject can regularly result in effective performance in technical aptitude instruments.

5.3.2.4 Conclusion seven: additional auxiliary endorsed type of secondary education

Overall, the secondary education type inclusive of the subjects' Mathematics and Science was rated the third best executor of five technical sub-tests. Within these measures, this group attained a shared first place for the spatial perception 2-D sub-test and a shared second position in the assembly instrument. In the dexterity, co-ordination and spatial perception 3-D sub-tests, this type of secondary education was ranked third in comparison to the other groups, with this placing being shared for the co-ordination measure. The deduction drawn for these results is that a Grade 12 qualification inclusive of the subjects Mathematics and Science can result in effectual outcomes in technical aptitude measures.

5.3.2.5 Conclusion eight: inadvisable types of secondary education

Taking into account the rankings obtained for the five technical aptitude tools, the general and technical types of secondary education were ranked fourth and fifth respectively in the second assessment phase. In comparison to the other three forms of Grade 12 qualifications, higher portions of candidates with these types of secondary education did not achieve the minimum cut-off requirements for the technical sub-tests employed in this study. It is hence concluded that these matriculation qualifications will not produce the calibre of technical aptitude necessary for automobile operator positions.

The previous sections have specified the conclusions drawn from the secondary objectives of this study. The subsequent section deals with the inferences relevant to the study's primary objective.

5.3.3 Primary objective

The primary objective of this study was to explore the relationship between the type of secondary education obtained and operator employability within the automobile industry. This objective relates to the ninth hypothesis and the results for all eight aptitude techniques are therefore applicable to this objective.

5.3.3.1 Conclusion nine: operator employability

More candidates with a secondary education that included Science as a subject were recommended for employability as automotive operators than any of the other four types of matriculation qualifications. Thereafter, the recommendations, based on type of secondary education type held, were in the following descending order: Grade 12 with Mathematics as a subject; Grade 12 including the subjects Mathematics and Science; a general type secondary education and, lastly, the technical Grade 12 qualification. It is, accordingly, concluded that the type of secondary education held by candidates is an important criteria to be considered in the selection of automotive operators. The fundamental question posed in the problem statement described in section 3.2.2 has thus been answered in this thesis.

Following on the aforementioned question posed in section 3.2.2, this study sought to investigate two further important issues. Firstly, whether subject choice impacted on operator employability and, secondly, whether an academic or technical type secondary education influenced applicants' success in the selection process of automotive operators. This study has specifically concluded that an academic type Grade 12 qualification, inclusive of Mathematics and/or Science, is more likely to result in recommendation than any other type of secondary education.

Section 5.3 has provided nine conclusions stemming from the study's empirical results. The section that follows offers recommendations to augment these established conclusions.

5.4 Recommendations related to objectives

This section is comprised of three parts. Initially recommendations pertaining to the broad field of human resource management are offered, with section 5.4.2 outlining suggestions for human resource practices specifically related to the automobile industry. The third part provides a proposal to providers of technical type secondary educational qualifications.

5.4.1 Recommendations for the human resource management field

Two specific recommendations regarding the use of the general and technical aptitude instruments are tendered in section 5.3. The first recommendation centres on the use of the

general aptitude measures with the second recommendation focussing on the employment of the technical aptitude instruments.

5.4.1.1 Recommendation one: use of general aptitude sub-tests

Conclusion one, in section 5.3.1.1, indicated that the non-verbal reasoning and comparison sub-tests' stanine results revealed a wider dispersal of scores than those achieved for the verbal reasoning tool. These two aptitude measures, then, revealed greater predictability in distinguishing higher performing candidates than the verbal reasoning sub-test. Nevertheless, all three measures yielded significant results in this study, so it is recommended that all three general aptitude instruments be retained for future use by automotive firms in the selection of operators.

5.4.1.2 Recommendation two: use of technical aptitude sub-tests

Based on conclusion four, in section 5.3.2.1, it is recommended that all five of the technical aptitude tools be maintained as the second assessment phase of the employability selection process for automotive operators. Whilst the dexterity and co-ordination measures did not yield scores in the high category and were hence more challenging for the study's respondents, all five technical sub-tests revealed significant distinctions between the five types of secondary education.

Having provided recommendations to the human resource management discipline in general, the subsequent section offers advice to the automotive industry in this regard.

5.4.2 Recommendations for the automotive industry

Three recommendations, stemming from the relevant conclusions, are now presented for consideration by the automobile industry. Initially two recommendations are offered with regard to the relative success of the five types of matriculation in the automotive operator selection process. Section 5.4.2.1 indicates the preferred types of Grade 12 qualifications and section 5.4.2.2 outlines those not conducive to the automotive industry's requirements. The final recommendation, explicated in section 5.4.2.3, offers an alternative perspective through considering the marketing of the automotive operator position.

5.4.2.1 Recommendation three: endorsed types of secondary education

Given conclusions two, five through to seven and conclusion nine, outlined in section 5.3, automobile firms are advised to increase their recruitment drive of applicants with an academic type of secondary education that includes Mathematics and/or Science as subjects. It is believed that focusing on these candidates will result in a higher return on the automotive industry's investment in operator recruitment and selection.

Chapter two's literature review, section 2.5.1, established that foundational skills, such as Mathematics and Science, were vital mechanisms for encouraging technological shifts and innovation crucial for South Africa's social and economic future (Manuel, 2011; National Treasury, 2011; White Paper on Science and Technology, 1996). The sub-test scores obtained in this study clearly indicate that differences in capabilities occurred between applicants with both Mathematics and Science, just Mathematics or only Science as matriculation subjects. However, this study has also confirmed that the common denominator for successful employability as an automotive operator is an academic type secondary education inclusive of one or both of these subjects. In order to adequately cope with the various transformations and competitive challenges being experienced, the automobile industry needs to focus specifically on academic Grade 12 qualifications inclusive of one or both of these subjects as a selection criterion for automotive operators.

Furthermore, chapter two's literature review, specifically section 2.5.1 and section 2.5.2, highlighted the significance of Grade 12 qualifications with Mathematics and Science for the manufacturing sector. This, therefore, provides additional support for this recommendation. The Manufacturing, Engineering and Related Services SETA (merSETA) has initiated various research projects to assist the South African manufacturing sector with, *inter alia*, skills development, artisan development, employability and return on investment. One particular special project launched by merSETA is the Science, Technology, Engineering Mathematics Project (Nzimande & Patel, 2012; Peo, 2013). The ramification of this study's third recommendation is that the automotive industry will need to support these initiatives proactively in order to improve the Mathematics and Science achievements of Grade 10, 11 and 12 students.

This will facilitate a larger pool of applicants with the GCA required by the industry and enhance their chances of sourcing a higher calibre of employees.

5.4.2.2 Recommendation four: injudicious types of secondary education

The fourth recommendation to the automobile industry is that it should not include the general and technical types of secondary education in their selection criteria for automotive operators. Conclusions three, eight and nine have highlighted that these forms of the Grade 12 qualifications will not provide the GCA necessary within the automobile industry.

Traditionally, automobile firms have focused on a technical type of secondary education in the recruitment and selection of the production worker category (Schafmeister, 2013; S. de Klerk, personal communication, May 9, 2013). Whilst this form of secondary education includes Mathematics and Science as subjects, this research study's findings have refuted the soundness of this practice. This study's finding is hence contrary to the research conducted by Mahembe (2012), where no significant difference was found in the percentage of students passing, at first sitting, the apprenticeship trade test between the N3 (the equivalent to a Grade 12) qualification and those with a Grade 12 (that is, either technical or academic) qualification.

It is appreciated that the automotive industry needs to adopt an inclusive approach in its recruitment and selection, thus aligning itself with the requirements of the Employment Equity Act (No. 55 of 1998). However, the inclusion of candidates with a general type Grade 12 qualification has not yielded sufficiently adequate results in this study to justify their inclusion in the recruitment and selection of automotive operators. The ramification of this recommendation is that an academic Grade 12 qualification, exclusive of Mathematics and Science as subjects, does not meet the automobile industry's requirements in terms of the GCA essential for its production worker category.

The ultimate objectives of any business are increased productivity and improved profitability in order to ensure the long-term sustainability of the business. Whilst section 2.2.1 highlighted the significant role of the human component for firms (Breugh, 2013; Naude & O'Neill, 2011), section 2.6.2.1 qualified this statement through the indication that not all

employees should be regarded as a source of competitive advantage (Abhayawansa & Abeysekera, 2008). The human capital theory therefore provides support for this study's fourth recommendation.

5.4.2.3 Recommendation five: marketing the operator position

Chapter two's literature review of the automobile industry, specifically section 2.3.2, indicated that both globally and nationally a technical qualification has historically been the preferred type of secondary education required of potential operator incumbents (Schafmeister, 2013; S. de Klerk, personal communication, May 9, 2013). However, this study has shown that the respondents with this type of Grade 12 qualification did not consistently perform effectively in the eight aptitude instruments. Therefore, in contrast to recommendation four, the automotive industry could consider enhancing the perception of the automotive operator position prior to subsequent recruitment drives. The industry may need to consider the use of promotional activities in secondary educational institutions in order to promote the operator position.

Higher calibre candidates from technical secondary educational institutions may be attracted to apply for the automotive operator position if the career path prospects for the position are made clear. Whilst the automobile industry's management may regard the projected career path for automotive plant operators and assemblers to be mostly towards obtaining an apprenticeship qualification and becoming an artisan, this may not be a shared perception amongst potential incumbents. Consistent with the current international practices outlined in section 2.3.2, it is recommended that the South African automobile industry implement novel proactive recruitment and selection tactics to entice the South African youth with the required technical skills into the industry.

This recommendation, then, places emphasis on the Department of Labour's current projects with regard to the technical profession (Evans-Klock, 2012; Mukora, 2008). As denoted by Manuel (2011) in section 2.5.2.4, the solution to South Africa's shortage of artisan skills lies with the marketing of apprenticeships and the development of a specialist technical career path.

Furthermore, students with an academic secondary education including Mathematics and Science would most likely be attracted to pursue an academic post-Grade 12 qualification. Other sectors, such as the financial sector, are also actively targeting and promoting the careers they offer to this pool of applicants. The automotive industry would, therefore, need to enhance its overall employment profile in order to become a viable alternative to be considered by the higher calibre portion of this group of candidates.

The preceding section offered three recommendations to the automotive industry stemming from the study's conclusions. The final recommendation ensuing from this study is explicated in the section that follows.

5.4.3 Recommendation for the technical training and educational field

From the study's conclusions a specific recommendation is directed to training and educational providers of technical type Grade 12 qualifications. This recommendation is espoused in the following section.

5.4.3.1 Recommendation six: technical secondary education

This study's results clearly illustrate that holding an academic secondary education, including Mathematics and/or Science, increased an applicant's chances of being employed as an automotive operator, in comparison to a technical secondary education inclusive of these two subjects. Given this finding, technical high schools and FET institutions are recommended to improve their current offerings in order to adequately equip applicants with the GCA required to improve their level of employability in the automotive industry. In this study it was established that a technical type of secondary education performed inadequately in the verbal reasoning, comparison, dexterity and spatial perception 3-D sub-tests in comparison to the other four forms of matriculation. It is hence suggested that technical training and education providers address these specific areas in their future offerings. Furthermore, these providers are encouraged to facilitate open discussions with the broader manufacturing sector in order to improve their understanding of industry requirements.

In chapter two's literature review, specifically section 2.4, a study conducted by Barnes and Meadows (2008), highlighted that graduates exiting FET institutions were not found to have a sufficiently high technical standard to meet the automotive industry's technical requirements. Furthermore, Peo (2013) noted that significantly low rates (16%) of automotive employees are being recruited from FET colleges. The conclusions drawn from these studies hence collaborate with this study's sixth recommendation.

This research study has added emphasis to the current debate on the challenges being faced by the national FET institutions (Department: Higher Education and Training, 2014; Manuel, 2011; Nzimande, 2010). Despite a high demand for learning opportunities within the South African population, FET colleges have not been successful in enticing the youth of the country to participate in their programmes. It was proposed that this may be due to the very weak relationships between FET colleges and the workplace, which results in unsuitable or incomplete training (Manuel, 2011). As alluded to previously in this section, technical training and educational providers are thus recommended to proactively engage with their customers in order to align and improve their offerings. This recommendation clearly has implications for the current policies and initiatives of the Department of Higher Education and Training and the South African Qualifications Authority.

Section 5.4 has explicated the study's six recommendations that have been offered to three fields of related research. Section 5.5 that follows documents the contributions made by the study.

5.5 Contributions of the study

The contribution of this research study is three-fold. Firstly, the study has yielded a psychological testing selection process to be considered within the automobile industry. Section 5.5.2, then, offers vital information pertaining to the optimum educational profile of automotive operators with section 5.5.3 outlining the study's contribution to national technical training and educational bodies. These contributions are discussed in detail within the next three sections.

5.5.1 Proposed selection process for automotive operators

It was established in section 2.4 that scant local research had been conducted on an optimal selection process for automotive operators, so this study can be considered a significant contribution to the field of human resource management as it is the first study to successfully provide data on the implementation of a selection process for automotive operators.

Chapter two's literature review, specifically section 2.4, indicted that a comprehensive multiple-hurdle selection process was successfully employed within a global automobile plant in the selection of operator level employees (Gump, 2006). Furthermore, Piro (2011) recommended that a standardised assessment procedure be utilised within the South African automotive industry to identify high potential candidates as matriculation certificates were not regarded as reliable indicators of cognitive capacity. This research study has provided evidence in support of these two studies by indicating the import of a multiple-hurdle standardised selection model within the South African context, specifically in the automobile industry.

In addition, it should be noted that this study has provided conclusive results on the significant contribution that GCA testing can add to the selection process used by an organisation. In line with research conducted by Van der Flier, Thijs and Zaaiman (2003), this study has confirmed the value of using matriculation and GCA test results in selection practices. Furthermore, it is plausible that the selection process proposed in this study could be employed by the automotive industry in the identification of potential artisans. Likewise, this selection method could also be drawn upon in a cross-industry context. The second contribution of this study is discussed in the subsequent section.

5.5.2 Development of an automotive operator educational profile

Prior to this study, limited research had been conducted on the optimum educational profile of automotive operators. Hence, the impact of the applicants' type of secondary education on their employability was unknown and this study sought to bridge that gap in the literature.

This study has resulted in the development of a preferred educational profile which can be applied to the automobile industry and potentially other manufacturing concerns. This is the

first educational profile of its kind as prior to this no other similar profile had been proposed. This educational profile will shed preliminary light on the importance of this aspect on future research, specifically in the selection of potential artisans. It can, thus, be considered a major contribution to the field of human resource management, specifically in recruitment and selection. By establishing a significant relationship between the candidates' type of Grade 12 qualification and employability within the automotive industry, this study provides support for the empirical research conducted by Semeijn, Van der Velden, Heijke, Van der Vleuten and Boshuizen (2005).

Furthermore, this study has generated conclusive evidence to refute one of the criticisms made against the human capital framework. In section 2.6.2.2, it was indicated that the human capital theory had been criticised due to its accessible research solely focusing on the impact of top management's human capital on organisational performance. This study has provided empirical research illustrating the impact of human capital at a different organisational level, that of production worker. The final contribution of this study is explained in the next section.

5.5.3 Transforming technical education and training

It is widely documented that the current South African further education, training and skills development sector is severely underperforming (Mahembe, 2012; Manuel, 2011). This research study has conducted labour market research further highlighting the importance of technical training and education providers being aware and understanding the country's human resource requirements. To facilitate this understanding, this thesis has specifically documented the need for increased linkages between these providers and workplaces.

Furthermore, this study has emphasised that technical high schools and FET colleges need to focus on improving their offerings in order to better respond to the identified skills needs within South African industries. Should the recommendations offered in section 5.4.3.1 be implemented by these providers this may significantly shape the production of technical skills in South Africa and assist in alleviating the shortage of artisan skills being experienced in the country. As is evident, section 5.5 has summarised the significance of the study and the subsequent section documents the limitations inherent in the research study.

5.6 Limitations of the study

The limitations of this research study are divided into two parts within this section. Section 5.6.1 details the limitations pertaining to the literature review whilst the second part of this section provides the limitations related to the empirical phase of the research.

5.6.1 Limitations of the literature review

There are two limitations resulting from the literature review. Both limitations are associated with the scant secondary information available on the research study's two variables.

Firstly, there is limited literature available on the global selection practices used for automotive operators. Where global literature was sourced, it was relevant but out-dated. Furthermore, despite an extensive search, no research on the operator selection processes used in the South African automobile industry was found. The compilation of the study's literature review and the development of an appropriate selection methodology were, therefore, considered to be challenging tasks.

Secondly, whilst psychological assessment and specifically aptitude testing have been widely researched, the use of GCA testing in local operator selection processes has not been empirically documented. Therefore, the selection of a suitable GCA test battery for this study was a difficult task. The following section addresses the limitations arising from the empirical research conducted.

5.6.2 Limitations of the empirical research

There are four limitations relating to the research methodology utilised in this study. The first two limitations are concerned with the study's sample, the third limitation pertains to one of the data collection instruments used and the final limitation relates to the data analysis approach adopted.

This study was conducted as part of a large recruitment process completed by a South African automotive assembly plant. The sampling frame for this study was a database of pre-screened potential operators. In comparison to the 2001 census, the sample is not in line with

either provincial or national data pertaining to age, race or gender (Lehohla, 2004). This means that the main shortcoming of this research is that the results cannot be generalised to either the South African or global automobile industry.

The second limitation pertaining to the study's sample concerns the aggregates obtained by the applicants in their Grade 12 qualifications. This aspect was specifically delineated as being outside of this study's scope. However, it is possible that the portion of the study's sample representing the technical type of secondary education were not of an adequate calibre. It has been recommended that this aspect be a consideration for future research.

The Trade Aptitude Test Battery was published in 1983 and according to the test distributors has not been updated since this publication date. This raises concerns regarding the culture friendliness of this test. Furthermore, the proposed validity study on this test, referred to in the test manual, had not been done by 2013. Whilst a registered and approved test by the Health Professions Council of South Africa and a widely used test battery within South Africa, these two issues do draw concern to this instrument.

The final limitation concerns the dilution of GCA scores obtained by the study's respondents. Adopting standard psychometric testing protocol, the candidates' raw scores in the sub-tests were converted to stanine scores for reporting purposes. Furthermore, the candidate's scores were further diluted into the three scoring categories, namely, low, moderate and high. Therefore, the intensity of the subtleties between scores achieved may have been mystified by this data analysis technique.

Despite the limitations documented in the preceding section, section 5.7 that follows offers recommendations for future research.

5.7 Suggestions for future research

With regards to future research that could potentially stem from this study, nine specific recommendations are made. These suggestions pertain to the biographical profile of the sample,

mark attainment in the subjects of Mathematics and Science, variations of the GCA test battery utilised and the replication of the study with a broader sample.

The suggestions are:

- Future research should investigate whether age and possibly the related increase in work experience is a contributing or limiting factor to success within similar selection drives. Specifically, future research may consider investigating the impact of age on GCA testing results.
- With regard to the age profile of this study's sample, most of the respondents had not recently matriculated as 45.3% were between the ages of 25 to 29 years, with 22.8% between 30 to 34 years of age. It is recommended that future research consider whether this finding is a current recruitment and selection trend and the implications thereof.
- In addition, it is recommended that future research consider the race and gender profile of successful incumbents in selection processes of a similar nature. This would have significant implications for organisations in terms of their compliance with employment equity legislation pertaining to recruitment and selection.
- The fourth recommended area for future research pertains to the marks obtained for the Mathematics and Science subjects at Grade 12. Understanding whether results achieved in these subjects are a contributing factor towards employability or not would inform the current debate pertaining to the current promotional requirements in the National Senior Certificate.
- Fifthly, it is recommended that replications of this study be done with alternative forms of aptitude and/or GCA test batteries to ascertain the repetition of the current study's results.
- With regard to a broader sample, future research may also consider applying a similar selection process on operators in other automotive firms in different provinces of South Africa and/or in alternative manufacturing industries such as the tyre industry or the transport sector.
- The seventh recommendation is that the selection process employed in this study be replicated for an artisan position. Given the local and global difficulty with the

accurate identification and development of an appropriate pool for this scarce skill, future research of this nature would provide fruitful benefits for the human resource management field as well as the broader manufacturing sector.

- This study's eighth suggestion is that future research should investigate the specific amendments required to improve the FET syllabus. This may then enhance the calibre of candidates generated through these training and educational institutions.
- Finally, longitudinal research could be conducted on the current study's sample to ascertain performance output of the candidates employed within the automobile industry. Information from performance appraisals could be analysed to establish whether the recommended respondents from this study are performing optimally on-the-job.

The final section of this chapter provides a concise précis of the conclusions, recommendations and limitations established within the chapter.

5.8 Summary and conclusions

This fifth and final chapter of this thesis has provided a summation of the study's main findings and described the ten conclusions established from these findings. These conclusions primarily focused on the optimum use of the aptitude sub-tests and the impact of the type of secondary education on the empirical results.

Drawing from these conclusions, two recommendations were then offered to the human resource management field and four to the automotive industry. Specifically, it was recommended that the eight aptitude measures employed in this study be retained for future use by the automobile industry in their selection of the production worker category. The central recommendation pertaining to type of secondary education counselled the automotive industry to focus on applicants with Mathematics and Science or Mathematics as subjects in their Grade 12 qualification.

This chapter has highlighted the significant contribution the study has made to both the human resource management field and to the automobile industry. In particular, this research

study has resulted in the noteworthy development of an automotive operator educational profile and has formulated an optimum selection process for automotive operators. Following on the elucidation of the limitations inherent to this study, this chapter has also made several suggestions with regard to future research.

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Annexure A: Ethical Clearance from the University of Fort Hare

University of Fort Hare
Together in Excellence

ETHICAL CLEARANCE CERTIFICATE

Certificate Reference Number:	VIL01 1SPUC01
Project title:	**The role of Secondary Education in Operator employability in the Automotive Industry.**
Nature of Project:	Masters
Principal Researcher:	Juliet Puchert
Supervisor:	Dr Nicole Dodd
Co-supervisor:	Mrs. Kim Viljoen

On behalf of the University of Fort Hare's Research Ethics Committee (UREC) I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instrument(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the UREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the document
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research

The Principal Researcher must report to the UREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

The UREC retains the right to

- Withdraw or amend this Ethical Clearance Certificate if
  - Any unethical principal or practices are revealed or suspected
  - Relevant information has been withheld or misrepresented
  - Regulatory changes of whatsoever nature so require
  - The conditions contained in the Certificate have not been adhered to
- Request access to any information or data at any time during the course or after completion of the project.

The Ethics Committee wished you well in your research.

Yours sincerely

Professor Gideon de Wet
Dean of Research

15 October 2013

Annexure B: Turnitin Originality Report

Turnitin Originality Report

Role of secondary education by Juliet Puchert
From Thesis (Thesis)

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Annexure C: Health Professions Council of South Africa: List of tests classified as being Psychological Tests

HPCSA
Health Professions Council of South Africa

FORM 207

THE PROFESSIONAL BOARD FOR PSYCHOLOGY

HEALTH PROFESSIONS COUNCIL OF SOUTH AFRICA

LIST OF TESTS CLASSIFIED AS BEING PSYCHOLOGICAL TESTS

Compiled by the Psychometrics Committee of the Professional Board for Psychology

WHY DO WE CLASSIFY TESTS

The use of a psychometric measuring device, test, questionnaire, technique or instrument that assesses intellectual/cognitive ability/functioning, aptitude, interest, personality make-up or personality functioning and which may, in terms of its content or responses required, result in either embarrassment or anxiety to the test-taker, is constituted as being a psychological act. According to the Health Professions Act, Act 56 of 1974, only registered psychologists are permitted to perform psychological acts which, in relation to evaluation, testing and assessment, are defined in Section 37 (2) (a), (b), (c), (d), and (e) as being:

"(a) the evaluation of behaviour or mental processes or personality adjustments or adjustments of individuals or groups of persons, through the interpretation of tests for the determination of intellectual abilities, aptitude, interests, personality make-up or personality functioning, and the diagnosis of personality and emotional functions and mental functioning deficiencies according to a recognised scientific system for the classification of mental deficiencies;

(b) the use of any method or practice aimed at aiding persons or groups of persons in the adjustment of personality, emotional or behavioural problems or at the promotion of positive personality change, growth and development, and the identification and evaluation of personality dynamics and personality functioning according to psychological scientific methods;

(c) the evaluation of emotional, behavioural and cognitive processes or adjustment of personality of individuals or groups of persons by the usage and interpretation of questionnaires, tests, projections or other techniques or any apparatus, whether of South African origin or imported, for the determination of intellectual abilities aptitude, personality make-up, personality functioning, psychophysiological functioning or psychopathology;

(d) the exercising of control over prescribed questionnaires or tests or prescribed techniques, apparatus or instruments for the determination of intellectual abilities, aptitude, personality make-up, personality functioning, psychophysiological functioning or psychopathology;

(e) the development of and control over the development of questionnaires, tests, techniques, apparatus or instruments for the determination of intellectual abilities, aptitude, personality make-up, personality functioning, psychophysiological functioning or psychopathology"

Thus, according to the Health Professions Act, Act 56 of 1974, tests, measures, questionnaires, instruments, etc. that tap psychological constructs must be used, interpreted, and controlled by psychologists. Certain psychological tests can, however, be used by psychometrists, psychotechnicians, and other professionals (e.g., speech and occupational therapists) provided that:

1. the use of the test has been certified for that category of tester by the Psychometrics Committee of the Professional Board for Psychology;

2. the tester complies with whatever restrictions may be placed on the test's use relevant to the category of test user that he/she is registered as. For example, a psychometrist may administer, score and preliminary interpret all psychological tests except [projective personality techniques;]

   A psychometrist will not be permitted to use:

   * ***certain personality measures (e.g., TAT, CAT, Rorschach);***
   * ***specialist neuropsychological measures; [and]***
   * ***measures that are used for the diagnosis of psychopathology (e.g., MMPI-2).***

3. the tester seeks mentoring from a psychologist where specialist input would enhance the testing process and the understanding of the test results; and

4. the tester has been appropriately trained and has achieved the minimum competencies required to use the test.

In view of the specific conditions under which psychological tests may be used by people other than registered psychologists, it is necessary to classify tests to facilitate the determination of the category of tester who may use them. The Psychometrics Committee of the Professional Board for Psychology has been mandated by the Board to, among other things:

> *"classify and advise on regular revision of any device, instrument, method, technique or test aimed at aiding persons or groups of persons in the adjustment of personality, emotional or behavioural problems or at the promotion of positive personality change, growth and development or for the determination of intellectual abilities, personality make-up, personality functioning, aptitude or interests."*

Classification of a test by the Psychometrics Committee of the Professional Board for Psychology does not impose any new restrictions on a psychological test (the Health Professions Act, Act 56 of 1974, imposes such restrictions). Instead, classification allows for the relaxing of conditions under which a test can be used, which makes the test more freely available.

BACKGROUND TO THE LIST OF PSYCHOLOGICAL TESTS

The tests indicated below represent a summative list of tests that:

* have been classified by the Psychometrics Committee (from 1996 onwards) as psychological tests *(tests with reference numbers listed)* or
* were classified as such by the Test Commission of the Republic of South Africa (up until 1996) or the Human Sciences Research Council, with these classifications being condoned by the Psychometrics Committee in 1998 *(tests with no listed reference number).*

Some important issues need to be pointed out to the users of psychological tests, measures, and instruments:

1. test users may find that many tests that are currently in use are not on the list. In such an instance it means that they have either currently be under classification consideration or they might not have been submitted for classification purposes to the Psychometrics Committee. The onus rests on test users to refer such tests to the Psychometrics Committee, even if they were developed overseas; and

2. it needs to be noted that even although a test may be classified as a psychological test, the onus rests on the test user to ensure that:

* the test is valid for the purposes for which it is being used;
* appropriate norms are consulted; and
* where tests that have been developed in other countries are concerned, appropriate research studies need to be undertaken to investigate whether the test is culturally biased and special care should be taken when interpreting the results of such tests.

ALPHABETICAL LIST OF TESTS CLASSIFIED AS BEING PSYCHOLOGICAL TESTS

Name of Test	Reference *
Academic Aptitude Test (AAT)(Standard 10)	
Academic Aptitude Test (AAT)(University)	
Academic-Technical Aptitude Tests (ATA)	
Adjective Checklist (EWL) - Part of Vienna Test System	
Adjective Checklist (EWL) - Part of Vienna Test System	
Adolescent Self Concept Scale	
Anxiety Questionnaire for Pupils (AFS) - Vienna Test System	
APIL	18/11/1
Aptitude Test Battery for Pupils in Standards 6 and 7 (ATB Standards 6/7)	
Aptitude Tests for School Beginners (ASB)	18/11/16
Aptitude Dimension Test	
Aptitude Profile Test	
Aptitude Test Battery for Adults (AA)	
BarOn Emotional Quotient Inventory (BarON EQ-I ™)	18/11/45
Bayley Scales II	
Beck Tensor (TENSOR) - Vienna Test Catalogue	
Bender Visual Motor Gestalt Test	
Benton Visual Retention Test	
Blox Test (A/80)	
Business Comprehension Test	18/11/116
California Psychological Inventory (CPI)	18/11/45
Campbell Interest And Skill Survey™ (CISS)	18/11/45
Career Development Questionnaire (CDQ)	18/11/25
Cattell Culture Fair Intelligence Tests	18/11/7
Children's Apperception Test - Human Figures (CAT-H)	
Children's Apperception Test - Supplement (CAT-S)	
Children's Apperception Test (CAT)	
Children's Personality Questionnaire (CPQ)	
Clerical Test Battery (CTB2)	18/11/66
Clinical Analysis Questionnaire (CAQ)	
Cognitive Process Profile (CPP)	18/11/59
Cognitrone (COG) - Vienna Test Catalogue	
Columbus Picture Analyses of Growth towards Maturity	
Communication and Insights Analysis Questionnaire (CIAQ)	
Complexity Navigation Test (CNT)	18/11/92
Computerised Adaptive Test of General Reasoning Ability (GSAT Senior)	18/11/19
Concentration under Monotony Test (Q1) - Austrian Road Safety Board	
Conceptual Reasoning Test (A/138)	
Continuous Attention Test (DAUF) - Vienna Test Catalogue	
Continuous Symbol Checking Test (CSC)(A/84)	
Critical Reasoning Test Battery (CRTB)	18/11/69
Customer Contact Styles Questionnaire (CCSQ)	18/11/44
Decision Reaction Test (DR2) - Austrian Road Safety Board	
Decision Preference Analysis	
Deductive Reasoning Test (B/112)	
Developmental Test of Visual Perception (Frostig)	
Developmental Test of Visual-Motor Integration (Beery)	
Differential Aptitude Tests: Forms R, S, K & L (HSRC)	18/11/54
Differential Interest Test (DIT) - Part of Vienna Test System	
Discus Behavioural Profile System	18/11/21

Electronic Diagnostic Systems (SADF)	
ESSI Reading and Spelling Tests	18/11/36
Experience of Work and Life Circumstances Questionnaire (WLQ)	
Eysenck Personality Inventory	
Eysenck Personality Profiler (EPP)	

Factors of Aggressiveness Questionnaire (FAF) - Part of Vienna Test System	
Family Functioning in Adolescence Questionnaire (FFAQ)	
Family Assessment Device	
Fifteen Factor Questionnaire (15FQ)	18/11/60
Fifteen Factor Questionnaire Plus (15FQPlus)	
Figure Classification Test (A/121)	
Fundamental Interpersonal Relations Orientation-Behaviour TM (FIRO-B) TM	18/11/45
Form Series Test (Industrial Version)(A/79)	

General and Graduate Test Batteries	18/11/67
General Scholastic Aptitude Test (GSAT)	18/11/18
Gesell Developmental Test	
Giessen Test (GIESS) - Part of Vienna Test System	
Giotto Integrity Questionnaire	18/11/43
Goodenough-Harris Drawing Test	
Graz Assertiveness Test (GAT) - Part of Vienna Test System	
Group Test for 5/6 and 7/8 year-olds	
Grover-Counter Scale of Cognitive Development	
Guidance Test Battery for Secondary Pupils (GBS)	

Hamburg Neuroticism and Extroversion Scale (HANES) - Vienna Test System	
Herbst Test	18/11/99
High School Personality Questionnaire (HSPQ)	
High Level Battery (B/75)	
High Level Figure Classification Test (A/129)	
High School Interest Questionnaire (HSIQ)	
Hypothesis Formation Test (HYPO) - Vienna Test Catalogue	

Impact 3.0	18/11/102
Individual Scale for Southern Sotho-speaking pupils	
Individual Scale for General Scholastic Aptitude (ISGSA)	
Individual Scale for Northern Sotho-speaking pupils	
Individual Scale for Tswana-speaking pupils	
Individual Scale for Xhosa-speaking pupils	
Individual Scale for Zulu-speaking pupils	
Industrial Test Battery (ITB) includes Anomalous Concept Test (ACTA)(A/133), Anomalous Figure Test (AFTA)(A/134), and Series Induction Test (SIT)(A/135).	
Integrity Profiles (IP-200)	18/11/79
Intelligence Structure Test (IST 70) - Vienna Test System	
Intermediate Battery (B/77)	
Interpersonal Relations Questionnaire (IRQ)	
Intra- and Interpersonal Relations Scale (IIRS)	
IPAT Anxiety Scale	

Jackson Personality Inventory – Revised (JPI-R)	18/11/45
Jung Personality Questionnaire (JPQ)	
Jung Type Indicator	18/11/62
Junior South African Individual Scales (JSAIS)	
Junior Aptitude Test (JAT)	
Junior Eysenck Personality Inventory	

Kolbe Conative Index (KCIA)	18/11/41

Learning Potential Computerised Adaptive Test (LPCAT)	18/11/49
Life Role Inventory (LRI)	18/11/27
Line Labyrinth Test (LL5) – Austrian Road Safety Board	
London House Personnel Selection Inventory (PSI-3)	
Luso Zakheni Attitude Tests (none preessurerised) IBM Test (pressurerised)	18/11/37

McCarthy Scales of Children Abilities	
Meyer Interest Questionnaire (MB-10)	18/11/30
Miller Assessment for Pre-Schoolers (MAP)	
Minnesota Multiphasic Personality Inventory – Short Form (MMPIK)	
Minnesota Multiphasic Personality Inventory (MMPI)	
Movement Assessment Battery for Children	
Myers-Briggs Type Indicator (MBTI)	

Neo Personality Iventory-Revised (NEO-PI-R) (Pam Morris and Collin Wilford) Neo Professional Development Report (NEO-PD-R) Neo Five Factor Inventory (NEO-FF-I)	18/11/76
Neo Personality Iventory-Revised (NEO-PI-R)	18/11/75
Nineteen Field Interest Inventory (19FII)	
Non Verbal Matrices Intelligence Test (M30) – Austrian Road Safety Board	
Normal Battery (A/76)	
Number Combination Test (ZVT) – Vienna Test Catalogue	

Occupational Interest Profile (OIP)	18/11/61
Occupational Personality Profile (OPP)	18/11/63
Occupational Personality Questionnaire (OPQ)	18/11/44
Organisational Personality Construct Scale (previously Managerial construct scale and work orientation scale)	18/11/52
Orpheus Personality Questionnaire	18/11/43

Paper and Pencil Games (PPG)	18/11/14
Paranoid Depressiveness Scale (PDS) – Vienna Test System	
Pattern Relations Test (B15/1)	
Perceptual Motor Survey (Kephardt)	
Personal, Home, Social and Formal Relations Questionnaire (PHSF)	
Picture Vocational Interest Questionnaire for Adults (PVI)	
Picture Motivation Tests (PMT)	
Porteus Mazes	
Potential Index Batteries (PIB) (previously Pro-Index)	18/11/23
Predictive Index (PI)	
Programmer Aptitude Battery (PAB)(A/137) – includes Procedures Test, Matrices Test I, and Matrices Test II.	
Profile XT	18/11/85
Psychological Map	

Questionnaire to Assess the Risks of Suicide (FBS) – Part of Vienna Test System	
Questionnaire: Assessing Willingness to take Risks (FRF) – Austrian Road Safety Board	

Raven's Progressive Matrices (RPM)	
Rorschach cards	
Rotate and Flip Test (RAFT)(A/136)	

Rothwell-Miller Interest Blank (RMIB)(C/134)	

Scholastic Aptitude Test Battery for Pupils in Standards 2 and 3 (SATB Standards 2/3)	
Scholastic Aptitude Test Battery for Pupils in Standards 4 and 5 (SATB Standards 4/5)	
School-readiness Evaluation by Trained Testers (SETT)	18/11/17
Self-Concept Scale	
Self-Directed Search Questionnaire (SDS)	
Self Scoring Interest Blank	18/11/72
Senior Aanlegtoets vir Swaksiendes (SAT-S)	
Senior Academic-Technical Aptitude Test (SATA)	
Senior Aptitude Tests (SAT)	
Senior South African Individual Scale – Revised (SSAIS-R)	18/11/15
Sexual Adaptation Functioning Test (SAFT)	
Short Questionnaire for Problem Detection (KFP30) – Part of Vienna Test System	
Siegmund System for Computerized Testing (pending final classification)	
Signal Detection (SIGNAL) – Vienna Test Catalogue	
Situation-Specific Evaluation Expert Batteries (SpEEX Batteries)	18/11/34
Sixteen Personality Factor Questionnaire (16PF)	18/11/64
South African Vocational Interest Inventory (SAVII)	18/11/28
South African Individual Scale for the Blind (SAISB)	
South African Wechsler Adult Intelligence Scale (SAWAIS)(C/35)	
Spielberger Trait/State Anxiety Scale	
Strong Interest Inventory (SII)	18/11/45
Structure of Intellect (SOI Tests)	18/11/58
Structured-Objective Rorschach Test (SORT)	
Suid-Afrikaanse Groeptoets vir Swaksiendes: Intermediêr (SAGS:I)	
Survey of Study Habits and Attitudes (SSHA)	

TAT cards (Murray)	
Technical Aptitude Test Battery for Low Literates (TAB)	
Test for Selection and Training (TST)	18/11/55
Test to Examine Reactive Stress Tolerance (RSTS) – Austrian Road Safety Board	
Test to Examine Peripheral Perception (PVT) – Austrian Road Safety Board	
Thomas International Personal Profile	18/11/5
Three-dimensional Point Tracking (3PTR) - Vienna Test Catalogue	
Three-dimensional Contour Tracking (3KTR) - Vienna Test Catalogue	
Toets vir Bestuurskennis	
Trade Aptitude Test Battery (TRAT)	
TRAM-1	18/11/2
TRAM-2	18/11/3
Two-dimensional Contour Tracking (2KTR) - Vienna Test Catalogue	
Two-dimensional Labyrinth Tracking (2PTR) - Vienna Test Catalogue	
Two-dimensional Point Tracking (2LTR) - Vienna Test Catalogue	
Two-hand Co-ordination (2HAND) - Vienna Test Catalogue	

Values and Motives Inventory	18/11/65
Values Scale (VS)	
Vienna Matrices Test (VMT) - Vienna Test Catalogue	
Vigilance (VIGIL) - Vienna Test Catalogue	
Vocational Interest Questionnaire for Pupils in Standards 6 to 10 (VIQ)	

Wechsler Pre-School and Primary Scale of Intelligence-Revised (WPPSI-R)	
Wechsler Intelligence Scale for Children (WISC-III)	
Wechsler Adult Intelligence Scale-Revised (WAIS-R)	

Wechsler Memory Scale-Revised (WMS-R)	
Work Orientation Scale	18/11/52
Work Performance Test Series (ALS) - Vienna Test Catalogue	
Cognitive and Potential Assessment (COPAS) version I & II	18/11/40
Emotional Intelligence questionnaire (EIQ) Thomas international	18/11/129
General Reasoning Test Battery (GRT2) Graduate Reasoning Test Battery (GRT1)	1/11/67
Technical Test Battery (TTB2)	18/11/68
Critical Reasoning Test Battery (CRTB1)(CRTB2)	18/11/69
Insights Learning and Development	18/11/97

TESTS CURRENTLY BEING DEVELOPED/ADAPTED

African Profile Technique (APT test)	18/11/98
Assessment Procedures Conducted by Speech-Language Pathologists and Audiologists	18/11/93

Brain Resources Company Web Neuro	18/11/117
Brain Resources Company Integ Neuro	18/11/118
Broad Band Competency Assessment Battery (BB CAB)	18/11/70

Career Path Appreciation (CPA) and Initial Recruitment Interview Schedule (IRIS)	18/11/110
Cogstate Sport	18/11/119
Contact Success Profile (CSP)	18/11/112
Contextual Performance Scale (CPS)	18/11/107
Culture-fair Abilities and Motivation Test (C-FAM)	

Dover System/Vienna Test	18/11/101
Drake Picasso	18/11/108

First View Assessment	18/11/78

Genos Emotional Intelligence	18/11/122

HR Chally Assessment	18/11/103

Integrity Profiles (IP-200) Comprehensive Test: Version I (	18/11/79
Integrity Profiles (IP-200) Simplistic Test: Version II	18/11/79
Integrity Measuring Instrument (IMI)	18/11/14

LENS	18/11/115
Linked Psychometric Assessment (LPA)	18/11/112
Locus of Control Questionnaire	18/11/81

Motivational Appraisal of Personal Potential	18/11/88
Motivational profile (MP)	18/11/121

Notification of Development of New Personality Instrument	18/11/95
Notification of Development of New Work Stress Instrument	18/11/94

Personality and Preference Indicator	18/11/104
Personality and Preference Inventory (PAPI)	18/11/106
Personality At Work (PAW)	18/11/107
Prevue Assessment	18/11/80
Profiles Step One Survey	18/11/85

Psychological Risk Inventory (PRI)	18/11/105

Sales Preference Indicator	
Sales Preference Questionnaire (SPQ Gold)	18/11/71
Saville Consulting Wave™ Styles questionnaires	18/11/113
Saville Consulting Aptitute Assessment Series	18/11/114
Sixteen Personality Factor Questionnaire Fifth Edition(16PF5)	18/11/64
Sixteen Personality Factor Questionnaire Select (16PF Select)	18/11/64
South African Wellness Questionnaire (SAWQ)	18/11/84

Test of Encounter Stress (TESS)	18/11/77
Total View Assessment	18/11/78

Values and Motives Inventory	18/11/65
Value orientation (VO)	18/11/120
Personality at Work (PAW)	18/11/123
PAPI –N (Cubiks)	18/11/124
INTEGNEURO	18/11/125
SELECTION INSTRUMENT RATIONALE	18/11/126
WORK DYNAMICS	18/11/127
CAREER AND STUDY INTEREST QUESTIONAIRE (CSIQ)	18/11/128
FAMILY RELATION TEST (FRT)	18/11/130
LEADER DEVELOPMENT ASSESSMENT (LDA)	18/11/131
SAVVY RECRUITER EMPLOYEE ASSESSMENT SYSTEM (HRVISION)	18/11/132
OMNI AA	18/11/134
Saville Consulting Wave: PERFORMANCEQ, MEASURING EMOTIONAL INTELLIGENCE	18/11/135
TMA Methods: SOBETHU	18/11/136
The Leadership Circle	18/11/133
Adolescent Psychological Well-being Index Questionnaire (Ad- PWIQ)	18/11/ 137
LIMRA – Selling Style Questionnaire	18/11/ 138
Prism Brain Mapping	18/11/139
Wellness Questionnaire for Higher Education	18/11/140
(Cobra) Console Operator basic requirement Assessments	18/11/141
Connector Ability 1.1. Version 2.1.	18/11/142
Workplace Big Five Personality 2.0.	18/11/143
Learning Orientation Index (LOI)	18/11/144

* Tests with a reference number were submitted for evaluation, tests without a number were condoned without being evaluated – see Background To The List Of Tests p. 2.

Updated: June 2007
Updated: June 2009
Updated: June 2010

Annexure D: Applicant Consent Form for the first assessment phase

ASSESSMENT CONSENT FORM PHASE 1

SURNAME: _____ FIRST NAME: _____

ID NUMBER: _____

HOME LANGUAGE: ☐ Afrikaans ☐ English ☐ Xhosa ☐ Other

GENDER: ☐ Female ☐ Male

RACE: ☐ Black ☐ Coloured ☐ Indian ☐ White

HOW ARE YOU FEELING TODAY? ☐ **Good** ☐ **Poor**

If poor, please provide a brief description:

_____

Are you taking medication at present? ☐ Yes ☐ No

If yes, what for? _____

Have you been admitted to the hospital in the past 6 months? ☐ Yes ☐ No

If yes, what for? _____

Have you undergone a psychometric assessment in the past year? ☐ Yes ☐ No

If yes, what for? _____

I, _____, voluntarily give my consent to serve as a candidate in an assessment conducted by Ilanga Consulting. I have received a clear and complete explanation of the general nature and purpose(s) of the assessment and the specific reason(s) why I am being assessed. I have also been informed of the kinds of tests to be administered and how the results will be used. I have been informed that the specific details & procedures of each test/assessment will be provided before I attempt each test/assessment. I hereby give permission that my assessment and psychometric test results may be made available to a third party for selection, recruitment or training needs analysis purposes.

SIGNATURE OF APPLICANT: _____DATE OF TESTING: _____

Annexure E: Applicant Consent Form for the second assessment phase

ASSESSMENT CONSENT FORM

PHASE 2

SURNAME: _____ FIRST NAME: _____

ID NUMBER: _____

HOW ARE YOU FEELING TODAY? ☐ **Good** ☐ **Poor**

If poor, please provide a brief description:

_____

Has anything changed since you completed the Phase 1 assessments? ☐ Yes ☐ No

If yes, what? _____

_____

I, _____, voluntarily give my consent to serve as a candidate in an assessment conducted by Ilanga Consulting. I have received a clear and complete explanation of the general nature and purpose(s) of the assessment and the specific reason(s) why I am being assessed. I have also been informed of the kinds of tests to be administered and how the results will be used. I have been informed that the specific details & procedures of each test/assessment will be provided before I attempt each test/assessment. I hereby give permission that my assessment and psychometric test results may be made available to a third party for selection, recruitment or training needs analysis purposes.

SIGNATURE OF APPLICANT: _____DATE OF TESTING: _____