**UNIVERSITY OF KWAZULU-NATAL**

*Analysis of open innovation strategy and challenges faced by automotive component manufacturers in KwaZulu Natal, Gauteng, and Eastern Cape in South Africa.*

By

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A thesis submitted in fulfillment of the requirements for the degree of

Doctor of Business Administration

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College of Law and Management Studies

Supervisors: Prof Stephen Migiro, Dr. Pfano Mashau

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South African automotive component manufacturing and managers were unbelievable; they brought this vital research experience of the South African Automotive industry to fruition. They often challenged my interpretation of the evidence that this investigation generated, considering their invaluable knowledge of the industry. Indeed, the findings of this research are congruent to the validation by the automotive industry stalwarts and are primarily due to them.

I extend sincere gratitude to the responsible authorities of four ACMs for granting permission to investigate their enterprises. It is humbling that the owners and executives of these companies revealed to me the details of the open innovation paradigm and challenges faced by their organisations magnanimously, unreservedly, and at length, in the spirit of sharing knowledge to create new awareness. Without their participation, as they remain anonymous stalwarts of the automotive industry innovation, this research would not have taken off, let alone concluded.

Without forgetting my wife Ntombizodwa and the boys, Neville, Tafadzwa and Tawanda, their tolerance for malingering family activities in pursuit of this colossal task of thesis writing was remarkable.

I dedicate this work to my dear mother for her famous parental rhetoric, "Ukuzala kuzelula."

Arthur Mzwandile Gonyora

## ABSTRACT

The automotive components manufacturing sector is an essential complementary strategic player in the automotive industry in South Africa. Without this sector's vibrancy, the automotive industry cannot forge ahead as a globally competitive player and critical economic growth driver in the local economy. This inevitable dynamism and its continued sustainability in the automotive industry is currently dependent on foreign players, who are bankrolling its activities. To successfully fulfil its mandate and survive the cut-throat competition, the automotive components manufacturers have no choice but to engage in innovation. However, the levels of competition in the sector have forced the automotive components manufacturers to move away from closed innovation to adopting a more open approach to innovation in the quest to build sustainable competitive advantage.

This study investigated how open innovation strategic alignment among the various organizational managers influences sustainable competitive advantage and decision-making from the selected automotive component manufacturers in South Africa. The study's broader aim was to examine the nature and extent to which these firms' top management are aligned to execute their open innovation strategies and overcome the inherent operational challenges. The study used a mixed research methodology with a sample of 44 randomly selected respondents drawn from a target population of 100 chief executive officers, senior and research and development managers subscribed to the National Association of Automotive Component and Allied Manufacturers from KwaZulu Natal, Gauteng, and Eastern Cape provinces The results identified that the challenges faced by automotive component manufacturers are lack of resources, lack of dynamic capabilities, and high-risk exposure, with the lack of resources being the most significant. The study contributes to knowledge by extending the concept of attaining above-average returns by integrating the resource-based view theory, the dynamic capabilities theory, and the portfolio theory. It further recommends practical managerial solutions to overcome open innovation challenges through managers' strategic alignment, risk mitigation, erosion factor mitigation, improved organisational innovation culture, and product development capabilities.

Keywords: Strategic Alignment, Open Innovation, Automotive Component Manufacturers Challenges, Competitiveness, Erosion Factors

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**List of Figures**

**List of Tables**

## List of Abbreviations and Acronyms

| Term | Definition |
|---|---|
| **ACM** | ACMs |
| **AGOA** | African Growth and Opportunity Act |
| **AIDC** | Automotive Industry Development Council |
| **AIEC** | Automotive Industry Export Council |
| **AfCFTA** | African Continental Free Trade Area |
| **APDP** | Automotive Production and Development Programme |
| **ASCCI** | Automotive Supply Chain Competitiveness Initiative |
| **BMW** | Bavarian Motor Works |
| **CBU** | Complete Build Up |
| **CEO** | Chief Executive Officer |
| **CII** | Cross-Industry Innovation |
| **CSFs** | Critical Success Factors |
| **DC** | Dynamic Capabilities |
| **DCT** | Dynamic Capabilities Theory |
| **DTI** | Department of Trade and Industry |
| **EBA** | Emerging Business Area |
| **EU** | European Union |
| **EU-SA** | European Union in South Africa |
| **GDP** | Gross Domestic Product |

| | |
|---|---|
| **GEM** | Global Entrepreneurship Monitor |
| **GSB** | Graduate School of Business |
| **GVA** | Gross Value Added |
| **GVC** | Gross Value Chain |
| **HCV** | Heavy Commercial Vehicle |
| **HP** | Hewlett Packard |
| **ICT** | Information Communication Technology |
| **IoT** | Internet of Things |
| **IP** | Intellectual Property |
| **IPR** | Intellectual Property Rights |
| **KBV** | Knowledge-Based View |
| **KPI** | Key Performance Indicator |
| **JIT** | Just In Time |
| **LCV** | Light Commercial Vehicle |
| **LV** | Light Vehicle |
| **M&HCV** | Medium & Heavy Commercial Vehicle |
| **MIDP** | Motor Industry Development Programme |
| **NAACAM** | National Association of Automotive Component and Allied Manufacturers |
| **NAAMSA** | National Association of Automobile Manufacturing of South Africa |
| **NAFTA** | North American Free Trade Area |
| **NPD** | New Product Development |
| **OEM** | Original Equipment Manufacturer |
| **OI** | Open Innovation |

| | |
|---|---|
| **OICA** | Organisation Internationale des Constrcteurs d' Automobile |
| **PSS** | Product Services Systems |
| **R&D** | Research and Development |
| **RBV** | Resource-Based View |
| **SA** | South Africa |
| **SAAM** | South African Automotive Masterplan |
| **Seda** | Small Enterprise Development Agency |
| **SKD** | Semi Knocked Down |
| **SME** | Small Medium Enterprise |
| **SPSS** | Statistical Package for the Social Sciences |
| **SWOT** | Strength Weakness Opportunities and Threats |
| **TPM** | Total Productive Maintenance |
| **UKZN** | University of KwaZulu-Natal |
| **WTO** | World Trade Organization |

## CONCEPTUAL DEFINITIONS

*Innovation:* Various authors have defined this phenomenon differently (Crossan & Apaydin, 2010), emphasising a different aspect of the term. It is known as industrial innovation, a term that incorporated technical design, manufacturing, management and commercial activities that are involved in the marketing of a new (or improved) product or the first commercial use of a new (or improved) process or equipment (Freeman, 1982). It has also been termed as the specific tool of entrepreneurs in exploiting change as an opportunity for success in different business or service. Drucker (1985) termed it "a new way of doing things (as termed by some authors) that are commercialised. Porter (1990) asserted that innovation is successful when it facilitates the creation and implementation of new processes, products, services and methods of delivery, resulting in significant improvements in outcomes, efficiency, effectiveness or quality (Albury, 2005); other definitions are as follows:

Innovation is the successful development, implementation, and use of new or structurally improved products, processes, services or organisational forms (Hartley, 2006); this is the definition that will be adopted in this study.

Innovation is something new realised with (hopefully) added value (Jacobs & Snijders 2008). Innovation is the adoption or production, exploitation and assimilation, of a value-added novelty in economic and social spheres; it is the renewal and enlargement of products, services and markets; development of new methods of production; and establishment of new management systems.

Innovation is both an outcome and a process (Crossan & Apaydin 2010: 1115).

*Open innovation:* is the new paradigm for realising change essential for profitable growth. It is a paradigm that assumes that firms use external and internal ideas and internal and external paths to the market as they look to advance their technology (Chesbrough, 2003a). Their more academic-oriented book (Chesbrough, Vanhaverbeke, & West, 2006) added that open innovation is achieved by using purposive inflows and outflows of knowledge to accelerate internal innovation and expansion markets for external use of change management. These authors stated that valuable ideas come from either inside or outside the company boundary. This concept has evolved, leading to a new refined definition that states that the idea is a distributed innovation process based on purposively managed knowledge flow that cross-cut organisational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organisation's business model (Chesbrough & Bogers, 2014). These flows of knowledge involve knowledge inflows to the focal organisation (leveraging external knowledge sources through internal processes), knowledge outflows from a focal organisation (leveraging internal expertise through external commercialisation processes), or both (coupling external knowledge sources and commercialisation activities.

*Competitive Advantage:* The concept of strategic management is a broad term consisting of various facets. However, it is essential for any organisation that thrives on being prosperous to gain competitiveness. Porter (1980) proposed achieving competitiveness by using the competitive force's approach that assesses strategy formulation about the industrial ecosystem. The plan advocates that there are five different forces in the industry. These forces are entry barriers such as the risk of substitutes, brokering capacity of consumers and suppliers and enmity in the business environment (Reed, Storrud-Barnes & Jessup, 2012).

*Erosion factors* are external trends or industry dynamics that impact the company's strategy. Chesbrough (2002; 2003a) and other authors in the field describe several erosion factors that compel companies to transform their innovation strategies into a more flexible OI approach:

- Skilled workers' increasing mobility
- Expanding amount of college and post-college training
- Knowledge spill out of the corporate central research labs to companies of all sizes
- External suppliers' increasing capability
- External options available for unused ideas
- Increasing globalisation of knowledge
- Increasing time to take products and services to markets
- Increasing the cost of researching the firms
- Venture capital markets creating new opportunities for companies.

*Strategy* is an old concept that originates from the military. It represented an elevated plan designed to contend and realise predetermined objectives in uncertain circumstances (Freedman, 2015). It defines finding, formulating and developing a principle used to achieve success in the long term if adhered to (Kvint, 2010). For that reason, strategy translates to settings goals that determine an action plan which mobilises resources to perform the proposed actions. This process also involves essential elements such as planning and strategic thinking, and alignment. Strategic alignment is linking an organisation's structure and resources with its strategy and business environment.

*ACM innovation Challenges:* They are three main categories of ACM challenges, which include an overall lack of resources, lack of dynamic capabilities, and high-risk exposure. These challenges form the theoretical underpinnings needed to give a better understanding of the landscape. The resource-related problems (inputs) stem from evaluating the resource-based view theory. The firm's capability related challenges (transforming these inputs into outputs) occur when examining the dynamic capabilities theory. The risk associated difficulties (related to the uncertainty of innovation project outcomes) assess the modern portfolio theory (Markowitz, 2009). Figure 3.2 illustrates how these three types of ACM challenges impact the ultimate performance goals of ACMs, whether they are financial or philanthropic.

# CHAPTER ONE

# ORIENTATION OF THE STUDY

## 1.1 INTRODUCTION

Ever-changing customer preferences compounded by technological advances have forced firms in the automotive industry to rethink their operational strategy. Several authors such as Poorangi, Khin, Nikoonejad and Kardevani (2013) suggest that all organisations, regardless of magnitude and scope of operation, face tough competitive challenges and to survive, they must adapt to their operational environment. This setting applies to the automotive industry, which has experienced considerable turmoil globally and locally.

Automotive Components Manufacturers (ACM) in South Africa have attempted to introduce new products, processes, and business models in their quest to attain a competitive advantage based on the industry dynamics. Researchers argue that open innovation is one of the available solutions which is no longer a source of competitive advantage but has become a competitive necessity (Chesbrough, 2003; Brunswicker & Van de Vrande, 2015). On the other hand, globalisation has become an undeniable fact based on the principle of competitive advantage, which advocates for maximum exploitation of the economic systems among ACMs (Hitt, Ireland, & Hoskisson, 2012). Hence, innovation is a critical driver in unlocking competitive advantage and creating business success (Johannessen, Olsen & Lumpkin, 2001). The speed at which business models have evolved in recent years has caused firms that operate sustainable ventures in the medium and long term to depend heavily on reinventing and innovating their business models.

The industry's performance had stagnated, resulting in significant reforms before 1995, which focused on enhancing global competitiveness and strengthening value-added production. The South African government pronounced these reforms to improve local production and open the industry to global competition through a structured programme of reducing tariffs and export orientation. Unfortunately, this has not yielded the desired outcome of shaping South Africa's automotive industry to a globally competitive environment. Since this industry is primarily essential to export creation, a decline in competitiveness impacts the country's exports and negatively affect localisation initiatives.

This need to create an attractive business environment presents the industry an opportunity for this empirical research to fill the gap in the literature and new knowledge by employing the following models: Open Innovation, ACM innovation challenges, and ACM Open innovation strategies. The research's focal point was on the strategic alignment of open innovation and identifying ACM challenges that inhibit competitiveness. This research intended to explore and explain the findings Chesbrough (2003), Brunswicker and Van de Vrande (2015) and Farha (2016). They conducted studies that identified several themes considered in this research project. ACMs play a role in coordinating and orchestrating open innovation operationalisation.

Since the literature on open innovation had multiplied over the years when Chesbrough pronounced his cutting edge work in 2003 (Chesbrough, 2003), ACM received little attention, with more focus given to multinational organisations regarding open innovation practices. Unfortunately, small organisations could not benefit from the lessons drawn from the global organisations' open innovation practices. Small firms are unique when considering their resource capabilities, skills, the relationship between the management and the open innovation strategy. They are essential in an economy, and different studies have established the relationship between open innovation and organisational performance (Oke et al., 2007; Rosenbusch et al., 2011). Although they are an economic driver, ACMs have size-related challenges; hence, it is essential to find ways to overcome this inherent weakness.

The thesis must focus on the automotive sector based on the role the industry plays in the economy. Accordingly, this thesis extended the work done by several authors (Brunswicker & Vrande, 2014, Hossain & Kauranen, 2016) regarding analysing open innovation strategy alignment and challenges faced by ACMs. Notwithstanding Farha's (2016) and Cornell (2012) concerning propositions they formulated, this thesis was adopted and tested in the automotive sector. This chapter presented the background of the study, problem statement, rationale, aim of the study, research objective and questions. The chapter also covered the research design, limitations and structure of the research.

## 1.2 THE BACKGROUND OF THE STUDY

The ACMs are the country's most important drivers of economic activities (Komarasamy, 2013). They are crucial catalysts in the industry not only in South Africa and other developing economies but in the developed economies, accounting for over 99% of all businesses and more than 60% of jobs produced, and they are an essential source of innovation (Audretsch, 1995 and Böttcher et al., 2015). Unfortunately, ACM's failure to survive and compete with multinational component suppliers is due to typical weaknesses such as resource constraint (time, money), dynamic capabilities (skills gap), and uncertainties. These weaknesses are a result of their size and stature (Slavec et al., 2012:283).

The size of an organisation is related to the availability of resources that directly impact acquiring skills and mitigating risk. The scarcity of resources among ACMs results in challenges of global competition exacerbated by the sluggish pace of innovation that has seen the domestic industry lagging behind its universal competitors. Hence the domestic manufacturing sector has experienced innovation efforts scuttled by challenges such as weak technology diffusion, environmental factors and uncertainties inherent in their operations.

Globally the motor industry is concentrated in the Triad countries of North America, Japan, and Europe. This industry, in the main, is composed of a few Original Equipment Manufacturers (OEMs). The characteristics of their location are industrialised markets, surplus production, high cost of production and poor economic performance. These characteristics have created both challenges and prospects for OEMs, signalling that countries seeking benefits from the growth and savings must be competitive (Phaho, 2008).

The rise of major global trends emanating from cost-cutting strategies compounded by various approaches employed by the leading OEMs in the Triad countries has resulted in economic activities, which have balanced the automotive demand and supply sides. This balance has to buttress the global trends and structural pressures that caused mergers and acquisitions strategies employed by the automotive industry: global surplus production, outsourcing strategies, and research and development in new technology and innovation.

There has been an increase in events and future growth prospects in the global automotive value chain. These global trends have witnessed significant growth, fostering critical players in developed and developing automotive producing countries such as South Africa. Meanwhile, the essential players have to cope with the diminished domestic and regional market dynamics. Notwithstanding that, the automotive industry generally exhibits a dependable perspective. The future for this industry looks bright due to the stimulating demand for vehicles in the local and regional markets and a growing quest for vehicle ownership among the middle class. This assertion (Barnes, Black, & Monaco, 2018) informs the view that the domestic component manufacturing sector needs to keep innovating for the development and sustainability of the value chain.

This view is supported by Meyer and Meyer (2017), who suggested that the failure of small businesses to form solid linkages upward with more substantial firms is the main reason for the unsuccessful innovations. These unsuccessful innovations and failed technology diffusion resulted in proposing governments incentives for R&D as an urgent intervention (Levie et al., 2016). These incentives for R&D initiatives aimed to promote innovation, attracting and strengthening endurance and linkages among domestic and foreign knowledge-intensive firms.

Therefore, urgent action was required to deal with the impact of component manufacturers on the automotive industry's competitiveness. Resulting in the department of trade and industry declaring that this industry's continued lack of competitiveness hampers the survival and growth of ACMs, a vital cogwheel of the economy (Barnes, Black, Combrie & Hartogh, 2018).)

### 1.2.1 Brief overview of the Local Motor industry

OEMs started to penetrate the local automotive market in 1920 as manufacturers, which saw the establishment of the domestic industry (Kok, 2010). By 1920, there was rapid expansion and growth that saw many new manufacturers entering the automotive market. In 1960, South Africa became the most significant automotive producer among the developing countries, with 87 000 units of vehicles annually by then, 8 OEMs operating in the country (Komarasamy, 2013).

The expansion of this industry has seen South Africa emerging from humble beginnings to become a force to reckon with as the world's number twenty-second most significant automobile producer. In 2012, the industry produced 92% (David, 2014). They attracted four major European automotive manufacturers: BMW, Mercedes Benz, Renault, and Volkswagen. At the same time, General Motors, Toyota, Ford and Nissan, who is Japanese, and other multinational producers, became 100% owned subsidiaries (Boonpan, 2012).

The industry contributes significantly to the rapidly growing economy and industrial development, accounting for 7% of the Gross Domestic Product (GDP) in 2012. This country was ranked number 23 in global automotive production, sharing 0.6% of the market in 2012 (David, 2014). There has been massive investment in this industry, which has facilitated exports, with capital expenditure support to OEMs over 1995-2011. This investment amounted to R 43.5 billion. At the same time, the actual value of automotive component exports grew over the 16 years 1995-2011 to R685.3 billion contributing to the annual growth rate of 20.5% (Merven, 2012).

The local automotive industry is driven strongly by the parent OEMs in operation strategies, which is worldwide. For this reason, the industry's structure has always been kept firmly in fit with the OEMs requirements in the domestic and international markets. This orientation is a deliberate attempt to making OEMs export-driven and significantly transforming the industry's operational structure and the outlook of the component manufacturing sector (Barnes, 2010).

The country's membership of the World Trade Organisation (WTO), the excellent trading relationships with the European Union (EU) and the competitive advantages over its competitors have stimulated the integration of the industry into a global supplier and sourcing among their global peers (Ambe, 2013).

From a worldwide perspective, flexibility and competitive advantage are critical since they are catalysts of business models. These attributes, namely the flexibility and competitive advantage, are suitable in successful niche markets requiring the same platforms to produce large quantities of products at low cost with specific model derivatives (Tolmay, 2012). The industry has significantly reserved its capacity and potential, with single facilities manufacturing products at competitive costs for domestic and export markets.

### 1.3 THE STATEMENT OF THE PROBLEM

South Africa's automotive industry remains a vital element in the country's economy. The industry plays both a strategic and catalytic role in economic development given its significant investments, modern advanced manufacturing activities, provider of quality employment, contribution to the country's GDP, earner of foreign currency, and its significant economic multiplier effect (Komarasamy, 2013). Long-term policy certainty is a crucial reason for the ongoing health and success of the country's automotive industry.

In the domestic arena, the automotive industry has undergone a vivid transformation from the emergency of democracy in South Africa. Multinational corporations dominate this industry with their integration into the global value chains. Although there are significant importers and exporters of components,the local industry has proven to produce vehicles and manufacturing automotive parts of high international standards. South African vehicle assembling plants and their complementary domestic component manufacturing partners have been awarded international accolades for the quality of their products, acknowledging this industry's capabilities (Barnes et al., 2018).

Like any other industry, automotive components manufacturers face challenges that include the unpredictable regulatory environment, lack of infrastructure for electric vehicles, technological advances, carbon emissions, low production for cars and components, and a decline in new vehicle sales. This study has categorised the challenges the component manufacturers face into three: an overall lack of resources, a lack of dynamic capabilities, and high-risk exposure. These challenges form the theoretical underpinning needed to understand better what type of open innovation (OI) strategies are required to create a sustainable competitive advantage in this industry.

Researchers have recognised open innovation as an essential strategy to overcome these typical ACMs weaknesses (Edwards et al., 2005; Lee et al., 2010; Rahman & Ramos, 2010; Wynarczyk, 2013). The resource-related problems (inputs) stem from evaluating the resource-based view theory (Fuller & Rothaermel, 2012). The firm's capability related challenges (transforming these inputs into outputs) occur when examining the dynamic capabilities theory (Teece, 2007). The risk associated difficulties (related to the uncertainty of innovation project outcomes) assess the portfolio theory (Jalonen, 2012).

Figure 1.1 illustrates the integration of the three interventions: resource-based view, the dynamic capabilities view and the portfolio through open innovation strategies to overcome the ACMs challenges.

The identified challenges present a research gap, and thus the focus of the current study existing at the intersections of several study domains, as shown in Figure 11. Hence, this study's scope is narrowly focused on the role that open innovation strategies can play in assisting ACMs with overcoming their size-related competitive challenges and increasing their economic performance. Other management concerns are essential to organisational success. However, these other non- innovation management topics are outside of the scope of this particular evaluation.

Consequently, the research problem in this study is how the South African ACMs seek to attain above-average returns by integrating the resource-based view theory, the dynamic capabilities theory and the portfolio theory through open innovation strategies. The nature and extent to which the automotive components manufacturing firms` top management is strategically aligned are critical to the achievement of this end.

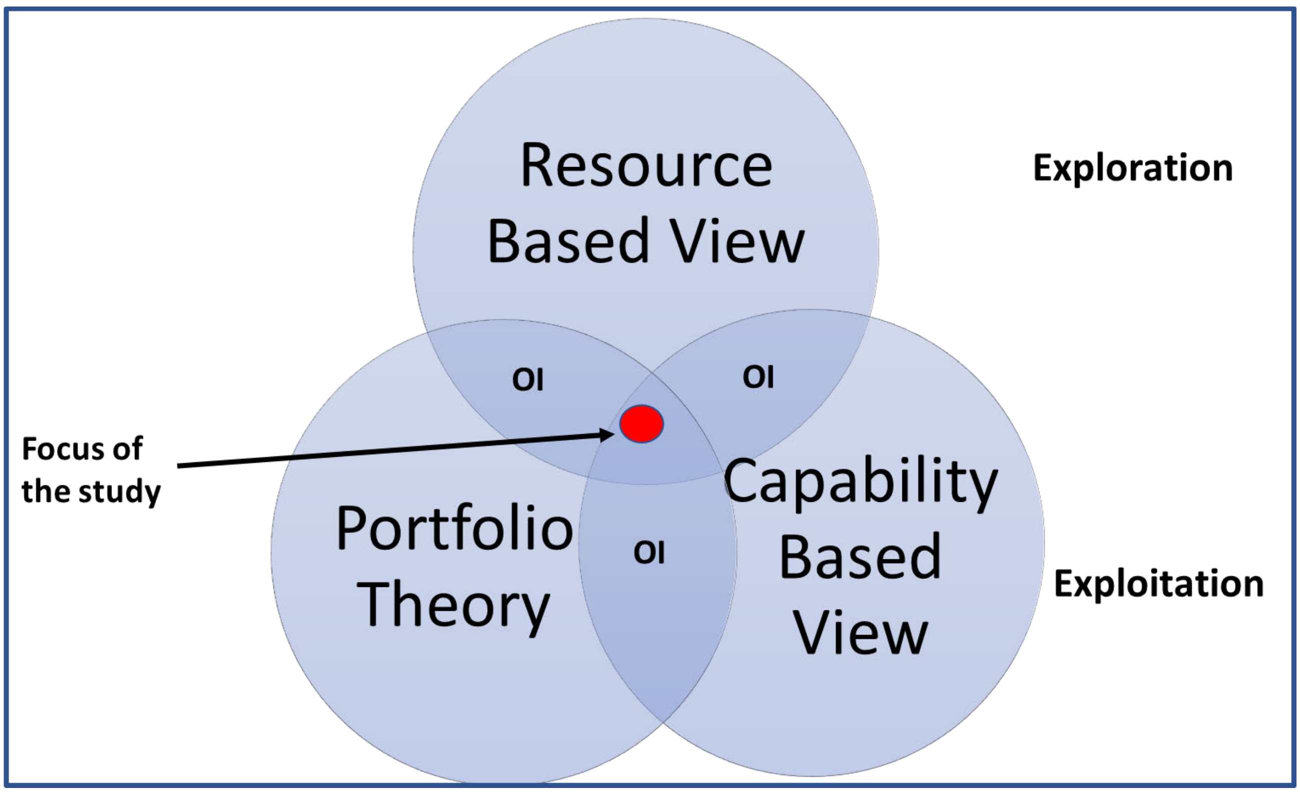


**FIGURE 1.1 THESIS FOCUS AREA**

Source: Own source, (2021)

### 1.4 RATIONALE OF THE STUDY

Despite the tremendous growth in open innovation studies, the present literature exposed an opportunity to investigate the nature and extent of analysing open innovation strategy and challenges faced by ACMs in South Africa. There are no open innovation studies among component manufacturers in South Africa, according to literature searched between 2015 to date. The automotive industry is highly technology-intensive, with business models focused on OEMs' operations. In most cases, there is no alignment between OEM business models with their respective ACMs. Although OEMs expect ACMs to manufacture components according to their specification, they hardly share their internal capabilities and expertise outside the boundaries of their organisations. This inability to share knowledge makes it an exciting area of study.

Driven by the Internet of Things (IoT), the industry dynamics have rapidly changed, and this has facilitated the availability of knowledge spontaneously, stimulating the interest in conducting this study. The automotive industry has gone through phases such as commodity and disaggregation of the value chain, the entrance of new firms, the increase in the availability of venture capital, a demanding customer base, and finally, an aggressively competitive environment. These transformations have diminished the long-established approaches and methods that organisations previously employed to achieve more openness and inclusiveness. As an illustration, by observing the top four OEMs worldwide, it is evident that they share their knowledge with the public. They have launched open innovation initiatives to facilitate the process of idea sharing outside organisational boundaries. These initiatives have triggered organisations' propensity to cooperate with external partners during innovative projects (Hipp, Gallego & Rubalcaba, 2015).

ACMs are a vital driver in technology transfer, economic growth and societal building (Chen et al., 2008). They are facilitators (Farha, 2016) and boosters (Mas-Tur & Soriano, 2014) in the open innovation ecosystem. In generating innovation and transferring technology in the industry, they are considered a strategic player. They are the brains of the industry (Hipp, Galego, & Rubalcaba, 2015). Presently, OEMs control only 25% of the value of goods used in the production process of an automobile when considering the total inventory in their assembly plants (Maxton & Wormald 2004). Surprisingly, the balance of 75% is in the hands of their suppliers. This scenario is an indication that this research is essential, as previously stated. A thriving motor industry acts as an economic barometer of both the country and the industry. This study tapped on the deliverables of the master plan for the vision 2035, which highlighted the challenges faced by ACMs in general, and that resulted in the impact of open innovation adoption, namely localisation initiatives (Barnes et al., 2018)

The terrain of global automotive competitiveness is exceedingly dynamic. The present study has focused much on literature concerning open innovation and appropriate strategies that ACMs could adopt to boost competitiveness. This study evaluates these existing theories in the automotive industry as compared to professional services (Farha, 2016) by modifying propositions to suit the industry that guides the aim of the study

**1.5 THE CONTRIBUTION OF THE STUDY**

The study contributes to knowledge by extending the concept of attaining above-average returns that integrate the resource-based view theory, the dynamic capabilities theory and the portfolio theory. It provides a further academic understanding of the open innovation strategic alignment imperatives and assists management to understand how they can ensure that strategic alignment between and amongst themselves, as managers should cascade to all levels in their firms to enhance sustainable competitive advantage

### 1.6 THE AIM OF THE STUDY

This study intended to propose a contextual open innovation adoption model that applies to ACMs in the motor industry by focussing on the innovation challenges faced by ACMs in KwaZulu-Natal, Gauteng and Eastern Cape. It also explored how ACMs can strategically overcome these challenges by embracing the concept of open innovation, which advocates enhancing competitiveness in the marketplace.

### 1.7 RESEARCH OBJECTIVES

1. To establish the nature and extent of ACMs` open innovation strategic alignment for sustainable competitive advantage in the automotive industry.

2. To ascertain what automotive components manufacturers' open innovation challenges affect the firms and their influence on risk exposure profiles.

3. To determine the nature and extent of erosion factors among the ACMs.

4. To establish what relationship exists between organisational culture, open innovation and competitiveness.

5. To investigate the impact of open innovation strategies on new product development prospects.

6. To propose a contextual open innovation adoption model that applies to the ACMs in the automotive industry.

### 1.8 RESEARCH QUESTIONS

1. What is the nature and extent of ACMs` open innovation strategic alignment for sustainable

competitive advantage in the automotive industry?

2. What are the automotive components of manufacturers' open innovation challenges and their influence on risk exposure profiles?

3. What is the nature and extent of erosion factors among the ACMs?

4. What relationship exists between organisational culture, open innovation and competitiveness?

5. What is the impact of open innovation strategies on new product development prospects?

6. What proposed contextual open innovation adoption model is applicable for the ACMs in the automotive industry?

**1.9 THE SCOPE OF THE STUDY**

The study focused on component manufacturers in KwaZulu-Natal, Gauteng and the Eastern Cape in the motor industry. The study established the nature and extent of open, innovative strategies that ACMs employ in the automotive industry to enhance competitiveness and ascertain what open innovation challenges hamper competitiveness. It furthermore determined the nature and extent of erosion factors in the components supply chain by evaluating their relationship with open innovation in the industry. The study examined the contextual factors impacting the ACM's open innovation initiatives and established the relationships between innovative organisational culture and open innovation adoption and competitiveness of ACMs in the industry. The study also investigated the impact of open innovation strategies on new product development prospects among ACMs in the automotive sector. Finally, it proposed an open innovation adoption model for the ACMs in the automotive industry in South Africa.

## 1.10 RESEARCH DESIGN AND METHODOLOGY

According to Goldstein et al., 2014, when conducting a study, the blueprint used is termed research design; it indicates the operationalisation of the research. Selltiz et al. (2013) corroborated that research design represents a road map that shows the most suitable route to follow when conducting a study. This design guides the methods and decisions taken by researchers to set the research's logic and uses them to interpret their findings (Bryman & Becker, 2012). The philosophical underpinning of the research design informs the quality of the results, and a decision had been taken to use both quantitative and qualitative approaches (Patton, 2016). In this research, a mixed-method was used, with a more significant bias towards the quantitative approach.

Ontology is the philosophical field around the nature of reality (all that is or exists) and the different entities and categories within reality. Epistemology is the philosophical field spinning around (the study of) knowledge and how to reach it. Both establish the nature of what is common knowledge by prescribing a methodology of assessing research quality. The research quality is available from different methods used to identify the experiences, and the same process uses validation criteria. Simply put, philosophical and theoretical assumptions influence both quantitative and qualitative research in different ways. They are bound to generate a contrasting set of criteria for judging the quality and credibility of the study (Patton, 2016). Thus, quantitative and qualitative research cooperates around the consistency of the research objectives and the underpinning assumptions (Babbie & Benaquisto, 2002).

Underpinning qualitative research is an epistemology of an interpretive paradigm representing the knowledge of the subject. This epistemology is the route to the known issue, arbitrating and characterising a curtain built from theoretical assumptions of that "other" in the different fields of study to the present model, where knowledge coexist in various contexts and moments (Mason, 2016). Categorically, known respondents by the qualitative researcher should always endeavour to identify an ontological rupture to recognise a human being (Clarke et al., 2015.).

A mixed research approach enables the researcher to gain extra mileage from the qualitative system that facilitates the capture and understanding of people's motives and the interpretations of the phenomenon under study and allows the researchers to gain insight into people's worldviews and presentations (Grauri & Gronhaug, 2014). The researcher believes the mixed research method approach will enable the study to obtain the respondents' underlying and salient qualitative information or views on the phenomenon under investigation and further the probing. A quantitative approach poses a limitation (Bryman & Becker, 2012).

The researcher found the mixed research method approach appropriate for this study in highlighting the strategies to overcome the shortcomings and embrace prospects of open innovation to enhance competitiveness (Becker et al., 2012).

## 1.11 LIMITATIONS OF THE STUDY

The study only focused on examining the nature and extent to which ACMs in KwaZulu-Natal, Gauteng and Eastern Cape can strategically overcome shortcomings and embrace prospects derived from open innovation adoption in enhancing their competitiveness. Therefore, the results could not be generalised because of the population spread, which is around three provinces KwaZulu Natal, Gauteng and the

Eastern Cape, where most activities of ACMs are prevalent even though other ACMs do operate outside the chosen areas. However, Barnes (2018) stated that the automotive industry is homogenous. The chances are high that, to a significant extent, the results obtained from these cases would reflect the general activities in the automotive industry.

## 1.12 RESEARCH STRUCTURE

Chapter One. This chapter introduces the study and presents the following: an explanation of the research background, the rationale for selecting the research area, the purpose of the research, objectives, questions, scope of the study, limitations of the investigation.

Chapter Two. This chapter contains the literature review of the study and evaluation of open innovation archetypes and frameworks that underpin the research. It presents an assessment of the critical variables and constructs from different authors' perspectives contributing to the study.

Chapter Three. This chapter presents the literature review of the study's evolution of open innovation in the global and local automotive industry. It also offers a localisation argument while focusing on the ACM innovation challenges model and explains the interventions in curtailing the challenges.

Chapter Four. This chapter plots the road map of the study regarding methodological issues. It presents the research process, research philosophy, research design, data collection methods, sampling, and ethical considerations.

Chapter Five. This chapter presents the primary data gathered using questionnaires and interviews in which bar charts/pie charts showed the results, followed by a brief discussion of the statistical results.

Chapter Six. This chapter is about the discussions and the analyses of the results and findings from the literature review. An outline of in-depth studies is presented in relationship to the research objectives.

Chapter Seven. This chapter is a conclusion to the study. It summarises the implications of the results in conjunction with the research aim, research objectives and the research questions. It presents the acknowledgement of the study's limitations and highlights the scope for future studies in the same research area.

This thesis includes the following topic areas indicated in Figure 1.2

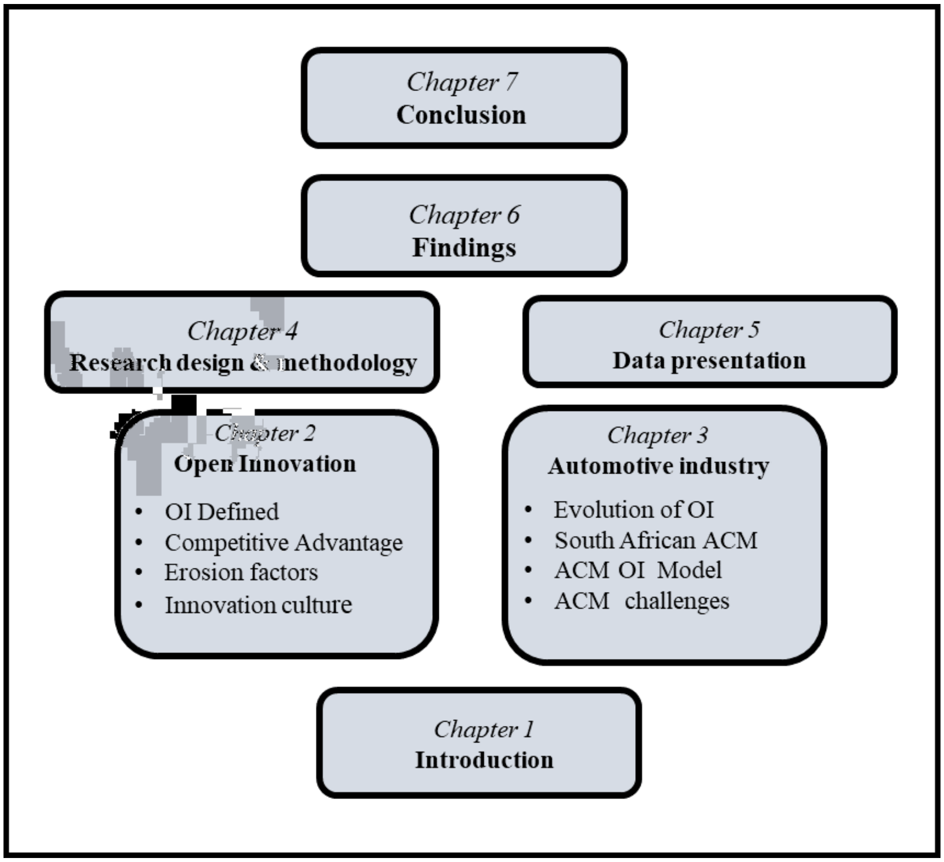


**FIGURE 1.2 RESEARCH STRATEGY FRAMEWORK**

**Source:** Own source. 2020

### 1.13 CHAPTER SUMMARY

This chapter outlined the background, highlighted the motor industry's global context, and overviewed this industry in the South African context. The study highlighted the problem statement, including the research objectives and questions. The study discussed the following focus and scope, limitations and the methodology employed in the survey. The next chapter will focus on the literature review. This section identifies the nature and extent of ACMs` open innovation strategic alignment for sustainable competitive advantage in the automotive industry and the erosion factors that inhibit the operationalisation of open innovation.

# CHAPTER TWO

# THE EVOLUTION OF OPEN INNOVATION

## 2.1. INTRODUCTION

The literature review in this study comprises two chapters. The first chapter covers a literature review on open innovation models and frameworks that underpin the theoretical foundation of the research. These open innovation models and frameworks are viewed as being open or closed. Some arguments have been forwarded in the literature that suggests South African ACMs can attain competitive advantage and hence above-average returns. The second chapter reviews the literature by various academics, authors, and industry experts on the evolution of open innovation in the South African automotive industry context. The South African automotive industry, particularly the component sector, is facing insurmountable innovation challenges. These challenges are size-related and hindering competitiveness (Barnes et al., 2018).

The South African automotive industry has not been spared from the ever-pressing economic hurdles that have resulted in organisations engaging in focused innovation approaches, emanating from the recent developments in globalisation, Information and Communications Technology (ICT), and technology's complexities (Barnes et al., 2018)). The argument is that ACMs in the South African automotive industry can strategically hedge themselves against these hurdles by engaging in a collaborative approach to innovation, that is, the argument for open innovation instead of closed innovation ( Lichtenthaler, 2011). The proponents for the closed innovation approach urge that organisations generate ideas internally built, develop, market and finance these ideas from within, resulting in cutting production costs. However, the movement of skilled labour, availability of highly educated people, venture capital funding for start-ups, reduced time to take products and services to markets, and increasing competition in the global marketplace has rendered closed innovation obsolete hence the argument for open innovation (Chesbrough & Bogers, 2014). Adopting open innovation South African ACMs to benefit from the movement of educated and skilled labour, venture capital funding, reduced lead times, and increasing competition in the global market (Mazzarol & Reboud, 2011).

South African automotive component manufacturers' managers can leverage their position on the marketplace by observing innovation changes that take advantage of potential innovation opportunities as they avail themselves in their business environments (Chesbrough, 2003a, 2006a). For ACMs, innovation will be crucial to attaining economic and social success and competitiveness in today's globalised market (Senge, Carstedt, & Porter, 2006). Nevertheless, the current study conceptualises that today's scholars still need to clearly define, fully develop, and understand innovation in the context of the developing economies such as South Africa and the rest of Africa (Mazzarol & Reboud, 2011). This practice-based approach of defining, developing and understanding innovation in the context of developing economies to some extent explains and presents a potential theoretical gap in the literature that the current study seeks to address (Brunswicker & Van de Vrande, 2015). Studies have indicated that participation by firms in open innovation is still relatively low in the South African context (Komarasamy, 2013) and that many more firms could benefit from at least limited participation in these strategies (Keupp & Gassmann, 2009). About 5% to 20% of ACMs in OECD countries engage in open innovation, depending on the country.

Nevertheless, roughly 20% to 60% of large firms in these countries participate in open innovation activities (De Backer, Lopex-Bassols, & Martinez, 2008). From these statistics, there is a clear indication that fewer ACMs are practising open innovation in OECD countries than the more giant corporations in the OECD countries. This scenario is in harmony with what is obtaining in the South African automotive industry (De Backer et al., 2008).

The South African ACMs failure to adapt to open innovation strategies may represent a gap in the available literature resulting in a theoretical deficit. As a result of this deficit, there arises a need to focus on the theoretical foundation of open innovation. This research integrates earlier findings that assist with developing literature and presenting comprehensible knowledge about the open innovation paradigm (Lichtenthaler, 2011).

The growing interest in open innovation management in ACMs provides several opportunities to shed new light on existing theoretical frameworks on innovation. The study argues that existing management theories should be combined to develop a consistent body of knowledge about the open innovation paradigm, particularly in the automotive component manufacturing sector. None of the current management theories fully explain how automotive component manufacturing organisations benefit from open innovation. Therefore, this study sheds light on open innovation from multiple perspectives and brings theories together to understand open innovation in the automotive industry better. Specifically, the study explores the necessity to integrate open innovation to the literature on strategy and different theories of the firm, such as the theory of competitive advantage, resource-based view, dynamic capabilities-based views, and portfolio theory.

## 2.2. OPEN INNOVATION PERSPECTIVES

In nurturing present and future business growth, the concept of open innovation is considered a critical element since it is a vital ingredient in the formation of products and services and organisational business paradigms (Chesbrough, 2003). Chesbrough (2003) detects a paradigm shift in innovation, which relies on the internal dynamics of organisations. The author further observes that organisations are now leveraging much information from outside their boundaries. This information indicates that organisations now combine outside and inside ideas in their quest for engaging in open innovation strategies. The current study conceptualises South African ACMs to tap into the open innovation model coined by (Chesbrough 2003). These ACMs can benefit from this model, which suggests that organisations should avoid engaging only intelligent people as part of their staff complement; instead, they can outsource competent services outside their operating environments.

The paradigm of closed innovation dictates that organisations generate ideas internally, built, develop, market and finance the ideas from the organisation. Historically, this approach produced favourable results. However, dynamic mobility of skilled labour, availability of highly educated people, venture capital funding for start-ups, reduced time to take products and services to markets, and increasing competition in the global marketplace renders closed innovation obsolete. Literature suggests that these are critical attributes for open innovation that ACMs can leverage for sustainable competitive advantage (Chesbrough & Bogers, 2014). These authors explain this initiative as a model that combines outside and inside ideas to generate value.

The current study operationally adopts the following perspective of open innovation. The open innovation process is the persistent flow of knowledge across the organisation's boundaries using economic and noneconomic instruments aligned to a specific organisational business model. The argument is that the ACMs need to strategically design their organisational business models and align them with the open innovation framework (Farha, 2016). ACMs can take advantage of the free movements of knowledge inflows to the critical administrative processes and leverage the outside knowledge sources through absorptive capacity. This process may also involve ACMs knowledge outflows and balancing inside knowledge using outside commercialisation techniques or linking outside knowledge sources and commercialisation activities (Chesbrough & Bogers, 2014).

South African ACMs stand to benefit from accelerating their innovation trajectory and strategies through open innovation as a tool and driver for generating the purposeful flow of knowledge inside and outside the operational boundaries while also growing markets for further innovation exploration in the future (Chesbrough, 2006). Borrowing a leaf from Chesbrough (2006), the current study notes that open innovation is a function of managing strategic exchanges of information with participants outside organisational boundaries and combining their capital and know-how in their innovative initiatives. However, this model approach can only benefit those ACMs organisations in South Africa willing to boost and leverage innovative ideas to deliver additional value for their customers and shareholders. Conversely, the open innovation model dictates that organisations, South African ACMs, should desist from attempting to produce the best ideas entirely by themselves. Tremendous synergies are accruing to collaboration that the South African ACMs can benefit from. When managing cost and risk and accelerating technological expansion for example, organisations need to optimally utilise all the potential internal and external options at their disposal. To achieve this, the knowledge sources that organisations such as ACMs may use can be external such as supplier base, research and development centres, universities, customer base, competitors and organisations with corresponding submissions (Von Hippel, 1988).

In addition, ACMs can employ crowdsourcing as an alternative to tapping into external innovation. Overcrowding entails processes where organisations engage with a wide range of other organisations practising open innovation activities in different locations and alternative sources. In essence, open innovation involves, in many cases, online crowdsourcing platforms designed to allow remotely-located individuals and organisations to collaborate during new product or service developments, a proliferation that ACMs in South Africa can arguably take advantage of the situation. This proliferation of platforms supporting innovation contests has increased significantly in the past decade (Adamczyk et al., 2012). South African ACMs can benchmark with companies such as Starbucks (My Starbucks Idea), Dell (Dell IdeadStorm), P&G, Cisco, Sony, and others that have launched online crowdsourcing platforms in order to tap in and obtain contributions from new innovators outside their boundaries (Chesbrough, 2003a; Del Rocio Martinez-Torres, Hossein & Islam, 2015,  2015b; Martínez-Torres, 2013; Ramaswamy & Gouillart, 2010; Rodriguez-Pinero, &  Toral, 2015; Westerski et al., 2013).

The main argument for such collaborative actions is that consumers who are potential customers for the South African ACMs, for instance, may not need to possess specific subject matter expertise to be able to contribute (Füller, Matzler, Hutter, & Hautz, 2012). Some authors for academic argument sack refer to this type of collaboration in companies as 'Enterprise 2.0' (Carbonera, Contrerasb, Hernandezc, & Gomez-Pereza, 2012). The 'Enterprise 2.0' tools are not designed only to develop new products but, in many cases, for promoting sustainability in the sector (Adamczyk, Bullinger, & Möslein, 2012). South African ACMs need such sustainability to sustain their competitive advantage. This current study notes and argues that the open innovation approach can help the South African automotive industry boost its competitiveness locally and globally. In 2013, for example, the motor giant Citroen built the UK's first crowdsourced car. This example is a perfect illustration for South African ACMs of how someone working in one field (automotive) can use their background, experience and smarts to innovate in another field.

Some South African ACMs can opt for selling themselves and all of their intellectual property, which can be an attractive option for seeking immediate financial returns. Alternatively, they can trade and barter with their intellectual property. The trade and barter strategy enables organisations to gain access to other firm's patents in return for granting access to their patents, a process referred to as cross-licensing (Parchomovsky & Wagner, 2005). Like large OEMs, ACMs in South Africa stand to benefit from patenting. Andries and Faems (2013) argue that patenting activities significantly helps ACMs to license out their knowledge to external parties for commercial gain. However, timely recognition of opportunities for out-licensing of organisations` technologies outside their core business is a challenge. For South African ACMs to overcome this challenge, they would need to possess a focused business portfolio, specialised knowledge base, and specific financial resources for innovation activities.

Bianchi et al. (2010) suggest a methodology that demonstrates how ACMs, in general regardless of their location, be it in South Africa or elsewhere, can identify viable out-licensing opportunities that suit their contexts. On the other hand Jeon, Lee, & Park, (2011). They demonstrated how to use patent information to search potential technology partners in open innovation. Moreover, present an alternative approach for finding external partners through patent information within the ACMs sector of the automotive industry. These authors argue that organisations such as ACMs in South Africa and elsewhere in the world can seek to find partners by undertaking three consecutive steps: data collection and pre-processing, transforming patent documents into co-occurrence vectors, and deriving potential technology partners based on similarity indicators and characteristics. When dealing with ACMs in particular, the literature argues that stakeholder organisations such as universities and relevant state organisations need to consider diverse and adaptable IP-management strategies that suit the context of the ACMs (Saguy & Sirotinskaya, 2014). This perspective has the potential of leveraging the South African ACMs strategic competitive advantage. For example, Spithoven et al. (2013) conclude that the turnover of ACMs from new products is mainly driven by patent protection, whereas large firms benefit predominantly from their searching strategies. The argument is proffered here is that ACMs can also benefit from the searching strategies, an attribute of open innovation. Suh and Kim (2012) intimate that technology acquisition is positively related to patenting activity in ACMs. South African ACMs may consider patenting their vital techniques to fully benefit from their innovation initiatives (Andries & Faems, 2013).

In collaboration, the synthesis argument is that ACMs in South Africa can use their IPRs, in the form of registered patents or trade secrets rights, to manage the proprietorship and the control of the capital shared or transferred to external partners. Collaboration of ACMs should depend and be guided by what the ACMs are strategically aiming to achieve. Spithoven et al. (2013) conclude that ACMs' cooperation with potential external agencies increases their chances of launching new products and services in the market. Parida et al. (2012) point out that vertical collaboration is arguably the most relevant strategy for radical innovation within the ACMs sector, while horizontal collaboration may be appropriate for incremental open innovation within the ACMs sector. These perspectives enlarge the open innovation scope horizons for ACMs in South Africa as well. However, under industries open innovation systems, vertical collaboration and specialisation may decrease the size of ACMs in the automotive industry (Lecocq & Demil, 2006). This is a phenomenon that ACMs in South Africa should be worried about as collaboration among ACMs should go beyond science and technology and include value chain partnerships that bring new knowledge bases that can be absorbed easily by the ACMs in South Africa (Spithoven et al., 2013). Wynarczyk (2013) distinguished between open innovating ACMs and closed innovating ACMs and believes that open innovation ACMs tend to collaborate for new product introductions in the market, whereas closed innovation ACMs tend to collaborate for incremental changes. South African ACMs need to aim beyond incremental changes, and as a result, they should strive for being open innovation ACMs. Studies repeatedly confirm that collaboration among ACMs is more critical in the commercialisation stages of their development than in their early stages of innovation (van de Vrande et al., 2009; Hemert et al., 2013). The size of the ACM firm matters and is related to the degree of collaboration by the ACM. As a result, size can be a limiting factor for South African ACMs when it comes to innovation. For example, the argument is that the smaller the size of an automotive component manufacturer, the less the degree the automotive component manufacturer can collaborate for innovation purposes (van de Vrande et al., 2009; Teirlinck & Spithoven, 2013).

## 2.3. OPEN INNOVATION CLASSIFICATION

Categorisation or classification of open innovation is critical to the South African ACMs strategic planning for innovation. It is paramount that the South African ACMs fully understand the implications of this phenomenon. Several authors share their thoughts on the phenomenon and identify three pillars or classifications of the paradigm (Chesbrough & Growther, 2006; Gassmann et al., 2010).

The pillars are, inbound which entails the ACMs, like other innovating organisations using within themselves acquired innovation core competencies from outside sources of innovation in the industry, such as the in-license of technology developed elsewhere, which integrates components from external sources into the ACMs technological solutions as compared to developing an equivalent technology in-house. This pillar offers the South African ACMs benefits and synergies that accrue from tapping into the latest state of the art technologies that competitors have developed in the market.

The "outbound" pillar offers the South African ACMs opportunity to apply knowledge sourced externally with the intentions of developing and commercialising their innovations (Chesbrough & Growther, 2006). Outbound may also involve out-licensing a product or service to another organisation that can affect further developmental changes to the following higher levels. A good example is that South African ACMs can obtain the required regulatory approvals from relevant authorities in the country. Conversely, or ACMs can out-license innovations for distribution purposes. This is some kind of franchising that the South African ACMs can benefit from the outbound paradigm.

Alternatively, the South African ACMs can adopt the "coupled processes" paradigm, which entails amalgamating the inside and the outside proportions of innovation knowledge sources. The key advantage of this paradigm is that instead of allocating current resources and expertise, ACMs rather come together to build up new ideas and innovative solutions (Gassmann & Enkel 2004). This kind of collaboration involves ACM organisations engaging in close integrations, such as joint ventures, or to a lesser extent committing to completion of innovation programs.

Dahlander and Gann (2010) suggest further dimensions to the classification of inbound and outbound open innovation that South African ACMs can consider adopting. The identified four main dimensions of openness are:

- revealing of internal organisational resources to the external environment without realising any immediate financial rewards ('revealing'),
- commercialising inventions and technologies through selling or licensing out resources ('selling'),
- using external sources of innovation by scanning the external environment before initiating internal R&D ('sourcing')
- acquiring input to the innovation process through the marketplace ('acquiring').

This classification is presented in Table 2, Classification of Open Innovation.

**TABLE 2.1 CLASSIFICATION OF OPEN INNOVATION BY DAHLANDER AND GANN (2010)**

| | **Non-Pecuniary** | **Pecuniary** |
|---|---|---|
| **Outbound Open Innovation** | Revealing | Selling |
| **Inbound Open Innovation** | Sourcing | Acquiring |

Another classification of open innovation is based on the concept of exploration and exploitation advanced by March (1991, 1995). By possibly adopting and engaging in exploration and exploitation, South African ACMs in the exploration stage will be carrying out R&D activities to develop their innovations, whereas, in the exploitation stage, they will now be commercialising their inventions (Lee et al., 2010).

In this current research, the classification provided by Dahlander and Gann (2010) will be modified and adapted to the concepts of exploration and exploitation. It can be argued that, depending on the phase of the development process where an open approach is needed, open innovation will take a different form, and, therefore, the South African ACMs should adopt a different approach. Furthermore, the 'coupled process' proposed by Enkel et al. (2009) will be included in the new proposed classification. When looking at the outbound open innovation paradigm, revealing internal knowledge and resources to the external environment and selling innovations are still an option for the South African ACMs and applicable for, respectively, exploration and exploitation. For the ACMs, open inbound innovation entails, in the exploration phase, 'sourcing' that is, collecting knowledge and resources to develop ACMs inventions, while 'acquiring' in the exploitation phase defines the South African ACMs acquisitions of potential innovation from the external environment. Finally, for the coupled open innovation paradigm, 'pooling' entails ACMs identifying the best combination of revealing their internal resources and sourcing for external resources, whereas 'jointly commercialising' refers to the process of ACMs in South Africa possibly collaborating to bring their innovations to the market. The proposed classification can be found in Table 2.2.

**Table 2.2 Proposed Classification of Open Innovation**

| | **Exploration** | **Exploitation** |
|---|---|---|
| **Outbound Open Innovation** | Revealing | Selling |
| **Inbound Open Innovation** | Sourcing | Acquiring |
| **Coupled Open Innovation** | Pooling | Jointly Commercialising |

There are arguments that South African ACMs may adopt open innovation for reasons other than for collaboration purposes; for example, they may do that for defensive purposes. This enables them to manage and reduce costs and risks that result from new product development initiatives. These are the risks of failure of the potential new products. To proactively control external knowledge, improve contributions and stay ahead of competitors, South African ACMs may have no choice but to frequently collaborate for offensive reasons to gain sustainable competitive advantage (Chesbrough & Growther 2006).

For example, the commercialisation of electric lighting led to multi-disciplinary teams (Pénin et al., 2011). This development is an excellent example of why South African ACMs need to integrate external ideas into their internal developmental trajectories to benefit from open innovation. The open and closed approaches to innovation differ in various ways; as previously stated, the differences are more ambiguous than expected due to the results of operational, strategic choices of ACMs based on the fusion methods (Dahlander & Gann, 2010; Lichtenthaler, 2011).

Open innovation as a model is a range that indicates openness as compared to a fixed option between closed and open innovation; hence flexibility is a significant determinant of this model. As a result the South African ACMs can only better approach these models with caution as they can apply particularly open innovation model in various ways that include mutual partnerships, network teams and the innovation "ecosystems," where participating South African ACMs can preserve their ideas and form collaborations off the record (Williamson & De Meyer, 2012). Additionally, the model provides various ways in which developed plans for the ACMs can be marketed. These ideas can be in-, out-and cross-licensing, cooperative R&D initiatives, venture capital, joint ventures and acquisitions. The programs also depend on the vibrancy and expectations of the ACMs IP provisions. Finally, other ideas at the disposal of the South African ACMs include development, as spin in or spin-off and crowdsourcing (Chesbrough, 2006; Pénin et al., 2011).

Recent literature concludes that present research on the concept of innovation focused on the outside-in approach to open innovation (West & Bogers, 2014). The key observations were that organisations do not utilise all the information available outside their boundaries, and they also fail to utilise potential internal ideas (Chesbrough, 2003). This model presents to the South African ACMs the conversion of the non-semi-permeable membrane, indicating how ACM organisations can quickly diffuse potential innovation from outside to the inside of their organisations. Chesbrough (2003) propounded the open innovation funnel model as discussed below.

### 2.2.1. Open innovation funnel

In the argument for open innovation and strategic operations as the best option for South African ACMs to adopt in their quest for attaining sustainable competitive advantage, this study advances the concept of the open innovation funnel as propounded by Chesbrough as a starting point in the examination of the phenomenon. Chesbrough (2003a) explains open innovation by using the innovation funnel as a convenient visualisation tool in his first book to illustrate the differences between closed and open innovation models. The current study uses the open innovation funnel (Gronlund et al., 2010) as a point of departure since it gives a quick examination of its constituent dimensions that already highlight the need to delve into a strategy a potential South African ACMs open innovation framework that takes into account the context of these ACMs. Business modelling, transactions, or collaborations with external partners, internal and external resources, are at the centre of open innovation that the South African ACMs can emulate.

The following section presents the open innovation funnel and its most important dimensions, such as the funnel theoretical concepts. Then the researcher proceeds with a discussion of literature streams and synthesis to enhance the understanding of the innovation funnel components. This open innovation funnel paradigm has a long history of application in innovation initiatives preferred within the Chandlerian "closed innovation" framework, where organisations such as the South African ACMs can organise research and development processes within their corporate boundaries. Chesbrough (2003b, 2006a) proposes that this funnel is the central concept in developing several key insights that may be at the disposal of the South African ACMs regarding open innovation initiatives. The funnel summarises and visualises the essential attributes of the open innovation model. This model has the potential to connect to the prevailing management science theories. In this chapter, the researcher uses particular constituent parts of the open innovation funnel (Gronlund et al., 2010). Firstly, it is a way to connect this model to existing management science theories and other theoretical applications. This study explains these potential links by referring to the open innovation funnel, as represented below.

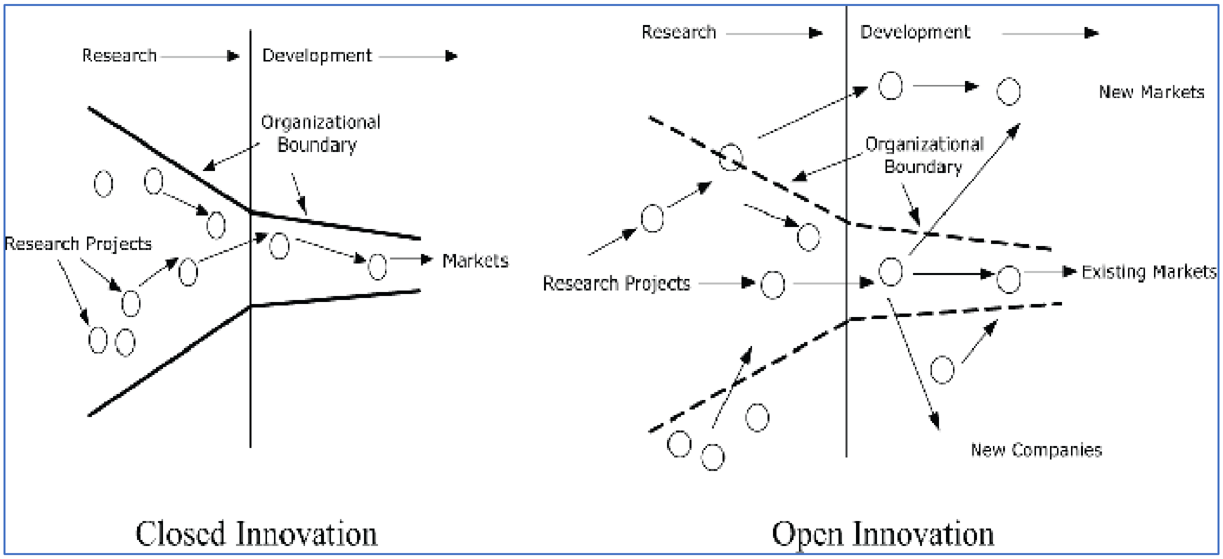


**FIGURE 2.1: OPEN INNOVATION FUNNEL**

Source: Chesbrough (2003)

As presented in the funnel diagram depicted in Figure 2.1, the new market and current market refers to the organisations` business models in an open innovation setup. The argument here is that open innovation strategies should drive south African ACMs business model thinking. Hence internal knowledge that does not support these organisations` business models should be out licensed or commercialised, and external expertise that complements the business models should be sourced, facilitating new products or new businesses. Accordingly, open innovation is appropriately understood when incorporated into the ACM organisations' strategies. This should not be withstanding that there is limited literature that examines how the overall design, the innovation strategy, and open innovation interconnect with each other, especially in automotive component manufacturing organisations in their South African context (Appleyard & Chesbrough, 2007).

Secondly, arrows crossing the organisational boundary in the figure represent different types of potential inter-organisational agreements that the South African ACMs can bring in as ideas and technologies into the funnel or monetise the idle technologies. Insourcing knowledge occurs through research and development agreements, co-development deals, corporate venturing, in-licensing agreements, or outright acquisitions as potential strategic options for the South African ACMs. In other cases, the ACMs can tap into communities of users or experts or rely on specialised intermediaries' services. In this case, the organisations can outsource their knowledge via alliances, licensing agreements and spin-offs. If the South African ACMs adopt open innovation, they will continuously decide which knowledge they have to develop internally, buy or co-develop, and sell or license. The choice between internal and external technology developments within the open innovation framework is closely related to the make-buy-ally decision-making processes (Van Rijnsoever et al., 2017; Sako et al., 2013; Gulati & Nickerson, 2008; Mudambi & Tallman, 2010). Consequently, the argument here is that future research should examine how the make-buy-ally and the open innovation literature streams relate to each other and how they can enrich each other. In this respect, open innovation research should undoubtedly pay more attention to how collaboration with external innovation partners redraws the boundaries (and the organisation) of (the innovation activities in) the firm.

Choosing appropriate sourcing modes would be crucial for the South African ACMs for their successful deployment of open innovation initiatives. The choice between the sourcing modes depends on the uncertainty both in technology development and the markets and will change in different stages in the funnel (Van de Vrande et al., 2009a). Arrows in the diagram present some type of inter-organisational transactions. In open innovation, organisations such as the South African ACMs can trade technology through market-like transactions, but they can also invest in complex, long-term agreements with their innovation partners in most cases.

Thirdly, figure 2.1 shows (R&D) projects represented by dots inside and outside the funnel. They start as ideas and develop over time into new business products for the potential South African ACMs. The process requires resources and capabilities, and although these are available internally, others are sourced externally. The biggest driver of open innovation is to gain access to these resources or capabilities, indicating a relationship of open innovation and Resource-Based View (RBV) (Barney, 1986, 1991; Wernerfelt, 1984). Literature also considers the knowledge-based view (KBV) as a specific case of (RBV) (Grant, 1996). RBV and knowledge-based opinions focus on the internal development of capabilities. To account for the growing use of external competencies, several authors have developed frameworks to incorporate the sourcing of capabilities and knowledge from external sources: The relation-based view theory focuses on how organisations can tap into external resources (Dyer & Singh, 1998). Similarly, the knowledge-based view applies to inter-organisational relations such as strategic alliances that the South African ACMs can forge (Grant & Baden-Fuller, 2004), external corporate venturing (Keil, 2004; Schildt et al., 2005) and acquisitions of start-ups (Wagner, 2011).

Finally, the open innovation funnel is viewed as a Stage-Gate process. Stage-Gate methodologies assist in managing closed innovation processes for organisations such as the South African ACMs (Cooper, 1999), but they can also be used differently in new product development (NPD) processes (Gronlund et al., 2010). The South African ACMs need to understand that innovation by its nature is a risk-laden activity that requires a sequence of investments by organisations engaging in it, first with small reversible steps followed by investments with an incremental financial commitment. For the South African ACMs the

Stage-Gate process would entail the ACMs aiming to reduce technological and marketing uncertainties characterising the earlier stages of the innovation processes and tending to discipline the ACMs to postpone significant investments until the uncertainties are low enough and can be manageable. In this way, the open innovation funnel defines a staged decision-making process that analyses the objective options theory perspective (Vanhaverbeke et al., 2008). Working with external partners in the early stages of the funnel can be considered an option in creating decisions, which offer these ACMs opportunity to make better-informed decisions about more costly investments in external technology during later stages of the funnel paradigm (Van de Vrande et al., 2009a).

This funnel provides different junctures between open innovation and prior management literature. The next section will explore the previous theories and criticism from various authors.

### 2.2.2. Previous Theories and Criticism

The open innovation adopting South African ACMs need to appreciate that open innovation was not coined out of thin air by Chesbrough (2003). Previous theories related to innovation observed the phenomenon from different lenses, the conclusion of which led to the coining of open innovation as a result of their limitations (Kovács, Van Looy & Cassiman, 2015; Tidd, 2013). However, the concept overlaps with many other existing theories, as shown in Table 2.3

**TABLE 2.3 OVERVIEW OF AUTHORS BY THEORY**

| Previous Theory | Some Authors |
|---|---|
| Collaboration | Mattesich and Monsey (1992); Roschelle and Teasley (1995); Dillenbourg (1999) |
| Partnerships and alliances | Das and Teng (1999); Koschatzky (2001); Hagedoorn and Duysters (2002) |
| Outsourcing | Loh and Venkatraman (1992); Apte and Manson (1995) |
| Knowledge and R&D Spillovers | Romer (1986); Krugman (1991); Harhoff (1996); Zucker, Darby and Armstrong (2002) |
| User generation and crowdsourcing (Distributed networks) | Gianiodis, Ellis and Secchi (2010); Hossein (2013) |
| R&D externalization and environmental interaction | Huang and Rice (2013) |
| User innovation | Paasi et al. (2015) |
| Learning theory | Gianiodis, Ellis and Secchi (2010) |

West and Bogers (2014) identifies an additional four related streams of open innovation research for the benefit of the potential innovating South African ACMs and other organisations elsewhere. The related streams of open innovation include the following:

(1) Obtaining external innovations;

(2) Integrating external innovations;

(3) Commercialising External Innovation Streams;

(4) Interactions between a local firm and its collaborators.

The concept of open innovation has attracted scholars from different disciplines, such as economics, finance, strategic management and marketing (Gianiodis, Ellis & Secchi, 2010). The literature focused on capabilities from four dimensions: resource-based view, organisational learning, knowledge-based and dynamic capabilities (Caroll & Helfart, 2015). Thus, it is essential to understand these previous and related theories to capture the contribution and the added value of the open innovation concept in the literature more significantly.

Despite the steady proliferation of the open innovation concept and its advocates, some academics have criticised the concept (Enkel & Lenz, 2009; Dahlander & Gann, 2010; Hossein, 2013; Huang & Rice, 2013; Huizingh, 2011; Trott & Hartmann, 2009; Trott & Hartmann, 2014) for different reasons. Mostly, sceptics claim that open innovation has been present before Chesbrough coined the concept. However, it was not necessarily termed as such (Hossein, 2013). Some academics mention that it is ‘old wine in new bottles or ’in fancy tuxedos, not bringing anything new to the table (Trott & Hartmann, 2014), only repackaging the old theories of R&D externalisation and collaboration (Huang & Rice, 2013). These academics claim that open innovation is based on previous theories in strategy, change management and organisation (Wikhamn & Wikhamn, 2013). In other words, the criticism is that there is nothing novel about open innovation. Another criticism is that open innovation slows down the speed of projects in organisations (Knudsen & Mortensen, 2011). As a result, the potential South African ACMs should trade with caution. However, despite these critics, the novelty of the open innovation concept is that ACMs can create adapted organisational models and processes to integrate several traditional collaborative innovation practices (Trott & Hartmann, 2014) and that open innovation is an ecosystem view rather than a simple firm's specific view (Wikhamn & Wikhamn, 2013).

### 2.2.3. Open innovation and firm strategy

Careful observation of organisations with an excellent record of open innovation indicates that this initiative is deep-rooted in an organisation's strategy. The researcher in this study touches on three aspects of this (potential) relationship between open innovation and the organisation's strategy: the potential South African ACMs can borrow a leaf from the experiences.

Firstly, the South African ACMs can learn that business model thinking lies at the heart of open innovation. Figure 2.1 already indicated that internal knowledge, not aligned to the organisation's business model, would be licensed or sold. In contrast, external experience complementing an organisation's business model can be regarded as insourcing that can be employed to develop new products or new businesses. This study acknowledges the work by (Chesbrough & Appleyard, 2007; Dittrich & Duysters, 2007), who examined the interconnection between strategy and open innovation, as other practitioners have indicated that open innovation is insignificant if not integrated with an organisation's strategy (Vanhaverbeke & Roijakkers, 2013). This nexus of strategy and open innovation deserves a central place in new studies such as this one.

Secondly, this study highlights the importance of the connection between corporate strategy and open innovation in those organisations that seek to engage in open innovation, such as the South African ACMs. Previous work on open innovation illustrates how organisations benefit from external knowledge sources in developing new products or existing businesses. The overemphasis on applying open innovation in existing businesses casts a shadow on other strategic uses of open innovation. A Dutch specialities chemical organisation established the EBAs (Emerging Business Areas), developing and incubating completely new divisions aimed at driving the organisation's future growth, achieved by building new businesses that did not exist before (Vanhaverbeke & Peeters, 2005). The development of these businesses results from collaborations with various peripheral (technology) partners, which are different from the partners involved in open innovation initiatives to grow existing businesses. Generating incremental growth in current companies requires another form of internal organisation than when the organisation intends to develop entirely new products in the future.

Strategically and based on different growth targets leading to diverse traditions of organising this archetype, various departments will report to the project leader and other lead partners. Consequently, open innovation links to the corporate growth strategy. This current study premises that this is one reason among many that the potential South African ACMs should find open innovation quite attractive as a strategy and leverage for their potential corporate growth. Sourcing knowledge from partners would be quite helpful to these ACMs as they strive to spur growth in existing businesses and incubate their early-stage ventures in areas that the ACMs top management identifies as corporate areas of development (outside the current departments in the organisation). Likewise, the ACMs can use open innovation to realise corporate renewal (Teece, 2007). The South African ACMs are expected to develop new (technological) competencies to achieve organisational growth and renewal. How these ACM organisations seek to create new skills by collaborating with different external knowledge partners is a subject that requires more attention to innovation management research. This scenario leads to exciting new developments in our understanding of the field of Dynamic Capabilities (Helfat et al., 2007; Teece et al., 1997; Teece, 2007).

Thirdly, for South African ACMs to benefit from innovation communities, corporate venturing, ecosystems, licensing deals, and venture acquisitions would require new strategic approaches. The primary literature streams in strategic growth and diversification strategy (Chandler, 1962), positioning strategy (Porter, 1980, 1985) and extensions (Brandenburger & Nalebuff, 1996), resource-based strategies (Wernerfelt, 1984; Barney, 1986,1991) and imitability and complementary assets – will have a strong influence in determining which ACMs will ultimately profit from an open innovation (Teece, 1986). The primary focus should be on internal assets, ownership and power as critical sources for strategic success. These directions proved to be fruitful for understanding business strategy when organisations rely mainly on internal technological capabilities to develop new products. However, none adequately accounts for collaborative or open innovation as an empirical phenomenon emerging in many industries, including the ACMs sector. There is a need to find new or adapted strategic approaches that can fully account for collaboration and cooperative strategies that the South African ACMs can potentially adapt. In this respect, one approach to consider is the recent work on managing innovation ecosystems (Nambisan & Shawney, 2011; Adner, 2012; Van der Borgh et al., 2012; Leten et al., 2013).

### 2.2.4. Open Innovation as a Competitive Advantage

It is paramount that the South African ACMs aim at gaining a competitive advantage over their competitors in the industry. They need to develop this distinctive edge to stay abreast of others (Freedman, 2015). Innovation is a critical ingredient for ACMs to sustain their competitive organisational position in the marketplace, and it is a different perspective of risk-taking, flexibility and decision-making. Innovation process management is an essential subject in modern-day business. Internationally to gain a competitive advantage, successful organisations deliberately create the conditions that enable ideas within the organisation to germinate and be implemented simultaneously. Hence innovation is viewed as a critical driver of economic performance (Kvint, 2010).

Strategy is an old concept at the disposal of the ACMs and other organisations and originated from the military. It represents an elevated plan designed to contend and realise predetermined organisational objectives in uncertain circumstances and environments (Freedman, 2015). It is also designed to help organisations such ACMs formulate and develop principles they can use to achieve success in the long term if adhered to (Kvint, 2010). For this reason, strategy translates into setting goals that determine action plans and help to mobilise resources to implement the proposed actions. This process also involves essential elements, such as planning and strategic thinking that South African ACMs cannot afford not to embrace as part of their competencies.

The main goal behind strategic planning is to create a competitive advantage that will allow them to attain their calculated objectives. The literature on this concept dictates that there are different ways organisations can use to gain this advantage. The traditional concept of competitive strategy by Porter (2008a) is applicable today in numerous organisations including ACMs based on differential strategies, cost leadership and niche market offerings. Porter (2008b) introduces an approach that considers competitive strategy factors such as bargaining and purchasing power, observing new entrants, new products, and service development. These factors add to competitive advantage but not explicitly essential to a competitive strategy that South African ACMs may need the most.

Alternatively, Prahalad and Ramaswamy (2003) propose that competitive strategy is an innovation paradigm that entirely changes the way of creating products and services and managing competition. This study supports Prahalad and Ramaswamy (2003) view of competitive strategy and proposes that South African ACMs embed this line of strategic thinking to strengthen their strategic fit for competitive advantage. Other authors (Tidd, Bessant & Pavitt 1997) acknowledge that innovation contributes severely to enhance the organisation's competitive advantage. These studies advocate for a strong correlation between market performance and new product proliferation. This current study is in harmony with the assertions forwarded by these past studies as they articulate the essence of innovation as a critical strategic issue.

Consequently, observation dictates that there are different views regarding the dynamics that can enhance the competitive organisational capacity of the South African ACMs and that of the other organisations that intend to engage in open innovation. Reed, Storrud-Barnes and Jessup (2012) acknowledge that innovation is a supplementary ingredient that drives organisations to achieve growth and sustainability in the market. Analysing the effects resulting from lack of innovation as reflected in organisational strategy and performance of many an organisations and where the driving force exists for barriers to entry and customer needs anticipation, organisational innovation skills can help organisations, including the South African ACMs to attain long-term competitiveness (Reed et al., 2012). The following section explores the relationship between open innovation and organisational strategy.

## 2.3. COMPETITIVE ADVANTAGE

ACMs in South Africa and other organisations must understand that strategic management broadly consists of various facets, including competitive advantage. As a result, such organisations, as they thrive for prosperity, must aim at gaining competitiveness. Porter (1980) proposes achieving organisational competitiveness by leveraging the famous competitive force's approach that assesses strategy formulation within the industrial ecosystem. This approach to issues of organisational competitiveness advocates for the five different competitive forces in the industry. These forces are entry barriers such as the risk of substitutes, brokering capacity of consumers and suppliers and enmity in the business environment (Reed et al., 2012). These forces determine how the organisations are ranked in the industry and, accordingly, assist in finding the organisations` approach to protecting themselves. When organisations shift from one force to another, they do so through benchmarking according to the business and market conditions. A similar style related to the above scenario is the Strategic Conflict Approach (Shapiro, 1989). The Strategic Conflict Approach acknowledges product and market imperfections, barriers to entry and strategic collaboration and examines how organisations attain competitiveness through investments, prices, signalling and evidence by using the game theory. The key determinant in these approaches is the market position.

The views of Barney (1991) are deemed critical to the South African ACMs in their endeavours to build sustainable competitive advantage. According to this author, competitive advantage occurs when organisations and their resources become heterogeneous. ACMs must build resources capacity and capabilities that are firm specific and cannot be easily imitable. In this regard, the most crucial factor is the growth of dynamic capabilities (Teece et al., 1997). These views note that organisation-specific resources and capabilities are central to developing a competitive advantage in an organisation. Teece et al. (1997) introduce different factors to explain the industry dynamics among rivalries, and these factors present an opportunity for alternative strategic approaches for organisations such as the South African ACMs. When comparing the framework proposed by (Porter 1980) to the dynamic capability's structure (Teece, 2007), exciting themes emerge. A depiction of a sharp break away from the Five Forces model (Teece, 2007) is the framework for dynamic capabilities. In the environmental context, this framework does not represent industries at large as articulated by (Porter, 1980) but instead presents the ecosystem that businesses operate in. This ecosystem comprises counterparts, providers, legal authorities, evaluators and educational and exploration institutions. On the other hand, dynamic capabilities occur when an organisation creates tools and business processes that develop a competitive advantage in acquiring and improving its investment assets (Teece, 2007).

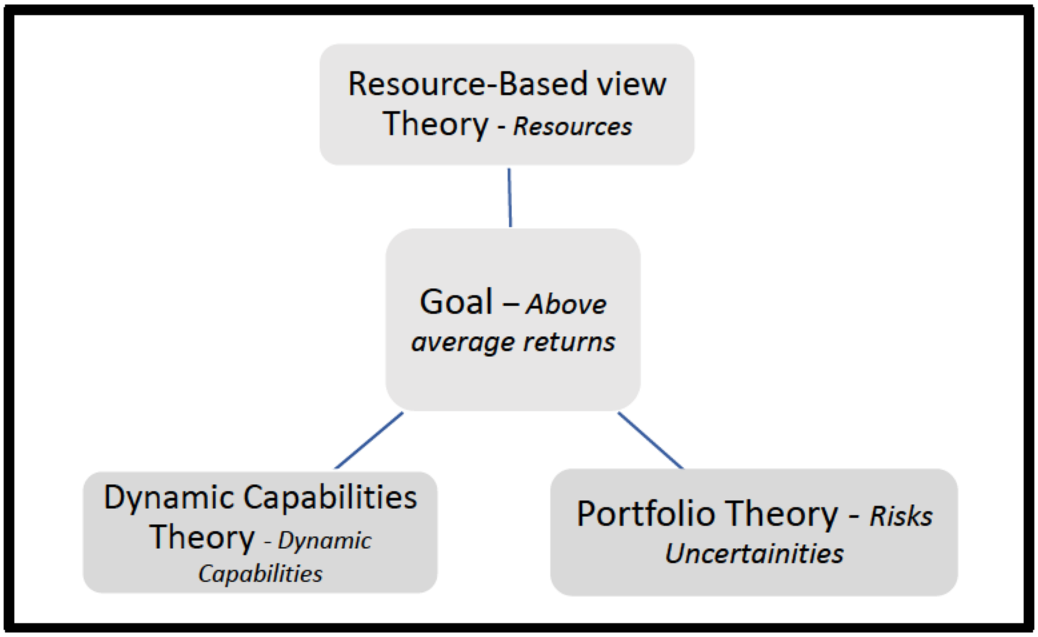


FIGURE 2.2 ACM CHALLENGES THEORIES

### 2.3.1 Resources Based View

This study argues that the central theme in attaining competitive advantage is how organisations utilise the Resource-Based View (RBV) theory depicted in Figure 2.2, which regulates the strategic resources available to the organisations. The argument is that the theory is strategically relevant to South African ACMs in their quest to build sustainable competitive advantage through open innovation. The resources based view includes finances, intangible as they may be; they are included as assets and proficiencies, processes, materials, and information. Organisations need to control these resources and use them to improve efficiency in operations. This view argues that it is possible to distinguish the basis of competitive advantage because organisations possess heterogeneous resources to achieve competitive advantage (Barney, 1991).

Attaining a continuous competitive advantage means the organisation's support system must have four attributes: value, scarcity, and inimitability. When these attributes are all present, the organisation can/will achieve sustained competitive advantage. This model can be used to assess the potential of an organisation's strategic resource availability, as described in the paragraph above. It follows that organisations should seek inside their boundaries to establish vital resources that will enhance competitive advantage instead of merely focusing on competitors and the markets (Barney, 1991).

Lavie (2006) extends the Resources-Based View theory by including the network resources of interrelated organisations, and this is identified as an addition to the resource-based view. The inclusion of resources from other organisations indicates that companies must not focus on the control or ownership of their support. The current study is in harmony with Lavie (2006)` s extension of the Resources Based View to include the network resources of interrelated organisations with the view that this aspect directly defines the essence of open innovation that lies at the South African heart ACMs. Open innovation is all about organisational networking and share of resources, knowledge, information and expertise. The author differentiates the shared from the non-shared resources. Further, it demonstrates the recognition of new types of rental and how organisational relations and partnerships specific factors affect networks of organisations. Based on the comparison of the RBV, which focuses on resources owned and managed by an organisation, the author argues that the model proposes to overcome eminent weaknesses of the Resources Based View theory since other organisations can simultaneously use the same resources available.

### 2.3.2 Dynamic Capabilities

The Dynamic Capabilities (DC) model (Teece et al., 1997) emphasises both internal and external capabilities that the South African ACMs and other organisations that innovate need to build in order to attain needed sustainable competitive advantage depicted in Figure 2.2. This approach introduces the notion that innovation is a source of competitive advantage. “Dynamic,” on the other hand, means the renewal of capabilities to adapt to the ever-shifting business landscape that South African ACMs find themselves operating in. While “capabilities” signify the adaptation of strategy by management, the integration and reconfiguration of internal and external skills are realised to meet uncertainties in the environment that businesses such as the South African ACMs operate in (Teece et al. 1997). Consequently, achieving the organisation's position via a process confined to the route of minimum imitability in capabilities is possible. These capabilities are administration, R&D, product and operation development and manufacturing techniques.

The framework by Teece et al. (1997) was complemented by the work of Eisenhardt and Martin (2000). These authors argued that DC is a variable of the change in the framework and that their role in value creation has inconsistencies, overlapping definitions, and outright contradictions that can confuse organisations, ACMs included. In contrast, an increasing confusion conforms to simple rules, the similarities of both structures from the inputs of the concept. Besides the present similarities, there are a few differences relevant to knowledge on the same idea. The similarities are the emphasis on the role of the organisation’s procedures, managerial processes, and DC as an addition to RBV (Peteraf et al., 2013). The outstanding point is how dynamic capabilities describe sustainable competitive advantage in the fast, ever-changing environment, an essential determinant of the complete framework. These similarities are significant in achieving competitive advantage (Teece et al., 1997). Eisenhardt and Martin (2000) disagreed that these similarities are insignificant and inconsequential, hence should not be considered.

It is possible to combine various interpretations in the application of dynamic capabilities (Peteraf 2013).

Besides the differences in the market and natural environment, DC enables organisations to gain sustainable competitive advantages in some instances (Peteraf et al., 2013). This is a critical disposition that the South African ACMs need to configure their strategic thinking along. Additionally, Teece (2007) prescribes important principles that include identifying, appropriating, reconfiguring and transforming.

Opportunities are always open for both present and new organisations, such as emerging ACMs in the dynamic innovation environment, highlighting the difficulty in identifying the opportunities in the industry. These opportunities are easily recogni**s**able in some markets; however, they are challenging to recogni**s**e and cherish in most industries, such as the automotive industry, meaning that sensing for new openings requires scanning and learning the environment (Teece, 2007). Consequently, when a unique opportunity avails itself, it becomes imperative for the South African ACMs and other innovating organisations to cease it. The reali**s**ation of unique opportunities is through developments in new products, processes, or services. Accordingly, there is an investment requirement in time and money, in the ability to utilise technology, in balancing assets and then in the design to achieve results in the market.

The ability of the South African ACMs to reconfigure assets and structure or configure them is central to attain sustainable profits and market advantage, especially as growth in the business and markets/technologies progresses with time. Additionally, reconfiguration if need be is critical in avoiding path dependencies that are negative to the organisational success (Teece, 2007). The author further argues that DC is the key ingredient to gaining a competitive advantage. Rapid changes in technology indicate how successful an organisation is in the conception and operation of intangible assets based on economic profits.

The approach of dynamic capabilities has, however, received criticism important to knowledge generation. According to Winter (2003) no organisation can certainly protect itself from the fast, ever-changing business landscape through DC over time. This information is critical to the South African ACMs. Nevertheless, there is a continued advantage of achieving potential success by focusing on the present strategic changes necessary for the South African ACMs and other innovating organisations to building sustainable competitive advantage. A literature review by Barreto (2010) explains how various scholars criticise the DC concept. Specifically, Williamson (1999) states that dynamic capabilities trace back to incorrectly unutilised success. Concerning its vagueness, Kraatz and Zajac (2001) reports that practical skills as a concept are quite undistinguishable and problematic to manage. A further understanding of the idea of DC would benefit the field, and this understanding could include an in-depth analysis of the possible processes and routines which might add to the existing theory. Nonetheless, the possibility of using and studying a concept leads to understanding and acknowledgement of its shortcomings.

### 2.3.3 Absorptive Capacity and Beyond

South African ACMs must build strong absorptive capacities to compete and sustain their competitiveness in the innovation environment meaningfully. Absorptive capacity is an organisational ability to evaluate, assimilate and commercialise knowledge that originates outside the firm. Cohen and Levinthal popularised the concept with their model describing the dual roles of R&D as a source of innovation and as a means of enhancing the firm's ability to learn. According to (Cohen & Levinthal 1989, 1990), through absorptive capacity, the organisation can recognise the benefit of new information and apply it to achieve business success. The literature about the model "open innovation" (Chesbrough, 2003a, 2006a; Chesbrough et al. 2006; Christensen et al. 2005) and absorptive capacity (Lenox & King, 2004, Arora & Gambardella, 1990; Ireland et al., 2002) emphasise how innovation in organisations benefits them when they utilise technology acquired outside the organisation. This conclusion is mainly stemming the assertion that absorptive capacity focuses on obtaining and exploiting outward knowledge inside the organisation (Lichtenthaler & Lichtenthaler, 2009). It is a concept at the heart of external and internal knowledge. The connection between absorptive capacity and open innovation stems from the link between them.

This relationship stresses the proper balance between these knowledge gaps. To access and assimilate external knowledge, organisations, South African ACMs included, should possess previously related knowledge (Cohen & Levinthal, 1990; Jansen et al., 2005). Recognising and monitoring exciting technologies developing outside the boundaries of organisations is a prerequisite of internal research and development capabilities. Conversely, internal research capabilities are crucial in the active exploitation of external expertise (Arora & Gambardella, 1994).

Rosenberg, 1990; Cohen & Levinthal, 1989). In-house R&D activities remain crucial to developing technological expertise, increasing the organisation's learning capacity, and improving its absorptive capacity. This initiative resonates in the open innovation literature, which states that internal R&D improves monitoring and using external knowledge resources (Rigby & Zook, 2002; Chesbrough, 2003b; 2006a).

There is so much literature at the disposal of the South African ACMs and other innovating organisations. In line with Cohen and Levinthal (1990) there is a school of thought for example, that advocates for balancing the ability to create value from external sources of knowledge and developing and exploiting inside knowledge (Chesbrough, 2003a, 2006a; Gassmann & Enkel, 2004). Accordingly, the growing focus on outside knowledge sources does increase the understanding of how organisations can generate and manage inside knowledge (Gambardella & Giarratana, 2004). The distribution and manipulation of technological expertise within the organisation reside in the relationship of organisational absorptive capacity and open innovation, focusing on how innovation processes occur internally (Nooteboom et al. 2007; Levinthal & March 1993; Argyres & Silverman, 2004). The availability of valuable outside sources of knowledge is not a reflection of a natural or automatic process of acquiring new knowledge. External knowledge sources are recognisable, accessible and assimilated when organisations develop procedures adjustable to their organisational structure and culture to enable open innovation processes to flourish (Dahlander & Gann, 2007). Consequently, open innovation scholars have taken advantage of the development in absorptive capacity literature to understand how organisations develop new procedures that draw more effectively on outside knowledge.

There are, however, also noteworthy differences between absorptive capacity and open innovation. The first contradiction is adaptation and amalgamation of outside knowledge, confined to the outside-in perspective of innovation. It implies that there is negligence in other aspects of the innovation processes. For example, the purposive outbound flows of knowledge and technology through licensing and spin-offs have accorded no recognition in the absorptive capacity literature so far. In terms of understanding capabilities, absorptive capacity fails to explain all dimensions of open innovation. Therefore, we need to balance the absorptive capacity as a concept with new theoretical developments. The study of Lichtenthaler and Lichtenthaler (2009) provides a significant first step towards this direction. They distinguished outside and inside exploration, retention and exploitation of open innovation and formulated a framework that is capacity-based. This thesis will restrict its attention solely to the external dimension since absorptive capacity is concerned with the organisational ability to evaluate, assimilate and commercialise knowledge that originates outside the organisation.

Firstly, outside knowledge exploration by ACMs and other organisations that are involved in innovation focuses on the assimilation from outside knowledge sources (Lane et al., 2006), which matches the absorptive capacity concept or paradigm. Secondly, outside retention of knowledge refers to embedding the knowledge inside organisations' relations with other partners such as research agreements, technology alliances, corporate venturing investments, technology acquisitions and many more. These define organisations' connective ability as key in maintaining and subsequently reactivating knowledge within inter-organisational relationships (Lichtenthaler & Lichtenthaler, 2009). Contrary to absorptive capacity, the focus lies on maintaining and managing knowledge externally instead of inward knowledge transfer. Gaining access to external sources of knowledge without the corresponding transfer of the partner's knowledge is a critical but neglected aspect of the first stage(s) of the open innovation funnel. The researcher in this current study hopes that this concept will be applied more in the future, partially because of the growing popularity of innovation ecosystems. Thirdly, the introduction of external knowledge exploitation as the monetisation of knowledge through external paths to the market can be beneficiary to the South African ACMs (Chesbrough, 2003b). It is not straightforward to monetise effectively on available technology. An organisation's absorptive capacity can help to generate revenues through extreme knowledge exploitation (Lichtenthaler & Lichtenthaler, 2009), complementary to internal knowledge application in an organisation's product markets (Lichtenthaler, 2007). The product markets consist of detecting outside knowledge exploitation prospects based on strategic and financial motives and the successful transfer of the knowledge to the partner firm(s) (Lichtenthaler & Lichtenthaler, 2009). Given that outside knowledge exploitation refers to outward knowledge transfer and external paths to market, it is a capability related to the inside-out dimension of the open innovation model.

The extension to three capabilities to explain open innovation practices is a remarkable extension of the absorptive capacity framework. The three absorptive capabilities are an organisation's ability to successfully learn, synthesize, and utilize knowledge from the external environment. Future research contributions should identify how organisations build these capabilities and to which extent they are different. In any case, it is evident that an extension is needed and that the distinction between different types of external knowledge capabilities is a fruitful step to understand the complex reality of open innovation.

**2.4 BUILDING AN INNOVATION CULTURE**

What is innovative organisation culture? According to Engel et al., (2015) innovative culture is values and behavioural norms that guide what people do and how they do it. The delineated factors for building innovative culture are as indicated in Table 2.4 below.

**Table 2.4 Building Innovation Culture**

| Factors | Values | Behavioural Norms |
|---|---|---|
| ENVIRONMENTAL | VALUES | Innovation resides in the operational principles |
| | LEADERSHIP | Managers' behaviour supports innovation |
| | RECOGNITION | Innovations and innovators are recognised and rewarded |
| | FREEDOM | The organisation gives employees time and space for innovation activities |
| MINDSET | CREATIVITY | Creativity: employees are open to new ideas and solve problems imaginatively |
| | RISK-TAKING | Risk-taking: taking appropriate risks is forested, and failures give lessons rather than punishment |
| | CUSTOMER ORIENTATION | Customer orientation: delighting the customer through innovation and quality is a demonstrated obsession |
| WAYS OF THINKING | COLLABORATION | Refers to work that takes place across functions and locations |
| | OWNERSHIP | Innovation is everyone's job and can come from anywhere, within or outside the organisation and its network |
| | OPENNESS | Openness: the organisation fights against the "not-invented-here" syndrome. There is an openness to and acceptance of external ideas and partners |

Source: Own elaboration based on Engel et al., (2015) Organisations such as South African ACMs have develop essential habits, actions and images familiar to their external associates, and they need to operate as social cement for the sack of the life of their organisational culture (Cameron & Quinn, 2011). Authoritative management tools exist to permit the organisational members to perform autonomously and reliably (Christensen, 2006). The "innovation culture" is credited for cultivating innovative thinking naturally inside the organisation and inspires innovation activities at all employment levels. Literature review on the topic reveals the presence of five specific characteristics of innovation culture that are at the disposal of the South African ACMs as well:

- Leadership;
- Teamwork;
- Autonomous participants;
- Innovation conducive environment favourable to innovation;
- Numerous informal linkages to external partners.

It is no secret that the success of the South African ACMs depends on these proportions and the ACMs innovator's existing discovery skills. The distribution of these skills at all levels of the organisation includes observing, questioning, networking, experimenting and associating with the external and internal environments. The next chapter gives a detailed account of the attributes of the five innovation cultures.

### 2.4.1 Presence of Innovative Leaders and Managers

The management of the organisational culture by organisations including South African ACMs depends mostly on how accountable their leaders are, and to drive this process, requires changes and commitment of management personalities (Cameron & Quinn, 2011). It follows that an organisation cannot transition from an old style management mode to a self-administered type without its management's dedication (Laloux, 2015) and thoughtful internal reflections (Collignon, 2016). People involved in the creation, production and development of discovery skills manage open innovation adoption better in many companies. They have a significant commitment to the transformation of the world (Dyer et al., 2013). The critical role of the South African ACMs leadership is to supply relevant departments in their organisations with innovative individuals with discovery skills (Dyer et al., 2013) and encourage creativity among the staff at the beginning of the innovation processes (Amabile et al., 1996). When a manager creates the right and conducive innovative climate in his department, he creates business success in the organisation, and the overall success depends on the effort other managers exert in their respective departments as well. One business unit can surpass the others in terms of the success in innovation operationalisation, simply based on the incumbent manager's effort in generating a conducive environment (Conti et al., 2016). Management is essential when building a culture of innovation in any organisation.

The country from which managers originate plays a crucial role in cultivating organisational culture. This is quite important premise that South African ACMs should understand and always bear in mind. The manager's conduct is rooted in the culture of the state of origin. This notion dictates that various power distances or uncertain tolerance influence the innovation process (Hofstede et al., 2010). Innovation thrives when there is a lower power distance preceded by a higher level of understanding for certainty.

Where there is a culture with boundless “power distance,” the ideas of the hierarchy are implemented. Inversely there will be delays in implementing new ideas when there is intolerance to uncertainty (Hofstede et al., 2010).

It is easier for an organisation to develop a culture of innovation in a country with a lower power distance (e.g., Israel, Sweden, Great Britain, Germany and the United States) t han with a higher power distance (e.g., Japan, France, Brazil, China and Russia). The situation dictates that innovative culture, in the latter case, is moderately incongruous with the organisation's culture (Hofstede et al., 2010). Similarly, countries like (Sweden, China, Great Britain, India and the United States) with a high tolerance for uncertainty will develop an innovation culture faster than countries like (Germany, Brazil, Israel, France, Japan, and Russia) (Hofstede et al., 2010) with a lower tolerance for uncertainty. Limited research on this phenomenon in Africa in general is making it difficult to classify countries such as South Africa in terms of their propensity to tolerance for uncertainty.

### 2.4.2 Presence of Innovative Teams

Building up innovative teams creates the needed organisational core competencies in innovation (Belbin, 2004) among South African ACMs. Many innovation processes are team-based, although artistic accomplishments are variable among them. The team’s performance is a function of motivational orientation (Rietzschel, 2011), and the actions of individuals or groups are consistent with the objectives, values and norms of the process. The motivation is either preventative, a circumvention of uncertainties or promotional, that is acquiring benefits from an ideal situation. Additionally, organisations assemble individuals who have complementary discovery skills and excel in their assignments; they also prefer less in numbers and well-organised (Dyer et al., 2013). An innovative team in ACMs must be composed of individuals who have different skills, excellent communication, openness to new ideas, and the ability to challenge, trust, and help each other be effective in creative work (Amabile et al., 1996).

### 2.4.3 Presence of Innovative Individuals

It is vital for the South African ACMs to recruit employees with discovery skills. Persons with advanced "discovery skills" are essential for organisational success in innovation (Dyer et al., 2013). Novel and valuable ideas from these individuals are the basis of innovation, which is the application of creative ideas (Amabile et al., 1996). Hence, these individuals add considerable performance and value in innovation initiatives. Dobni (2008) acknowledges that seven factors attract individuals who excel in complementary discovery skills that use the measurement of an innovation culture to refer to persons. These factors are innovation propensity, organisational constituency, organisational learning, creativity and empowerment, market orientation, value orientation, and implementation context. There is a direct link between individual engagement and organisational change, noted by the outcome of "work engagement surveys" (Gallup, 2012).

There was the appointment of more than 25 million gainfully employed people measured by the Gallup Institute in 195 different countries. This process included all sectors, including commercial, non-profit and others. They categorised personnel into three subdivisions, namely "engaged, non-engaged and actively disengaged." They observed that the first group of "engaged individuals" were characterised by the passion aligned to organisational vision. They inspired innovation and were a vital driving force. The second group, "non-engaged", had no desire to excel; they only did their jobs as required. Finally, the third group comprised the "actively disengaged" employees who were unhappy at work and demoralised others (Dyer et al., 2013).

It is paramount that South African ACMs deliberately invest in their critical staff with potential innovation ideas. According to Gallup (2015) employees are most likely to contribute to organisational innovations. Thus, organisations seeking to be innovative should understand that employee characteristics and behaviours are responsible for triggering and enhancing innovative initiatives. Hence deeper understandings from Gallup research reveals the close relationship between employee engagement and innovation that the South African ACMs need to fully understand and appreciate. The study further states that engagement is a core resource in promoting innovative workings in organisations such as South African ACMs. With a lack of engagement, any attempt at innovation is lacklustre. If organisations multiply greater engagement by greater insight into behaviours, it can significantly differentiate their innovation projects. Engagement and innovation reinforce each other, engaged staff are more likely to be innovative, and an innovative organisation is expected to motivate and engage its employees (Birkinshaw, 1997).

### 2.4.4 Presence of an Organisational Context Conducive to Innovation

The importance of South African ACMs to conduct the internal environmental analysis and understanding of their organisational context conducive to innovation needs not to be over emphasised. This defines the essence of corporate culture, a vital ingredient for innovation. The two axes that describe the four categories of corporate culture are hierarchy (control and internal focus), market (control and external focus), clan (flexibility and internal focus), and adhocracy (flexibility and external focus). Cameron and Quinn (2011) compare modern organisational cultures along these axes, which are: stability and control against flexibility and discretion on one axis and internal focus and integration versus external focus and differentiation on the other axis. Laloux (2015) proposed that organisational culture comprises an evolutionary model based on the adhocracy quadrant, which corresponds to the innovation culture. At every developmental stage, individuals have invented unique social structures that brought about fundamental organisational innovations. There are five categories of organisations in existence.

The first one is "red organisations," which date back from the hunter-gatherers; these organisations believe in relational violence. They introduced the notion of hierarchy and the division of tasks. A typical example of an organisation that applies to this culture is the Mafia. Agriculture, which is characterised by a great conformism, was introduced by the second category, termed the "amber organisations," which invented processes and stability over time. Public administrations are examples. The best illustration of "amber organisations." The third one is "public administrations". "Orange organisations" from Renaissance and Industrial revolutions thrive on the notion of achieving success. The inventions associated with them are innovation, responsibility and meritocracy. It is the model within which most multinationals today operate. The fourth is the most recent organisation called "green type," which surfaced 40 years ago. This organisation came up with the information age and signified the plurality stage, characterised by employee empowerment, stakeholder integration, and values consolidation.

The fifth category has emerged; it is referred to as "evolutionary" and is opal in colour. This evolution developed around self-governance, which is the declaration by an organisation and an evolutive reason for existence. In their present form, they resemble amber or orange organisations. The culture of innovation increases with the progression in the stages of evolution; hence this evolution is a component of orange, green and opal stages in any organisation going through this transformation. The innovation process is different based on the growth of the organisation and the developmental state of the innovation culture. Hence there are fewer processes framed and explained in a natural innovation environment. Best practices emanate from the focus on systems that analyse the presence or absence of the methods characterising the capacity to adopt an innovation (Morel et al., 2015; Boly et al., 2016). The internal organisational context has 18 practices, of which 16 are identified as linked to creativity, new product development, human resources management, strategy, innovative project management, knowledge management, while eight relate directly to the product and the client.

### 2.4.5 Presence of Multiple Links with the Environment Outside of the Organisation

It is important that South African ACMs become aware and familiar with the presence of potential multiple links with the environment outside their boundaries. Emphasis on creating relationships with organisations outside the South African ACMs` boundaries is one dimension of the innovation culture (Cameron & Quinn, 2011). According to these authors, the proportion of openness is equivalent to diversity and competitiveness. These two features (Laloux, 2015) refer to organisations in the orange stage. At the scene of evolution, the author notes that organisations progress in external relations in a specific way. At this stage, there are frequent wars, and the other partners are enemies. The organisation does not desire to associate externally, and its priority is self-sustenance with an aim for monopoly. In this scenario, different organisations and transformative philosophy cause suspicion. There is competition between organisations and individuals at the orange stage, resulting in the other organisations becoming rivals and engaging in battles for one to stay ahead of the other.

There is the consolidation of justice, equality and harmony at the green stages of the ACMs and other innovating organisations, and this is required by all participants (i.e., shareholders, employees, stakeholders, management, civil society and nature). The organisation self-regulates and integrates the human element in inclusiveness at the opal stage. Whether internal or external and to function, the dynamics in this organisation dictate how it will relate to others (Laloux, 2015). Therefore, depending on the organisation in question, the outside relationship progresses through denial and suspicion to trust and cooperation, based on the ability of the ACMs to network as part of "discovery skills" required at all levels of the organisation by "individuals, teams and management" (Dyer et al., 2013:334). As in opal organisations, external relations refer to staff in direct contact with the outside world referred to as "front line" staff.

The external links for ACMs and other organisations that engage in open innovation are customers and developments happening outside the firm. Organisations view external links differently; the observations are "inside out" and "outside-in" open innovation processes. The boundaries around the organisations are stakeholders, institutions, large groups, financiers, entrepreneurs, population, local culture and available skills. The approach is broader and allows a more dynamic or even collaborative mapping of the environment, which assimilates a sequential measurement (Hwang & Horowitt, 2012). This scenario exists inside the organisation. Characteristics of the external environment that have relationships that favour innovation are a generous view of the external outlook, internal situation, internal/external contact points and the ease and speed of setting up collaborations, which are characteristics of the external environment that have relationships that favour innovation.

## 2.5 CLOSED Vs. OPEN INNOVATION PRINCIPLES

There are two innovation paradigms that are at the disposal of the South African ACMs. The terms 'closed" and "open" distinguish the two paradigms. The element of "openness," referred to as open innovation, is a strategy or a concept of access to change. It allows the involvement of all employees and sometimes progresses beyond the boundaries of the organisation – enables customer engagement, the general public and the competing operators. Typically, it is bound to a crowdsourcing platform or open co-working centres that allow the sharing of ideas, resources, and risks.

According to Chesbrough (2006) the logic behind open innovation hinges on plentiful knowledge, which ought to be readily used to provide value to the organisation that formulates it. The experience created by an organisation in its research initiatives should not restrict its inside movements to the market. Also, its interior pathways to the market should not necessarily be utilising the organisation´s internal knowledge. This perspective suggests some unique unifying principles for research and the field of innovation. Table 2.5 indicates these principles of open and closed innovation.

**FIGURE 2.5 COMPARISON OF OPEN INNOVATION PRINCIPLES**

| Closed innovation Principles | Open Innovation Principles |
|---|---|
| An organisation should hire all the experts it needs | The organisation appoints not all experts. Instead, the organisation needs to work with experts from inside and outside the organisation. |
| The organisation must discover, develop and ship R&D to benefit from it | The organisation can generate value from external R&D, and internal R&D can be responsible for a portion of this value. |
| When the organisation discovers innovation first, it will get it to the market promptly. | The organisation can gain profits from research not originating from it. |
| It is not the organisation that gets an innovation to market first that will win | It is more important to build a better business model than getting to market first |
| The organisation that generates more and better ideas in the industry will win | Organisations win when they optimise internal and external ideas. |
| Control of IP prevents competitors from benefiting from the organization´s ideas | The organisation can generate profit from the use of its IP and the purchase of external IP if it brings improvements to the business model |

Source: Own elaboration based on Chesbrough (2006)

Table 2.5 indicates the difference between closed and open innovation principles, as stated above. These differences have to lead to the realisation of the benefits of open innovation, notwithstanding some external factors that have caused challenges in open innovation adoption.

**2.6 EROSION FACTORS**

External trends or industry dynamics that impact the companies such as South African ACMs` strategies are known as Erosion Factors. A variety of studies (Chesbrough, 2002; 2003) and other authors on the topic describe the following several erosion factors compelling companies to transform their innovation strategies into a more flexible OI approach:

- Increasing mobility in skilled workers
- Expansion in the amount of college and post-college training
- Knowledge from corporate research labs to companies of all sizes
- Increasing capability from external suppliers
- Unused ideas forming external options
- Increasing knowledge globalisation

- Increasing turn around to market for products and services

- The increasing cost of research and development

- Opportunities for companies from venture capital markets.

Due to the deficiency in explaining the sustainable competitive advantage on the open innovation strategy, there is a gap in knowledge about the main traditional strategic and innovation views. Many researchers (Chesbrough, 2003, 2006; Dahlander & Gann, 2010; Elmquist et al., 2009; Enkel et al., 2009) have stated that open and collaborative innovation practices of firms have started to open their boundaries to tap knowledge from the outside and using the market as an extension of the firm. Recent literature revealed the growing interest in open innovation in practice as a new form of conducting change due to shorter innovation cycles, industrial research, escalating developmental costs, and the dearth of resources (Gassmann & Enkel, 2004).

### 2.6.1 Architecture Modularity and Openness

Part of the erosion factors happening in the industry dictates that architecture modularity is the key factor related to OI that South African ACMs must understand. Doran and Starr (2010) present "*modular"* or *"combinatorial"* production capacities in a manufacturing context as those activities required to design and manufacture components whose configuration is different in several ways. Ulrich (1995, p. 123), in the same context, stated that: *"In a modular architecture, interfaces between components decouple and there is a one-to-one mapping between physical components and functional elements."* The *"loose coupling"* of different standardised components permits interchanging or "mix and matching" that corresponds most to the end-user or customer preferences. In the review of more than 100 journal articles, Salvador (2007, p. 113) identified the most used perspectives of product modularity as *"component commonality," "component combinability, function binding, interface standardization,"* and *"loose coupling."* The modularity of products, processes, or services is an essential factor that allows open innovation to occur. Companies active in modularised types of industries "*can increase their innovativeness by opening up their innovation process." In contrast,* those engaged in industries with low modularity have limited advantages to applying OI (Gassmann & Enkel, 2004, p. 79).

According to Doran and Starr (2010) generic modularity is an easy substitution of one thing for another; services built into goods viewed in the same light as modular parts. Modularity is a way of enhancing mass customization (Rajahonka, 2013). Organisational outsourcing is a means of achieving modularity (Schilling & Steensma, 2001). Product and organisational modularity are strongly linked. The concept aims to balance the efficiency of delivering and then capture the value from a customer perspective. In the case of services, modularity is closer to processes than products, making it more complex to manage and study (Rajahonka, 2013). The interfaces between the different modules are considered 'soft' in the services industry, based on human relationships and knowledge, making interchangeability difficult. Ulkuniemi et al., (2011) studied modularity in professional services firms (engineering, project management). They considered three aspects of modularity: service offering, which helps the customer assess service outcomes, processes that influence expectations from the customer regarding quality expectations and organisational, allowing project implementation. As a result, the concept of modularity is still better defined and more precise in a product-oriented context, particularly in the automotive industry.

## 2.7 OPEN INNOVATION IN PRACTICE

Open innovation in practice in the form of case studies that are presented in this section provide critical experiences and lessons to the South African ACMs for benchmarking purposes. Organisations that shun away from innovation perish; hence they should not expect technology to remain unchanged in the long run. They should rather anticipant changes in unpredictable ways than assume that things will stay in their current state for a prolonged period. Many organisations have taken this concept to new dimensions involving communities in solving complex problems or going into collaborations with competitors.

### *(i) Hewlett Packard*

Hewlett Packard (America, 2008) embraced the ideals of the concept of open innovation. They have developed labs and created teams that thrive on the idea and linked them to researchers and entrepreneurs in business, government, and academia. Collaboration assisted in unearthing innovative solutions to hard problems aimed at developing breakthrough technologies. For example, HP is undertaking the initiative of moving open innovation forward by working with universities in their “HP Labs Innovation Research Program” to invite universities worldwide to get involved in joint research with HP Lab Scientists.

These teams consist of global players gathered worldwide with the expertise to foster discovery and address critical issues. Through ground breaking programs and connecting the world are leading researchers, scientists and entrepreneurs who collaborate with the teams to tackle the next generation of breakthrough technologies.

### *(ii) Philips Research*

Filippov et al., (2010) present a case study of project portfolio management at Philips Research, an international organisation that introduces meaningful innovations to the business sector to improve people´s lives. This case study offers practical and strategic benchmarks for South African ACMs. In both developed and surfacing markets, Phillips provided technology options for changes in health and well-being. Philips Research works in tandem with the Philips business sector and plays a significant role in bringing technology enabled innovations, but they do not work in isolation. They also work together with complementary organisations with the same vision. This shared vision is why they actively pursue "open innovation", which enables them to share their expertise and technical abilities with universities, institutes and other organisations so that, in partnership, they can realise the best ideas.

There are two categories of open innovation trajectories at the disposal of the South African ACMs for benchmarking purposes:

"inside-out" innovation – availing skills and resources outside organisation boundaries (undertaking contract research for external parties, providing technical facilities and support and assisting with IP licensing),

"outside-out" innovation – tapping from capacities of individuals, organisations and small start-ups globally to provide health and well-being; hence these strategic partners are critical in new insights and access to new technologies.

Philips Research is always looking for creative new sources of innovation and has decades of experience in both these approaches. They are now experimenting with strategies like crowd-sourcing and social networking to introduce new technical solutions. This results from building on their long-standing relationships with universities and technical institutes and their experience in countless public-private partnerships.

***(iii) Starbucks***

During the last fifteen years, Starbucks (Pha-Gia, 2009) has pioneered open innovation. Opening up instead of shutting out the outside world provides real value with relatively small investments. So far, they have received 100 000 ideas from their customers, a great success story considering the workshops and focus groups hosted to generate many ideas. The essence of open innovation was bringing a group of people with a common goal to collaborate and achieve results using the internet, enabling everybody to work together in larger groups. Instead of merely asking management or the R&D department, they invite all organisation members to participate in the innovation process, leading to different results. Fresh perspectives brought about innovation with the organisation´s partners, customers, or competitors, and they certainly get new ideas compared to only innovating internally.

These case studies present good examples for South African ACMs to develop strategies that introduce change in global supply chain management to view cost reduction, collaborate with external stakeholders, and bring technology-enabled innovations to build the competitive advantage to overcome the size-related hurdles.

### 2.7.1. Open innovation in ACMs

It is critical that the South African ACMs fully understand the dynamics in open innovation. Van de Vrande et al., (2009) show that larger firms adopt open innovation to a larger extent than ACMs in general. The authors identified several managerial and organisational challenges perceived by ACMs in adopting open innovation practices that involve their customers: (1) Organisational and cultural barriers that include the balance between daily tasks and the innovation project, communication problems, the alignment with partners and the organisation of the open innovation activity itself; (2) Resources in terms of the costs and the time required by the activity; (3) Intellectual property rights that raise the question of the ownership of ideas and developments and commercialised innovations especially in cases where different parties are cooperating; (4) Adoption problems, e.g., the misinterpretation of customer requirements; and (5) Demand of customers that might be too specific, or the innovation seems not to fit the desired market. Compared to large enterprises, ACMs possess less external relations with innovation partners beyond their business sector. Consequently, the potential to exchange innovation related information and to collaborate in innovation projects is restricted (Kaufmann & Tödtling, 2002). According to Kaufmann and Tödtling (2002:151), there is a limited number of employees "who can act as nodes establishing and maintaining links to innovation networks". A solution to overcome the limited resources of ACMs regarding innovation is to use the input and services of external partners or collaborations that operate as intermediaries to facilitate innovation (Lee et al., 2010). This study focuses on one specific form of an intermediated model: An open innovation intermediary between the ACMs and the innovating community. The objective is to analyse how the open innovation intermediary can help the ACMs to overcome size-related hurdles (primarily based on size and resource restrictions).

### 2.7.2. The process of Open Innovation

Methods of open innovation are currently increasing. They provide the possibilities of how to improve an organisation's processes and gain competitive advantages. Employees of the organisations personalize open innovation methods to their organisations to create new techniques for using open innovation in organisations. Every innovation is a process of change, so it is a process of implementing change. The process modified to open innovation is shown in figure 2.3 below.

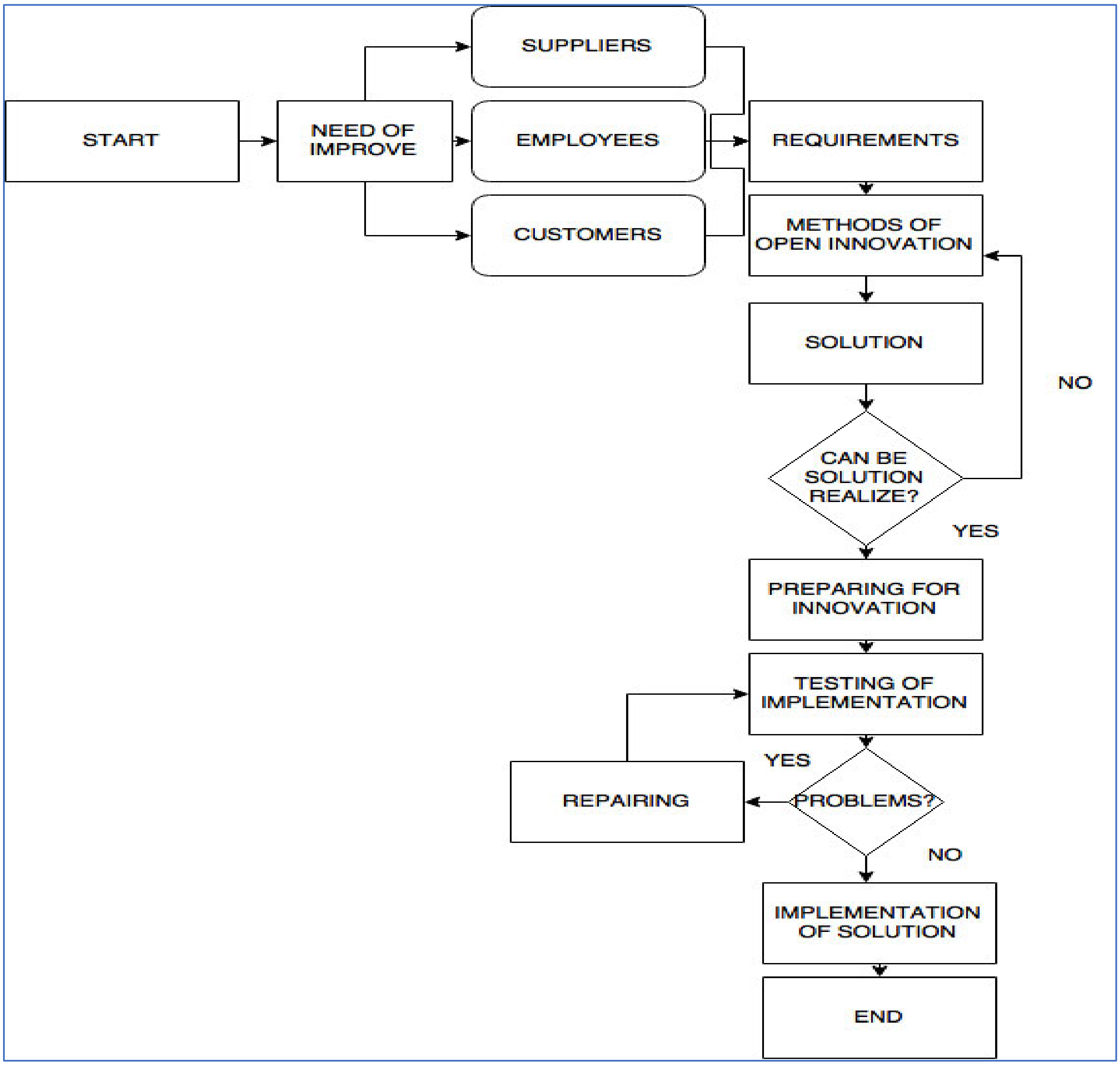


**FIGURE 2.3 PROCESS OF IMPLEMENTATION OF OPEN INNOVATION**

Source: Davies and Bulsine (2018)

Primary, the organisation, must want to change. The organisations that have not improved their processes will face challenges from competitive organisations that innovate. So first, find out where the organisation has an area for improvement. One way is to enquire from people who have daily contact with the organisation. It means suppliers, employees and customers. These people can provide suggestions and requirements for improving the organisation’s processes; after this step, open innovation methods for improving the required procedures resulting in many possibilities of open innovation prospects can be introduced and applied.

For example, it can be brainstorming, brain writing and questionnaire research. The critical part of open innovation is the integration of all employees. From this step, the point of view from other angles realised since employees on different levels in the organisation have different opinions. Anonymous or public approval of advice is the individual opinion (which means it depends on an organisation's culture and the relationship between employees). After applying methods of open innovation, it is necessary to choose marketable thoughts. This step eliminates most of the views because the person who makes the decision has other conditions to consider. Other conditions can be the cost of the proposed solution, the period of applying the proposed settlement or the number of employees (eventually new employees) retrained. It is acceptable to write opinions unrealised since they are for future use. Now control is available if the solutions (ultimately solutions) are realisable. It is necessary to determine whether it is possible to apply open innovation in the organisation, whether the answer is relevant to opinions.

The organisation must prepare for the change to take place. Underestimating this step will result in potential problems with implementing innovation and future inability to measure progress. Organising for innovation means planning innovation implementation systematically. It is necessary to provide information about the change to the employees and delegate a person (eventually team) responsible for innovation. This person should be able to solve implementation issues.

The next step is testing the implementation process. Methods of testing the implementation process are numerous; hence every organisation must use methods at their disposal. Testing of the implementation process usually detects problems. It is necessary to repair and dissolve issues before the full implementation. After improving and dissolving all issues, the executed trial of the implementation process commences. When the situation is appreciated, then the complete application follows. It is now possible to compile documentation about implementation and note the problems with the process. The documentation can be for planning the next innovation initiative.

Implementation of the solutions is unique for every organisation, South African ACMs included. Firstly, employees are made aware of the execution of innovation. When the application is in process, there will be people available working as "technical support." These people will solve potential problems and eventually assist with change management. After successful innovation is open, there must be written documentation about the implementation of innovation, which can help pre-empt difficulties with the application of the next innovation stage.

### 2.7.3. Open Innovation and New Product Development

In recent times, competition between companies, not only South African ACMs focuses on activities associated with supply chain management, such as transporting raw materials and finished products. However, these activities are non-value adding to products, so they are an area of significant opportunities for cost reduction consideration. Global OEMs are seeking innovative business strategies that capacitate the approach towards their target markets while reducing distances. These initiatives, in turn, allow them to decrease production costs, deliver quality products promptly, reduce cycle times, and improve overall product quality (Feng, 2012). To respond to these globalisation processes, the big players who are the international players establish local subsidiaries at an (OEMs) platform, especially manufacturing plants in other countries, to obtain a better geographical position to reach their markets. Benefits from this trend include government subsidies from the host country, appropriate infrastructure, local skilled workforce and low production costs, among others (Grosse, Mudd & Cerchiari, 2013).

The local OEMs industry is comprised of companies that depend on a parent corporation with headquarters in a foreign country. The parent company's role is to identify customer needs and market strategies and define the product platform, which is assembled at the local OEM’s plants (Heid, Larch & Riano, 2013). This action means that OEMs has no direct contact with the final customer or end-user in most cases. Their direct customer is the parent company (Blyde, 2014), leading to the belief that their products are being exported as a hard sell. From the purported exports, they receive incentives from their governments.

Based on the needs of parent companies, these OEMs are allocated production capacity, machinery and equipment manufacturing purposes. Likewise, the established structures meet the product requirements and literary controlled from the parent companies. The established organisational structures and production processes are highly specialised and responsive to changes in demand, thanks to the high training of local employees and the technology installed.

South Africa is a facilitator or host country of OEMs who offer competitiveness and proximity to global markets. Additionally, the South African automotive industry offers above-average resources such as good infrastructure, a competent labour force, proficiency and job training, operationalise technology, and tremendous experience in logistical processes.

Complementary to OEMs, there are large component manufacturers with bases in South Africa, such as Arvin Exhaust, Bloxwich, Corning and Senior Flexonics. There are also about 200 locally owned and operated ACMs in South Africa who supply the OEMs and more than 150 others that provide the industry on a non-exclusive basis. These companies are the main focus of this study.

Unfortunately, the main markets of the automotive industry globally have been decreasing due to financial crises, and the most affected in the supply chain are the ACMs since they have numerous challenges to overcome. As a result, ACMs face impermanent shutdowns or technical stoppages to accommodate workers to keep their jobs and for companies to hold on to valued skilled human resources. The price of holding on to their human resources reduces financial income or total work stoppage. This problem has forced top managers to innovate and develop new products manufactured with the available infrastructure, robust organisational structure, modern production systems and skilled workforce. Inevitably, new product development enables companies to increase their income, become more competitive, avoid frequent loss of highly skilled workers, and stop the knowledge transfer.

Besides the present challenges, South African ACMs have to develop innovations and new products contrary to the traditional innovation process. They have to identify customers’ needs and requirements from the production process capacity and the organisational structure they possess. Their inability to implement drastic changes to their production processes and only be ready and attentive to their parent companies' requirements makes them vulnerable to competitiveness, and innovation is the answer to this ever-changing business environment (Van der Meer, 2007).

For South African ACMs innovation means new products, services, or novel technologies. Converting monetary value to technological knowledge and creativity is the process of the management of change in these innovating organisations. In recent times, these ACMs seized with the idea that the model that can achieve this objective is open innovation (Van der Meer, 2007). This model comes in different dimensions, which gives productivity to the concept but does not facilitate the development of theory on the subject (Huizingh, 2010). One of the significant contributions of this model is its identification of new product development and performances of R&D activities within the organisation. It also highlights the need for outside sources, such as the individual’s knowledge, ideas from customers and technical input into the processes (Chiaroni et al. 2011; Trott, 2008).

Besides, South African ACMs like other organisations are opening their innovation processes to obtain knowledge from external environments and use other organisations for technology commercialisation that help to achieve higher profitability than internally focused initiatives (Lichtenthaler & Lichtenthaler, 2009). To increase product diversity and better match products and consumer preference, South African ACMs are viewing openness as a stimulant to innovation since it combines a broad and different pool of external sources (Boudreau, 2006; Chesbrough, 2003; Von Hippel, 2005).

Figure 2.3 below shows the three phases of the innovation process.

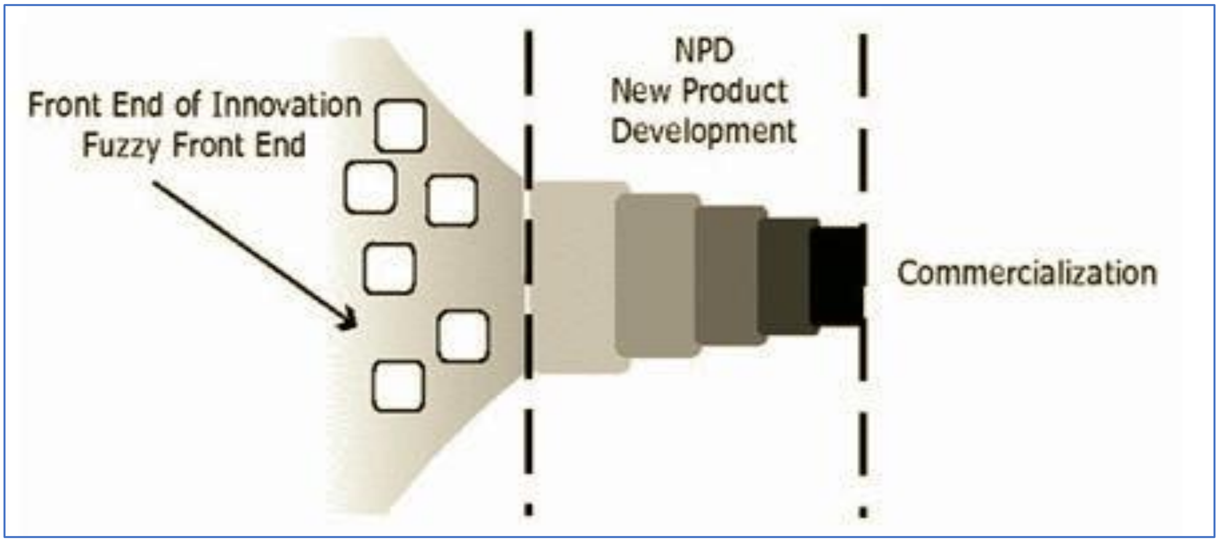


**FIGURE 2.4 THREE PHASES OF INNOVATION**

Source: Koen et al. (2002).

The new product development context includes the following elements, this is notwithstanding the background of new product development for goods and services for a detailed organisation, or contextually:

To successfully develop an idea requires input from several different sources that include customers, competitors, suppliers, employers and other industries. This process of idea generation for new product development is known as the "fuzzy front end."

At various stages of a new product (goods or services) development, organisations South African ACMs included need to evaluate whether the idea should be dropped or developed; this occurs during the subsequent phases, and this process involves multiple and sometimes overlapping steps.

South African ACMs should fully understand that total participants of multifunctional teams start from inception of the innovation strategies. Primarily, participants share ideas consistently, resulting in cross-functional teams that must be established, comprising of marketing, engineering, operations, research and development, and corporate departments. Ongoing success increases based on collaboration in generating the most promising ideas and considering different views to be combined in the new product development processes (Boyer & Verma, 2009).

#### 2.7.3.1. Innovation and New Product Development in the Automotive Industry

With respect to ACMs in South Africa and elsewhere innovation is about the adoption of an idea or behaviour (Jiménez-Jiménez & Sanz-Valle, 2011) on the development of new products (Gündoğdu, 2012) and initiating changes on the established phenomenon (Turker, 2012), identification of critical success factors (CSFs) or activities (Huang et al., 2012). Currently, the innovation process is key to different companies and countries. Schumpeter is the first economist to pronounce the importance of innovation and development for any entity (Tohidi & Jabbari, 2012]. Additionally, a recent overview of the economic importance of innovation has found an adjacent relationship between these two variables for any country (Barnett, Diewert & Maasoumi, 2016). Innovation is considered as a potential strategy for ACMs in South Africa and elsewhere that adhere to long-term plans based on OEM operational strategy (Wonglimpiyarat, 2015), especially in capitalist environments, where production and consumerism are vibrant (Murphy, 2015).

Innovative practices assist South African ACMs and other innovating organisations in terms of the supply chain integration in traditional markets that are saturated with traditional products. ACMs usually know what their customers need and based on long-term forecasting processes, however, little modification of products is proposed using the structural organisation and production processes. This ACMs forecast adheres to long-term plans that are based on OEM operational strategy (Wonglimpiyarat, 2015) Despite this, thanks to their technical capabilities, ACMs can expedite proposed products with the suitable characteristics, and that is a great advantage since the time required for the new product development (NPD) processes are lengthy in smaller companies. However, currently, these ACMs have developed much expertise in product changes and they can respond swiftly back to their parent companies' requirements at any time.

Fortunately, some South African ACMs now have product development departments that aim at improving product characteristics through innovative practices. In contrast, some OEMs have introduced technical development centres that provide technical support to other departments in NPD and component suppliers in their value chains. These companies take advantage of their geographical location, which is strategically a critical success factor in competing with other global players in the automotive industry. Nevertheless, one of the essential issues concerning innovation in these ACMs is the relationship between the different critical factors associated with the success of NPD and competitive advantage (Molina-Castillo, Jimenez-Jimenez & Munuera-Aleman, 2011). Therefore, this relationship makes it an area to be given exceptional and consistent attention if competitiveness is to be achieved.

#### 2.7.3.2. Critical Success Factors in NPD and Innovation

Innovation and NPD present an opportunity for strategic perspectives and benefits in the automotive and other industries in South Africa as they offer related processes that are necessary for identifying organisational critical success factors (CSFs) or activities (Huang & Lai, 2012). There has been an intensified effort by numerous authors on the role of CSFs; the literature review shows that management commitment is crucial for NPD (Lynn, Abel, Valentine & Wright, 1999; Cooper, 2003), survival and success. Other extensively studied CSFs are team development skills (Lynn, Abel, Valentine and Wright, 1999) and the internal processes companies use to retain a trained workforce. Similarly, authors have highlighted the processes for the identification of the following: market needs (Cheng, Chang & Li, 2013; Henard & Szymanski, 2001), the translation of those needs into a workable design to be manufactured (Evanschitzky, Eisend, Calantone & Jiang, 2012; Chen, Damanpour & Reilly, 2010), and the cultural adaptations made as companies introduce the structural changes required to keep people continuously informed in an even developmental process (Cheng, Chang & Li, 2013; Chen, Damanpour & Reilly, 2010).

In the context of ACMs (Molina-Castillo, Jimenez-Jimenez & Munuera-Aleman, 2011) recently authenticated three dimensions addressed in (Evanschitzky et al., 2012) as CSFs. These dimensions are product, market and process characteristics. Furthermore, Martínez-Baeza et al., (2014) confirmed organisational and marketing attributes, suggesting that these CSFs are considered in NPD.

Several authors have discussed and presented their evidence and, finally, identified benefits gained from NPD for both customers and companies worldwide. Table 2.5 presents the most important benefits. However, the question is, are these findings applicable to South African ACMs as processes and innovation practices? The answer is based on the relationship between innovation and NPD and the benefits derived from open innovation explored in the next section.

TABLE 2.6 BENEFITS OF OPEN INNOVATION IN ACMS

| Benefits for Companies | References |
|---|---|
| Competitive edge | Molina-Castillo et al., (2011); Cheng, Chang, and Li, (2013) |
| Financial performance | Molina-Castillo et al., (2011); Cheng, Chang, and Li (2013); Chen, Damanpour, and Reilly (2010) |
| Innovation speed | Molina-Castillo et al., (2011); Chen, Damanpour, and Reilly (2010); Carbonell and Rodriguez (2006) |
| Financial profit | [Chen Damanpour and Reilly (2010); Huang, Soutar, and Brown (2004) |
| Market share | Chen, Damanpour, and Reilly (2010); Huang, Soutar, and Brown (2004) |
| Product adaptation to the environment | Carbonell and Rodriguez (2006) |
| Adaptation to customer demands | Cheng, Chang, and Li, (2013); Huang, Soutar, and Brown (2004) |
| Technological upper hand over competitors | Huang, Soutar, and Brown (2004) |
| Long-term view | Tsai and Yang (2013) |
| Reduced product lifecycle | Chen, Chang, and Lin (2010) |
| Market growth | Chen, Chang, and Lin (2010) |
| Product acceptance in the market | Cankurtaran, Langerak, and Griffin (2013) |
| **Benefits for Customers** | |
| Customer satisfaction | Molina-Castillo et al., (2011); Chen, Damanpour, and Reilly (2010] |
| Innovation of a new product | Molina-Castillo et al., (2011); Chen, Damanpour, and Reilly, (2010) |
| Product quality | Molina-Castillo et al., 2011; Cheng, Chang, and Li, (2013) |
| Technological innovations | Molina-Castillo et al., 2011; Huang, Soutar, and Brown (2004) |

| | |
|---|---|
| Product functionality | Chen, Chang, and Lin (2010) |
| Reliability of the new product | Chen, Chang, and Lin (2010) |
| Technical support and performance | Chen, Chang, and Lin (2010) |

### 2.7.4. Benefits of open innovation in ACMs

There are critical lessons as depicted in table 2.6 that South African ACMs need to learn from the experiences of their counterparts elsewhere with regard to practising open innovation for sustainable competitive advantage. Lee et al., (2009) intimate that open innovation is not a walk in the park, especially for the early-stage ventures which do not have adequate capabilities regarding research and development and massive capital investments. Open innovation has a high potential for ACMs including those practising in South Africa (Lee et al., 2010). Nevertheless, Oakey (2013) criticises Chesbrough for exaggerating the applicability of open innovation systems because returns from research and development are often long-term, expensive and always risky and require the protection of consequences. The author further argues that closed innovation remains an effective option for research and development investment. With its supporting tools such as Web 2.0, the Internet is becoming increasingly essential to leverage ACMs' internal and external capabilities (Bell & Loane 2010). Some scholars argue that ACMs are more effective than OEMs in using various open innovation practices in parallel because of their unwavering support and control of parent companies compounded by their ability to utilise external sources of information (Spithoven et al., 2013). However, Lichtenthaler (2008) found that most ACMs are still pursuing closed over open innovation. Torok and Toth (2013) argue that firms that provide their ideas to external parties are more product innovative orientated than non-providers. The authors suggest that mutual rather than one-way exchanges are relationships that significantly raise the probability for ACMs to experience substantial benefits from contributing to other firms' new product development projects. Tranekjer and Søndergaard (2013) explored Danish small and medium enterprises and identified the costs linked to numerous sources of innovation.

The automotive manufacturers in South Africa need to build relationships between the market and science sources as means to minimise collaboration costs. The argument being that suppliers of similar knowledge base are related to the performance of the market, and cooperation with customers, results in lesser project fees. Nevertheless, it is found that the degree of novelty in new products is lower in ACMs that individually innovate than in those that are firmly embedded with suppliers. Technology scouting is a low cost but useful alternative for ACMs involved in high-tech activities (Parida et al., 2012). Overall, ACMs include those in South Africa are increasingly adopting open innovation as a part of operational strategies (Xiaobao et al., 2013; van de Vrande et al., 2009).

ACMs in South Africa can as well benefit from engaging in open innovation like ACMs elsewhere that employ the paradigm as their innovation strategy. A critical study by van de Vrande et al., (2009) found that ACMs adopt open innovation primarily for commercial interests such as meeting customer demand and keeping up with competitors. Hemert et al., (2013) demonstrates that ACMs' interaction with sources of innovation is not essential during the phase of recognising the innovation process and at the end stage to facilitate successful commercialisation of a product or service. Kang et al., (2013) asserts that the firm magnitude and the degree of government support significantly impact the commercialisation of ACMs. They established that appropriability, innovative capabilities, and investment in external research and development positively impact ACMs' initiatives to commercialise. Lee et al. (2010) further argue that

ACMs are good at inventions but lack essential commercialisation resources. Hence, ACMs suggest that collaboration with other partners, including intermediaries at the commercial stage, may help overcome their limitations for commercialisation. Collaboration for ACMs is more critical in the commercialisation stage than in different stages such as ideation and research, and development (Van de Vrande et al., 2009; Hemert et al., 2013; Theyel, 2013). For ACMs, open innovation is less valuable than revenue generation because of their inherent challenge of resource deficiency (Chaston & Scott 2012; Spithoven et al. 2013). Nevertheless, cooperation with industry incumbents helps overcome challenges ACMs encounter (van de Vrande et al., 2009).

## 2.8 CHAPTER SUMMARY

This chapter defined open innovation according to various authors, outlining the firm's strategy and competitive advantage. The chapter presented the competitive advantage concept based on the resource-based view, dynamic capabilities, risks, and absorptive capacity. The chapter highlights the relevance of an open innovation strategy in building an organisational culture based on teams, individuals and multiple links outside the organisation. The chapter also includes erosion factors and the implementation of open innovation archetypes, and new product development.

The next chapter details the second phase of the literature review, mainly based on the evolution of open innovation globally and locally. The innovation challenges that influence South Africa's global competitiveness are presented.

# CHAPTER THREE

## EVOLUTION OF THE AUTOMOTIVE INDUSTRY IN SOUTH AFRICA

### 3.1 INTRODUCTION

This chapter presents a literature review by various academics, authors, and industry experts on the evolution of open innovation in the South African automotive industry, focusing on automotive component manufacturers. Strategic alignment of the South African ACMs to open innovation model provides a synopsis of the present scenario in the global automotive industry. The chapter highlights the characteristics of open innovation adoption in the South African automotive industry, maps and analyses the significant trends and developments impacting the automotive industry's performance.

From the inception of open innovation to date, much literature has been accumulated regarding open innovation in the automotive industry (Cassia et al., 2012; Lazzarotti et al., 2013). However, there is still much to be explored in research on the phenomenon in the South African context and the automotive component industry. Gassmann (2006) and Ili *et al*. (2010) have looked at the appropriateness of open innovation in the global automotive industry. These authors affirmed that open innovation is applicable in the automotive manufacturing sector based on its global coverage, technology intensity, high levels of technology fusion, and adaptability to new business models in different locations. Alfredo et al. (2012) stated that the two most important drivers of innovation in the automotive sector are customer demand and globalisation. Ili et al. (2010) acknowledged that the properties of open innovation had demonstrated their relevance to the automotive industry, including the South African industry. In summary, these authors suggested that the open innovation model is appropriate for the automotive industry globally.

This research recognises these authors' valuable contribution; however, the research urges that the field has developed further, and other perspectives and areas need to be reviewed and integrated accordingly. Nonetheless, the South African automotive component manufacturers' operations are dominated by the closed innovation paradigm. Barnes et al. (2018) acclaim that the automotive industry should consider adopting the open innovation paradigm, notwithstanding its existing limitations.

The South African automotive industry is analysed based on its strategic alignment to open innovation adoption. The competitive advantage gained is in outlining South Africa's key trading partners and detailing the evolution of the model and intervention by automotive industry players (Barnes et al., 2018). The South African automotive industry is analysed based on changes in the automotive component manufacturing (ACMs) sector. These changes influence the driving principles of global competitiveness and critical factors impacting the competitiveness of the ACMs.

## 3.2 THE GLOBAL AUTOMOTIVE INDUSTRY TRENDS INFLUENCES

The global automotive industry trends have primarily influenced the evolution of the South African automotive industry. Alfaro, Bizuneh, Moore, Ueno and Wang (2012) outlined that the most significant trend in the automotive industry recently that has most likely affected the South African automotive industry is the Complete Build-Up (CBU) production volumes to the emerging markets. This shift to developing countries is the driving factor due to the rapid growth of the CBU units demand in the developing world and the lower labour costs in developing countries. Alfaro et al. (2012) emphasised that the rising of incomes among the working class in China, India, and Brazil has resulted in the mushrooming of middle classes investing in ownership of automobiles. Similarly, the same has obtained in South Africa as a member of the BRICS countries, with the same socio-economic dynamics. Blumenberg and Pierce

(2012) noted that for the first time in 2010, emerging markets accounted for over half of the light vehicle sales globally. The General Household Survey 2018 found that 30.6% of South African households own a vehicle, up to half a percentage point from 2017. This survey found that households in metropolitan areas have considerable higher vehicle ownership (39.4%) than 14.3% in rural areas (Mdluli & Dunga, 2021).

The global trends in automobile demand and the reduction in labour costs prompted (Di Minin et al., 2010) to develop a study at Fiat that indicated the influence of the trends in the global automotive industry and pronounced open innovation as a bifocal strategy to stimulate competitiveness in the industry. This strategy balanced the focus on the availability of limited resources and the continued investment in the organisations' future to strengthen operational efficiency while preserving and enhancing Research and Development (R&D) effectiveness. Lazzarotti et al. (2013) explored "whether, why, and how" open innovation influences trends in the automotive industry, the South African automotive industry included. This study is in harmony with Ili et al. (2010), who suggested that the South African automotive industry is trapped by cost and innovation pressure from customer demands who always ask for technologically advanced products at low prices, as evidenced in the South African automotive industry (Lazzarotti et al., 2013). These authors (Di Minin et al., 2010; Lazzarotti et al., 2013 & Ili et al., 2010) agree that partnerships are the essential manifestation of open innovation in the automotive industry. They concluded that Tier 1 suppliers are more likely to engage with broader knowledge base partners such as universities (Lorentzen & Barnes, 2004). The authors further suggested that studies on open innovation are a necessary positive trajectory, and they recommended a supplementary investigation of open innovation initiatives among ACMs, which this study aims to achieve.

By focusing on the various collaborations and relationships of a single global automotive Original Equipment Manufacturers (OEM), Karlsson and Sköld, 2013 demonstrated that the network is a more relevant point of departure in analysing organisations engaged in open innovation such as the South African ACMs. These authors distinguished the difference between vertical and horizontal relationships and further identified that large enterprises develop and manufacture complex products using different forms of open innovation. This analysis indicated the concurrent existence of combined open innovation and closed innovation approaches on ACMs competitiveness. Dodourova et al. (2014) stated that the open innovation approach often results in vertical relationships associated with large, influential suppliers who own scarce technology or prescribe technological content. This relationship is obtaining among the OEMs and ACMs in the South African automotive industry, where most advanced technology resides with the OEMs. Innovation activities performed outside the organisation resemble open innovation of the firm boundaries. They dominate in horizontal closed innovation relationships.

Drucker (1985) excellently christened the automobile industry as the industry of industries indicating its magnitude. Takeishi (1998) noted that a typical passenger car contains more than 30,000 parts, and this ranges from several mechanical to electrical components, which proved to be true when considering the input into an average vehicle. This target requires innovation consistently and persistently administering open innovation paradigm to meet industry demand (MacDuffie & Fujimoto, 2010; Sako, 2002). The paradigm demands that change must be open and intra-organisational. This model represents the future and success of ACMs in the South African automotive industry and suggests that these organisations embrace it.

The process of opening knowledge boundaries as it obtains in the global automotive industry is a challenge for the South African ACMs and OEMs, who are mature and asset-intensive firms in the automotive industry. Knowledge boundaries, by their nature, bring rigidity to the automotive industry, especially the industry's internal innovation processes (Chiaroni et al., 2011). It is becoming severely costly for OEMs to go deep across all technologies, indicating the necessity for them to engage ACMs in their noncore activities. To be competitive and keep abreast of competition, the ACMs automotive, in their quest for innovation, need to combine knowledge from numerous scientific disciplines such as chemistry (e.g., batteries), materials science (e.g., lightweight materials), and consumer electronics (e.g., infotainment). The pressure to innovate and integrate new functionalities in the vehicle has increased OEMs' efforts to obtain innovations from outside their traditional firms and supply chain boundaries and embed themselves in more or less loosely coupled networks of different actors (Laursen & Salter, 2006). To generate new knowledge for innovative initiatives, OEMs and ACMs in South Africa need to focus their attention on external factors such as engineering firms, private inventors, research institutes, competitors, and other service providers (Ragatz et al., 1997; Wong et al., 2013). These authors further acknowledge that OEMs need to build relationships with traditional automotive systems or component manufacturers because they later integrate into OEMs' New Product Development (NPD) processes.

### 3.3 SOUTH AFRICAN AUTOMOTIVE INDUSTRY

When the domestic South African automotive industry entered the global arena, exciting observations emerged. Most notable is the importance of the industry and the opportunities and challenges inherent in the position of the South African automotive industry in the Global Value Chains (GVC). The presentation below depicts that the local industry is a borderline case in light vehicle production globally. The local industry possesses 0.68% of the global output and 0.69% market share of worldwide consumption. According to the rankings, the industry is ranked 26$^{th}$ for passenger vehicles and 15$^{th}$ for light commercial vehicle production. South Africa, as a country, is classified as a second-tier producer, while immediately ahead are economies like Poland, Iran and Slovakia. Directly behind South Africa are Malaysia, Argentina, and Hungary. In 2015 the South African total vehicle production was 615,658 units, as depicted in table 3.1 and at that point, that production was considered insignificant compared to the Tier 1 global producers, which produced more than 1.5m products per year.

**Table 3.1 South African Contribution 2012 2015.**

| Year | Passenger | | LCVs | | Total | |
|---|---|---|---|---|---|---|
| | Contribution | Ranking | Contribution | Ranking | Contribution | Ranking |
| 2012 | 0.44% | 27th | 1.38% | 16th | 0.64% | 24th |
| 2013 | 0.41% | 28th | 1.41% | 15th | 0.63% | 24th |
| 2014 | 0.41% | 28th | 1.43% | 15th | 0.63% | 24th |
| 2015 | 0.50% | 26th | 1.31% | 15th | 0.68% | 22nd |

Source: OICA (2013-2016). Data excludes double counts.

Previously the domestic market's relative position on the global market mainly endured the same with its relative rankings, and its comprehensive offerings stagnated. As shown below table 3.2, there was a local production of heavy trucks at 0.9% in 2015, complemented by buses and coaches at 0.4%.

**Table 3.2 South African Global M & HCV Production 2012-2015 1**

| Year | Heavy trucks | | Buses and coaches | |
|---|---|---|---|---|
| | Contribution | Ranking | Contribution | Ranking |
| 2012 | 0.74% | 14th | 0.35% | 14th |
| 2013 | 0.79% | 13th | 0.35% | 13th |
| 2014 | 0.83% | 12th | 0.46% | 13th |
| 2015 | 0.89% | 13th | 0.38% | 13th |

Source: OICA (2013-2016)

Table 3.3 Automotive Manufacturing in SA in 2015 1

| SA Contribution | Gauteng | KwaZulu-Natal | Eastern Cape |
|---|---|---|---|
| **Population (% of SA total – 55m)** | 13.2m (24.0%) | 10.9m (19.8%) | 6.9m (12.6%) |
| **GDP contribution as a percentage of the total SA (R3.8tn*)** | 34.4% | 16.1% | 7.6% |
| **LV OEMs (vehicle assembly plants)** | BMW, Nissan, | Toyota | VW, Mercedes- |
| | Ford | | Benz, GM, |
| **Major M&HCV and yellow metal organizations** | Iveco, Scania, | Bell Equipment, | FAW, |
| | MAN (buses), | Hino, MAN (trucks) | GM /Isuzu, |
| | Marco Polo | | Mercedes-Benz |
| **Automotive Component organizations** | 200 | 80 | 150 |
| **Total Vehicle population: (11.7m units4)** | 38.6% | 13.5% | 6.6% |
| **PV sales: % 2015 total (412,670 units)** | 35.3% | 12.9% | 3.8% |
| **LCV sales: % 2015 total (174,544 units)** | 31.2% | 12.2% | 4.7% |
| **M&HCV sales: % 2015 total (30,535 units)** | 36.2% | 16.3% | 4.2% |
| **LV production: % total 2015 (583,999 units)** | 30.9% | 22.9% | 45.9% |

| | | | |
|---|---|---|---|
| **LV exports: % 2015 total (333,802 units)** | 33.3% | 17.1% | 48.8% |

Source: AIEC (2016)

* GDP at market prices for 2014

In the global context, the South African automotive industry's production is substantially insignificant. It is, however, an essential component of the South African economy, contributing 7.5% to GDP, including multipliers as indicated in the Master Plan 2035. The multipliers include retail and aftermarket maintenance and repair services, while manufacturing among component manufacturers provided most of the contribution. The South African automotive industry operates in a highly competitive and dynamic environment that is proliferating due to international competition and changing customer demands. Furthermore, new competitors are continuously entering the market, introducing new competing brands, making it even more difficult for different brands to be competitive and profitable. Besides these challenges caused by the emerging competition, the industry in 2015 created R235 billion sales in production, included R151.5 billion in exports and 113,532 employees hired across the board in the body shop, paint shop and assembly departments. The rest are employed in the components and tyre manufacturing sectors. The current study identified that value addition activities are focused mainly on three provinces, namely Eastern Cape, Gauteng and KwaZulu-Natal. The location of leading ACMs is in the regions where the country’s leading OEMs are also located.

The local automotive industry's current scenario presents a gloomy picture from the Motor Industry Development Program (MIDP) departure in 2012. The Automotive Production and Development Programme (APDP) replaced the Motor Industry Development Programme (MIDP) in 2013, with minor changes implemented in 2016 (Barnes et al., 2018). . Similarly, the development of the South African Master plan 2035 and the policy revision after that gives guidance around how the sector is expected to develop in the medium to long term. The Key Performance Indicators (KPIs) selected and presented in Table 3.4 have revealed that the strategic position of this industry remains unchanged despite the advent of the APDP. On a positive note, as depicted in table 3.4, the production of passenger vehicles has amplified, and OEMs procurements from ACMs have increased. Additionally, exports in CBU are fully-fledged, but imports have deteriorated in unit terms. Exports in components have increased, causing a ripple effect on OEM employment, which has increased marginally. However, on the contrary, table 3.4 also reveals a marginal decline in Light Commercial Vehicle production and a decrease in automotive component manufacturing employment as per Statistics South Africa's labour force survey report 2020. Notwithstanding NAACAM data, which suggest growth, the local content in South African vehicle production has declined by 39%. The industry revenues reached R135 billion in 2015, but the trade deficit remained stagnant primarily from 2012.

**Table 3.4 SA Automotive Key Indicators 2012-2015**

| KPI | MIDP-end | APDP-start | APDP-latest | Change since |
|---|---|---|---|---|
| | -2012 | -2013 | -2015 | 2012 |
| LV production | 517,162 | 513,645 | 583,999 | 66,837 |
| PV production | 272,076 | 265,249 | 341,025 | 68,949 |
| LCV production | 245,086 | 248,396 | 242,974 | -2,112 |
| M&HCV production | 21,702 | 24,079 | 24,303 | 2,601 |
| Local content per SA LV | 46.6% | 40.9% | 38.7% | -7.9% |
| LV component purchases | R35.2bn | R 37.9bn | R 52.9bn | R 17.7bn |
| CBU exports – units | 276,183 | 274,444 | 332,247 | 56,064 |
| CBU exports – Rands | R 50.0bn | R 60.5bn | R 101.9bn | 51.9 |
| CBU imports – units | 366,862 | 384,73 | 340,57 | -26,292 |
| CBU imports – Rands | R 50.1bn | R 63.6bn | R 61.6bn | -R 11.5 |
| CBU imports: % SA PV market | 73.2% | 75.2% | 73.0% | -0.2% |
| CBU imports as % LCV market | 24.1% | 24.4% | 19.6% | -18.5% |
| Component exports – Rands | R 36.9bn | R 42.2bn | R 49.6bn | R 12.7 |
| Component imports – Rands | R 86.0bn | R 102.9bn | R 135.1bn | R 49.1 |
| Auto trade balance – Rands | (R 46.7bn) | (R 63.8bn) | (45.2bn) | R1.5bn |
| Manufacturing employment | 100,566 | 104,772 | 113,532 | 12,966 |
| OEM employment (NAAMSA) | 30,566 | 30,132 | 31,432 | 866 |
| Auto components (NAACAM) | 70 | 74,64 | 82,1 | 12,1 |

| | | | | |
|---|---|---|---|---|
| Auto components (StatsSA) | 58,057 | 53,563 | 45,735 | -12,322 |

Source: AIEC (2016); StatsSA (2016)

This industry is overwhelmed by many challenges, the major one being competitiveness among automotive component manufacturers (Barnes et al., 2018). The South African automotive manufacturing sector is a borderline player globally, with relatively few vehicles assembling plants, compounded by an immature automotive components industry compared to competitors in the developed and some developing economies (AIEC, 2016). The sector plays a critical role in the South African economy, both totally and in its contribution to the Manufacturing Value Chain (MVA). Within the MVA chain, the South African automotive industry is a second-tier actor; besides that, this viewpoint fluctuates substantially from one vehicle manufacturing process to the operation process and the next. Apparently, in the South African automotive industry, out of the seven passenger vehicles OEMs, four of them belong to the second tier of global activities of the parent organisations, with the rest belonging to the third tier. There are compartments of an essential addition to the bus and yellow metals assembly industry value, and this sector belongs to M&HCV, which comprises SKD assembly operations (AIEC, 2016). Domestic motorcycle production is non-existent and has an insignificant market (21,000 units) countrywide. Besides the simplicity of its manufacturing processes, this market size is not justifiable to support (Barnes et al., 2018). The technical complexities in the CBU sector have exerted considerable pressure on the ACMs; this sector has barely managed to increase its market size because of the shortcomings in production volumes from local OEMs. The local market for components is fragmented and aggravated by intensifying global competition (Stats SA, 2016).

The weak domestic market performance is a significant fracture point concerning the country's present position in the GAV chain to the extent that imports into the local market have weakened the regional market conditions. Unfortunately, besides the positive outlook, the confidence of the local markets has declined, with the short-term forecast being quiet. The South African automotive industry is experiencing harsh market conditions and a challenging strategic position due to the growth in the current production of vehicles exported into foreign, established markets. The increase in production has resulted from commodities backed by the AGOA and EU-SA Free Trade Areas treaties, and locally the APDP. The commodities are mainly catalytic converters exported to AGOA and the EU-SA free trade areas. ACMs receive rebates that offset the industry's significant shortcomings, which are high manufacturing costs. The other challenge is the limited regional market aspects that do not stimulate local vehicle production, the underpinning competitive advantage pursued by all competing economies (Barnes et al. 2018).

Nevertheless, the African Continental Free Trade Agreement AfCFTA marks a key milestone for Africa's continental trade system by presenting an alternative to the AGOA and the EU-SA free trade area agreements. The size of the AfCFTA trade area offers promising economic development and sustainable growth that reaches all market sectors and participants. Additionally, the timing of the initial launch is expected to contribute to the alleviation of the pandemic's economic damages (Scribbr, 2021) and will be a challenge to the AGOA and EU-SA Free Trade Areas treaties

Although this industry has not retrogressed from introducing the APDP initiative in 2013, negative signs are signalling the lack of positive energy in the operations field. Accumulated production of vehicles has increased, but there has been a decrease in the production for local and regional markets. There has been an increase in the production of cars assembled locally, but local content has declined to 40% and below, and cumulative industry employment figures have declined (AIEC, 2016). An increase in local content and jobs are essential government indicators in policy crafting, and these two facets are the centre of the justification for the South African government to back the industry. The extensive improvement in the industry's CBU is an essential step towards trade liberation since the APDP.

Local demand for vehicles and the exporting of assembled cars with less locally manufactured components resulted in a trade deficit comprising elements that have remained obstinately elevated in 2015, at R45.2 billion. Unfortunately, the picture does not present an essential change in either the industry's ability to participate or justify its position strategically. Besides authorities lending their support through the ADPA to the industry, it has not performed as expected compared to other markets. While the intention to provide higher levels of support to vulnerable component industries via the APDP was noble, this support was not sustained, and it brought into question the long-term sustainability of the local components manufacturing sector (Bronkhorst et al., 2013).

A SWOT analysis conducted amongst industry stakeholders revealed the critical fundamental challenges facing this industry, including logistics costs and employee skills (Barnes et al., 2018). Additionally, the SWOT analysis acknowledged several main threats in the industry: the increasing need to lower the cost of the competition and dilapidated and expensive infrastructure. These identified deficiencies were proved to be devastating to the future success of this sector (Barnes et al., 2018).

The SWOT analysis also highlighted numerous current strengths and prospects. Government backing is recognisable as strength and the presence of OEMs who have a considerable amount of obsolete capital. The following are the other strengths derived from demonstrated ability to produce a large variety of vehicles and components, namely, possible factory costs, operational business set-up and superior global market penetration. The prospects acknowledged were: worldwide growth and local market incentives, improvements in logistic costs, improved local content, personal skills development and production adaptation (Oke et al., 2007; Rosenbusch et al., 2011).

There exists anticipation of the long-term development of the South African automotive industry based on the vast number of opportunities identified. When assessed concurrently with the limited constructive development of industrial infrastructure as a result of APDP, augmented by the substantial contribution made by this industry to economic activities in South Africa, the industry has a great potential in supporting economic growth and development (Oke et al. 2007; Rosenbusch et al. 2011). The critical challenge on which this thesis is focused is the industry’s potential in supporting economic development and realising the industry’s full potential as articulated by the Master plan 2035.

Barnes et al. (2018) researched the SAAM and identified six essential Master plan building blocks that focused on certain critical areas that need attention up to 2035. These building blocks are illustrated in Table 3.5:

**TABLE 3.5 SUMMARY OF SAAM OBJECTIVES**

| Objective | Estimated impact on SA auto industry |
| --- | --- |
| 1. Grow SA vehicle production to 1% of global output | CBU production to 1.39 million units annually (129% higher than 2015 levels)<br><br>Increase of value of vehicle production to R314 billion |
| 2. Increase local content in SA assembled vehicles to up to 60% | Increase of R135.4 billion on 2015 local content levels<br><br>Local content increase of 21.3% per vehicle produced (55% increase)<br><br>Increase automotive component aftermarket and export production by at the same pace as local content growth |
| 3. Double employment in the auto value chain | Double employment in the auto<br><br>value chain<br><br>Employment growth of 112,000<br><br>Aggregate employment from 112,000 to 124,000 |

| | |
|---|---|
| 4. Improve auto industry competitive levels to that of leading international competitors | Sustainable automotive industry based on comparative price and nonprice competitiveness versus leading international competitiveness<br><br>Sustained export competitiveness |
| 5. Transformation of the South African<br><br>automotive value chain | 25% Black-owned involvement at Tier 2 and Tier 3 component<br><br>manufacturer levels, as well as in dealership networks and authorised<br><br>repair facilities<br><br>Amplified skills development of Black South Africans<br><br>Enhanced employment equity at senior management, artisan and<br><br>professional employment levels across the automotive value chain |

| | |
|---|---|
| 6. Deepen value addition within SA auto value chains | Growth in R&D and other innovation metrics within the South African automotive value chain |

As outlined in the SAAM document, the six building blocks intended to aggressively support the achievement of vision 2035. The most important outcome of this vision is the realisation of a fundamental and supportive policy established after the finalisation of the APDP in 2020 (Barnes et al., 2018; Oke et al., 2007; Rosenbusch et al., 2011).

### 3.3.1 Localisation Opportunities for the Automotive Industry

The main challenge facing the South African automotive industry is the substantial growth of vehicle production. Similarly, a crucial and related problem is developing locally manufactured components adding to the domestic and regional automotive value chain. By 2015 local content was only 38.7% of all assembled vehicles, which did not meet the set target of 60%. Local content figures indicated the industry's inability to achieve its growth potential (Barnes et al., 2018). The decline in anticipated growth resulted from a lack of specific technology in areas like the main drive and power trains, protection and infotainment.

On the other hand, local content provides considerable opportunities to increase in response to the demand for locally assembled vehicles, demonstrated by the experiences of countries such as Turkey, Thailand

and Brazil, which are also second-tier automotive manufacturers (AIEC, 2016). In the South African context, local content is currently below 40%, and unless this figure increases, the prospects for industry growth will be severely compromised. The 60% target defined in the 2035 Master plan is based on recognising substantial localisation opportunities, partly in high value-added segments like drivetrain/powertrain, safety and telematics technology (Barnes, Black, Markowitz, & Monaco 2021).

In response to the need to increase local content, a multi-faceted reaction is required in developing localisation initiatives that can solve the multi-dimensional challenges faced by the South African ACMs. The multi-dimensional challenges are related to enhancing the automotive industry’s operational cost profile comprising overheads, labour, materials and productivity. The economy should have the capability to ensure that technology and skills are available to respond to the demands of this industry. It is noted as insufficient to strengthen local content within the industry by only enhancing these factors. However, the Master plan underlined the devastating influence of high transportation costs and state control of prices for the following commodities: energy, water, sanitation, rates and taxes on operational expenses (Barnes et al., 2018; Oke et al., 2007; Rosenbusch et al., 2011). These interventions have led to localisation opportunities and resulted in significant operational challenges for South African ACMs. In response, automotive component manufacturers have changed their modus operandi to suit the increase in costs; hence, crucial local content production and related technologies and skills have demised. Correcting the situation entails balancing state-driven service costs and promoting and expanding the necessary techniques and accompanying skills needed to achieve these value-add initiatives to acquire components/materials locally instead of importing them. This building of the capability base is bound to improve the wide-range ranking of the local value add and generate prerequisites that encourage the strengthening of availability of internal components (Barnes et al., 2018; Oke et al. 2007; Rosenbusch et al., 2011).

The other crucial factors are establishing focused specialisation within the MVC and linking the potential of the material base with developing automotive industry opportunities strategically. Based on speciality, South African automotive component manufacturers can secure markets in the local industry setting. It follows that they should identify opportunities to connect to improved markets (Lee et al., 2010; De Propris, 2002). Identifying opportunities is partially a policy issue and therefore not part of the study, however although moderate, it is a strategic undertaking that requires coordination within the industry compounded by structural interpositions. The Automotive Supply Chain Competitiveness Initiative (ASCCI) resulted from detecting and responding to localisation opportunities in the industry (Barnes et al., 2018). It has bridged the gap of collaborating with the government at the highest level. Local content is a crucial initiative necessitating all stakeholders (industry and government) to work together on detailed agreed-upon terms. These terms provide the scope to enhance this initiative through local supply chains and launch possible specialisation fields for the domestic automotive industry within GVCs (Lee et al., 2010; De Propris, 2002).

It is important to note that all major stakeholders operating in the industry are presently exploring localisation opportunities and transformation programmes. The National Association of Automobile Manufacturers of South Africa (NAAMSA) is currently running consultations on potential opportunities through the OEM Purchasing Council and is testing the adoption of a black industrialists fund and a transformation fund. The National Association of Automotive Component and Allied Manufacturers (NAACAM) has recently concluded a survey of BBBEE compliance amongst automotive component manufacturers. It is actively engaged in best practice education via a black supplier development programme run jointly with the Automotive Supply Chain Competitiveness Initiative (ASCCI). NAACAM also provides legal assistance to its members to assist in achieving compliance with the BBBEE scorecard (Barnes et al., 2021). The ASCCI is endeavouring to target interventions to build supplier capabilities, drive localisation, and develop strategic insights into future opportunities for the value chain. All of these elements have transformation objectives. In Gauteng, the Automotive Industry Development Centre (AIDC) is promoting Automotive Incubation Centres linked to individual OEMs (the most advanced project being at Ford) and is also running a supplier development programme (Barnes et al., 2021). In KZN, the Durban Automotive Cluster (DAC) is currently testing a supplier development model based on the formation of joint ventures between established component manufacturers and emerging black suppliers. All these initiatives are linked to the open innovation approach of creating above-average returns through collaboration and building dynamic capabilities among South African ACMs.

### 3.4 OPEN INNOVATION IN AUTOMOTIVE COMPONENTS MANUFACTURING

Automotive components manufacturers, commonly known as ACMs, confront diverse concerns with open innovation implementation compared with large organisations OEMs. When implementing innovation (Lee et al., 2010), organisations face deficiencies in vital skills, information, infrastructure and financial resources. In contrast, more prominent organisations face challenges around the state of oligopoly, impracticality to innovate and non-functional R&D departments. There is a link in different studies concerning this model and ACMs' performance (Oke et al., 2007; Rosenbusch et al., 2011). They noted that it is essential that ACMs ought to identify a way to conquer these vulnerabilities. The uncertainties that hinder the successful implementation of innovation can be overwhelmed by embracing the model

(Lee et al. 2010; De Propris, 2002)”.

The uncertainties faced by automotive component manufacturers have been identified as lack of resources, lack of capabilities and uncertainties and these challenges have made the industry traditionally a closed industry. Customers are not willing to pay extra despite their constant demand for innovations and better products and services. Regardless of the high-cost challenge, automotive component manufacturers will still have to commit resources to lower carbon emissions, development of environmental benevolence and high safety standards for automobiles

This study agrees with Alfredo et al. (2012) that the two most important drivers of innovation in the automotive sector are customer demand and globalization. This assertion is supported by Barnes et al. (2021) through their work on localisation benefits in the global marketplace. Globally the customers demand more and more from the automobile manufacturers without a price change. In a bid to meet local demands in some other emerging markets, OEMs tend to adapt vehicles for local use. Some OEMs have to customise cars to be produced and used in South America and African countries.

Both Gassmann (2006) and Ili et al. (2010) have looked at the appropriateness of open innovation in the automotive sector. They suggested that the application of open innovation in the sector should be based on its global coverage, technology intensity, high levels of technology fusion and adaptability to new business models in different locations. This study suggests that open innovation should be given an opportunity in the automotive industry due to continuous demand for innovation by customers and short cycles of technological innovations, cost pressure, globalization, technology intensity and fusion. The automotive industry may have to also look outside its boundaries to achieve this through Cross-Industry

Innovation (CII), a deliberate combination of the potentials of companies operating in different industries (Gassmann et al., 2004).

According to Dodourova and Bevis (2012), the automotive industry in the 1980s witnessed a move from the prevalent central R&D lab model towards a more distributed R&D model that encouraged supplier involvement in new product development. However, this study disagrees that the movement signified the operationalisation of open innovation since the manufacturers worked under strict guidelines and specifications provided by OEMs. The stringent requirements apply concerning product quality, safety, health and environmental impacts. These OEMs still maintained powerful central laboratories while experimenting with coordinating R&D at different levels (Tidd et al., 2005 as cited by Dodourova and Bevis, 2012).

South African automotive component manufacturers must learn from the spillover effects of producing components for leading OEMs, which offer them contracts to supply components that meet approved designs. These local ACMs are allowed to engage in reverse engineering and, in some cases, acquire a license from other global suppliers known to their buyers (the OEM). Doner et al. (2006) also suggested contract supplying, acquisition of a license as a learning pathway for local automotive component manufacturers in developing countries

### 3.4.1. The antecedent of Open Innovation in Automotive Component Manufacturing

The management of innovation needs a contingency approach (Gassmann, 2006), and this model's suitability varies between organisations. With the implementation of this model, there must be some consideration of various aspects and characteristics to evaluate the existing conditions. The first is checking whether it is necessary to implement the model and identify the present motives. Van de Vrande et al., 2009, stated that organisations adopt open innovation based on different reasons. Furthermore, they commented on how diverse reasons apply to unique methods. Their work did not cover employee involvement but covered the utilisation of knowledge from employees not involved directly in R&D. This model relies on the principle, which states that an entity cannot possess all expertise it requires (Chesbrough, 2003). Organisations should utilise external ideas with inside pathways to the market termed "inbound open innovation" and inside ideas with extrinsic pathways to the market termed "outbound open innovation." The present study promotes "employee involvement" as part of the model, as it refers to utilising internal knowledge of an organisation with no collaboration with outside partners `

### 3.5 ACM OPEN INNOVATION MODEL

The ACM Open Innovation Strategies model represents the various approaches that diverse ACMs are likely to apply to strengthen the performance of an organisation by increasing innovation activity and economic performance. The strategies are responsible for the successful overwhelming core challenges faced by component manufacturers about their size, otherwise coined (size-related challenges). Referred to in this model as "resource scarcity, inadequate dynamic capabilities, and extreme exposure to risk." This model assumes that ACM's "knowledge exploration," referred to as "creation of value," and "knowledge exploitation," referred to as value capture," helps to select the appropriate strategic options to follow. It assumes that ACM's leverage changes over time and can hypothetically accept other alternatives in the future.

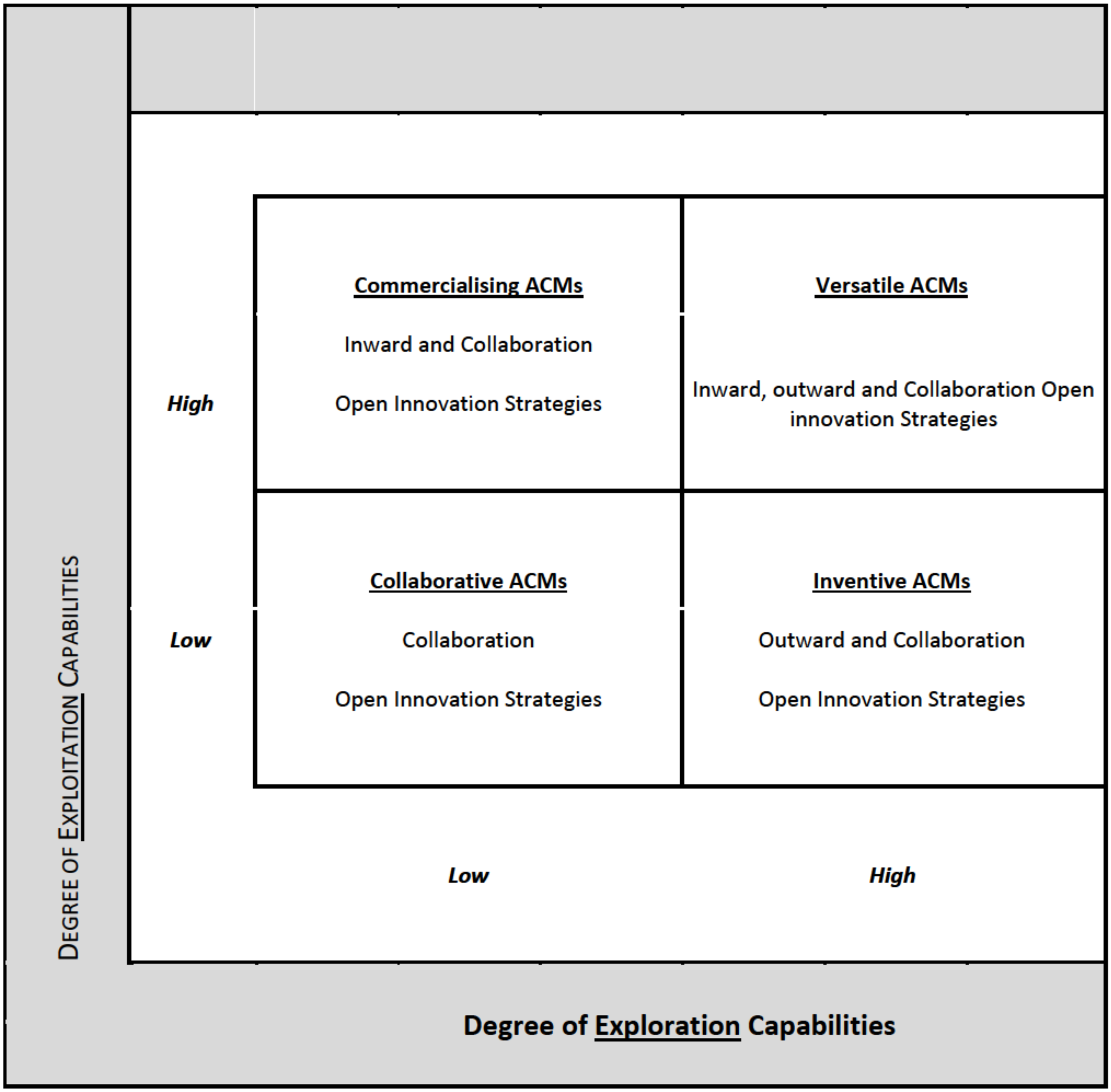


**Figure 3.1 ACM Open Innovation Strategies**

Source: Cornell (2012)

Cornell (2012) suggested that in the management process the open innovation strategies model (figure 3.1), ACMs must concentrate on essential elements, which encompass guidance, reinforcement of absorptive and adsorptive capacities, cultivation of risk-taking culture, employee motivation, exploiting functional business systems, effective decision-making and employee assurance and other numerous factors. The proposed model highlights those facets since they are vital in determining which strategy an ACM should pursue. This model incorporates management considerations to focus on lower forms of innovation strategies adopted by ACMs who have unique strengths in competition depending on whether they are "exploration and exploitation capabilities" (Dahlander & Gann, 2010).

With the automotive industry being the focal point, the study author adopted this model to assess various ACM approaches for contending with others in this environment, given ACM's relative innovation exploration and exploitation strengths. There are many combinations of strategies and sub-strategies. For example, inward open innovation is viewed in numerous ways, including Inward and outward innovation, combining other unique strategies such as cross-licensing. Simply put, this model focuses on the three main groupings (inward, outward, and collaboration strategies) of open innovation. The model pairs the main groupings into categories that ACMs will use and benefit from them based on the following:

Its ability to increase ACM innovation outputs and financial performance.

Its strategic mitigation or aggravation of the mentioned challenges is resource scarcity, limited dynamic capabilities and disproportionate risk exposure.

The present study intends to establish the link between the reduction of challenges affecting these ACMs to the actual performance outcomes; the study allows us to evaluate the impact and challenges encountered by ACMs in implementing the model. It also considers the archetype's validity, allowing it to apply to various industries and product range and be intentionally recognised. The configuration of resources and dynamic capabilities determines the organisation's unique quantity and quality of value capturing and creation capability from one product to the next. For example, from a study based on the microprocessor industry, an ACM with advanced research expertise may not possess high knowledge value creation in the mobile device or hard drive manufacturing sector. Also, an organisation may have a product in the Inventive quadrant (Product A), while the more recent product may be in the Collaborative quadrant (Product B). This situation is acceptable when an organisation does not have exploration capabilities associated with Product B.

The name of each quadrant describes the archetypical strategic orientation of ACMs in that quadrant. As an illustration, ACMs in the upper left quadrant are likely more focused on commercialization activities, whereas ACMs in the lower right quadrant are more likely to produce new knowledge (inventing). Each quadrant describes all ACMs, but these names invoke a more unforgettable generalization. For example, all ACMs could be collaborative. However, the ACMs in the lower left quadrant are more likely to employ only collaborative open innovation strategies since they lack the exploration (value creation) competencies to be considered "inventive," the exploitative (value capture) capabilities to be "commercializing," and both of these capabilities together to be considered "versatile." This assertion does not imply that ACMs in the other quadrants could not also be "collaborative." Collaborative open innovation strategies are available strategic options for ACMs in every quadrant.

### 3.5.1 Collaborative ACMs Quadrant

ACMs that collaborate are represented in the lower-left quadrant possessing a lack of innovative exploration and exploitation capabilities. Besides the lack of explorative or exploitative capabilities, they can implement various collaboration approaches that permit the exploration and exploitation of strengths over other organisations. Besides, there are three core classifications of collaborations with employees termed "closed innovation approach." These collaborations are (Poot et al., 2009) vertical, horizontal and knowledge-intensive collaborations. While collaboration is the primary open innovation strategy available, it is not exceptional to the collaborative organisations only since ACMs in supplementary quadrants could, by choice, implement collaboration-interrelated strategies. These subsequent suggestions are about ACMs universally, notwithstanding the quadrant they occupy.

### 3.5.2 Inventive ACMs Quadrant

The inventive quadrant is on the lower right side of the model. Since the ACMs in this quadrant have strong knowledge creation (exploration) abilities, referred to as "inventive," they are likely to depend on their unique configuration of resources and capabilities. Many ACMs belong to this group because they experience challenges with value capture (Lee et al., 2010). Additionally, (Motohashi, 2008) noted that ACMs who possess fewer capabilities to commercialise resort to the option of licensing out their innovations to willing partners.

### 3.5.3 Commercialising ACMs Quadrant

The upper left quadrant of the model is the "Commercialising" ACMs quadrant. These organisations are characterised by intense commercialisation, which is "exploitation capabilities" matched with not as robust knowledge creation, which are "exploration capabilities." The conversion of external ideas into new products achieved through Commercialisation and ACMs in this quadrant focus on this activity. There are fewer ACMs in this grouping than in Inventive or Collaborative quadrants because many organisations lack commercialisation capabilities (Keupp & Gassmann, 2009). This grouping includes manufacturers and niche organisations with specialised distribution channels. Other organisations are bound to gain an advantage by obtaining IP since their positioning makes them better positioned to consider IP a feasible option. “Inward open innovation” gives ACMs a competitive edge when bringing products to the market.

### 3.5.4 Versatile ACMs Quadrant

The Versatile ACMs quadrant is on the upper right side of the model and depicts the most robust organisations. More established mid-sized and small organisations in this cluster have reached maturity and are deeply rooted in niche markets. They possess robust knowledge creation and exploitation capabilities. They are self-reliant in exploration or exploitation assistance and can opt for a more closed innovation approach. They can benefit by implementing more than one innovation strategy: inward, outward, or collaboration.  Automotive components enhance their organisational performance and competitive standing by implementing different strategies, sub, or coupled strategies. When negligible benefits derived from the formation of these actions are equal to the marginal costs, these organisations start seeking an approach to change the excellent symmetry of depth (intensity) and breadth (scope) of these activities; hence we reach the final proposition.

## 3.6 ACM OPEN INNOVATION CHALLENGES

Innovation is the driving force in the long-term survival of organisations (Van de Ven, 2008). South African Automotive Masterplan (Barnes et al., 2018) noted that numerous innovation competitive challenges are overwhelming the industry. This industry is a borderline global player characterised by comparative insignificant vehicle assembly plants coupled with an immature component manufacturing industry, both developed and developing economies. This sector is essential to the local economy and equally to the manufacturing portion of the automotive value chain.

Drucker (2015) excellently christened the automobile industry “the industry of industries,” which proved to be true when considering the input into an average vehicle. One vehicle carries an excess of 30,000 parts. There is a need to have consistent and persistent innovation support. Hence innovation ought to be open and intra-organisational to meet the demands of this industry. This model is the future success in the automotive industry and will benefit it. Despite the outlined benefits, ACMs in this industry still face challenges that can stimulate valuable innovations. These challenges are lack of resources for R&D operationalisation, constrained market access, lack of innovation partners, high cost of fortifying and administering IP and limited efficient management of capability (Bianchi et al., 2010). For this thesis, the ACM challenges have been grouped into three categories: Resource-based challenges, capacity/dynamic-based challenges, and uncertainty (risk) (Cornell, 2012). This thesis intends to apply this categorisation to understand better and propose interventions ACMs can use to gain a competitive advantage in their endeavour to satisfy the unpredictable market.

The study evaluated the following theoretical underpinning capabilities and challenges to understand better the challenges faced by ACMs in terms of the Resource-Based View theory. There is a relationship between organisational capabilities and the challenges they encounter, and challenges are converting inputs into outputs. This process is explained by exploring the dynamic capabilities theory. Similarly, any challenges related to risk are based on the uncertainty of any innovation project results understood in the context of Portfolio Theory. Figure 2.2 below demonstrates how the three categories of ACM challenges influence the final set goals for performance management.

### 3.6.1 Lack of Resources Challenges

Various authors (Raman & Ramos, 2010; Lee et al., 2010; Bianchi et al., 2010; Chesbrough, 2010) have noted that ACMs by nature possess limited resources and have less access to currency, partnerships and legal expertise, which makes them unable to act or implement any of their innovative ideas. Profitability has been affected by markets, scope and increased variable costs (Habaradas, 2009; Gnyawali & Park, 2009; Plehn-Dujowich, 2009), while a lower customer base and an insignificant supply chain impacts on the competitiveness of ACMs. The inability to find partners because of a less established reputation and lack of brand awareness ((Madrid-Guijarro et al., 2009; Chesbrough & Garman., 2009) affects expansion initiatives. ACMs cannot take their ideas to fruition regardless of their ingenuity and value to an industry or financial returns. There are also organisational challenges employees face when they try to turn an idea into action and take advantage of these. ACMs should support idea generation initiatives from employees to gain successful outcomes.

### 3.6.2 Lack of Capabilities Challenges

The capability to innovate is key to organisations maintaining a competitive posture. There has been an attempt by scholars and managers to understand how organisations reposition themselves when responding to changes in their strategy or the environment they operate. ACMs face innovation capabilities challenges as articulated by various authors (Lee et al., 2010; Keupp & Gassmann, 2009; Rahman & Ramos, 2010; Chesbrough, 2010; Bianchi et al., 2010; Enkel, Gassmann & Chesbrough, 2009). They stated that ACMs face the following challenges: insufficient commercialisation capabilities, redundant production facilities, unreliable marketing channels, inferior supply chain networks. The failure for organisations to utilise the knowledge acquired outside the organisations results from a lack of absorptive capabilities (Chesbrough, 2010; Huang & Rice, 2009; Poot et al., 2009). The deficiency leads to difficulty in addressing growth surges (Madrid-Guijarro, 2009; Habaradas, 2009). Other authors (Lee et al. 2010; Van de Vrande et al. 2009; Madrid-Guijarro, 2009; Habaradas, 2009) have noted that also lack of capabilities result in challenges with recruiting and retaining talent. Non-standardised, less efficient processes contribute to scrap and rework, impacting the profitability of organisations (McAdam et al., 2008; Terziovski, 2010; Van de Vrande et al., 2009; Chesbrough, 2010).

### 3.6.3 Vulnerability to Risk Challenges

Small businesses are unique in many ways, and they do not have the extensive resources or knowledge base that larger organisations have, making it tough to endure and flourish when systematic risks emerge like economic depressions. They also experience complex non-systematic risks due to a lack of diversification of the innovation portfolio (Lee et al., 2010; Bianchi et al., 2010; Parchomovsky & Wagner, 2005; Van de Vrande et al., 2009; Madrid-Guijarro, 2009; Plein-Dujowich, 2009). ACMs threats are due to the existence of imitations and theft, which are accompanied by the risk of high legal fees (Lee et al., 2010; Bianchi et al., 2010; Parchomovsky & Wagner, 2005; Enkel et al., 2009; Chesbrough, 2010; Motohashi, 2008; Leiponen and Byma, 2009).

Besides all the benefits, there is the risk of innovation deficiency during project execution and production (Lee et al., 2010; Madrid-Guijarro, 2009; Keupp & Gassmann, 2009; Plein-Dujowich, 2009), which ACMs incur. The high impact of employee turnover results in the loss of necessary scarce skills (Lee et al., 2010; Madrid-Guijarro, 2009; Habaradas, 2009). Cash flow is one of the biggest concerns for ACMs and results from customers paying late (Lee et al., 2010; Rahman & Ramos, 2010).

## 3.7 PRINCIPLE THEORETICAL UNDERPINNING OR FOUNDATION OF INNOVATION

Some of these theories, particularly the resources-based theory and the capabilities theory, were introduced in open innovation as a competitive advantage. The two concepts deal with views or schools of thought. However, in this section, the researcher revisits the concepts as foundational theories driving the open innovation trajectory.

### 3.7.1 Resource-Based View Theory

RBV model is used to understand the process of resource utilisation in an organisation. It is a leading theory used to date in the studies related to strategy management (Gruber, Heinemann, Brettel, and Hungeling, 2010; Barney, 1991). RBV philosophy is central to the notion of "difficult to imitate" characteristics of the organisation that are the source of superior performance and competitiveness (Barney, 1986; Hamel and Prahalad, 1996). It is known that resources transferred or purchased to avoid imitation by rivalries require a lengthy learning curve or a significant change in how an organisation performs. These resources are exceptional to the organisation. Performance variance in organisations depends on the proprietorship of exclusive ideas and resources (Conner, 1991).

The (RBV) theory argues that the organisation must possess specific resources with the right characteristics to obtain a competitive advantage. With its unique resources relative to resources of rivalries, an organisation can sustain its competitive advantage (Clarke and Turner, 2003; Black and Boal, 1994). Organisations have a wide range of physical capital resources in their possession, namely cash, property, machinery, and workforce (Barney, 1991).

The generation of knowledge transfer and utilisation are the main elements for achieving competitive advantage (Grant, 1996; Reus, Ranft, Lamont, & Adams, 2009; Bogner & Bansal, 2007; Clarke & Turner, 2003). An organisation's knowledge endowment of competitive advantage is created and not acquired (Bogner & Bansal, 2007). However, the evidence that exists does not support this claim. Organisations such as Google are examples of establishments that have developed a competitive advantage, mainly through knowledge acquisitions (Chesbrough & Appleyard, 2007). The knowledge-based view has some limitations, and it incorporates knowledge as a form of intangible resource, making it a valuable theory to appraise automotive ACM open innovation challenges.

The main challenge facing ACMs is an overall shortage of resources and dynamic capabilities than larger competitors (Madrid-Guijarro et al., 2009; Gnyawali &Park, 2009; Grant & Baden-Fuller, 2004). As a result of this challenge, the dominant agreement is that ACMs are at a strategic disadvantage in comparison to more prominent organisations (Lee et al. 2010; Bianchi et al. 2010; McAdam et al. 2008; Terziovski, 2003, 2010; Parchomovsky & Wagner, 2005; Clarke & Turner, 2003; Van de Vrande et al. 2009; Chesbrough, 2010; Motohashi, 2008; Keupp and Gassmann, 2009; Poot et al., 2009; Rahman & Ramos, 2010). Additionally, (Grant & Baden-Fuller, 2004) allude to the RBV theory, which explains the ever-increasing tendency for industries worldwide to facilitate collaboration and other partnership initiatives to increase access to supplementary ACMs usually have lower economies of scale and scope due to the few resources available to them (Habaradas, 2009; Gnyawali and Park, 2009; Plein-Dujowich, 2009). Some have dedicated to other functions (environmental scanning, R&D, business development) from the few available (Van de Vrande et al., 2009; Enkel et al., 2009). Typically, these organisations have lesser customer bases and weak distribution channels (Lee et al., 2010; Keupp & Gassmann, 2009) and a less reputable organisational character (Chesbrough, 2010; Madrid-Guijarro, 2009).

Organisations need to possess valuable resources that will enable them to exploit opportunities and mitigate threats in their environments to achieve a competitive advantage. They also need to increase organisational efficiency and effectiveness, which have the following attributes (Terziovski, 2010; Barney, 1991):

- Rare and not owned by rivals,
- Complicated and costly for competitors to reproduce
- It cannot be substituted

The actual value of resources an organisation possesses and the strategic fit of the actual value of an organisation's resources with the external environment is in the actual combination and configuration of its resources and capabilities (Gruber et al., 2010; Black & Boal, 1994). Therefore, replicating an organisation's mix of its unique resources and capabilities is more challenging and costly than replicating unique resources and capabilities.

Money is a shared resource that can impact an organisation's performance without creating a competitive advantage. Additionally, aid granted to organisations positively correlates with innovation and overall firm performance (McAdam et al., 2008).

### 3.7.2 Dynamic Capabilities Theory

The DCT theory is a strategic management framework that builds on the RBV theory. RBV is naturally static since an organisation's resource change; in the long run, the DCT adds enabling characteristics for organisations to create a competitive advantage. The dynamic capabilities model maintains that with enough resources and core competencies, an organisation can uphold a competitive advantage in the short run but will not in the long run. It follows that an organisation must have dynamism over time in response to environmental changes, both internally and externally (Kolk & Puumann, 2008; Teece, 2007). Based on the organisation's dynamic capabilities and to sustain a competitive advantage, the capabilities must be exclusive and inimitable (Teece & Pisano, 1994; Grant, 1996).

For an organisation to be successful, it relies on its core capabilities, which are skills, expertise and knowledge, as advocated by the resource-based view, meaning that dynamic capabilities are an addition to the core capabilities concept. The capability that highlights the importance of an organisation's capabilities continually evolves and adjusts to shifts in the business landscape (Gronlund et al., 2010; Kolk & Puumann, 2008). It follows that organisations should continuously adjust their business models and capabilities accordingly or face the risk of core rigidity and lack of resilience (Gronlund et al., 2010; Teece, 2007). The ever-changing business landscape (externally) requires organisations to develop or acquire new capabilities over time, indicating that these capabilities should introduce essential innovations in new products.

Teece (2007) acknowledges that DC identifies and outlines opportunities and threats, appropriation of options, and the maintenance of competition through enhancement, combination, protection, and, when necessary, reconfiguration of the business's total possessions. Although the resource-based view is concerned with tangible and intangible assets, upholding it comparative to competitors creates a competitive advantage. Hence, the DCT focuses on deploying and protecting these intangible assets' creation and protection from competitors (Teece, 2007). Therefore, to evaluate ACM opens innovation challenges and strategies, the RBV and the DCT are needed.

There is a significant difference that exists between intangible assets (patents) and dynamic capabilities. While capabilities are tacit knowledge and not easily transferable, patents resemble codified specific knowledge that can be commercialised. Capabilities can be moved from one organisation to another by either learning from individuals in other organisations or transferring between organisations (Teece & Pisano, 1994; Grant, 1996; Grant & Baden-Fuller, 2004). DC model argues that the generation of competitive advantage is not the only result of transforming resources into profits. It follows that without these DC, an ACM will fail to effectively influence or expand on innovations from inside and outside its boundaries (Kolk & Puumann, 2008; Teece & Pisano, 2004). The amount of collaboration in an organisation is linked directly to the success of innovation projects; an example is an innovation between marketing and R&D functions (Igartua, Garrigós & Hervas-Oliver, 2010).

Empirical evidence suggests a unique relationship between the resources and capabilities of an organisation and its performance. An organisation does not necessarily perform well when it lacks abundant resources or strong capabilities; it is more likely to succeed with both co-existed (Gruber et al., 2010). Access to resources will yield no assistance to ACMs if they do not have the capabilities to utilise them. For example, the indication from globally innovating ACMs indicates that external funding from global and local partners does not translate into positive results in many of these organisations. Additional resources are not helpful when there is insufficient DC to operationalise them (Habaradas, 2009).

Generally, ACMs lack the heterogeneity of larger organisations' capabilities because they are typically very specialised (Bianchi et al., 2010; Motohashi, 2008; Gnyawali & Park, 2009). Korean ACMs face the most considerable capability-related challenge of deficiency in capabilities in commercialisation (Lee et al. 2010). This assertion was supported by (Van de Vrande et al. 2009), who concluded that ACMs engaged in open innovation in the Netherlands lacked the competencies of dealing with sudden growth waves (Madrid-Guijarro, 2009; Habaradas, 2009) and faced challenges in the recruitment and retainment of staff (Lee et al. 2010; Van de Madrid-Guijarro, 2009; Habaradas, 2009). This study is in harmony with this assertion that ACMs are agile and elastic in their operations, and they usually have fewer similar processes with competitors since they are typically are not identical (McAdam et al. 2008; Terziovski, 2010; Van de Vrande et al. 2009; Chesbrough, 2010).

Since these organisations need to evolve their collaborative efforts and absorptive capabilities to succeed, literature dictates that dynamic capabilities are a critical driver of this process (Kolk & Puumann, 2008). Absorptive capacities are linked to an organisation's success when they utilise open innovation; these capacities are an essential type of dynamic capability (Igartua et al., 2010; Huang & Rice, 2009). They represent an organisation's ability to successfully absorb, understand, and use knowledge outside its boundaries (Reus et al., 2004). To fully understand external innovations, an organisation must possess an open innovation culture and sufficient internal expertise. Over-reliance on purchasing innovations from external sources can constrain the long-term absorptive capabilities of an organisation. Over time, the organisation loses internal innovation capabilities by focusing and losing attention on inside R&D initiatives. Hence, the philosophy of continuous improvement must be the driving force for any organisation that intends to consolidate its absorptive capacities to acquire externally developed innovations (Huang & Rice, 2009).

ACMs have less absorptive capacity than larger organisations because they mostly focus on transferring innovations externally instead of acquiring them from the external environment (Chesbrough, 2010). He also noted that in implementing and benefiting from this archetype, the ones that have higher absorptive capacities are more effective. (Huang & Rice, 2009). When evaluating the network variable in conjunction with the absorptive capacities' variable, there was a strong correlation; however, the performance of ACMs is not the only function of the networking variable.

An overall lack of resources and capabilities necessitates ACMs participating in collaborative partnerships such as strategic alliances (Clarke & Turner, 2003). However, the shortage of resources and dynamic capabilities impairs their ability to network (Huang & Rice, 2009). Additionally, the larger the network becomes, the more exponentially difficult and costly it is to collaborate with partners (Keupp & Gassmann, 2009; Lee et al., 2010). Smaller organisations are less attractive as potential partners due to a shortage of resources, dynamic capabilities and less established organisational reputation; they also experience more difficulty forming partnerships. Nevertheless, organisations with exceptional knowledge in a focused field possessing valuable resources (patents) are more favourable as partners since they are more appealing as prospective associates (Chesbrough, 2010).

### 3.7.3 Portfolio Theory

The portfolio theory is the third underpinning theory of the study. This theory was adapting from the literature on finance and applied to non-financial fields of management, mainly those related to the mitigation of risk exposure. The application of this model in marketing has helped develop principles that seek to capitalise on the proceeds of an organisation's projects based on the risk profile (Ryals, Dias & Berger, 2007). They argued that risk is not only accounted for in investment portfolios but also in innovation portfolios. Risks are proportional to project returns and diversification, and this is evidenced by pursuing multiple projects simultaneously, complementary or in entirely different areas, rather than concentrating all of an organisation's efforts on a single project. When seeking a single project, returns tend to be potentially high due to the exposure to risk that increases (Ryals et al., 2007).

The development of patent portfolio theory came from the Modern Portfolio Theory (Parchomovsky & Wagner, 2005). According to the "patent portfolio theory," when the scale and diversity of a patent portfolio increase, similarly, the portfolio value increases and risks decrease. Larger organisations with technologies covering multiple industries have an advantage over ACMs since they have more significant patent portfolios and are more diverse; this exposes smaller organisations to higher non-systematic risks (Parchomovsky & Wagner, 2005). These risks termed "Non-systematic or Unsystematic" impact individual organisations; they include risks from project failures and poor organisational performance. On the other hand, systematic risks comprise macro-economic, governing and other forces that influence organisations within an industrial sector (Branger et al., 2008; Lubatkin & Chatterjee, 1994).

Most strategic investment decisions are not liquid and reversible, making innovation portfolios different from financial investment portfolios. As other complementary innovations enter the portfolio, they enhance the values and returns of individual innovations. There is a difference between financial risk aversion that obtains balance by diversifying risk and actively mitigating risks systematically (Teece, 2007). An optimal approach takes calculated risks while actively mitigating any potential realization of those risks (Schneider et al., 2008). Non-systematic risks reduce when unrelated innovations increase a portfolio's diversification. Organisations that innovate inside particular technological areas still face unrelated innovations that can increase a portfolio's diversification, which considerably increases proceeds from these associated innovations when complementing and enhancing one another. In their endeavour to maximise benefits from complementary innovations, organisations often diversify narrowly (Lubatkin & Chatterjee, 1994; Teece, 2007). Complementary or collectively increasing patents enhance the defensive position of the organisation; there is empirical evidence indicating that the collective value of a patent portfolio will be higher than the total value of each patent (Parchomovsky & Wagner, 2005).

For organisational performance to be high, risk must be adequately mitigated rather than left to materialise. When managing an innovation portfolio, there must be a balance between risk and rewards resulting from a continuous evaluation of the various innovation processes and intellectual assets developed or possessed by the organisation (Igartua et al., 2010). Excessive risk aversion stifles radical innovations, and on the contrary, an organisation's failure can result from excessive optimism that causes it to take unnecessarily reckless risks or be unprepared for the potential realisation of specific risks. (Teece, 2007). Since the accomplishment offset the negative returns of failed projects, R&D diversification in innovation portfolios has proved to lower innovation exposure risk in organisations (Wagner, 2005).

Besides, Lubatkin and Chatterjee (1994) noted that a reduction in non-systematic R&D project risks leads to an increase in the competitive position of an organisation within an industrial sector. They established a substantial negative relationship between R&D intensity and the risk that innovations create barriers for an organisation's rivals. Simply put, organisations with high R&D activity levels create higher barriers for their rivals because they have lower risk exposure since they are better positioned strategically within their industry. However, they also found that ACMs often focus on generating patents that lead to genuine innovations and competing against more significant rivals. They do not build barriers against competition or prevent others from patenting around their innovations, and they do not devote any resources towards building defensive patents (Motohashi, 2008).

ACMs are easily affected by downturns in the economy since they have fewer resources to endure sudden shocks and higher exposure to systematic risks (Igartua et al., 2010; Habaradas, 2009; Keupp & Gassmann, 2009; Gnyawali & Park, 2009). The sudden shocks are also valid with non-systematic risks, which are higher for ACMs due to their overall lack of resources. They are more exposed to risks of late payments by customers (Rahman & Ramos, 2010) since they often have a smaller customer base and fewer liquid assets available. Furthermore, larger organisations face a lower non-systematic risk impact of employee turnover (Lee et al., 2010; Madrid-Guijarro, 2009; Habaradas, 2009). When one employee loses employment in an organisation with ten employees, this equals 10% turnover. However, when the same scenario occurs in a 10,000-employee organisation, it would be equivalent to attrition of only 0.01%. High search costs and risks are establishing new open innovation strategic partnerships with organisations in other industries. ACMs need to build fewer, more profound and longer-lasting relationships with their partners to mitigate these risks (Lee et al., 2010).

Figure 3.2. below summarises the automotive SME open innovation challenges.

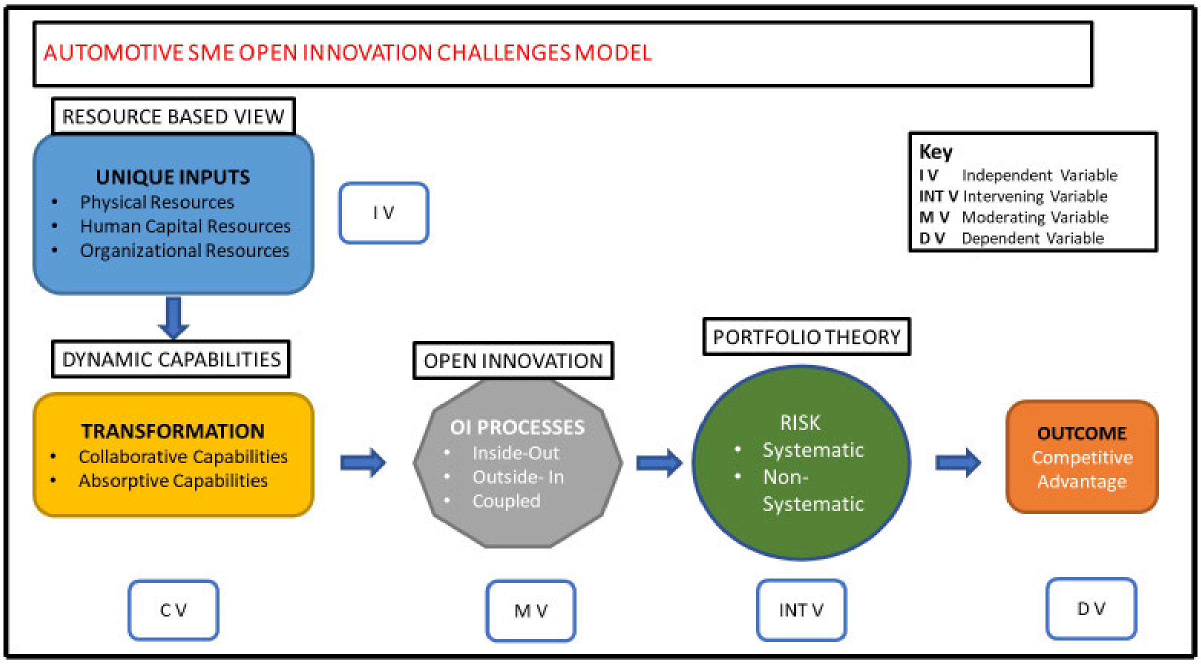


**FIGURE 3.2 AUTOMOTIVE ACM OPEN INNOVATION CHALLENGES MODEL**

Source: Own source (2019)

They are various types of risks and uncertainties related to patenting. The most significant business risk is that new product launches may fail and that patents do not translate into economic gains. When organisations create patents for identical innovations, they risk not generating revenues from them since they might not be enforceable, or legal fees may be too high even if they are enforceable (Huang, 2009). ACMs face relatively higher litigation risks, and the average costs of litigation are too high for them. Larger organisations have more resources enabling them to absorb high litigation costs. Additionally, ACMs generally have a less defensive patenting advantage than more substantial organisations that are less likely to litigate than them. Small patent portfolios harm the following: the ACMs' bargaining power, the appeal of ACMs' possible business associates and the ability to acquire investment capital

(Parchomovsky and Wagner, 2005).

### 3.8. CHAPTER SUMMARY

This chapter examined the related literature in open innovation and discussed the foundation principal theories informing the phenomenon. It also included an outline of the South African automotive industry perspective, open innovation in ACMs, ACMs' open innovation strategies model and ACMs' open innovation challenges. Finally, the chapter covers the main theoretical underpinnings or foundations of innovation.

The next chapter deals with the research design and methodology employed in the study. It presents a literature review, quantitative research, and qualitative analysis to understand the industry's present state, analyse inferences, and make recommendations.

# CHAPTER FOUR

## RESEARCH DESIGN AND METHODOLOGY

### 4.1 INTRODUCTION

In research, design and methodology outline and guide data collection, analysis, conclusions, and study recommendations. The research objectives and questions informed the selection of the design and methods, respectively. The previous chapter outlined the literature review on the evolution of open innovation strategies and challenges faced by ACMs in gaining a competitive advantage to achieve above-average returns. The selected methodology was deemed relevant and appropriate for exploring the strategies and challenges faced by ACMs, based on the topic, research objectives and questions. Hence, the chapter provides a comprehensive overview of the methods the researcher selected, and these methods were based on the rationale of the choice of the research strategy (Bryman & Becker, 2012). Therefore, this chapter covers the following: study overview, research design, philosophy and approach, sampling and data collection, instruments, reliability and validity, and ethical issues.

### 4.2 THE OVERVIEW OF RESEARCH

Research means different perspectives from one person to another (Collis and Hussey, 2009). It is systematic, methodical and increases knowledge by investigating a phenomenon under study. According to Cavana Delahaye and Sekara (2001). research is a routine, organised process that examines specific problems or opportunities. Further, Collis and Hussey (2009) add that research systematically and methodically processes inquiries and investigations with the sole purpose of increasing knowledge. Therefore, considering these research characteristics, the researcher should use suitable methods for collecting and analysing data, this thesis aimed at compiling, interpreting, constructing and reporting information for automotive industry business decision-making.

Hair, Celsi, Money, Samuel and Page (2011).pronounced that some significant occurrences and trends are the primary influences of business research. Relationship marketing has generated new ideas and presented the increasing need to integrate research on business studies among various stakeholder groups. Consequently, this has facilitated the globalisation of business, which demands researchers to focus on previously unfamiliar global cultures and revolutions, providing them with easy access to a magnitude of data.

### 4.3. AIM, RESEARCH OBJECTIVES AND QUESTIONS

The thesis aimed at examining the nature and extent to which ACMs in KwaZulu-Natal, Gauteng and Eastern Cape strategically overcome innovation challenges that inhibit them from embracing prospects of open innovation to enhance competitiveness and achieve above-average returns.

### 4.4 RESEARCH OBJECTIVES

- To establish the nature and extent of ACMs` open innovation strategic alignment for sustainable competitive advantage in the automotive industry.

- To ascertain what automotive components manufacturers’ open innovation challenges affect the firms and their influence on risk exposure profiles.

- To ascertain the nature and extent of erosion factors among the ACMs.

- To establish what relationship exists between organisational culture, open innovation and competitiveness.

- To investigate the impact of open innovation strategies on new product development prospects.

- To propose a contextual open innovation adoption model that applies to the ACMs in the automotive industry.

## 4.5 RESEARCH QUESTIONS

- What is the nature and extent of ACMs` open innovation strategic alignment for sustainable competitive advantage in the automotive industry?

- What are the automotive components manufacturers' open innovation challenges and their influence on risk exposure profiles?

- What is the nature and extent of erosion factors among the ACMs?

- What relationship exists between organisational culture, open innovation and competitiveness?

- What is the impact of open innovation strategies on new product development prospects?

- What proposed contextual open innovation adoption model is applicable for the ACMs in the automotive industry?

## 4.6 RESEARCH DESIGN

Research design is the process of guiding issues involved in designing and developing a research strategy.

Neuman (2014) and Bryman (2016) viewed this process as a blueprint used when conducting a study. Goodenough and Waite, 2012 concurred and stated that research design forms the basis of directing research activity as a structure or plan. Broadly, it encompasses five categories: longitudinal, cross-sectional, comparative, experimental and case study.

Research design is also a procedure and plan for research that extends pronouncements from wide-ranging notions to comprehensive data collection methods. It involves combining inquiry strategies, philosophical assumptions and detailed techniques (Creswell & Zhang, 2009). Collis and Hussey (2009) stated that research design is a product with a background that guides and links to the world's expectations and characteristics that advocate that design determine the research paradigm. Vogt, Gardner, and Haeffele (2012) acknowledge that research design is a comprehensive map for investigating what overlaps from the research questions to data analysis and reporting. Hair et al. (2011) pronounced these designs according to their purposes: exploration, descriptive, prediction and explanation. Different purposes involve different designs and, therefore, different statistical analyses. The purpose of the present survey research is to generalise from a sample to a population about inferences on characteristics, attitudes, or behaviour of how managers in South African automotive component manufacturers view open innovation as a tool for sustainable competition (Babbie, 1990). Therefore, the research design category is twofold: descriptive and exploratory and will be explored further in this chapter, together with other sub-sections: analytical and predictive designs.

#### 4.6.1 Exploratory Research

Collis and Hussey (2009) highlight that exploration occurs when limited previous studies result in little information referenced concerning the phenomenon researched. Exploratory research mainly focuses on obtaining understanding knowledge within a subject matter for further rigorous investigation. Sekaran and Bougie (2009) point out that these studies are essential when additional evidence is required to develop a viable theoretical framework. Hence such an approach is a crucial component during these rigorous investigations.

Hair et al. (2011) highlighted that central to any study is a search for hypotheses or patterns that, when tested, form the basis of additional research. Case studies and historical analysis are techniques applied in exploratory research. According to Dane (1990), analyses for exploratory research tend to be qualitative rather than quantitative. The analysis involves determining whether something has happened. Hair et al. (2011) further pronounced that exploratory study gives guidance on future research. However, it rarely provides conclusive answers. The present study intends to propose a contextual open innovation adoption model that applies to the ACMs in the automotive industry giving relevance to the second qualitative phase of the study to include exploratory research.

### 4.6.2 Descriptive Research

Descriptive research identifies and classifies the elements or attributes of phenomena in existence (Collis & Hussey, 2009). It ascertains and describes the attributes of pertinent issues since it examines the problem in more depth than exploratory research does. Such an approach is classified as cross-sectional, as it provides a statically summarised snapshot of the elements (Hair et al., 2011). The analyses for descriptive research tend to be simple inferential statistics that enable one to summarise the obtained means of central tendency and estimate values for the population generalised (Edmonds & Kennedy, 2013).

A descriptive research design underpins this thesis with an explanatory sequential mixed-methods approach. This procedure is two-phased with quantitative data collected during phase one from the 44 respondents; the results are analysed and then used to consolidate phase two, qualitatively conducted from eleven interviews. The goal of this method is for qualitative data to assist in explaining the details of the initial quantitative results (Creswell, 2014).

The current thesis adopted this approach based on two reasons: firstly, significant facets of this research are limited to few studies and scarce information on open innovation activities in the South African motor industry, especially among ACMs. Secondly, primary data sources establish the challenges and benefits of the use and appetite for open innovation among ACMs in South Africa.

### 4.6.3 Analytical Research

The descriptive approach is not merely recounting attributes but analysing and explaining how or why the occurrence of the phenomena is under observation (Collis & Hussey, 2009). Therefore, analytical research aims at understanding phenomena by measuring and determining causal relations among them. Edmonds and Kennedy (2013) highlighted that the critical component of analytical research is identifying and controlling what variables are present; this allows explaining essential variables of characteristics. Dane (1990) noted that manipulation of the independent variable explanatory research generally involves comparing the various groups, which is not the case in the present investigation.

### 4.6.4 Predictive Research

Collis and Hussey (2009) outline that predictive research simplifies the analysis by predicting certain phenomena based on hypothesised general relationships. Therefore, considering close analysis available for evidence in cause and effect, predictive research is intelligent speculation on future possibilities. Dane

(1990) asserts predictive analysis on correlation techniques when determining the relationship of variables and regression analysis to construct prediction equations when specific predictions are essential.

### 4.6.5 Research Design for the present study

The research design approach in the present study was twofold that is: exploratory and descriptive. This dual approach has two reasons:

- Firstly, significant facets of this research are from limited studies and scarce information available on open innovation activities in the South African automotive industry, especially ACMs.
- Secondly, primary data sources were expected to establish the challenges and benefits of the use and appetite for open innovation among ACMs in South Africa.

## 4.7 RESEARCH PHILOSOPHY AND APPROACH

The research philosophy is a particular way of thinking and dealing with an issue; it includes beliefs that influence decisions and behaviours (Johnson & Onwuegbuzie, 2004). The philosophy is an abstraction and knowledge, thinking and attitude on which the methodology is action-focused. The approach somewhat links the philosophy to methods and tools, review, and attitude to doing and action (Johnson & Onwuegbuzie, 2004). In summary, research philosophy is a system of beliefs and assumptions about the development of knowledge (Gavigan, 2017).

A research viewpoint is a principle of how data on a phenomenon is collected, analysed and used. This philosophy focuses on the development, source and nature of knowledge development (Baipai, 2011). Although knowledge creation is profound, there is an engagement in knowledge creation to achieve the study's objectives. The design of new knowledge results from collecting secondary and primary data and the arrangement of the data analysis. Consequently, this ultimately leads to the answer to the research questions.

It entails being aware of and articulating beliefs and assumptions to address research philosophy in a study. The research philosophy for this study is at the highest layer. Hence, this study adopted a pragmatic philosophy based on exploring the meaning and application of the phenomenon of axiology, epistemology, and ontology.

The study adopted the research onion depicted in Figure 4.1 to describe the research philosophy and strategy.

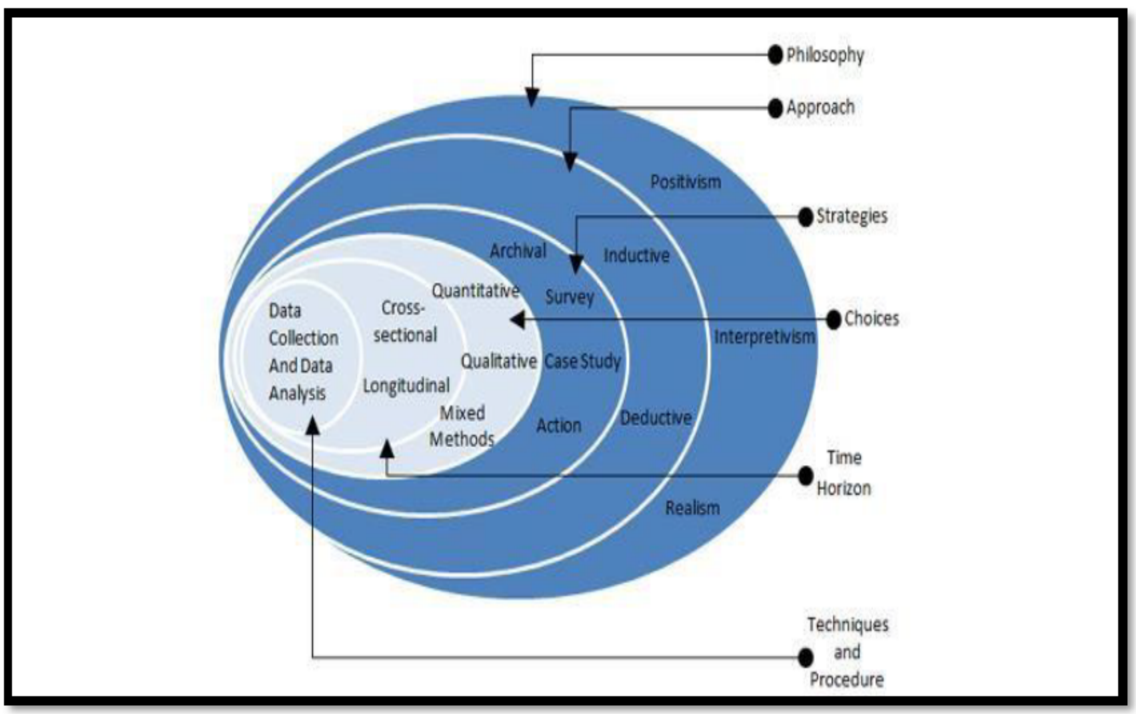


**FIGURE 4.1 THE RESEARCH ONION**

**Source:** Saunders, Lewis and Thornhill (2009)

The researcher identified the external and multiple methods that best describe the views of managers of ACMs to answer the research questions. Based on the highest layer, pragmatism is the most suitable approach to the thesis, as it assisted the application of the research problem in theory and practice. Since empirical evidence is essential and an indication of subjective meanings to managers of ACMs, the highly dynamic and innovative environment entrenched the study's research objectives. The focus of the study was on mixing various perspectives to help interpret data applied to overcome the research's contradiction (Saunders, Lewis & Thornhill, 2009).

Fundamentally the present study is based on both deductive and inductive approaches. Deductive reasoning works from the more general to the more specific. Sometimes this is informally called a top-down approach. The conclusion follows logically from premises (available facts). Inductive reasoning works the other way, moving from specific observations to broader generalizations and theories. Informally, this process is referred to as the bottom-up approach. The conclusion is likely based on-premises and involves a degree of uncertainty. Considering the challenges faced by ACMs, the research design is deductive, trying to establish the fundamental challenges in the automotive industry to inductive after the literature review in the second phase. This process helps to accommodate the opinions from various stakeholders in this dynamic automotive industry to consider as the research progresses. The third phase of the approach is deductive and aims to test the conceptual model and identify, reduce, and generalise the research problem's features. Regarding the influence on the research objective, not all variables are tested and evaluated, resulting in an inductive impact.

This chapter discusses the selection and establishment of the methods used to explore the research problem. This exploration is applicable in theory and practice, as indicated by the literature review and the research onion's conceptual model depicted in figure 4.1. Tested data modifies and decompiles the complexity of the research objectives. The design is "triangulated," depending on the complexity of the research problem.

The study addresses the research question from a theoretical perspective by multiple applications of a body of knowledge and approaches the research problem from different positions (Blumberg, Cooper & Schindler, 2008). The positions necessitate the combination of a descriptive and exploratory study into two stages of design. The design identifies the factors influencing the sustainability of operations in the automotive industry, particularly among ACMs. The explanatory part explains the relationships of the variables in the conceptual model (Saunders et al., 2009), whereas the exploratory part clarifies the solution to the research problem (Saunders et al., 2009),

In this case, collecting data is a matter of choice (Saunders et al., 2009); this approach is encouraged for business research (Curran & Blackburn, 2001). Based on previous discussions, when mixing quantitative and qualitative methods, the first step is to revise the central issues and the conceptual model and explain the relationships of the research variables (Karami, Rowley & Analoui, 2006). This assists in combining micro and macro phases of the research, which is imperative for the research objective and equivalent to the pragmatic research approach (Onwuegbuzie & Leech, 2005).

### 4.7.1 Axiology

Axiology is the judgment on the role of values (Saunders et al., 2012). Specifically, it is about engagement with how researchers assess their value at various phases of the research process (Li, 2016). Hence, this philosophy is primarily concerned with the aim of the study. This philosophy seeks to elucidate what the researcher intends to explain or predict or wants only to understand (Lee & Ling, 2008). Simply put, the philosophy focuses on what the value is and how the value affects the research. Finally, it focuses on the conduct and value of the research findings.

### 4.7.2 Epistemology

In business research, epistemology is a philosophy of dealing with sources of knowledge. Concisely, the philosophy focuses on how we get to know something or how we gain knowledge. This philosophy is explicitly concerned with the limitations of knowledge as well as nature and its sources. Research philosophy comprises diverse knowledge sources related to business research and classified into four types: Intuition, faith, and beliefs constitute intuitive knowledge based on human feelings. These feelings play a significant part in contrast to depending on facts.

1. Research papers, experts, and supreme powers generate authoritarian knowledge dependent on material acquired from books.

2. The application of rational reasoning creates logical knowledge through the creation of new knowledge.

3. The empirical knowledge is demonstrated and established from objective facts.

4. The research integrates all sources of knowledge into a single study; however, this study has omitted the use of other forms of learning since it concentrated on facts, not faith or beliefs.

On the contrary, the present study used empirical knowledge since it relied on established and demonstrated facts. The application of open innovation has received outstanding success; hence, the study proposed creating a competitive advantage among ACMs. Authoritative knowledge has played a significant role during the literature review process, and relevant expertise used when analysing primary data. Empirical knowledge underpinned this research.

Epistemology has various divisions, including constructivism, idealism, rationalism, perspective, historical, empiricism, perennials, essentialism, and progressivism. This study focused on rationalism and empiricism, which are the central debate within the arena of epistemology. Rationalism is a function of empirical findings gained through reliable and valid procedures. On the other hand, empiricism, an accurate source of knowledge, advocates for personal experiences associated with senses, feelings, and observations.

This study assumed the epistemological approach of pragmatism and employed associated research methods that depended upon the research question, thereby accepting that knowledge was dictated either from observable phenomena and subjective meanings.

### 4.7.3 Ontology

Research philosophy has two different perspectives, namely ontology, and epistemology. Regarding business research, ontology is a study of science or being (Blaikie, 2010), which focuses on the nature of reality. The reality of nature is understanding an individual’s worldview about what is factual, which forms a belief system embedded in the ontology. In other words, it links the core question of the perception of the subjectivity or objectivity of social entities. Consequently, subjectivism and positivism (or objectivism) are two critical aspects of ontology.

Objectivism depicts that social entities exist, peripheral to social actors involved (Saunders et al., 2012). Otherwise, the assertion of objectivism stems from a position that advocates that social phenomena are independent of actors (Bryman, 2012).

An assertion of subjectivism, also known as constructionism or interpretivism, is a social phenomenon created from perceptions and consequent actions of the actors concerned with their existence. Inversely, social actors acknowledge constructionism as a position that asserts social phenomena and their meanings (Bryman, 2012). Hence, it is critical to identify ontology at the beginning of the research process since it determines the choice of the design.

## 4.8 CHOICE OF RESEARCH PHILOSOPHY

The research onion depicted in figure 4.1 indicates a pragmatic philosophy trajectory. Pragmatism as philosophy allowed the adaptation of a mixed approach in this study, which afforded flexibility in responding to the study's research questions. Pragmatics recognise that the interpretation of the world is in many ways, and this research followed that trajectory where ACMs managers open innovation views were expected to be different. Hence there was a need to investigate if the ACMs managers were strategically aligned concerning the open innovation operationalisation. There is no single point of view that gives the whole picture that can indicate multiple realities in a given situation. (Saunders et al., 2012).

This philosophy asserts that the essential attribute of any study is the research questions. Hence, pragmatists can combine positivist and interpretivism positions within the scope of a single study, depending on the nature of the research questions.

Pragmatist management researchers are comparable to architects since they utilise various methods to establish solutions to research questions. Compared to architects, they use whatever materials and methods at their disposal to construct a structure based on a drawing. Concurrently, they use a method or combination of methods that will help to advance a specific study. Finally, it is essential to note that they can use various techniques as ACMs managers have to adopt specific architectural techniques such as the Plan Do Check Act (PDCA) cycle, a  systematic series of steps for gaining valuable learning and knowledge for the continual improvement of a product or process.

The philosophical assumption underlining the study was mixed methods research, which refers to the underlying beliefs or assumptions that guided this inquiry (Creswell & Clark, 2011). Hence, this research adopted pragmatism as the ontology and epistemology of the research philosophy bordering on the behaviour of the ACMs views on the open innovation paradigm. The following were the significant elements in the worldview of the researcher in this study (Creswell, 2009):

- Consequences of actions,
- Problem-centred,
- Pluralistic,
- Real-world practice-oriented

This philosophy influenced the practice of the present research and shaped its design. Central to the research process stands the answer to ACMs innovation challenges, such as how can ACMs adopt open innovation, its impact on organisational performance, and how it depicts the holistic model of open innovation paradigm? This urgent need for action justified the adoption of the pragmatic approach (Creswell, 2009).

The research area was selected based on the researcher's professional and personal interest in engineering, manufacturing, and knowledge management. The researcher formulated the aim, objectives, and research questions from personal experience of the everyday challenges faced by the South African ACMs in their quest to be competitive and achieve above-average returns. The literature review identified whether the problem statement had received adequate attention in the previous studies. The literature reviewed conformed to the aims and objectives of the study. A wide range of secondary data was utilised, such as books, newspapers, magazines, journals, and online articles. Data collection methods were evaluated and critically analysed for their advantages and disadvantages.

## 4.9 RESEARCH METHODOLOGY

Information and data gathering about a specific phenomenon in any inquiry can be conducted in many ways, such as quantitative, qualitative, and combining the two (Franklin, 2013). The author further noted that the technique selected directly affects the usual questions and respective answers.

This study used quantitative and qualitative research methods, better known as the mixed research method (Creswell,2009). The researcher found this methodology appropriate for extracting data from a selected sample comprising South African automotive component manufacturers to examine the nature and extent to which they can strategically overcome innovation challenges (Edmond & Kennedy, 2013). The authors further highlight that the primary objective in formulating a mixed-method study is to determine whether the design is emergent or fixed. The researcher predetermined the application and integration of a qualitative and quantitative method by applying a fixed method design. Inversely, an emergent strategy could have been adopted when deciding to include a qualitative or quantitative strand within the ongoing examination in this study.

Edmonds and Kennedy (2013) highlighted that mixed-method allows the researcher to assess the qualitative data from well-established quantitative findings. This assessment helped to interpret the new quantitative results using qualitative data. In response to the exploratory questions addressed to South African ACMs through questionnaires and the confirmatory questions addressed through interviews, the study used mixed research methods coupled with qualitative and quantitative designs (Hair et al., 2011). Consequently, the theory of open innovation existing in the study was constructed and confirmed through the mixed methodology. Bryman and Bell (2007) argued that these methods strengthen results by contributing to knowledge and theory development. Besides maximising the strengths, they also minimise the weaknesses of both approaches as stand-alone.

Mixed methodology answers research questions within a single study, such as in the present research on the open innovation operationalisation in the South African automotive industry. The methodology was considered a more practical approach to the study of this nature as it attempted to legitimatise the use of multiple methodological strategies (Edmonds & Kennedy, 2013). The primary objective in the justification of choosing a mixed-method approach in this study (as stated earlier) was to determine if the design should have been fixed or emergent.

Based on the complexity of the present study, the approach to the research problem emanated from different angles since the practical solutions to the research questions could not be achieved from a one-dimensional approach. The study employed a hybrid process to identify the open innovation challenges faced by South African ACMs to achieve competitiveness and achieving above-average returns (Leedy and Ormrod, 2005). Alternatively, this study could have used either qualitative or quantitative methods. When using both research methods, the approach is known as triangulation, where it is possible to combine qualitative findings and quantitative research results in the same project. Neuman (1997) outlined that the triangulation method includes various methods like interviews, Likert type questions and focus groups that considerably enhance the research approach. Collis and Hussey (2009) highlighted that triangulation reduces bias in data sources, methods used and researchers, leading to better reliability and validity than a single method approach.

According to Collis and Hussey (2009), the potential elements of triangulation in research are divided into four main categories:

- Triangulation of theories- A theory is taken from one discipline and used to explain a phenomenon in another discipline;

- Data triangulation- Data are collected at different times or from different sources in the study of a phenomenon;

- Investigator triangulation- Different researchers independently collect data on the same phenomenon and compare the results;

- Methodological triangulation- Using more than one method to collect and analyse data, choosing them from the same paradigm is still essential.

### 4.9.1 Quantitative Research Method

Quantitative research enquires into an identified problem such as the open innovation challenges faced by the South African ACMs by measuring and analysing the statistical data and testing theory. This research has the attributes of an observable phenomenon challenges of open innovation in the automotive industry in South Africa that have inhibited ACMs to achieve above-average returns. Conceptually, the quantitative research method was expected to reveal statistically significant differences between samples obtained through the mathematical analysis of the independent sample T-test (Cooper & Schindler, 2008). According to Cavana et al. (2001), this research method measures specific features within a sample size of less than 100 to project the results of the entire population through structured data collection procedures. The researcher in the present study purposively selected 44 respondents from South African ACMs managers. This sample size was deemed suitable and convenient according to Hair et al. (2011) since the subject under investigation was highly technical, and only a few employees per firm could competently respond to the questionnaire.

The study maintained an impartial approach throughout the process when gathering, analysing and interpreting data. The responses from questionnaires were numerical (Likert scale), and the data generated from the sample were subjected to statistical analysis techniques, with the inference on the broader population.

### 4.9.2 Qualitative Research Method

This research method focused on meanings expressed by the ACMs managers in words and had two common characteristics. Firstly, it was about what phenomena occurred in the specific context of South African ACMs. Secondly, it involved studying phenomena in totality, such as the broader ACMs challenges inherent in their manufacturing operations (Edmonds & Kennedy, 2013). The qualitative method consists of data collection that focuses on understanding and emphasising meaning and exploring the 'how' and 'why' of systems and human behaviour. In the case of the South African ACMs, this would involve the how and why open innovation suits their innovation challenges. Based on theory building, the adoption of inductive processes facilitates qualitative research.

On the contrary, this study examined and presented the potential practical solutions to the South African ACMs open innovation challenges (Edmonds & Kennedy, 2013). Hair et al. (2011) highlighted that this research method is the most appropriate:

- When there is no information about the research problem;
- Where previous research only partially explains the research question;
- Where current knowledge is not accessible using surveys and experiments and;
- If the primary purpose of the research is to propose new ideas tested with quantitative research.

In this research, the qualitative approach consisted of interviewing eleven critical industry experts directly involved with the ACMs sector who were purposively selected because of their expertise in the automotive industry. The following section provides a comprehensive account of the research strategy for the study.

## 4.10 QUANTITATIVE AND QUALITATIVE RESEARCH STRATEGIES

Research strategies are systematic processes of how research is conducted to solve an inquiry problem. In this study, the inquiry problem was how South African ACMs could strategically overcome innovation challenges that inhibit them from embracing prospects of open innovation to enhance competitiveness and achieve above-average returns.

Edmond and Kennedy (2013) grouped quantitative research strategies into three categories: true experimental research strategy with experiments tested through hypothesis, quasi-experimental research strategy dealing with correlational and single-subject studies, and non-experimental research studies conducted through surveys. In the present study, the quantitative research strategy was based on the survey inquiry.

Hair, Money, Samuel, and Page (2011) presented the qualitative research strategies as involving: ethnography, a study of a cultural group in a natural setting conducted over a long period involving the collection of observed data. Phenomenological research strategy is a study of lived experiences of people concerning specific phenomenon conducted over a prolonged period, and data collection are per participants discretion. Grounded theory research strategy generates a general theory of action, processes or interaction between people based on a participant views and involves multiple data collection stages to refine the information obtained. On the other hand, narrative research strategy facilitates a study of individuals and their life experiences. Case study research strategy deals with a detailed study of processes, people, activities and programs; detailed data is collected about a particular case depending on the inquiry objectives. For the present study, the qualitative research strategies employed were narrative and case studies involving South African ACMs.

The comprehensive study aimed to analyse the strategies and challenges of open innovation among ACMs in South Africa, using the quantitative research strategy and the qualitative research strategy (Saunders et al., 2009).

### 4.10.1 Operationalisation of research strategy

The present study operationalised the research strategy through a sequential explanatory process characterised by data collection and analysis of quantitative data in the first phase of the research, followed by collecting and analysing qualitative data in the second phase, building on the initial quantitative results. The weight of the study was on quantitative data, and the mixing of the data occurred when the initial quantitative results informed the secondary qualitative data collection. The two forms of data were separated but connected (Creswell, 2009), as depicted in figure 4.2.

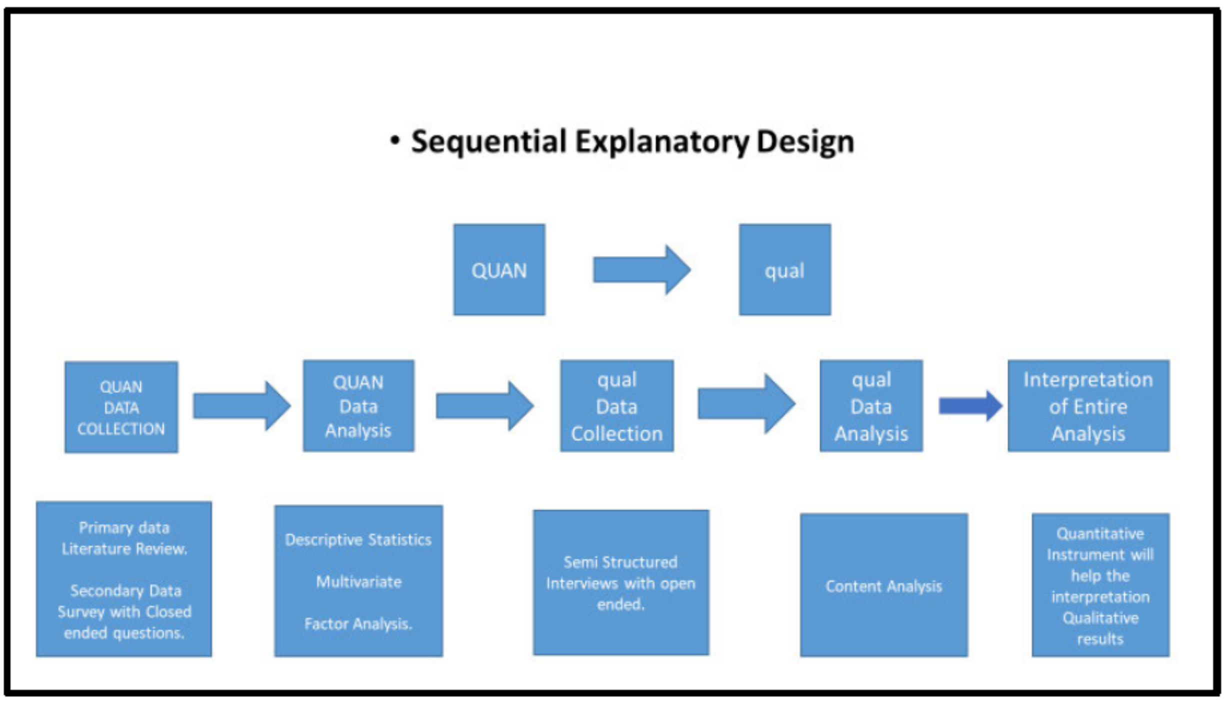


**FIGURE 4.2 SEQUENTIAL EXPLANATORY PROCESS**

The sequential explanatory process was helpful when unexpected results arose from the quantitative aspect of the study (Morse, 1991). The following qualitative data collection phase examined these surprising results in more detail. The main weakness of the sequential explanatory process was the time involved in data collection with two separate phases.

## 4.11 STUDY PARAMETERS

### 4.11.1 Target Population of the Study

This study targeted South African ACMs producing and selling components to the original equipment manufacturers. Naude and Badenhorst-Wess (2011) applied this target population in their research to investigate supply chain management problems encountered by ACMs. The present study's target population was ACMs in South Africa. This group plays a vital role in the local automotive industry by manufacturing and supplying components to the domestic OEM market.

Blanche, Durrheim and Painter (2006) stated that the bigger pool from where the study draws sampling elements and generalise findings is the target population. Goodenough and Waite (2012) additionally argued that the target population emanates from the cosmos of elements. Saunders (2011) concurs by upholding that the target population is the complete instances of the sample.

As the primary key stakeholder, ACMs are vital in providing better information and more insights into the open innovation challenges faced by management than the target population. Ambe and Badenhorst-Wess (2013) also used this target population when they investigated challenges faced by companies in the local vehicle supply chain in South Africa. The selection focused on the role, expertise and experience in the automotive industry. This target group established the influence that supply chain sources of knowledge have on innovation within developing country automotive component manufacturing (Gumede, 2016). In their study, the target population was ACMs, and the selection justified by their representation in the sector. In the present study, the selection is identical to Ambe and Badenhorst-Wess

(2013) choice and focused on the role, expertise and open innovation paradigm knowledge of South African ACMs management.

From the above assertions, the inference is that it is beneficial for this current research study to utilise this target group since it is a central player in the South African automotive industry. The organisations used for this present study are ACMs based in KwaZulu Natal, Gauteng and Eastern Cape. The unit of analysis sampled was employees of these organisations, namely the R&D managers, decision-makers, and team leaders. NAACAM database provided the target population for this study, which contains companies participating in the automotive industry. In other words, the study considered respondents from the component manufacturers segmented among business owners or managers and innovation decision-makers (van de Vrande et al., 2008).

### 4.11.2 Sample and Sampling Techniques

In the present study, sampling was used to generalise the properties and characteristics of the entire population by selecting an adequate number of elements. Sampling is a process of selecting an adequate number of elements from a population to make it possible to analyse and comprehend the properties and characteristics of the sample subjects (Cavana, Delahaye & Sekara, 2001). Their study (Hair et al., 2011) stated that the choice of the sampling method includes considering the nature and objectives of the research and the time and budget available. These requirements depend on related theoretical and practical issues.

Hence, the study determined that a whole population's characteristics and parameters are achieved by selecting a suitable representative part of a population, the South African ACMs management (Sekaran & Bougie, 2016). Sampling in the current study was essential in determining the appropriate target sample from the broader population; since it was costly, needless and impractical to investigate each member to determine the values of the parameters. Data collected when conducting business research is irrespective of whether an investigation is qualitative or quantitative. A sample rather than the entire population produces dependable results by minimising exhaustion and producing fewer errors from collected data when many elements are involved (Sekaran & Bougie 2016).

Regardless of elements, geographical boundaries and time, sampling began by precisely defining the target population (Sekaran & Bougie, 2016). The target population was determined from the research objectives and the scope of the study based on the role they play. Sekaran & Bougie (2016) further emphasised that all the elements in the population where the sample is drawn represent the sample frame. This frame is useful in providing a listing of each element in the population, but it may not always be in the current study

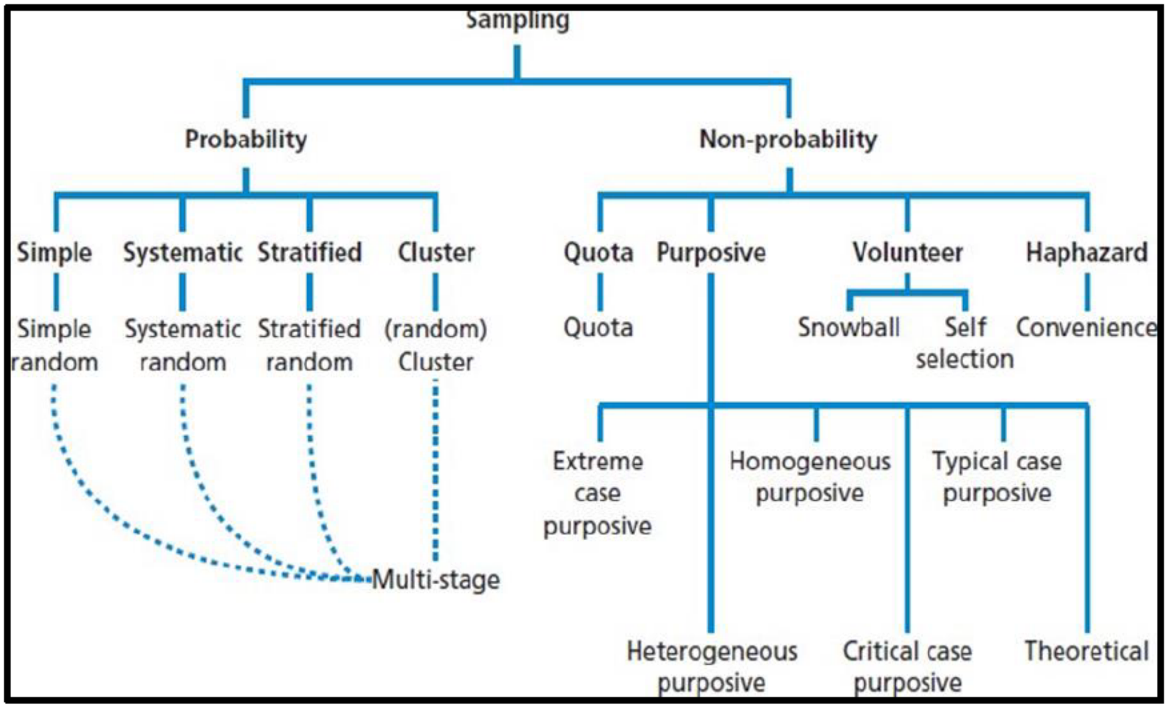


**FIGURE 4.3 CATEGORISATION OF SAMPLING TECHNIQUES**

Source: Saunders et al., 2012

Edmonds and Kennedy (2013) noted that probability and non-probability sampling are traditional sampling methods divided into two major categories. These designs have different sampling strategies, which are dependent on how much generalisability is desired, such as availability of time, other resources and purpose of the study. Hence different categories of probability and non-probability sampling designs are chosen.

### 4.11.3 Probability Sampling

Dane (1990) defines probability sampling as a technique that ensures an equal chance of being included in the sample for every element in the sample frame. Hair et al. (2011) assert that in drawing a sample, selecting elements is random and gives elements a nonzero chance of being chosen, thereby minimising selection bias. Therefore, the findings based on a probability sample are generalised to the target population of a pre-determined level of confidence. Sekaran and Bougie (2009) indicate several variations employed in probability sampling techniques, namely, systematic sampling, simple random sampling, clustering sampling and stratified sampling.

### 4.11.4 Simple random sampling

Simple random sampling is a process that assigns each element of the target population an equal probability of being selected and involves an unsystematic random selection. Although the technique overcomes prejudice and offers the most generalisability, it is expensive and cumbersome.

### 4.11.5 Systematic sampling

According to ordered criteria, systematic sampling is selecting elements from a randomly arranged sampling frame. The technique allows a researcher to select a random initial starting point on a list, followed by selecting a point at every *n*th element in the sample frame.

### 4.11.6 Stratified random sampling

Stratified random sampling is a process of separation, followed by selecting random subjects from each stratum. The process involves dividing the population into relevant, mutually exclusive groups by using the appropriate and meaningful context of the study. Stratification is an efficient research sampling design that follows the lines appropriate to the research question and information for a given sample size. The researcher determines the total sample size and the required sample size for each of the individual strata.

Cavan, Delahaye and Sekara (2001) note that a stratified sample is selected in one of two ways, proportionally or disproportionately. In proportionately stratified sampling, the overall sample size will be the total of all elements from each of the strata. In disproportionately stratified sampling, the selection of sample elements is in two ways. One approach involves choosing the elements according to their relative importance from each stratum, which focuses on the economic importance of various strata. Alternatively, consider the unpredictability of data within each stratum, selected based on the relative variability of the elements.

#### 4.11.7 Clustering sampling

The target population of diverse groups are called clusters. The most frequently used type of cluster sampling is geographic area sampling. Of all the probability-sampling designs, it is the least generalisable because the conditions of intracluster diversity and inter-cluster similarity are not encountered and have a higher bias.

#### 4.11.8 Non-probability sampling

The probability of selecting every element of the target population is unlikely when using this sampling technique. Hence, the inclusion or exclusion of the sample elements depends on the researcher's discretion. The generalisability of the findings from the sample study to the population cannot be guaranteed (Cavana et al., 2001). Nonprobability sampling is associated with extensive classifications of purposive and convenience sampling.

#### 4.11.9 Convenience sampling

Convenience sampling entails selecting elements that can provide the information required and are generally readily available to partake in a study. It is complicated and perilous to generalise to a more significant population when using convenience sampling methods. The best way of collecting necessary information swiftly and efficiently is by a convenience sample regularly used at the exploratory phase of a research project.

### 4.11.10 Purposive sampling

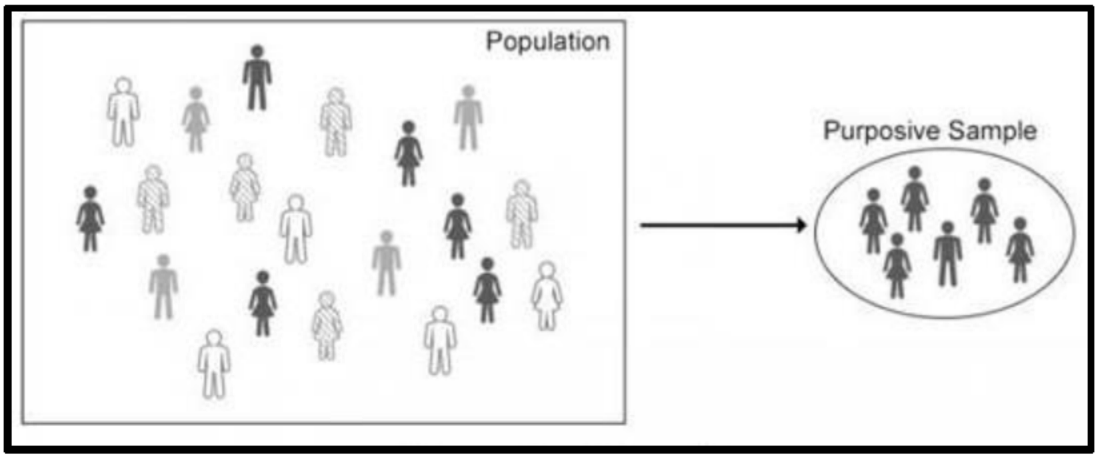


**Figure 4.4 Purposive Sampling**

Source: Black, 2010

Purposive sampling involves selecting elements in the sample for a specific purpose. This sampling technique is mainly used for qualitative methods, in which the researcher's judgement determines the sample elements. Variations of purposive sampling include snowball, expert and heterogeneity sampling. For the present study, the target population consists of a sample of 11 randomly selected respondents drawn from a target population of 44 Chief Executive Officers (CEOs), senior and R&D managers subscribed to the National Association of Automotive Component and Allied Manufacturers (NAACAM) from KwaZulu Natal, Gauteng and Eastern Cape provinces.

#### 4.11.11 Census Sampling

Census Sampling, also referred to as the Complete Enumeration Survey Method, involves selecting all items in the universe for the data collection (Bryman & Bell, 2011). The universe constitutes a particular place, a group of people or any specific locality, which is the complete set of items of interest in a particular situation. This sampling method is applied whenever the entire population under study requires the collection of detailed data. One of the significant advantages of the census method is the accuracy achieved from the data collected from every unit of the population being studied before drawing any research conclusions. The more the data collected, the higher the degree of correctness of the information collected. Also, there is less bias in the results obtained. The study used the census sampling method to determine the sample for the quantitative analysis stage.

## 4.12 SAMPLE SELECTION

The sample selection in this study was disproportionally stratified across the respondents. Potential respondents were selected randomly from the population; suppliers selected were defined as all firms with no less than five employees. Firms with less than five employees (i.e., micro-firms) were excluded from the sample because, in general, they have no or minimal in-house research and development activities. Also, the population of micro-firms contains a relatively high share of start-ups. Such firms did not satisfy the criterion of companies that have to be in operation for at least five years.

Sample selection involved choosing one organisation from KwaZulu Natal and two organisations from Gauteng under the Automotive Industry Development Centre (AIDC), and one organisation from the Eastern Cape. The total number of employees directly involved in research and development among the four organisations amounted to 100. This figure presented a ratio of 1:2:1, respectively, with 100 employees in Kwazulu Natal, 200 employees in Gauteng and 100 employees from Eastern Cape. These figures were extrapolated from the report by (Comrie, Terreblanche &Johnson 2013)

The sampling technique of choosing these organisations and their geographical spread is convenient and supported (Thierat, 2014). The total number of firms selected had an excellent geographical presence, and the stated provinces are the leading representatives of the automotive industry. The geographic distribution of component manufacturers is primarily limited to four regions, Kwazulu Natal. Gauteng and the Eastern Cape being the central three provinces, as suggested earlier in the study. The largest concentration of suppliers is found in Gauteng, where nearly half of all Tier 2 component manufacturers are located, followed by the Eastern Cape with 21%, Kwazulu-Natal with 24% and the Western Cape with nearly 8% as indicated in Table 4.5. The split for Tier 1 producers is very similar except that Kwazulu-Natal takes the second position in the number of firms instead of the Eastern Cape.

The spread allowed for a better representation of the findings. Babbie and Benaquisto (2002) confirm that this technique is called purposive or judgmental sampling. Several other researchers in social sciences supported this approach (Beaud, 1992; Churchill, 1995). Therefore, since the research is explanatory and seeking to test theory rather than formulating a new idea, the sampling technique of choosing four ACMs is justified as justified by pragmatism, which allows the adaptation of a mixed-method approach, which affords flexibility in responding to research questions. Pragmatics recognise that the interpretation of the world is in many ways; hence it was the determining factor of sample selection. There is no single point of view that gives the whole picture indicating multiple realities (Saunders et al., 2012).

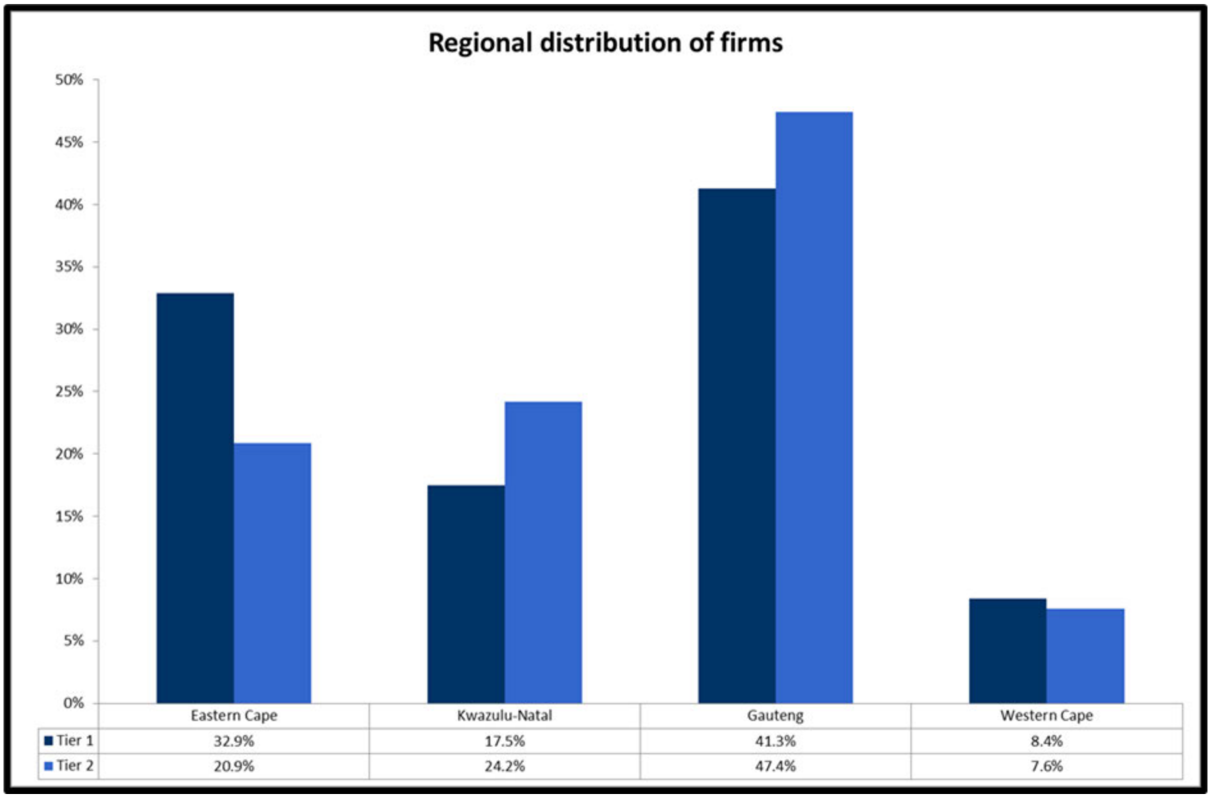


**FIGURE 4.5 REGIONAL DISTRIBUTION OF ACMS**

Source:

### 4.12.1 Sample Size

The population to which the study results were generalised depicted in table 4.4 emanate from the South African ACMs management from four ACMs based in KwaZulu Natal, Gauteng and Eastern Cape. These employees occupied the following positions: owners/CEOs, senior managers, middle managers and team leaders. This classification was suitable for the study because participants holding these positions could give input (open innovation strategies and challenges) that addressed the research questions. Most manufacturing firms' operational structure is based on the depiction in Table 4.1, and the total number of employees eligible for participation in the quantitative survey was eleven per company. Hence, the total population was 44 participants interviewed during the quantitative research phase as per the census sampling model previous stated. In the qualitative phase, 11 experts in the South African ACMs were interviewed to determine their views regarding the results of the quantitative phase.

**Table 4.1 Research and Development Employee Structure**

| Level | Position | Number |
|---|---|---|
| 1 | Owner / CEO | 1 |
| 2 | Senior Manager | 2 |
| 3 | Middle Managers | 3 |
| 4 | Team Leaders (Artisans) | 5 |
| | TOTAL | 11 |

A recent and exhaustive list of the population was unavailable from the respective companies; their human resources departments could not avail of such information classified as confidential. Since a list of the population was not available, the census population was used for the research.

Using Krejcie and Morgan's formula, the required sample size was 40 with a margin error of (0,05) and a confidence level of 95%. This margin error was considered high and thereby increasing the validity and reliability of data collected.

**Calculation of Sample Size**

| | |
|---|---|
| Sampling Frame | 400 employees |
| Margin of error | 0,05 |
| Standard deviation | 95% |
| | |
| Sample size | $n = \frac{N}{1+(N)e^2}$ |
| | $n=\frac{400}{1+(400)(0,05)^2}$ |
| | n=40 |

The data collected for this empirical research study included descriptions, concepts, strategies, explanations, applications and processes to analyse the innovation challenges faced by ACMs in KwaZulu-Natal Gauteng and Eastern Cape and explore how ACMs can strategically overcome these challenges by embracing the concept of open innovation, which advocates enhancing competitiveness in the marketplace. A quantitative survey was undertaken to identify the factors influencing ACMs competitiveness in South Africa's automotive component industry. Hence, in addition to a quantitative research strategy, a qualitative research strategy was appropriate for this research.

## 4.13 RESEARCH PROCEDURE

For this study, an ethical clearance certificate was issued by the University of KwaZulu Natal and obtained. Above all, it granted permission to commence data collection. The study conducted self-administered questionnaires and interviews with the participants. The questionnaires were administered to managers and supervisors, whereas the interviews were conducted with company executives and industry experts at convenient times and locations.

### 4.13.1 Research Instrument and Instrumentation

In the first phase of the empirical study, data were collected from primary data using questionnaires. A survey instrument is a data collection tool in quantitative research. In this study, the instrument was modified based on the Open Innovation Holistic Model (Gassmann, Enkel, & Chesbrough, 2010). Other authors have used this approach (Chesbrough & Brunswicker, 2013; Farha, 2016). The modified version of the "holistic model" described by Chesbrough and Brunswicker (2013) accommodates relevant literature findings and recommendations by experts. The other modification included incorporating the SME Competitive Challenges Model and the SME Open Innovation Strategies Model (Cornell, 2012).

In their evaluation of the current state of the open innovation literature, the seminal theorists in the field identified a critical need for a holistic model of open innovation (Gassmann, Enkel, & Chesbrough, 2010, p. 219). Others have indicated the necessity of a holistic model that can illustrate strategic choices that firms can make in the open innovation environment (Hobady, 2005; Schneider, Tejeda, Dondi, Herzog, Keel & Geering, 2008).). The Holistic Model of Innovation conceptualises a high-level version of such a model. Rather than merely being a model of open innovation, this model is truly holistic in that it also includes closed innovation channels and both product and non-product innovations. They provide a more realistic representation of reality than a model that examines open innovation in isolation from other forms of innovation. Most of the concepts and decision alternatives presented in this model are from the writings of the management theorists presented throughout the literature review and cited as appropriate.

Fink (2002) identifies four categories of instruments for the collection of data:

- Self-administered questionnaires.
- Interviewer administered questionnaire;
- Web-based questionnaires (internet), and
- Structured interviews.

This study selected both self-administered and structured interviews. Edmonds and Kennedy (2013) support the use of both descriptive and explanatory research questionnaires. The research topic determines the choice of this instrument used, sample characteristics, and the survey's cost. Below are the determinants of the construction of the instrument of the questionnaire.

**4.13.2. Designing the Questionnaire**

Cavana et al. (2001) outline that the focus should be on the following two principles when designing a questionnaire:

The wording of the questions entails categorising, scaling and coding questionnaires after receiving the responses to ensure proper planning of the questionnaire variables.

The questionnaire's general layout and appearance are of great importance during questionnaire design since they eliminate biases in research. Figure 4.6 below illustrates the factors.

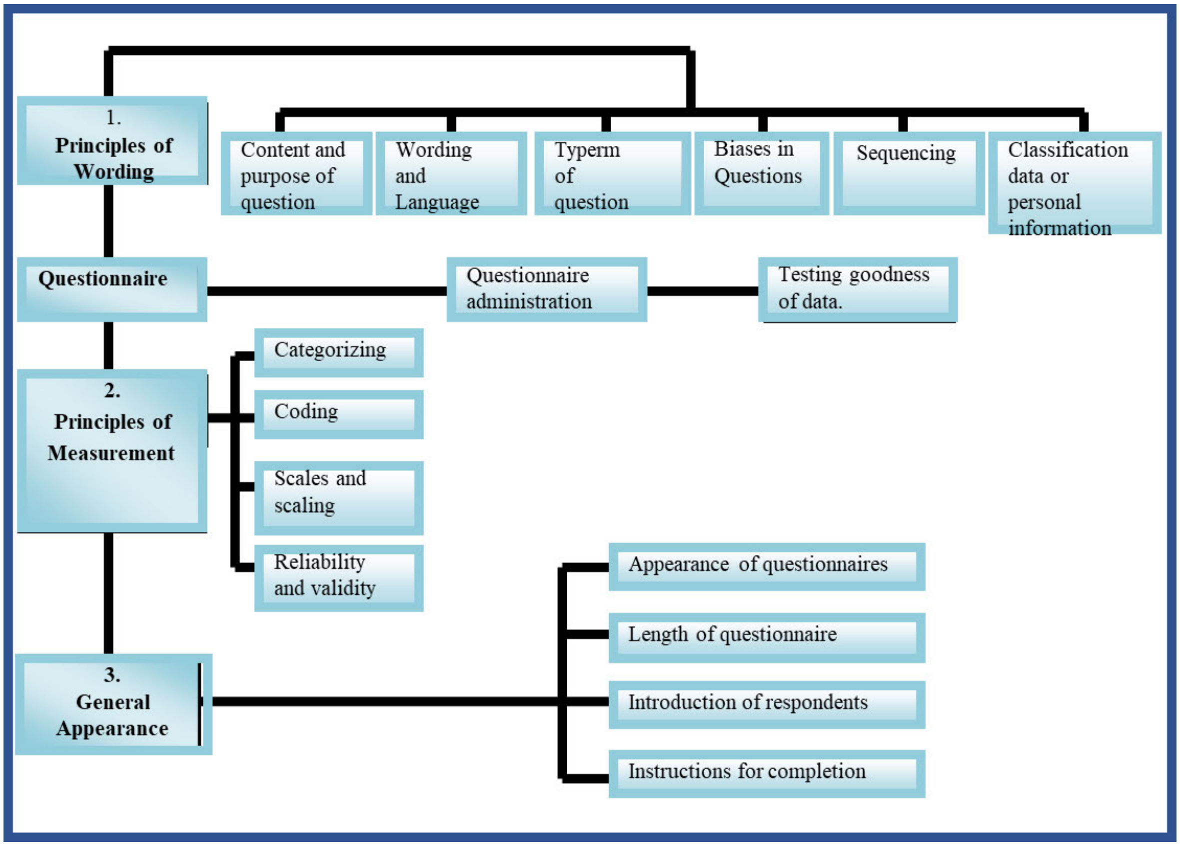


**FIGURE 4.6 CONSTRUCTION PRINCIPLE OF QUESTIONNAIRE**

**Source:** Cavana, et al. (2001)

A questionnaire is a technique for primary data collection where a sample of the population is requested to respond to carefully structured questions chosen after considerable testing, aiming to extract reliable responses. Sekaran and Bougie (2009) state that besides serving as efficient data collection mechanisms, they must measure the variables of interest known. Hair et al. (2011) note that an instrument is developed scientifically to measure the phenomena being researched and ensure data accuracy. Hair et al. (2011) further note that a questionnaire consists of open-ended and closed-ended questions depending on whether they answered according to respondents' choices of the alternatives given.

The questionnaire was modified based on (Farha 2016) work and used for data collection during the quantitative aspect of the research process. Useful results depend on the questions' content, wording, sequence and instructions to the respondent. The questionnaire addressed the research objectives and collected the relevant data systematically to assist the respondents in understanding the questionnaire's design, thereby ensuring simplicity, user-friendliness, and succinctness.

Cooper and Schindler (2008) assert that by arranging the questions logically, the researcher enhances the standard of the responses, assists the respondents and induces a harmonious flow of thought in the questionnaire. The design of survey questions is influenced by relating each question to the others in the survey. Cooper and Schindler (2008) further highlight that the funnel approach moves from general to more specific questions. The questionnaire in this study followed the funnel approach beginning with general questions and then moving on to particular objective questions.

In this research, the questionnaire (Appendix C) has seven divisions covering the following aspects:

- The nature and extent of open innovation strategic alignment among a

- Automotive component manufacturers.

- Mapping of the industry evolution in relationship to the automotive component manufacturers

- Inquiry about automotive component manufacturers overall organisation and support systems for innovation.

- Inquiry about automotive component manufacturers activities regarding internal ideas out to market.

- Inquiry about automotive component manufacturers activities regarding bringing external ideas from the market.

Investigate automotive component manufacturers overall collaboration and interaction or coordination of external and internal knowledge / Innovation / Services.

Inquiry about automotive component manufacturers performance and innovation.

The questionnaire consisted of 7 sections. Section 1 consisted of general questions. The data obtained in this section allowed the researcher to categorise companies for analysis purposes. Sections 2-7 consisted of questions focusing on the six specific research objectives of the study. Grouping questions into categories facilitated answering the questions more comfortably and achieving the desired impact. The questions were on a numerical ranking scale, and the questionnaire was based on closed-ended questions. All questions were closed-ended, allowing the respondent to choose one answer since the questions were closed-ended. The questions were answered by placing a tick in the appropriate checkbox on each question, making the data easily identifiable.

A cover letter accompanied each questionnaire; this letter outlined the aim and objectives of the study and provided a brief explanation of the purpose and the potential benefit to the ACMs and the industry in general. An assurance of confidentiality in respect of company-specific information was provided in writing. This study used a sequential explanatory strategy where data were collected in two phases and over an 8-12-week period.

### 4.13.3. Pilot Study

The pilot study aimed to pre-test the instrument to provide the present research with a practical approach to testing the questionnaire and ensure that it reflected the theoretical model developed and the epistemological approach adopted. The systematic method of pre-testing or validating the questionnaire suggested in this study was seminal since the study differed from previous studies, and the need for modification of the pretesting method was necessary as research projects differed substantially. Four participants from academia and industry participated in the pilot study to pre-test the instrument, and their contributions helped validate the instrument depicted in Table 4.3.

Hair et al. (2011) assert that the administration of a questionnaire occurs after testing for the accuracy and consistency of the responses. The testing was achieved by pretesting it using a small sample of respondents with characteristics similar to those of the target population. Cavana et al. (2001) outline that the following types of pre-tests can be carried out; among the most important is the face and content validity or pilot study. Face validity addresses whether the questionnaire appears to measure the concepts being investigated, mainly if the wording of the items is clear and understandable. Content validity relates to the representatives of the questionnaire regarding the historical constructs to be measured. A pilot study gives a reasonable sample of respondents from the target population or who closely resemble it that should be used (Cavana et al., 2001).

Pretesting the instrument was done to fine-tune the questionnaire to facilitate better understanding and accurate responses. Pre-testing aimed to establish completion time for the survey, understand the survey layout, establish the level of interest in the study, and avoid data recording deficiencies. Accordingly, an initial questionnaire was administered to four respondents as a pre-test (see table 4.2 below) to fine-tune and ensure user-friendliness.

TABLE 4.2 PILOT STUDY LIST OF RESPONDENT

| **Respondents Position** | **Company** |
|---|---|
| CEO | Company X |
| Managing Director | Company Y |
| Managing Director | Company Z |
| Lecturer (Supervisor) | College D |

As articulated above, the feedback from the pre-testing or pilot study respondents was very positive in all aspects of the survey. The process highlighted grammatical errors, which were corrected. There was a concern about including participants from the pilot study in the primary research because only those involved in the pilot, and not the whole group, will have had the experience. In this study, it was simply not possible to exclude these pilot-study participants because to do so would result in too small a sample in the primary survey (Leon, Davis & Kraemer, 2011)

### 4.13.4. Scaling

Sekaran and Bougie (2009) asserted four measurement scales, namely, ordinal, interval, ratio and nominal. Cavana et al. (2001) outline that with the progression from nominal to a ratio scale, fine-tuning sophistication increased progressively. Table 4 3 below outlines the different types of measurement scales, their typical use and statistical outcomes.

**Table 4.3 Types of Measurement Scales**

| Scale | Basic Empirical Operations | Typical Use | Typical Statistics | |
|---|---|---|---|---|
| | | | Descriptive | Inferential |
| Nominal | Determination of equality | Classification: Male, Female Purchaser, Non-Purchaser | Percentages Modes | Chi-square Binomial Test |
| Ordinal (Likert) | Determination of greater or less | Rankings: Preference data<br>Market position Attitude Measures | Median | Mann-Witney U Friedmann two-way ANOVA Rank order Correlation |
| Interval | Determination of equality of intervals | Index numbers Attitude measures Level of knowledge brands | Mean Range Standard Deviation | Product Moment Correlation T-Test Factor analysis ANOVA |
| Ratio | Determination of ratios | Sales Units produced Number of customers Costs | | Coefficient of variation |

Source: Sekaran and Bougie (2009) and Cavana, et al., (2001)

A straightforward scale has specific groups, which are analysed using frequency distribution. (Hair et al. 2011). Likert is a non-comparative scaling technique (Bryman and Bell, 2007), which is unidimensional, while Dane (1990) asserts that it consists of items reflecting extreme positions on a continuum. Bryman and Bell (2007) state that the respondents can give neutral viewpoints using a three or 5-point Likert scale. Interval scales differ, and both nominal and Likert scales provide additional information but have similar characteristics to the latter. There are fixed and absolute zero points; this makes ratio scales the most powerful scales (Cavana et al., 2001). A combination of scales was used in the research study to ascertain the essential information required for analysis purposes.

### 4.13.5. Reliability and Validity

Saunders, Lewis and Thornhill (2003) highlight that when condensing the likelihood of finding the wrong answer to the research problem, it is essential to pay attention to two critical research design areas: reliability and validity.

### 4.13.6 Validity

Validity is the extent to where a construct gives an adequate measurement that translates to the true meaning of the concept measured (Hair et al., 2011). According to Saunders et al. (2003), validity is about results being what they appear to be. Vogt, Gardner and Haeffele (2012) defined validity as the extent to which differences in observed scale scores reflect actual differences among objects on the characteristic measured rather than systematic or random errors.

Cavana et al. (2001) highlight that many validity tests are utilised to gauge the accuracy of measures. They classify this testing under four broad headings:

- Face validity-It is a primary and minimal index of validity. It indicates that the items included in the questionnaire are comprehensible and understandable to the respondents;

- Content validity- Ensures that the measures include an adequate and representative set of items that draw on the concept;

- Criterion-related validity- This is determined when the measure differentiates individuals in terms of a criterion of the measure to predict;

- Construct validity- This authenticates how well the results achieved from the measure fit the theories around which the test was designed.

In this study, credibility is a critical factor, and both face validity and content validity test the intended measurement of each objective validated by the questions formulated in the questionnaire. The study sizes are reliable because when there is a slight variation in results, the respondents' scores are relative. The acceptable degree of accuracy validates the soundness and effectiveness of the measuring instrument (Cavana et al., 2001).

**4.13.7 Reliability**

Cooper and Schindler (2008) outline that reliability refers to the extent to which a scale produces consistent results based on repeated measurements on the characteristic (if the measure is not reliable, it cannot be valid). Dane (1990) confirms this assertion and highlights that reliability is necessary for quality measurement, although not sufficient. Reliability is only the extent to which the measure is consistent, and before accepting any measure, it must be valid.

The reliability of the research project is a significant factor to consider as the central aim is to determine the influence and impact of open innovation adoption on ACMs in South Africa on the economic growth and sustainability of the industry.

The empirical study comprised of two phases; phase one involved conducting interviews with key industry stakeholders. Phase two focused on quantitative research. A questionnaire was designed and encompassed the problems emanating from the literature review. This questionnaire was sent to the respondents being the ACMs in South Africa.

Cavana et al. (2001) noted that reliability relies on the stability and consistency of the instrument and the concept determining the assessment of the ‘goodness’ of the dimension measured.

A recording device was used as a primary tool during the interviews to ensure reliability in the research. Completed questionnaires and email correspondence from respondents are kept on record, as the researcher was personally responsible for the data collection.

**Table 4.4 Population Sample Responses and Interviews**

| | | |
|---|---|---|
| **Desired Respondents from Gauteng** | **24** | **Percentage responses** |
| Total number of respondents that completed the questionnaire | 18 | 75% |
| Total number of incomplete questionnaires | 0 | |
| **Desired Respondents from KwaZulu Natal** | **10** | **Percentage responses** |
| Total number of respondents that completed the questionnaire | 8 | 80% |
| Total number of incomplete questionnaires | 0 | |
| **Desired Respondents from Eastern Cape** | **10** | **Percentage responses** |
| Total number of respondents that completed the questionnaire | 7 | 70% |
| Total number of incomplete questionnaires | 0 | |

## 4.14 DATA COLLECTION

### 4.14.1. Collection of Quantitative Data

Data is information collected from participants by observing or secondary data (Cooper & Schindler, 2006). Sekaran and Bougie (2009) outlined that data collection methods are an integral part of research design as the appropriate methods enhance the value of the research.

Several data collection methods, like interviewing, administering questionnaires, and observing people and phenomena, serve as the three primary data collection methods in survey research. The sample frame, the research topic, the sample characteristics, and the survey costs influence choosing a data collection method.

Collis and Hussey (2009) stated various ways to collect data; however, the two main data collection methods used in this study were self-completion questionnaires and interviews. Questionnaires are the primary data collection tool for the quantitative aspect, and interviews conducted to collect qualitative data.

#### 4.14.2 Analysis of Quantitative Data

As already stated, quantitative data analysis was used to make sense of the data collected, to respond to research questions and objectives. Hair et al. (2011) outline that data analysis in quantitative research involves the following steps:

- Review the conceptual framework and proposed relationships;
- Prepare for data analysis;
- Determine if the research involves descriptive analysis or hypothesis testing;

- Conduct analysis and;
- Evaluate the findings to assess their meaning.

Data analysis used descriptive and inferential frequency as data evaluated through a single approach yields incomplete views and provides a small segment of its whole meaning (Leedy & Ormrod, 2005). As the numbers represent the values of variables, which measure the characteristics of subjects, respondents, or other cases, (Hair et al., 2011) warned that quantitative data analysis is a complex field of knowledge. The present study also used tabulation and other statistical analysis tools.

The first step in the process was to capture the data into a database and record it manually. The data was then subjected to an error and code verification process to ensure that all codes captured were legitimate. Data analysis was carried out using the Statistical Package for Social Sciences (SPSS Statistics version 27) and Excel, facilitating discussions of the research results. The SPSS program is recommended for the analysis of the research results.

Inferential statistics were used to permit inferences from a sample population to be made and test what descriptive results exist at random factors or relationships (Cavana et al., 2001). Through inferential statistics, dependencies between the independent and dependent variables were obtained. Each independent variable was tested for correlation to the dependent variables.

Descriptive statistics determined the characterisation, collection and presentation of data to describe various features. The data, which included frequencies, measures of central tendencies and measures of dispersion, was done by using descriptive statistics. Data presentation used figures in the form of bar graphs and tables. The frequency tables and indexes were further analysed to determine a more detailed breakdown of the respondents where relevant. The investigation contained the responses of the ACMs and the key industry stakeholders. Structured interviews and the literature study supported frequency tables and indexes by providing a descriptive analysis of the processed responses captured from the empirical survey.

Sekaran and Bougie (2009) assert that a statistical measure of the evaluation of central location quantifies most of the observations concentrated hence enabling researchers to summarise and condense information for better understanding. Hair et al. (2011) outline that the measures of dispersion describe the tendency for responses to depart from the central tendency. Hence calculating the dispersion of the data is another way of summarising the data. The measures of dispersion were used in this study to describe the variability in the distribution of numbers, including the range, variance, standard deviation and skewness.

The sequential explanatory design typically assisted in explaining and interpreting quantitative results by collecting and analysing follow up qualitative data. The qualitative data analysis then allowed definite conclusions on ACM's strategic alignment to open innovation and mitigate challenges they face in the automotive industry.

#### 4.14.3 Collection of Qualitative Data

#### 4.14.4 In-depth Interviews

The predominant data collection tool employed in the study was the interview. According to Berg (2009), an interview is a conversation to determine a purpose. The purpose of interviews is to gather practical information to address the issues (Kumar, 2008). Interviews in the present study helped the researcher collect in-depth data relevant to the research questions and objectives ranging from structured to unstructured (Berg, 2009). Semi-structured interviews were deemed most appropriate because they allowed the researcher to have conversations with informative officials and ask questions in a way that flows with the discussion. Depending on the interviewee's role in the automotive industry, interviews varied, ascertained before conducting the interview. The researcher included additional questions during interviews in specific organisational contexts about the research topic. The order of questions was not of great importance in this study; however, the researcher had to maintain a good flow during each interview and address every important issue. Saunders et al. (2009) assert that semi-structured interviews also allow a researcher to change the order of questions, depending on the flow of the conversation. The interviews were conducted with CEOs, R&D, and Senior managers of four component manufacturers in the three provinces, namely Gauteng, Kwazulu Natal and the Eastern Cape. The interviewer planned to have a total of 11 interviews with members of the sample who were the contact persons overseeing and heading the operations of technology or R&D in their organisations. Four respondents from Gauteng had previously been involved in the quantitative research stage and gave valuable contributions to open innovation operationalisation. The data which were acquired through the interviews were supported by the data collected through the questionnaire survey.

A voice recorder was used to record all conversations during interviews, and the interviewer also had a notebook to record notes such as the interviewees' reactions to questions. The interviewer used an interview schedule (see table 4 5 below) that shows the following respondents who participated in the interviews.

**Table 4.5 Qualitative Interview Schedule**

| Position | Date | Time |
|---|---|---|
| Executive Director | 2020/02/20 | 1400hrs |
| Executive Director | 2020/02/27 | 1000hrs |
| CEO | 2020/02/21 | 1000hrs |
| CEO | 2020/02/22 | 1100hrs |
| CEO | 2020/02/23 | 1200hrs |
| Senior Manager | 2020/02/24 | 0900hrs |
| Senior Manager | 2020/02/24 | 1400hrs |
| Senior Manager | 2020/02/24 | 1400hrs |
| CEO | 2020/02/26 | 1000hrs |
| Owner | 2020/02/26 | 1200hrs |
| Owner | 2020/02/28 | 1400hrs |

#### 4.14.5 Analysis of Qualitative Data

Qualitative data analysis is a non-mathematical procedure that analyses the meaning of people's words and behaviour (Cavana et al., 2001). According to Hair et al. (2011), qualitative data analysis aims to examine, identify, compare, interpret patterns, and compare themes. Sekaran and Bougie (2009) outline qualitative data analysis as making valid inferences from the often overwhelming amount of data collected. They further note that there are generally three steps in qualitative data analysis:

- Data reduction: is transforming the data to make it more manageable and understandable through a process of selecting and coding;

- Data display: is the presentation of the data in the forms of a matrix, graphs or charts illustrating patterns in the data;

- The displaying of data to assist in concluding was based on patterns in the reduction of information.

Coding assisted simultaneously to develop ideas on how the data were displayed and draw preliminary conclusions since the analysis was not a systematic linear process.

Cavana et al. (2001) outline that the overall rationale for analysing data is to comprehend the phenomenon being studied by identifying the themes and subthemes in the raw data, which will present an understanding of the phenomenon investigated. This process of uncovering these themes and subthemes is called content analysis. Content analysis allows the themes to emerge from the raw data and this describes the key focus of the qualitative analyst.

Several computer packages are designed to support qualitative data analysis, with the most popular being the NVIVO program. The program allows the researcher to manage the diversity of data, record decisions and create new records. Cavana et al. (2001) highlight that there are three systems in NVIVO for managing data, namely:

- the document system, which accepts plain or rich text, records

- the node system, which is the container for themes or categories and coding.

- the attributes, which allow the researcher to assign values to the nodes and documents

The qualitative aspect of the study was conducted through personal interviews with eleven essential industry experts. The aim of conducting interviews was to extract qualitative data to determine open innovation adoption in the automotive component manufacturing industry in KwaZulu-Natal, Gauteng and Eastern Cape.

The interviews were voice recorded to ensure the reliability of data, which were later transcribed. After transcribing the data, it was read through carefully and classified into meaningful categories. The data were categorised by identifying themes or patterns into coherent categories that summarised and brought meaning to the text. This process was done by using Thematic Content Analysis (TCA). According to Vogt, Gardner and Haeffele (2012), TCA identified, analysed, and reported themes within the data in the present study. The authors further highlight that TCA captures themes from the research question and represents some level of patterned response within the data in the research process. This process was data-driven, with data collected specifically for the research via interviews.

The researcher had to compile and engage further with the interviewees in informal discussions to understand better the phenomena outlined specifically with problems identified from the respondents. Further engagements and informal discussions intended to ensure that the data collected were both reliable and valid. The data collected were analysed using the NVIVO software package.

## 4.15 CHAPTER SUMMARY

This chapter covered the design and methodology of the study. It gave a brief overview of the covered research, followed by a discussion of the research design, research philosophy, choice of the research philosophy, methodologies, research strategy, and the study parameters that were comprehensively addressed. A combination of a quantitative and qualitative approach through questionnaires and structured interviews was considered the most suitable research study strategy. The main methods of data collection were questionnaires and interviews used as the primary data collection methods.

In the next chapter, the presentation and analysis of the data, followed by results and findings, will be presented.

# CHAPTER FIVE

# DATA ANALYSIS AND PRESENTATION OF RESULTS

## 5.1 INTRODUCTION

The study identified the innovation challenges and prospects faced by ACMs in South Africa and proposed strategic interventions to overcome these weaknesses by embracing open innovation. The chapter presents data analysis and the presentation of the results obtained from data that were collected both quantitatively and qualitatively in a single mixed research methodology study. This process analysed the emphasis of data on its relevance to the research problem comprehensively discussed in chapter one, identifying the nature and extent of the strategic alignment of open innovation and competitiveness and the challenges faced by ACMs in ACMs in KwaZulu-Natal, Gauteng and Eastern Cape.

The mixed research approach necessitated using a structured questionnaire and the interview protocol to collect data (Bryman and Bell, 2011). The questionnaire was administered to manage the ACMs comprising the Chief Executive Officers (CEOs), Senior Managers, Research and Development Managers, and others (Artisans). Out of the 44 questionnaires distributed, 33 were returned and analysed using the Statistical Package of Social Sciences (SPSS) version 27 for Windows. The researcher was satisfied with the response and return rate of 70.2%.

**Table 5.1 Response Rate**

| | Questionnaires Administered | Questionnaires filled and returned | Percentages |
|---|---|---|---|
| **Respondents** | **44** | **33** | **75%** |

## 5.2 DATA PRESENTATION

### 5.2.1: Respondents' Demographic Characteristics

**Table 5.2 Respondents Managerial Position**

| POSITION | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percentage | Valid Percent | Cumulative Percent |
| Valid | CEO | 5 | 15.2 | 15.2 | 15.2 |
| | Senior Manager | 9 | 27.3 | 27.3 | 42.4 |
| | R&D Manager | 4 | 12.1 | 12.1 | 54.5 |
| | Others | 15 | 45.5 | 45.5 | 100.0 |
| | Total | 33 | 100.0 | 100.0 | |
| | | | | | |

It is indicated in Table 5.2 above that the majority of the respondents were occupying positions other than top managerial. These were Artisans occupying technical positions in the selected automotive component manufacturing companies in KwaZulu-Natal, Gauteng and the Eastern Cape Province. Artisans provide technical advice to the management; this is a strategic role and function, and above all, they are the implementers of the organisation's open, innovative strategies. However, strategic planning is primarily the responsibility of top management. Cumulatively management constituted 54.5% of the total respondents, with 15.2% being Chief Executive Officers, 27.3% being Senior Managers and 12.1%, Research and Development Managers. The researcher believes the respondents were strategically configured and positioned to competently answer the questionnaire and help the researcher gather relevant information and data to solve the research problem.

**Table 5.3 Respondents Qualifications**

| QUALIFICATIONS | | | | | |
|---|---|---|---|---|---|
| | | Frequency | Percentage | Valid Percent | Cumulative Percent |
| Valid | Diploma | 9 | 27.3 | 27.3 | 27.3 |
| | Degree | 8 | 24.2 | 24.2 | 51.5 |
| | Masters | 10 | 30.3 | 30.3 | 81.8 |
| | PhD | 2 | 6.1 | 6.1 | 87.9 |
| | Others | 4 | 12.1 | 12.1 | 100.0 |
| | Total | 33 | 100.0 | 100.0 | |

Table 5.3 above shows that out of a total of 33 respondents, the majority constituting 30.3% had a Master's degree, followed by 27.3% with a Diploma, 8% with first degrees, 12.1% with other qualifications such as relevant Certificates and 6.1% had PhDs. It noted that 81.8% of the respondents fell in the category of suitably and relevantly qualified respondents cumulatively. As a result, the researcher had no reason to doubt the managerial capabilities of the respondents and their competence to handle the questionnaire.

## 5.3 DATA ANALYSIS

### 5.3.1 Reliability Analysis of the Questionnaire

This section presents the reliability analysis of the respondent's responses to the 57 items of the questionnaire used to collect data in this study. The questionnaire was self-developed by the researcher and used for the first time. An analysis of the underlying dimensions of open innovation strategies was performed by applying Factor Analysis and Principal Components Analysis (PCA) to the participant's responses to the questionnaire.

### 5.3.2 Approaches to Reliability Test

The definition of *reliability,* about a questionnaire "psychological test instrument," is described as "the attribute of consistency in measurement. Reliability is "best viewed as a continuum that ranges from minimal consistency of measurement (e.g., simple reaction time) to near-perfect reliability of results (e.g., weight). The simplest method of determining the reliability of test scores is administering the same test on two occasions to the same set of respondents. In this situation, a perfectly reliable test would provide identical responses for all respondents on both test occasions. In such a situation, the correlating scores from the first administration with those of the second administration would find a perfect correlation ($r$ =

1.00). Should the instrument be "perfectly unreliable," respondents would have different scores on the first administration concerning the second administration, and there would be no correlation between test scores ($r$ = 0.00).

The administration of this instrument on two occasions to the respondents was not a practical approach given the constraints of the current study. The "Reliability Instrument" presents respondents with "split-half reliability". This approach split the test into equal halves, the scores for respondents on one-half correlated with the scores in the second half of the test. The difficulty in this approach is determining whether the two halves are equivalent. The Cronbach`s coefficient alpha (commonly referred to as "Cronbach's Alpha"), which is the mean of all possible split-half coefficients, was used to measure the estimated reliability of the instrument. A test with "robust" reliability would display a Cronbach Alpha above 0.90.

The scores for each item within the instrument may be correlated with scores on the total test by examining the reliability of individual items within the examined instrument. An instrument with a high level of internal consistency would consist of reasonably homogeneous items, which display high item-total correlations.

### 5.3.3 Reliability Analysis of Responses to the 57 item Questionnaire

**TABLE 5.4 RELIABILITY ANALYSIS OF THE 57 ITEMS QUESTIONNAIRE**

| RELIABILITY TEST | |
|---|---|
| Cronbach's Alpha | N of Items |
| .899 | 54 |

Table 5.4 above presents the results of the reliability test of the 57 items of the Automotive Component Manufacturing Companies` managers` questionnaire for the 33 respondents who provided complete sets of responses. The analysis indicated an unusually high level of reliability with a Cronbach's Alpha of .899, that is, items scoring 89.9%. Table 4.3 above reflects the resultant Cronbach's Alpha for the questionnaire used in this study.

Bryman and Bell (2011) stated that it is essential to appreciate the basic features of reliability test means, whereas Cronbach's alpha is commonly used to test internal reliability. It essentially calculates the average of all possible split-half reliability coefficients. A computed alpha coefficient will vary between 1 (denoting perfect internal reliability) and 0 (denoting no internal reliability). Figure 0.80 is typically employed as a rule of thumb in denoting an acceptable level of internal reliability, though many writers accept a slightly lower figure. For example, in the case of the "Burnout Scale" replicated by several researchers, alpha was 0.7, which they suggested 'as a rule of thumb' was efficient.

### 5.3.4 Measures of the appropriateness of factor analysis

In addition to the reliability test performed on the analysis of responses to the 57 items of the Automotive Component Manufacturing Companies` managers` questionnaire for the 33 respondents who provided complete sets of responses, the researcher performed the measures of the appropriateness, which is Factor Analysis. The tests performed were the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's test of sphericity.

The following are the interpretive adjectives for the Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.900 marvellous, 0.800 meritorious, 0.700 average, 0.600 mediocre, 0.500 miserable and below 0.500 unacceptable. These values are represented by the 57 items on the managers` questionnaire for 33 respondents. These respondents responded equating to 0.874, which is labelled or interpreted as 'meritorious. There was no need for further examination of the Anti-Image Correlation Matrix because the KMO met the minimum criteria

Bartlett's test of sphericity tests the hypotheses in the correlation matrix as an identity matrix; i.e., all diagonal elements are one, and all off-diagonal elements are 0, implying that all of the variables are uncorrelated. If the significant value for the study’s test is less than the Cronbach’s alpha level and the KMO Measure of Sample Adequacy, the researcher rejected the null hypothesis that the population matrix is an identity matrix. The significant value for this analysis led the researcher to reject the null hypothesis and concluded that there are correlations in the data set appropriate for factor analysis. This analysis met this requirement, and the interpretation is that the researcher’s sample of 33 respondents was adequate, and the researcher asked the right questions in the questionnaire. Table 5.5 shows the resultant KMO Measure of Sample Adequacy and Bartlett’s Test.

Table 5.5 KMO and Bartlett's Test

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | 0.874 |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 6.7653 |
| | Diff | 1891 |
| | Sig | 0.000 |

The test measured a Principal Axis Factor with a Varimax (orthogonal) rotation of 53 of the 57 Likert scale questions from this open innovation strategy survey questionnaire conducted on data gathered from 33 respondents. An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the sample was factorable (KMO = 0.874). With the satisfactory results of the Cronbach's Alpha, the KMO Measure of Sample Adequacy and Bartlett's Test, the researcher proceeded with Factor analysis to validate the instrument and answer research question six as depicted in table 5.5

## 5.4 ANALYSIS OF QUANTITATIVE DATA

The quantitative data gathered from the questionnaire were statistically, descriptively and inferentially analysed and presented in terms of the variables or constructs of the phenomenon under study. The quantitative statistical analysis output presented in tables and figures format meant to present the data in a more visual format for quick appreciation and comprehension. All data presentation provided some form of the numerical score, and some expressed as percentages and other measures of central tendency and inferential statistics in support of purported relationships among certain study variables. The tabular visual presentation of the data in numerical form and the percentages assisted the researcher to analytically describe and interpret the statistical results using descriptive and inferential statistical techniques.

### 5.4.1 Research Question 1:

What is the nature and extent of ACMs` open innovation strategic alignment for sustainable competitive advantage in the automotive industry?

This study is modelled in line with Cornell (2012) open innovation strategies framework or model in Figure 4.7 below. The framework assumes that ACMs` knowledge exploration (value creation) and exploitation (value capture) strengths assist in determining which open innovation strategic options the company could opportunistically pursue. The model highlights these value creation facets and the value captured since they are critical in determining which strategy an automotive component manufacturer should strategically pursue.

At the centre of open innovation is 'openness' as the underlying basis for open innovation. Open innovation is a distributed innovation process based on purposively managed knowledge flows across organisational boundaries, utilising pecuniary and non-pecuniary mechanisms in line with each organisation's business model. These flows of knowledge may involve knowledge inflows to the focal organisation (leveraging external knowledge sources through internal processes), knowledge outflows from a focal organisation (leveraging internal knowledge through external commercialisation processes), or both (coupling external knowledge sources and commercialisation activities (Chesbrough and Bogers, 2014).

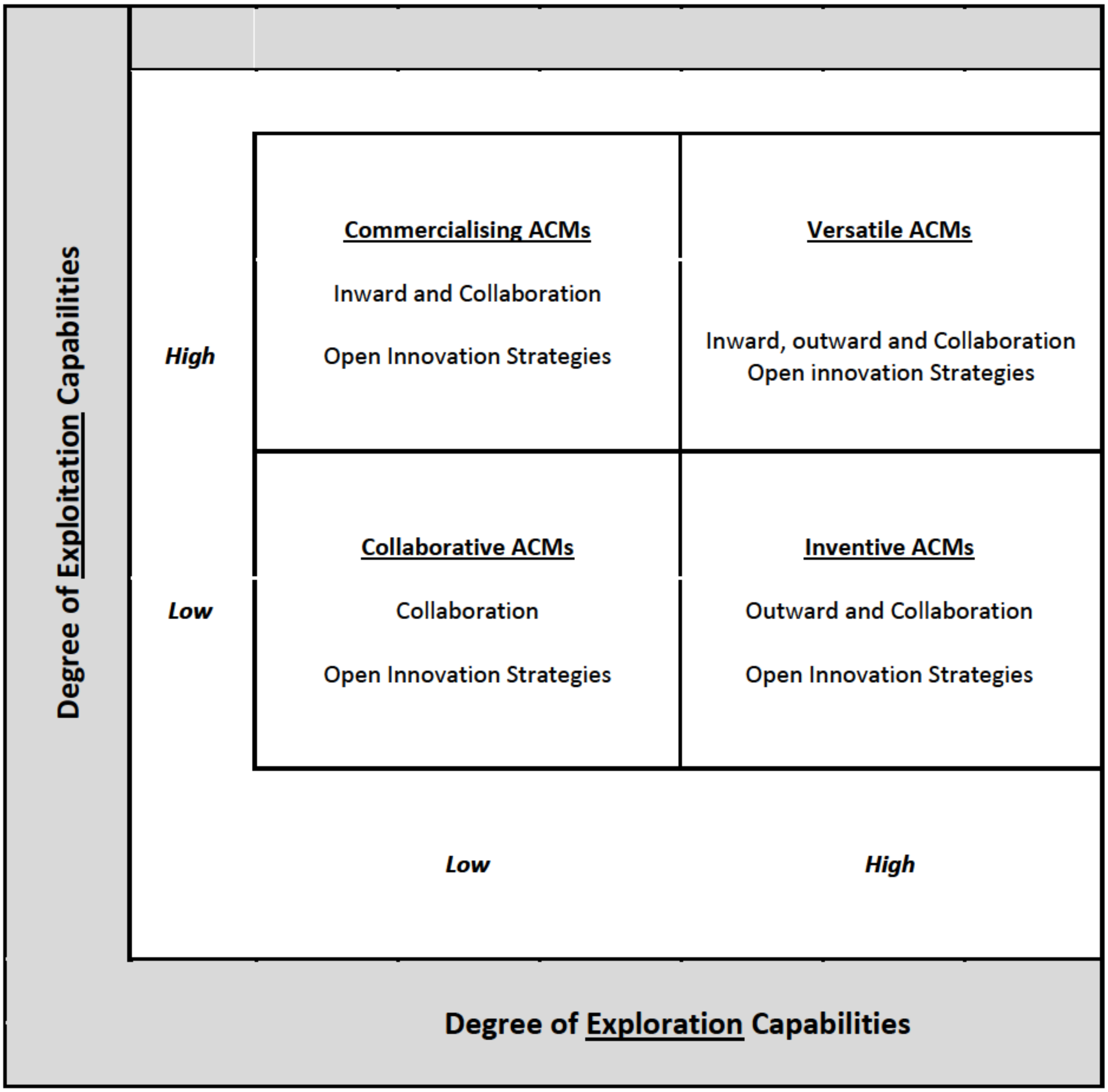


**FIGURE 5.1 ACM OPEN INNOVATION MODEL**

Source: Cornell (2012)

A comprehensive reference to the model in Chapter five is in conjunction with the discussion of the results.

#### 5.4.1.1 Open Innovation Versatile Strategy

Table 5.5 below addresses the nature of open innovation`s versatile strategy as conceptualised above in harmony with Cornell (2012). Table 5.6 provides the descriptive statistical results obtained regarding the nature of the ACMs' open innovation versatile strategy.

**TABLE 5.6 OI VERSATILITY STRATEGY**

| INDIVIDUAL DESCRIPTIVE STATISTICS | | | | | |
|---|---|---|---|---|---|
| | **N** | **Min** | **Max** | **Mean** | **Std. Deviation** |
| Seeking new outside applications for internally developed innovations, knowledge, tools, and ideas | 33 | 1.000 | 5.000 | 3.485 | 1.482 |
| Sharing important innovation with external stakeholders | 33 | 1.000 | 5.000 | 2.879 | .992 |
| Personal drive and convictions for sharing important innovations with external parties | 33 | 1.000 | 5.000 | 3.475 | 1.228 |
| Safe guarding trade secrets | 33 | 1.000 | 5.000 | 2.303 | 1.045 |
| Observation of non-disclosure and other contractual agreements | 33 | 1.000 | 5.000 | 3.303 | 1.425 |
| Protection of copy rights and patents | 33 | 1.000 | 5.000 | 2.727 | 1.206 |
| Valid N (listwise) | 33 | | | | |

From Table 5.6 above, the nature of the ACMs` open innovation versatile strategy is driven and characterised by strategy seeking for external applications for internally developed innovations, developed knowledge, developed tools and developed ideas by the focal automotive component-manufacturing organisation or firm as indicated by the mean of (3.485) and corresponding standard deviation of (1.482). The results show significant evidence of strategic leveraging of external knowledge sources through internal processes by the focal automotive components manufacturers. Open innovation thrives from incumbent management`s drive and convictions for sharing important organisational innovations with external parties (mean, 3.474, and corresponding standard deviation of (1.228).

This standard deviation is followed by observation of non-disclosure and other contractual agreements with a mean of (3.303) and corresponding standard deviation of (1.425), notwithstanding the importance of sharing important innovation with external stakeholders. In other words, the success of open innovations acknowledges the importance of sharing the focal firm or organisation`s essential innovations with the external stakeholders bearing in mind that some of these could be competitors. This assertion is supported by the mean of (2.879) and the corresponding standard deviation (0.992). It is worth noting that the protection of copyrights, patent and safeguarding trade secrets, which are strategic components of closed innovation, are rated the least in the matrix of open innovation with means of (2.727) and (2.300) and corresponding standard deviations of (1.206) and (1.045) respectively. At the outset, copyrights, patents and trade secrets may contradict the open innovation model in that they protect inventions from unauthorised exploitation by competitors. In contrast, the open innovation model purports to allow the access of these intellectual assets by competitors to promote the advancement of technologies. These results are in harmony with Chesbrough & Bogers (2014) and support the assertion that the protection of copyrights, safeguarding trade secrets and patents, are against the spirit of open innovation.

Table 4.5 addresses the extent of ACMs` open innovation versatile strategic alignment for sustainable competitive advantage in the automotive industry. Mainly the descriptive statistics measure the extent or degree of open innovation strategy alignment between the automotive component manufacturing companies` Chief Executive Officers (CEOs) and their functional Senior Managers.

### Table 5.7 Versatility Strategy Group Descriptive statistics

| GROUP DESCRIPTIVE STATISTICS | | | | | |
|---|---|---|---|---|---|
| | **Position** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| Seeking new outside applications for internally developed innovations, knowledge, tools, and ideas | CEO | 5 | 4.400 | .894 | .400 |
| | Senior Manager | 9 | 3.440 | 1.509 | .503 |
| Sharing important innovation with external stakeholders | CEO | 5 | 2.400 | .894 | .400 |
| | Senior Manager | 9 | 3.110 | .928 | .309 |
| Personal drive and convictions for sharing important innovations with external parties | CEO | 5 | 3.800 | 1.095 | .490 |
| | Senior Manager | 9 | 4.000 | .866 | .289 |
| Safeguarding trade secrets | CEO | 5 | 2.600 | .894 | .400 |
| | Senior Manager | 9 | 1.780 | .972 | .324 |
| Observation of non-disclosure and other contractual agreements | CEO | 5 | 4.400 | .894 | .400 |

The results in Table 5.7 above indicate that there is variance in the open innovation component driver, 'Seeking new outside applications for internally developed innovations, knowledge, tools and ideas' between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs is (4.400) with a corresponding standard deviation of (0.894). While the group mean for the nine Senior Managers is (3.440) with a corresponding standard deviation of (1.509). The results indicate a higher variance from the mean as supported by the more significant standard deviation in the Senior Managers group compared to the CEOs group meaning there is variance in strategy alignment between

CEOs and Senior Managers.

Also indicated in Table 5.7 above is a moderate variance in the open innovation component driver, ‘Sharing important innovation with external stakeholders’ between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs is (2.400) with a corresponding standard deviation of (0.894), and the group mean for the nine Senior Managers is (3.110) with a corresponding standard deviation of (0.928). The results indicate a moderate variance from the mean as supported by the narrow spread or standard deviation in the Senior Managers group compared to the CEOs group, meaning there is moderate variance in this strategy alignment between CEOs and Senior Managers.

As shown in Table 5.7 above is a moderate variance in the open innovation component driver, ‘Personal drive and convictions for sharing important innovations with external parties’ between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs is (3.800) with a corresponding standard deviation of (1.095 group mean for the nine Senior Managers is (4.000) with a corresponding standard deviation of (0.866). These results show a higher variance from the mean as indicated by the wider spread or standard deviation in the CEOs group compared to the Senior Managers group concerning this innovation component driver, meaning there is substantial variance in this strategy alignment between CEOs and Senior Managers.

Table 5.6 above indicates a moderate variance in the open innovation component driver, ‘Safeguarding trade secrets’ between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs is (2.600) with a corresponding standard deviation of (0.894) and the group mean for the nine Senior Managers is (1.780) with a corresponding standard deviation of (0.972). From the levels of standard deviations, the conclusion drawn is that there is an average variance from the mean in the CEOs group compared to the Senior Managers group concerning this innovation component driver, meaning there is moderate variance in this strategy alignment between CEOs and Senior Managers.

The results also indicate variance in the open innovation component driver, ‘Observation of non-disclosure and other contractual agreements` between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs is (4.400) with a corresponding standard deviation of (0.894). The nine senior managers' group mean is (2.890) with a corresponding standard deviation of (1.691). The results reflect a more extensive spread or variance from the mean as supported by the higher standard deviation in the Senior Managers group compared to the CEOs group meaning there is variance in strategy alignment between CEOs and Senior Managers concerning the observation of non-disclosure and other contractual agreements.

The results in Table 5.7 above indicate that there is variance in the open innovation component driver, ‘Protection of copyrights` between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs is (3.400) with a corresponding standard deviation of (1.140), and the group mean for the nine Senior Managers is (2.330) with a corresponding standard deviation of (1.118). These results reflect wider spreads or variances from the means of both groups as indicated by the higher standard deviations of both the Senior Managers group and the CEOs group, meaning there is variance in strategy alignment between CEOs and Senior Managers concerning the protection of copyrights.

Table 5.8 below addresses the independent sample T-tests conducted to determine if the established variances in the group mean concerning versatile open innovation strategy are significant. In other words, to establish if the group means are significantly different.

**TABLE 5.8 GROUP INDEPENDENT MEAN SAMPLE TEST VERSATILITY STRATEGY**

| INDEPENDENT SAMPLES TEST | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Levene's Test for Equality | | t-test for Equality of Means | | | | | | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Diff. | Std. Err Dif. | 95% Confidence Interval Lower | 95% Confidence Interval Upper |
| New outside applications for internally developed innovations, knowledge, tools, and ideas | Equal variances assumed | 1.349 | .268 | 1.282 | 12 | .224 | .956 | .745 | -.668 | 2.579 |
| | Equal variances not assumed | | | 1.487 | 11.845 | .163 | .956 | .643 | -.447 | 2.358 |
| Sharing important innovation with external stakeholders | Equal variances assumed | .101 | .756 | -1.390 | 12 | .190 | -.711 | .511 | -1.825 | .403 |
| | Equal variances not assumed | | | -1.406 | 8.665 | .194 | -.711 | .506 | -1.862 | .440 |
| Personal drive and convictions for sharing important innovations with external parties | Equal variances assumed | .455 | .513 | -.378 | 12 | .712 | -.200 | .529 | -1.353 | .953 |
| | Equal variances not assumed | | | -.352 | 6.847 | .736 | -.200 | .569 | -1.551 | 1.151 |
| Safeguarding trade secrets | Equal variances assumed | .008 | .929 | 1.557 | 12 | .145 | .822 | .528 | -.328 | 1.973 |
| | Equal variances not assumed | | | 1.597 | 9.026 | .145 | .822 | .515 | -.342 | 1.986 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Observation of non-disclosure and other contractual agreements | Equal variances assumed | 4.762 | .050 | 1.837 | 12 | .091 | 1.511 | .822 | -.281 | 3.303 |
| | Equal variances not assumed | | | 2.186 | 12.000 | .049 | 1.511 | .691 | .005 | 3.017 |
| Protection of copyrights | Equal variances assumed | .001 | .979 | 1.699 | 12 | .115 | 1.067 | .628 | -.301 | 2.434 |
| | Equal variances not assumed | | | 1.689 | 8.239 | .129 | 1.067 | .632 | -.382 | 2.516 |

The results in Table 5.8 above indicate that the *t* values for (seeking new outside applications for internally developed innovations, knowledge, tools, and ideas: 1.282; sharing important innovation with external stakeholders: -1.390; Personal drive and convictions for sharing important innovations with external parties: -.378; safeguarding trade secrets: 1.557; as well as protection of copyrights: 1.699) are less than the critical value of 2.179 at (12 degrees of freedom) obtained from the "Student`s T Distribution Tables." The results imply that the group means for the five CEOs and the nine Senior Managers are not significantly different concerning the respective innovation component drivers. Furthermore, to affirm these results, the respective innovation component drivers` *p* values are not statistically significant, as they are greater than 0.05. However, observation of non-disclosure and other contractual agreements has a *t* value (2.187) higher than the critical value (2.179) and a significant *p*-value (0.049), meaning the group means were different concerning this innovation component driver. The overall results are alignment between CEOs and their Senior Managers for open innovation versatile strategy.

#### 5.4.1.2 Collaborative Open Innovation Strategy

Table 5.9 below addresses the nature of open innovation`s collaborative strategy as conceptualised in harmony with Cornell (2012). The table provides the descriptive statistical results obtained regarding the nature of the ACMs' open innovation collaborative strategy.

**Table 5.9 Descriptive Statistics Collaborative strategy**

| DESCRIPTIVE STATISTICS | | | | | |
|---|---|---|---|---|---|
| | **N** | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |
| Idea Generation | 33 | 2 | 5 | 3.730 | .876 |
| Experimentation | 33 | 2 | 5 | 3.420 | .867 |
| Manufacturing | 33 | 2 | 5 | 3.790 | .820 |
| Commercialization | 33 | 2 | 5 | 3.730 | .911 |
| Valid N (listwise) | 33 | | | | |

Table 5.9 above shows that the nature of the ACMs` collaborative open innovation strategy is driven and characterised by strategic collaboration in manufacturing with a mean of (3.790) and corresponding standard deviation of (0.820), followed by collaborative idea generation with a mean of (3.730) and corresponding standard deviation of (0.876). Collaborative commercialisation follows, as indicated by the mean of (3.730) and the corresponding standard deviation (0.911). Collaborative experimentation with a mean of (3.420) and a standard deviation of (0.867) ranks the least in the collaborative open innovation strategy.

Table 5.10 below deals with the extent of ACMs` collaborative open strategic innovation alignment for sustainable competitive advantage in the automotive industry. In particular, the descriptive statistics measure the extent or degree of collaborative open innovation strategy alignment between the automotive component manufacturing companies` CEOs and their functional Senior Managers.

**Table 5.10 Group Descriptive Statistics Collaborative Strategy**

| GROUP STATISTICS | | | | | |
|---|---|---|---|---|---|
| | Position | N | Mean | Std. Deviation | Std. Error Mean |
| Idea Generation | CEO | 5 | 4.400 | .548 | .245 |
| | Senior Manager | 9 | 3.330 | 1.000 | .333 |
| Experimentation | CEO | 5 | 3.400 | .894 | .400 |
| | Senior Manager | 9 | 3.000 | .866 | .289 |
| Manufacturing | CEO | 5 | 3.800 | .837 | .374 |
| | Senior Manager | 9 | 3.330 | .866 | .289 |
| Commercialisation | CEO | 5 | 3.800 | 1.095 | .490 |
| | Senior Manager | 9 | 3.220 | .833 | .278 |

Table 5.10 above shows that there is variance in the collaborative open innovation strategic component driver, 'Idea Generation' between the group of five CEOs and the group of nine Senior Managers, as evidenced by the group mean for the five CEOs of (4.400) with a corresponding standard deviation of (0.548). In comparison, the group mean for the nine Senior Managers is (3.330) with the corresponding standard deviation of (1.000). The results reflect wider spread or variance from the mean as supported by the higher standard deviation in the Senior Managers group compared to the CEOs group meaning there

is variance in strategy alignment between CEOs and Senior Managers for collaboration in idea generation.

The results in Table 5.10 above indicate that there is variance in the versatile open innovation strategic component driver, ‘Manufacturing’ between the group of five CEOs and the group of nine Senior Managers, evidenced by the group mean for the five CEOs of (3.800) with a corresponding standard deviation of (0.837) and the group mean for the nine Senior Managers of (3.330) with a corresponding standard deviation of (0.866). The results reflect a modest spread or variance from the mean as supported by the moderate standard deviations in the Senior Managers' group and the CEOs’ group meaning there is variance in strategy alignment between CEOs and Senior Managers for collaborative manufacturing.

Indicated in Table 5.10 above are the descriptive statistical results indicating a variance in the collaborative open innovation strategic component driver, ‘Commercialisation’ between the groups of five of the CEOs and the group of nine Senior Managers. The variance translates to the following: the group mean for the five CEOs is (3.800) with a corresponding standard deviation of (1.095), and the group mean for the nine Senior Managers is (3.220) with a corresponding standard deviation of (0.833). The results reflect a higher spread or variance from the CEOs group's mean than that of the Senior Managers group, meaning that there is variance in strategy alignment between CEOs and Senior Managers for collaborative commercialisation.

The results also show in Table 5.10 above that there is variance in the collaborative open innovation strategic component driver, ‘Experimentation’ between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs of (3.400), and a corresponding standard deviation of (0.894) supports this assertion. The nine Senior Managers have a group mean of (3.000) with a corresponding standard deviation of (0.866). However, the standard deviations are even and moderate, indicating a modest variance in the group means. The conclusion is that there is a variance in strategy alignment between CEOs and Senior Managers for collaborative experimentation.

Having established a variance in the strategic alignment between the CEOs and senior managers regarding the collaborative open innovation strategy, Table 5.10 below shows the independent sample T-tests conducted to determine if the established variances in the group mean for collaborative open innovation strategy are significant. In other words, to establish if the group means are significantly different.

**TABLE 5.11 GROUP INDEPENDENT MEAN SAMPLE TEST COLLABORATIVE STRATEGY**

| INDEPENDENT SAMPLES TEST | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Diff. | Std. Err. Diff. | 95% Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| Idea Generation | Equal variances assumed | 2.086 | .174 | 1.184 | 12 | .050 | 1.067 | .488 | .003 | 2.131 |
| | Equal variances not assumed | | | 1.169 | 11.984 | .024 | 1.067 | .414 | .165 | 1.968 |
| Experimentation | Equal variances assumed | .042 | .841 | .819 | 12 | .429 | .400 | .488 | -.664 | 1.464 |
| | Equal variances not assumed | | | .811 | 8.147 | .440 | .400 | .493 | -.734 | 1.534 |
| Manufacturing | Equal variances assumed | .216 | .651 | .977 | 12 | .348 | .467 | .478 | -.574 | 1.507 |
| | Equal variances not assumed | | | .987 | 8.647 | .350 | .467 | .473 | -.609 | 1.542 |
| Commercialisation | Equal variances assumed | .009 | .925 | 1.115 | 12 | .287 | .578 | .518 | -.551 | 1.707 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Equal variances not assumed | | | 1.026 | 6.642 | .341 | .578 | .563 | -.769 | 1.924 |

The results in Table 5.11 above show that the t values for (idea generation: 1.184; experimentation: 1.169; manufacturing: 0.987; commercialisation: 1.115) are less than the critical value of 2.179 at (12 degrees of freedom) obtained from the “Student`s T Distribution Tables.” This assertion implies that the group means for the five CEOs and the nine Senior Managers are not significantly different concerning the respective collaborative open innovation component drivers. Besides, and affirming this assertion, all the respective *p* values of the collaborative open innovation strategy component drivers are statistically insignificant, as they are all greater than 0.05. The overall results are strategic alignment between CEOs and their Senior Managers for the collaborative open innovation strategy.

#### 5.4.1.3 Commercialisation Open Innovation Strategy

Table 5.12 below depicts the nature of open innovation`s commercialisation strategy as conceptualised in harmony with Cornell (2012). The table provides the descriptive statistical results obtained regarding the nature of the ACMs’ open innovation commercialisation strategy.

**Table 5.12 Descriptive Statistics Commercialisation Strategy**

| DESCRIPTIVE STATISTICS | | | | | |
|---|---|---|---|---|---|
| | **N** | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |
| We share identical management styles | 33 | 1 | 5 | 3.270 | 1.098 |
| Mutual interest in working collaboratively | 33 | 2 | 5 | 3.610 | .899 |
| High level of trust among partners | 33 | 2 | 5 | 3.520 | .906 |
| Matching technological competencies | 33 | 1 | 5 | 3.150 | .906 |
| Access to partners technological resources | 33 | 1 | 5 | 3.300 | 1.075 |
| The synergy created from combining knowledge among participating firms | 33 | 2 | 5 | 3.520 | .870 |
| Valid N (listwise) | 33 | | | | |

As shown in Table 5.12 above, the nature of the ACMs` commercialisation open innovation strategy primarily driven by mutual interests in collaborative working with partners, as evidenced by the mean of (3.610) and corresponding standard deviation of (0.899), followed by perceived synergies derived from combining knowledge among the participating partners. This assertion is evidenced by the mean of (3.520) and the corresponding standard deviation (0.870). A high level of trust among the partnering parties scored the mean of (3.520) and the corresponding standard deviation (0.906). Then follows access to partners` technological resources, with the mean of (3.300) and standard deviation of (1.075), sharing of identical management styles, with the mean of (3.270) and corresponding standard deviation of (1.098). Matching technological competencies ranked the least with the mean of (3.150) and the corresponding standard deviation (0.906).

Table 5.13 below describes the extent of ACMs` commercialisation open strategic innovation alignment for sustainable competitive advantage in the automotive industry. The descriptive statistics measure the extent or degree of commercialisation of open innovation strategy alignment between the automotive component manufacturing firms` CEOs and their functional Senior Managers.

### Table 5.13 Group Descriptive Statistics Commercialisation Strategy

| GROUP STATISTICS | | | | | |
|---|---|---|---|---|---|
| | **Position** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| We share identical management styles | CEO | 5 | 3.600 | .894 | .400 |
| | Senior Manager | 9 | 2.560 | 1.424 | .475 |
| A mutual interest in working collaboratively | CEO | 5 | 3.600 | .548 | .245 |
| | Senior Manager | 9 | 3.670 | 1.000 | .333 |
| High level of trust among partners | CEO | 5 | 3.600 | 1.140 | .510 |
| | Senior Manager | 9 | 3.330 | .707 | .236 |
| Matching technological competencies | CEO | 5 | 3.400 | .548 | .245 |
| | Senior Manager | 9 | 2.670 | 1.118 | .373 |
| Access to partners' technological resources | CEO | 5 | 3.000 | 1.414 | .632 |
| | Senior Manager | 9 | 3.330 | 1.225 | .408 |
| The synergy created from combining knowledge among participating firms | CEO | 5 | 4.000 | 1.000 | .447 |
| | Senior Manager | 9 | 3.330 | .866 | .289 |

Table 5.13 above shows that there is variance in the commercialisation of the open innovation strategic component driver, 'Synergy created from combining knowledge among participating firms'

The group of five CEOs and the group of nine Senior Managers, as evidenced by the group mean for the five CEOs of (4.000) with a corresponding standard deviation of (1.000). In comparison, the nine senior managers' group mean is (3.33) with a corresponding standard deviation of (0.866). These results indicate a more extensive spread or variance from the mean as supported by the more significant standard deviation in the CEOs group than the Senior Managers group, meaning there is variance in strategy alignment between CEOs and Senior Managers for creating synergies from combining knowledge among the participating firms.

The results in Table 5.13 above indicates that there is variance in the open innovation component driver, ‘Mutual interest in working collaboratively` between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs is (3.600) with a corresponding standard deviation of (0.548), and the group mean for the nine Senior Managers is (3.670) with a corresponding standard deviation of (1.000). These results reflect wider spreads or variances from the mean of the Senior Managers group as evidenced by the higher standard deviation compared to that of the CEOs’ group, meaning there is variance in strategy alignment between CEOs and Senior Managers for mutual interest in working collaboratively.

Also indicated in Table 5.13 above is that there is variance in commercialisation of the open innovation strategic component driver, ‘High level of trust among partners’ between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs of (3.600) with the corresponding standard deviation of (1.140) and the group mean for the nine Senior Managers of (3.330) with the corresponding standard deviation of (0.707) demonstrate the high level of trust among partners. The results show a higher spread or variance from the mean of the CEOs group as compared to that of the Senior Managers group meaning that there is variance in strategy alignment between CEOs and Senior Managers for a high level of trust among partners.

Indicated in Table 5.13 above is that there is variance in commercialisation of the open innovation strategic component driver, ‘We share identical management styles’ between the groups of five CEOs and the group of nine Senior Managers. The results of the group mean for the five CEOs of (3.600), and the corresponding standard deviation of (0.894) and the group mean for the nine Senior Managers of (2.560) with a corresponding standard deviation of (1.424) demonstrate the perception of sharing identical management styles. These results reflect a higher spread or variance from the mean of the Senior Managers’ group as compared to that of the CEOs’ group meaning that there is variance in strategy alignment between CEOs and Senior Managers for sharing of identical management styles.

The results in Table 5.13 above also reveal that there is variance in the commercialisation of the open innovation strategic component driver, ‘Matching technological competencies’ between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs of (3.400) with the corresponding standard deviation of (0.548) and the group mean for the nine Senior Managers of (2.670) with a corresponding standard deviation of (1.118) support the assertion of matching technological competencies. These results indicate a higher spread or variance from the mean of the Senior Managers’ group as compared to that of the CEOs’ group meaning that there is variance in strategy alignment between CEOs and Senior Managers for matching of technological competencies.

Table 5.12 above also shows that there is variance in the open innovation component driver, ‘Access to partners’ technological resources` between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs is (3.000), and the corresponding standard deviation of (1.414) and the group mean for the nine Senior Managers is (3.330) and the corresponding standard deviation of (1.225). These results show that there are wider spreads or variances from the means of both groups as indicated by the higher levels of standard deviations of both the Senior Managers' group and the CEOs' group, meaning there is variance in strategy alignment between CEOs and Senior Managers for accessing of partners` technological resources.

After establishing that there is variance in the strategic alignment between the CEOs' group and the Senior Managers' group regarding the commercialisation of open innovation strategy, Table 5.14 below indicates the independent sample T-tests performed to determine if the established variances in the group mean concerning the commercialisation of open innovation strategy are significant. In other words, to establish if the group means are significantly different.

### Table 5.14 Group Independent Mean Sample Test Commercialisation Statistics

| INDEPENDENT SAMPLES TEST | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Diff. | Std. Err. Diff. | 95% Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| We share identical management styles | Equal variances assumed | 2.423 | .146 | 1.472 | 12 | .167 | 1.044 | .710 | -.502 | 2.591 |
| | Equal variances not assumed | | | 1.683 | 11.648 | .119 | 1.044 | .621 | -.313 | 2.401 |
| A mutual interest in working collaboratively | Equal variances assumed | .843 | .377 | -.137 | 12 | .894 | -.067 | .488 | -1.131 | .997 |
| | Equal variances not assumed | | | -.161 | 11.984 | .875 | -.067 | .414 | -.968 | .835 |
| High level of trust among partners | Equal variances assumed | 1.470 | .249 | .546 | 12 | .595 | .267 | .488 | -.797 | 1.331 |
| | Equal variances not assumed | | | .475 | 5.761 | .652 | .267 | .562 | -1.122 | 1.655 |
| Matching technological competencies | Equal variances assumed | 2.196 | .164 | 1.361 | 12 | .199 | .733 | .539 | -.441 | 1.907 |
| | Equal variances not assumed | | | 1.644 | 11.946 | .126 | .733 | .446 | -.239 | 1.706 |
| Access to partners' technological resources | Equal variances assumed | .487 | .499 | -.463 | 12 | .652 | -.333 | .720 | -1.902 | 1.236 |
| | Equal variances not assumed | | | -.443 | 7.387 | .671 | -.333 | .753 | -2.095 | 1.428 |
| | Equal variances assumed | .073 | .792 | 1.309 | 12 | .215 | .667 | .509 | -.443 | 1.776 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| The synergy created from combining knowledge among participating firms | Equal variances not assumed | | | 1.252 | 7.387 | .249 | .667 | .532 | -.579 | 1.912 |

From the results in Table 5.14 above, the *t* values for (we share identical management styles: 1.472; a mutual interest in working collaboratively: -0.137; high level of trust among partners: 0.546; matching technological competencies: 1.361; access to partners technological resources: -0.463 and synergy created from combining knowledge among participating firms: 1.309 are less than the critical value of 2.179 at (12 degrees of freedom) obtained from the "Student`s T Distribution Tables." Therefore it implies that the group means for the five CEOs and the nine Senior Managers are not statistically significantly different concerning the commercialisation of open innovation component drivers. Overall, all the respective p values of the commercialisation of open innovation strategy component drivers are statistically insignificant, as they are all above 0.050. The overall results are strategic alignment between CEOs and their senior managers to commercialise open innovation strategy.

#### 5.4.1.4 Inventive Open Innovation Strategy

Presented below in Table 5.15 is the nature of open innovation`s inventive strategy as conceptualised in harmony with Cornell (2012). The descriptive statistical results were obtained in the table concerning the nature of the ACMs' open innovation inventive strategy.

**Table 5.15 Descriptive Statistics' Inventive Strategy**

| DESCRIPTIVE STATISTICS | | | | | |
|---|---|---|---|---|---|
| | **N** | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |
| Driven by Universities and research centres | 33 | 2 | 5 | 3.150 | .972 |
| Driven by Government agencies | 33 | 1 | 5 | 3.180 | .983 |
| Driven by Suppliers | 33 | 2 | 5 | 3.970 | .684 |
| Driven by the Original Equipment Manufacturers | 33 | 1 | 5 | 3.670 | .924 |
| Driven by Competitors within the industry | 33 | 2 | 5 | 3.330 | .890 |
| Driven by Competitors in other industries | 33 | 1 | 4 | 2.970 | .770 |
| Valid N (listwise) | 33 | | | | |

As reflected in Table 5.15 above, the nature of the ACMs` inventive open innovation strategy is primarily characterised by inventions driven by suppliers, as evidenced by the mean of (3.971) and the corresponding standard deviation of (0.684), followed by inventions driven by original equipment manufacturers with the mean of (3.670) and the corresponding standard deviation of (0.924). Competitors drive inventions within the industry, an assertion supported by the mean of (3.330) and the corresponding standard deviation (0.890). Next in line is inventions driven by Government agencies, evidenced by the mean of (3.180) with the corresponding standard deviation of (0.983), inventions driven by Universities and research centres, with the mean of (3.150) and corresponding standard deviation of (0.972). Inventions driven by competitors in other industries ranked the least with the mean of (2.970) and the corresponding standard deviation (0.770).

Depicted in Table 5.16 below is the extent of ACMs` inventive open innovation strategic alignment for sustainable competitive advantage in the automotive industry. The descriptive statistics measure the extent or degree of inventive open innovation strategy alignment between the automotive component manufacturing firms` CEOs and their functional Senior Managers.

### Table 5.16 Group Descriptive Statistics Inventive Strategy

| GROUP STATISTIC | | | | | |
|---|---|---|---|---|---|
| | Position | N | Mean | Std. Deviation | Std. Error Mean |
| Driven by Universities and research centres | CEO | 5 | 2.600 | 1.342 | .600 |
| | Senior Manager | 9 | 3.440 | .882 | .294 |
| Driven by Government agencies | CEO | 5 | 3.000 | .707 | .316 |
| | Senior Manager | 9 | 3.220 | 1.302 | .434 |
| Driven by Suppliers | CEO | 5 | 4.000 | .707 | .316 |
| | Senior Manager | 9 | 3.890 | .928 | .309 |
| Driven by the OEMs | CEO | 5 | 3.800 | .837 | .374 |
| | Senior Manager | 9 | 3.440 | 1.333 | .444 |
| Driven by Competitors within the industry | CEO | 5 | 3.800 | .447 | .200 |
| | Senior Manager | 9 | 3.220 | .972 | .324 |
| | CEO | 5 | 3.200 | .447 | .200 |

| | | | | | |
|---|---|---|---|---|---|
| Driven by Competitors in other industries | Senior Manager | 9 | 2.890 | 1.167 | .389 |

The results in Table 5.16 above indicate that there is variance in the open innovation component driver, ‘Driven by Suppliers` between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs is (4.00) with the corresponding standard deviation of (0.707), and the group mean for the nine Senior Managers is (3.89) with a corresponding standard deviation of (0.928). These results reflect modest spreads or variances from the mean of the Senior Managers’ group and that of the CEOs’ group as evidenced by the moderately different standard deviations, implying that there is variance in strategy alignment between CEOs and Senior Managers for inventions driven by suppliers.

As indicated in Table 5.16 above, there is variance in the open innovation component driver, ‘Driven by Competitors within the industry` between the group of five CEOs and the group of nine Senior Managers, with the group mean for the five CEOs standing at (3.800) with the corresponding standard deviation of (0.447), while the group mean for the nine Senior Managers is standing at (3.220) with the corresponding standard deviation of (0.972). These results indicate a more extensive spread or variance in the mean of the Senior Managers’ group compared to the CEOs’ group as shown by the standard deviations, meaning that there is variance in strategy alignment between CEOs and Senior Managers for inventions driven by competitors within the industry.

The results in Table 5.16 above also show that there is variance in the inventive open innovation strategic component driver, ‘Driven by the original equipment manufacturers’, between the group of five CEOs and the group of nine Senior Managers. The group mean for the five CEOs of (3.80) with the corresponding standard deviation of (0.837) and the group mean for the nine Senior Managers of (3.440) with a corresponding standard deviation of (1.333) support this premise. These results indicate a higher spread or variance in the mean of the Senior Managers group than that of the CEOs' group, implying variance in strategy alignment between CEOs and Senior Managers for inventions driven by the original equipment manufacturers.

Table 5.16 above also shows that there is variance in the inventive open innovation strategic component driver, 'Driven by Competitors in other industries', between the five CEOs and the group of nine Senior Managers. The group mean for the five CEOs is (3.200) with the corresponding standard deviation of (0.447), and the group mean for the nine Senior Managers is (2.890) with a corresponding standard deviation of (1.167) support this premise. These results indicate a higher spread or variance in the mean of the Senior Managers group than that of the CEOs' group, indicating that there is variance in strategy alignment between CEOs and Senior Managers for inventions driven by the competitors in other industries.

Also shown in Table 5.16 above is that there is variance in the inventive open innovation strategic component driver, 'Driven by Government agencies between the group of five of the CEOs and the group of nine Senior Managers. This perception is evidenced by the group mean for the five CEOs of (3.000), and the corresponding standard deviation of (0.707) and the group mean for the nine Senior Managers of (3.220) and the corresponding standard deviation of (1.302). These results show a higher spread or variance in the mean of the Senior Managers group as compared to that of the CEOs group implying that there is variance in strategy alignment between CEOs and Senior Managers for inventions driven by Government agencies.

Also shown in Table 5.16 above is that there is variance in the inventive open innovation strategic component driver, ‘Driven by Universities and research centres’ between the group of the five CEOs and the group of nine Senior Managers. The perception is evidenced by the group mean for the five CEOs of (2.600), and the corresponding standard deviation of (1.342) and the group mean for the nine Senior Managers of (3.44) and the corresponding standard deviation of (0.882). These results show a higher spread or variance in the mean of the CEOs group compared to that of the Senior Managers group implying that there is variance in strategy alignment between CEOs and Senior Managers for inventions driven by Universities and research centres.

After establishing that there is variance in the strategic alignment between the CEOs’ group and the Senior Managers’ group regarding the inventive open innovation strategy, Table 5.17 below shows the independent sample T-tests performed to determine if the established variances in the group mean concerning innovative open innovation strategy are statistically significant. In other words, to establish if the group means are statistically significantly different.

**TABLE 5.17 GROUP INDEPENDENT MEAN SAMPLE TEST INVENTIVE STRATEGY**

| INDEPENDENT SAMPLES TEST | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Diff. | Std. Err. Diff. | 95% Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| Driven by Universities and research centres | Equal variances assumed | .478 | .502 | -1.432 | 12 | .178 | -.844 | .590 | -2.130 | .441 |
| | Equal variances not assumed | | | -1.264 | 5.979 | .253 | -.844 | .668 | -2.481 | .792 |
| Driven by Government agencies | Equal variances assumed | 4.397 | .058 | -.350 | 12 | .732 | -.222 | .635 | -1.606 | 1.161 |
| | Equal variances not assumed | | | -.414 | 11.990 | .686 | -.222 | .537 | -1.392 | .948 |
| Driven by Suppliers | Equal variances assumed | .391 | .544 | .231 | 12 | .821 | .111 | .480 | -.935 | 1.157 |
| | Equal variances not assumed | | | .251 | 10.507 | .807 | .111 | .442 | -.868 | 1.090 |
| Driven by the OEMs | Equal variances assumed | 1.421 | .256 | .535 | 12 | .602 | .356 | .664 | -1.092 | 1.803 |
| | Equal variances not assumed | | | .612 | 11.652 | .552 | .356 | .581 | -.914 | 1.626 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Driven by Competitors within the industry | Equal variances assumed | 10.181 | .801 | 1.241 | 12 | .238 | .578 | .465 | -.436 | 1.592 |
| | Equal variances not assumed | | | 1.518 | 11.825 | .155 | .578 | .381 | -.253 | 1.409 |
| Driven by Competitors in other industries | Equal variances assumed | 9.466 | .110 | .565 | 12 | .582 | .311 | .550 | -.888 | 1.511 |
| | Equal variances not assumed | | | .711 | 11.221 | .491 | .311 | .437 | -.649 | 1.271 |

From the results in Table 5.17 above, the *t* values for independent sample tests driven by Universities and research centres are: -1.432; driven by Government agencies: -0.350; driven by suppliers: 0.231; driven by the OEMs: 0.535; driven by competitors within the industry: 1.241 and driven by competitors in other industries: 0.565) are less than the critical value of 2.179 at (12 degrees of freedom) obtained from the "Student`s T Distribution Tables." The results imply that the group means for the five CEOs and the nine Senior Managers are not statistically significantly different concerning the respective inventive open innovation component drivers. Overall, all the respective *p* values of the inventive open innovation strategy component drivers are statistically insignificant, as they are all above 0.050. The overall results are strategic alignment between CEOs and their Senior Managers for the inventive open innovation strategy.

### 5.4.2 Research Question 2:

What are the automotive components manufacturers' open innovation challenges and their influence on risk exposure profiles?

Table 5.18 below shows the descriptive statistics depicting the open innovation challenges that the ACMs face in their adoption of open innovation for sustainable competitive advantage.

**Table 5.18 Open Innovation Challenges**

| DESCRIPTIVE STATISTIC: FIRM CHALLENGES IN ADOPTION OF OPEN INNOVATION | | | | | |
|---|---|---|---|---|---|
| | N | Minimum | Maximum | Mean | Std. Deviation |
| Resources constraints | 33 | 2.000 | 5.000 | 3.3939 | 1.29758 |
| Dynamic capabilities limitations | 33 | 1.000 | 5.000 | 3.2727 | 1.46357 |
| Uncertainties | 32 | 1.000 | 5.000 | 3.8438 | 1.08090 |
| Valid N (listwise) | 32 | | | | |

The results in Table 5.18 above show that the automotive component manufacturing companies face various challenges from risk exposure. This challenge is the most pressing, as evidenced by the mean of (3.8438) with the corresponding standard deviation (1.08090). Risk exposure follows resource constraints with the mean of (3.3939) and the corresponding standard deviation (1.29758). Dynamic capabilities limitations are ranked the least with the mean of (3.2727) and the corresponding standard deviation (1.46357).

Table 5.19 below shows the likely statistical results from measuring the impact of the open innovation challenges that the ACMs face when adopting open innovation for competitive advantage. The results indicate whether the open innovation challenges positively or negatively correlate with the firms` competitiveness. In other words, the competitiveness of the ACMs is impacted by the open innovation challenges of risk exposure profiles, resource constraints, and the limitation of the dynamic capabilities of the ACMs.

### TABLE 5.19 CORRELATION BETWEEN OI CHALLENGES AND RISK EXPOSURE

| CORRELATION | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Resources constraints | Lack of dynamic capabilities | Risk exposure profiles | Negative impact on the firms' reputation | Knowledge leakages and copyrights by | Loss of human capital to competitors | Difficulty in protecting Intellectual Property | External partner's opportunistic | Loss of focus on critical priorities | Low returns from collaboration efforts |
| Resources constraints | Pearson Correlation | 1 | .534** | .567** | .486** | .318 | .583** | .473** | .288 | .160 | .797** |
| | Sig. (2-tailed) | | .001 | .001 | .004 | .071 | .000 | .005 | .104 | .375 | .000 |
| | N | 33 | 33 | 32 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Lack of dynamic capabilities | Pearson Correlation | .534** | 1 | .597** | .103 | .406* | .418* | .416* | .239 | .023 | .351* |
| | Sig. (2-tailed) | .001 | | .000 | .568 | .019 | .016 | .016 | .181 | .897 | .045 |
| | N | 33 | 33 | 32 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Uncertainties | Pearson Correlation | .567** | .597** | 1 | .086 | .447* | .499** | .232 | .409* | -.014 | .367* |
| | Sig. (2-tailed) | .001 | .000 | | .639 | .010 | .004 | .201 | .020 | .939 | .039 |
| | N | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | | | | | | | |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | | | | | | | | |

As shown in Table 5.19 above resources constraints was found to be strongly positively correlated with (lack of dynamic capabilities, r (0.534**) = 0.534, p = 0.001; risk exposure profiles, r (0.567**) = 0.567, p = 0.001; negative impact on the firm`s reputation, r (0.486**) = 0.486, p = 0.004; loss of human capital to competitors, *r* (0.583**) = 0.583, *p* = 0.000; difficulty in protecting IP, *r* (0.473**) = 0.473, *p* = 0.005; low returns from collaborative efforts, *r* (0.797**) = 0.797, *p* = 0.005) respectively.

The results in Table 5.19 also show that lack of dynamic capabilities was found to be strongly positively correlated with risk exposure profiles, *r* (0.597**) = 0.597, *p* = 0.000, moderately positively correlated with knowledge leakages and copyrights by competitors, *r* (0.406**) = 0.406, *p* = 0.019; moderately positively correlated with loss of human capital to competitors, *r* (0.418**) = 0.418, *p* = 0.016. Lack of dynamic capabilities was also found to be moderately positively correlated with difficulty in protecting IP, *r* (0.416**) = 0.416, *p* = 0.016 and also moderately positively correlated with low returns from collaborative efforts, *r* (0.351**) = 0.351, *p* = 0.045.

From the results in Table 5.19 above, risk exposure profiles were found to be moderately positively correlated with knowledge leakages and copyrights by competitors, *r* (0.447**) = 0.447, *p* = 0.010, strongly positively correlated with loss of human capital to competitors, *r* (0.499**) = 0.499, *p* = 0.004. The results also indicate that risks exposure profiles correlated moderately positively with external partners' opportunistic behaviour towards firms' openness, *r* (0.409**) = 0.409, *p* = 0.020 and correlated moderately positively with low returns from collaboration efforts, *r* (0.367**) = 0.367, *p* = 0.039.

### 5.4.3 Research Question 3:

What is the nature and extent of erosion factors among the ACMs?

Table 5.20 shows the descriptive statistics of the nature and extent of the erosion factors among the ACMs.

**Table 5.20 ACM Erosion Factors**

| DESCRIPTIVE STATISTICS | | | | | |
|---|---|---|---|---|---|
| | N | Minimum | Maximum | Mean | Std. Deviation |
| Increasingly becoming an integrator of technology internally and externally | 33 | 3 | 5 | 4.360 | .603 |
| Skilled worker migration | 33 | 2 | 5 | 3.240 | .867 |
| Increasing inbound knowledge from suppliers | 33 | 3 | 5 | 4.000 | .661 |
| Increase in knowledge exploration | 33 | 2 | 5 | 3.420 | .792 |
| Increase in knowledge exploitation from Original Equipment Manufacturers | 33 | 2 | 5 | 3.550 | 1.121 |
| Increase in Research and Development costs | 33 | 2 | 5 | 3.670 | .924 |
| Venture Capital increasing competition | 33 | 2 | 5 | 3.390 | 1.144 |
| Valid N (listwise) | 33 | | | | |

As indicated in Table 5.20 above, the automotive component manufacturing companies grapple with several erosion factors in their adoption of open innovation. Among these firms' most or predominant erosion factor is the notion: "decreasingly becoming an integrator of technology both internally and externally." The mean of (4.360) evidences this notion with the corresponding standard deviation of (0.603). Followed by increasing inbound knowledge from suppliers with the mean of (4.000) and standard deviation of (0.661), increase in research and development costs, as evidenced by the mean of (3.670) with the standard deviation of (0.924). The results of the descriptive statistics are as follows: "increase in knowledge exploitation from the original equipment manufacturers," the mean is (3.550), standard deviation (1.121), followed by an “increase in knowledge exploration,” mean (3.420) and standard deviation (0.792), and “competition as a result of venture capital financial support,” mean of (3.390) standard deviation (1.144). “Skilled worker migration” is the least ranked with the standard deviation (3.240) and standard deviation (0.867).

### 5.4.4 Research Question 4:

*What relationship exists between organisational culture, open innovation and competitiveness?*

Table 5.21 below shows the correlation inferential statistics inferring the relationship between organisational culture, open innovation and competitiveness.

**TABLE 5.21 CORRELATION BETWEEN ORG CULTURE, OI AND COMPETITIVENESS 1**

| CORRELATIONS | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Adequate time allocation for innovation projects | Leadership support for external collaborations | Employee incentives for external collaborations | Increased external knowledge sharing | Driven by Universities and research centres | From idea generation | Seeking new outside applications for internally | The synergy created from combining knowledge | Improved access and cooperation with external | Advanced technology and knowledge acquisition | Meeting financial objectives | Being more innovative in the market |
| Adequate time allocation for innovation projects | Pearson Correlation | 1 | .308 | .373* | .310 | -.129 | .249 | .162 | .004 | .066 | -.005 | .302 | .217 |
| | Sig. (2-tailed) | | .081 | .033 | .079 | .473 | .162 | .367 | .981 | .713 | .978 | .088 | .224 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Leadership support for external collaborations | Pearson Correlation | .308 | 1 | .444** | .378* | .028 | .457** | .180 | .158 | .228 | .393* | .279 | .408* |
| | Sig. (2-tailed) | .081 | | .010 | .030 | .877 | .008 | .316 | .380 | .201 | .024 | .116 | .018 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Employee incentives for external collaborations | Pearson Correlation | .373* | .444** | 1 | .205 | -.179 | .632** | .409* | -.126 | .261 | .520** | .360* | -.136 |
| | Sig. (2-tailed) | .033 | .010 | | .252 | .319 | .000 | .018 | .486 | .143 | .002 | .039 | .450 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Increased external knowledge sharing | Pearson Correlation | .310 | .378* | .205 | 1 | -.222 | .149 | -.051 | .128 | .219 | .408* | .212 | .373* |
| | Sig. (2-tailed) | .079 | .030 | .252 | | .214 | .409 | .776 | .479 | .221 | .018 | .237 | .032 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Driven by Universities and research centres | Pearson Correlation | -.129 | .028 | -.179 | -.222 | 1 | -.060 | -.183 | .090 | .326 | -.160 | .185 | .107 |
| | Sig. (2-tailed) | .473 | .877 | .319 | .214 | | .740 | .309 | .620 | .064 | .374 | .303 | .552 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| From idea generation | Pearson Correlation | .249 | .457** | .632** | .149 | -.060 | 1 | .539** | .108 | .248 | .679** | .420* | .044 |
| | Sig. (2-tailed) | .162 | .008 | .000 | .409 | .740 | | .001 | .549 | .164 | .000 | .015 | .808 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Seeking new outside applications for internally developed innovations, knowledge, tools and ideas | Pearson Correlation | .162 | .180 | .409* | -.051 | -.183 | .539** | 1 | .115 | .266 | .379* | -.047 | -.386* |
| | Sig. (2-tailed) | .367 | .316 | .018 | .776 | .309 | .001 | | .523 | .134 | .030 | .797 | .027 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Synergy created from combining knowledge among participating firms | Pearson Correlation | .004 | .158 | -.126 | .128 | .090 | .108 | .115 | 1 | .354* | -.075 | -.056 | .332 |
| | Sig. (2-tailed) | .981 | .380 | .486 | .479 | .620 | .549 | .523 | | .043 | .679 | .757 | .059 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Improved access and cooperation | Pearson Correlation | .066 | .228 | .261 | .219 | .326 | .248 | .266 | .354* | 1 | .357* | .143 | .056 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| with external partners | Sig. (2-tailed) | .713 | .201 | .143 | .221 | .064 | .164 | .134 | .043 | | .041 | .428 | .758 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Advanced technology and knowledge acquisition | Pearson Correlation | -.005 | .393* | .520** | .408* | -.160 | .679** | .379* | -.075 | .357* | 1 | .446** | .013 |
| | Sig. (2-tailed) | .978 | .024 | .002 | .018 | .374 | .000 | .030 | .679 | .041 | | .009 | .942 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Meeting financial objectives | Pearson Correlation | .302 | .279 | .360* | .212 | .185 | .420* | -.047 | -.056 | .143 | .446** | 1 | .289 |
| | Sig. (2-tailed) | .088 | .116 | .039 | .237 | .303 | .015 | .797 | .757 | .428 | .009 | | .103 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Being more innovative in the market | Pearson Correlation | .217 | .408* | -.136 | .373* | .107 | .044 | -.386* | .332 | .056 | .013 | .289 | 1 |
| | Sig. (2-tailed) | .224 | .018 | .450 | .032 | .552 | .808 | .027 | .059 | .758 | .942 | .103 | |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| *. Correlation is significant at the 0.05 level (2-tailed). | | | | | | | | | | | | | |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | | | | | | | | | |

From the results in Table 5.21 above, adequate time allocation for innovation projects was moderately positively correlated with employee incentives for external collaborations, *r* (0.373*) = 0.373, *p* = 0.033. Leadership support for external collaborations was found to be moderately positively correlated with employee incentives for external collaborations, *r* (0.444*) = 0.444, *p* = 0.010, moderately positively correlated with increased external knowledge sharing, *r* (0.378*) = 0.378, *p* = 0.030, strongly positively correlated with, from idea generation, *r* (0.457**) = 0.457, *p* = 0.008. The results also show that adequate time allocation for innovation projects was moderately positively correlated with advanced technology and knowledge acquisition, *r* (0.393*) = 0.393, *p* = 0.024, and moderately positively correlated with being more innovative in the market, r (0.408*) = 0.408, *p* = 0.018.

Table 5.21 above also shows that employee incentives for external collaborations was found to be strongly positively correlated with, from idea generation, *r* (0.632**) = 0.632, *p* = 0.000, moderately positively correlated with seeking new outside applications for internally developed innovations, knowledge, tools and ideas, *r* (0.409*) = 0.409, *p* = 0.018. Employee incentives for external collaboration was also found to be strongly positively correlated with advanced technology and knowledge acquisition, *r* (0.520**) = 0.520, *p* = 0.002 and moderately positively correlated with meeting financial objectives, *r* (0.360*) = 0.360, *p* = 0.039. Increased external knowledge sharing was found to be moderately positively correlated with advanced technology and knowledge acquisition, *r* (0.408*) = 0.408, *p* = 0.018, and moderately positively correlated with being more innovative in the market, *r* (0.373*) = 0.373, *p* = 0.032.

Regarding the results in Table 5.21, idea generation was strongly correlated with seeking new outside applications for internally developed innovations, knowledge, tools, and ideas, *r* (0.539**) = 0.539, *p* = 0.001. Also found to be strongly positively correlated with advanced technology and knowledge acquisition, *r* (0.679**) = 0.679, *p* = 0.000 and moderately positively correlated with meeting financial objectives, *r* (0.420*) = 0.420, *p* = 0.015. The results also show that seeking new outside applications for internally developed innovations, knowledge, tools, and ideas were found to be moderately positively correlated with advanced technology and knowledge acquisition, $r$ (0.379*) = 0.379, $p$ = 0.030 and also moderately positively correlated with being more innovative in the market, $r$ (0.386*) = 0.386, $p$ = 0.027. The synergy created from combining knowledge among participating firms was moderately positively correlated with improved access and cooperation with external partners, $r$ (0.354*) = 0.354, $p$ = 0.043.

Table 5.21 also indicates that improved access and cooperation with external partners were moderately positively correlated with advanced technology and knowledge acquisition, $r$ (0.357*) = 0.357, $p$ = 0.041. Advanced technology and knowledge acquisition were strongly positively correlated with meeting financial objectives, $r$ (0.446**) = 0.446, $p$ = 0.009.

### 5.4.5 Research Question 5:

What is the impact of open innovation strategies on new product development prospects?

Table 5.22 below shows the inferential correlation statistics measuring the impact of open innovation strategies on new product development prospects.

## Table 5.22 Impact of OI Strategies on New Product Development

| CORRELATIONS | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Adequate time allocation for innovation projects | Leadership support for external collaborations | Employee incentives for external collaborations | Increased external knowledge sharing | Driven by Universities and research centres | From idea generation | Seeking new outside applications for internally developed | The synergy created from combining knowledge among | Improved access and cooperation with external partners | Advanced technology and knowledge acquisition | Meeting financial objectives | Being more innovative in the market |
| Adequate time allocation for innovation projects | Pearson Correlation | 1 | .308 | .373* | .310 | -.129 | .249 | .162 | .004 | .066 | -.005 | .302 | .217 |
| | Sig. (2-tailed) | | .081 | .033 | .079 | .473 | .162 | .367 | .981 | .713 | .978 | .088 | .224 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Leadership support for external collaborations | Pearson Correlation | .308 | 1 | .444** | .378* | .028 | .457** | .180 | .158 | .228 | .393* | .279 | .408* |
| | Sig. (2-tailed) | .081 | | .010 | .030 | .877 | .008 | .316 | .380 | .201 | .024 | .116 | .018 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Employee incentives for external collaborations | Pearson Correlation | .373* | .444** | 1 | .205 | -.179 | .632** | .409* | -.126 | .261 | .520** | .360* | -.136 |
| | Sig. (2-tailed) | .033 | .010 | | .252 | .319 | .000 | .018 | .486 | .143 | .002 | .039 | .450 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Increased external knowledge sharing | Pearson Correlation | .310 | .378* | .205 | 1 | -.222 | .149 | -.051 | .128 | .219 | .408* | .212 | .373* |
| | Sig. (2-tailed) | .079 | .030 | .252 | | .214 | .409 | .776 | .479 | .221 | .018 | .237 | .032 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Driven by Universities and research centres | Pearson Correlation | -.129 | .028 | -.179 | -.222 | 1 | -.060 | -.183 | .090 | .326 | -.160 | .185 | .107 |
| | Sig. (2-tailed) | .473 | .877 | .319 | .214 | | .740 | .309 | .620 | .064 | .374 | .303 | .552 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| From idea generation | Pearson Correlation | .249 | .457** | .632** | .149 | -.060 | 1 | .539** | .108 | .248 | .679** | .420* | .044 |
| | Sig. (2-tailed) | .162 | .008 | .000 | .409 | .740 | | .001 | .549 | .164 | .000 | .015 | .808 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Seeking new outside applications for internally developed innovations, knowledge, tools and ideas | Pearson Correlation | .162 | .180 | .409* | -.051 | -.183 | .539** | 1 | .115 | .266 | .379* | -.047 | -.386* |
| | Sig. (2-tailed) | .367 | .316 | .018 | .776 | .309 | .001 | | .523 | .134 | .030 | .797 | .027 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| The synergy created from combining knowledge among participating firms | Pearson Correlation | .004 | .158 | -.126 | .128 | .090 | .108 | .115 | 1 | .354* | -.075 | -.056 | .332 |
| | Sig. (2-tailed) | .981 | .380 | .486 | .479 | .620 | .549 | .523 | | .043 | .679 | .757 | .059 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Improved access and cooperation with external partners | Pearson Correlation | .066 | .228 | .261 | .219 | .326 | .248 | .266 | .354* | 1 | .357* | .143 | .056 |
| | Sig. (2-tailed) | .713 | .201 | .143 | .221 | .064 | .164 | .134 | .043 | | .041 | .428 | .758 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Advanced technology and knowledge acquisition | Pearson Correlation | -.005 | .393* | .520** | .408* | -.160 | .679** | .379* | -.075 | .357* | 1 | .446** | .013 |
| | Sig. (2-tailed) | .978 | .024 | .002 | .018 | .374 | .000 | .030 | .679 | .041 | | .009 | .942 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Meeting financial objectives | Pearson Correlation | .302 | .279 | .360* | .212 | .185 | .420* | -.047 | -.056 | .143 | .446** | 1 | .289 |
| | Sig. (2-tailed) | .088 | .116 | .039 | .237 | .303 | .015 | .797 | .757 | .428 | .009 | | .103 |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |
| Being more innovative in the market | Pearson Correlation | .217 | .408* | -.136 | .373* | .107 | .044 | -.386* | .332 | .056 | .013 | .289 | 1 |
| | Sig. (2-tailed) | .224 | .018 | .450 | .032 | .552 | .808 | .027 | .059 | .758 | .942 | .103 | |
| | N | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 |

| |
|---|
| *. Correlation is significant at the 0.05 level (2-tailed). |
| **. Correlation is significant at the 0.01 level (2-tailed). |

Table 5.22 above indicates that from an idea generation perspective, it is important to positively impact seeking new outside applications for internally developed innovations, knowledge, tools and ideas, *r* (0.539**) = 0.539, *p* = 0.001. From idea generation was also found to be having a strong positive impact on process of new product / processes development, *r* (0.556**) = 0.556, *p* = 0.001, strong positive impact on introduction of new products / processes development *r* (0.497**) = 0.497, *p* = 0.003. “Seeking new outside applications for internally developed innovations, knowledge, tools, and ideas” were found to be having a strong positive impact on the process of new product/processes development, *r* (0.518**) = 0.518, *p* = 0.002.

The results also show that synergy created from combining knowledge among participating firms is having a strong positive impact on the opening of new markets, *r* (0.631**) = 0.631, *p* = 0.000. Process of new product / processes development was found to be having a strong positive impact on introduction of new products / processes development, *r* (0.697**) = 0.697, *p* = 0.000 and a strong positive impact on introduction of new processes/ services, *r* (0.455**) = 0.455, *p* = 0.008. On the other hand, the introduction of new products/processes development had a strong positive impact on the introduction of new processes/ services, *r* (0.455**) = 0.455, *p* = 0.008, while the introduction of new processes/services has a strong positive impact on the opening of new markets, *r* (0.459**) = 0.459, *p* = 0.008.

### 5.4.6 Research Question 6:

What proposed contextual open innovation adoption model is applicable for the ACMs in the automotive industry?

Bryman and Bell (2011) say that factor analysis is employed to multiple-indicator measures to determine whether groups of indicators tend to bunch together to form distinct clusters, referred to as factors. Its main goal is to reduce the number of variables. Researchers sometimes use factor analysis to establish whether the dimensions of a measure they expect to exist can be confirmed. Against this background, the researcher opted to employ factor analysis, particularly principal components analysis in this study, specifically for research question six.

The principal components analysis, followed by a varimax rotation, extracted fifteen components with eigenvalues greater than one. The fifteen components accounted for 89.4% of the total variance, as shown in Table 5.23 below. The total variance explained is very important because it gives and explains the extent to which the factors extracted explain the phenomenon under study: proposed open innovation.

TABLE 5.23 VARIANCE WITH EIGENVALUES GREATER THAN ONE

| TOTAL VARIANCE EXPLAINED | | | | | | |
|---|---|---|---|---|---|---|
| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 11.117 | 20.588 | 20.588 | 11.117 | 20.588 | 20.588 |
| 2 | 6.869 | 12.720 | 33.308 | 6.869 | 12.720 | 33.308 |
| 3 | 4.910 | 9.093 | 42.400 | 4.910 | 9.093 | 42.400 |
| 4 | 4.255 | 7.879 | 50.280 | 4.255 | 7.879 | 50.280 |
| 5 | 3.355 | 6.212 | 56.492 | 3.355 | 6.212 | 56.492 |
| 6 | 3.136 | 5.807 | 62.299 | 3.136 | 5.807 | 62.299 |
| 7 | 2.469 | 4.573 | 66.872 | 2.469 | 4.573 | 66.872 |
| 8 | 2.125 | 3.935 | 70.807 | 2.125 | 3.935 | 70.807 |
| 9 | 1.924 | 3.563 | 74.370 | 1.924 | 3.563 | 74.370 |
| 10 | 1.817 | 3.364 | 77.734 | 1.817 | 3.364 | 77.734 |
| 11 | 1.665 | 3.084 | 80.818 | 1.665 | 3.084 | 80.818 |
| 12 | 1.346 | 2.492 | 83.310 | 1.346 | 2.492 | 83.310 |
| 13 | 1.193 | 2.210 | 85.520 | 1.193 | 2.210 | 85.520 |
| 14 | 1.055 | 1.954 | 87.474 | 1.055 | 1.954 | 87.474 |
| 15 | 1.017 | 1.884 | 89.358 | 1.017 | 1.884 | 89.358 |

Innovation adoption model or framework. Given the large number of items entered in this analysis, it represents a satisfactory solution. The number of components extracted generally lies in the range of K/3 and K/7, where K represents the number of variables entered into the analysis (Tabachnick & Fidel, 1996).

The scree plot graph can also assist in appreciating the usefulness of factor analysis. It graphs the eigenvalue against the component number—these values presented in the first column of Table 5.23 above. From the fifteen components, we can see that the line on the scree plot in Figure 5.2 below is almost flat, meaning that each successive component is accounting for smaller and smaller amounts of the total variance. In general, according to factor analysis, the interest is in keeping only those principal components whose eigenvalues are more significant than 1.

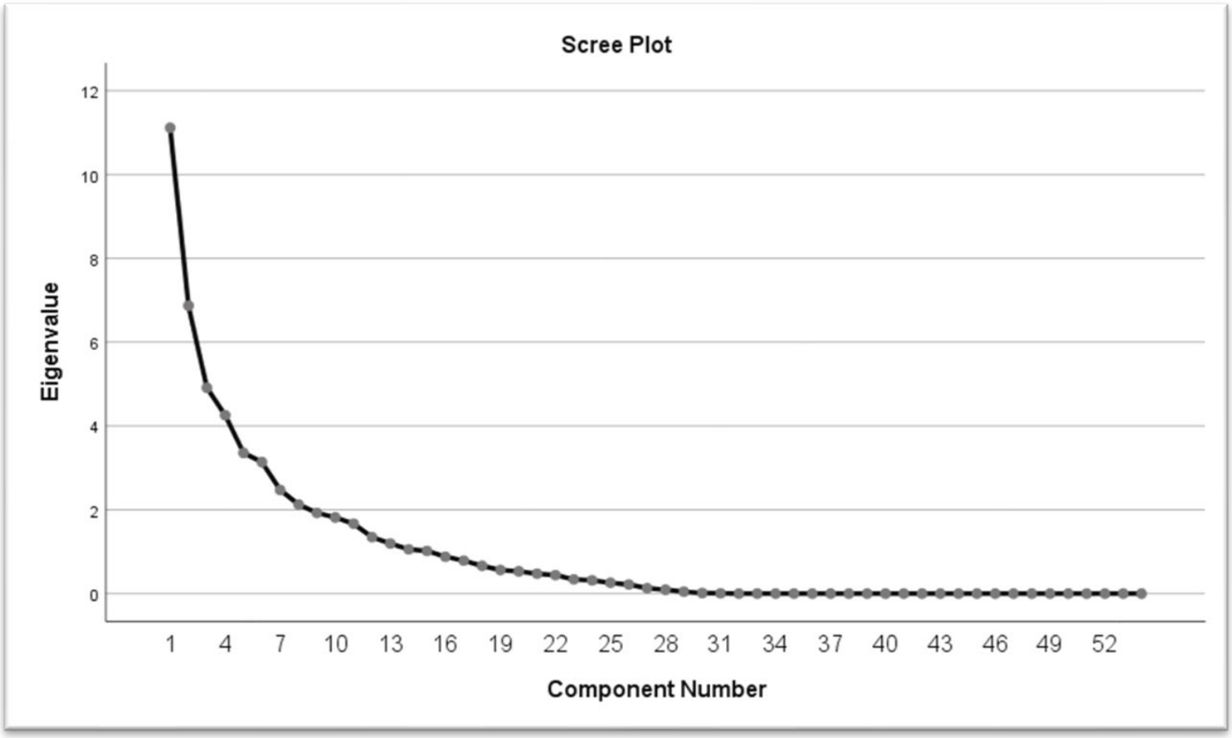


**FIGURE 5.2 SCREE PLOT GRAPH FOR THE 15-FACTOR COMPONENTS EXTRACTED**

#### 5.4.6.1 Rotated principal component loading

The rotated principal component loading or rotated matrix indicates which factors are related and to what extent the factors are related. In this case, the researcher settled for the eight-factor components or dimensions that appeared to comprehensively relate and make up the phenomenon under study after eliminating potential factor dimensions 5, 7, 9, 10, 11, 13 and 15. The rotated factor component loadings are items of the primary loading, eight-factor dimensions. For each item, only the ‘primary’ loading is (that is, the highest loading for that item across the factors); the only items with primary loadings on factors, one through eight, are included and present both primary and minor loadings for all items.

**TABLE 5.24 TOTAL VARIANCE EXPLAINED ON OI ADOPTION MODEL**

| TOTAL VARIANCE EXPLAINED | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
| | Total | % of Var. | Cum. % | Total | % of Var. | Cum. % | Total | % of Var. | Cum. % |
| 1 | 16.896 | 29.641 | 29.641 | 16.896 | 29.641 | 29.641 | 5.316 | 9.326 | 9.326 |
| 2 | 3.321 | 5.827 | 35.468 | 3.321 | 5.827 | 35.468 | 5.220 | 9.158 | 18.483 |
| 3 | 2.390 | 4.193 | 39.661 | 2.390 | 4.193 | 39.661 | 5.037 | 8.837 | 27.320 |
| 4 | 2.146 | 3.764 | 43.425 | 2.146 | 3.764 | 43.425 | 4.037 | 7.083 | 34.403 |
| 5 | 1.855 | 3.254 | 46.680 | 1.855 | 3.254 | 46.680 | 3.769 | 6.612 | 41.015 |
| 6 | 1.769 | 3.104 | 49.783 | 1.769 | 3.104 | 49.783 | 3.268 | 5.734 | 46.749 |
| 7 | 1.674 | 2.936 | 52.720 | 1.674 | 2.936 | 52.720 | 2.977 | 5.223 | 51.972 |
| 8 | 1.605 | 2.816 | 55.536 | 1.605 | 2.816 | 55.536 | 2.031 | 3.564 | 55.536 |

The results of principal components factor analysis in Table 5.24 above show that the phenomenon under study, the proposed contextual open innovation adoption model, is explained and accounted for up to 55.5%. There are eight groupings or components on the elements of the proposed contextual open innovation model.

As indicated, component or factor dimension one labelled, ‘versatile in seeking new outside applications for internally developed innovations, knowledge, tools and ideas'; 'collaboration in manufacturing; mutual commercialisation interests in collaborative work with partners'; the invention is driven by suppliers, accounted for the most significant percentage of the variance of 29.6% out of the maximum of 55.5%. This large percentage of variance means that the factor constitutes the most critical elements of the phenomenon under study.

The following component or factor 2, is labelled, 'versatile in personal drive and convictions for sharing important innovations with external parties'; 'collaborative idea generation'; 'commercialisation synergies created from combining knowledge among participating firms'; and 'original equipment manufacturers drive inventions,' accounted for 5.8%. Together with the other factor variance cumulatively, this current factor variance accounted for the variance up to 35.5%.

Factor or component 3, labelled, 'versatile in observation of non-disclosure and other contractual agreements; collaborative commercialisation; high level of trust among the partnering commercialisation parties; and inventions driven by competitors within the industry,' accounted for 4.2% and raising the cumulative variance to 39.7%.

Following is factor or component 4, labelled, 'versatile in safeguarding trade secrets; collaborative experimentation; commercialisation through access to partners` technological resources; and inventions driven by Government agencies,' accounted for 3.8%, and added to the cumulative variance 43.4%.

Component or factor 5, labelled, 'versatile in the protection of copyrights; commercialisation by sharing of identical management styles; and Universities and research centres drive inventions', accounted for 3.3%. They were cumulatively rising to the variance of 46.7%.

The next factor or component 6, labelled ‘versatile in sharing important innovation with external stakeholders; commercialisation through matching technological competencies; and inventions driven by competitors in other industries,’ accounted for 3.1% and auditing to the cumulative variance of up to 49.8%.

Factor or component 7, labelled ‘inventive through being more innovative in the market; introduction of new products/processes development, and opening new markets,’ accounted for 2.9% and cumulatively raising the overall variance to 52.7%.

Finally, the last factor or component 8, labelled, ‘from idea generation; the process of new product/processes development; and introduction of new processes/ services,’ accounted for 2.8%, pushing the overall cumulative total variance to 55.5%.

There is a comprehensive discussion of the factor dimensions extracted by the principal components factor analysis in chapter 4, and it informs the construction of the proposed contextual open innovation adoption model or framework for the automotive industry.

## 5.5 ANALYSIS OF QUALITATIVE DATA

Qualitative data analysis conducted in this study served as a basis for ensuring that the qualitative data collected through the interview protocol or schedule were systematised and thematically organised to constitute part of the combined data and triangulated with the quantitative data collected through the questionnaire. This study's qualitative data analysis processes concluded by describing the emerging thematic patterns and relationships in the phenomenon under study. As a result, these thematic patterns and relationships that emerged and were identified during the data analysis process corroborated the qualitative data and contributed towards the proposed contextual open innovation adoption model comprehensively described and framed in chapter 5 of this study. To maintain the anonymity of the organisations that participated in this research, they shall be referred to as company (W, X, Y, Z).

### 5.5.1 Research Question 1:

*What is the nature and extent of ACMs` open innovation strategic alignment for sustainable competitive advantage in the automotive industry?*

According to Chesbrough (2006), open innovation is the utilisation of purposeful inflows and outflows of knowledge to help speed up internal innovation while at the same time striving to expand markets for external consumption and use of the innovation. In other words, open innovation entails strategic management of exchanges of knowledge and information with partners or actors outside the organisations, targeted at the integration of the organisational strategic resources and knowledge into the organisations' innovative processes.

Chief Executive Officer 1 had the following to say,

*"The fundamental principles for the success of open innovation initiatives are the ability within the top organisational management to be able to set plans and organise the innovation activities that are linked and drive the organisation`s sustainable competitive advantage in this industry. Embedded in the organisation`s culture is the ability of the executives to see these things with the same eye. There must be strategic alignment in thinking, in understanding and way forward in pushing this open innovation trajectory".* (Company X, EasternCape)

Senior Manager 3, who suggested the following, corroborated the views of the Chief Executive Officer,

"Like any other strategic initiative by us, open innovation requires careful planning, organising, staffing, controlling…uhm, by a dedicated team of managers, working together in harmony, in the same mind and vision, not half-hearted, it must be dedicated persons - that is essential for me.” (Company Z, Gauteng)

Chief Executive Officer 2 was quite elaborate on this concept of open innovation and how they are implementing open innovation in their automotive component manufacturing firm. He had the following to say,

“It takes basic knowledge of what open innovation is, its environment, its constituencies both within the organisation and externally and also the necessary skills and expertise that are required to be able to handle and drive the organisation`s open innovation initiatives. These skills mean a lot about the people involved. Think in the first instance; these persons should be strategists, uhm…. not on their capacities but as a collective body of top management to understand the strategic positioning of the company`s open innovation plans. Strategically going from innovative products, processes so forth…and to a great sustainable competitive advantage, if that is the decision. So, these persons should be strategists, strategic, understand the strategy, understand structure relationships, and understand the implementation of the open innovation strategy. What does it look like on the ground? They have to bear that in mind.” (Company W, Gauteng)

It is clear from the participants` views that at the centre of successful adoption and implementation of open innovation lies the abilities of top managers to work together and understand the strategic direction that the firm seeks to take in its open innovation adoption. In other words, when executives do not support the firm`s open innovation strategic initiatives, they are bound to fail. Strategic alignment among the top management is critical for the success of organisational open innovation adoption.

### 5.5.2 Research Question 2:

*What are the automotive components manufacturers' open innovation challenges and their influence on risk exposure profiles?*

Innovation is critical, and it drives the long-term competitiveness and survival of businesses (Van de Ven, 2008). According to the South African Automotive Masterplan (Barnes et al. 2018), the South African automotive industry faces many open innovation adoption competitiveness challenges. This industry contributes marginally to the global market, which is characterised by comparatively small automotive assembling plants, relying on the underdeveloped automotive components sector. However, this scenario is common for both developing and developed competing economies.

Senior Manager 1 raised the following concerns as the open innovation adoption challenges,

*"Our major challenge is the risk-related challenges that are inherent, such as risk related to the uncertainties surrounding the innovation project outcomes. The probabilities that the desired results or outcomes of innovation are unsuccessful and inevitable. As small businesses, unlike large corporations, we do not have extensive resources and knowledge bases. As a result, survival becomes difficult and later on prospering under the attacks of economic downturns, for example. In a nutshell, the risks of innovation projects and product failure remains there."* (Company Y, KwaZulu Natal)

In addition to the above, Senior Manager 2 had this to say,

*"We find challenges in our efforts to implement innovative ideas. Challenges of lack of resources* include *limited access to money from the financial market, knowledgeable people, right relationships and networks, legal resources information, and other relevant resources. This makes us unable to action our innovative ideas, while our potential competitors, large corporations, benefit from economies of scale; we suffer diseconomies of scale and scope and continue to see our variable costs rising higher and higher."* (Company Y, KwaZulu Natal)

Chief Executive Officer 2 had the following observations,

*"It is important that we remain capable of innovating if we are to withstand the rising competition in our industry. A lack of capabilities hampers our competitiveness to renew themselves, for example, in readiness and response to environmental changes and demands for innovation that remain a strategic issue and driver for competitiveness. Failure to utilize the knowledge that we acquire from outside our organisation remains a serious cause for concern, and our absorptive capabilities are weak in terms of manufacturing facilities, marketing channels, supply chains, and ability to produce and distribute products to our potential customers."* (Company W, Gauteng)

In summary, the participants raised their concerns for challenges that the ACMs face in their adoption of open innovation. These challenges ranged from lack of resources, exposure to risks and lack of capabilities.

### 5.5.3 Research Question 3:

What is the nature and extent of erosion factors among the ACMs?

Erosion factors include, among many, such factors as the increasing mobility of employees, universities becoming more capable, declining country hegemony, and increasing access to start-up venture capital. These erosion factors have changed the conditions under which firms innovate. The automotive industry in South Africa is not an exception. In essence, erosion factors are at the centre and a core of why open innovation defines and reflects a paradigm shift as underlying assumptions, solutions, problems, and methodologies for conducting research and practices of the 21st industrial century industrial of innovation (Chesbrough, 2006).

Senior Manager 3 had this to say regarding the open innovation erosion factors, *“In our efforts to continue innovating and reaping the befits of first-mover, we find ourselves gradually eroded in terms of ability to leverage inflows and outflows of knowledge within and across our business boundaries, abilities to manipulate or leverage external sources of knowledge in particular and see our commercialisation paths carved. We find ourselves gradually losing our positions as integrators of technology internally and externally in the automotive industry.”*(Company Z, Gauteng)

Chief Executive Officer 1 corroborated the above assertions as follows.

*“From a strategic point of view, while benefits are accruing to us as we engage in open innovation, there is a trade-off or what economics would refer to as opportunity costs…uhm, open innovation renders us vulnerable and susceptible to skills migration to our competitors. Inbound knowledge from suppliers increases, which affects our claims on purposive inflows and outflows of knowledge; at the same time, we are experiencing increased knowledge exploration and exploitation from the original equipment manufacturers. Research and development costs, in the long run, become unsustainable.”*(Company X, Eastern Cape*)*

Erosion factors are the downside of open innovation. However, the benefits of innovation outweigh the negative impacts of engaging in open innovation. In essence, erosion factors, evidence of spillover effects of open innovation.

### 5.5.4 Research Question 4:

*What relationship exists between organisational culture, open innovation, and competitiveness?*

Organisational culture is the assortment of standard values, beliefs, habits, norms, representations, and behaviours commonly shared by the organisation`s members. Organisational culture serves as the social cement cementing the life of organisations. It is also a powerful management instrument and tool that allows organisational members to act consistently and independently. On the other hand, innovation culture is a distinct and particular configuration that stimulates innovative thinking within organisations and encourages innovation initiatives and activities at the organisational leadership level as well as within all organisational employees (Rahman and Ramos, 2010).

Chief Executive Officer 2 motivated his thoughts on the phenomenon as follows,

*"Organisational culture lies at the heart of successful open innovation….mm…particularly the culture of fostering independent thinking among top organisational management. The whole thing begins with individual idea generation, promoting new ideas through external engagements by seeking new outside applications for internally developed innovations and knowledge. Without cultivating the right culture, the culture that promotes individual independent thinking engaging in open innovation becomes a futile activity. There is a correlation between sound organisational culture and open innovation efforts and activities."*(Company W, Gauteng)

Like any other competitiveness driving strategic management trajectories, open innovation hinges on the embedded organisational culture. In essence, organisational culture is the driving force behind these business competitiveness drivers.

Chief Executive Officer 1 had the following to say,

*"As a competitive firm, we are small as we need to cultivate a culture of encouraging workers creativity and leadership support for external collaboration and external knowledge sharing. This culture is the starting point...hmmm...the initial step in innovation. There is a positive correlation between organisational culture and innovation. Knowledge acquisition is key and technological advancement*."(Company X, Eastern Cape)

Senior Manager 2 expressed himself as follows, *"Since engaging in consistent innovation in terms of new products, new processes, quick and positive response to market demand changes, and customer preferences, we have seen our financial performance improving tremendously. We have been able to meet our set financial objectives to the satisfaction of our shareholders."*(Company Y, KwaZulu Natal)

Senior Manager 3 had this to say,

*"Innovation can be in the form of new products, new services, processes, or novel technology converted to a monetary value for the good of the company. It is our duty as management just to do that; otherwise, all the technical knowledge and creativity becomes useless."*(Company Z, Gauteng)

It is pretty clear from the participants' responses that organisational culture plays a critical role in driving organisational innovation initiatives to create needed sustainable competitive advantage. Alternatively, there is a positive correlation, moderate or intense, existing between organisational culture and innovation initiatives for competitiveness.

**5.5.5 Research Question 5:**

*What is the impact of open innovation strategies on new product development prospects?*

Open innovation identifies new product development prospects and performance with the aid of organisational internal R&D activity. R&D provides new product development needs solely, while open innovation needs external sources such as external knowledge of expert individuals, ideas of customers, and technologies (Chiaroni et al. 2011; Trott, 2008). There are several attempts concerning open innovation models with the notion that openness could steer and stimulate the processes of innovation by integrating large and different pools of external sources, resulting in increased product development diversity and optimal matching of consumer preferences and products (Boudreau, 2006; Chesbrough, 2003; Von Hippel, 2005).

Senior Manager 1 intimated as follows,

*"It takes new idea generation and pushing these ideas through by seeking new outside applications for these internally generated new ideas to fruition as developed innovations, developed new knowledge, developed new processes and tools."*(Company Y, KwaZulu Natal)

In support of Senior Manager 1, Senior Manager 3 suggested as follows,

*"Open innovation hinges on open-mindedness and creativity in coming up with new products, new processes, and services to sustain the livelihood of the company bearing in mind that successful development of new ideas requires various stakeholders' input and several different sources such as competitors, suppliers, customers, other industries and employers of course."*(Company Z, Gauteng)

Chief Executive Officer 2 could only say,

*"Innovation in new product development only takes creative minds…nhm...creativity, creativity, no more, no less."*(Company W, Gauteng)

From the participants' assertions, open innovation does impact new product development prospects for the ACMs. There was one thing in common, what all the participants said in response. At the centre of new product development, new processes and services lie individual creativity and open-mindedness.

Table 5.25 summarises the participants` responses and findings concerning the study`s research questions.

TABLE 5.25 EMERGED THEMES SUMMARY OF FINDINGS ON RESEARCH QUESTION ONE

| EMERGED THEMES SUMMARY | | | |
|---|---|---|---|
| **Research Question** | **Category** | **Central theme** | **Interviewee** |
| "The nature and extent of ACMs open innovation strategic alignment for sustainable competitive advantage in the automotive industry"- derived from research question 1 | (i) Similar executive management strategic thinking and open innovation orientation. | Strategic alignment | CEO 1 |
| | (ii) Same level and degree of management commitment to open innovation initiatives. | Open-mindedness | Senior Manager 3, |
| | (iii) Willingness to explore external knowledge acquisition | Inbound and outbound focus | CEO 2 |
| | | External knowledge acquisition | |
| "The automotive components manufacturers open innovation challenges and their influence on risks exposure profiles"- derived from research question 2 | (i) Uncertainty surrounding open innovation projects outcomes | ➢ Inherent risks exposure | Senior Manager 1, |
| | (ii) Limited resources to drive open innovation initiatives | ➢ Diminishing competitiveness | CEO 2 |
| | (iii) Lack of capabilities to drive forward open innovation initiatives | | |
| "The nature and extent of erosion factors among the ACMs"- derived from research question 3 | (i) The increasing loss of ability to leverage inflows and outflows of knowledge within and across organisational businesses' boundaries | ➢ Erosion of open innovation benefits | Senior Manager 3, |
| | (ii) Increased loss of integrator of technology internally and externally in the automotive industry status | ➢ Eroded investment returns | CEO 1 |
| | (iii) Increased skills migration | | |

| | | | |
|---|---|---|---|
| “Relationship existing between organisational culture, open innovation and competitiveness”- derived from research question 4 | (i) Organisational culture as a primary driver for successful open innovation | Sustainable organizational culture | CEO 2, |
| | (ii) A culture that fosters leadership support for external collaboration and external knowledge sharing | External collaboration and knowledge sharing | CEO 1, |
| | (iii) The culture that fosters independent thinking among top organisational management | Individual independent thinking | Senior Manager 2, |
| | | | Senior Manager 3 |
| “The impact of open innovation strategies on new product development prospects”- derived from research question 5 | (i) Open-mindedness and creativity in coming up with new products | Openness | Senior Manager 1, |
| | (ii) Seeking new outside applications for these internally generated new ideas | Creativity | Senior Manager 3, |
| | | Outward looking | CEO 2 |
| | | New markets development | |

**5.6 CHAPTER SUMMARY**

This chapter covered data analysis and presentation of the results. The study employed a mixed research methodology. As a result, both qualitative data and quantitative data were collected and analysed quantitatively and qualitatively. Descriptive statistics and inferential statistics answered the study`s research questions that addressed the nature and extent of strategic alignment among the ACMs' top management, the challenges of adopting open innovation and their influence on risk exposure. The questions also addressed the open innovation erosion factors, the relationship existing between organisational culture, open innovation and competitiveness, and finally, the impact of open innovation strategies on new product development prospects.

The next chapter deals with the discussion of the results.

# CHAPTER SIX

## DISCUSSION OF THE RESULTS

### 6.1 INTRODUCTION

The present study was designed to examine the innovation challenges and prospects faced by ACMs and how they can strategically overcome them by embracing the concept of open innovation to enhance their competitiveness in the marketplace. This chapter presents the study`s results obtained from quantitative and qualitative data analysed in chapter five. The discussion of the empirical results and findings collates existing literature and critique where possible. The analysed data were collected using the instruments of a questionnaire and an interview protocol, personally administered to the management of the ACMs comprising of the Chief Executive Officers (CEOs), Senior Managers, Research and Development Managers, and others (Artisans). The process retained 33 personally administered questionnaires for analysis, and 5 Chief Executive Officers and Senior Managers targeted for in-depth interviews. The focus of the study was the ACMs in KwaZulu-Natal, Gauteng and Eastern Cape provinces. The primary quantitative data were analysed using SPSS version 25 for Windows, and descriptive and inferential statistics and principal components analysis generated to help answer the study`s research questions and achieve the objectives.

The results were analysed per each of the research questions and presented in the table and figure forms: as separate from the quantitative analysis section and the qualitative analysis section. The study`s questionnaire was constructed and structured into sections, each covering the study`s research questions over and above the general demographics of the respondents. The first section dealt with the open innovation strategic alignment issues, while the second section covered the open innovation challenges and their impact on risk exposure profiles, with the next section dealing with the open innovation erosion factors. The sections cover the relationship between organisational culture, open innovation and competitiveness, and the impact of open innovation strategies on new product development prospects. Descriptive statistics of the means and standard deviations, inferential statistics of the correlations, and principal components factor analysis helped analyse and compare the study`s variables as defined in the study`s objectives and the research questions.

The questionnaire went through several tests. These included the reliability test, which had satisfactory results at a level of the alpha coefficient higher than the benchmark of 0.7. Also conducted were measures of the appropriateness of factor analysis, and the Kaiser-Meyer Olkin measure of sampling adequacy was more than satisfactory at the level of 0.87. With the satisfactory results of these tests performed, the researcher proceeded with the rest of the statistical analysis to obtain the results comprehensively discussed below in terms of the study`s research objectives.

## 6.2 THE PRIMARY QUANTITATIVE RESULTS

### 6.2.1 Discussion

The following is a discussion of the first quantitative results about the study`s research objectives:

#### 6.2.1.1 Research Objective One:

> *To establish the nature and extent of ACMs` open innovation strategic alignment for sustainable competitive advantage in the automotive industry.*

This section discusses the nature and extent of open innovation strategic alignment between the ACMs

CEOs and their functional Senior Managers.

The results in chapter five established that the ACMs engage in a *versatile open innovation strategy*. For the studied automotive components manufacturers, their versatile open innovation strategy is characterised mainly by deliberate strategic seeking for external applications for internally developed innovations, internally developed knowledge, internally developed tools, and progressive ideas by the focal automotive component-manufacturing companies. These firms strategically leverage the potential external knowledge sources through their internal processes and take advantage of their being the focal automotive components manufacturers. The top management personnel of these ACMs portray a strong disposition towards being personally driven by conviction for sharing important organisational innovations with external parties, some of which may be competitors. This level of open-mindedness is buttressed by complete comprehension of the concept of open innovation and its strategic benefits accruing to the focal automotive component manufacturing company adopting open innovation, assists the management in understanding the trade-off that entirely exists between adopting open innovation and preceding the benefits of protection of copyrights and safeguarding trade secrets.

These results are in harmony with Cornell (2012). He suggests that versatility elevates the automotive firms in this category to the most reliable automotive components manufacturers as they become more and more open to potential external knowledge sources as they grow in versatility. As a result, these automotive components manufacturers have the potential of adopting opportunistic approaches to use different open innovation strategies, sub-strategies and combinations thereof in various situations; and when doing so, they could enhance their firm's performance and competitiveness (Reed, Storrud-Barnes and Jessup, 2012). They could also seek to approach the dynamically changing optimum equilibrium positions of depth (intensity) and breadth (scope) of open innovation activities to the point where the marginal benefits of the configuration of these activities equal the marginal costs of engaging in these innovation efforts.

There were varying views between the CEOs and their functional Senior Managers as indicated by the statistical results in chapter five regarding strategic seeking for new outside applications for internally developed innovations, knowledge, tools, and ideas while sharing important innovation with external stakeholders. These variances were evident due to the perceptions on personal drive and convictions for sharing important innovations with external parties, safeguarding trade secrets, observing non-disclosure and other contractual agreements, and protecting copyrights. Although the variance concerning the observation of non-disclosure and other contractual agreements was significant, the overall result is that there is strategic alignment between the ACMs and their functional Senior Managers for the versatile open innovation strategy. What this means is that the entire team of the top management of these ACMs share the same vision and aspirations of becoming reliable, versatile open innovating ACMs.

These results fit well with the views of other authors who see open innovation as an organisational cultural strategic issue that requires deliberate efforts by organisations to build teams of innovative leaders and managers to drive their open innovation trajectories (Cameron and Quinn, 2011; Christensen, Dyer and Gregersen, 2013; Amabile, Conti and Coon, 2016; Laloux, 2015). Leaders and managers are therefore critical role players in approaching organisations` innovation culture.

The results in chapter five also suggested that the ACMs could adopt the *collaborative open innovation strategy* to enhance their competitiveness. According to the ACMs studied, the collaborative open innovation strategy signifies strategic collaboration in manufacturing, collaborative idea generation; collaborative commercialisation and collaborative experimentation.

In this category as well, the CEOs and their functional Senior Managers did not show any significant variance in strategic alignment. The results did indicate some degrees of variance in the perception or views of the CEOs and Senior Managers regarding the option of collaborative open innovation strategising through collaborative manufacturing, collaborative idea generation, collaborative commercialisation and collaborative experimentation. These results prove that CEOs and functional Senior Managers are strategically aligned with the collaborative open innovation strategy as an alternative strategy that the ACMs could adapt or adopt to leverage their competitiveness.

There is strong evidence that the top management teams of the ACMs are fully aware of the strategic importance of collaborative open innovation. This assertion is in harmony with past studies and empirical evidence. Literature suggests that realisation and acknowledgement of lack of strength in both innovation exploration and exploitation capabilities by the ACMs motivate and drive them to seek collaborative open innovation as an alternative strategy (Poot et al., 2009; Cornell, 2012). While not having value creation or value capture strengths, these ACMs still have the potential strategic option to implement various open innovation collaboration strategies, allowing them to leverage the explorative and exploitative strengths of others, including their internal employees.

Concerning the *commercialisation of open innovation strategy*, the selected studied ACMs indicated that this strategy is driven or characterised by mutual interests in collaborating with partners and perceived synergies derived from combining knowledge among the participating partners. In other words, the commercialisation of open innovation strategy hinges on the ability of the ACMs to engage in mutual beneficiary collaborative interests and leverage the potential synergies that may accrue. However, there is a need for high levels of trust among the partnering parties, access to partners` technological resources, sharing identical management styles, and matching technological competencies. These aspects are critical to the competitiveness of the ACMs that seek to initiate and adopt open innovation.

The results indicated variances between the CEOs and Senior Managers in measuring the strategic alignment concerning the commercialisation of open innovation strategy. There were variances regarding the synergy created from combining knowledge among participating firms, mutual interest in working collaboratively, high level of trust among partners, sharing of identical management styles, matching technological competencies and access to partners' technological resources. However, none of these variances was statistically significant, resulting in strategic alignment between the ACMs` CEOs and senior managers to commercialise open innovation strategy.

According to Keupp and Gassmann (2009), the commercialising ACMs possess the strengths-focused on the commercialisation processes of converting external ideas into new products and new processes. In their efforts to commercialise, these ACMs include manufacturers and niche firms with specialised distribution channels and partner with them on mutually beneficial contracts. While the other alternative open innovation strategies offer the ACMs potential benefits from acquiring intellectual property, the commercialising or the commercialisation opens innovation strategy positions for the ACMs to consider inward open innovation as a viable strategic option, given their competitive strengths with bringing products to the markets (Lee et al., 2010; Cornell, 2012). It is clear from the results that these studied ACMs are fully aware of the potential benefits enunciated in the literature cited above that could accrue by adopting the commercialisation of open innovation strategy.

According to the results obtained in chapter five concerning *inventive open innovation strategy,* the ACMs revealed that inventions driven by suppliers drive this strategy; inventions driven by original equipment manufacturers; inventions driven by competitors within the industry; inventions driven by Government agencies; inventions driven by Universities and research centres; and inventions driven by competitors in other industries.

The essence of suppliers being proffered as the primary drivers of the inventive open innovation strategy clearly explains the importance of the quality of strategic raw materials for automotive components manufacturing. As a result, suppliers of these strategic raw materials play a critical role in successfully implementing the invention of open innovation strategy. The original equipment manufacturers set the tone for the specifications, brands and quality of the automotive components to be manufactured by the automotive components manufacturers. On the other hand, the competitors play a significant role in facilitating continuous improvement in the components' quality as they strategically seek to outwit each other in the market. These three parties contributing to the invention of open innovation strategy are the most critical, both technically and conceptually knowledgeable regarding the component products. Government agencies, universities and research centres play the very much needed role of support in facilitating research and development and knowledge creation.

Chief Executive Officers and their functional Senior Managers demonstrated that strategic alignment is essential to management teams in these ACMs. The variances in the perception or views of the CEOs and Senior Managers for the aspects of the inventive open innovation strategy, such as inventions driven by suppliers, driven by the original equipment manufacturers; driven by competitors in the industry, were not statistically significant as well as inventions that are driven by competitors in other industries, driven by Government agencies and those driven by Universities and research centres. The results affirmed that there is strategic alignment between the automotive components manufacturers CEOs and the companies' Senior Managers for inventive open innovation strategy as a potential alternative innovation strategy that could raise the competitiveness of the ACMs.

Lee et al. (2010) suggest the ACMs in this category of open innovation strategy possess strong knowledge creation (exploration) abilities (likely based on their unique configuration of resources and capabilities); however, they lack commercialisation (exploitation) capabilities. Further indicates that many of these ACMs are likely to fall into this category since many have difficulty and challenges with exploitation activities. It is clear from the results that the studied ACMs management is aware of the potential strategic benefits that accrue from adopting this category of open innovation strategies and leveraging their strong knowledge creation abilities and capabilities. These are prerequisite core competencies needed to drive competitiveness in this category of open innovation strategies.

In summary, the lessons drawn from the results concerning this study`s research objective and its related research question are that without strategic alignment between and among the top management of organisations, no strategy is successfully implementable. It is highly critical that before uniformity in understanding the organisational strategic intents, cascade down to the lowest levels of employees in the organisation, clear strategic thinking, conceptualisation, and an implementation road map in the minds of all the organisation's top management. Simply put, it is the organisation's strategic direction that should transcend individual perceptions and views.

#### 6.2.1.2 Research Objective Two:

*To ascertain what automotive components manufacturers' open innovation challenges affect the firms and their influence on risk exposure profiles.*

This section discusses the open innovation challenges that the automotive components manufacturers face in their adoption of the open innovation strategies and how these challenges influence the risks exposure of the ACMs.

The results in chapter 5 revealed that the ACMs meet several challenges when they initiate and adopt open innovations strategies. The most prominent challenge raised was that of risk exposure profiles that the firm experience. While these firms are susceptible to inherent industrial risks, they are individually affected by varying risks proportions depending on individual firm-specific factors such as core competencies they possess in their capacities. For example, their resources configuration, knowledge and capabilities differ, including their preference for the open innovation strategy category. Automotive component manufacturing firms in the inventive open innovation strategy category may possess more knowledge, but they may lack the capacity to commercialise their inventions. These results affirm the findings by several studies conducted on the phenomenon and they are quite in harmony.

The other challenges highlighted were resource constraints. Lack of resources or their limitation possesses severe limitations in innovation efforts. What it means is that the firms have to work within the constraints and try to optimise, while their competitors with much more resources continue enjoying and benefiting from economies of scale. Resource constraints severely curtail growth and the competitiveness of the ACMs is hampered (Barnes et al. 2018). These challenges include limited financial resources for R&D, restricted market influences, lower standing as innovation partners, cost of securing and enforcing intellectual property (IP) and less systematic management capability (Bianchi et al. 2010). Various authors (Raman and Ramos, 2010; Lee et al. 2010; Bianchi et al. 2010; Chesbrough, 2010) have noted that ACMs by nature possess limited resources and have less access to money, people, relationships, legal resources information and other resources, which makes them unable to act on or implement any of their innovative ideas. Lower economies of scale and scope and higher variable costs (Habaradas, 2009; Gnyawali and Park, 2009; Plein-Dujowich, 2009) have affected profitability.

The results also indicated that the ACMs are suffering the challenge of dynamic capability limitations. This means that these firms' capability to innovate is curtailed and limited, with the result that they cannot renew themselves in response to changes in the environment and strategic needs to innovate to boost competitiveness. Literature indicates that among many challenges, lack of commercialisation capabilities such as lack of manufacturing facilities, marketing channels, supply chains and lack of ability to produce and distribute products to customers inhibit the ACMs on the marketing front. They fail to utilise the knowledge acquired outside the organisations due to lack of absorptive capabilities (Chesbrough, 2010; Huang and Rice, 2009; Poot et al. 2009; Lee et al., 2010; Keupp and Gassmann, 2009; Rahman and Ramos, 2010; Bianchi et al., 2010; Enkel, Gassmann and Chesbrough, 2009).

The results indicated that lack of resources positively correlates with limitations in dynamic capabilities indicating that the more the automotive components manufacturers lack resources, the more it curtailed their dynamic capabilities or their capabilities to innovate. In other words, lack of resources exposes these firms to several risks’ profiles such as the negative impact on the firms` reputation, loss of human capital to competitors, lower returns from collaborative efforts. Lack of dynamic capabilities particularly exposes the ACMs to the risks of knowledge leakages and copyrights by competitors, and they find it challenging to protect their intellectual capital. These ACMs suffer exposure to their external partners' opportunistic behaviour who take advantage of their openness.

In summary, the ACMs face a cocktail of open innovation challenges in their efforts to innovate for competitiveness. The significant challenges are exposure to risks, lack of limited resources and limited dynamic capabilities to engage in innovation. However, what did come to the fore is that lack of resources is the leading cause of risk exposure to curtailing dynamic capabilities. That is, the more the lack of resources becomes a challenge, the more the ACMs suffer the challenge of lack of dynamic capabilities.

#### 6.2.1.3 Research Objective Three:

*To ascertain the nature and extent of erosion factors among the ACMs.*

This section deals with the discussion of nature and the extent of the open innovation erosion factors among the ACMs.

The results obtained indicate that the ACMs are engaging and adopting open innovation experience open innovation erosion factors such as decreasing in becoming integrators of technology internally and externally. That is, they gradually lose that vital identity. They also experience the negative impacts of increasing inbound knowledge from suppliers meaning suppliers' bargaining power increases to the disadvantage of the ACMs. Research and development costs also increase with time as new prospects for innovation emerge. There is an increase in knowledge exploitation and exploration from the original equipment manufacturers who take advantage of their size and stature. Venture capital support of new start-ups increases competition and affects the profitability and competitiveness of the existing ACMs, while skilled migration increases labour turnover challenges for the ACMs.

These results are in harmony, particularly with Chesbrough (2010), who summarises erosion factors to this effect, the erosion factors, such as increased employee mobility, increasing access of start-up funds from venture capital, the emergence of universities that are becoming more and more capable and declining country hegemony. These erosion factors have changed the manner and conditions under which companies innovate. Chesbrough (2010) proposes an additional erosion factor that enables companies to leverage increasing sources of knowledge, such as the rising usage of the Internet (and the reasonably incidental to rising of social media and networks). The Internet has facilitated access to knowledge and sharing of capabilities of previous company-specific internal Information Communication Technology networks to the World Wide Web. Also, the erosion factors lie at the centre and core of why open innovation defines and reflects a paradigm shift by challenging the status core, problems, underlying assumptions, solutions and methods for conducting research and practices of the 21st-century industrial innovation revolution.

In summary, while open innovation has several strategic benefits to ACMs such as competitiveness and profitability, the benefits come at a cost. As the firms adopt and implement open innovation, they experience erosion due to their being innovative and need to keep a watchful eye.

#### 6.2.1.4 Research Objective Four:

*To establish what relationship exists between organisational culture, open innovation, and competitiveness*

This section discusses the relationship that exists between organisational culture, open innovation and competitiveness.

As shown in the results in chapter five, organisational culture plays a critical role in the successful implementation of the ACMs' open innovation. It is also clear that corporate culture has a filtering effect on the firms` competitiveness. The culture that Forester's leadership support for external collaboration and giving enough time for innovation projects enhances and incentivises the innovators over and above financial relayed incentives offered by the firms. As employees are encouraged, and the environment allows them and exposes them to increased external knowledge sharing, idea generation increases. The results also indicate that extra time allocated for innovation projects gives the ACMs capabilities to amass advanced technology and knowledge acquisition. The impact of all these innovation activities is felt in the market as the competitiveness of these firms improves.

As employees receive incentives for external collaboration, idea generation increases and employees become motivated to seek new outside applications for their internally developed innovations, knowledge, tools and ideas, and increased acquisition of advanced technologies and knowledge to enhance the dynamic capabilities of these ACMs. The results indicate that these innovations and organisational cultural activities have a positive impact on the firms` financial objectives as their competitiveness is bound to improve. Increased external knowledge sharing, for example, increases advanced technology and knowledge acquisition and motivates the firms to be more innovative in the market.

The quest for idea generation strongly motivates the ACMs' employees to seek more new outside applications for their internally developed innovations, knowledge, tools and ideas, and in the process, the firms advance in new technologies and knowledge acquisition. As the firms become more innovative in the market, they create synergies from combining knowledge among participating firms, and this improves access and cooperation with their external partners. Improved access and cooperation with external partners enhance the space and opportunities for the ACMs to acquire advanced technology and knowledge, and their competitiveness improves as they meet financial objectives.

These results are in harmony with the literature. Organisational culture serves as social cement for the Organisation's life (Cameron and Quinn, 2011). Besides, it is a powerful management tool that allows organisational members to act independently and consistently (Christensen, 2011). As a result, corporate culture intimates that innovation culture is a peculiar configuration and disposition for innovative independent thinking that comes naturally within organisations and fosters innovation activities cutting across all levels of employees (Christensen, 2011). Strategically it is the responsibility of the top management of organisations to cultivate a culture of innovation in their organisations. The evolution of innovation culture in the organisation takes and requires changes that personally concern the administration or the leadership (Cameron and Quinn, 2011). For example, a firm may not move away and progress from traditional management approaches and modes that allow for independent management thinking, open-mindedness and external collaboration. These changes in the management philosophies require unwavering management support, notably support for external knowledge acquisition, seeking more new outside applications for the internally developed innovations, knowledge, tools and ideas (Laloux, 2015). The current management requires profound personal introspect and questioning in terms of abilities and capabilities.

In summary, organisational culture is critical to driving the ACMs` open innovation initiatives and achievement of competitiveness. An influential culture of management support for external collaboration and independent thinking is essential.

#### 6.2.1.5 Research Objective Five:

*To investigate the impact of open innovation strategies on new product development prospects.*

This section discusses the impact of open innovation strategies on the new product development prospects of ACMs.

The results obtained in chapter five indicate that idea generation positively influences the open innovation activity of seeking new outside applications for internally developed innovations, knowledge, tools and ideas on new product development. Idea generation also positively impacts new processes development as well as the introduction of new product development. The results also indicate that the synergies created from combining knowledge among participating firms have a positive, substantial impact on the opening of new markets for new products. The introduction of new processes or services has a strong positive impact on the opening of new markets for new products. New processes and services such as distribution channels and value chains are essential and critical for new product development.

Literature suggests that several attempts have proffered in open innovation strategies that at the centre of everything lies openness and its ability to stimulate innovation within firms by combining extensive and different pools of external sources resulting in increased diversified products and better processes of matching products to consumer preferences (Huizingh, 2010; Chiaroni et al. 2011; Boyer and Verma, 2009). Open innovation management creates and brings monetary values to innovative technological knowledge and individual creativity. Literature has, in recent years, popularised this model of bringing monetary value to innovation as open innovation (Van der Meer, 2007). However, open innovation is not a one-dimensional concept; it culminates in many tastes and forms, and although it adds to the richness of the open innovation concept, it hinders theory development (Huizingh, 2010). Above all, open innovation enables the identification of new product development performances, even in situations where internal R&D activities provide new product development needs solely and goes beyond by engaging external sources such as the knowledge of individuals as well as ideas from customers and technology (Chiaroni et al. 2011; Trott, 2008).

The automotive components manufacturers need innovators who create products, develop discovery skills and who believe that they can change the world (Christensen, Dyer and Gregersen, 2013) as they lead these innovative organisations. Organisational leadership and management play an essential role in staffing all organisational departments with innovative individuals (Christensen, Dyer and Gregersen, 2013) and encouraging employee creativity as the basis for innovation (Amabile, Conti and Coon, 1996).

In summary, new product development encompasses physical product development, processes development and services development, of which innovation plays a vital role in their achievement. New product development requires innovative employees, leaders and creative managers, believe in themselves and are driven by the quest for knowledge acquisition.

#### 6.2.1.6 Research Objective Six:

*To propose a contextual open innovation adoption model that applies to the ACMs in the automotive industry.*

This section deals with factor analysis and principal components analysis results conducted in chapter five to propose a contextual open innovation model or framework that could apply to the context of the automotive components manufacturers in the automotive industry in South Africa.

The principal components analysis initially extracted fifteen components with Eigenvalues greater than one and these fifteen components accounted for 89.4% of the variance in the constructs of open innovation strategies investigated. A further rotated principal component analysis was performed from these fifteen components and related factors loaded into eight components or dimensions. At their level of the total variance of 55.5%, the researcher believed these were enough to estimate the proposed open innovation model. Eight groupings or components of the elements of the proposed contextual open innovation model were established after the elimination of potential factor dimensions 5, 7, 9, 10, 11, 13, and 15.

Below are the factors loaded into each of the eight proposed components or factor dimensions.

#### *6.2.1.6.1 Component or Factor dimension 1:*

versatile in seeking new outside applications for internally developed innovations, knowledge, tools, and ideas

- collaboration in manufacturing
- mutual commercialisation interests in collaborative working with partners
- suppliers drive inventions

These elements of the factor dimension 1 constituted a total variance of 29.6% out of the maximum of 55.5%. This result indicates that the factor comprises the most critical elements of the phenomenon, proposed contextual open innovation model or framework that the automotive components manufacturers could adopt. Principal components analysis extracted factors from the versatile open innovation strategy, the collaborative open innovation strategy, commercialisation and inventive open innovation strategies.

These results depict a potential open innovation strategy that combines the most critical elements from the Cornell (2012) automotive component open innovation strategies model. In other words, the proposed model advocates for a much more integrated approach to open innovation strategies.

#### *6.2.1.6.2 Component or Factor dimension 2:*

versatile in personal drive and convictions for sharing important innovations with external parties

- collaborative idea generation
- commercialisation synergies created from combining knowledge among participating firms
- original equipment manufacturers drive inventions

This factor dimension accounts for 5.8% of the variance from the total of 55.5% and cumulatively accounts for 35.5% of the variance. The component or factor dimension proposes an integrated open innovation model or framework that also cuts across the four quadrants of the Cornell (2012) automotive component open innovation strategies model. The framework also emphasises a more integrated approach to alternative potential open innovation strategy.

#### *6.2.1.6.3 Component or Factor dimension 3:*

- versatile in observation of non-disclosure and other contractual agreements
- collaborative commercialisation
- high level of trust among the partnering commercialisation parties

- competitors within the industry drive inventions

This factor dimension accounts for 4.2% of the total variance of 55.5% and cumulatively accounts for 39.7% variance. Like the factor dimensions 1 and 2, this factor dimension proposes an open innovation strategy model that cuts across the Cornell (2012) automotive component open innovation strategies model quadrants. It also emphasises an integrated approach that integrates the key identified elements extracted from each quadrant of the Cornell (2012) model.

***6.2.1.6.4 Component or Factor dimension 4:***

- versatile in safeguarding trade secrets
- collaborative experimentation
- commercialisation through access to partners` technological resources
- Government agencies drive inventions

In this factor dimension, 3.8% of the total variance accounted for, and cumulatively 43.4% of the variance accommodated.  Although the factor dimension also proposes an integrated approach that cuts across the Cornell (2012) model quadrants, the element or factor extracted look and sound weak for an open innovation strategy model or framework.

***6.2.1.6.5 Component or Factor dimension 5:***

- versatile in the protection of copyrights

- commercialisation by sharing identical management styles

- Universities and research centres drive inventions

This factor dimension accounts for 3.3% of the total variance of 55.5% and cumulatively accounts for 46.7% of the total variance. The factor dimension eliminates collaboration of the open innovation strategy in the Cornell (2012) ACMs open innovation strategies model. This result defines a significant weakness in the model as a potential contextual open innovation framework or model that the ACMs could adopt.

***6.2.1.6.6 Component or Factor dimension 6:***

- versatile in sharing important innovation with external stakeholders

- commercialisation through matching technological competencies

- competitors in other industries drive inventions

This factor dimension accounts for 3.1% of the total variance of 55.5% and cumulatively accounts for 49.8% of the total variance. The factor dimension also eliminates collaboration of open innovation strategy in the Cornell (2012) ACMs' open innovation strategies model. Such a model would be significantly weak for a potential contextual open innovation framework or model that manufacturers could adopt.

***6.2.1.6.7 Component or Factor dimension 7:***

- inventive through being more innovative in the market

- introduction of new products/processes development

- opening new markets

This factor dimension accounts for only 2.9% of the total variance of 55.5%, and the model only identifies the invention through being more innovative in the market and being supported by a strategy to open new markets. The factor dimension proposes a weak framework or model for ACMs.

***6.2.1.6.8 Component or Factor dimension 8:***

- from idea generation

- process of new product/processes development

- introduction of new processes/ services

This factor dimension accounts for only 2.8% of the total variance of 55.5%, and the model does not identify any of the Cornell (2012) ACMs' open innovation strategies model quadrant. The factor dimension proposes a poorly structured framework or model for ACMs.

In summary, the principal components analysis performed in chapter five extracted eight potential factor dimensions that could use the basis for the structure of the proposed contextual open innovation model or framework that considers the context of the ACMs in the automotive industry. Based on the factor dimension`s variance that it accounts for towards the total variance of 55.5%, the study recommends factor dimension one as it accounts for a variance of 29.6% of the total variance of 55.5%. Factor dimensions 2, 3, and 4 can be integrated into factor dimension 1 to develop the proposed contextual open innovation model or framework that the ACMs could adopt. The basis for the integration is that the three-factor dimensions depict elements that cut across the four quadrants of the Cornell (2012) model.

## 6.3 THE PRIMARY QUALITATIVE RESULTS

### 6.3.1 Discussion

The following is an account of the primary qualitative results about the study`s research objectives.

### 6.3.2 Research Objective One:

> *To establish the nature and extent of ACMs` open innovation strategic alignment for sustainable competitive advantage in the automotive industry.*

The qualitative study was conducted concurrently with the quantitative research and not in a phase of its own. As a result, the results obtained corroborate the quantitative results of the investigation. It is clear from the results that the Chief Executive Officers 1 and 2 and the Senior Manager 3 interviewed had a common understanding of the nature of their automotive component open innovation strategies. All the participants interviewed had an evident appreciation that it takes basic knowledge of what open innovation is, its environment, its constituencies both within the organisation and externally, and the necessary skills and expertise required to be able to handle and drive the organisation's open innovation initiatives. The success of the organisation's open innovation strategies requires a dedicated team of managers, working together in harmony, in the same mind and vision. Precise strategic alignment between the management teams driving the organisations' open innovation is critical for its success. In other words, the people driving organisational open innovation initiatives need to be strategists, strategic, understand the strategy, understand structural relationships, and understand the implementation of open innovation strategies.

In summary, the qualitative results obtained through interviews of the CEOs and the automotive components' manufacturers Senior Managers corroborated the quantitative results and affirmed that there was strategic alignment between the CEOs and their functional Senior Managers.

### 6.3.3 Research Objective Two:

To ascertain what automotive components manufacturers' open innovation challenges affect the firms and their influence on risk exposure profiles.

Senior Managers 1, 2, and Chief Executive Officer 2 concurred that their efforts to engage and implement open innovation curtailed by the main challenges of lack of resources that range from financial resources, expertise and proper relationships and networks and lack of knowledge base. The other challenge raised was risk exposure. The primary risk is the risk related to the uncertainties surrounding the innovation project outcomes. The chances are that the desired results or outcomes of innovation are unachieved are inevitable because of the small size of these firms compared to their competitors, who are large corporations. The argument by the participants was that large corporations have economies of scale that help them hedge against risk exposure.

Firm size affects these organisations in terms of risk exposure and involves them in terms of dynamic capabilities. Also, pulling the dynamic capability challenge is either a lack of or limited resources that the ACMs encounter. This challenge, according to the participants interviewed, affects the firms. For example, they fail to renew themselves in readiness and response to environmental changes and demands for innovation, despite their awareness of the strategic importance of innovation to organisational competitiveness. The managers highlighted that they fail to utilise the knowledge they acquire from outside their organisations. Their absorptive capabilities are weak in manufacturing facilities and processes, marketing channels, supply chains, and producing and distributing products to their potential customers.

In summary, the qualitative results corroborated the quantitative results as the interviewees affirmed their knowledge and full understanding of the open innovation challenges that their ACMs are facing in their efforts to implement open innovation.

### 6.3.4 Research Objective Three:

*To ascertain the nature and extent of erosion factors among the ACMs.*

Senior Manager 3 and Chief Executive Officer 1 strongly corroborated the qualitative results on this aspect of open innovation erosion factors. It became evident that the ACMs' managers are aware of the impact of these erosion factors. Some of the erosion factors are unavoidable, and they are manageable. As the ACMs continue innovating, they find themselves gradually losing the capability to leverage inflows and outflows of knowledge within and across their business boundaries. The capability to manipulate or leverage external sources of knowledge in particular. As their commercialisation paths are carved, they lose their positions as integrators of technology internally and externally in the automotive industry as their dynamic capabilities continue to erode.

As the ACMs' employees develop innovation skills, expertise, and experiences, they attract the attention of competitors. This attention renders the ACMs vulnerable and susceptible to skills migration to their competitors as the value chain matures, resulting in inbound knowledge from suppliers increasing, which dilutes the firms` claims on purposive inflows and outflows of knowledge, thus experiencing increased knowledge exploration and exploitation from the original equipment manufacturers. Research and development costs continue to grow as more innovation is engaged and becomes unsustainable for most

ACMs.

In summary, the participants interviewed were quite aware of the nature and extent of the open innovation erosion factors and strongly corroborated the results obtained from the quantitative data analysed in chapter five.

### 6.3.5 Research Objective Four:

*To establish what relationship exists between organisational culture, open innovation and competitiveness.*

It is clear from Chief Executive Officers 1, 2, and Senior Managers 2 and 3 that organisational culture plays a very critical role in the successful implementation of open innovation by the ACMs. It is, therefore, paramount that the ACMs leverage their corporate culture to create conducive climates for open innovation in their firms. The managers interviewed reiterated that organisational culture lies at the heart of successful open innovation, particularly fostering independent thinking among top management.

The managers reiterated that they need to cultivate a culture that encourages employee creativity, leadership support for external collaboration, and external knowledge acquisition. They suggested that the whole thing begins with individual idea generation, promoting the new ideas through external engagements by seeking new outside applications for the internally developed innovations and knowledge. The absence of deliberate moves to cultivate the right culture, the culture that promotes individual independent thinking engaging in open innovation, becomes a futile activity. All the managers interviewed acknowledged the correlation between sound organisational culture and open innovation efforts, and the competitiveness of the ACMs.

In summary, these qualitative findings strongly corroborated the quantitative results obtained in chapter five. What emerged from both qualitative and quantitative results was the explicit recognition of the role that organisational culture plays in driving open innovation to success, particularly sustainable competitiveness. The ACMs` organisational cultural driven open innovation activities have seen the financial performance of the ACMs improving tremendously.

### 6.3.6 Research Objective Five:

*To investigate the impact of open innovation strategies on new product development prospects.*

All three managers interviewed by the researcher, Senior Managers 1, 3, and Chief Executive Officer 2 intimated that successful product development begins with idea generation from individual innovators in their firms. These ideas are pushed through by seeking new outside applications for their internal development and fruition, such as developing new innovative products, acquiring new knowledge, and developing new processes and services. The managers acknowledged that open innovation hinges on open-mindedness and creativity in the introduction of new products, new methods and services to sustain the livelihood of the company bearing in mind that successful development of new ideas requires various stakeholders' input and several different sources such as employees, competitors, suppliers, customers and other industries.

## 6.4 INTEGRATION OF QUALITATIVE AND QUANTITATIVE RESULTS

The study identified specific five themes from qualitative and quantitative data. These themes emerged during qualitative data analysis. Participants in the study talked about (1) strategic alignment, (2) open innovation challenges and on risks exposure profiles, (3) erosion factors, (4) organisational culture, open innovation and competitiveness and (5) the impact of open innovation strategies on new product development prospects. This section presents an integrated discussion of the thesis's quantitative and qualitative results based on the themes.

### 6.4.1 The nature and extent of ACMS open innovation strategic alignment

Qualitative results indicate that the centre of successful adoption and implementation of open innovation lies in the abilities of top managers to work together and understand the strategic direction that the firm seeks to take in its open innovation adoption. In other words, when executives do not support the firm`s open innovation strategic initiatives, they are bound to fail. Strategic alignment among the top management is critical for the success of organisational open innovation adoption.

Quantitative results indicate that no strategy is successfully implementable without strategic alignment between and among the top management of organisations. It is highly critical that before uniformity in understanding the organisational strategic intents, cascade down to the lowest levels of employees in the organisation, clear strategic thinking, conceptualisation, and an implementation road map in the minds of all the organisation's top management. Simply put, it is the organisation's strategic direction that should transcend individual perceptions and views.

The qualitative and quantitative results show some congruency in that strategic management and top management involvement are critical to attaining competitive advantage in an organisation. In summary, the qualitative results obtained through interviews of the CEOs and the automotive components' manufacturers Senior Managers corroborated the quantitative results and affirmed that there was strategic alignment between the CEOs and their functional Senior Managers.

### 6.4.2 ACMs open innovation challenges and risk exposure.

Qualitative results indicated that efforts to engage and implement open innovation were curtailed by the main challenges of lack of resources that range from financial resources, expertise and proper relationships and networks and lack of knowledge base. The other challenge raised was risk exposure. Firm size affects these organisations in terms of risk exposure and involves them in terms of dynamic capabilities and economies of scale. Also, pulling the dynamic capability challenge is either a lack of or limited resources and lack of absorptive capacity that the ACMs encounter.

The quantitative results show that ACMs face a cocktail of open innovation challenges to innovate for competitiveness. The significant difficulties are exposure to risks, lack of limited resources and limited dynamic capabilities to engage in innovation. The more the lack of resources becomes a challenge, the more the ACMs suffer the challenge of lack of dynamic capabilities

The qualitative results corroborated the quantitative results as the interviewees affirmed their knowledge and complete understanding of the open innovation challenges that their ACMs are facing in their efforts to implement open innovation

### 6.4.3 The nature and extent of erosion factors among ACMs

Qualitative results highlighted that when ACMs innovate, they gradually lose the capability to leverage inflows and outflows of knowledge within and across their business boundaries, resulting in a loss of the capacity to manipulate or leverage external sources of knowledge. Their commercialisation paths are limited, and their dynamic capabilities erode.

Quantitative results revealed that while open innovation has several strategic benefits to ACMs, such as competitiveness and profitability, the benefits come at a cost. As the firms adopt open innovation, they experience erosion due to their being innovative and need to keep a watchful eye for potential competition.

Quantitative and qualitative results are in harmony with Chesbrough (2010), who summarises that erosion factors are becoming more capable and declining. Qualitative results revealed that the participants interviewed were quite aware of the nature and extent of the open innovation erosion factors and strongly corroborated the results obtained from the quantitative data analysed in chapter five.

### 6.4.4 Relationship between organisational culture, open innovation and competitiveness

Qualitative findings strongly corroborated the quantitative results obtained in chapter five. What emerged from both qualitative and quantitative results was the explicit recognition of the role that organisational culture plays in driving open innovation to success, particularly sustainable competitiveness. The ACMs` organisational culture guided by open innovation activities have seen the financial performance of the ACMs improving tremendously.

### 6.4.5 The impact of open innovation strategies on new product development prospects

Quantitative results indicated that new product development encompasses physical product development, processes development and services development, of which innovation plays a vital role in their achievement. New product development requires innovative employees, leaders and creative managers, believe in themselves and are driven by the quest for knowledge acquisition.

These qualitative results are in harmony with the quantitative results obtained in chapter five. It is clear from both qualitative and quantitative results that idea generation lies at the centre of product development. It takes innovators with open minds to achieve this end and acknowledge the importance of sharing the new ideas with the external stakeholders for their fruition into finished products

In summary, the overall qualitative results are in harmony with the quantitative results obtained for the five themes that emerged from the study. The themes were: strategic alignment, open innovation challenges and on risks exposure profiles, erosion factors, organisational culture, open innovation and competitiveness and the impact of open innovation strategies on new product development prospects. The integration of these themes is critical to the automotive component manufacturers sustained competitive advantage.

## 6.5 CHAPTER SUMMARY

This chapter discussed the quantitative and qualitative results obtained in chapter four. The discussion focused on the results relating to the nature and extent of strategic alignment between the ACMs, Chief Executive Officers and Senior Managers. It also covered the spirit of open innovation challenges that the innovating firms meet to implement innovation and how they expose the firms to risks. This chapter explored open innovation erosion factors comprehensively. Including the relationships between organisational culture, open innovation, and competitiveness and the impact of open innovation strategies on new product development prospects concluded the chapter. The next chapter deals with the conclusion of the study and the recommendations that emerged from it.

# CHAPTER SEVEN

## CONCLUSIONS AND RECOMMENDATIONS

### 7.1 INTRODUCTION

This chapter deals with the research conclusions and recommendations to map the strategic alignment, challenges and prospects of open innovation adoption in automotive components' manufacturers and suppliers in the automotive industry in South Africa. The chapter summarises the research conclusions on the main results and the research`s findings detailed in chapter five and comprehensively discussed in chapter six on the nature and extent of open innovation strategic alignment, open innovation challenges and their influence on risk exposure profiles. Finally, the chapter explores the impact of open innovation strategies on new product development prospects in the automotive manufacturing sector.

The mixed research methodology employed in this study and a combination of literature on the phenomenon with primary data collected quantitatively and qualitatively using the structured questionnaire and interview protocol enabled the researcher to achieve the study`s objectives. The open innovation strategically aligned and expert automotive components manufacturers` top managers provided in-depth insights into the conceptualisation of the open innovation strategies and their impact on the competitiveness of the automotive components manufacturers. However, this was not without understanding the inherent challenges that the automotive components manufacturers meet in their innovation paths and the related risks they are exposed to in the process.

The objectives of the study were as follows:

- To establish the nature and extent of ACMs` open innovation strategic alignment for sustainable competitive advantage in the automotive industry.

- To ascertain what automotive components manufacturers' open innovation challenges affect the firms and their influence on risk exposure profiles.

- To ascertain the nature and extent of erosion factors among the ACMs.

- To establish what relationship exists between organisational culture, open innovation and competitiveness.

- To investigate the impact of open innovation strategies on new product development prospects.

- To propose a contextual open innovation adoption model that applies to the ACMs in the automotive industry.

## 7.2 RESEARCH CONCLUSIONS

From a broader perspective, this study aimed to examine the nature and extent to which ACMs in KwaZulu-Natal, Gauteng and Eastern Cape strategically engage in open innovation, overcome the open innovation challenges and embrace prospects of open innovation in terms of new products development to enhance their competitiveness. The analysis focused on ACMs utilisation of various open innovation strategies and the ability/inability of these strategies to overcome their main size-related competitive challenges (i.e., lack of resources, limited dynamic capabilities and high-risk exposure).

The integration of the South African automotive industry into the global market is evidenced enough of the importance of this industry in the country`s economy and how it helps drive the country's economic growth. As the industry is key to the overall growth of the South African economy, the importance of its competitiveness needs not to be overemphasised. Like in any other industry, the competitiveness of the automotive industry is a strategic issue that drives the need for a culture of innovation within the ACMs in particular.

The performance or non-performance of the automotive industry has spillover effects on other industries as it has these deep linkages to the broader economy. This situation exerts a lot of pressure on the automotive industry to remain competitive because of its strategic role in the economy. As a result, its sub-sector, automotive components manufacturing, is more than equally affected. The automotive components manufacturing sector`s survival rests on its competitiveness in productivity in new products and processes. The continuous introduction of new products remains a priority for this sector`s growth. As a result, the automotive components manufacturers invest many financial and other resources in research and development (R&D) for potential innovation in technology and production of new products. It is no surprise that these automotive component manufacturing firms in R&D are a single strategic measure and indicator for the levels of attention on innovation for sustainable competitiveness in terms of meeting the market demand for automotive components products in the automotive industry.

The ability of these automotive component manufacturing firms to sustain their competitiveness through open innovation depends on the disposition of their top management in terms of strategic alignment. It is, therefore, critical for management to be strategically aligned, agree, thinking and conceptualisation the concept of open innovation bearing in mind that most of these managers come from the traditional background of closed innovation. It is not easy for them to move on and forward to embrace open innovation. Nevertheless, in their efforts to adopt open innovation, they are faced with challenges of limited resources and dynamic capabilities, over and above exposure to risks. Deliberate efforts to cultivate a culture of open innovation help these firms overcome the challenges and build sustainable competitiveness.

As qualitative results simply corroborate the quantitative results because they were obtained concurrently, the researcher found no merit in dealing with them in separate sections or isolation. The following conclusions are drawn from both the quantitative and qualitative results:

(i) The execution of any open innovation strategy that the automotive components manufacturers chose to adopt requires precise strategic alignment between the firms` top management teams to move forward with the strategy.

In other words, it will be difficult for the organisational vision around open innovation strategic choices to cascade down to all the levels of employees in the firm if there is strategy confusion at the top. The results also indicated that managers and leaders must understand the nature of the open innovation strategy of choice and the demands of that particular strategy for its implementation and how the strategy impacts the desired outcomes.

(ii) Open innovation challenges hamper the ability of ACMs to acquire sustainable competitiveness and growth.

As a result, the automotive industry in the country continues to experience the negative perceptions and views that are enunciated in literature as well. The results highlighted a lack of resources as the major challenge as it has trickling effects on other challenges, such as limited dynamic capabilities. The more the ACMs experience shortages of resources, the more their critical dynamic capabilities are exacerbated. With adequate resources available, the ACMs can mitigate the challenge of loss of dynamic capabilities. What this means is that they can build their dynamic capabilities with an abundance of resources. They can minimise the negative impacts of risk exposure. The availability and adequacy of resources would minimise the chances of innovation project failure.

(iii) Over and above the open innovation challenges, the ACMs are subjected or become vulnerable to open innovation erosion factors.

Literature gives the impression that erosion factors are inherent and, as a result, inevitable for those organisations engaging in open innovation. The study`s results revealed that as the ACMs engage in open innovation, with time, they cease to become integrators of technology both internally and externally as many players come in, such as increasing inbound knowledge from suppliers. Increasing inbound knowledge increases the bargaining power of the suppliers. As knowledge exploration increases, knowledge exploitation rises as well, especially exploitation by the original equipment manufacturers. Competition increases as more start-ups are attracted into the market, and venture capital is available to finance these start-ups. The automotive components’ manufacturers also find it hard to retain their skilled workforce as the competitors attract it, and R&D costs increase as the firms engage in more and more innovative activities.

(iv) Organisational culture plays a critical role in driving organisational strategies for success. It is paramount that firms cultivate the culture that would help them achieve their set strategic objectives.

The main aim of the ACMs is to achieve sustainable competitiveness in product productivity and profitability. They should be able to meet the product demand of their markets. Innovation can only help firms to remain competitive and achieve growth. A sustainable culture of innovation is critical for achieving this end, a culture that fosters leadership support for external collaboration, giving enough time for innovation projects and encouraging employees' creativity. There is a strong positive and significant correlation between organisational culture, open innovation, and competitiveness.

(v) Product development lies at the heart of innovation. The primary reason firms innovate is to develop new products to meet the changing environmental demands of the markets.

The results indicate a strong positive and significant correlation between open innovation strategies and new product development prospects. Product development is broader than physical products and incorporates the development of new processes and services. The automotive industry sector is experiencing a significant transformation from a product-centric business motive to one that focuses on service delivery a model termed Product Services Systems (PSS) (Erkoyuncu, Roy, Shehab & Wardle, 2009). This process has typically been achieved through long term contracts, which consider product delivery through components. The intangible product delivery is concerned with the data (e.g. performance, component availability) that helps plan for the future Just In Time (JIT). Furthermore, service relates to functions like Total Productive Maintenance (TPM), training, breakdowns and plant maintenance. As an outcome, the production department is assured of attaining equipment availability over a long duration. The competitiveness of the automotive components manufacturers depends on their ability and capabilities to innovate new high-quality products and competitive prices. In the concept of open innovation, unlike in closed innovation, idea generation plays a significant role. Traditionally, a company's designers, engineers, and marketing personnel are the ones who take on innovation activities and the tasks that require creativity (Lee, 2009). These professionals try to be creative in solving relevant problems. The central assumption behind this approach is that company professionals, unlike users and customers, have the experience, knowledge, and expertise required to come up with genuinely new and valuable ideas. Consequently, their views should most likely succeed in the marketplace (Lee. 2009).

New and promising methods that may support the idea generation phase in innovation and new product development have emerged through the dissemination of internet-based technologies. These technologies enable companies to draw on the efficiency of markets and the "wisdom of the crowd" (Soukhoroukova, Spann et al., 2012). Crowdsourcing, that is, outsourcing the entire idea generation phase to a crowd of users, is becoming increasingly popular (Poetz and Schreier 2012). Internet-based innovation communities for open source projects is yet another example (von Hippel 2005), as is innovation contests on the internet or idea competitions (Soukhoroukova, Spann et al. 2012). Idea generation then seeks new outside applications to develop the idea to take advantage of the synergies created from combining knowledge among participating firms which closed innovation cannot achieve.

(vi) From the principal components analysis results, the researcher concludes that the factor dimension one is loaded with the following extracted elements or factors:

These factors are versatility in seeking new outside applications for internally developed innovations, knowledge, tools and ideas; collaboration in manufacturing; mutual commercialisation interests in collaborative working with partners and invention driven by suppliers. These factors can form the basis for the proposed contextual open innovation adoption model that applies to the ACMs in the automotive industry. The factor dimension consists of the factors extracted from all four quadrants of the Cornell (2012) ACMs open innovation model. In essence, the factor dimension advocates for a more integrative model that combines critical elements from the four quadrants of the Cornell (2012) model.

## 7.3 MANAGERIAL RECOMMENDATIONS

This section outlines the recommendations of managerial implications informed by the conclusions drawn from the quantitative and qualitative results of the study obtained to achieve the research objectives and insights from the literature reviewed. The results of this study give rise to several managerial implications that will add value, particularly to the ACMs' approach to open innovation and management of their open innovation trajectories for sustainable competitiveness.

### 7.3.1 Strategic alignment

The study results from both quantitative and qualitative analysis showed that the automotive components manufacturers Chief Executives and their functional Senior Managers are in the same mind when it comes to an understanding of the nature of their open innovation strategies and implementation. There is a vital strategic alignment between the top management of automotive components manufacturers. From a strategic management perspective, this is the right phenomenon; harmonious strategic thinking and alignment required and necessary to drive the organisation's open innovation strategies and achieve the objectives for those strategies successfully. The primary objective of why automotive components manufacturers engage in open innovation is to leverage sustainable competitiveness. The study recommends that the management of the automotive components should ensure that the evidenced strategic alignment between and among themselves as managers should cascade to all levels of employees in their firms. This strategic alignment is critical as the implementation of strategies hinges on the strategic dispositions of the operational levels of organisational employees.

### 7.3.2 Improve challenges mitigation measures

Lack of resources is a challenge that cuts across all the industries in an economy. Firms find their efforts to achieve strategic objectives severely curtailed by challenges of lack or limited resources. It was found from the results in this study that the challenge of lack of resources among the automotive components manufacturers has negative spill-overs to other sets of challenges such as dynamic capabilities and the ability to hedge against risks exposure. The challenge of lack of resources came out very strongly from the respondents in this study that the automotive components manufacturers find it challenging to adopt and implement open innovation successfully. The study recommends that the automotive components manufacturers need to implement strategic measures to mitigate the adverse spill-over effects of the lack of resources. It is clear that the more the firms run into the challenge of resources, the more they become disabled in terms of dynamic capabilities and the risks of their open innovation projects failure increase. As a result, mitigation lies in measures put in place to improve the firms' resources configuration. Streamlining of investment priorities needs to be considered to invest more in resource acquisition to capacitate the capabilities to engage in open innovation key to successful sustainable competitiveness.

### 7.3.3 Improve open innovation erosion factors mitigation measures

The results indicated that open innovation erosion factors, while not outweighing the benefits of open innovation, do push back the efforts of the automotive components manufacturers to build sustainable competitiveness. As more inbound knowledge comes from the suppliers and venture capital finances, the competition between new start-ups grows in the automotive components manufacturing sector and market and this erodes the benefits of adopting open innovation. In the long run, the automotive components manufacturers engaging in open innovation find it challenging to protect their intellectual capital and retain their skilled labour as it migrates to competitors. Research and development costs escalate as more open innovation activities are pursued. The study recommends that the automotive components manufacturers design measures that would help overcome or minimise the negative impacts of the open innovation erosion factors. Efforts to retain a skilled workforce for a more extended period should be put in place. In other words, the automotive components manufacturers need to be always ahead of their competitors in skills retention. Research and development costs should be managed and kept below the benefits of adopting open innovation and adequate measures to curb knowledge exploitation.

### 7.3.4 Improve open innovation culture

Organisational culture is a phenomenon that evolves with time. It takes time to develop an organisational culture. For such reason, there is no time when organisations can be content that their organisational culture has matured enough. Schein (2017) concurred with this assertion and stated that organisations take time to develop a culture as the employees go through various changes and adapt to the external environment and solve organisational problems. There is no doubt that organisational culture plays an essential role in driving an organisation's strategies. The automotive components manufacturers are aware of the importance of developing and cultivating a culture of open innovation. The results indicated a strong positive and significant correlation between organisational culture, open innovation and the competitiveness of the automotive components manufacturers. The study recommends that automotive components manufacturers continue building and cultivating an influential culture for open innovation to benefit from open innovation initiatives and achieve sustainable competitiveness fully.

### 7.3.5 Improve product development capabilities

The nature of the automotive components manufacturers demands that their performance be measured in product development productivity. The demand for components parts is exceptionally high and ever-increasing in the automotive industry. Quality determines the life span of the component products; thus, the need for continuous innovation in new product development overwhelms the automotive components manufacturers. Dynamic capabilities required are the integration, building, and reconfiguration of internal competencies to address new product development initiatives (Teece et al., 1997, Teece, 2007).lie at the centre of achieving all these. Therefore, the study recommends that the automotive components manufacturers invest in improving their dynamic capabilities to turn ideas generated into new innovative products to remain competitive in the country's automotive industry and keep the sector globally competitive.

### 7.3.6 Proposed model for automotive components manufacturers

The Cornell (2012) automotive components manufacturers open innovation strategies model informed this study. The automotive components manufacturers apply the open innovation strategies suggested by the Cornell (2012) model. The Cornell (2016) model proposes four open innovation strategies quadrants that manufacturers can adopt as their alternative open innovation strategy. The results of the principal components analysis in this study suggest a more integrated approach to the Cornell (2012) model that could form the strategic basis for the future development of the contextual open innovation strategies model that the automotive components manufacturers can adopt. The study recommends that the automotive components manufacturers need to be flexible as they consider open innovation strategy to apply for their purposes.

## 7.4 RECOMMENDATIONS FOR FUTURE RESEARCH

The last objective of the study was a proposed automotive component manufacturer open innovation model that considers the context of the South African automotive components Manufacturers. The researcher believes the principal components analysis performed resulted in a sound basis for the potential development of the proposed model based on the factor dimension one extracted from and across the four quadrants of the Cornell (2012) model. The factor dimension constituted 29.6% of the total variance of 55.5% of the eight extracted components or factor dimensions. For these reasons, the study recommends future research to develop the proposed contextual automotive components manufacturers open innovation strategies model or framework.

In developing a model, the study recommends future research to be conducted using the grounded theory approach and assess the potential theory that could emerge from the qualitative data that would be collected using the instrument whose constructs are developed from the elements and factors that were extracted to constitute the factor dimension 1. Alternatively, the study recommends that the principal components analysis be extended further and perform structural equation modelling to model the framework to its conclusion.

The study focused on the few selected automotive components manufacturers in KwaZulu-Natal, Gauteng and Eastern Cape Provinces and only worked with 40 questionnaires for the quantitative aspect of the study that were returned. This limitation poses a risk of generalisability of the results to the more significant automotive industry. The study, therefore, recommends future research covering a broader scope of populations to enhance the chances of generalisability of the results and more potential insights into the phenomenon.

## 7.5 LIMITATIONS TO THE STUDY

A study of a strategic nature such as this would naturally face limitations in terms of the target population of corporate executives that might not be willing to divulge information. Predominantly the local or domestic ACMs are more reluctant to share information as they perceive threats to their production capabilities and processes, especially regarding the use of external knowledge and contents of materials and local suppliers in fear of the likelihood of being sidelined by the multinational corporations who are dominating the market share of the South African automotive industry.

The study was predominately quantitative, and bulk data were collected using a structured questionnaire. A structured questionnaire limited the respondents, and they could not express their personal views and opinions beyond the structured constructs in the questionnaire, unlike the interview protocol would allow.

The study was limited to a small sample drawn from KwaZulu-Natal, Gauteng and the Eastern Cape with the diversity of the ACMs compared to the limited number of companies that were covered externally in this research; and this limitation is essential for future research. Not all subsectors of the automotive industry have been covered in the research due to the technical nature of the study where research and development are not prerequisites among small and micro firms. A more comprehensive sample would have enhanced the potential for the generalisability of the results of the study

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## APPENDIX A

## DATA COLLECTION TOOLS : Interview Questions (Industry Experts)

University of KwaZulu-Natal
University Road Westville
www.ukzn.ac.za

Supervisors: Prof Migiro,
Dr. P Mashau,
Tel: 031 260 8104
Email: migiro@ukzn.ac.za
mashau@ukzn.ac.za

HSSREC RESEARCH OFFICE
Dr. R Sibanda
Westville Campus
Contact: 0312604557

**Title: An analysis of open innovation strategy alignment and challenges faced by ACMs in KwaZulu Natal, Gauteng and Eastern Cape in South Africa**

My name is Arthur Mzwandile Gonyora, a PhD student at the University of KwaZulu-Natal. I am researching the strategic alignment of open innovation and challenges faced by ACMs based in KZN, Gauteng, and the Eastern Cape. This project is under the supervision of Professor Steven Migiro, and Dr Pfano Mashau, from the University of KwaZulu- Natal.

This research study intends to answer the following research questions:

1. What is the nature and extent of open, innovative strategies that ACMs employ in the automotive industry to enhance their competitiveness?
2. What open innovation challenges hamper the competitiveness of ACMs?
3. What is the nature and extent of erosion factors and their relationship to open innovation adoption?
4. What is the impact of open, innovative strategies on new product development prospects?
5. What open innovation adoption model for the ACMs is applicable in the automotive industry.

Upon completion of the study, and on request, a hard or digital copy of the full research report is available.
For any further information, please do not hesitate to contact the undersigned
Kind sincere regards,

[redacted]

Arthur Mzwandile Gonyora
University of KwaZulu Natal
agonyora@icloud.com

# To Whom It May Concern

Dear Respondent,

Your involvement in this survey is hugely welcome. Notwithstanding your participation in understanding open innovation and collaboration in the organisation, this survey will enhance the ability to gain competitiveness through improvement in performance and productivity in the department and your workplace at large.

Kindly respond to the question below, a diagram of open innovation has been provided to assist and refresh your memory: this survey will take 8 -10 minutes to complete.

We are willing to share early and privileged results with each Respondent.

Kind regards,

[redacted]

The Researcher.

# CONSENT FORM

I________________________________________(Full name),

Click in the box provided

Confirm that I understand the information of the above study and I have the right to ask questions. ☐

Understand that my participation to this study is voluntary and I am free to withdraw at any time, without giving any reasons. ☐

Agree to take part in this study. ☐

Agree to the use of anonymous quotes in the publication. ☐

| | | |
|---|---|---|
| Signature | Date | Place |
| ARTHUR MZWANDILE GONYORA | 30 SEPTEMBER 2019 | [redacted] |
| Full name of the Researcher | Date | Signature |

## APPENDIX B QUALITATIVE INTERVIEW OUTLINE

**Automotive Components Manufacturers**

In the interview, other questions may arise. The interview aims to get information on crafting the open innovation strategy to assist the organisation in the challenges and prospects of adopting this paradigm to ACMs. The questions are as below:

- Please give details about the following: the company, number of employees, educational background, current position, the technology used, and product offered by the company and how many employees?
- What is your understanding of the conception of "open innovation"?
- What open innovation activities exist presently? Give some detail.
- Based on innovation strategies in existence, have the company adopted open innovation strategies? Specify model applied? If not implemented an open innovation model, Why? When does the intention to implement one?
- Does the company create any innovations?
- What type of innovations is the most common in the company (technologies, products, processes, and client experiences.)?
- Who are the primary external parties contributing to the company's innovation projects (e.g., universities, technology suppliers, OEMs, competitors)?
- What maturity level is the company in its industry sector? What are the key drivers of technology/product advancement?
- What are the firm-level challenges in the adoption of open innovation? How have they mitigated/resolved?
- Are there collaboration initiatives with external partners, like customers, suppliers, universities? What is the way of collaboration?
- Please indicate the external help the organisation receives.
- What is the impact of open innovation on new product development?

**APPENDIX B:**

Questionnaire (CEO / Senior Managers / R&D Managers)

University of KwaZulu-Natal
University Road Westville
www.ukzn.ac.za

Supervisors: Prof Migiro,
Dr. P Mashau,
Tel: 031 260 8104
Email: migiro@ukzn.ac.za
mashau@ukzn.ac.za

HSSREC RESEARCH OFFICE
Dr. R Sibanda
Westville Campus
Contact: 0312604557

**Title: An analysis of open innovation strategy alignment and challenges faced by ACMs in KwaZulu Natal, Gauteng and Eastern Cape in South Africa**

My name is Arthur Mzwandile Gonyora, a PhD student at the University of KwaZulu-Natal. I am researching on the strategic alignment of open innovation and challenges faced by ACMs based in KZN, Gauteng, and the Eastern Cape. This project is under the supervision of Professor Steven Migiro, and Dr Pfano Mashau, from the University of KwaZulu- Natal.

This research study intends to answer the following research questions:

1. What is the nature and extent of ACMs` open innovation strategic alignment for sustainable competitive advantage in the automotive industry?
2. What are the automotive components manufacturers' open innovation challenges and their influence on risk exposure profiles?
3. What is the nature and extent of erosion factors among the ACMs?
4. What relationship exists between organisational culture, open innovation, and competitiveness?
5. What is the impact of open innovation strategies on new product development prospects?
6. What proposed contextual open innovation adoption model is applicable for the ACMs in the automotive industry?

Upon completion of the study, a hard or digital copy of the full research report is available. For further information, please do not hesitate to contact the undersigned.

Sincerely,

[redacted]

Arthur Mzwandile Gonyora

University of KwaZulu-Natal [redacted] / 218076191@ukzn.stu.ac.za / agonyora@icloud.com

# CONSENT FORM

I ________________________________________________________________(Full name),

Click in the box provided

- Confirm the understanding of the information on the above study, and have the right to ask questions. ☐
- Understand that participation in this study is voluntary, and one is free to withdraw at any time without giving any reasons. ☐
- Do agree to take part in this study. ☐

- Do agree to the use of anonymous quotes in the publication. ☐

______________________________ ________________ ________________________

Signature Date Place

ARTHUR MZWANDILE GONYORA 30 SEPTEMBER 2019

[redacted]

______________________________ ________________ ________________________

Full name of the Researcher Date Signature

**Questionnaire**

**This questionnaire consists of 13 questions, kindly answer them**.

**SECTION 1**

**General data**

(Click in the relevant box below)

1. What is your current position in the firm?

CEO ☐ Senior Manager ☐ R&D Manager ☐ Other ☐

2. What is your highest academic qualification?

Diploma ☐ Degree ☐ Masters ☐ PhD ☐

Other ☐

3. How many years of experience in your organisation?

1-5 ☐

6-10 ☐

11-15 ☐

16-20 ☐

**SECTION 2.**

**Q1: Mapping Evolution of the Industry (Erosion Factors)**

Based on the statements given below and the Likert scale, choose a score from 1 to 5 (by selecting the appropriate box) using the criteria below:

1-strongly disagree: 2-disagree: 3-neutral/no opinion: 4-agree: 5-strongly agree

**TABLE 1**

| Q1 | For the past five years, please indicate your level of agreement with the following statements about your firm | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **1.1** | As a firm, our role is increasingly becoming an integrator of technology internally and externally. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **1.2** | Skilled workers are increasingly leaving our firm | ☐ | ☐ | ☐ | ☐ | ☐ |
| **1.3** | External suppliers (products and services) are increasingly knowledgeable. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **1.4** | Knowledge development by the firm is increasingly available to external parties | ☐ | ☐ | ☐ | ☐ | ☐ |
| **1.5** | Knowledge from OEM is increasingly available. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **1.6** | Cost of doing R&D internally is increasingly available | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | |
|---|---|---|---|---|---|---|
| **1.7** | Venture capital is increasing new opportunities in your industry | ☐ | ☐ | ☐ | ☐ | ☐ |

Q2: Organisational Support for Innovation

**TABLE 2**

| Q2 | Please indicate your level of agreement with the following statements | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **2.1** | We are always given time to work on innovation projects | ☐ | ☐ | ☐ | ☐ | ☐ |
| **2.2** | Our leadership has become more open to external collaboration opportunities for the firm | ☐ | ☐ | ☐ | ☐ | ☐ |
| **2.3** | The firm increases rewards/incentives to employees for external collaboration | ☐ | ☐ | ☐ | ☐ | ☐ |
| **2.4** | The firm has increased knowledge-sharing activities, tools and processes externally with OEMs and other suppliers, | ☐ | ☐ | ☐ | ☐ | ☐ |

Q3: Quadrant 1 Inventive

**TABLE 3**

| Q3 | Please indicate the extent to which your firm has collaborated with the following stakeholders in innovation activities over the last five years: | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 3.1 | Universities and research centres. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3.2 | Government agencies (list some). | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3.3 | Suppliers. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3.4 | OEMs. | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | |
|---|---|---|---|---|---|---|
| **3.5** | Competitors within the industry. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **3.6** | Competitors are operating in other industries. | ☐ | ☐ | ☐ | ☐ | ☐ |

Q4: Quadrant 3 Collaborative (CIP)

**TABLE 4**

| **Q4** | **Please indicate the extent to which your firm has collaborated with external partners in the following phases of the innovation process over the last five years:** | **Strongly Disagree** | **Disagree** | **Neutral** | **Agree** | **Strongly agree** |
|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** |
| **4.1** | Idea generation / exploratory research. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **4.2** | Experimentation. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **4.3** | Manufacturing. | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | |
|---|---|---|---|---|---|---|
| **4.4** | Commercialisation. | ☐ | ☐ | ☐ | ☐ | ☐ |

Q5: Quadrant 2 Versatile

**TABLE 5**

| Q5 | Please indicate the extent to which your firm uses knowledge and technologies from outside the firm's boundaries. | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **5.1** | Seeking new outside applications for internally developed innovations, knowledge, tools, and ideas | ☐ | ☐ | ☐ | ☐ | ☐ |
| **5.2** | Sharing important innovation with external stakeholders | ☐ | ☐ | ☐ | ☐ | ☐ |
| **5.3** | Personal drive and convictions for sharing important innovations with external parties | ☐ | ☐ | ☐ | ☐ | ☐ |
| **5.4** | Safe guarding trade secrets | ☐ | ☐ | ☐ | ☐ | ☐ |
| **5.5** | Observation of non-disclosure and other contractual agreements | ☐ | ☐ | ☐ | ☐ | ☐ |
| **5.6** | Protection of copy rights | ☐ | ☐ | ☐ | ☐ | ☐ |

Q6: CommercializationQ6: Erosion Factors (EF)

**TABLE 6**

| Q6 | Please indicate your agreement with each of the following statements concerning your firm's working relations in innovation with external partners: | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **6.1** | We share identical management styles. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **6.2** | There is mutual interest in working collaboratively among partners. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **6.3** | There is a high level of trust among partners. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **6.4** | Technological competencies match up. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **6.5** | Access to partners technological resources. | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | |
|---|---|---|---|---|---|---|
| **6.6** | The synergy created by combining knowledge among participating firms. | ☐ | ☐ | ☐ | ☐ | ☐ |

Q7: New Product Development (NPD)

TABLE 7

| Q7 | Please indicate how well you have worked with external partners in innovation activities regarding the following objectives over the last five years: (Outside-In) | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **7.1** | In the process of new product/process development | ☐ | ☐ | ☐ | ☐ | ☐ |
| **7.2** | Introduction of new/improved products or processes. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **7.3** | Introducing new or improved processes for producing products or services. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **7.4** | Opening of new markets. | ☐ | ☐ | ☐ | ☐ | ☐ |

Q8: Firm-Level Changes in Adoption of Open Innovation

**TABLE 8**

| Q8 | Please indicate your agreement with each of the following statements concerning the challenges that are faced by your firm in adopting innovation. | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **8.1** | Resource constraints is the main reason for being uncompetitive on the market. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **8.2** | The firm does not possess enough internal capabilities to increase productivity. | ☐ | ☐ | ☐ | ☐ | ☐ |
| **8.3** | We do not sell IP due to the risk of losing competitiveness. | ☐ | ☐ | ☐ | ☐ | ☐ |

**Q9: Risk Effects when collaborating with external partners**

TABLE 9

| Q9 | Please indicate your agreement with each statement concerning the importance of each of the following risks when collaborating with external parties on innovation projects. | Strongly Disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| **9.1** | Negative impact on the firm's reputation | ☐ | ☐ | ☐ | ☐ | ☐ |
| **9.2** | Knowledge leakages and copywrites by competitors | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | |
|---|---|---|---|---|---|---|
| **9.3** | Loss of human resources to competitors | ☐ | ☐ | ☐ | ☐ | ☐ |
| **9.4** | Difficulty in protecting firm's Intellectual Property | ☐ | ☐ | ☐ | ☐ | ☐ |
| **9.5** | External partner's opportunistic behaviour towards your firm's openness | ☐ | ☐ | ☐ | ☐ | ☐ |
| **9.6** | Loss of focus on key priorities | ☐ | ☐ | ☐ | ☐ | ☐ |
| **9.7** | Low returns from the collaboration | ☐ | ☐ | ☐ | ☐ | ☐ |

**Q10: Measures of Competitiveness**

**TABLE 10**

| **Q10** | **Please indicate your agreement with each of the following statements concerning the performance of your firm in the past five years, your firm has:** | **Strongly Disagree** | **Disagree** | **Neutral** | **Agree** | **Strongly agree** |
|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **4** | **5** |
| **10.1** | Better access and cooperation with external partners (OEMs) | ☐ | ☐ | ☐ | ☐ | ☐ |

| | | | | | | |
|---|---|---|---|---|---|---|
| **10.2** | Improved advanced technologies and knowledge acquisition | ☐ | ☐ | ☐ | ☐ | ☐ |
| **10.3** | Attracted new clients | ☐ | ☐ | ☐ | ☐ | ☐ |
| **10.4** | Cost of generating ideas has improved and sources have increased | ☐ | ☐ | ☐ | ☐ | ☐ |
| **10.5** | Time to market is reduced | ☐ | ☐ | ☐ | ☐ | ☐ |
| **10.6** | Constantly meeting financial objectives | ☐ | ☐ | ☐ | ☐ | ☐ |
| **10.7** | Become more innovative on the market | ☐ | ☐ | ☐ | ☐ | ☐ |

## APPENDIX C:

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI
Graduate School of Business and Leadership

9 November 2018

**Student Name:** **Arthur Mzwandile Gonyora**

**Student No:** **218076191**

**Name of School:** **Graduate school of Business & Leadership**

**Proposed Qualification:** **Doctor of Business Administration**

**Title: Operationalisation of open innovation in a challenging South African automotive industry**

**The doctoral panel decision:** Based on your presentation, the doctoral panel has approved your research proposal. Please apply for ethical clearance certificate. Note that data should not be collected until full ethical approval is obtained.

**Best regards**

[redacted]

Prof. Muhammad Hoque
Academic Leader: Higher Degrees and Research
Graduate School of Business & Leadership
University of KwaZulu-Natal Westville Campus
South Africa
**E-Mail:** Hoque@ukzn.ac.za

University of KwaZulu-Natal
Postal Address: Private Bag X54001, Durban, 4000, South Africa
Website: www.ukzn.ac.za

UNIVERSITY OF KWAZULU-NATAL

Graduate School of Business and Leadership
Physical Address: Room 59, GSB&L Building, Ground Floor, UKZN Westville Campus, Westville, Durban, 3630
Tel: +27(0)31 260 2784
Website: www.gsbl.ukzn.ac.za

Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

**APPENDIX D:**

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

15 June 2020

Mr Arthur Mzwandile Gonyora (218076191)
Grad School Of Bus & Leadership
Westville Campus

Dear Mr Gonyora,

**Protocol reference number:** HSSREC/00000071/2019
**New Project title :** ANALYSIS OF OPEN INNOVATION STRATEGY AND CHALLENGES FACED BY AUTOMOTIVE COMPONENT MANUFACTURERS IN KWAZULU NATAL, GAUTENG AND EASTERN CAPE IN SOUTH AFRICA.

## Approval Notification – Amendment Application

This letter serves to notify you that your application and request for an amendment received on 12 June 2020 has now been approved as follows:

- Change in title

**Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form; Title of the Project, Location of the Study must be reviewed and approved through an amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.**

**PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.**

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

Best wishes for the successful completion of your research protocol.

Yours faithfully

[redacted]

..............................................................
Professor Dipane Hlalele (Chair)

/dd

Humanities & Social Sciences Research Ethics Committee
UKZN Research Ethics Office Westville Campus, Govan Mbeki Building
Postal Address: Private Bag X54001, Durban 4000
Tel: +27 31 260 8350 / 4557 / 3587
Website: http://research.ukzn.ac.za/Research-Ethics/

**APPENDIX E:**

Turnitin Originality Report

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PhD ReSubmission By Arthur Gonyora

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## APPENDIX F:

### CERTIFICATE OF EDITING


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**2020-06-08**

***ANALYSIS OF OPEN INNOVATION STRATEGY AND CHALLENGES FACED BY AUTOMOTIVE COMPONENT MANUFACTURERS IN KWAZULU NATAL, GAUTENG AND EASTERN CAPE IN SOUTH AFRICA.***

By
Arthur Mzwandile Gonyora
218076191

A dissertation submitted in fulfilment of the requirements for the degree of
Doctor of Business Administration

Graduate School of Business and Leadership
College of Management Studies

Supervisors: Prof Stephen Migiro, Dr Pfano Mashau

It is hereby certified that this thesis has been proof read and edited and that the academic content has in no instance been altered.

[redacted]

Maurine Fischer.
Proofreader and Editor.