Sustainability of SMEs in the South African manufacturing and agriculture sector from 2010 to 2020

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DECLARATION

I, Masana Ludwick Rikhotso, declare that this research article is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

ML Rikhotso

(Masana Ludwick Rikhotso)

Signed at Mbombela, Nelspruit, South Africa

On the 27th day of February 2023.

DEDICATION

To my wife Audry, my brothers Mufumi and Xichavelo and my parents Mackson and Norah.

This research is dedicated to each of you. You all play a central role in my life. I am because of who you are.

My wife Audry, it is your unwavering love and support that drives me to keep going and grounds me. I feel blessed to have you by my side.

Mufumi and Xichavelo, my dear brothers, your love and support is my inspiration. You teach me to never give up daily.

Mom and Dad, you are the foundation of our family, you have been my cornerstone. I am so blessed to have your love and guidance. All of your hard work is why I am here today. Thank you, I could never repay you.

To the Dube's. Thank you for raising an amazing daughter so our paths would cross.

Each page of this research paper stands as a testament to your love and support.

Sincerely,

Masana

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Several individuals have been instrumental in getting me to this point.

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ABSTRACT

Aim: South Africa's start-up SME failure rate is on the higher end. Estimates place the failure rate of formal SMEs in South Africa between 70% and 80% in the first 5 years (News24, 2022, p. 1). This study investigates the relationship that demographic factors of SMEs play to their survivability. The main aim will be to identify predictors of SME survival and make recommendations that will assist other SMEs to increase their odds of survival.

Methods: Secondary data were obtained from the South African Supplier Diversity Council (SASDC), which is a South African registered company that facilitates SMEs to get access to business and finances from larger organisations. The scope of the research is limited to SMEs that operate in the manufacturing and agricultural sectors. The research only focuses on formal SMEs, which are those that have been registered with the Companies and Intellectual Property Commission (CIPC) and thus file for taxes. Given a lack of a formal database available to extract the data, individual files were sent to the researcher from the SASDC data administrators. The files sent comprised of data on an individual SME in the format of a Microsoft Word document and a PDF. The data were manually collated by the researcher to create a database that could be analysed through the STATA 17 statistical tool.

The selection of variables was based on available demographic data in the files informed by literature from previous similar studies. A bivariate analysis was conducted to assess if there is a relationship between the dependent variable (survival) and the independent factors. To conduct the analysis, Kaplan-Meier and life tables were used alongside the Cox proportional hazard model.

Results: The multi-variable analysis found that demographic factors could indeed be associated with SME failure. For example, SMEs that had owners with less work experience had lower survival odds. Overall, using the Cox proportional hazards model, the hazard ratios for work experience and the gender of the CEO identified these as factors that played a role in SME survival.

Conclusions: The findings highlight that although there is further research that needs to be done on this topic, there are demographic factors associated with failed SMEs and these factors can be used as predictors of SMEs. Caution must be taken not to discriminate against SMEs with these factors but to equip these SME CEOs with tools to prevent failure.

Keywords: SME, Survival analysis, sustainability

LIST OF ABBREVIATIONS

SME	Small, Medium Enterprise
GDP	Gross Domestic Product
SASDC	South African Supplier Diversity Council
CIPC	Companies and Intellectual Property Commission
SARS	South African Revenue Services

BACKGROUND

The role of SMEs internationally and in South Africa has been identified as key to job creation and GDP growth. Despite the significance of formal SMEs to the South African economy, SMEs continue to have high failure rates. There is a common belief that South African SMEs do not survive beyond their third year of operation. This paper aims to understand the survival rates of South African SMEs by focusing on SMEs that operate in the Agriculture and Manufacturing industry. By analysing 1) the demographic characteristics associated with failed SMEs and 2) identifying the predictors associated with failed SMEs in South Africa, a development institution, governments, investors and founders can better make decisions that can improve SME survival rates. The research will analyse formal South African SMEs in the Agriculture and Manufacturing industries that were operational in the year 2010 (post-global economic crisis) and analyse their survival for the decade till the year 2020 to establish survival rates. Demographic characteristics of failed and successful SMEs will be identified, with predictors of SME failure and success being highlighted. The

research will provide recommendations based on the findings of the analysis aimed at increasing SME survival rates.

1. INTRODUCTION

The World Bank states that Small, Medium Enterprises (SMEs) are crucial to most economies. These are defined as independent organizations that employ less than a specific number of employees (which varies between countries ranging between 50 to 250 (Organisation for Economic Co-operation and Development, 2005). In 2022, the World Bank reported that SMEs accounted for most of the global business making these essential to economic development and job creation. They noted a 90 percent of contributions towards global businesses, and 40 percent of Gross Domestic Product (GDP) in emerging economies, with that figure being greater if informal SMEs are included (World Bank, 2022). The World Bank estimates a 600 million job demand globally in 2030, making SME development a top priority for most governments globally. In emerging economies, 7 out of 10 formal jobs are created by SMEs (World Bank, 2022).

Moreover, in Africa, SMEs are responsible for an estimated 80 percent of jobs and contribute to 70 percent of the GDP (World Economic Forum, 2022). In Africa's biggest economy based on GDP, Nigeria, SMEs provide over 80 percent of the economy's jobs and nearly 50 percent of the GDP (WorldBank, 2021). Egypt, Africa's second-largest economy by GDP, has over 3.8 million SMEs Organisation for Economic Co-operation and Development et al. (2018), which account for 44.6 percent of organizations in the formal sector. In South Africa, it is estimated that SMEs comprise 91 percent of formal businesses and are responsible for an estimated 60 percent of economic jobs and 34 percent of the GDP (Bary, 2019).

Despite the immense contributions to the economy, SMEs continue to struggle to sustain themselves. This is evident in the number of years that they spend operating in the economy compared to large corporations. A report by Weetracker noted that failure rates for African start-ups between the years 2010 to 2018 were an estimated 54.20 percent (Weetracker, 2020). The author further reports that Ethiopia, Rwanda,

and, Ghana had the highest failure rates, at 75 percent, 75 percent, and 73.9 percent respectively, whilst South Africa experienced a 54.39 percent failure rate.

With such levels of failure rates, it is thus crucial to understand the factors associated with these failures. Moreover, it is important to understand the number of years that these SMEs spend operating until failure. An understanding of these timelines allows us to critically assess the different factors contributing to high failure rates at different time points. As stated above, in South Africa, SMEs contribute immensely to the development of their economy. The key economic sectors in South Africa are mining, transport, energy, manufacturing, tourism, and agriculture (South African Government, 2022). However, despite their GDP economic contributions, agriculture and manufacturing contribute a small portion of the number of SMEs in South Africa (4 percent and 9 percent) of all industries.

Hence, this paper will explore the survival rates of SMEs within the agriculture and manufacturing sectors between the years 2010 to 2020. In addition, the paper will further explore the different factors associated with survival rates from the time of inception of the company to its closure.

1.1. Justification

The period 2010 to 2020 was selected to limit the number of years due to the availability of data and resource limitations. Between 2007 and 2008, South Africa experienced a contracting GDP due to the financial-economic crisis (Leung et al., 2009). This provides an opportunity to analyse the SME environment post the global recession. Authors such as Cant and Ligthelm (2002), focused on SMEs post the early 2000s, this paper will look at the late 2000s to explore if their findings are still relevant to South Africa. Given that it is a commonly-held view that South African SMEs do not survive past their third year of operation, an analysis of 10 years will suffice to conduct a survival analysis.

South African manufacturing SMEs contribute only to a tenth of the revenue but an estimated fifth of the employment in the country (Ngibe M. & Lekhanya L.M., 2019).

The ability to absorb human capital makes manufacturing SMEs crucial to the South African economy.

According to Kew et al. (2015), South Africa's agricultural SMEs contribute only 2.9% of new business ventures despite their crucial role in the livelihood and economy of its people. This research aims to provide some insights and recommendations that current and prospective SME founders in the agricultural industry can use to improve their survival odds.

For this research, the industries selected will be kept broad to allow for deep analysis. Given that the organisations selected for analysis have been narrowed to two industries (manufacturing and agriculture) and will focus on SMEs started in 2010, further segmenting the industries could limit the sample and affect analysis rigour.

1.2. Problem statement

The paper aims to understand the survival rate of South African SMEs in the Agriculture and Manufacturing industry. To achieve this aim we need to answer two questions:

1) What are the demographic characteristics associated with failing SMEs in South Africa? And,

2) What are the predictors associated with failed SMEs in South Africa?

1.3. Research objective

Aim: To explore the industry survival rates for the SMEs in South Africa's two main GDP-contributing sectors between the years 2010 and 2020 in the Agriculture and Manufacturing industries.

Objective 1: To understand the demographic characteristics associated with the failure of SMEs in South Africa.

Objective 2: To explore predictors of SME survival in South Africa.

1.4. Thesis organisation

Section 2 highlights research conducted by previous researchers that applied survival analysis approaches to study SME survivorship in the manufacturing and Agricultural industry. Other researchers who have applied survival approach methodologies were used to supplement the limited research that is available on SMEs in South Africa. Section 3 looks into the approach taken in selecting the variables. The analysis methods to be used; Kaplan-Meier, Life Tables, and the Cox Proportional Hazard model are elaborated on with a basic explanation of what they aim to achieve. Section 4 covers the Methodology. Section 5 will detail the data validation and reliability approaches taken to enhance the research. Section 6 looks at the ethical considerations of the research, whilst Section 7 unpacks the data utilised in the research, including how it was sampled and collected. Section 8 looks at the research and analysis and Section 9 is the conclusion, discussion, and recommendations. Annexure A includes the consistency matrix to summarise the aim and methodology of the research.

2. LITERATURE REVIEW

In this section, we first look at the research that other authors have contributed to the topic regarding the importance of SMEs in economic contributions and job creation. We then look at the literature regarding the survival rates of South African SMEs. To address the main aim of the research paper which seeks to explore industry survival rates for Agricultural and Manufacturing SMEs; 1) We look at the literature associated with demographic characteristics with South African SMEs and, 2) Explore possible predictors of SME survival rates.

2.1. SME definition

As stated in Bruwer and Coetzee (2016), the definition of SMEs was initially formally recognised through the National Small Business Act No.102 of 1996 (Rogerson, 1997). According to this Act, SMEs are defined as distinct and separate business

entities managed by a single owner or more, conducting their business operations in South Africa, despite the industry of operation. SMEs can be categorised in size; micro, very small, and medium. This Classification is based on four factors: 1) The total number of full-time employees in the organisation, 2) the organisations turnover, 3) the organisation's gross asset values, and 4) the industry cycles that the organisation operates in. In South Africa, the upper limit of employees is 250 with the turnover ceiling being R 220 million depending on the industry (de Wet, 2019). For this research, we use the limit of 250 employees to identify an SME.

2.2. Formal SME definition

For purposes of this research, formal SMEs are regarded as those that have been registered with the CIPC, thus are tax registered with the South African Revenue Services (SARS). The SASDC only works with SMEs that are registered with the CIPC and submit a tax report annually.

2.3. Economic contributions of South African SMEs

In 2020, Statistics South Africa noted a growing role of SMEs in the formal business sector, this growth trend has been noted years prior by Kongolo (2010) reporting 51 to 57 percent of the GDP attributable to SMEs. In the same year, Olawale and Odeyemi (2010), supported this finding by noting a 30 to 57 percent GDP contribution by the SMEs. This shows the importance of SMEs in the development of the South African economy and with the persistent employment and income distribution challenges, these companies are paramount in emerging economies (Leboea, 2017; Cant & Wiid, 2013). The performance and growth of SMEs are crucial drivers and benchmarks of the level at which a country's industrialisation, urbanisation, modernisation meaningful employment, income per capital, income distribution, and quality of life can be measured (Aremu & Laraba, 2011). This economic contribution is highlighted by the SMEs having generated an estimated R 10.5 trillion in turnover for the formal business sector in the year 2019 (Stats SA, 2020).

According to Fatoki et al. (2011), South Africa's SMEs contribute an estimated 36% of the GDP, these findings are in line with authors Kongolo (2010) and Owale and Odeyemi (2010). Fatoki and colleagues (2011) elaborated that this contribution to GDP is low when South Africa is measured against its comparable developing countries. Brazil's SME industry contributes an estimated 59 percent whilst Chile contributes 57 percent of their national GDP. According to Leboea (2017), this low contribution can be attributed to low SME growth rates compounded with high SME failure rates. Medium-sized businesses contribute 10 percent, small businesses contribute 22 percent and businesses account for 68 percent of the R 10.5 trillion.

2.4. SMEs' role in employment in South Africa

A 2016 analysis by Bruwer and Coetzee on the sustainability of SMEs in South Africa concluded that SMEs add substantial value to the provision of employment opportunities. These findings support earlier findings by Naidoo and Urban (2010) and Olwale and Odeyemi (2010) who reported an estimated 61 to 80 percent of South African jobs provided by SMEs. Moreover, in 2019, Moyo stated that unemployment can be addressed through SMEs as it constitutes 60 percent of all employment in South Africa. This immense impact has been said to account for 10.1 million jobs of the 14.9 million jobs in South Africa (Small Enterprise Development Agency, 2021; Moyo, 2019). The importance of SMEs in employment creation is further seen in its contribution of 10.1 million of the 14.9 million jobs in South Africa, which is 68 percent (Small Enterprise Development Agency, 2021).

To alleviate poverty and unemployment in South Africa, SME development must be prioritised. SMEs are a vital source of innovation and development (Mahadea & Rawat, 2008). The growth of SMEs over the past two decades has been so exponential that an estimated nine out of ten businesses in South Africa can be classified as SMEs (Mouloungui, 2012). Moreover, the writer states that SMEs are more likely to employ low-income employees making their role even more critical. SMEs on average use more labour intensive methods of production, contributing to a majority of private sector employment, this further highlights the greater propensity for

SMEs to absorb labour capacity which is crucial for reducing the unemployment rate that is currently at 34.5% (Stats SA, 2022). SMEs in developing countries eradicate poverty as their contributions are not simply limited to income generation alone but to income distribution (Tshikhudo et al., 2015). SME performances are frequently interrelated with the economic performance of the country as a whole.

2.5. SME global survival

Literature on SME survival is scarce, despite it being a key measure of business performance (Rahman et al., 2016). Kristanti et al. (2019) conducted a survival analysis in Indonesia. Survival analysis was used due to its consistency and accuracy, Cox Hazard Model identified that organisations that pass eight years of operation had a low probability of financial distress. A focus on generating venture capital, monitoring inflation and economic growth policy is identified as being crucial to helping SMEs have optimal working capital to survive. In Poland, Steinerowska-Streb et al. (2022) looked at SME survival rates post the global economic crisis in 2008 and argue that organisation size or type of business activity are not important factors for SME survival. A survival analysis conducted by Cao (2012) in central China using 54 573 SMEs founded between 1998 and 2007 used life tables and the log-logistic model to conclude that SMEs in larger and monopolistic industries in less concentrated industries have better odds of survival. A survival analysis by Shin et al. (2017) looked at internal and external factors affecting SME survival in South Korea. Internal factors such as firm origins (previous experience) and external factors such as strategic alliances and research and development (R&D) funding were identified as affecting the hazard rates to increase survival odds.

2.6. SME survival in South Africa

Mbhonyane (2006) states that an average of 50 percent of South African SMEs that are started fail, moreover, some fail to grow beyond the survivalist stage, which is the first two years of operations. The writer argues that there is very little support available for SMEs, resulting in their low survival rates. Wiese (2014) supports this view by

highlighting that although the economic value that South African SMEs provide to the economy is evident, they have amongst the worst global track records regarding remaining in operation. Additionally, Olawale and Garwe (2009) state that the failure rate of South African SMEs is amongst the highest globally at 75 percent. There is a belief that most new SMEs fail to survive their first years of operation preventing them from realising their potential economic benefit (Leboea, 2017).

According to Berry et al. (2002), In the late 1990s, the period after the National Small Business Act No. 102 of 1996 was implemented, an estimated 1.6 million to 3 million SMEs were active in South Africa. Despite the attempts by the government, SME survival rates continue to this day to be low. In 2002, Cant and Ligthelm constructed a survey questionnaire using judgment sampling techniques to collect data from 300 SMEs in South Africa. The researchers found that, despite government support, an estimated 70 percent to 80 percent of SMEs in South Africa were no longer in operation after their third year of business from the implementation of the National Small Business Act No. 102 of 1996 to the early 2000s. This finding is further supported by Eeden et al. (2003) who further highlight that millions of Rands are lost on these failures.

Bruwer and Coetzee (2016) highlight that the trend of high failure rates continued until the early 2010s. In a study by Cant and Wiid (2013) using primary data collected from South African SMEs consisting of 81 organisations in the Tshwane region, they estimated that 63 percent of South Africa's SMEs were out of business within two years of their operation in the early 2010s.

2.7. SME sustainability

Sustainability for South African SMEs can be defined as the ability to achieve long-term economic, social, and environmental success and being able to meet the needs of future generations. Sustainability often includes the implementation of sustainable practices that can mitigate the negative effects of business operations on society and the environment and improve business profitability and competitiveness.

Numerous studies have been led in South Africa to investigate SME sustainability and the various factors that affect it. Authors Msomi and Olarewaju (2021, pp. 112–113) argued that financial access, financial awareness, and financial skills are crucial in promoting managerial stability which leads to sustainable businesses.

Authors Zor et al. (2019, p. 673) found that budgeting has a positive effect on SME financial sustainability. In this study, the authors found that SMEs in developed countries use budgets more often, resulting in higher sustainability rates. Authors Hamdan et al. (2020) support this view by highlighting the role that budgets provide in performance preparation, monitoring, assessment, and evaluation.

Authors K. Ogujiuba et al. (2021, p. 22) argue that government support and labour relations are crucial determinants of sustainable SMEs. The authors further argued that start-up capital, the environment, and expertise were insignificant to sustainability. Staden (2022, p. 466) contradicts the view of K. Ogujiuba et al. (2021, p. 22) that expertise is insignificant by stating that management expertise is the most positive factor that influences SME operations.

Other authors have focused on locations or industries. For instance, K. Ogujiuba et al. (2022, pp. 16–17) found that the location of a company affects its sustainability. Rural-based SMEs were identified to receive less government support and were thus less sustainable.

There is extensive literature that shows that there is a relationship between company sustainability behaviour and financial performance (Martins et al., 2022, p. 14). Most of the literature highlights that a positive relationship exists, where an increase in sustainable behaviour leads to increased financial performance. The author's Martins et al. (2022, p. 14), highlight that further research into whether the relationship between company sustainability behaviour is driven directly by environmental, ethical, social, or a combination of the sustainable factors would be beneficial.

2.8. Objective 1: Demographic characteristics associated with the SMEs in South Africa

Ligthelm (2011) notes that there are demographic characteristics that South African SMEs are associated with. The Small Enterprise Development Agency (2021) further mentions that these demographics affect the survival of SMEs. However, despite these inputs, limited research was found that focuses on how specific demographics may be linked to SME failure. In this research paper, the first objective is to explore the demographic characteristics that are associated with SMEs. The Small Enterprise Development Agency (2021) identifies seven demographic characteristics in the SME environment:

i) Owner Age

A majority of the SME owners are between 30 years to 54 years. The data showing the total distribution of the SME owners by age is provided based on age ranges; 40 to 44 is highest with 14, 8 percent, 45 to 49 is 14.5 percent, 35 to 39 is 14.4 percent, 30 to 34 is 14.1 percent and 50 to 54 is 12.1 percent (Small Enterprise Development Agency, 2021). In 2021, SEDA reported that those between the ages of 25 to 55 were much more affected by the COVID-19 lockdowns, with 14% of the total SME cohort closing down. This accounted for 80 percent of all SME closures, this is contrary to the 60 to 70-year-old age group which increased in ownership. This makes this demographic characteristic (owner experience) interesting as it could imply that older SME owner's experience could make them better prepared to navigate challenging economic periods. Therefore, in this research, a focus will be placed on understanding the impact of experience on the Agricultural and Manufacturing sectors.

ii) Enterprise age

The enterprise age range with the highest number of South African SMEs is 11 to 20 at 20.9 percent, 6 to 10 at 20.0 percent, 3 to 5 at 15.9 percent, 21 to 50 at 13.2 percent and 0 to 1 at 12.2 percent (Small Enterprise Development Agency, 2021). In a study conducted on Libyan SMEs, Zarook et al. (2013) argue that demographic characteristics such as the age and size of a business define successful SMEs.

Ogujiuba and Boshoff (2020) added to the research by looking at South African SMEs to find that the age of business is crucial in fostering a sustainable SME.

Younger businesses are more susceptible to failure (Small Enterprise Development Agency, 2021). SMEs less than 3 years old were responsible for 46 percent of all closures. Businesses that are older than 20 years show the best resilience. Given that an estimated 40.9% of SMEs lie between the 6 years to 50 years enterprise range, it is indicative that the SME ecosystem in South Africa is comprised of older companies. This is in line with the notion that owner age is a crucial demographic for SMEs.

iii) Formal and informal sectors

Two-thirds of SMEs in South Africa are informal (Small Enterprise Development Agency, 2021). Despite this, most SME owner's in the formal sector employ people in their operations while an estimated 81 percent of the informal sector are sole entrepreneurs, in contrast to the 25 percent of sole entrepreneurs in the formal sector. For this research, we will only focus on the formal sector due to its greater potential for job creation and economic contribution.

iv) Industry

SMEs are spread out unevenly across South Africa's provinces; Gauteng comprises 33 percent of all SMEs, KwaZulu-Natal 18 percent, Western Cape 11 percent, Limpopo and Eastern Cape 10 percent each, Mpumalanga 9 percent, Free State 5 percent, North West 3 percent and Northern Cape 1 percent (Small Enterprise Development Agency, 2021). Cant and Wiid (2013) refer to the location as an important demographic factor, they conclude that the location of the business is a key marketing variable. Geographical proximity to buyers and suppliers is viewed as a crucial characteristic of SMEs. Cant and Wiid (2013) based their research on Tshwane SMEs and admit to using a small sample size (n = 81). Thus, variables cannot be generalised to represent all SMEs in South Africa and the Tshwane region.

v) Population Group

An estimated 75 percent of SME owners are Black, 17.3 percent are White, 3.9 percent are Coloured and 3.7 percent are of Indian or Asian descent (Small Enterprise

Development Agency, 2021). Gono et al. (2016) looked at SMEs in the ICT sector and found that sectors such as logistics are black-dominated but are struggling with a skills deficit.

vi) Educational attainment

The majority of SME owners have not completed secondary education (36 percent), those that have completed a secondary education follow (28.9 percent), and tertiary educated owner's (20.1 percent) (Small Enterprise Development Agency, 2021). Olawale and Garwe (2009) highlight that the two main contributors to low new organisation creation and failure are education and training. In South Africa, this characteristic is said to contribute more than financial support as stated by Herrington et al. (2010). The authors highlight that the lack of education and training reduces management capabilities for new SMEs, which explains the high SME failure rates. Brijlal et al. (2013) explored education and gender and their effects on SMEs in the Western Cape with Ogujiuba and Boshoff (2020) supporting the notion that these demographics appear to play a role in SME survival.

vii) Occupation group

The majority of SME owners are in elementary occupations (24.9 percent), followed by Managers (21.4 percent) and craft and related trade workers (21.1 percent) (Small Enterprise Development Agency, 2021). According to Olawale and Garwe (2009), managerial competencies, including knowledge, skills, behaviours, and attitudes contribute to individual effectiveness. This is further supported by Ogujiuba and Boshoff (2020) who state that management know-how is a common feature of sustainable SMEs. Thus, managerial competencies are important to the growth and survival of SMEs. Knowledge of the industry received before SME ownership and after is linked to profitability (Soriano & Castrogiovanni, 2010).

2.9. Objective 2: Predictors associated with the survival of SMEs in South Africa

Several authors have investigated possible predictors of success for SMEs, to assist owners, government, and investors in growing the SME sector. The predictors can be classified under two categories: 1) internal factors and 2) external factors.

Internal and external factors

Olawale and Garwe (2009) investigated internal and external factors that affect SME survival. Internal factors comprised of access to finance, skills, networking, investment towards Information and Technology, and cost of production. External factors comprised of the markets, infrastructure, crime, labour, economic environment, and regulations. Cant and Wiid (2013) further explored by investigating exogenous and endogenous factors, in addition to the factors identified by Olawale and Garwe (2009), internally they identified good pricing strategies and location and as good predictors of SME success.

Fatoki and Odeyemi (2010) looked at the financial challenges that South African SMEs in the Eastern Cape Province face, the authors identified the lack of availability of finance as a primary reason for SME failure. In addition, Bruwer and Coetzee (2016) conducted a literature review to investigate the sustainability of SMEs in South Africa using 680 papers the writers maintain the view that access to finance is a good predictor of SME success. van Scheers (2011) explored marketing-related obstacles and marketing skills shortages that South African SMEs face. The writer found a positive correlation between poor marketing skills and business failure in South Africa, good marketing skills can be viewed as predictors of success. Cant and Wiid (2013) expand on the marketing factors by stating that pricing strategies, business locations, and knowledge of the target market are predictors associated with SME success.

Brink et al. (2003) conducted an early study and found that macro-environmental factors contribute to SME success. (Cant & Wiid, 2013) investigated further by providing a view of various problems that SMEs experience namely; social influences, the lack of marketing knowledge, limited management skills, and lastly financial-

related matters and human resource constraints. As a result, SMEs that have leaders that can navigate the macro environment due to their education, skills, and business acumen are more likely to survive. Tshikhudo et al. (2015) focused on the construction industry, and surveyed it to understand the critical success factors of construction SMEs in South Africa. The authors identify access to finance, marketing strategy, effective management, good record keeping, product quality, management of performance, experience, and knowledge, diverse experience, and market specialisation as success factors.

Some of the recent and relevant contributions on the subject matter are the research by Ligthelm (2011). The author conducted a survey and applied survival analysis techniques on informal SMEs using a panel of 300 businesses from the years 2007 to 2010. The author found a high correlation between entrepreneurial acumen and business management skills and the likelihood of an SME surviving.

According to Dockel and Ligthelm (2002, p. 1), economy-based risk is associated with national economic factors related to the state of the economy, such as the specific phase of the business cycle, growth policies, employment prospects and the economic environment created by the national government for positive business growth. The lack of fear of risking funds in a new entrepreneurial venture, the ability to take calculated risks, and completing a business plan were the greatest predictors of SME survival. Ligthelm (2011) also found that external factors such as the availability of business credit and offering services and products in small quantities to reduce operational costs resulted in a higher likelihood of SMEs surviving.

The literature from the authors highlights the important role that SMEs in South Africa play in stimulating the GDP and being primary job creators. Despite the various literature about SMEs in South Africa, to our knowledge, no survival analysis has been conducted on SMEs in the formal sector using secondary data. Moreover, there is a scarcity of data or research exploring survival rates amongst the high GDP-contributing industries with a focus on agriculture and manufacturing. The findings from this research will assist governments and investors to promote SMEs that exhibit the predictors associated with success to grow and become large businesses. In

addition, this will also assist government and development agencies to identify organisations that lack predictors associated with survival to get training and relevant assistance. In this research, we will also explore any other possible variables not listed that may be predictors of SME survival.

2.10. Hypothesis

The educational attainment levels and age of the SME owner and the location of the SME are demographic factors associated with SME survival in South Africa. Gender and population group are not associated with SME survival.

SMEs with educated and experienced owners, located in the metropolitan cities are effective predictors of SME survival.

3. METHODOLOGY

This section highlights the models that this study uses. The Kaplan-Meier and life tables are identified as the most common Survival Analysis techniques that are used to determine survival ratios over a period of time, including determining survival probabilities (Kleinbaum & Klein, 2005, pp. 69–70). The Cox proportional hazard model is effective in determining the strength of the relationship between variables in increasing the probability of survival.

3.1. How the Survival analysis will be conducted

Formal SMEs in the agriculture and manufacturing industries that were operational between the years 2010 to 2020 will be analysed from their inception. Their survival will be analysed until the year 2020. The focus will be to create life tables to visualise ‘time to event’ distributions, plot the ‘time to event’ data through Kaplan-Meier Survival Analysis and use Cox regression to explain how the multiple variables affect the survival rates.

The analysis will include observations that have not failed, these observations will then be further analysed to understand what makes the SMEs successful to identify demographic characteristics or predictors of SME success. To conduct this survival analysis, SMEs that have ‘closed’ within the 2010 to 2020 period and those that are ‘still operating’ will be included and analysed.

For this Survival analysis, we will include techniques such as life tables, Kaplan-Meier Survival Analysis, and Cox regression to analyse the data and make recommendations that will infer SME sustainability (Gupta, 2017).

3.1. Survival analysis

Survival analysis includes various statistical models, tools, and concepts that look at the occurrence of events over a period of time for various variables (Nyinawajambo, 2018, p. 13). Survival analysis mainly conducts its statistical analysis using survival curves (survival functions). The subjects being studied in a Survival analysis may be biological or non-biological i.e.: animals, cells, humans or motor engines, etc.

In a Survival analysis, the objective is to model a time to an event. The survival time is the time that passes from a preliminary event to a definite end-point.

E.g.: - From the start-up of the SME to its failure (time = survival duration)

- From birth to death (time = age)

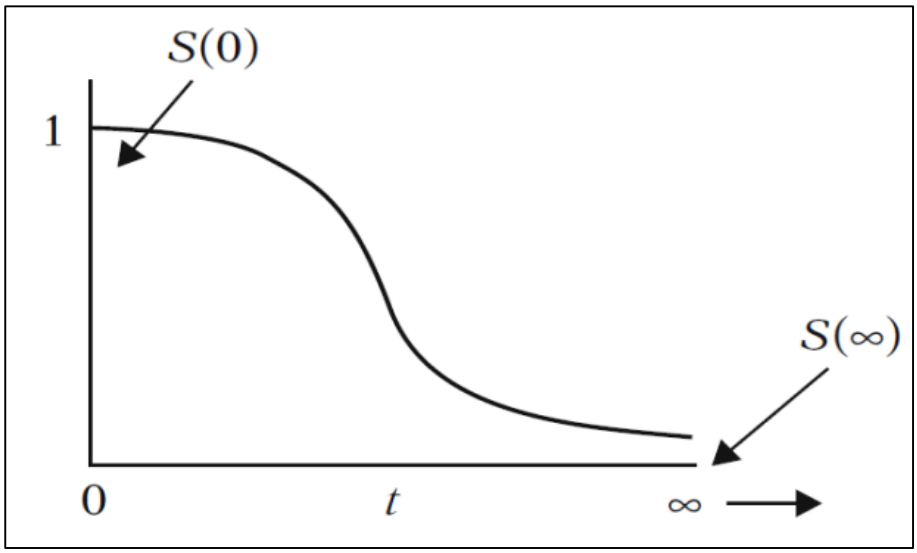
- From drinking alcohol to getting drunk (time = soberness duration)

- From engine running to engine breaking (time = engine duration)

- From being married to divorced (time = duration of marriage)

Survival analysis as a statistical technique allows us to portray a survival event over a period of time. The graph is often portrayed as a downward-sloping curve, time (t) is at the x-axis, and the probability of survival is at the y-axis.

Figure 1: A common example of a Survival analysis curve



Source: (Kleinbaum & Klein, 2005, p. 9)

Three important components allow for survival time to be estimated:

1) **Time the subject enters the study**: In this research, this will be the date the SME formally began to trade.
2) **Occurrence of an event of interest**: In this research, the time to SME failure is the event of interest. If the SME does not fail, this will form part of the analysis to understand the success factors.
3) **A scale to measure the passage of time**: In this research, the passage of time will be measured in years. This is the time between the date the SME started to trade to when it failed.

Unlike other models, survival models explore the relationship between survival time and the independent variables (covariates). By applying survival models, we can identify which predictors are best associated with South African SME survival (Gupta, 2017). This model examines the length of time before an event occurs which in this research paper will constitute the day at which the organisation ceases to operate. Survival analysis, in its simplest form, answers the question; when will the event occur? In this research, this is important as we are exploring the time that the SME will

fail given the studied variables. This research will quantify the relationship between the survival time and the variables in the data. Cox proportional hazards model will be used, proposed by Cox (1975), is the most popular covariate effect model to analyse survival probability and failure time.

3.3. Life tables

This is a survival analysis technique that does not include parameters, it generates distributions for the time to an event of the whole dataset or separately for each factor. Life tables further divide periods of observation into small periods to estimate their probabilities.

3.3. Limitations of the life table technique

In events where individual information is unavailable, the life table technique is used alongside the Kaplan-Meier technique to determine the survival probabilities (Nyinawajambo, 2018, p. 19). Life table techniques assume that mortality or failure patterns are proportional every year and often provide estimates in intervals. Different cohorts present different mortality or failure rates thus assuming proportionality is inaccurate as excess or lower mortality or failure can occur.

3.4. Kaplan-Meier Survival Analysis (KMSA)

This technique generates tables and plots the-time-to event data. This is a descriptive procedure. dj is the number of instances that experience the event (failure) at time t(j) whilst nj is the number of incidents that have not yet experienced the event at that time and thus are still ‘at risk’. The equation for the model is expressed below:

$$S(t) = \prod_{j\,/\,t(j)<t} (1-dj/nj) ,$$

3.5. Limitations of the Kaplan-Meier Survival Analysis (KMSA)

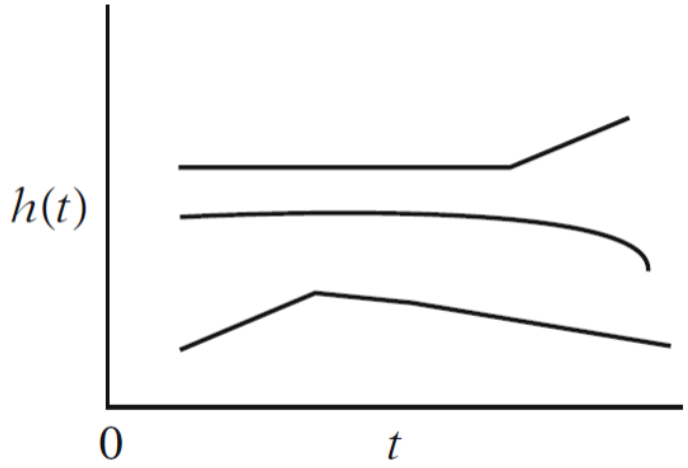
The Kaplan-Meier technique is widely considered the most common of all the Survival analysis techniques (Nyinawajambo, 2018, p. 17). Alongside the log-rank test, the Kaplan-Meier technique assists in estimating the survival probabilities of variables and in establishing comparisons between two groups. However, at times, a comparison between more than two groups is necessary and still be able to determine the strength of each factor. In this situation, the Kaplan-Meier and log-rank tests are not effective as they are significance tests (tests to see if the differences in the results are due to chance or sampling error). In such a situation, the Cox proportional hazard model is best.

3.6. Cox regression

This is a semi-parametric technique that explores survival probabilities and failure times. These models advantage lies in its ability to allow multiple variables to explain the survival probabilities and failure rates. Time-dependent and time-varying variables can be used in a Cox regression. As proposed by Cox (1975), the equation for the model is expressed below: $h(t|X)=h0(t)g(X,\beta)=h0(t)\exp(X\beta)$

β is a vector (has both direction and magnitude) of regression coefficients that are unknown, $h0(t)$ is the baseline hazard which represents the hazard when all independent variables (predictors) are zero.

Figure 2: A common example of a Hazard function



Source: (Kleinbaum & Klein, 2005, p. 9)

According to Dessai and Patil (2019), Cox model makes the below assumptions:

Random censoring: Censoring in statistics occurs when the value of an observation is partially known. Cox regression assumes that censoring in the data is random (non-informative). Random censoring occurs when each subject has a censoring time that is independent of the failure time. This assumption is crucial however the disadvantage is that it cannot be tested statistically. Rigorous data collection is noted as the best control for this. Failure to conduct rigorous data collection could affect the validity and reliability of the findings. This could result in demographic characteristics and predictors of SMEs that are not true indicators of successful SMEs in South Africa. By using data from the SASDC, a reputed institution, we aspire to optimise the reliability and validity of the findings.

Linearity: A multivariate survival analysis assumes that continuous covariates are linear. However, this can be a disadvantage when the relationship is a curve which could affect the predictability of the model. This assumption must be confirmed by plotting a graph of the variables to ensure that we identify a nonlinear relationship. In such an instance, the variable would need to be transformed.

3.7. Limitations of the Cox regression technique

Estimation of the strength that factors have on survival outcomes is mainly done by the Cox proportional hazard model. For the Cox proportional model to function, the two assumptions mentioned earlier; random censoring and linearity must be met. Without these two conditions being met, the results become inaccurate.

3.8. Regression coefficients

The use of Pearson's correlation coefficient will be instrumental in creating the basis of the research. This will establish the various relationships between specific variables. Regression coefficients will inform us on which factors (variables) are significant contributors to formal SME survival. The analysis will be conducted through the use of STATA.17 statistical software tools. When conducting a regression analysis, four outputs will be important:

Standardised beta coefficient (β): This is the strength of the effect of the individual variable when compared to the dependent variable. A higher beta coefficient implies a stronger effect.

The standard error (Std. error): This value provides the average distance that the observations fall out of the regression line, it will thus tell on average, how accurately the regression model estimates the coefficient's unknown value.

Significance (Sig.): This is also called the P-value. It tells us how confident we can be that the given variable (dependent variable) is correlated with the dependent variable. A value lower than 5% or 0.05 will be considered statistically significant.

Adjusted R2: This output provides the model fit. By identifying the percentage of variance that can be explained by the inputs, it estimates the fit of the linear regression.

3.9. Limitations of regression coefficients

According to Flom (2018), linear regression makes some assumptions:

Linearity: Linear regression assumes that the relationship between the independent and dependent variables is linear. However, this can be a disadvantage as the relationship could be a curve. To identify such occurrences, we will use graphical representations to visualise the relationship to promote a model that predicts the relationships reliably.

Normality: Linear regression assumes that the residuals of the models are normally distributed. As a result, it only considers the mean of the dependent variables. The disadvantage of linear regression is that it is not a complete description of relationships among variables. To promote reliability and validity, quantile regression can be used.

Homoscedasticity: Linear regression assumes equal or similar variances in the different groups being analysed. The disadvantage of this is that it is sensitive to outliers. This can affect the predictability of the model, resulting in biased or skewed results. Data cleaning and creating multi-level models by separating variables are possible solutions to these challenges.

Independence: Linear regression assumes that the data is independent. Despite being common, this is not always correct such as in instances of clustering in space and time (measuring of same subjects multiple times). Multilevel models or transforming the data can be explored to address this challenge.

4. UNINTENDED CONSEQUENCES OF THE RESEARCH

The research is intended to be used for positive decision-making, to help SME owner's, government, development agencies and investors. The intention is to have SMEs that exhibit demographics that are associated with low survival rates or lack the success predictors to get relevant assistance to promote their survival.

The unintended consequences are that this technique could be used to discriminate against them, thus denying them an opportunity to benefit from growth opportunities such as funding, mentorship, or marketing opportunities.

5. DATA VALIDATION AND RELIABILITY

The research utilises confidential and sensitive data provided by the SASDC. Data validation is focused on ensuring that the data that is collected is accurate, complete, and consistent. Data validation is focused on ensuring that the data can more accurately represent the real-world occurrences that it seeks to measure. To ensure that the data provided is valid and reliable a few steps have been taken:

- **Data from a reliable and reputable source**: The data collected is from the SASDC, as a registered company that works with SMEs in South Africa, the SASDC is a reliable source to gather the data. The data is updated regularly by the SASDC data stewards.
- **Data completeness and accuracy**: Checks to ensure that the data is complete and accurate have been performed using the internal audit processes of the SASDC. The researcher has also cross-checked the data to ensure the completeness of the data sent.
- **Verifying data consistency**: Data entry has been cross-checked to prevent finger errors, and checks across the data sources have been done to prevent calculation errors with statistical analysis being used to check the consistency. The internal policies of the SASDC ensure that the data gathered meets the required standards.
- **Establishing effective data quality standards**: The researcher and the data stewards from the SASDC clearly defined the objective of the research before data gathering. Discussions on available data, scope, sample size selections, and other relevant matters were discussed. A secure way to share the data and weekly check-ins to discuss the data were scheduled to ensure a high data quality standard.
- **Data validation tools**: To attain internal validity, the data will be analysed through the STATA 17 statistical tool. This will allow for a thorough, rigorous, and clear process to achieve reliability. Validation tools coupled with the use of literature reviews from recent, reputable journal sources from industry experts is an added control to increase internal validity.

6. ETHICAL CONSIDERATIONS

To conduct this analysis, data will be requested from the primary researchers of the SASDC to access their SME database. Ethical considerations such as maintaining anonymity, confidentiality, results communication, as well as using the data only for the intended purposes will be maintained.

In addition, written permission was sent to the Chief Executive Officer (CEO) of the SASDC from the researcher with assistance from the supervisor to use the data of the SASDC (See Annexure B). The researcher communicated with the SASDC CEO using digital channels and signed a Non-disclosure Agreement to protect the privacy of the companies in the data sent by the SASDC. To further protect the security of the data, the researcher is obliged to remove any data from any external files and devices and conducted the research using cloud-based software i.e.: Gmail and Google Drive, and OneDrive.

7. DATA

The survival analysis conducted is a retrospective study of selected SMEs in the South African economy. It was discussed in previous sections that SMEs in South Africa account for the majority of the GDP, however, have a high rate of failure. To assess the risk factors associated with SMEs, companies in the Manufacturing and Agricultural sector were selected by data stewards from the SASDC. Companies that were operating between the years 2010 and 2020 were observed to investigate if they will survive, those that failed to reregister with the SASDC failed to meet their ability to be financial going concerns and are regarded as failed.

7.1 Data collection

This research paper analysed secondary data. Data from the South African Supplier Diversity Council (SASDC) was used for mathematical modelling using regression techniques and survival analysis as mentioned above. This methodology is most

appropriate to be able to determine the predictors of success as well as identify which demographic factors lead to the highest success probability for formal SMEs.

Due to the difficulty in accessing SME data, using secondary data from a reputed organisation that has resources and experience in obtaining the data of South Africa's SMEs is more likely to result in a more generalizable approach.

Limitations of the data collection method

The limitation of the method is that intrinsically because this is secondary data, we have limited control and oversight of how it is collected, recorded, and updated.

7.2 Data type collected

The data that will be analysed will include owner age, enterprise age, industry, province (location), population group of owner, occupation of owner and active status. The variables provided may be nominal, ordinal, interval and ratio in nature.

Nominal: These are categorical scales. Province (location), industry and population group of the owner.

Ordinal: These have qualities including the description alongside having an intrinsic order which includes educational attainment/level.

Interval data has a known order of variables including known differences between the variables. No interval data will be collected, however, additional variables are expected to be created as interval data during the data analysis phase using the statistical tools.

Ratio data provides an order of variables, differentiates between variables, and has a true zero value. The owner age and enterprise ages are relevant.

7.3 Data analysis

The purpose of this chapter will be to undertake a detailed quantitative analysis. In its raw form, data present little meaning to most people (Saunders et al., 2016). This quantitative research will look to quantify the problem. To answer the main question

of finding the survival rates for formal SMEs in agriculture and manufacturing in South Africa, objectives 1 and 2 need to be addressed. Objective 1 requires we explore demographic characteristics associated with the SMEs and Objective 2 explores predictors of formal SME survival.

For this study, secondary data has been utilised. The secondary data of SMEs has been collected from files sent by the SASDC. The SME files are collated into a single database for analysis. The considered period is ten years from 1 January 2010 to 31 January 2020. This time period has been considered due to it being the recent window post the economic global recession. The reason for not considering the period afterward is that the SME ecosystem was affected by the Covid-19 pandemic resulting in many SMEs failing. To control for the effects cause by the pandemic, this study excludes the period after 31 January 2020.

The scope of this study is limited to covering South African SMEs that have registered with the Companies and Intellectual Property Commission (CIPC) and have registered with the SASDC. Due to the difficulty of finding data that is rich in demographic factors, using the data from the SASDC ensures that the two objectives can be researched; 1) exploring demographic characteristics associated with SMEs and 2) exploring predictors of formal SME survival. The SASDC only registers companies with greater than 50% Black ownership. Companies in financial distress are those categorised as companies that failed to reregister with the SASDC.

7.4. Sample size

The data collected are based on 2 files sent by SASDC data stewards containing data on an individual SME, including a Microsoft Excel and PDF document. The researcher consolidated the findings into a single database to allow for analysis. Various factors resulted in the research being limited to a smaller sample size:

Difficulty in accessing data: The lack of a standardised database that consolidates all of the SME data and the difficulty in obtaining the data affected the ability to get a larger sample size.

Time & resource constraints: This research utilises secondary data from the SASDC to make an analysis. A smaller sample size was selected to save time and resources. A convenience sample or a non-probability sample was selected.

Accessibility to population: There were an estimated 2.6 million SMEs in South Africa as of the year 2022, of which 37% were formal (OECD, 2022). This means that there were an estimated 962 000 formal SMEs. The SASDC has connections with over 918 SME data in South Africa that it assists in facilitating their business. The SMEs in the manufacturing and in particular the agricultural sector are often small and difficult to access. This presents a challenge in obtaining a representative sample that is generalizable. A smaller sample size was selected.

Limited variability: The SMEs in the manufacturing and agricultural sectors displayed homogenous traits amongst their separate industries. This limited variability may be sufficient in obtaining accurate estimates of the population as a smaller sample is likely to represent the total population accurately.

7.5. Sampling technique

The research is conducted using a Convenience Sampling technique. The SME data collected by the SASDC is stored in document format as there is no formal database with a complete list of all the SME data. The limited availability of the data coupled with the challenge of accessing the data has resulted in a non-random sampling approach being selected.

7.6. Selection of variables

To conduct the Survival Analysis, direct determinant data regarding how old the SME is and how long it took before it failed was gathered. These factors are directly linked to the survival of SMEs. The SASDC also gathers indirect factors that will be analysed to determine if they influence the survival of SMEs.

Direct factors: These include the date of SME trading, age of SME, age of failure of SME, and whether the SME is still active.

Indirect factors: These are factors that when combined with direct factors, are likely to contribute to the survival of SMEs (Nyinawajambo, 2018). Demographic factors, Business Capability, and Maturity health are all factors that will be studied to see the impact they play on the survival rates of SMEs. Below, Table 1 highlights the variables studied in this research.

Table 1: Variables selected for Survival Analysis.

Variables	**Label**
Survival Analysis	
Date	Date SME started trading
Age	Age of SME (Survival)
Failure age	Age at failure of SME
Active Status?	Active status of SME
Demographic factors	
Owner gender	Gender of owner
Owner age	Age of owner
Location	Location of operations of SME
Education	Highest education level of owner (None, Matric, Certificate, Diploma, Degree, Masters, PhD)
Industry	Industry the SME is in
Work experience	Industry work experience
Occupation	Occupation of owner
BEE Ownership %	Percentage of BEE ownership
Woman Ownership %	Percentage of woman ownership
Black Youth ownership %	Percentage of Black Youth ownership
Number of employees	No. of employees in the company
Financial factor	
NPAT	Net Profit After Tax
Business capability	
Leadership	Leadership

Customer	Customer
Process Management	Process Management
People	People
Support	Support
Maturity Health	
SM	Strategic Management
M&L	Management and Leadership
UotS	Understanding of the Sector
M&S	Marketing and Sales
O&P	Operations and Productions
EM	Environmental Management
F	Finance
HR	Human Resources
IM	Information Management
QM	Quality Management

The dependent variable in this study is the 'Survival Rate' that will indicate if the SME survives or not and will determine the number of years of survival.
The survival time (in years) of the SMEs that survived or failed during the periods 2010 – 2020 were calculated as follows:

- **Survival time of SMEs that are still active**: (Date of analysis - Date SME started trading)/12.
- **Survival time of SMEs that are not active**: (Age of SME at failure)/12.

Demographic factors of the SMEs were recorded and include 11 variables: 1) Owner gender, 2) Owner age, 3) Location, 4) Education, 5) Industry, 6) Work experience, 7) Occupation, 8) BEE Ownership %, 9) Woman Ownership %, 10) Black Youth ownership %, 11) and Number of employees in the company. These factors were analysed to investigate the relationship they have in determining the survival rate of an SME.

Net profit after Tax is the factor that will be used to analyse the financial well-being of the SME.

The SASDC gathers Business Capability and Maturity Health factors. These factors are used by the SASDC to assess the overall sustainability of the SME out of a rating of 100% to categorise the factor as being Foundation (less than 50%), Intermediate (greater than 50% but less than 70%), or Advanced (greater than 70%). These factors will be analysed to see if they are capable of predicting SME survival and sustainability.

Business Capability: These factors look at what the SME requires to perform its main function. There are 5 Business Capability factors; 1) Leadership, 2) Customer, 3) Process Management, 4) People, and 5) Support.

Maturity Health factors: These factors assess how mature the organisation is across its core functions. There are 10 Maturity factors;1) Strategic Management, 2) Management and Leadership, 3) Understanding of the Sector, 4) Marketing and Sales, 5) Operations and Productions, 6) Environmental Management, 7) Finance, 8) Human Resources, 9) Information Management and 10) Quality Management.

8. RESULTS AND ANALYSIS

In this section we discuss the findings from the analysis.

8.1 Descriptive statistics

Table 2. Table showing predictors between the manufacturing and agricultural industries.

Predictors	Manufacturing	Agriculture	Total
CEO Gender			
Male	11	2	13
Female	10	2	12
Education			
- Ph.D.	0	1	1

- Degree	10	0	10
- Diploma	4	0	4
- Some education	3	1	4
- No education	4	2	6
CEO work experience (years)			
0-5	1	0	1
6-10	7	0	7
11+	13	4	17
Location			
Gauteng	9	0	9
Western Cape	3	0	3
Limpopo	0	3	3
Kwa-Zulu Natal	7	1	8
Eastern Cape	2	0	2
Number of employees			
0-5	10	3	13
6-10	5	1	6
11+	6	0	6
Net Profit After Tax (ZAR)			
<0	4	1	5
0 - 100 000	10	2	12
100 001 - 500 000	3	1	4
> 500 000	4	0	4
SME still active?			
Yes	7	1	8
No	14	3	17

A sample of 25 SMEs was provided and analysed for this research. This comprises four (4) agricultural SMEs and twenty-one (21) manufacturing SMEs. For agriculture, the SASDC highlighted that manufacturing SMEs are underrepresented across South Africa. The SASDC only has access to data for four SMEs. Thus, despite the data accounting for only four SMEs, it is inclusive of the total sample size that the SASDC has access to. The twenty-one SMEs studied were selected through a convenience sampling technique by the SASDC data stewards.

In Table 2, a description of available data between the manufacturing and agricultural industries has been provided. Data were available for four companies in the agriculture industry and twenty-one companies in the manufacturing industry. Due to the lack of data, the summaries were provided as the actual value calculated. For both industries, there were no significant differences in the management based on gender, with 13

male CEOs and 12 female CEOs, whilst in the agricultural industry there was an equal distribution.

In terms of education, most of the CEOs possessed a degree qualification (10). Followed by a diploma (4) and no other education (4) for those in the Manufacturing industries. Those with some education, which comprised of having a certificate or a matric certificate were four, 3 in the manufacturing industry and 1 in agriculture. There was only one CEO who possessed a Ph.D. in the whole cohort, their SME is the only one that is active in agriculture.

The majority of the businesses were based in the Gauteng province (9) followed by the Kwa-Zulu Natal with 8 companies. However, these comprised manufacturing companies whilst the majority of the agricultural sector were based in Limpopo.

For both sectors, the most common number of employees was between 0-5 with 13 SMEs, the others (6 to 10) and greater than 10 were equally distributed. For agriculture, no SME had a greater than 10 staff complement.

The majority of SMEs in the sample had a Net profit after Tax of between R0 to R 100 000, and only four companies had a value greater than R500 000, of which all were from the manufacturing sector.

Of the twenty-five observed SMEs, only 8 were still active in the year 2020, the rest (17) were considered failed and were unable to re-register with the SASDC.

Business Capability

Table 3. Table showing SASDC Business Capability scores.

Sector	Survival Years	Leadership	Customer	Process management	People	Support
Manufacturing	3	70%	75%	60%	30%	70%
Manufacturing	1	70%	45%	50%	25%	65%
Manufacturing	6	80%	87%	70%	60%	55%

Manufacturing	2	79%	82%	85%	90%	92%
Manufacturing	24	70%	80%	85%	59%	80%
Manufacturing	5	50%	55%	50%	35%	40%
Manufacturing	5	60%	62%	55%	60%	55%
Manufacturing	6	50%	60%	70%	50%	60%
Manufacturing	6	50%	75%	40%	20%	40%
Manufacturing	30	60%	70%	70%	60%	80%
Manufacturing	11	70%	70%	68%	68%	60%
Manufacturing	2	60%	65%	30%	30%	35%
Manufacturing	1	90%	30%	30%	20%	40%
Manufacturing	2	60%	65%	65%	50%	50%
Manufacturing	32	65%	65%	60%	70%	65%
Manufacturing	22	85%	80%	80%	85%	75%
Manufacturing	4	40%	40%	40%	25%	25%
Manufacturing	9	50%	60%	65%	60%	70%
Manufacturing	8	55%	60%	70%	50%	45%
Manufacturing	5	55%	58%	65%	50%	50%
Manufacturing	3	60%	55%	60%	50%	50%
Agriculture	7	30%	35%	20%	30%	20%
Agriculture	11	10%	3%	40%	15%	2%
Agriculture	4	18%	3%	19%	3%	3%
Agriculture	6	76%	70%	78%	58%	65%

The SASDC rates the SME's Business Capability out of a score of 100%. In Table 3, the five factors are measured; Leadership, Customer, Process Management, People, and Support. On average, agriculture scored 30% across all its factors, whilst manufacturing scored 57%. Manufacturing SMEs that are still active scored 67%, whilst inactive (failed SMEs) scored 56%. The active agriculture SMEs scored 69% whilst the inactive SMEs scored 19%. Agricultural SMEs scored poorly, indicating that they are more likely to experience sustainability challenges. As expected, failed SMEs had poorer Business Capability metrics indicating that these factors could be used as

predictors of success. Overall, the cohort performed poorly in the People factor (46%), which may be an indicator of poor internal staff training and management.

Maturity Health

Table 4. Table showing SASDC Maturity Health scores.

Sector	Survival Years	SM	M&L	UotS	M&S	O&P	EM	F	HR	IM	QM
Manufacturing	3	60%	60%	60%	70%	70%	30%	65%	30%	50%	30%
Manufacturing	1	80%	40%	25%	40%	40%	30%	60%	30%	60%	40%
Manufacturing	6	65%	80%	99%	70%	65%	80%	65%	20%	25%	60%
Manufacturing	2	70%	80%	70%	70%	70%	90%	70%	70%	99%	80%
Manufacturing	24	50%	70%	70%	75%	75%	75%	70%	50%	80%	80%
Manufacturing	5	40%	50%	50%	50%	35%	35%	70%	25%	5%	40%
Manufacturing	5	60%	60%	60%	50%	60%	65%	99%	50%	40%	40%
Manufacturing	6	50%	55%	55%	55%	55%	55%	60%	55%	55%	70%
Manufacturing	6	50%	50%	85%	60%	60%	35%	40%	25%	30%	25%
Manufacturing	30	47%	75%	67%	75%	73%	71%	89%	61%	72%	67%
Manufacturing	11	80%	65%	70%	70%	50%	70%	70%	50%	35%	75%
Manufacturing	2	60%	60%	60%	35%	50%	50%	20%	20%	50%	20%
Manufacturing	1	80%	99%	35%	30%	30%	25%	25%	15%	35%	40%
Manufacturing	2	60%	60%	70%	60%	60%	55%	35%	45%	40%	60%

Manufacturing	32	80%	60%	70%	65%	80%	65%	60%	70%	65%	40%
Manufacturing	22	80%	80%	75%	70%	70%	70%	80%	80%	60%	60%
Manufacturing	4	30%	50%	33%	42%	40%	38%	0%	25%	44%	33%
Manufacturing	9	47%	50%	56%	67%	60%	67%	78%	64%	72%	83%
Manufacturing	8	30%	75%	56%	58%	67%	64%	44%	31%	56%	67%
Manufacturing	5	37%	67%	67%	42%	67%	64%	56%	44%	56%	67%
Manufacturing	3	67%	58%	67%	50%	60%	60%	67%	36%	44%	67%
Agriculture	7	30%	40%	50%	25%	30%	35%	0%	25%	10%	20%
Agriculture	11	3%	15%	25%	25%	40%	25%	3%	25%	0%	30%
Agriculture	4	15%	25%	25%	25%	5%	5%	5%	5%	5%	25%
Agriculture	6	80%	80%	80%	80%	85%	85%	65%	45%	45%	80%

The SASDC rates the SME's Business Capability out of a score of 100% (Refer to Table 1 for label names). In Table 4, ten factors are measured. Manufacturing SMEs that are still active scored 58%, whilst inactive (failed SMEs) scored 56%. Active SMEs in agriculture scored 73% and the inactive SMEs scored 20%. Similar to the Business Capability factors, agriculture SMEs have lower ratings overall. Human Resources (40%), Information Management (45%), and Finance (52%) were overall poor for the cohort.

8.2 Correlation coefficients

A correlation coefficient grid was created to assess the relationship that the variables have with each other. The stronger the correlation coefficient, the closer the relationship between the variables.

Table 5: Table showing demographic factors between the manufacturing and agricultural industries.

	Survival	Woman Ownership %	Black Youth %	Owner Age	Work Experience	Number of employees	Net profit after tax	Education level	Location	Sector	Owner gender
Survival	1.0000										
Woman Ownership %	-0.0036	1.0000									
Black Youth %	0.0712	0.0796	1.0000								
Owner Age	0.5169	-0.1643	-0.3256	1.0000							
Work Experience	0.3417	-0.1284	-0.1226	0.7996	1.0000						
Number of employees	0.5128	0.0522	-0.1532	0.3693	0.3749	1.0000					
Net profit after tax	0.7167	-0.0837	0.3272	0.1644	0.2534	0.0808	1.0000				
Education level	0.2919	-0.0872	0.1628	0.4227	0.4573	0.0914	0.2723	1.0000			
Location	0.2505	0.2267	-0.0763	0.4123	0.2347	0.4406	-0.0810	0.2087	1.0000		

Sector	0.0811	-0.0186	-0.2003	-0.4609	-0.3824	0.2002	0.0811	-0.3399	-0.3546	1.0000	
Owner gender	-0.0167	-0.9329	-0.0541	0.0977	0.0334	-0.0603	0.0378	0.0795	-0.2087	0.0175	1.0000

As this study focuses on the survival of SMEs, the main interest was to analyse the correlation coefficient of the survival (years the SME is active) against the other demographics. Net Profit after Tax was also plotted alongside demographics to visualise its relationship with the other factors.

In Table 5, a high correlation coefficient (0.72) is observed between the years a company survives and the Net profit After Tax (Refer to Annexure C for STATA source code). This finding supports the view from Olawale and Garwe (2009) as internal factors such as profitability drive the survival of an SME.

A small positive correlation (0.51) can be observed between the number of years an SME survives and the number of employees it has. The age of an owner also has a slight positive correlation with the survival of an SME at 0.52. This finding supports the view from Zarook et al. (2013) who argue that age defines successful SMEs. What is interesting to note is how weak the relationship between survival and education (0.29), work experience (0.34), and location (0.25).

A majority of the correlation coefficients amongst the other demographics are weak, what is notable is the high correlation between work experience and owner age (0.79), this is to be expected as an older CEO is likely to have more years of experience in their industry. Education and Owner age (0.42) and Education and Work experience (0.46) also have a weak positive correlation, possibly indicating that older CEOs are more likely to be educated and also have more work experience.

An area of concern lies in that having higher female ownership and the CEO being female results in a slightly negative relationship with Survival. This could allude to issues of discrimination and lack of opportunities for women.

Business capability

Table 6: Table showing the SASDC of Business Capability factors coefficients.

	Survival	Leadership	Customer	Process management	People	Support
Survival	1.0000					
Leadership	0.0908	1.0000				
Customer	0.2488	0.7196	1.0000			
Process management	0.3646	0.5733	0.7438	1.0000		
People	0.4444	0.5903	0.7360	0.8455	1.0000	
Support	0.3597	0.7641	0.8169	0.8357	0.7966	1.0000

In Table 6, the factors utilised by the SASDC to assess the SME's business capabilities do not have high correlation coefficients that are strong enough to show a relationship between Survival and other factors. What is interesting to note is that Process Management has high correlations with People and Support (0.84) and (0.83) respectively.

Maturity Health

Table 7: Table showing the SASDC Maturity Health factors coefficients.

	Survival	Strategic Management	Management and Leadership	Understanding of the Sector	Marketing and Sales	Operations and Productions	Environmental Management	Finance	Human Resources	Information Management	Quality Management
Survival	1.0000										
Strategic Management	0.0775	1.0000									
Management and Leadership	0.1418	0.6457	1.0000								
Understanding of the Sector	0.2669	0.4683	0.5706	1.0000							
Marketing and Sales	0.4371	0.5101	0.5556	0.7554	1.0000						
Operations and Productions	0.4468	0.4546	0.5565	0.7557	0.8291	1.0000					
Environmental Management	0.3551	0.4642	0.6284	0.7517	0.7664	0.8142	1.0000				
Finance	0.3318	0.5498	0.4718	0.5459	0.7462	0.6529	0.6664	1.0000			
Human Resources	0.5816	0.4230	0.3503	0.4317	0.6573	0.6824	0.7180	0.6722	1.0000		
Information Management	0.3265	0.4552	0.5191	0.3200	0.5926	0.6710	0.6462	0.5426	0.7143	1.0000	
Quality Management	0.2244	0.3208	0.5183	0.4638	0.6892	0.5941	0.7997	0.6233	0.6367	0.6063	1.0000

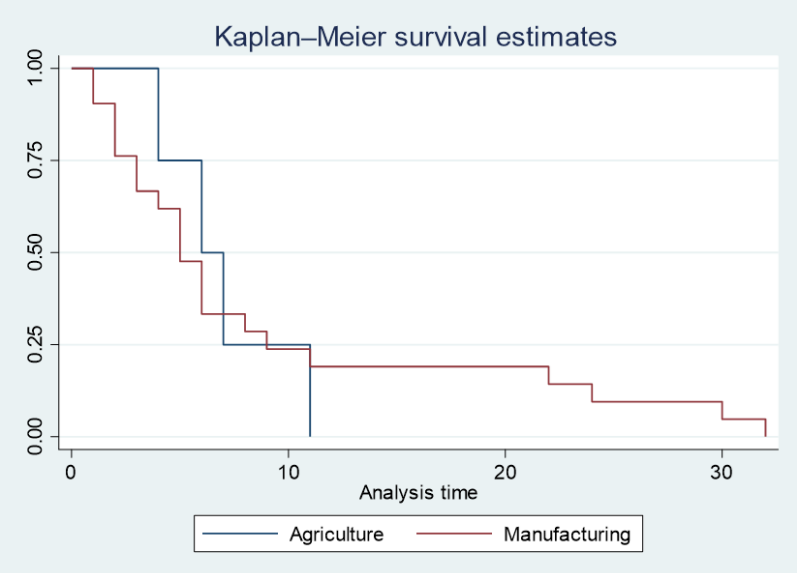
In Table 7, overall, the ten Maturity Health factors appear to have a positive relationship with the survival of an SME, although to varying degrees. Human Resources has the highest positive coefficient correlation (0.58), followed by Operations and Productions (0. 44) and Marketing and Sales (0.44). These factors could indicate that organisations with more of these developed factors could have a higher chance of survival. These findings are consistent with those of Olawale and Garwe (2009) who found that internal factors such as access to resources and skills affect SME survival. van Scheers (2011) supports this view by highlighting the importance of marketing skills to South African SMEs.

8.3. Survival probabilities

The Survival analysis of formal South African SMEs in the agriculture and manufacturing sector indicates extremely low survival probabilities. This could be even further exacerbated in the agriculture sector by the limited availability of SMEs.

8.3.1. Kaplan-Meier model

Figure 3: Figure showing the Kaplan-Meier survival estimates in the agriculture and manufacturing sectors.



In Figure 3, the Y-axis which represents the number of SMEs has been converted to percentages due to the great difference in numbers between the two industries. This allows the industries to be tracked over a period of time (X-axis). Using the Kaplan-Meier survival model, the SMEs located in the two sectors are tracked over a period of time.

Although both sectors show a great decline over periods of time, agriculture shows a decline to almost zero in just over a decade, as opposed to more than thirty years for manufacturing. Based on this sample, within the decade, manufacturing SMEs decline at a less steep pace whilst agriculture shows a great decline. Manufacturing companies in this sample show a greater propensity to survive than agricultural companies and outlast them by over a factor of 3.

8.3.2. Cox proportional –hazards model

Models to check for violations of regression were run. Coupled with literature from authors such as Dockel and Ligthelm (2002, p. 5) who found that demographic factors such as owner experience and qualifications were important in separating successful SMEs from unsuccessful ones.

Table 8: Table showing the Cox proportional hazard ratios.

Predictors	Hazard ratio	P-value	95% CI
Education level	0.734	0.132	0.49-1.09
Work Experience	0.964	0.104	0.92-1.00
Location	0.856	0.500	0.54-1.34
CEO gender	1.183	0.710	0.48-2.878

To investigate the effects of education and work experience on survival we used a cox regression. Therefore:

Education level: The chance (hazard) of an SME failing lowers by 26.56% (100% - 73.44%) for every unit higher in education. This suggests that small business owners in the manufacturing and agricultural sectors have a higher chance of surviving if they have higher levels of education. This might be the case because

those with more education may have the tools, resources, and expertise necessary to operate their businesses more successfully and overcome obstacles. This is consistent with Olawale and Garwe (2009), Brijlal et al. (2013) and Ogujiuba and Boshoff (2020) who found that education is an important demographic in SME survival.

Work experience: The risk of a firm failing falls by 3.56% (100% - 96.44%) for every one-unit increase in work experience. This shows that more experienced small business entrepreneurs have a higher chance of surviving in both sectors. This could be because experience can give business owners the abilities and knowledge required to manage the difficulties of running a successful business. These results are consistent with Zarook et al. (2013) and Ogujiuba and Boshoff (2020) who argue that the age of a business are predictors of survival.

Location: Each one-unit increase in location reduces the risk of business failure by 14.31% (100% - 85.69%). This implies that businesses in certain areas are more likely to survive than others. This could be due to factors such as market access, infrastructure, or government policies that help businesses. These results support the findings by Cant and Wiid (2013) who conclude that SMEs closer to their market have higher survival rates.

CEO gender: The risk of business failure rises by 18.37% for every unit increase in CEO gender. This suggests that businesses with female CEOs may be more likely to fail than those with male CEOs. This could be due to discrimination, a lack of funding or resources, or gender stereotypes that influence how female CEOs are perceived in the business world. These findings are consistent with the findings by Brijlal et al. (2013) who found that gender affected SME survival in the Western Cape.

The hazard ratios for work experience and CEO gender are statistically significant at the 0.10 level, according to the p-values you provided, whereas the hazard ratios for education level and location are not statistically significant at the 0.13 and 0.50 levels, respectively.

This suggests that the hazard ratios for education level and location may be insufficient to conclude that they have a statistically significant effect on business survival in the manufacturing and agriculture industries. The hazard ratios for work experience and CEO gender, on the other hand, have p-values that indicate they are more likely to have a statistically significant effect on business survival.

8.3.3. Life tables

Life tables were not appropriate for this study and thus the Kaplan-Meier estimator and Cox regression were selected. These were issues that prevented Life tables from being reliable:

1. Continuous time intervals: Life tables assume fixed and equal time intervals. In this study, the intervals were continuous and thus the Kaplan-Meier estimator and Cox regression were used.
2. Group comparison: Sometimes life tables are not suitable to compare survival between two groups, Cox regression was selected for better analysis.

9. CONCLUSION

The study conducted aimed to explore the survival patterns of South Africa's SMEs in the agriculture and manufacturing sectors. The research aimed to determine survival patterns by focusing on identifying demographic factors of failed SMEs and investigating the success factors associated with more successful SMEs. This paper was intended to answer these two questions: 1) What are the demographic characteristics associated with failing SMEs in South Africa? And, 2) What are the predictors associated with failed SMEs in South Africa?

By using data from the SASDC, twenty-five SMEs were analysed, four from the agriculture sector and twenty-one from the manufacturing sector. Demographic factors of the company and the owners were analysed to determine what contributes to failed SMEs.

Demographics associated with failing SMEs

Using Pearson's correlation coefficients, the Survival of SMEs had a positive relationship with Net Profit after Tax. Thus SMEs with lower Net profit after Tax are associated with failure. This is expected as for an SME to be sustainable, it needs to be able to have enough cash to run its operations.

All but two of the factors under demographics show a positive relationship with survivability. This means that work experience, number of employees, education, and location to some varying degrees show a positive effect on Survivability. Any deviation from the mentioned demographic factors is likely to increase SME failure. Women ownership and female CEOs reveal to have a negative correlation coefficient relationship, which means that the South African SME environment could be less welcoming to women leaders.

Predictors associated with failed SMEs

The correlation coefficients reveal that the SASDCs monitoring of SME Business Capability and Maturity Health also alludes to the fact that SMEs that score higher will slightly increase their survival rates.

The Cox proportional hazard model reveals that:

- The lack of education from the CEO and the location of the SME is not necessarily a strong predictor of an SME that is likely to fail.
- Work experience from the CEO increases the odds of survival, none or little work experience from the CEO is a predictor of SME failure.
- SMEs located in certain areas are not necessarily less likely to survive compared to others.

In summary, an inexperienced female CEO is most likely to have a failed SME. The recommendations must address mitigating the risk of failure for such

10. DISCUSSION

Despite strong attempts to increase SME survival rates, the survival rates in South Africa remain extremely low. At the end of this study, only one agriculture and seven manufacturing SMEs were still active. The Kaplan-Meier model revealed that SMEs experience a very steep failure rate within the decade. Once the decade passes, the failure rates stabilise. It is, therefore, necessary for South African government leaders, investors, and organisations to consider offering support to help SMEs navigate the first decade that presents high failure risk.

In the Cohort, 10 SMEs did not have financial data, as a result, the effect the Net Profit after Tax has on survivability was removed from the Cox proportional hazard model.

Cox proportional hazard revealed that work experience and CEO gender in favour of males increases the survival odds. These results are in line with Dockel and Ligthelm (2002, p. 5) who stated that owner age and experience affect what makes

SMEs successful. However, the findings here contradict the findings by the authors who argued that gender does not affect SME success and that education is a significant factor.

11. RECOMMENDATIONS

As a result of the finding in this research, the researcher proposes:

11.1. Recommendations for SME data collection and gathering

A more rigorous database that collects data from South African SMEs needs to be included by organisations such as the SASDC. The researcher created a database off on the data files sent through email. The researcher contacted the Small Enterprise Development Agency (SEDA) and the CIPC (both of which are organisations that work with formal SMEs) to obtain more data to analyse the survival rates of South African SMEs. A lack of an accessible database was highlighted by all organisations. This results in data with reduced statistical power.

Funding into creating a database that has detailed, collated information regarding formal SMEs including their demographic factors would assist in being able to conduct a more rigorous analysis that provides generalizable results. Organisations such as the SASDC, SEDA, and CIPC would best be suited to creating databases that are more suitable for detailed analysis.

11.2. Recommendations for further research

A follow-up study using a larger dataset should be made to investigate the survival rates of South African SMEs. The follow-up study should look at data across all industries to make more informative and generalizable recommendations for South African SMEs.

Caution must be taken to help equip SME leaders to be better positioned to lead their companies to success. By conducting more research utilising Survival analysis techniques, corporations and governments can become more proactive in identifying opportunities to increase SME survival.

11.3. Recommendations for South Africa

The results highlight the importance of data accessibility in making more detailed analyses and recommendations. Government should invest in creating a database that contains SME data that is rich and updated regularly. The CIPC, which is a government organisation needs to ensure that crucial statistics are available without the need for special investigation at the time of occurrence.

11.4. Recommendations for SME sustainability

SMEs experience a positive effect on performance from the use of data and technology (Chimucheka et al., 2018, p. 9). The use of data and technology needs to be enhanced in South Africa to increase the survival rates of SMEs. For SMEs to become sustainable, more research needs to be conducted into understanding the success determinants of the SMEs in each sector.

Funding that addresses the limited research into understanding the success factors of SMEs and how they directly play a role in sustainability would assist in getting better insights into how corporations and governments can better play their role.

Women empowerment

The findings reveal that having a female CEO increases the failure rates of SMEs. Despite there being 13 men and 15 women CEOs, the findings reveal that female CEOs have a higher failure rate. This could also be exacerbated by the cultural stigmas revolving around female leaders. A focus on offering women tutoring, resources, and training and mentorship opportunities could assist. The results have

identified work experience increases SME survival odds, and government funding initiatives into female-led SMEs could result in long-term changes. Learner-ships, traineeships, and other opportunities that can increase the experience of women CEOs will improve the survival odds in the long term.

Work experience

The results indicate that programmes that help quickly accelerate industry work experience and knowledge will result in a higher survival rate. Governments. Non-profits and corporations need to invest more into helping SMEs develop learner-ships and training opportunities.

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11. ANNEXURES

Annexure A: Consistency matrix

Problem or scope of project stated here					
Sub-problem	**Literature Review**	**Hypotheses or propositions or questions**	**Source of data**	**Type of data**	**Analysis**
Find demographic characteristics associated with SMEs in South Africa	(Small Enterprise Development Agency, 2021) (Ligthelm, 2011) (Cant and Wiid, 2013) (Olawale and Garwe, 2009)	Are there specific demographic characteristics that result in SMEs surviving? Which demographic characteristics are irrelevant or even discourage survival?	SASDC data	**Nominal** (Location, industry, population group of owner) **Ordinal** (education attainment/level) **Interval** (NA) **Ratio** (owner age, enterprise age, employee count)	Regression analysis to analyse relationships with variables.

Problem or scope of project stated here					
Sub-problem	**Literature Review**	**Hypotheses or propositions or questions**	**Source of data**	**Type of data**	**Analysis**
Explore predictors of SME survival rates	South Africa (Bruwer and Coetzee, 2016) (Fatoki and Odeyemi, 2010) (Ligthelm, 2011) (Cant and Wiid, 2013) (Olawale and Garwe, 2009) Global (Kristanti et al., 2019) (Cao, 2012) (Shin et al., 2017)	How long do the given SMEs survive? How do the demographic characteristics come into play?	SASDC data	**Nominal** (Province, industry, population group of owner) **Ordinal** (education attainment/level) **Interval** (NA) **Ratio** (owner age, enterprise age, employee count)	Survival analysis techniques

Annexure B: Consent Form

Belos is the Consent Form sent to the CEO of the SASDC

University of the Witwatersrand,
1 Jan Smuts Ave, Braamfontein, Johannesburg, 2000
011 717 1000

South African Supplier Diversity Council
1st Floor, Building 9, St David's Office Park, St David's Place, Parktown, Johannesburg, 2193

19 June 2022

Dear Sir/Madam,

Re: Permission to conduct research at South African Supplier Diversity Council

My name is Masana Ludwick Rikhotso

I am studying for an MBA in Johannesburg at the University of the Witwatersrand. I am seeking permission to do research at SASDC.

For my Research paper, under the supervision of Dr Renee Horne, I would like to write a paper that conducts a survival analysis of South African SMEs from 2010 to 2021. To do so I need data for SME's in South Africa from 2010 to 2021. The main data labels would ideally include; Company names, date of registration (creation), whether they are currently active or inactive and the industry they are operating in. Additional labels such as provinces/ regions of creation etc. may also provide additional insight into this research. I am looking to narrow down the research to major economic industries that contribute most to the GDP.

I believe that by conducting a survival analysis on South African SMEs, I will be able to get information that may drive decision-making in specific industries. The findings could be used to assist the government to bolster their SME initiatives or help prospective investors find investment opportunities but at large, I would like to unveil entrepreneurship opportunities.

Individual privacy will be maintained in all published and written data resulting from the study.

All research data will be preserved anonymously during use and later destroyed from my personal device.

I, therefore, request permission in writing to conduct my research using your organisation. The permission letter should be on your organisation's headed paper, signed and dated, and specifically referring to myself by name and the title of my study.

Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Yours sincerely,

Masana Ludwick Rikhotso

Masana
Cell: 0734242700
535623@students.wits.ac.za

Dr. Renee Horne
Wits contact number
renee.horne@wits.ac.za

Annexure C: STATA 17 Source code

Below is the source code used to analyse the data

```
import excel "C:\Users\27734\OneDrive\Documents\Consolidated (2).xlsx", sheet("Sheet1") firstrow case(lower) clear

//summary table

tab ownergender sector


//education
```

```
tab educationlevel sector


//creating this variable to make certificate  and matric as "some education"

cap drop educationlevel1

encode educationlevel, generate(educationlevel1)

replace  educationlevel1 = 1 if educationlevel1== 4


///label values educationlevel1 (certificates = "some_edu")/// code not working therefore certificates is some education


//this summarises

tab educationlevel1 sector


//work experience categories (creating categoes which will be 1 = 0-5 years, 2 = 6-10 years, 3 = 11+)

egen workexp_cat = cut(workexperience), at(0 5 10 100)

replace workexp_cat = 1 if workexp_cat == 0

replace workexp_cat = 2 if workexp_cat == 5

replace workexp_cat = 3 if workexp_cat == 10
```

```
tab workexp_cat sector


/// location

tab location sector

encode sector, gen(sector1)

cap drop location1

encode location, gen(location1)

cap drop ownergender1

encode ownergender, gen(ownergender1)


//survival data

encode activestatus, gen( activestatus1)


stset survivalyears,failure (activestatus1)


 stsum, by(sector1)

 stcox educationlevel1, strata(sector1)

 stcox educationlevel1 workexperience , strata(sector1)


 stcox educationlevel1 workexperience location1 ownergender1, strata(sector1)
```

/// should have done this in the beginning, to check if the hazards assumption have not been violated

//running the cox regression

stcox survivalyears educationlevel1 ownergender1 ownergender1, strata(sector1)

// checking for proportinal hazards assumption

estat phtest, detail

//checking for residuals

///estat phtest, residuals(resid)

/// since the data doesnt meet the assumptions

stcox survivalyears educationlevel1 ownergender1 location1, strata(sector1)

save newdata

***

import excel "C:\Users\27734\OneDrive\Documents\Consolidated.xlsx", sheet("Sheet1")

corr Sector SurvivalYears BlackYouthOwnership Location OwnerGender OwnerAge EducationLevel Workexperience

***Correlations**

encode EducationLevel, generate (EducationLevel1)

encode Location , generate (Location1)

encode Sector , generate (Sector1)

encode OwnerGender , generate (OwnerGender1)

corr Sector SurvivalYears WomanOwnership BlackYouthOwnership Location OwnerGender OwnerAge EducationLevel Workexperience

corr Sector SurvivalYears WomanOwnership BlackYouthOwnership Location OwnerGender OwnerAge EducationLevel Workex Numberofemployees NetProfitAfterTax EducationLevel1 Location1 Sector1 OwnerGender1

corr SurvivalYears Leadership Customer Processmanagement People Support SM ML UotS MS OP EM F HR IM QM

corr SurvivalYears Leadership Customer Processmanagement People Support

corr SurvivalYears SM ML UotS MS OP EM F HR IM QM