

The sustainability of managing the environmental process of agglomerating smelter by-products

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ABSTRACT

This study was commissioned to examine the factors that affect the sustainability of businesses that manage the environmental process of agglomerating smelter fines in South Africa. Ores are produced from mines, crushed and screened and supplied to the smelters. These in turn produce alloys as final products through the furnace smelting method. The alloys are further crushed and screened to customer specifications.

During this process, dust and fines are generated along the value chain. These fines are harvested and converted by the contract agglomerators into bigger sizes which are fed back to the smelters. This creates value and a closed loop.

An extensive literature survey on sustainability centring on the PESTEL and SWOT techniques was done followed by a qualitative survey approach. The population included all smelters in South Africa [15 in total]. A sample of four smelters and their contract agglomerators were selected out of the fifteen. A total of eight top managers were selected for interviews. The interview was structured to extract details on the research topic.

The interviews were transcribed and analysed. From both the literature survey and the interviews, it was concluded that the main factors affecting the long term sustainability of agglomerators were identified as

- The uncertainties in the regulatory framework of the governing authorities puts pressure
- Technology and development can wipe out the briquetting route especially the DC furnaces
- Environmental solutions makes agglomerating very attractive and viable
- Unstable global alloy market brings uncertainties
- Agglomerators' intellectual property
- Good Product Quality
- Inconsistent Quality of screened fines from the Smelter
- High electricity costs and erratic supply
- Cyclic demand/Client changing the strategic scope from the Smelter
- Flexibility and adaptability of the contractors
- Adequate and clear communication and exchange of information

These eleven factors were identified as critical in the long term sustainability of contract agglomerating businesses.

It was recommended that the Smelter/Contractor should establish and maintain communication channels that allow uninterrupted exchange of information and data to allow either party to plan. In doing this, a lot of uncertainties will be managed.

Furthermore, the combination of a volatile and cyclical state of the agglomerating market coupled with factors like smelter/client making short- and long-term strategic changes make it crucial for agglomeration firms to be **flexible and adaptable** to these changes in order to ensure its sustainability in the long term.

List of key terms: Agglomeration, environmental, by-products, binders, briquetting, briquettes, alloys, ferroalloys manganese, ferromanganese, ferrochrome, smelters, extrusion, pelletising, PESTLE, SWOT.

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CHAPTER 1: NATURE AND SCOPE OF STUDY

1.1 INTRODUCTION

This research investigates the sustainability of businesses that manage the process of agglomerating smelter by-products in a South African setting. It revolves around the mines that produce the input material [ore], the smelters that convert this input material into final products [they generate by-products in the process] and contracted businesses that agglomerate these by-products.

This section starts by setting the background before dwelling on the problem statement. The research questions and objectives are then formulated as well as the research methodology.

1.2 BACKGROUND SETTING

Sustainability has become a buzzword in the business world. Research has shown that a growing number of companies have adopted sustainability related strategies in order to remain competitive after taking notice of these paradigm shifts (Eccles, Perkins, & Serafeim, 2012). According to the University of Alberta (2012), sustainability is the process of meeting own needs within the limits of physical, natural and social resources without compromising the ability of future generations to meet theirs.

Sustainability, although it has become a value shared by many, its definition is too broad as the world is diverse. Therefore, for it to remain a pivotal tool, it is important to adapt to the local context. It is in the vein that the researcher wishes to apply the sustainability concept to mines-smelter-agglomerating businesses in the South African context.

South African mines produce oxide ore from underground or open pits. This is mainly iron ore, chrome ore, manganese ore and silica ore as well as coal and coke. Before the ore and coal are supplied to the smelter, they are crushed and screened to certain size fractions as required by the smelter clients. There is quite a lot of fines and dust generated in this crushing and screening process.

The crushed and screened material is then supplied to the smelter where they are blended and fed into an electric arc furnace. The furnace can only tolerate a limited amount of fines in

the blended mixture for the smelting process to be efficient. In the furnace, the blend is heated up [ore, coal and coke], reacted and converted into molten alloys [main product] and slag [unwanted product]. Coke is specifically added to act as reducing agent in the smelting process. During the electric arc furnace process, a lot of dust is generated. This dust comprises of useful elements like coal dust, coke dust and ore dust.

The molten metal is subsequently cast into ingots and left to cool down. The ingots are later crushed and screened into various size fractions, according to the market demand and then sold. During the crushing process, dust metallic is generated.

The useful dust and fines generated in this value chain process are called smelter by-products. These are harvested and used in the agglomeration process and are:-

- Fines generated during the crushing and screening of ore at the mines.
- Fines generated during the crushing and screening of coal and coke.
- Due to the violent nature of the smelting process, a lot of dust blows out of the top of the furnace and this dust is captured and used in the agglomeration process.
- The process of crushing and screening the metal / alloy into different size fractions according to market specifications generates fine metallic dust. This dust cannot be thrown away as it is final product. However, it is unsuitable for the market and cannot be sold in this fine sized state.

These products or materials described above known as smelter by-products are then sent for agglomeration.

Agglomeration is a process of binding together small particles of fine material or dust to form a bigger sized particles or lumps. There are several methods of agglomerating fine material such as;

- briquetting,
- pelletising,
- extrusion,
- Sintering or block making.

Firstly, the fine materials are transferred into a mixing vessel where binding agents or chemical binders are added. The binding agents help to ensure the formed lumps, or briquettes in this example, stay intact and do not break up when feeding them back into the furnace with the other raw ore oxides. The chemical binding agents that are typically used in the agglomeration process are cement, starch, molasses, bentonite, polymers and acrylics.

Secondly, the mixed materials are discharged from the mixer and fed to the next stage where they are agglomerated by one of the agglomerated methods mentioned above [briquetting, pelletising etc.].

After the agglomeration process, the iron ore, coal and coke are fed back into the furnace while the alloy is sold to the market. In this way, contract agglomerating businesses unlock value for the alloy smelter. The contractor manages the environmental process to agglomerate these smelter by-products into briquettes as an ore replacement and environmental solution for the alloy smelter company that acts as the client.

In view that most contractors use the briquetting method as the chosen agglomeration method, this study will mainly focus on briquetting as an agglomeration method to agglomerate smelter by-products which acts as an environmental cost saving process.

1.3 PROBLEM STATEMENT

This study focuses on businesses managing the environmental process of agglomerating fine smelter by-products and creating a desirable product for the client, whilst making suitable profits and is sustainable in the long term. It is designed to explore how this can be achieved and to unlock the key drivers for market success in order to ensure profit and capital gains in the long run.

Historical research carried out on the environmental process to agglomerate the by-products from alloy smelters mainly focused on the smelters' side and not from the contractor's perspective. Most previous studies either explained "what" and "how" the agglomeration process of forming briquettes works, the product specifications required by the smelter organisation (Holta & Olsen, 1985; Huaming & Guanzhou, 1998) and environmental and energy gains achieved (Mohamed, Ahmed, & Shalabi, 2004; El-Hussiny & Shalabi, 2010).

Other studies conducted in this field concentrated on the advantages for the client like energy savings, reducing the environmental waste, the specifications and properties of the product that are required for the furnace operations and how it affects or benefits these operations (Mohamed *et al.*, 2004; El-Hussiny & Shalabi, 2010).

Although much research has been conducted on the advantages of agglomeration in terms of environmental cost savings and recuperating of resources, not much focused on the business managing these processes (Steele & Bizhanov, 2011).

It is known that setting up a briquetting plant for the process of agglomeration is fairly capital and labour intensive. The binders used in the agglomeration process to produce briquettes from ores fines and other by-products are usually a combination of cement, lime, bitumen and molasses (Olsen, Olsen, Tangstad, & Lindstad, 2007). However, development of cost effective binders that are added in lower percentages to the material mixture may give contractors the competitive edge over competitors and in terms of the production cost.

Briquettes are used as part of the raw materials mixture and when the briquettes are combined with a set percentage coal, it has the added advantage of enhancing the exothermic reaction in the furnaces (Holta & Olsen, 1985; Huaming & Guanzhou, 1998). Therefore, the agglomerating process is critical.

The difference between this study and previous ones is that it focusses on the organisation delivering the environmental service of agglomerating the smelter by-products and fine raw materials for the smelter clients. This study will focus on a client-contractor relationship, and will try and establish what key elements can lead to a mutual beneficial relationship between these two parties. Attention will also be given to advantages and disadvantages of this type of relationship in the environmental agglomeration process. The study will also identify the challenges that the client and contractor face in the micro and macro environment, and how these factors affect the sustainability of the contractor company in the long run.

This study will unlock the key drivers of sustainability of the agglomerating businesses and their survival in the long run. Management will be able to better allocate resources and assist in strategic short- and long-term planning.

1.3.1 Research question

Contract agglomerators need business sustainability. They need to come up with business models and make managerial decisions to survive long term and avoid deciding based on short term profits but think long term. As a result, sustainable companies thrive, surviving shocks like global recessions, worker strikes, executive scandals and boycotts by environmental activists (Rowe & Bansal, 2013). Therefore, sustainable companies:

- Create long-term financial value.
- Are conscious that their actions affect the environment and actively work to reduce their impacts.
- Do care about their employees, customers and communities and work to make positive social change.
- Understand these three elements are intimately connected to each other.

Due to the lack of research or limited information in the South African context concerning contract agglomerators, these businesses are operating in a grey area. Little is known about the key drivers for the market and how to achieve them from a contractor point of view. As earlier mentioned, the study aims to unlock the key drivers of sustainability for the agglomerating businesses and their survival in the long run.

Based on the problem stated and the theoretical framework the study aimed at answering the following sub-questions:

- What are the positive and negative aspects of contracting-out the environmental agglomeration process?
- How do short- and long-term strategic decisions affect the contractor managing the environmental agglomeration process?
- How is this client-contractor arrangement [of outsourcing the agglomeration process] supportive of your core business strategy and does this client-contractor relationship form part of your long-term strategy?
- What challenges are faced by the contractor managing the environmental agglomeration process?

1.4 OBJECTIVES OF THE STUDY

1.4.1 Primary objective

The general objective of the study is to identify the factors affecting the sustainability of agglomeration businesses by analysing the micro- and macro business environment and identify the internal and external factors affecting its sustainability.

The study will identify the possible advantages and disadvantages for organisations in the field of agglomeration and give possible solutions to overcome these challenges in order to gain a competitive advantage.

1.4.2 Secondary objectives

The secondary objectives are divided into general and specific objectives:

- To identify the internal and external factors affecting the sustainability of agglomeration businesses in the micro-environment.
- To analyse the factors affecting the sustainability of agglomeration companies in the macro environments.
- To analyse the current client-contractor relationship and how can it be improved.

1.5 METHODOLOGY AND RESEARCH DESIGN

The methodology involves a literature review in order to understand the academic aspect of the subject followed by a qualitative interview process on the selected sample.

1.5.1 Literature Survey

The survey intends to identify key performance indicators in terms of achieving market success, gaining competitive advantage and dealing with market price fluctuations that effects client production behaviours and in turn the contracted client company. Topics such as sustainability and environmental, political and economic factors as well as micro and macro factors that should be considered in the contract agglomerating businesses will be discussed in order to give a robust theoretical framework.

In order to conduct a comprehensive literature review, multiple sources will be used during the research process. The sources that will be consulted include:

- Academic journals
- Books
- Internet
- Interviews

1.5.2 Research Design

The research design uses a qualitative approach with interviews being conducted to obtain data and gain the necessary insight to help answer the research question, thus making it a qualitative study (Kotzé, 2007). The qualitative research approach also offers more flexibility when collecting the data necessary for the study.

The study will be cross-sectional as the interview and study will take place in a single point in time (Trochim & Donnelly, 2006). The data collected in the interviews will be the same over different time periods, thus a cross-sectional study will be sufficient to gather the data.

1.5.3 The Study Population

In research, the population refers to the focal group from which the researcher will draw conclusions. It is a totality of persons, events, organization units, cases with which the specific research problem is concerned (De Vos, Strydom, Fouche, & Delpont, 1998; Goddard & Melville, 2004).

A sample is normally selected from a population. The need for a sample is driven by the impracticality of collecting data from the entire population. Budget and time are constraints to surveying the entire population (Mark, Philip, & Adrian, 2009). The total population was 15 smelters in South Africa. Four of these were selected as a sample as they used a common method of agglomerating – briquetting and briquetting manganese ore fines. Furthermore, participants were selected from the sample. The participants were eight top managers in total [four from the smelters/clients and four from the contractors]

The participants selected for the interviews are part of the smelter management that makes strategic decisions that may have an impact on the contractor responsible for the agglomeration process. Respondents of the management of these agglomeration firms will also be interviewed to form part of the qualitative study. All the respondents have good knowledge in the field of study and the data that will be collected will prove invaluable towards answering the research question.

1.5.4 Ethical considerations

According to Weare (2004) there are certain key ethical considerations when interviews are conducted for the purposes of and these are:-

- To be granted permission from the institution in which the research is done.
- Receive informed consent from all the participants before conducting the interview. Participants should be informed that the interviews are recorded.
- Inform the institutions and interviewees of the confidentiality and anonymity of the nature and purpose of the research as well as the procedures being adopted.
- Assign number codes to the respondents' interviews rather than their real names to ensure confidentiality and anonymity.
- Make sure that the interviewee will not be harmed, but rather benefit from taking part in the study.
- To establish who receives feedback from the study and not to make promises to institutions and respondents and then they don't receive the feedback promised.
- To thank the participants that took time to take part in the study.

1.6 LIMITATIONS OF THE STUDY

The main limitation of the study is the small sample size available for the study. There is a limited amount of ferroalloys smelter companies that are using agglomeration contractors as part of process and to which access could be arranged.

All the interviewees work for smelter companies producing ferromanganese that does not give a representative view of all smelter clients and agglomeration companies.

Other agglomeration companies did not want to disclose any information about their business or clients because of a conflict of interest.

1.7 LAYOUT OF THE STUDY



Figure 1: Layout of the Study.

CHAPTER 2: LITERATURE REVIEW OF ORGANISATIONAL SUSTAINABILITY

2.1 INTRODUCTION

The literature review will provide a framework that will assist in achieving the research objectives. In order to effectively analyse the organisational sustainability of agglomerating businesses, we will look at the definition of sustainability, and the factors affecting organisational sustainability. These topics will be presented under their own sub-headings and consequently explained.

2.2 DEFINITION OF SUSTAINABILITY

The term sustainability has been around for a long time and has become an important topic for businesses that are conducting strategic planning and looking at the long-term future of the business. According to the United Nation's 1989 Brundtland Commission, the definition of sustainability is "meeting the needs of the present without compromising the needs of future generations" (Tsai, Tsai, & Chang, 2013).

At a business level, organisational sustainability can be defined as a firm's ability to meet short-term financial commitments without compromising its ability to meet future requirements. In order to ensure the survival of an organisation, strategic goals need to include short-term profit goals as well as goals to ensure stable and long-term revenue streams.

According to Raderbauer (2011), a sustainable business can be defined as one that operates to ensure all stakeholders are benefitted as well as ensuring the long-term survival and success of the business while focussing on factors related to the organisation like economic, social and environmental structures. When business takes all these sustainable factors into account, that approach is called the 'triple bottom line' approach. Therefore, to effectively measure the sustainability, there needs to be an analysis of the macro- and micro environmental levers in which the client and contractor operate (Bansal & DesJardine, 2014).

According to Giurco and Cooper (2012), a sustainable business will foster and grow its capital assets, guarding against strategic actions that may diminish or reduce these

organisational assets. Businesses need deeper understanding of its own financial sustainability and profitability because these get affected in the long run by external factors such as environmental and social issues. To define sustainability in the mining and alloy industry, the organisations need to determine the acceptable amount of natural capital to be converted into financial, manufacturing and human capital.

2.3 FACTORS AFFECTING SUSTAINABILITY

According to Tsai *et al.* (2013) there are direct and indirect factors that affect organisational sustainability. Direct factors affect the organisational economic, environmental and social performance while indirect factors are all the concepts that affect the competitive advantage of the organisation (Bos-Brouwers, 2010). A closer look at all these aspects helps in assessing the sustainability of the organisation.

According to Civelek, Çemberci, Kibritci Artar, and Uca (2015), the short-term targets of businesses are improving efficiency and productivity, reduce waste, and have a better return on investments. It was then concluded that organisations that aim to increase their market share and competitive advantage, end up achieving better profitability in the long term.

To measure the factors affecting sustainability, the direct and indirect factors in the short- and long-term need to be identified for these agglomeration firms and their clients for which, they conduct business for. These factors will be analysed by conducting a PESTLE and SWOT analysis.

The PESTEL model, which is used in business strategy analysis, can be used to evaluate the landscape of the mining and alloy industry as well (Gillespie, 2007; Shilei & Yong, 2009). The combination of the SWOT and PESTLE analysis provides a broad and much more accurate analysis of the complexities and multidimensional interactions of the studied environment.

On one hand, the SWOT approach identifies the micro economic factors [or internal factors] while the PESTLE provides a further analysis of the macro-economic these factors [external factors] (Srdjevic, Bajcetic, & Srdjevic, 2012).

Therefore, the micro- and macro environments of the alloy smelter market and agglomeration firms operating in this environment are best studied using the PESTLE analysis and the SWOT analysis respectively.

2.4 Evaluating the six components of the macro-environment [PESTLE]

A strategic analysis of the company is one of the first common steps and includes an analysis of the environment in which the organisation conducts its business (Ülgen & Mirze, 2007). There are multiple factors that impact the client and contractor individually, but ultimately these factors have a combined impact on both client and contractor company.

The PESTLE analysis is a tool that can be used to measure the sustainability of agglomeration companies by analysing the macro-environment where these companies operate in. The analysis of an organisation’s macro-environment is important to identify factors that might have an effect on an organisation’s future supply and demand levels as well as costs (John & Scholes, 2002).

The client and contractor are thus in a mutually beneficial relationship. Most factors that impact the client company, positively or negatively, will ultimately flow down and affect the contractor company.

Table 1: PESTLE analysis of the macro-environment – Alloy market.

<p>Political factors</p> <ul style="list-style-type: none"> ▪ BBEE [broad-based black economic empowerment] ▪ Political uncertainty ▪ Nationalisation of mines/Future legislation 	<p>Economic factors</p> <ul style="list-style-type: none"> ▪ Domestic and global economic state ▪ International demand and commodity prices ▪ International trade and globalisation of markets ▪ Exchange rate risks ▪ Electricity supply and prices ▪ Operational risks
<p>Social factors</p> <ul style="list-style-type: none"> ▪ Health and Safety ▪ Skills shortages ▪ Skills development ▪ Discrimination and inequality 	<p>Technological factors</p> <ul style="list-style-type: none"> ▪ Research and development
<p>Legal factors</p> <ul style="list-style-type: none"> ▪ Increased environmental legislature ▪ Regulatory uncertainty and labour unions ▪ Legislative frameworks 	<p>Environmental factors</p> <ul style="list-style-type: none"> ▪ Environmental solutions ▪ Water scarcity ▪ Environmental rehabilitation costs

2.4.1 Political factors

- **BBBEE [Broad-based black economic empowerment]**

The BBBEE legislative provision was imposed on all mining stakeholders and is applying pressure to the sector. It was therefore necessary for them to negotiate a charter and declaration in 2003 that was updated in September 2010 [amendment to the Broad-Based Socio-Economic Empowerment Charter for the South African Mining and Minerals Industry] (Technology Innovation Agency, 2012).

Between the year 2000 to 2016, South Africa's mining industry was the biggest contributor to economic empowerment, with broad-based black economic empowerment [BBBEE] deals worth R205-billion (Chamber of Mines of South Africa, 2016). Black economic empowerment targets apply to all companies in the country, meaning a certain percentage of local assets must be sold to black South Africans.

In 2009, black ownership in the mining sector was measured at 8.9%. This was well below the proposed target set out in the Mining Charter proposed target rate of 15% by the end of 2007. There is continued pressure being applied onto companies doing business in the mining sector to reach the next target of 26% by the end of 2014 (Oxford Business Group, 2012; Oxford Business Group, 2014).

- **Political uncertainty**

From the presidency, down to government personnel, there is uncertainty in decision making and policy changes. This has a detrimental effect on foreign investment in the mining and ferroalloy sector. This sector by nature is highly dynamic and with price volatility of the metal and mineral market, political instability can lead to a considerable shift in patterns of international trade (Upson & Clarke, 2015). These uncertainties can lead to difficult strategic decision making and fluctuations in the ZAR/USD exchange rate that affects the profitability of the alloy sector that is discussed in the next point.

As a result, the mining and alloy sector also have huge challenges in order to conduct successful long-term strategic planning because of this regulatory uncertainty (Lane, Guzek, & Van Antwerpen, 2015).

- **Nationalisation of mines/Future legislation**

There is widespread news coverage on the thorny issue of nationalisation of the mining industry. Although government have stated that nationalisation of mines does not form part of their strategy, these rumours have a negative impact on the industry and investment.

Other groups have called for mines to be transformed into state-owned enterprises, and there are ongoing debates about licences, royalties and ownership. Not only is the mining and alloy industry facing difficult economic and operational issues, but regulatory uncertainty as well in the midst of a global trend to nationalise resources (Lane *et al.*, 2015).

According to the report by Oxford Business Group (2012), mining royalties is managed by the Minerals and Petroleum Resources Royalty Act that was passed in 2008 but only implemented after the economic recession of 2010. The delay was a temporary relief for the mining sector. Royalties is a profit based scheme where firms are required to pay between 5% and 7% on gross sales. It was reported that the Revenue service of South Africa collected more than R7 billion in the first year of application, but experts in the sector believes that this scheme undermines the South Africa's global competitiveness.

2.4.2 Economic factors

- **Domestic and global economic state**

The commodity prices have slowly increased from extreme lows after the global economic crises in 2008, but a global recession meant that prices remained stationary or even decreased which meant the domestic and global mining and alloy industry showed limited revenue potential (Lane *et al.*, 2015). During the economic boom cycle of 2001 and 2007, the manganese industry was at its peak with the capacity for manganese ore and alloy production greatly increased to meet the high global demand (Ratshomo, 2013).

- **International demand and commodity prices**

Ratshomo (2013) further pointed out that the manganese sector was at all-time high during the economic boom cycle from 2001 to 2007. After this period the production

capacity decreased dramatically as the global market was flooded with high stock quantities of manganese ore and alloys (International Manganese Institute, 2015).

As a result of these factors, manganese was the poorest performing commodity in 2016, as prices were on record low levels dating back to the 1990's (van Zyl, Bam, & Steenkamp, 2016).

There is also a definite link between the commodity prices and exchange rate movements (Kohlscheen, Avalos, & Schrimpf, 2016), which have a direct impact on the demand for these commodities on international markets. These exchange rate fluctuations can also have a negative effect on profitability of firms operating in the South African alloy industry, as can be seen under the sub-heading, 'Exchange Rate risks'.

- **International Trade and globalisation of markets**

Globalisation has an especially big influence in the international financial system because of the free movement of capital that includes direct foreign investments, internationalisation of banks, the link between stock exchanges and the simplification of financial innovation (Mascarilla-Miró, 2009). The ease of trade between most countries together with globalisation means that commodity supply, demand and prices are not subject only to the country of origin, but is affected on a global scale.

The major manganese companies in South Africa are South32 [previously known as BHP Billiton or Samancor Manganese], Assmang Limited, Transalloys, Mogale Alloys, Kalagadi Manganese, United Manganese of the Kalahari [UMK] and Tshipi Manganese. Almost all of these major manganese players operating in South Africa are owned by foreign conglomerates (Basson, Curr, & Gericke, 2007; Gajigo, Mutambatsere, & Adjei, 2011). There are a few smaller manganese companies like Kudumane, Metmin and National Manganese Mines, as well as several smaller BBBEE manganese companies that have entered the manganese industry over the last few of years (van Zyl *et al.*, 2016).

- **Exchange rate risks**

The South African manganese ore and manganese ferroalloys industry is one of the largest in the world. This industry is the largest exporter of manganese ore and is a key competitor in the production of ferromanganese and the global trade of these alloys (van

Zyl *et al.*, 2016). According to Basson *et al.* (2007) the volatility the South African Rand leads to short-term fluctuations in the exchange rate and is a disruptive force in commodity prices and the profitability of South African alloy producers and exporters. The ferroalloys industry is placed in the global competitive market and thus give rise to high fluctuation in the international price of ferroalloys due to the fact that price is affected by supply and demand (Harman, 2007).

- **Electricity supply and prices**

From early 2000, there were already reports that regularly pointed to concerns and problems over the electricity supply of South Africa. These reports suggested that the country's electricity demand has caught up with the electricity-generating capacity of the state-owned electricity supplier, Eskom. Further, there were no clearly laid out plans for expanding the electricity-generating capacity of Eskom.

There were also reports that suggested global alloy and mining industry organisations had serious reservations about Eskom's electricity-generating capacity to supply the South African mining and alloy sector and let alone for major planned investments in new product facilities. Experts believed that this pressure on Eskom would lead to South Africa losing its competitive advantage as a low-cost electricity provider for local industries and international investments (Basson *et al.*, 2007). All of this is evident in the report compiled by Oxford Business Group (2014) that the cost of electricity in South Africa has increased by 20-30% in the last few years.

- **Operational risks**

The financial and strategic decisions around capital investment in new or current operations are influenced by various South African and global factors. The current political and regulatory uncertainty in South Africa, together with issues like the volatile labour market, electricity cost and supply, have all increased the country's inherent operating risk. All of these factors together with increased production costs have limited companies to produce at their full potential and in turn, adversely affected profitability.

All these factors increase the operational risks and needs to be taken into consideration. Therefore, the mining and alloy industry has to increase the profit margin threshold for new projects and will not pursue projects that does not offer high enough returns (Lane *et al.*, 2015).

2.4.3 Social factors

The department of Trade and industry of South Africa completed the Codes of Good Practice in 2007. The Codes of Practice is a broad framework for organisations to use in order to alter their Corporate Social Responsibility practices toward employees and to increase organisations overall impact on society.

The Codes of Practice have guidelines for companies to achieve transformation and BBBEE targets as well as improve their social responsibility. Although the Codes of Practice focus mainly on BBBEE, it also includes sections for promoting good corporate governance and charitable giving (Arya & Bassi, 2011). The mining and alloy sector includes the highest number of illiterate employees, high levels of HIV/AIDS infections and have rate high Health and Safety incidents where respiratory health illnesses (Technology Innovation Agency, 2012).

- **Health and safety**

In the last ten years, occupational health and safety remained a crucial and priority issue in the mining and alloy sector with long-term statistics showing that it is a high risk industry for employees. Most mining companies stated that Health and Safety as well as sustainable communities are important aspects for sustainable development in the sector.

Health and Safety is indeed one of the top priorities in the mining and alloy sector. It has to be ensured, without no exception, that each and every employee works a lifetime in the sector and at the end is still healthy and unharmed (Starke, 2016).

There are also activities in the mining and alloy sector that can pose health and safety risks to citizens and the local community. These risks include respiratory and health issues because of air pollution, discharge of toxic materials or gasses and citizens accessing unprotected dangerous areas (Buxton, 2012).

- **Skills shortages**

According to the Technology Innovation Agency (2012) report, the alloy and mining sector has a strong need for experienced and skilled workforce. These skills shortages

are found in professionals, technicians and trades workers, directors and corporate managers, machine operators and drivers. The report also stated that a study shown that the age of mining professions is currently between 50 and 55 years. This indicates that there is high rate of employee turnover in the mining and alloy sector.

- **Skills development**

Training and education of a companies' workforce is one way to contribute towards sustainable development by building human capital. This builds up human capital in a sector that has increasing levels of specialisation and technological advanced job requirements. Training and education of local employees, instead of hiring trained workers, will uplift the local community and gain support from local business and government (Starke, 2016).

- **Discrimination and inequality**

According to the Chamber of Mines of South Africa (2017), the main risks facing the female workforce are safety, physical limitations and equipment. Safety for women includes issues like sexual harassment and violence as well as facilities, like restrooms, that were previously exclusively designed for men.

This issue also holds true for equipment as well as personal protective clothing that does not properly fit women because it wasn't specifically designed and manufactured with women in mind. Women, in general terms, also do not consist of the same physical strength as some male workers. The organisations also have to make provisions for workers to do safe work during pregnancy. Organisations in the mining and alloy sector have also adjusted their sustainable development framework to provide equal opportunities to all regardless of gender, race, disability or religion (Azapagic, 2004).

The percentage of female workers in the mining sector increased considerably in the last 15 years from nearly 11 400 in 2002 to almost 57 800 in 2015. This is over 13% of the mining industry's workforce (Chamber of Mines of South Africa, 2017). Social development of improving equality in the workforce has been included in many organisations social development strategies. BHP has strategic plans to restructure its workforce so that 50% of all employees are female by 2025. In the fiscal year of 2017 alone, they have hired 1000 more women and increased the female workforce presence by more than 20% (Creagh, 2017).

2.4.4 Technological Factors

- **Research and development**

There are several factors in the South African ferroalloys industry driving research, development and implementation of technologies. Some of these factors are the rising cost of electricity, environmental issues and operational and labour costs. These technological changes need to ensure a high level of furnace availability is maintained and does not affect the very sensitive dynamics of the furnace operations.

Technologically advanced and effective furnace operations can deliver better yields at lower operating and electrical costs (Basson *et al.*, 2007). Agglomerated ore replacements are more consistent in size and uniform in chemical composition, thus ensuring lower power utilisation because the agglomerated products have better reducibility than the natural ore lumps, as well as assisting in better flowing furnace operation. These agglomerated products can be created by a various of methods, like briquetting, pelletising, extrusion and more (Harman, 2007).

2.4.5 Legal factors

- **Increased environmental legislature**

There is continued pressure on organisations to comply with the increasingly stringent environmental legislation and enforcement and this has led to much lower levels of pollution and particulate matter emission levels from ferroalloy plants. The regulatory environment in South Africa contains policies and regulations that organisations need to adhere to, like the Mineral and Mining policy for South Africa white paper policy document of 1998, the mining Charter of 2002 and other environmental acts and legislations (Basson *et al.*, 2007).

In addition, the King Code on Governance for South Africa, King III, is a framework which organisations can follow to improve their corporate social responsibility and it claims that people, the planet and profit are interlinked (Ackers & Eccles, 2015).

- **Regulatory uncertainty and labour unions**

There is a lot of government policy and regulatory uncertainty in South Africa. The nationalisation of mines and other natural resources is fuelled by a global trend of calling for nationalisation of natural resources.

Governments believe that the profits from these mining activities would help improve the socio-economic situation and support a slow growing and struggling economic environment. Prevailing poor governance, infrastructure and service delivery is coupled with widespread corruption and thus creates an undesirable business operating and investment environment. Strategic business planning is also complicated by tenuous legislative frameworks, fragile contract agreements, complicated royalty and tax systems (Lane *et al.*, 2015).

South African labour and trade unions are powerful entities that have considerable influence in the mining and metal industry and its workforce. Cosatu [Congress of South African Trade Unions] showed its power in 2008 by being the main force in replacing the current South African president at the time, Thabo Mbeki, and appointing their preferred candidate, Jacob Zuma.

The reason given by Cosatu for this move was because Thabo Mbeki followed policies that they believed, did not benefit the ordinary workers. Although Cosatu can exert pressure for political change, its main focus is still the wellbeing of its members in the workplace (Azapagic, 2004).

There have been huge increases in the cost of labour and energy costs, which have far exceeded the inflation rate. Annual strike actions are due to continued increase in demands by labour unions and workers without attention being given to the difficult economic situation and the challenging environment in which the mining and ferroalloy industry operates in (Lane *et al.*, 2015).

- **Legislative frameworks**

According to Technology Innovation Agency (2012) some of the legislation that regulates the mining sector are the Mine Health and Safety Act, 1996 [Act No. 29 of 1996], the Mine Health and Safety Amendment Act [Act No. 74 of 2008] and more. The joint effect

of the legislative framework and attractive commodity prices have resulted in an increased number of new entrants to the mining market and have applied for prospecting and mining licences.

This new legislative body tries to mitigate concerns that exist, in that the industry will not meet its BEE targets by 2014 as well as the completion of the adaptation to new order mining rights (Technology Innovation Agency, 2012). For organisations to comply with all these legislation, along with compliance on all environmental laws, makes it a very costly exercise.

2.4.6 Environmental factors

- **Environmental solutions**

To reduce an organisation's environmental footprint is a costly exercise and innovative solutions need to be implemented to make the business operations as environmentally friendly as possible. The problem of rising electricity costs is addressed by smelter companies by trying to increase the energy efficiency of the furnaces through developing ways to reduce heat loss and heat recovery, designing closed furnaces only and power generation from the off-gas during the melting process (Steenkamp & Basson, 2013).

South32, previously Metalloys plant of Samancor Manganese, installed the Metalloys Elgin Power Generation Plant which is a electricity generation facility driven by the CO-rich furnace off-gas and dramatically reduces the company's CO₂ emissions and in turn converts the CO₂ gas generated in the furnace process into useable electricity for its operations and even sells the excess electricity back onto ESKOM's grid (Roos & Hearn, 2004).

The use of agglomerated products like briquetting, pelletising and sinter plants, improves the energy efficiency of furnaces and metallurgical properties. These agglomerates can be used in both old and new types of furnaces (Basson *et al.*, 2007).

- **Water scarcity**

The mining and the alloy industry uses water in their processes and the management and protection of this natural resource is of major importance. Toward the end of life, the mine and production facilities can pose quite a few environmental issues, including water

contamination because of corrosive mine waste and other poisonous leachates, irreversible loss of biodiversity, loss of land and a visual impact. There are several environmental issues, like water, energy, biodiversity protection, and green-house gas emissions that are very important to insurers, local communities, local government and authorities, as well as Non-Governmental Organizations [NGO's] (Azapagic, 2004).

There is no evident cross-industry acknowledgment of the business case for investing in sustainable development, despite the fact that some industry pioneers see sustainable development as a competitive advantage and are starting to stick to the thought of shared value. Be that as it may, sustainable development is all the more firmly part of operational risk management, as variables like increased water and electricity shortages, and the geopolitics of mining in remote regions compel mining organisations to consider these issues. Environmental worries around water, electricity and potentially climate change have increased, and gave rise to innovative solutions being created. Nevertheless, inspections of the work done on termination of mining operations are expected to guarantee the vital progress and action on inheritance sites (Buxton, 2012).

- **Environmental rehabilitation costs**

According to the National Environmental Management Act (1998), all mining activities, including the smelter process, need to adhere to the rehabilitation practices and guidelines so the environment is rehabilitated to its previous state after mining activities have ended.

Mining has several activities that forms part of the full life cycle from exploration survey stage through to mining, production, processing and sales activities after which the rehabilitation process starts. Although the whole value chain of mining creates millions of jobs and contributes significantly to the economy, mining and all its accompanied activities has always been criticised and these organisations comes under extreme scrutiny because of its essentially negative environmental impact.

Especially in South Africa, the global economy has been for a long time greatly dependant on mining and this will most probably not change in the near future. Health and safety are and have been a crucial focus point in mining and modern mining methods has become much safer, but government regulations have also included an

environmental focus to its legislation to mitigate the effect that mining and its activities have on the environment.

As a result of government regulations, mining business operations requires an approved plan that includes all the provisions for termination including the shutting down process of the business before any operations commence. A mandatory compliance plan needs to be submitted with the National Environmental Management Act (1998) before any mining operations can begin. When mining operations start, the rehabilitation and closure activities also start. As ore extraction takes place, the rehabilitation and maintenance process gets implemented at the mined-out and stockpile areas. These rehabilitation activities focus on land, water and other natural resources that gets impacted by the mining operations, according to the requirements of the resource management permits (Technology Innovation Agency, 2012).

The social and environmental legislation of South Africa demand that mines have to rehabilitate the land affected by its operations and disclose its environmental accountability, after it closes and ends its business operations. As stated above, a complete environmental rehabilitation plan needs to be submitted before a mining license can be issued. Thus, the company applying for a mining licence should submit their financial statements showing that there is a budgeted amount made available for the environmental rehabilitation (de Villiers, Low, & Samkin, 2014).

2.5 SWOT analysis of alloy agglomeration businesses

Identifying agglomeration businesses strengths, weaknesses, opportunities and threats [SWOT] in the alloy market in order to analyse and identify internal and external factors affecting the agglomeration business is critical for sustainability.

The SWOT analysis is an instrument utilised for dissecting the internal and external environments with the specific end goal of enabling management with a systematic approach and support to make good decisions. The strengths and weaknesses are considered internal factors and opportunities and threats are the external factors affecting the organisation (Kurttila, Pesonen, Kangas, & Kajanus, 2000).

In this study, we applied the SWOT analysis on prominent agglomeration companies operating in the South African alloy industry. The strengths, weaknesses of the organisation were identified as internal factors, while the opportunities and threats were studied as external factors. The drivers and barriers within the organisation are the internal factors, while the drivers and barriers in the overall alloy market affecting the organisation was regarded as the external factors.

The strengths, weaknesses, opportunities and threats associated with establishing and managing an agglomeration business in the South African alloy market are summarised below in Table 2. The SWOT analysis groups the strengths and weaknesses part of the internal factors and the opportunities and threats as the external factors.

Table 2: SWOT analysis of alloy agglomeration businesses.

INTERNAL	
Strengths	Weaknesses
<ul style="list-style-type: none"> ▪ Intellectual property ▪ Environmental solutions ▪ Quality ▪ Business alliances ▪ Problem solving ▪ Economy of scale 	<ul style="list-style-type: none"> ▪ High capital start-up costs ▪ High operating costs ▪ Economy of scope ▪ Marketing
EXTERNAL	
Opportunities	Threats
<ul style="list-style-type: none"> ▪ International markets ▪ Growing global demand ▪ Agglomeration of other products ▪ Resource abundance in South Africa 	<ul style="list-style-type: none"> ▪ Cyclical demand ▪ Exchange rate risks ▪ Change in raw materials ▪ Client changing strategic scope ▪ Government regulations & electricity availability and price

2.5.1 Strengths

- **Intellectual property**

There are several factors in the agglomeration industry that classify it as a specialised field. One component of specialisation is the research and development of the chemical binders used to bind the agglomerated product while also meeting the clients' specification in terms of compression strength, waterproofing and high temperature strength. Another aspect is the development of the agglomerating machines used on the plant, such as a briquetting machine and its components, along with the production process, plant layout and lastly but also very important, skills and knowledge of employees.

- **Environmental solutions**

Agglomerated fines of smelter by-products are not only fed back into the furnace as an ore replacement or part of the metal recovery process, but the smelter by-products would otherwise be classified as a waste and pose an environmental headache for the smelter organisation.

Some of the smelter by-products are pumped into sludge dams or transported to a hazardous waste disposal site, which are both expensive options. Permits are also very difficult to obtain for gaining permission to build extra sludge dams. But because all these by-products still contain alloy, it is also a loss in profit as these materials are not optimally utilised.

- **Quality**

The agglomerated material needs to meet several quality specifications according to the smelter / client. The agglomerated product need to be waterproof, high temperature resistant, pass the compression test and should not break up when handled and moved by loaders and conveyor belts until the time it gets fed into the furnace. These specifications are important for the client's smelting operations and may affect furnace yields positively or adversely.

Quality has to do with the effectiveness of the agglomeration processes but is also very closely linked to the combinations of binders used. It is ultimately the chemical binders

that give the agglomerated products like, briquettes, pellets or extrusion pieces, the necessary quality aspects required by the client.

- **Business alliances**

For especially smaller firms, it may be advantageous to have a business alliance of some sort in order to combine specialities in order to form mutual beneficial relationship. Some smaller companies do not have the research capabilities, capacity or even marketing skills necessary to access internal and external opportunities. Alliances with bigger firms may allow smaller businesses with access to complementary assets like marketing, manufacturing, financial and information and research data (Rothaermel, 2001).

Agglomeration companies need to do continuous chemical binder research in order to stay up to date with the latest innovations and cost effective chemical binders to use in the agglomeration process. The chemical binders make up the highest percentage of production costs and continuous research needs to be conducted to try and find a better quality and more cost effective chemical binder to use. A business alliance may be formed with chemical suppliers to do collaborative research in order to find better chemical binders. However, business alliances can also assist smaller firms to market their services and products in order to obtain new business or help with the capital costs on new projects.

- **Problem solving**

Every smelter / client has its own unique processes, generate different by-products and may require agglomeration mixtures unique for their own smelting process. Not all of these mixtures are agglomerated with the same ease and may require different combinations of binders in order to meet the client's specifications.

- **Economy of scale**

Agglomeration plants are production plants and the higher the production, the bigger the proportionate saving in costs gained because of lower cost per unit produced. Although the production and maintenance costs of an agglomeration plant are quite high, high production volumes may lead to better economies of scale. However, this may also have an adverse effect on the agglomeration company's costs when the client orders less of the agglomerated product.

2.5.2 Weaknesses

- **High capital start-up costs**

Since large sums of capital are required to construct a new agglomeration plant, it makes it difficult for smaller businesses to obtain the capital required to take on such projects. Most contractor companies establish a contract with the client to build and/or operate these plants for the clients on a turnkey basis. Turnkey projects involve shifting most of the responsibilities from the contractor to the supplier or sub-contractor for successful delivery that is within the allotted time frame, within budget and scope of objectives set by the client (Ahola, Laitinen, Kujala, & Wikström, 2008). This also enables smaller firms to accept these projects without taking on the huge capital burden and risk associated with the project.

- **High operating costs**

The operating and labour costs of agglomeration plants are quite high and because the plant's remuneration works on production output, it can generate quite huge losses if it does not reach production targets or receive product orders from the client.

- **Economies of scope**

The market price of certain alloy materials makes it unviable to agglomerate the smelter by-products because the profit margin is too low or it may be the case that the market price of the ore oxide is less than the agglomeration production costs.

- **Marketing**

Smaller firms don't have their own marketing team or department, but to ensure growth and sustainability of a business it is critical to do proper marketing and get the necessary exposure. Marketing of the business and its operations may also enhance the business' image and may even generate new business opportunities.

When smaller firms forms alliances with bigger firms, they may benefit from the established marketing departments, campaigns, and resources (Rothaermel, 2001). Most big organisations also have a much bigger client and business base which can be accessed to reach other business sectors that smaller firms would otherwise not be able to reach.

2.5.3 Opportunities

- **International markets**

Although South Africa has an abundance of mineral wealth (van Zyl *et al.*, 2016) there are certain challenges of doing business in South Africa, as pointed out under the PESTLE analysis. It is thus a good option to reach out into international markets and spread the company's business footprint and in so doing spreading the operational risk of only doing business inside South Africa. Developing countries have shown big growth in countries like Russia and Kazakhstan (Humphreys, 2015) and could be a potential opportunity for new business.

- **Growing global demand**

According to (Humphreys, 2015), the commodity boom cycle was in ten-year period from the year 2000, which saw incredible high commodity prices and record production figures fuelled mainly by a rapidly growing Chinese economy and imports. In the next decade when economic growth percentage of China slowed down to single figures, markets balanced out and this left the market flooded with ferroalloys. Growing global demand is also linked to growing emerging markets, which share of global GDP rose from 37% in 2000 to more than 50% in 2013.

- **Agglomeration of other products**

Iron ores, ferrochrome, ferromanganese, ferrosilicon and aluminium oxides are some ferroalloys products which have the potential to incorporate agglomeration solutions into their process. There are, therefore, a lot of opportunities for agglomeration business expansions.

- **Resource abundance**

South Africa has a vast abundance of ferroalloy resources where identified manganese reserves are between 75-80% of the world's total reserves (van Zyl *et al.*, 2016) and around 80% of the world's viable chrome ore reserves (Beukes, Dawson, & Van Zyl, 2010). The fact that there is such an abundance of ore deposits ensures the industry will not collapse because of depleted resources, and thus ensures the long-term sustainability of the agglomeration industry.

2.5.4 Threats

- **Cyclical demand**

The global demand and supply are constantly changing and make it difficult to do proper forecasting and make successful long-term strategic decisions difficult. This coupled with events such as the global recession in 2008, has a cyclical effect on commodity prices and the supply and demand of commodities (Humphreys, 2015).

- **Exchange rate risks**

Some of the chemical binders used in the agglomeration process are imported, which means these agglomeration firms are exposed to exchange rate risks. These chemical binders are a huge process cost item and most companies don't possess the working capital to buy these chemical binders in bulk in order to try and hedge themselves against fluctuating currencies.

- **Change in raw materials**

The smelter client has certain by-products that are generated through the smelter process as explained in the background setting section. If one or some of these materials are not available anymore or substituted, it causes a huge disruption in the agglomeration process. These changes may cause the current combination of binders not to be as effective for agglomeration, not to meet the client agglomeration criteria and may result in loss of production.

It is thus of utmost importance that these proposed changes are communicated clearly and as early as possible as to allow the agglomeration contractor to do the necessary test-work on the new materials and operational planning.

- **Client changing strategic scope**

In most cases, the client issues a monthly purchase order for agglomerated product and the contractor supply them with the tonnages specified in the purchase order. The contractor thus manages the agglomeration plant and allocates the appropriate amount of resources to meet the production target as set out in the client's purchase order.

When the client makes short-term strategic changes that affect the amount of agglomerated materials being ordered, there are direct cost and profit implications for the agglomeration contractor.

- **Government regulations & electricity availability and price**

This element of analysis is closely linked to the analysis of 'Legislative frameworks' and 'Electricity supply and prices' in the PESTLE analysis. These two factors have a downstream effect on the agglomeration contractor because the loss in production leads to less agglomerated material required.

During winter months, electricity is more expensive which may force the client to downsize production as the higher electricity prices directly affect profit margins. With the unstable electricity supply and the rising demand, the limited supply of electricity may lead to production loss and ineffective furnace operations.

As a contractor, BBBEE is compulsory. The client / smelter company needs to be BBBEE compliant. These regulations as well as other regulatory legislation place a huge burden upon the agglomeration firms and may even lead to termination of their contract with the client if it is stipulated so in their agreement.

2.6 SUMMARY

Sustainability in relation to organisational sustainability was researched in the literature study to form the basis of the study with the goal of achieving the research objectives. Sustainability was defined in terms of business sustainability and the different aspects to measure organisational sustainability were presented.

Literature research was done on the factors affecting organisational sustainability. These factors were analysed using the PESTLE and SWOT analysis to study the micro- and macro factors affecting organisational sustainability in the alloy market and of agglomeration firms.

The six components of the macro-environment, or PESTLE, were used to analyse these components that may affect the sustainability of organisations conducting business within the macro-environment. The SWOT analysis helps to study internal and external factors in the micro-environment of businesses and how these factors affect organisational sustainability.

This literature study will be supplemented with qualitative research. Interviews will be created, conducted and the results of the qualitative research will be combined with the literature study in order to achieve the research objectives.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter presents the outline of the empirical study and explains the research design of the study. It also gives in depth details about the interview process, the limitations of the study, how the data will be reported and the ethical considerations as well.

3.2 Qualitative Empirical Setting

Qualitative research describes methodologies that use an inductive process to investigate issues, phenomena, and understand peoples' interpretations in a holistic fashion. This means that qualitative researchers study things in their natural settings.

The setting of the interview took place in the offices of the selected managers where access is easily obtained. These managers had limited time and scheduling the interview needed careful planning to accommodate the interviewees. The researcher presented himself in a professional manner as the interviewees were part of the top-management of the smelter works and contract agglomerators.

3.3 Entrée and Establishing Researcher Roles

A formal meeting request for conducting the interviews was sent to the top management of the contract companies to contact the proposed participants. The management of the agglomeration contractor company was used as an intermediary to make contact with the interviewees in order to schedule the interview appointment. This is because the management of the agglomeration contractor works closely together with the various managers at the alloy smelter sites.

The interview schedules were created in order to conduct all the interviews and leave enough time to compile all the data gathered. Participatory research was visible in the study as the researcher was actively involved in the research field.

3.4 Sampling

The sampling strategy chosen to best support the qualitative process of this study was the purposive sampling strategy method. The target population available for the study was the alloy smelters in South Africa. These are fifteen.

From the population, a sample of those alloy smelters using the briquetting technique was selected and these units of analysis were limited to four smelter organisations. These four alloy smelter use the briquetting technique in converting the by-products and therefore have all things in common. In addition, they all produce the same ferromanganese alloy.

According to Kotzé (2007) the individual persons taking part in the interviews for the data collection purpose is the sampling units of the study. For the purpose of this study, the interviews were deliberately focused on top-level managers of these alloy smelters which can give valuable data in the target research field.

Furthermore, these managers are the individuals in management that make decisions, which have a direct impact on the businesses involved in the environmental agglomeration process. These included the general managers, production managers, raw material managers and environmental managers. These managers gave insightful information from which conclusions can be drawn. Table three summarises the interviewees' composition.

Table 3. Sample details

Details of Sample on Smelter/Client Side	Details of Sample on Contractor
Smelter / Client 1: One Senior Manager	Contractor 1: One Senior Manager
Smelter / Client 2: One Senior Manager	Contractor 2: One Senior Manager
Smelter / Client 3: One Senior Manager	Contractor 3: One Senior Manager
Smelter / Client 4: One Senior Manager	Contractor 4: One Senior Manager

3.5 Data collection methods

The study made use of semi-structured interviews with a list of themes and questions designed to extract specific details. The list was sent in advance to the interviewees. This gave the participants and the interviewer freedom to discuss the various topics and

questions in depth. The interviewer coordinated the process within the confines of the questions asked.

The interview involved these questions:-

- **Questions 1:** What are the positive and negative aspects of contracting-out the environmental agglomeration process?
- **Questions 2:** How does short- and long-term strategic decisions affect the contractor managing the environmental agglomeration process?
- **Questions 3:** How is this client-contractor arrangement [of outsourcing the agglomeration process] supportive of your core business strategy and does this client-contractor relationship form part of your long-term strategy?
- **Questions 4:** What challenges are faced by the contractor managing the environmental agglomeration process?
- **Questions 5:** Finally, please give recommendations or suggestions on how the relationship between the two organisations can be improved?

3.5.1 Recording of data

The interviews were recorded using a recording application installed on an Apple iPad. This was a secure way of recording the data and the data was automatically backed-up in the cloud storage system. After all the interviews were completed, all the recorded interview data was transcribed. This was done by an institution that specialises in transcriptions to ensure that the integrity of the interviews was kept.

3.5.2 Data analyses

All interviews were recorded and then the answers were evaluated and put into writing. All the answers were appraised for similarities and differences. This formed the basis of the evaluation of the research question.

The answers gathered in the interviews gave insight into the research and the identification of key functions that have the biggest impact on the sustainability of the environmental agglomeration business.

3.5.3 Strategies employed to ensure quality data

The following strategies were used to ensure the quality of the data in this study;

- The internal validity, reliability and objectivity of the qualitative research study were ensured.
- Replicability was used during the research paper to ensure claims are supported by sufficient evidence.
- An alternative to external validity is to ensure the transferability of the data. This however will be difficult as this qualitative research study has a very specific research setting.
- An alternative to objectivity is to ensure conformability, where the data will help confirm the findings and implications of the research.
- Triangulation of multiple sources of data was used to corroborate or elaborate the research question.
- Comparison of participants' experiences and perspectives towards the research topics and questions.
- Used the member validation strategy.

3.5.4 Reporting

A scientific style will be used for reporting the results and findings of the study. Scientific explanations of the data and findings will be formal and logical. The data of the transcribed interviews will be analysed and compared against the literature study in order to meet the research objectives. After careful consideration of all the data, conclusions will be made in order to answer the research question.

3.6 Ethical considerations

All the ethical considerations were discussed under section 1.5.4 on page 17.

3.7 SUMMARY

This chapter gave an account of the interview process of the qualitative study. Details regarding the process of gathering the data and presenting the results, along with the proposed discussion of the findings are explained.

In the following chapter, the data gathered during the interview process is presented and analysed. The literature study together with the data obtained from the interview process will be used to reach this study's research objectives.

CHAPTER 4: RESULTS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents the findings of the qualitative data analysis and how it correlates with the literature study that was done. In this chapter, a summary of all the interviews will be compiled together with the fully transcribed interviews.

It will be followed by a discussion of the main and secondary objectives as presented in chapter. Before this, a brief summary of the findings so far will be given

4.2 Summary of Work Done

The general objective of the study is to identify the factors affecting the sustainability of agglomeration businesses by analysing the micro- and macro business environment and identify the internal and external factors affecting its sustainability.

The research took a qualitative approach. The population was all the smelter – contract agglomerators in South Africa. These are 15. The sample was selected to be four and these are the smelter – contract agglomerators that exclusively use the briquetting technology to agglomerate. In addition, they produce a common product – ferromanganese.

Eight interviewees were selected [four from the smelter and four from the contractor]. These were top managers whose decisions impact their respective businesses.

Table 3 [reproduced] from Chapter 3

Details of Sample on Smelter/Client Side	Details of Sample on Contractor
Smelter / Client 1: One Senior Manager	Contractor 1: One Senior Manager
Smelter / Client 2: One Senior Manager	Contractor 2: One Senior Manager
Smelter / Client 3: One Senior Manager	Contractor 3: One Senior Manager
Smelter / Client 4: One Senior Manager	Contractor 4: One Senior Manager

The participants selected for the interviews are part of the management that make strategic decisions and they have impact on the contractor that is responsible for the agglomeration

process. The respondents have good knowledge in the field of study, thus the data being collected will prove invaluable towards achieving the research objectives of this study.

The literature study identified the main factors affecting the long-term sustainability of the contractor company managing the agglomeration process. The micro- and macro environments were analysed in the literature study by using the PESTLE and SWOT analysis tools. The data gathered in the interviews, along with the literature study, will aim to answer the research objectives of the study. The literature study was measured against the findings from the interview data.

4.3 Research Participants

The table showed the actual participants who were interviewed. Although the sample size was small, some level of high data saturation was found

Table 4: Research participants

Details of Sample on Smelter/Client Side	Details of Sample on Contractor
Smelter 1: One Senior Manager: conducted	Contractor 1: One Senior Manager: conducted
Smelter 2: One Senior Manager: conducted	Contractor 2: One Senior Manager: conducted
Smelter 3: One Senior Manager: conducted	Contractor 3: One Senior Manager: conducted
Smelter 4: One Senior Manager: not done	Contractor 4: One Senior Manager: conducted

The “Client” respondents are the smelter firms that contract the agglomeration process out to a contractor. The “Contractor” respondents are thus the agglomeration firm that handles this process on behalf of the smelter client.

The fully transcribed interviews are presented in tables 5 to 9 on pages 63 to 69.

4.4 RESEARCH DISCUSSIONS

This section will be structured by presenting all the data and findings for each research objective as presented in chapter one.

4.4.1 Achieving the Main objective

As stated, the main objective was to:

‘To identify the main factors affecting long-term sustainability of businesses managing the environmental process of agglomerating smelter by-products.’

To effectively address the objective, we need to look at both the factors highlighted in the literature survey and the results from the interviews. Firstly, we will look at the secondary objectives before evaluating the main objective.

4.4.2 Achieving the Secondary Objectives

4.4.2.1 Secondary Objective One

‘To identify the internal and external factors affecting sustainability of agglomeration businesses in the micro-environment’

In the literature study the internal and external factors that affects agglomeration firms was analysed using the SWOT analysis. The data gathered during the interviews will aim to supplement the literature study and the respondents’ findings will be measured against the literature. The analysis of these internal and external factors will form part of the main objective of the study as it may enable the agglomeration company to be sustainable in the long-term. The goal is to enable the organisation to have a better idea of the strengths and weaknesses of the firm which are the internal factors

The literature study used the SWOT analysis to identify the possible internal and external factors of an agglomeration firm in the South African alloy industry. The strengths, weaknesses of the organisation were identified as internal factors, while the opportunities and threats were presented as external factors. The organisational drivers and obstacles within the organisation are the internal factors, while the drivers and barriers in the overall alloy market affecting the organisation was regarded as the external factors.

The internal and external factors identified are summarised as below in the table. This is table 2 reproduced.

Table 2. SWOT analysis

INTERNAL	
Strengths	Weaknesses
<ul style="list-style-type: none"> ▪ Intellectual property ▪ Environmental solutions ▪ Quality ▪ Business alliances ▪ Problem solving ▪ Economy of scale 	<ul style="list-style-type: none"> ▪ High capital start-up costs ▪ High operating costs ▪ Economy of scope ▪ Marketing
EXTERNAL	
Opportunities	Threats
<ul style="list-style-type: none"> ▪ International markets ▪ Growing global demand ▪ Agglomeration of other products ▪ Resource abundance in South Africa 	<ul style="list-style-type: none"> ▪ Cyclical demand ▪ Exchange rate risks ▪ Change in raw materials ▪ Client changing strategic scope ▪ Government regulations & electricity availability and price

The views of the Client respondents and Contractor respondents represent some of the internal factors and some of the external factors affecting the agglomeration business. The client and contractor have knowledge of internal and external factors of both organisations.

Several respondents believed that agglomeration is a specialised field. They further revealed that the client gains expertise and skills by contracting out the agglomeration process to a specialist in the field.

“The agglomeration process is very specialized so relying on the experience and expertise of the contractor is easier and results in reduced Research & Development costs.” (Client Respondent 1, 2017)

“The advantages of sourcing out the agglomeration process to a contractor are that the client obtains skills and know-how through the contractor that specialises in agglomeration.” (Contractor Respondent 3, 2017)

The contractor also has the intellectual property rights of some of the chemical binding agents used in the agglomeration process. This greatly improves the contractor's organisational sustainability because the company's services are hard to replicate or replace. The client thus receives these intellectual benefits when the agglomeration contractor manages the agglomeration process on their behalf.

“...the chemical binders the contractor use in the agglomeration process is their intellectual property and the client thus becomes dependent on the contractor...”
(Contractor Respondent 1, 2017)

Most participants agreed that agglomeration is an environmental solution and a cost benefit. Not only does the client recycle its by-products produced by the smelter process, but it increases the client's ore yields. If these by-products are not recycled through a process like agglomeration, they would need to be stored or transported to a waste facility. These alternatives lead to increased pollution and expenditures for the client.

“Outsourcing the agglomeration process results in an environmental cost saving and other cost increased ore yields for us as the client.” (Client Respondent 1, 2017)

The quality of the agglomeration product delivered by the contractor is of utmost importance to the client. The specifications and quality standards of the agglomerating products are important elements that are defined in the contract between the client and contractor. Most respondents agreed that it is best for the client and contractor if the specifications and quality standards of the agglomeration product are clearly defined in a contract.

“Another advantage is that the client and contractor agrees on the quality and specifications of the agglomeration products in a contract and thus have the assurance that the contractor needs to deliver the agglomeration product according to the contract standards.” (Contractor Respondent 2, 2017)

Most importantly, if the quality of the agglomeration product is sub-standard, it will have a negative impact on the client's smelting process. Some of the Client respondents felt that one of the main negative impacts of poor quality agglomeration products manifest in the inefficient operation of the furnace. Furnace performance is compromised.

“The only negative is if the agglomeration contractor’s product does not conform to quality specifications, it may affect furnace efficiency adversely.” (Client Respondent 2, 2017)

Contractor respondent 1 felt that the agglomeration contractor could assist in problem solving for the client because the top management of the agglomeration firm has vast insight and knowledge of some of the client’s processes. In operational terms, the agglomeration contractor can modify its processes and business structure to accommodate the client’s needs or requirements.

However, the respondent felt that none of this is possible if there aren’t trust-based relationships between the client and contractor. A good client-contractor relationship will ensure effective communication flow and mutual trust. Only then can there be a collaborative effort to solve problems and work towards common goals.

The agglomeration contractor needs to manage costs carefully in order to realise a profit while still delivering a high-quality product and service acceptable to the client. The chemical binder input costs of the agglomeration process are very high because of all the quality standards and specifications set and required by the client.

“The chemical binders form the largest part of the input costs of agglomeration because it needs to adhere to stringent client quality standards and consist of properties like being waterproof, stays in tact at high temperatures, does not generate too much fines when being moved to the furnace and compression strength.” (Contractor Respondent 2, 2017)

Another respondent described this situation as a balancing act between costs and quality.

“On the one side the client would like to get the best quality agglomeration product and service for the price they are paying the contractor, while the agglomeration firm’s management want to reduce input costs and realise profits. It’s thus difficult to find the equilibrium between quality delivered and cost to agglomeration firm.” (Contractor Respondent 2, 2017)

Different alloy materials are priced differently in the market. This may reduce, or completely diminish, the cost advantage of the agglomeration process, unfortunately. One respondent stated that the change in raw materials may affect production outputs of the agglomeration firm.

“...the agglomeration fixed cost to produce its product may be higher or almost equal to the ores the client uses and thus does not offer such a big cost advantage to the client anymore.” (Contractor Respondent 1, 2017)

Contractor respondent 2 felt that because the agglomeration firm’s primary focus is agglomeration, it has become a specialist through research and experience gained by agglomerating various smelter by-products. This opens up opportunities for the agglomeration firm to pursue new business of managing the agglomeration process for other smelter organisations.

Contractor respondent 2 also felt strongly that the agglomeration company needs creative management in order to capitalise and retain its status as a market leader in the field of agglomeration. It is important for the agglomeration company to market itself and to pursue new opportunities in order to ensure the long-term sustainability of the organisation.

Prices of alloy products are driven by supply and demand forces in the market. This cyclical movement of the market runs down to the smelter client that needs to adapt its production outputs according to the market demand.

“Because of the cyclical state of the market, the price of metal alloy fines increases when the market demand is high and decrease to extreme low level when the market is oversaturated.” (Contractor Respondent 1, 2017)

“Changing market conditions may lead to the client changing its raw materials used in their processes and thus lead to changes in the by-products produced.” (Client Respondent 4, 2017)

So, when production outputs are lower, the by-products supplied to the agglomeration process are lowered automatically. This results in the client issuing orders for lower

quantities of the agglomeration product which in turn affects the profitability of the agglomeration firm.

“Reduced production demands by clients’ does not always meet to meet minimum production amount order to cover fixed costs in order to keep the plant running and pay employees.” (Contractor Respondent 3, 2017)

Client contractor 4 felt that cyclical demand is thus a driver for change in the type and quantities of raw materials used in the agglomeration process because the client looks for cheaper ores to use in their process and thus reduce its input cost. This, according to the respondent, will lead to a competitive advantage for the smelter organisation.

“The long-term goal of the client is to stay competitive on the global market.” (Client Respondent 4, 2017)

Contractor respondent 1 also added that the long-term goal of smelter organisations is to decrease their input costs as low as possible and utilize the ore as efficiently as possible.

All the Contractor respondents, and most of the Client respondents, felt that these changes in the raw materials used in the client’s smelter process that lead to changes in the by-products supplied to the agglomeration process was one of the main external threats to the agglomeration firm.

“These changes in the by-products create production and quality challenges in the agglomeration process.” (Client Respondent 4, 2017)

The agglomeration firm has a contractual agreement with the client to deliver an agglomeration product of a certain quality and according to specifications that are agreed to in the contract. So, when the input materials of the agglomeration process change, it will, in turn have an effect on the quality and specifications of the product produced.

“Changing and different by-products supplied by the client to be used in agglomeration process created quality challenges and affects production outputs.” (Contractor Respondent 3, 2017)

Some respondents mentioned that the client might lower production outputs because of higher input costs. One of these input costs is electricity that is used in the smelter process to power the furnaces. If the market demand for the client's alloy products is low, together with higher electricity prices during winter, the client might decide to switch off some or all furnaces during winter in order to reduce input costs and production outputs. The higher electricity prices have a dramatic impact on the profitability of the smelter organisation.

“Short term production changes like the furnaces switching off because of higher electricity prices in winter and thus no by-products for agglomeration are generated.”
(Client Respondent 2, 2017)

These changes run down to the agglomeration firm because they get fewer by-products from the client. This also goes along with agglomeration firms that need to be flexible and be adaptable to client's short-term strategy changes or changes in the market.

The volatile and cyclical state of the market together with factors like client making short- and long-term strategic changes makes it crucial for agglomeration firms to be flexible and adaptable to these changes in order to ensure their sustainability in the long term. Some respondents felt that the agglomeration firms need to be set-up in such a way that they are adaptable to handle these changes.

“Short term strategies involve how to agglomerate current materials as well as the contractor being able to handle changes in the material or other strategic changes made.” (Client Respondent 1, 2017)

“The design of the agglomeration plant needs to be flexible enough to absorb these short-term strategy changes of the client.” (Client Respondent 4, 2017)

“In the short-term it is important for the contractor to be adaptable to these changes.”
(Contract Respondent 2, 2017)

“The contractor, agglomeration processes and plant need to be very adaptable to changes in the short term.” (Contract Respondent 3, 2017)

According to Manu, Ankrah, Proverbs, and Suresh (2013), a flexible organisation that can adapt to changes is a component of competitive advantage. It is crucial for the agglomeration firm to manage and adapt to strategic changes from the client in order to ensure the sustainability of the agglomeration business.

A trust-based client-contractor relationship will ensure an effective flow of information along the supply chain activities of the client, which will assist the flexibility of the agglomeration firm (Swan, McDermott, Wood, Thomas, & Abott, 2002). If the contractor received timely and effective communication from the client about proposed changes in the smelter process, the agglomeration firm can better manage these changes in order to adapt to it.

4.4.2.2 Secondary Objective Two

‘To analyse the factors affecting the sustainability of agglomeration companies in the macro environments’

According to Ülgen and Mirze (2007), the strategic analysis of a company begins by analysing the environment in which that company conducts its business in. In order to achieve the research objectives of this study, the factors affecting sustainability in the macro-environment were identified by the PESTEL approach. The summary table is reproduced below and measured against the interview responses.

Table 1. PESTEL analysis

<p>Political factors</p> <ul style="list-style-type: none"> ▪ BBBEE [broad-based black economic empowerment] ▪ Political uncertainty ▪ Nationalisation of mines/Future legislation 	<p>Economic factors</p> <ul style="list-style-type: none"> ▪ Domestic and global economic state ▪ International demand and commodity prices ▪ International trade and globalisation of markets ▪ Exchange rate risks ▪ Electricity supply and prices ▪ Operational risks
<p>Social factors</p> <ul style="list-style-type: none"> ▪ Health and Safety ▪ Skills shortages ▪ Skills development ▪ Discrimination and inequality 	<p>Technological factors</p> <ul style="list-style-type: none"> ▪ Research and development
<p>Legal factors</p> <ul style="list-style-type: none"> ▪ Increased environmental legislature ▪ Regulatory uncertainty and labour unions ▪ Legislative frameworks 	<p>Environmental factors</p> <ul style="list-style-type: none"> ▪ Environmental solutions ▪ Water scarcity ▪ Environmental rehabilitation costs

There are multiple factors that impact the client and contractor individually, but ultimately these factors have a combined impact on both client and contractor company. The client and contractor are thus in a mutually beneficial relationship. This means that most factors that have a positive or negative impact on the client company will ultimately flow down and affect the agglomeration contractor company.

Most participants strongly felt that the volatile state of the global alloy market makes it very difficult for the client to do effective long-term planning.

“Because of the volatile market, it makes it difficult for the client to do effective long-term planning because market indicators don’t always follow market trends and this give rise to situations like steep drop in alloy prices that force the client to adjust its long-term strategies.” (Client Respondent 1, 2017)

“The cyclical and volatile global market makes it difficult for the client do to effective short- and long-term planning.” (Contractor Respondent 1, 2017)

It is important to minimise the negative impact the business activities of the smelter client may have on the community. These social factors may include health and safety issues like air, water and noise pollution.

“Other advantages are in terms of the client having to employ fewer workers and thus lowering their labour compliment together with lower health and safety responsibilities.” (Contractor Respondent 3, 2017)

According to Buxton (2012), respiratory health issues and risks include air pollution, the release of toxic dust particles or gasses and also the unauthorised entry of citizens to unprotected dangerous areas.

Client contractor 4 believes that because the agglomeration process is contracted out to an agglomeration firm; the client has less responsible to do skills training or the employment of additional skilled personnel.

Some of the Client respondents felt that because the agglomeration contractor is an expert in the field, they obtain all the research resources and skills by contracting out the agglomeration process.

“Or it will be very costly to conduct research and find new chemical binders that will deliver an agglomeration product with the same or better quality.” (Contractor Respondent 1, 2017)

Contractor respondent 1 also added that Long-term strategy changes by the client like switching from their current furnace to a new DC Furnace, that can handle alloy fines to be fed directly back into the furnace, will make it difficult for the agglomeration plant to reach production targets because they don't receive enough by-products because of this change in the smelter process.

The respondents identified Health and Safety and Environmental regulations as legal factors that exist in the macro-environment.

Respondents believed that the agglomeration process forms part of the smelter clients' long-term environmental strategy. The agglomeration process not only decreases the current environmental footprint of the company, but also reduces the historical by-products previously generated by the smelter process. The agglomeration process is however not a quick solution and may take a long time to obtain permits before the agglomeration process can commence.

“Another negative is that the environmental permits to conduct agglomeration may take a long time to obtain and thus makes it a long-term solution. Agglomeration is thus no short-term fix for environmental recycling of the by-products produced by the smelter process.” (Contractor Respondent 1, 2017)

Some respondents felt that because the agglomeration process is contracted out, the client shifts some of his Health and Safety regulatory responsibilities to the contractor. The client has a smaller employment complement and thus reduces its human resources and training costs.

Environmental factors in the macro environment are a continuous and long-term strategy that needs to be adopted by the smelter client. The agglomeration process plays a critical part in this strategy as it manages all current and historical by-products generated by the smelter process.

To reduce an organisation's environmental footprint is a costly exercise and innovative solutions need to be implemented to make the business operations as environmentally friendly as possible.

The prevalent feeling was that agglomeration results in an environmental cost saving for the client as all current arising by-products are recycled back into the smelter process. Higher ore yields, higher furnace efficiency, reduced environmental footprint, reduced air pollution and less stockpiling of by-products is some of the other environmental benefits of the agglomeration process mentioned by the respondents.

According to Basson *et al.* (2007) the use of agglomerated products like briquetting, pelletising and sinter plants, improves the energy efficiency of furnaces and metallurgical properties. These agglomerates can be used in both old and new types of furnaces and also consists of a huge environmental cost saving for the smelter client.

4.4.2.3 Secondary Objective Three

'To analyse the current client-contractor relationship and how can it be improved'

To establish how the relationship between the client and contractor can be improved, the interviewees were asked to give their suggestions or recommendations on how the client-contractor relationship can be improved. The summary of the different recommendations and suggestions from the client and contractor interviewees are tabulated in Tables 5 to 9: Summary of interviews findings are on pages 63 to 69.

Most participants agreed that some sort of improved communication between the client and contractor will improve the current client-contractor relationship. This was the topic that was most mentioned in the answers given by the interviewees as a way to improve the client-contractor relationship. It was also notable that the views of both Client- and Contractor

Respondents were very similar in that “communication” was most prevalent in their responses as a way to improve the client-contractor relationship.

“Regular and effective communication.” (Client Respondent 4, 2017)

“In order for smooth operations and to uphold strategic alignment, open and effective communication is recommended between both parties.” (Contractor Respondent 6, 2017)

It is not only more and improved communication that will improve the relationship, but also the levels at which the communication is done.

“Establish regular communication between client and contractor, especially between senior management.” (Client Respondent 1, 2017)

According to Manu, Ankrah, Chinyio, and Proverbs (2015), this fact was also established that efficient communication at all management level builds trust and honesty between the client and contractor.

Client Respondent 1 also stated the importance of relevant product quality and specification information discussed between top management of the client and contractor, to be communicated down the line to all employees in order to achieve these product quality standards goals.

There were other “communication” related recommendations and suggestions by the respondents that they also believed will improve the client-contractor relationship. Client Respondent 2 suggested that a representative of the agglomeration contractor should be included in the periodic communications held by the client in order for the client and contractor to stay informed about the relevant business operations of both parties.

Contractor Respondent 1 and 4 believe that there needs to be a healthy balance between too many meetings or formal communication and too few communication sessions between the client and contractor. The respondents believe that when communication becomes too much, it may annoy the client and in turn affect the client-contractor relationship negatively.

The way the client and contractor communicates with each other, will have an impact on the state of the relationship. Some organisations use impersonalised modes of communication which makes it difficult to build a strong relationship

“Communication should consist of formal as well as informal communication.”
(Contractor Respondent 4, 2017)

This was exactly the case with the Client Respondent 4 whose organisation implemented a computerised program, which is an online communication platform used to manage client-contractor relations. According to the study conducted by Bresnen and Marshall (2000) it is important to establish personal forms of communication to build relationships between organisations.

The quality of the product and services delivered by the agglomeration contractor might also be affected by ineffective or lack of communication. The quality of the agglomeration products does not only affect the client but also the outputs of the contractor managing this process.

“The client and contractor needs to be on the same page in terms of production, quality and specifications of the agglomerated product.” (Client Respondent 4, 2017)

Some respondents felt that effective communication need to include communication from the contractor about all the aspects of the agglomeration process as well as communication from about factors affecting the client which might have an impact on the agglomeration process.

“The quality of the agglomeration products needs to be more widely communicated to relevant client employees.” (Client Respondent 2, 2017)

“When the agglomeration contractor has production issues, it needs to be communicated immediately to the client in order to avoid delays or loss of production.” (Client Respondent 2, 2017)

A well-defined contract was one aspect respondents felt would sustain the client-contractor relationship while ensuring quality standards are met by the contractor.

“Having a clear concise contract between the client and the contractor that allows for some flexibility within the process but not on the quality of the products.” (Client Respondent 1, 2017)

“These agglomeration standards, specifications and quality needs to be clearly defined in the contract between the client and agglomeration contractor company.” (Client Respondent 4, 2017)

According to Khalfan, McDermott, and Swan (2007), a contract between a client and contractor needs to encourage a relationship of trust and collaboration.

A mutually beneficial or trust-based relationship will set the client and contractor at ease to disclosing organisational long- and short-term strategy.

“If the client plays more open cards about its business situation, it will enable to contractor to plan accordingly and even assist with problem solving or offer possible solutions.” (Contractor Respondent 1, 2017)

“Transparency within the contractor’s business would also allow for more trust between the client and the contractor.” (Client Respondent 1, 2017)

Open and reliable communication channels will be ensured if the relationship between the client and contractor is trust driven and it will be less likely that information is withheld intentionally or that actions are taken against the interests of both parties (McDermott, Khalfan, & Swan, 2004).

A few participants felt that business ethics and ethical conduct plays a big role in establishing trust in the client-contractor relationship.

“The client may sometimes be overly cautious to avoid contractors that may have unethical business practices. Because of this, control measures are put in place and this may lead to a situation where communication becomes very formal.” (Contractor Respondent 2, 2017)

“Client and contractor needs to conduct business ethically and with integrity.” (Contractor Respondent 3, 2017)

In order to build sustainable relationships, the levels of ethics or trust needs to be developed natured in order to achieve a high ethics foundation (Wood, McDermott, & Swan, 2002).

Contractor respondent 1 felt that the client may have a perception that the contractor is only looking after its own interest and to enrich the company. The respondents further felt that this is not true as the success of the agglomeration firm is almost entirely dependent on the success of the client.

The respondent felt that the relationship between the client and contractor is sometimes driven by perceptions. These perceptions are difficult to manage; however, they are of utmost importance. To manage perceptions at lower levels of client and contractor personnel is also very difficult.

According to Elsbach (2003), organisations have several individual perceptions that need to be managed in terms of the organisational image, trustworthiness, credibility, reputation and corporate identity.

Table 5a: What are the positive and negative aspects of contracting-out the environmental agglomeration process?

Client	
Positives	Negatives
<ul style="list-style-type: none"> ▪ Cost advantage. ▪ Increased yields. ▪ Environmental solution to recycle by-products. ▪ Improved furnace power efficiency. ▪ Reduced labour cost. ▪ Reduced employee complement. ▪ Less maintenance and Health and Safety responsibilities. ▪ Financially feasible. ▪ No Human Resource problems when production is stopped. ▪ Intellectual capital of the contractor reduces the costs of employment and R & D needed by the client as the process is done externally. ▪ Faster internal processes due to the agglomeration process already being implemented by the contractor ▪ Pilot plant set up on small scale to determine the benefits of the agglomeration process before upscaling the technology to a larger plant. ▪ Better resource management as client does not have to worry about other processes other than smelting. ▪ Job creation in local community. 	<ul style="list-style-type: none"> • Low quality of agglomeration product may affect furnace efficiency. • Quality parameters are difficult to define. • Reduced control over agglomeration processes, product specification and quality standards. Higher risk with the appointment of an unknown contractor without a proven track record.

Table 5b: What are the positive and negative aspects of contracting-out the environmental agglomeration process?

Questions 1: What are the positive and negative aspects of contracting-out the environmental agglomeration process?	
Contractor	
<p style="text-align: center;">Positives</p> <ul style="list-style-type: none"> ▪ Cost advantage to client in terms of higher ore yields. ▪ Partially reduced by-products increase furnace outputs and efficiency because it requires less energy in the process. ▪ Some by-products may already contain reductant so client saves on reductant addition to the furnace process. ▪ Client acquires skills and know-how that the contractor firm possesses. ▪ Logistical and transport saving for client as the agglomeration process is done on-site. ▪ The agglomeration products get screened twice to limit the number of fines fed into the furnace. ▪ The client has a guarantee that the agglomeration plant will be successful and reach production targets because the contractor gets paid on a toll basis. ▪ The client receives the chemical binder used in the process at a reduced rate. ▪ Easier human resources management if the client only wants to do agglomeration in the short term (3-5 years). ▪ Acquire technologically advanced skills without having to do the R & D themselves. ▪ Client obtains specialised equipment and know-how developed and sourced by the contractor. ▪ The agglomeration firm have in depth knowledge of the furnace operations and can act preventatively in favour of the client. ▪ The client can outsource other activities to a contractor that does not form part of their core business. ▪ The reduction of the environmental footprint and elimination of the environmental liability. ▪ Environmental cost saving by recycling the by-products while reduced stockpiling of by-products and air pollution. ▪ Client has lower Health and Safety responsibilities. ▪ Lower client employee complement and labour costs. ▪ Client saves on employee training costs. ▪ Contract specified quality standards enforced on the contractor. 	<p style="text-align: center;">Negatives</p> <ul style="list-style-type: none"> ▪ Client has no direct control over the agglomeration process in terms of product specifications and quality standards. ▪ Client has a degree of risk if the contractor delivers sub-standard quality agglomerated products that can destabilise the furnace operations. ▪ The chemical binders used in the agglomeration process are the contractor's intellectual property and the client thus becomes dependent on the contractor. ▪ To obtain the environmental permits to conduct agglomeration may take a long time. ▪ Agglomeration isn't a short-term environmental solution. ▪ Clients and contractors don't always share the same business principles. ▪ Ensuring consistent raw material supply. ▪ Adjusting to changes in raw materials in order to keep quality standards. ▪ Communication between client and contractor could lead to possible deviation from quality. ▪ Lots of skills required.

Table 6a: How does short- and long-term strategic decisions affect the contractor managing the environmental agglomeration process?

Client	
<p>Questions 2: How does short- and long-term strategic decisions affect the contractor managing the environmental agglomeration process?</p> <p>Short-term</p> <ul style="list-style-type: none"> ▪ Client may reduce or completely stop production in winter when electricity prices are high resulting in less by-products for agglomeration and thus lower or no outputs and profits. ▪ The contractor needs to adapt to strategic and material changes in order to maintain consistent quality in the agglomeration process. ▪ The agglomeration plant should be designed to handle short-term changes. ▪ Agglomeration production information communicated to relevant client personnel. ▪ Weather affects agglomeration production and may affect the quality of the product. 	<p>Long-term</p> <ul style="list-style-type: none"> • Agglomeration is a long-term strategy to reduce the environmental impact by capturing and recycling the by-products from the smelter process. • Difficult to do effective long-term planning because of the volatile market conditions. • Changing ore products are driven by the client's long-term strategy of perusing low-price ores in order to reduce their input costs. <p>(Long and short-term decisions that affect the client will result in the replacement of the contractor as client is focussed on his own interests.)</p>

Table 6b: How does short- and long-term strategic decisions affect the contractor managing the environmental agglomeration process?

Contractor	
Short-term	Long-term
<ul style="list-style-type: none"> • Direct influence on resources allocation in terms of the number of employees that is necessary to reach production targets. Can result in over saturation. • Agglomeration process and contractor needs to be very adaptable to short-term changes. • Agglomeration plants needs to be designed to handle these short-term changes. • Short-term strategic decisions to change ore may lead to problematic by-products for the agglomeration process that may affect the quality in the long term. • Plant capacity should enable the contractor to make up lost production in the short term. • Affects workforce stability. • Costly process of employees needs to be retrenched and re-hired. • The short-term performance of the contractor may ensure the long-term partnership between client and contractor. • The contractor needs to realise profits and be commercial viable during the duration of the contract during the contract term. • The cyclical state of the market that affects the price of metal alloy fines directly influence the amount of the metal fines being made available by the client to the agglomeration process, affecting outputs and grade of the agglomeration product. • The cyclical and volatile global market makes it difficult for the client do to effective short -term planning. 	<ul style="list-style-type: none"> • Has a relatively low negative impact. • The client's strategy may change in the long-term due to organisational changes in top management or shareholders that may affect the agglomeration contractor. • Long-term changes to furnace operations, like switching to a DC furnace that can handle fine products, will impact the agglomeration process directly. • Client may change their market strategy of supplying a lower grade alloy to a certain market segment. The price of these lower grade ores may be similar to the agglomeration fixed cost and thus diminishes the cost advantage of agglomeration process. • Agglomeration contractor needs be creative in the long-term to capitalise and retain its status as a market leader. • New entrants to agglomeration market. • New innovations from agglomeration competitors. • The contractor realise that it is difficult for the client to follow their long-term strategy because of the volatile and cyclical state of the market. • Long-term strategic decisions may lead to better workforce security for contractor.

Table 7: How is this client-contractor arrangement (of outsourcing the agglomeration process) supportive of your core business strategy and does this client-contractor relationship form part of your long-term strategy?

Questions 3: How is this client-contractor arrangement (of outsourcing the agglomeration process) supportive of your core business strategy and does this client-contractor relationship form part of your long-term strategy?	
Client	Contractor
<ul style="list-style-type: none"> • Agglomeration considered a supportive process of the clients' core business as it has a cost benefit in terms of higher ore yields and giving them a competitive advantage. • Long-term strategic goal of client is to stay competitive in the global market. • Environmental cost saving • Environmental impact is the main focus which is reduced using the agglomeration process. • Agglomeration is considered a core business strategy not the contractor. • Long-term strategic goal of client is to stay competitive in the global market. 	<ul style="list-style-type: none"> • Some respondents believe agglomeration forms part of the core business and others don't. • The client's core business is much broader and bigger than a single process like agglomeration. • The client issues more control over core business functions like furnace operations, and less control over sub-process like agglomeration. • The long-term strategy of the client is to decrease their input costs as low as possible and utilize the ore as efficiently as possible. • Agglomeration forms part of the long-term environmental strategy to recycle the by-products. • The client required that the environmental process of agglomeration should recycle historical and current by-products. • Agglomeration forms part of the total strategy that includes managing environmental issues. • The agglomeration process increases furnace yields. • Both client and contractor protect their own interests. • Cooperation between client and contractor to assist each other with challenges the may face. • Good client-contractor relationship will assist in better service delivery from the contractor. • Excellent service delivery and agglomeration product quality will make it difficult for the client to move to a new contractor.

Table 8: What challenges are faced by the contactor managing the environmental agglomeration process?

Questions 4: What challenges are faced by the contactor managing the environmental agglomeration process?	
Client	Contractor
<ul style="list-style-type: none"> • Not sufficient client support in problem solving. • Changes in raw materials may affect agglomerating quality. • Availability of by-products for agglomeration process. • Client should ensure enough by-products are supplied to the agglomeration process so contractor can reach production targets. • Meeting client specifications and quality standards. • Contractor has operational challenges to manage resources and costs in order to deliver desirable agglomeration products to clients and still make a profit. • Payment structure • Poor communications results in client being unaware of current contractor difficulties. 	<ul style="list-style-type: none"> • Financial implications due to the payment structure affected by not reaching targets. (toll basis) • To achieve high quality agglomeration products when certain by-products adversely affect the quality. • Weather conditions like rain affects the quality and production of agglomeration process • Satellite agglomeration sites are difficult to manage from a central office. • Need competent and trustworthy managers on these satellite agglomeration sites that are able to produce the desired quality agglomeration products enhance the business image and sustain and improve the relationship between the contractor and client. • Logistical challenges because the agglomeration plants are widespread. • Difficult to find the equilibrium between quality delivered and cost to agglomeration firm. • The chemical binders used in the agglomeration process forms the largest input cost and is the core component to deliver a product that adhere to client's specifications and quality standards. • Stringent client agglomeration quality standards that consist of properties like being waterproof, stays in tact at high temperatures, does not generate too much fines when being moved to the furnace and compression strength. • The Chemical binders combinations differ depending on the mixture of furnace by-products at various clients and different alloy types. • By-products supply variation makes it difficult to meet agglomeration production targets. • By-products supply variation influence the specification, composition and quality of the product. • Minimum production order needed to cover fixed cost of agglomeration plant. • Changing of raw materials in terms of composition and quantity results in more research in binders to still meet customer requirements. • Cyclical position of the alloy market may have a more positive or negative attitude toward the agglomeration process. • Health and safety and training costs and responsibilities. • Fluctuation in order quantities based on clients' needs.

Table 9: Finally, please give recommendations or suggestions on how the relationship between the two organisations can be improved?

Questions 5: Finally, please give recommendations or suggestions on how the relationship between the two organisations can be improved?	
Client	Contractor
<ul style="list-style-type: none"> • Ensure a mutually beneficial relationship • The contract needs to be clear about payment and specifications as well as process in order to insure security for the client and contractor. • The contract needs to be firm on material quality but flexible in terms of the process. • Communication should span from high level to bottom level to ensure consistency. • Long term vision for companies. • Transparency in terms of agglomeration costs • Frequent and effective communication on management level. • Regular or monthly meetings. • Regular and effective communication. • Quality and production issues of agglomeration communicated to relevant client personnel. • The agglomeration standards, specifications and quality need to be clearly defined in the contract between the client and contractor. • Quick response from contractor to report problems or issues. • Contractor should strive to ensure constant agglomeration supply to avoid furnace instability. • Client-contractor relations are of high importance and are sustained by a framework implemented by an organisation. 	<ul style="list-style-type: none"> • Improve communications between both client and contractor on all levels. • Communication should consist of formal as well as informal communication. • Balance between too many and too little communication. • Client may be cautious to avoid being linked to unethical business practices of contractors and thus implement control measures leading to communication to be very formal. • If client plays more open cards about its business situation, it will enable to contractor to plan accordingly and even assist with problem solving or offer possible solutions because of top management in agglomeration firms vast experience in furnace operations. • Perception management between client and agglomeration contractor is very difficult to manage and to affect positive change. • Client involvement and open communication channels. • Relationships take time to strengthen and improve. • It takes time for the client and contractor to learn and understand the processes and challenges faced by both parties. • The advantages of the agglomeration process are not immediate. • Constant good service and product quality delivered will enhance the business relationship between the contractor and client. • Long term contracts of 5 years and more will instil trust in the client which could lead to reduced costs. • Stability in client and contractor management. Contact persons between client and contractor. • A sound company reputation may aid the contractor-client relationship.

4.5 SUMMARY

This chapter compiled the qualitative data gathered through the interviews and presented the data according to the findings made. These findings were measured against the literature study done and against previous researched literature.

These findings presented in this chapter, together with the literature study, were aimed to achieve the research objectives of the study. It was found that most of the qualitative findings agreed with the literature study.

A summary of all the interview findings was summarised in Tables 5 to 9 in order to more clearly distinguish the relationship between the responses of both the client and the contractor respondents.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF THE CURRENT STUDY

This study focuses on businesses managing the environmental process of agglomerating fine smelter by-products and creating a desirable product for the client, whilst making suitable profits and ensuring sustainable in the long term.

The background setting of the study explained the value chain of the smelter client and of the agglomeration contractor. The process flow was examined from the mining of the raw ore, converting in the smelter plant, preparation of the final product for dispatch to the market. Within this whole process, the by-products generated at each process stage were explained. These form part of the total agglomeration mixture. This mixture is then put through the agglomeration plant to form the lumpy products that are recycled back into the smelter for reprocessing.

The term sustainability or organisational sustainability was defined in the literature study. According to Bansal and DesJardine (2014), organisational sustainability was defined as an organisation's ability to meet short-term financial commitments without compromising its ability to meet future requirements.

The micro and macro factors affecting sustainability were analysed with the help of the PESTLE AND SWOT techniques. The SWOT analysis identifies the positive and negatives of the internal factors while the PESTEL analysis provides a further analysis of these factors and external factors as well (Srdjevic *et al.*, 2012)

A qualitative study was conducted where the selected respondents are managers at smelter organisations and at agglomeration plants. The sampling strategy chosen to best support the qualitative process of this study was the purposive sampling strategy method. The data were analysed to identify the determinants of organisational sustainability of agglomeration companies. These determinants identified were measured against the literature study in order to validate the findings

The voice recordings from the interviews were transcribed and the data was presented in full under ANNEXURE 1 and ANNEXURE 2, as well as a tabulated summary of the Client and Contractor respondents in tables 5 to 9 on pages 63 to 69.

5.2 CONCLUSIONS

The conclusions are drawn per each objective beginning with the secondary objectives first and finally the main objective. Conclusions are separated as factors good for sustainability and factors bad for sustainability.

5.2.1 Secondary Objective One

'To identify the internal and external factors affecting sustainability of agglomeration businesses in the micro-environment'

From the literature and the interviews, the micro factors identified were

- Intellectual property
- Environmental solutions
- Good Product Quality
- Inconsistent Quality of screened fines
- High electricity costs
- Cyclic demand/Client changing the strategic scope
- Flexible and adaptability

The internal and external sustainability factors that were identified in the micro environment are summarised under how positively or negatively they affect the sustainability of the agglomeration contractor's organisation.

5.2.1.1 Internal Factors good for Sustainability

A majority of the respondents agreed on the importance of agglomeration firms to be flexible and adaptable to short- and long-term changes in order to ensure its sustainability in the long term. By analysing the interview data, it was found that this was one of the most important sustainability factors. It is vital for the agglomeration firm to manage and adapt to strategic changes from the smelter client in order to ensure the long-term sustainability of the agglomeration business.

Secondly, several respondents indicated that agglomeration is a highly specialised field and that the client does not have to manage it and instead contracts out the agglomeration process to a specialist in the agglomeration field. This gives the agglomeration firm a competitive advantage because and the agglomeration cannot be easily replaced.

It was also found that the agglomeration contractor has a competitive advantage because it owns the intellectual property rights of some of the chemical binding agents used in the agglomeration process. This greatly improves the contractor's organisational sustainability because the company's services are hard to replicate or replace. The client has the added benefit because it receives these intellectual solutions when the agglomeration contractor manages the agglomeration process on their behalf.

Furthermore, most participants agreed that agglomeration is a long-term environmental solution and a cost benefit for the client. This strengthens the agglomeration business's position of sustainability.

Most respondents agreed that the quality of the agglomerated product delivered by the contractor is of utmost importance to the client. The specifications and quality standards of the agglomerating products are very important element that's defined in the contract between the client and contractor. If the agglomeration firms deliver top quality agglomeration products and service, it will greatly improve its sustainability position.

It was found that the agglomeration firm's primary focus is agglomeration, and that enabled it to become a specialist in the field through research and experience gained by agglomerating various smelter by-products. This specialisation opens up new business opportunities for the agglomeration firm to pursue by managing the agglomeration process for other smelter organisations. This specialisation will make it difficult for new market entrants to enter the agglomeration field.

Some of the contractor respondents felt that the agglomeration contractor could assist in problem solving in areas other than just agglomeration. The top management of the agglomeration firm has vast knowledge in the smelter processes and may even handle processes that does not form part of the client's core business. This may increase the responsibilities of the agglomeration firm and improve its sustainability.

5.2.1.2 Internal Factors Bad for Sustainability

All the contractor respondents and most of the client respondents felt that the fluctuations or variations in the quality of the raw materials used in the client's smelter process lead to inconsistencies in the by-products supplied to the agglomeration process. This was identified as one of the main external threats to the agglomeration firm.

Good agglomeration quality can positively contribute to the organisational sustainability of the agglomeration firm. However, if the quality of the agglomeration product is not up to standard, it may have a negative impact on the client's smelter process. Some of the client respondents felt that poorly agglomerated products can negatively impact the smelting operations.

Some respondents agreed that the prices of alloy products are driven by supply and demand forces in the market. They believed that the cyclical market creates alloy price fluctuations that influence the client, and these positive or negative effects will have an effect on the client's production output strategy.

The respondents also agreed that the different grades of alloys are priced differently in the market which may reduce, or completely diminish, the cost advantage of the agglomeration process if the client decides to move to a lower grade ore that is less expensive. The cost advantage of recycling the by-products through the agglomeration process is reduced because the ore prices are almost the same, or even cheaper.

The respondents explained that when the client lowers production outputs, the by-products supplied to the agglomeration process are also less. This may result in the client issuing orders for lower quantities of the agglomeration product which in turn affects the profitability of the agglomeration firm. This may even lead to the agglomeration process being economical unviable.

It was found that one of the clients main input costs are the electricity used in the smelter process to power the furnaces. If the market demand for the client's alloy products is low together with higher electricity prices during winter, the client might decide to switch off some or all furnaces during winter in order to reduce input costs and production outputs. This strategic decision may have a huge impact on the smelter client's profitability.

Most respondents felt that these strategic changes from the client may have a huge impact on the profitability of the agglomeration business because it gets paid per ton agglomeration product delivered to the client.

Some contractor respondents also felt strongly that the agglomeration company needs management to be creative in order to capitalise, and retain, its status as a market leader in the field of agglomeration. New innovation from competitors may decrease the market share of the agglomeration company and the competition may even persuade current smelter clients to replace the current agglomeration contractor with them.

The agglomeration contractor needs to manage costs carefully in order to realise a profit while still delivering a high-quality product and service acceptable to the client.

Most respondents felt that a trust-based relationship between the client and contractor is necessary to ensure the long-term sustainability

5.2.2 Secondary Objective two

‘To analyse the factors affecting the sustainability of agglomeration companies in the macro environment’

From the PESTEL analysis and the interviews, the common macro factors that affect sustainability were identified as

- Uncertainties in the regulatory framework
- Technology and development
- Environmental solutions
- Unstable global alloy market

The sustainability factors that were identified in the macro environment are presented under how positively or negatively they affect the sustainability of the agglomeration contractor’s organisation.

5.2.2.1 Macro Factors Good for Sustainability

The regulatory environmental factors are a continuous and long-term strategy that the smelter client needs to adopt and incorporate into their total strategy. The qualitative data also showed that the smelter client continuously aim to reduce their environmental footprint.

The prevalent feeling was that agglomeration results in an environmental cost saving for the client as all current arising by-products are recycled back into the smelter process. These findings mean that the agglomeration process will form part of the long-term environmental strategy of the client and thus makes the agglomeration firm viable in the long-term.

It was found that respondents felt that when the client contracts out processes, like agglomeration, the client has less Health and Safety responsibilities and requires less human resources costs. This smaller complement of workers reduces the client's liability because the agglomeration process is managed by the agglomeration contracting firm. These agglomeration employees are skilled and trained and will make it an expensive and difficult exercise for the client to quickly replace the agglomeration contractor.

It was also found that because the agglomeration contractor is an expert in the field of agglomeration, the client has the advantage of obtaining all these research and development resources, skills and know-how by contracting out the agglomeration process. This makes the agglomeration firm a cost-effective solution for the client.

The respondents felt that the agglomeration process reduces the social impact on their own employees and the community. The agglomeration process is more environmentally friendly because it recycles all the by-products produced by the smelter client.

5.2.2.2 Macro Factors Bad for Sustainability

Most participants strongly felt that the state of the global alloy market makes it very difficult for the client to do effective long-term planning. The client's uncertain long-term strategy leads to short-term disruptions for the agglomeration process.

Technological factors like long-term strategy changes by the client may render the agglomeration process completely economical unviable. The client might want to switch from their current furnace to a new DC Furnace. This furnace operation can handle alloy fines to be

fed directly back into the furnace and thus making it impossible for the agglomeration plant to reach its production targets because they don't receive the same number of by-products from the smelter process anymore.

5.2.3 Secondary Objective three

'To analyse how the client-contractor relationship can be improved'

Most participants agreed that improved communication between the client and contractor will improve the current client-contractor relationship. This was the topic that was most mentioned in the answers given by the interviewees as a way to improve the client-contractor relationship.

It was also notable that the views of both client and contractor respondents were very similar in that "communication" was most prevalent in their responses as a way to improve the client-contractor relationship.

It is not only more and improved communication that will improve the relationship, but it should be at every employee level.

Some contractor interviewees went further that they should be a healthy balance between too many meetings/formal communication and having too few communication sessions between the client and contractor. The way the client and contractor communicates with each other, will have an impact on the state of the relationship. Some organisations use impersonalised modes of communication which makes it difficult to build a strong relationship

The quality of the product and services delivered by the agglomeration contractor might also be affected by ineffective or lack of communication. The quality of the agglomeration products does not only affect the client but also the outputs of the contractor managing this process.

Some respondents felt that effective communication need to include communication from the contractor about all the aspects of the agglomeration process as well as communication from about factors affecting the client which might have an impact on the agglomeration process. A mutually beneficial or trust-based relationship will set the client and contractor at ease in disclosing organisational long- and short-term strategy.

Client Respondent 1 also stated the importance of relevant product quality and specification information discussions between top management of the client and contractor. Such type of details should cascade down the line to all employees in order to achieve these product quality standards goals.

Furthermore, a well-defined contract was one aspect respondents felt would sustain the client-contractor relationship while ensuring quality standards are met by the contractor. A number of participants felt that business ethics and ethical conduct plays a big role in establishing trust in the client-contractor relationship.

5.2.4 Main Objective

The primary objective of the study was;

‘To identify the main factors affecting long-term sustainability of businesses managing the environmental process of agglomerating smelter by-products.’

From both the literature survey and the interviews, it can be concluded that the main factors affecting the long term sustainability were identified as

- The uncertainties in the regulatory framework of the governing authorities puts pressure
- Technology and development can wipe out the briquetting route especially the DC furnaces
- Environmental solutions makes agglomerating very attractive and viable
- Unstable global alloy market brings uncertainties
- Agglomerators’ intellectual property
- Good Product Quality
- Inconsistent Quality of screened fines from the Smelter
- High electricity costs and erratic supply
- Cyclic demand/Client changing the strategic scope from the Smelter
- Flexibility and adaptability of the contractors
- Adequate and clear communication and exchange of information

These eleven factors were identified as critical in the long term sustainability of contract agglomerating businesses.

5.3 ACHIEVEMENT OF THE OBJECTIVES OF THE STUDY

The study identified the factors in the micro- and macro environment that may affect the sustainability of agglomeration firms positively or negatively. These factors were identified with a literature study being conducted and measured against the qualitative data obtained through the interview process.

A definite correlation was found between the literature study and the findings of the qualitative data. The findings made through the interview process were measured against previous research and some correlation was established.

Through some level of data saturation on certain aspects of the interview process, we could also identify which factors the respondents felt most strongly about affecting the agglomeration organisation's sustainability positively or negatively.

5.4 RECOMMENDATIONS

- **Communication**

This issue was topical. The Smelter/Contractor should establish and maintain communication channels that allow uninterrupted exchange of information and data to allow either party to plan. In doing this, a lot of uncertainties can be managed including a host of the factors found to influence sustainability.

- **Flexibility and Adaptability on contract firms**

The volatile and cyclical state of the market together with factors like client making short- and long-term strategic changes makes it crucial for agglomeration firms to be flexible and adaptable to these changes in order to ensure its sustainability in the long term. The agglomeration firm needs to be set-up in such a way so that it's adaptable to handle these changes.

5.5 RECOMMENDATIONS FOR FUTURE RESEARCH

The sample was limited to only four smelters / contractors in a population of fifteen due to the geographical dispersion of the population and the difficulties in organising interviews. It is therefore suggested that the survey be done on a larger sample.

Not all factors in the PESTEL and SWOT were tested. Secondly, it would be interesting to find the effect on sustainability by other factors such as the BBBEE legislation, nationalisation and discrimination/inequality.

Furthermore, research needs to be conducted to find the ideal business model on how to mitigate the threats of organisational sustainability on agglomeration businesses

REFERENCES

- Ackers, B. & Eccles, N.S. 2015. Mandatory corporate social responsibility assurance practices: The case of King III in South Africa. *Accounting, Auditing & Accountability Journal*, 28(4):515-550.
- Ahola, T., Laitinen, E., Kujala, J. & Wikström, K. 2008. Purchasing strategies and value creation in industrial turnkey projects. *International Journal of Project Management*, 26(1):87-94.
- Arya, B. & Bassi, B. 2011. Corporate social responsibility and broad-based black economic empowerment legislation in South Africa: Codes of good practice. *Business & Society*, 50(4):674-695.
- Azapagic, A. 2004. Developing a framework for sustainable development indicators for the mining and minerals industry. *Journal of cleaner production*, 12(6):639-662.
- Bansal, P. & DesJardine, M.R. 2014. Business sustainability: It is about time. *Strategic Organization*, 12(1):70-78.
- Basson, J., Curr, T. & Gericke, W. 2007. South Africa's ferro alloys industry-present status and future outlook. (In organised by: Mintek.
- Beukes, J.P., Dawson, N. & Van Zyl, P.G. 2010. Theoretical and practical aspects of Cr (VI) in the South African ferrochrome industry. *Journal of the Southern African Institute of Mining and Metallurgy*, 110(12):743-750.
- Bos-Brouwers, H.E.J. 2010. Corporate sustainability and innovation in SMEs: evidence of themes and activities in practice. *Business strategy and the environment*, 19(7):417-435.
- Bresnen, M. & Marshall, N. 2000. Building partnerships: case studies of client–contractor collaboration in the UK construction industry. *Construction Management & Economics*, 18(7):819-832.
- Buxton, A. 2012. MMSD+10: Reflecting on a decade. London.

Chamber of Mines of South Africa. 2016. Mine SA 2016.

Chamber of Mines of South Africa. 2017. Women in Mining.

Civelek, M.E., Çemberci, M., Kibritci Artar, O. & Uca, N. 2015. Key factors of sustainable firm performance: a strategic approach: Zea Books.

Creagh, B. 2017. BHP adds 1000 women to workforce. <https://www.australianmining.com.au/news/bhp-adds-1000-women-workforce/> Date of access: 21 September 2017.

de Villiers, C., Low, M. & Samkin, G. 2014. The institutionalisation of mining company sustainability disclosures. *Journal of Cleaner Production*, 84:51-58.

De Vos, A., Strydom, H., Fouche, C. & Delpont, C. 1998. Research at grassroots level. *A premier for caring professionals*, 1.

Eccles, R.G., Perkins, K.M. & Serafeim, G. 2012. How to become a sustainable company. *MIT Sloan Management Review*, 53(4):43.

EI-Hussiny, N. & Shalabi, M. 2010. Effect of recycling blast furnace flue dust as pellets on the sintering performance. *Science of Sintering*, 42(3):269-281.

Elsbach, K.D. 2003. Organizational perception management. *Research in organizational behavior*, 25:297-332.

Gajigo, O., Mutambatsere, E. & Adjei, E. 2011. Manganese industry analysis: Implications for project finance: African Development Bank.

Gillespie, A. 2007. PESTEL analysis of the macro-environment. *Foundations of Economics, Oxford University Press, USA*.

Giurco, D. & Cooper, C. 2012. Mining and sustainability: asking the right questions. *Minerals Engineering*, 29:3-12.

Goddard, W. & Melville, S. 2004. Research methodology: An introduction: Juta and Company Ltd.

- Harman, C. 2007. Innovations in ferro alloys technology in India. *INFACON XI*:25-37.
- Holta, O. & Olsen, S.E. 1985. Composite Briquettes of Manganese Ore and Coal. (In. Electric Furnace Proceedings organised by. p. 273-277).
- Huaming, Y. & Guanzhou, Q. 1998. New Development of Mechanical Alloying (MA) Technology [J]. *Chinese Journal of Rare Metals*, 4.
- Humphreys, D. 2015. An Industry Transformed. The Remaking of the Mining Industry. Springer. p. 114-139).
- International Manganese Institute. Manganese. 2015. Essential Manganese: Annual Review 2015.
- John, G. & Scholes, K. 2002. Exploring Corporate Strategy-text and Cases: New Jersey, prentice-Hill Inc.
- Khalfan, M.M., McDermott, P. & Swan, W. 2007. Building trust in construction projects. *Supply Chain Management: An International Journal*, 12(6):385-391.
- Kohlscheen, E., Avalos, F.H. & Schrimpf, A. 2016. When the walk is not random: commodity prices and exchange rates.
- Kotzé, T. 2007. Guidelines on writing a first quantitative academic article. *Department of Marketing and Communication Management, University of Pretoria*.
- Kurttila, M., Pesonen, M., Kangas, J. & Kajanus, M. 2000. Utilizing the analytic hierarchy process (AHP) in SWOT analysis—a hybrid method and its application to a forest-certification case. *Forest policy and economics*, 1(1):41-52.
- Lane, A., Guzek, J. & Van Antwerpen, W. 2015. Tough choices facing the South African mining industry. *Journal of the Southern African Institute of Mining and Metallurgy*, 115(6):471-479.

Manu, E., Ankrah, N., Chinyio, E. & Proverbs, D. 2015. Trust influencing factors in main contractor and subcontractor relationships during projects. *International Journal of Project Management*, 33(7):1495-1508.

Manu, P., Ankrah, N., Proverbs, D. & Suresh, S. 2013. Mitigating the health and safety influence of subcontracting in construction: The approach of main contractors. *International Journal of Project Management*, 31(7):1017-1026.

Mark, S., Philip, L. & Adrian, T. 2009. Research methods for business students: Prentice Hall.

Mascarilla-Miró, Ò. 2009. The commodity markets. *Paradigmes: economia productiva i coneixement*(2).

McDermott, P., Khalfan, M. & Swan, W. 2004. An exploration of the relationship between trust and collaborative working in the construction sector. *Construction Information Quarterly*, 6(4):140-146.

Mohamed, F., Ahmed, Y. & Shalabi, M. 2004. Effect of organic binders on the quality of manganese ore sinter fines briquettes. *TESCE.*, 30(2):871.

Olsen, S.E., Olsen, S., Tangstad, M. & Lindstad, T. 2007. Production of manganese ferroalloys: Tapir Academic Press.

Oxford Business Group. 2012. The Report: South Africa 2012: Oxford Business Group.

Oxford Business Group. 2014. The Report: South Africa 2014: Oxford Business Group.

Raderbauer, M. 2011. The importance of sustainable business practices in the viennese accommodation industry. *University of Exeter as a thesis for the degree of Master of Science.*

Ratshomo, K. 2013. South Africa's Manganese Industry Developments 2004-2011.

Roos, J. & Hearn, A. 2004. Optimising the effective use of energy in the ferroalloy industry through innovative technology. (*In. Proceedings, Tenth International Ferro Alloys Congress, Cape Town organised by. p. 712-725*).

Rothaermel, F.T. 2001. Incumbent's advantage through exploiting complementary assets via interfirm cooperation. *Strategic Management Journal*, 22(6-7):687-699.

Rowe, A. & Bansal, T. 2013. Ten steps to sustainable business in 2013. *Ivey Business Journal Online*, 1.

Shilei, L. & Yong, W. 2009. Target-oriented obstacle analysis by PESTEL modeling of energy efficiency retrofit for existing residential buildings in China's northern heating region. *Energy Policy*, 37(6):2098-2101.

Srdjevic, Z., Bajcetic, R. & Srdjevic, B. 2012. Identifying the criteria set for multicriteria decision making based on SWOT/PESTLE analysis: a case study of reconstructing a water intake structure. *Water resources management*, 26(12):3379-3393.

Starke, L. 2016. *Breaking new ground: Mining, minerals and sustainable development*: Routledge.

Steele, R.B. & Bizhanov, A. 2011. Stiff extrusion agglomeration of arc furnace dust and ore fines for recovery at a ferro alloy smelter. (In. Proc. 32nd Biennial Conf organised by. p. 41-53).

Steenkamp, J. & Basson, J. 2013. The manganese ferroalloys industry in southern Africa. *Journal of the Southern African Institute of Mining and Metallurgy*, 113(8):667-676.

Swan, W., McDermott, P., Wood, G., Thomas, A. & Abott, C. 2002. *Trust in construction: achieving cultural change*: Centre for Construction Innovation Manchester.

Technology Innovation Agency. Mining. 2012. *The Mining sector Innovation Strategies Implementation Plan 2012/13 - 2016/17*.

Trochim, W. & Donnelly, J.P. 2006. *The Research Methods Knowledge Base*: Cengage Learning.

Tsai, M.-S., Tsai, M.-C. & Chang, C.-C. 2013. The Direct and Indirect Factors on Affecting Organizational Sustainability. *Journal of Management and Sustainability*, 3(4):67.

Ülgen, H. & Mirze, S.K. 2007. İşletmelerde stratejik yönetim: Arıkan Basım Yayım Dağıtım.

University of Alberta. 2012. What is sustainability? <https://www.su.ualberta.ca/services/sustainsu/about/definition/> Date of access: 12 September 2017.

Upton, S. & Clarke, C. 2015. Socio-economic assessment in the extractive industries—Avoiding the pitfalls. *The Extractive Industries and Society*, 2(4):671-675.

van Zyl, H., Bam, W. & Steenkamp, J. 2016. Identifying barriers faced by key role players in the South African manganese industry. (In. Institute for Industrial Engineering Conference organised by. p. 365).

Weare, K., Bryant, I., Paul, M., Woollard, J., Ratcliffe, M., Swan, J., Prosser, J. & Lees, S. 2004. Research methods support for masters level students in the School of education. Vol. Part 1: University of Southampton.

Wood, G., McDermott, P. & Swan, W. 2002. The ethical benefits of trust-based partnering: the example of the construction industry. *Business Ethics: A European Review*, 11(1):4-13.

ANNEXURE 1: Client interviews:

Responded number	Question number	Interviewee responses
Client respondent 1	1	The agglomeration process is very specialized so relying on the experience and expertise of the contractor is easier and results in reduced Research & Development costs. The turnaround time is faster due to a faster agglomeration process. The other advantage is that the client does not need to employ additional staff for the agglomeration process as it is already managed by the contractor. A test plant was constructed in order to determine the benefits of the agglomeration process on the overall plant. There is a higher risk when employing an unknown contractor without a proven track history. It is difficult to effectively define quality standards of briquettes and this result in some flexibility being needed. It is important to ensure a good relationship between the client and the contractor that is mutually beneficial.
	2	Short term strategies involve how to agglomerate current materials as well as the contractor being able to handle changes in the material or other strategic changes made. Environmental impact is a long-term strategy as well as adaptation to the client changes in terms of materials and bi-products.
	3	Outsourcing the agglomeration process results in an environmental cost saving and other cost increased ore yields for us as the client.
	4	A challenge is that there is not sufficient client support in the problem solving of the contractor. Another challenge for the contractor would be if there is a change in the raw materials then this could affect the quality of the products. Lastly, the payment structure is a big issue as the payment is based on production tons.
	5	Having a clear concise contract between the client and the contractor that allows for some flexibility within the process but not on the quality of the products. Establish regular communication between client and contractor, especially between senior management. Improved communication between client and contractor's workers (bottom level) in order to ensure specifications

		are met. Transparency within the contractor's core business would also allow for more trust between the client and the contractor.
Client respondent 2	1	<p>There is a cost advantage for the client in terms of increased ore yields and reduced labour costs as well as lower employee complement.</p> <p>If for some reason the agglomeration production needs to stop for a period of time or for some reason, they don't have the cost of retrenching the employees or find other work for them. Because it is a contractor, it falls within their responsibility to manage their human resources.</p> <p>Environmental cost advantage because all by-products from the furnace and smelter operations gets agglomerated and re-used if the agglomerated materials are fed back at 10% of total furnace product.</p> <p>Agglomerated products fed back into the furnace help improve power efficiency of the furnace.</p> <p>The only negative is if the agglomeration contractor's product does not conform to quality specifications, it may affect furnace efficiency adversely.</p>
	2	<p>In the short term, all parties need to be kept in the loop about production schedules, changes in specifications or quality of agglomerated products.</p> <p>Short term production changes like the furnaces switching off because of higher electricity prices in winter and thus no by-products for agglomeration is generated.</p> <p>Whether conditions like rain usually affect agglomeration quality, curing time and production outputs.</p>
	3	Agglomeration does for part of the long-term strategy as it is also included in the environmental plan which consists of smelter by-products being captured and recycled back into the furnace.
	4	<p>Changes in raw materials used by client affects the quantities and type of by-products supplied for the agglomeration process.</p> <p>The availability of certain by-products differs from time-to-time.</p> <p>The client should help ensure that there are enough by-products for the contractor to reach its agglomeration production targets.</p>

	5	<p>Regular or monthly meetings that includes a representative from the agglomeration contractor. The quality of the agglomeration products needs to be more widely communicated to relevant client employees.</p> <p>When the agglomeration contractor has production issues, it needs to be communicated immediately to the client in order to avoid delays or loss of production.</p> <p>All of these aspects are to ensure constant supply of agglomerated product and ensure constant furnace performance and stability.</p>
Client respondent 3	1	<p>The result of the agglomeration process is increase yields. If the contractors' operation is located onsite it lowers transport costs. The core business is to smelt manganese and outsourcing the agglomeration process means their full attention can be kept on the core process. (Resource management). Outsourcing also results in job creation in the local community. No negatives.</p>
	2	<p>Decisions, both long and short term that affects the client will in turn affect the contractor such that if the contractor cannot adhere to the new terms then they will be replaced.</p>
	3	<p>The agglomeration process forms part of the core business not the contractor. Existing strategy plan to remove current and historical waste and bi-products. (Environmental impact). Historically they used to use briquetting to resolve current and historical bi-products but this was phased out to handle current bi-products.</p>
	4	<p>The client doesn't want to be involved in the contractor's issues. The wish to remain independent. Lack of communication results in the client being unaware of the contractor's issues. (contradictory)</p>
	5	<p>Our organisation has created and implemented a program that helps sustain, strengthen, develop and improve client-contractor relations. This easy online platform allows the client and contractor to communicate all aspects relating to business elements between the two parties.</p>
Client respondent 4	1	<p>Cost saving for the client if they contract the agglomeration process out as well as fewer personnel employed by the client, thus smaller employee complement, maintenance and health and safety responsibilities. Because the client's core focus is not</p>

		<p>agglomeration, it makes sense to contract out this process to a contractor that specialises in this field.</p> <p>One negative is the client's control over the agglomeration process is limited and determined by the specifications and quality standards in the contract between the client and contractor.</p>
	2	<p>Conditions in the market like volatility may affect the client and these effects runs down to the contractor managing the agglomeration process. Because of the volatile market, it makes it difficult for the client to do effective long-term planning because market indicators don't always follow market trends and this give rise to situations like steep drop in alloy prices that force the client to adjust its long-term strategies.</p> <p>The design of the agglomeration plant needs to be flexible enough to absorb these short-term strategy changes of the client.</p> <p>The client strives to stay competitive in the market by perusing low price ores and in turn reduce their input costs.</p>
	3	<p>The long-term goal of the client is to stay competitive on the global market. The agglomeration process is supportive of the client's core business because it leads to increased ore yields along with the accompanying environmental cost saving because of the recycling of the by-products from the smelter process.</p>
	4	<p>Changing market conditions may lead to the client changing its raw materials used in their processes and thus lead to changes in the by-products produced. These changes in the by-products create production and quality challenges in the agglomeration process.</p> <p>The operational challenges faced in the agglomeration process is to manage resources and costs carefully in order to produce cost effective agglomeration products that still falls within the price range, specifications and quality standards required from the client, while still realising a profit for these products delivered.</p>
	5	<p>Regular and effective communication. The client and contractor needs to be on the same page in terms of production, quality and specifications of the agglomerated product. These agglomeration standards, specifications and quality need to be clearly defined in the contract between the client and agglomeration contractor</p>

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ANNEXURE 2: Contractor interviewees:

Respondent number	Question number	Interviewee responses
Contractor respondent 1	1	<p>The first advantage is the reduction of the environmental footprint and elimination of the environmental liability because all the by-products from the smelter process get recycled.</p> <p>The contractor can also handle other activities that the client does not want to focus on because it does not form part of their core business.</p> <p>Most of the management within the agglomeration firm have in depth knowledge of the furnace operations and can act preventatively because they know what issues may pose a risk for the client.</p> <p>By-products that are born through the furnace processes are already partially reduced and require less energy during the furnace process and thus increase the furnace outputs or efficiency.</p> <p>The agglomeration process increases the ore yields for the clients.</p> <p>Some of the by-products in the agglomeration mixture contains reductant and thus saves the client to add less reductant which has become increasingly expensive.</p> <p>Another big cost saving advantage for the client is that the agglomeration takes place onsite and thus does not have big logistical and transport costs involved to get the by-products to the agglomeration plant and back into the furnace.</p> <p>The agglomeration products get screened twice to limit the number of fines fed into the furnace.</p> <p>The client has a guarantee that the agglomeration plant will be successful and reach production targets because the contractor only gets paid per ton of product delivered that conforms to contract specifications and quality standards.</p> <p>Because the contractor manages the agglomeration process, the client actually receives the chemical binder used in the process at a reduced rate because the client pays per ton produced that includes the chemical binder added by the contractor.</p> <p>The client is relieved of certain responsibilities because the</p>

		<p>contractor hires the plant from the client and thus becomes liable to comply with health and safety regulations.</p> <p>One negatives aspect is that the chemical binders the contractor use in the agglomeration process is their intellectual property and the client thus becomes dependent on the contractor because they can't do the agglomeration without the chemical binders. Or it will be very costly to conduct research and find new chemical binders that will deliver an agglomeration product with the same or better quality.</p> <p>Another negative is that the environmental permits to conduct agglomeration may take a long time to obtain and thus makes it a long-term solution. Agglomeration is thus no short-term fix for environmental recycling of the by-products produced by the smelter process.</p> <p>The client has a degree of risk because the contractor may deliver agglomerated product that does not conform to the composition specifications and quality standards and my impact furnace performance. This may have a big impact on the client's production as a big furnace may take up to 10 days to stabilise again.</p>
	2	<p>The cyclical and volatile global market makes it difficult for the client do to effective short- and long-term planning.</p> <p>Because of the cyclical state of the market, the price of metal alloy fines increases when the market demand is high and decrease to extreme low level when the market is oversaturated. Because these fines get used in the agglomeration process, it affects the process dramatically when the client sells these alloy fines on the market when the price is high. Not only does it affect the agglomeration outputs, but it also affects the grade of the agglomerated product.</p> <p>When the client changes their furnace processes and supply the agglomeration plant with different by-products, this affects the outputs of the agglomeration plants.</p> <p>Long-term strategy changes by the client like switching from their current furnace to a new DC Furnace, that can handle alloy fines to be fed directly back into the furnace, will make it difficult for the agglomeration plant to reach production targets because they don't receive enough by-products because of this change in the smelter</p>

		<p>process.</p> <p>Other long-term strategies may include producing a lower grade alloy to supply a certain market segment and because the lower grade ores are much cheaper, the agglomeration fixed cost to produce its product may be higher or almost equal to the ores the client uses and thus does not offer such a big cost advantage to the client anymore.</p>
	3	<p>The agglomeration process itself is not part of the core business of the client. The client issues more control over core business functions like furnace operations, and less control over sub-process like agglomeration.</p> <p>The long-term strategy of the client is to decrease their input costs as low as possible and utilize the ore as efficiently as possible. This increased ore yields together with the environmental cost savings may lead to a competitive advantage for the client.</p>
	4	<p>Raw material changes by the client leads to changes in the by-products supplied to the agglomeration process.</p> <p>Weather conditions like rain makes agglomeration very difficult as moisture addition in the process are carefully monitored to ensure the chemical binders have the most efficient reaction and ensure quality standards are met.</p> <p>Logistics to the agglomeration sites is expensive because the chemical binders need to be transported to these sites that are widespread.</p> <p>The chemical binders form the largest part of the input costs of agglomeration because it needs to adhere to stringent client quality standards and consist of properties like being waterproof, stays in tact at high temperatures, does not generate too much fines when being moved to the furnace and compression strength.</p> <p>The chemical binders' combinations do not offer the same success to deliver the desired quality on all furnace by-products at various clients and alloy types.</p> <p>Satellite agglomeration sites are difficult to manage from a central office and very competent and trustworthy managers need to be employed on the agglomeration site that will produce the desired</p>

		quality agglomeration products, enhance the business image and sustain and improve the relationship between the agglomeration contractor and the client.
	5	<p>Communication between the client and the contractor needs to be managed carefully and the contractor needs to be sensitive and find a balance between too many and too little meetings between the two parties.</p> <p>If the client plays more open cards about its business situation, it will enable to contractor to plan accordingly and even assist with problem solving or offer possible solutions.</p> <p>Because top management of the agglomeration has vast experience and know-how of the furnace operations of the client and may assist in possible solutions for the client, the client sometimes has a perception that the contractor is only looking after its own interest and to enrich themselves. Where in fact the success of the agglomeration firm is almost entirely dependent on the success of the client.</p> <p>The relationship and perception of the client towards the agglomeration contractor is very difficult to manage but is of utmost importance. To manage perceptions on bottom level of the client and contractor is also very difficult.</p> <p>When client management moves to different positions or new managers are employed, the relationships between contractor and client needs to be rebuild.</p>
Contractor respondent 2	1	<p>One advantage is that the client appoints a company that specialises in agglomeration and have a lot of knowledge and skills obtained through years of experience. Because these firms' primary focus is agglomeration, they have done a lot of research and gained experience of agglomerating various smelter by-products. The client thus does not have to obtain any additional skills by employing their own personnel to manage and run the agglomeration process.</p> <p>Another advantage is that the client and contractor agrees on the quality and specifications of the agglomeration products in a contract and thus have the assurance that the contractor needs to deliver the agglomeration product according to the contract standards.</p>

		A disadvantage is that the client has a certain loss of control over processes the contractor follow or don't follow for instance health and safety or quality assurance.
	2	<p>Long-term is defined by the contract length between the client and contractor. In the short-term, the contractor needs to realise profits and be commercial viable during the duration of the contract during the contract term. This short-term performance of the contractor may ensure the long-term partnership between the two parties or the contract renewal at the end of the current contract term.</p> <p>The client's strategy may change in the long-term due to changes within the organisation like changes in top management or shareholders and these strategy changes will run down influence the management of the agglomeration contractor.</p> <p>In the short-term it is important for the contractor to be adaptable to these changes. The contractor company also needs to be creative in the long-term in order to capitalise and retain its status as a market leader in the field of agglomeration. Continued threats of competitors and new market entrants may influence clients to move to new clients that may have more innovative practices.</p>
	3	<p>Agglomeration does not form part of the core business strategy of the client but fits more into the total strategy. This total strategy includes the environmental strategy and the issues of handling and recycling the current and historical by-products in the smelter process. The financial cost advantage and environmental cost saving of the agglomeration process makes it an important factor to include it in the total strategy of the client. The client's core business is much broader and bigger than a single process like agglomeration.</p>
	4	<p>Variations of inputs in the agglomeration process influence the specification, composition and quality of the product. The client's initial expectation of by-products it will supply to the agglomeration process changes as market conditions change and the agglomeration firm needs to be innovative and creative in adapting and managing these changes.</p> <p>Depending on the cyclical position of the alloy market, the client may</p>

		have a more positive or negative attitude toward the agglomeration process and may influence contractual renewal if the contract ends in a market period of negative sentiment.
	5	<p>It is important to establish adequate and effective communication between the client and the contractor. This communication should consist of formal as well as informal communication between the contact persons of the client and contractor. Formal communication methods do not always leave room for discussion of lighter issues that may exist where informal communication helps grow the relationships between the contact persons.</p> <p>The client may sometimes be overly cautious to avoid contractors that may have unethical business practices. Because of this, control measure is put in place and this may lead to a situation where communication becomes very formal.</p>
Contractor respondent 3	1	<p>The advantages of sourcing out the agglomeration process to a contractor is that the client obtains skills and know-how through the contractor that specialises in agglomeration. The cost saving to the client in terms of higher yields and reduced environmental costs is another advantage. Other advantages are in terms of the client having to employ less workers and thus lowering their labour compliment together with lower health and safety responsibilities.</p> <p>The only disadvantage is that the client has no direct control over the agglomeration process and management.</p>
	2	<p>The contractor, agglomeration processes and plant needs to be very adaptable to changes in the short term. A plant needs to be designed with this in mind and enables management with more resources to absorb these short-term changes. The plant capacity should be designed to enable production to catch up on lost production. As the contractor, they realise that the volatility and market conditions makes it very difficult for the client to do long-term planning.</p>
	3	<p>The relationship between the client and contractor is very important to ensure cooperation and assistance from both parties when challenges arises.</p> <p>A good relationship between both parties will in turn make it easier</p>

		<p>for the contractor to deliver a better service to the client.</p> <p>At the specific client, the agglomeration process does form part of their core business strategy. Because of the service and quality of the agglomerated product, it will be difficult and costly for the client to replace the current contractor.</p>
	4	<p>One of the most difficult tasks for the contractor is to manage a balancing act between client and contractor company's concerns. On the one side the client would like to get the best quality agglomeration product and service for the price they are paying the contractor, while the agglomeration firm's management want to reduce input costs and realise profits. It's thus difficult to find the equilibrium between quality delivered and cost to agglomeration firm.</p> <p>Changing and different by-products supplied by the client to be used in agglomeration process created quality challenges and affects production outputs.</p> <p>Reduced production demands by clients' does not always meet to meet minimum production amount order to cover fixed costs in order to keep the plant running and pay employees.</p>
	5	<p>Client and contractor needs to conduct business ethically and with integrity. The quality of service delivered by the contractor in the long run will enhance the business relationship between the contractor and client.</p> <p>The contact persons on either side build a relationship firstly between two persons and over a period of time.</p> <p>The agglomeration business' reputation, history and references may also aid the perception the client might have of the contractor company.</p>
Contractor respondent 4	1	<p>The advantage of outsourcing is that it is a technologically advanced field which would require research and skills training if the client performed the agglomeration process in-house which means that all that falls on the contractor. Client side labour is also more expensive so outsourcing would allow for a cheaper process. The problem with outsourcing is that the client will need to ensure that the contractor receives the same raw materials in terms of material supply and</p>

		composition. The contractor will also need to be able to adjust to the requirements while maintaining quality.
	2	Because of volatile global markets in general strategic planning is shorter. Global alloy prices affect the smelters production which in turn affects the contractor. Short term decisions also have a larger impact. Long term decisions have a lower impact. The strategic plans of the client are not communicated to the contractor and this can cause difficulties in maintaining a sustainable business model.
	3	The contractor does for part of the core business strategy as it allows for higher yields as well as cost saving.
	4	The contractor will have to deal with changes in raw material supply, fluctuation in composition as well as quantity of the raw materials. Another challenge is fluctuations in product demand of the client and the pricing structure as it works on a toll basis.
	5	Long term contracts of 5 years and longer will instil trust in the client which could lead to reduced costs. There is also no need for frequent renewal of contracts. It is important for the contractor and the client to build a relationship by having a solid foundation in terms of management that remains constant. If there is regular manager turnover the relationship will need to be re-established by the management parties.
Contractor respondent 5	1	The advantage of outsourcing the agglomeration process is that there is less responsibility for the client as well as safety responsibility. A disadvantage would be that communication between the client and the contractor would need to be kept in check. Another issue could be a deviation in quality.
	2	Short term strategies have a direct influence on resource allocation in terms of staff which can result in over saturation. Long term strategies have the least negative impact.
	3	Briquetting is considered a core process as it increases yields of the furnaces. Both the client and the contractor protect their own interests.

	4	A challenge of the contractor would be to meet target with the allocated raw materials. If the target is not attained then the contractor could be faced with payment penalties which could lead financial implications due to the payment structure. Another challenge for the contractor is that new research will need to be done in order to handle changes in the raw materials allocated. Health and safety issues could arise between contractor and client.
	5	In order for smooth operations and to uphold strategic alignment, open and effective communication is recommended between both parties.
Contractor respondent 6	1	Some of the advantages are the environmental cost saving of re-using the by-products. The equipment and know-how the contractor developed and sourced. In terms of human resources management, it makes sense to contract out the agglomeration on the short term, 3-5 years, because of the cost involved for the client employ and then retrench the employees after when the agglomeration is no longer necessary. The client saves on training employees and ensures smaller workforce complement on site. Some negative aspects are that contractors don't always share the same business principles as safety standards, quality standards and does not always follow the prescribed procedures laid out by the client's systems.
	2	Long-term strategy decisions do not really affect the contractor company and may actually benefit the firm as they can structure resources according to the long-term strategy and enables effective cost management. This will also ensure better workforce stability. Short-term changes affect workforce stability for the agglomeration contractor or may even lead to employee retrenchments. If the client requires the agglomeration services again, the employees need to be re-employed by the contractor firm. This process of retrenchment and re-employment is a human resource management nightmare and is very costly for the agglomeration firm. Short-term decisions to change the ores used in the furnace process may affect the quality of the agglomeration product in the long run.

	3	Agglomeration does not form part of the core business of the client. The agglomeration does however form part of the long term environmental strategy of re-working historical and current arising (by-products) through the agglomeration process.
	4	To achieve a high quality agglomerated product is one of the main issues the contractor needs to manage as some products that forms part of the agglomeration mix has a negative effect on the quality of the product.
	5	Client involvement and open communication channels are important for the client and contractor partnership. Relationships takes time and it also takes time for the client and contractor to learn and understand the processes and challenges faced by both parties, as well as the advantages achieved through the agglomeration process.