A COMPETITIVENESS ANALYSIS OF THE SOUTH AFRICAN MANGANESE INDUSTRY USING PORTER'S DIAMOND MODEL

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, in partial fulfillment of the requirements for the degree of Masters of Science in Engineering.

Johannesburg, 2020

DECLARATION

I declare that this research report is my own unaided work. It is being submitted for the degree of Masters of Science in Engineering to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

Signed:

Maphutha Delson Adams

This _________ day of ___________ year___________

ABSTRACT

In 2017, it was estimated that South Africa had about 80% of the manganese global resources, but produced only about 36% of the global manganese production. About 90% of the global output of manganese is currently utilised in steel production and there is currently no substitute for manganese in steel production. The global outlook for steel demand is expected to continue on a growth path into the near future. The expected increase in manganese demand is expected to lead to the need for the global manganese industry to invest in additional production capacity to meet the demand. South Africa needs to be more competitive regarding its significant manganese resources in order to grow her share of the global production.

The aim of this research study was to conduct a competitiveness analysis of the manganese industry using Porter's diamond model. Porter's diamond model was used because when it was compared to other competitiveness analysis models, it was found to be relatively more holistic. Porter's diamond model has four main aspects of the model, which are the factor conditions, demand conditions, related and supporting industries, and company structure, strategy and rivalry. The competitiveness of the South African manganese industry was compared to the manganese industries in Brazil, India, Ukraine, Australia, and Gabon since these countries have significant manganese resources outside of China and are major manganese producers.

The South African and Gabonese manganese industries were found to be less competitive in terms of the factor conditions compared to Australian, Brazilian, Indian and Ukrainian manganese industries. However, when it comes to the demand conditions, related and supporting industries and company strategies, structure and rivalry the South African manganese industry was found to be competitive or on par with the other major manganese producing countries. Overall, the Australian, Indian and Brazilian manganese industries were found to be more competitive than South Africa and Gabon. In conclusion, the South African manganese industry was found to be less competitive when Porter's diamond model was used to analyse competitiveness.

The South African manganese industry requires significant improvement mostly in the factor conditions in order to be competitive like Australia, Brazil and India. Issues such as quality education of its citizens in key sectors that drive the economy, the upgrading of the manganese, the management of scarce water resources, access to electricity and the threat of renewables on electricity costs, limited capital resources and foreign direct investment, and logistics competitiveness need to be addressed.

DEDICATION

Reratilwe, Mogale, and Kgaugelo Adams

and

“Now unto him that is able to keep me from falling, and to present me faultless before the presence of his glory with exceeding joy,

To the only wise God our Saviour, be the glory and majesty, dominion and power, both now and ever.”

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
CAGR	Continuous Annual Growth Rate
CFA	Companhia Ferroligas do Amapa
CSN	Companhia Siderurgica Nacional
CVRD	Companhia Vale do Rio Doce
DBSA	Development Bank of Southern Africa
DMR	Department of Mineral Resources
EMM	Electrolytic Manganese Metal
FDI	Foreign Direct Investment
FeSi	Ferro Silicon
GCI	Global Competitive Index
GDP	Gross Domestic Production
GII	Global Innovation Index
GTCI	Global Talent Competitiveness Index
H_2O	Water
HCFeMn	High Carbon Ferro Manganese Alloy
ICT	Information and Communication Technology
IHA	International Hydroelectric Association
IMD	Institute for Management Development
IMnI	International Manganese Institute
INCC	Irish National Competitiveness Council
IRENA	International Renewable Energy Agency
ISD	Industrial Union of Donbass
ISO	International Organisation for Standardisation/Standards
ITA	Information Technology Association
ITIF	Information Technology and Innovation Foundation
Kg	Kilogram
KMF	Kalahari Manganese Field
Kt	Kilo Tonne
LPI	Logistics Performance Index
MB	Metal Bulletin
METS	Mining Equipment and Technology Services
Mn	Manganese
MPRDA	Mineral and Petroleum Resources Development Act
MQA	Mining Qualifications Authority
Mt	Million tonnes
Mtpa	Million tonnes per annum
NZF	Nikopol
OECD	Organisation for Economic Cooperation and Development
Ref FeMn	Refined Ferro Manganese Alloy
RULC	Relative Unit Labour Costs
SFP	Stakhanovsky
SiMn	Silico Manganese Alloy
SME	Small-and-Medium Enterprises
USGS	United States Geological Survey
WEF	World Economic Forum
ZFZ	Zaporozh’e

1. INTRODUCTION

1.1. Background

Manganese is an important industrial mineral, with about 90% of its global output used in steel production (Roskill Information Services, 2008). There is no substitute for manganese in the production of steel. These two factors result in steel production being the primary driver of global manganese consumption (Roskill Information Services, 2008). The average growth rate in global steel production for the period 2000 to 2006 was 6% per annum. The global manganese ore production for the period 2001 to 2006 increased from 23 million tonnes per annum (“Mtpa”) to 34 Mtpa, with an average growth rate of about 8% per annum (International Manganese Institute, 2013). The respective growth rates in steel and manganese demand during the same period indicate that there is a correlation between a growth in steel demand and an increase in manganese consumption. This correlation also means that a forecast in steel demand is able to provide useful information in determining the future demand for manganese.

Pillay (2008) indicated that the global outlook for steel demand remains positive, with the demand for steel expected to continue on a growth path into the foreseeable future. The basis for the positive outlook on steel demand is the projected growth in China’s gross domestic production. The projected growth in global steel demand into the future is expected to result in a corresponding increase in manganese demand. An increase in manganese demand will result in the need for the global manganese industry to invest in additional production capacity to be able to meet the increase in demand.

The 2009 geological data on manganese ore reserves as illustrated in Figure 1.1 indicates that nearly 80% of the world’s manganese ore reserves are located in South Africa; this is a significant mineral endowment for South Africa (U.S. Geological Survey, 2009). This significant mineral endowment means that South Africa has a comparative advantage, and is expected to have a significant role in the global supply of manganese relative to the rest of the world.

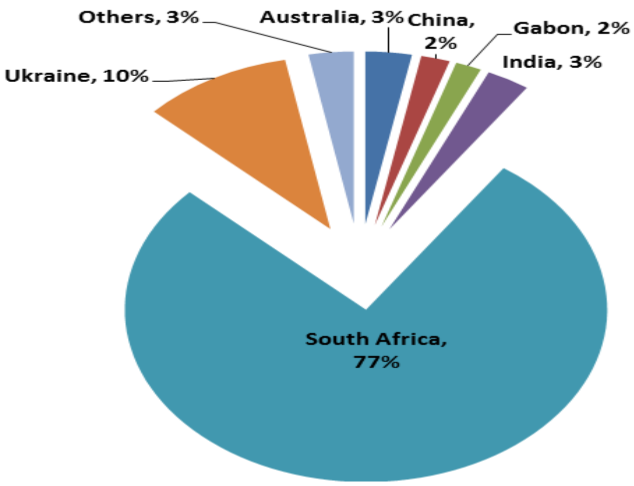

Figure 1.1: Global manganese reserves for 2009 (Source: U.S. Geological Survey, 2009)

The 2009 global manganese ore production data as illustrated in Figure 1.2 shows that although South Africa has about 80% of the world's manganese resources, it contributed about 17% of global manganese ore production. The data in Figure 1.2 also shows that countries such as Australia, China, Gabon, and India have had production levels that are proportionally higher in comparison to their mineral resource base.

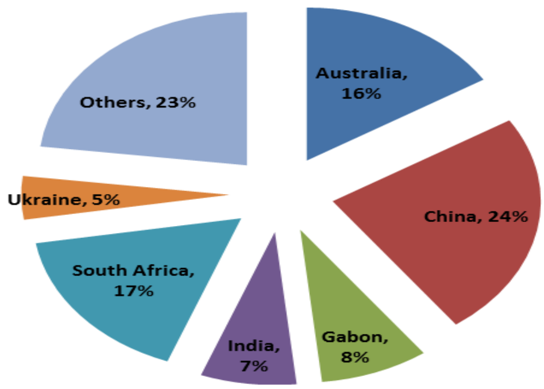

Figure 1.2: Global manganese production for 2009 (Source: IMnI, 2013)

The global manganese ore production data as illustrated in Figure 1.3 shows that South Africa has improved its position from contributing 17% of global manganese production in 2009 to contributing about 36% of global manganese production in 2017. South Africa is now the largest global producer of manganese, with countries such as Australia, Brazil, Gabon, and India continuing to produce at high levels in proportion to their mineral endowment.

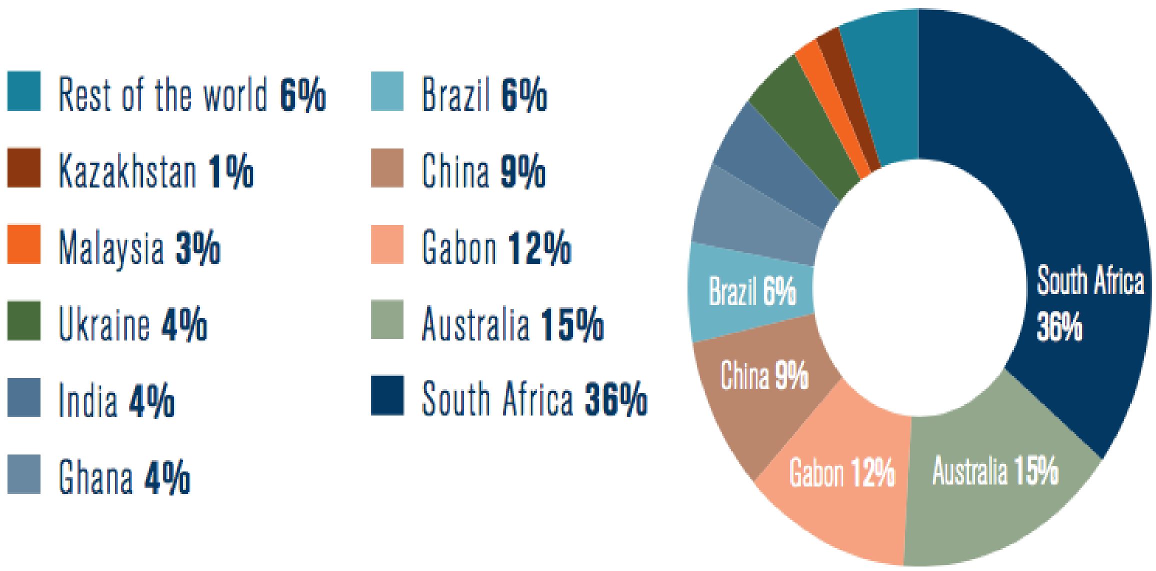

Figure 1.3: Global manganese production for 2017 (Source: IMnI, 2018)

South African manganese industry to be able to increase its production to be more in proportion with its mineral resource base, it needs to increase its current level of production to either capture more of the existing market or gain more of the growing demand. The additional manganese production to either capture more of the existing market or more of the projected growth in the market will require investment, and for this investment in additional manganese production from South Africa to occur it will need to be the most competitive investment option when compared to investing in the same additional production in other manganese producing countries.

There are a number of researchers that have studied the relationship between competitiveness and attracting mining investment. Jara (2017) considered the role of a country's competitiveness in attracting mining investment. The premise of this research was that the competitiveness of a country's mining industry determines its effectiveness in attracting investment. Ernst & Young (2017) highlighted the top ten risks that are facing the mining and metals industry. The report highlighted access to capital as one of the risks. The main reasons that were mentioned on the difficulties encountered in accessing capital are the increased costs of capital and the security needs of financial institutions to manage the risk of default. The report also indicated that most of the capital loans that have been granted in recent times have been used to re-finance existing projects that have less uncertainty. Hutton (2015) stated that in the current environment it is difficult to find investors for projects, and therefore traditional approaches to investments and operations need to be changed in order to attract investors. Kasatuka and Minnitt (2006) studied the relationship between investment and non-commercial risks and concluded that developing countries are at a disadvantage in being able to attract foreign direct investment (FDI). In addition, the study also concluded that if investors were given a choice between countries that have the same mineral potential, they would generally invest in countries that have lower non-commercial risks. Gajigo et al (2011) conducted a study on the implications for project finance within the manganese industry. The study shows that the number of transactions that involved the iron group of metals (including manganese) have been low for transactions completed between 2005 and 2010. These studies indicated that there is an increase in competition for investment capital, and that only projects that are relatively more competitive in terms of risk and returns will be able to access the required capital.

The projected increase in global manganese demand into the future provides South Africa with the opportunity to continue to grow its production level, and capture a greater share of the global manganese production. This increase in manganese production will enable South Africa to have production that will be more in proportion with its mineral endowment. The South African manganese industry needs to attract more investment in order to take advantage of this opportunity, which in turn enables it to have a higher increase in its production capacity when compared to other manganese producing countries.

1.2. Problem statement

There is limited research work that has been done to understand the competitiveness of the South African manganese industry relative to other manganese producing countries. There is only one study that has been conducted by the Department of Mineral Resources (“DMR”) in South Africa. The research study was a mineral economic study, and the aim of the study was to understand the potential impact on the domestic market of introducing a new entrant or a third producer into the South African manganese industry (Department of Mineral Resources, 2006). The study did not explore in detail the impact on South Africa’s competitiveness as a result of introducing a new entrant (Department of Mineral Resources, 2006).

There are a number of other research studies that have been conducted on the different aspects of competitiveness of the South African mining industry; and this is despite the lack of specific research on the competitiveness of the South African manganese industry relative to other countries. These research studies and their conclusions are useful in giving a general understanding of the competitiveness of the South African mining industry, but are not helpful in determining the competitiveness of the South African manganese industry relative to other manganese producing countries.

1.3. Research aim

The aim of this research project is to conduct an analysis of the competitiveness of the South African manganese industry relative to other manganese producing countries that have significant manganese mineral resources. Figure 1.4 shows the top 10 countries that imported manganese ore in 2018.

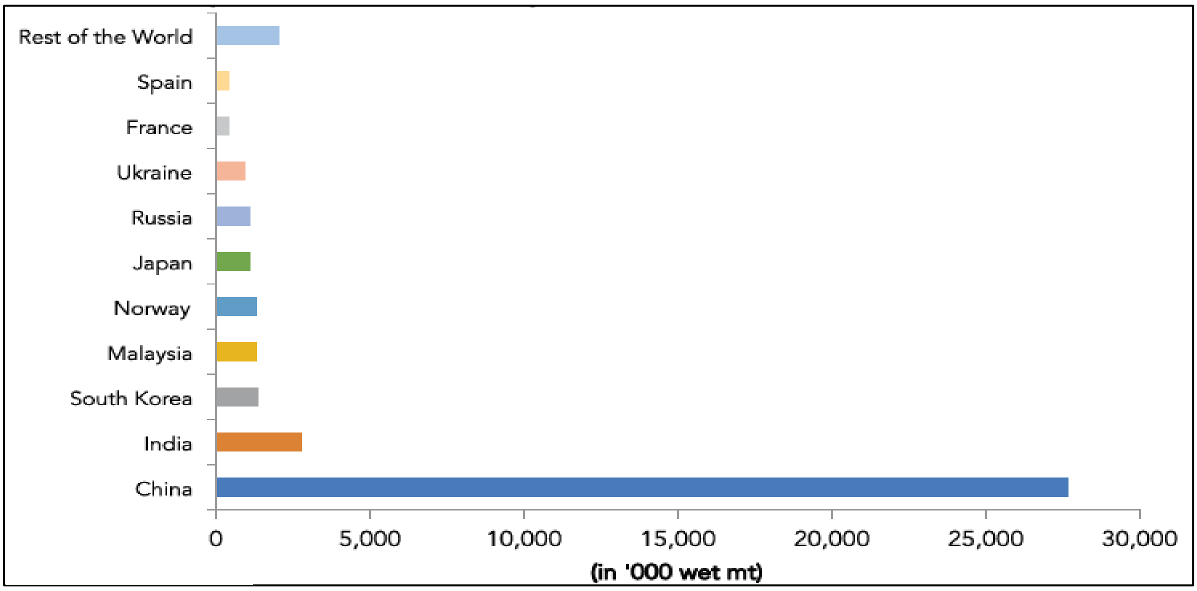

Figure 1.4: Top 10 countries in 2018 that imported manganese ores (Source: IMnI, 2019)

Figure 1.4 indicates that China is the dominant source of manganese ore demand. This results in manganese ore exporting countries competing to gain market share in China. The goal of this research project is to determine the current state of competitiveness of the South African manganese industry relative to other major manganese producing countries outside of China. China is excluded as it is expected to remain the main demand center for manganese ore into the foreseeable future.

The outcomes of this research project will enable stakeholders to determine what needs to be done to improve the South African manganese industry, and ensure that it is the most competitive relative to other manganese producing countries outside of China. The benefit of having a South African manganese industry that is more competitive is that the manganese industry will be a more attractive destination for investment, and as a result will be able to increase its production and capture an increasing portion of the global manganese demand.

1.4. Objectives

The main objectives of this research project were to:

- Conduct an analysis of the current state of competitiveness of the South African manganese industry relative to other manganese producing countries.
- Identifying the gaps or shortfalls in competitiveness for the local industry that needs to be addressed for the sector.
- Provide the different stakeholders to the South African manganese industry with actions that need to be taken to ensure the industry is the most competitive relative to other manganese producing countries outside China.

1.5. Structure of the report

This research report consists of five main chapters. The first chapter introduces the research topic and the last chapter contains the conclusions and recommendations of the research.

The contents of the main chapters of the research project are as follows:

- Chapter 1 introduces and defines the problem statement for the research project. It also outlines the objectives and the structure of the research project.
- Chapter 2 discusses the literature review on the current body of work that has been done, which is relevant to the research project.
- Chapter 3 discusses the research methodology that was used to conduct the research.

- Chapter 4 discusses the details of Porter's diamond model analysis that has been conducted on the competitiveness of the South African manganese industry.
- Chapter 5 summarises the conclusions that have been drawn from the research conducted and the recommended actions to ensure that the South African manganese industry is the most competitive relative to other manganese producing countries outside China.

2. LITERATURE REVIEW

The literature review covers the subject of competitiveness, a central theme of this research project. The literature review covers the definition of competitiveness, how it is measured, and how the concept is used to compare different industries and sectors. The different models used to measure competitiveness are compared with each other. There is a review of previous work that was done to assess the competitiveness of the South African manganese industry. Porter's diamond model is discussed in detail as it has been used in this research project to conduct an analysis of the competitiveness of the South African manganese industry relative to other manganese producing countries.

2.1. Competitiveness

2.1.1. Definition of competitiveness

Arslan and Tatlidil (2012) stated that in a globalised world the concept of competitiveness has been gaining importance in recent years. This is attributed to more liberal economic policies of developing countries that have led to these countries having a greater connection to international markets and also the need for increased competition to access these markets. Siudek and Zawojska (2014) indicated that although competitiveness is one of the most commonly used concepts in economics; there is no generally accepted definition of the term. The main reason for the different definitions of competitiveness is the complexity of the term and its composite character. There are several concepts and theories of competitiveness that range from considering a nation's competitiveness from a macro-perspective and to those that concentrate on individual companies (i.e. looking at competitiveness in micro-economic terms). The macro-level approaches to competitiveness often refer to international trade and a nation's comparative advantage in the production of certain commodities that are subject to foreign trade (Siudek and Zawojska, 2014). Competitiveness is a complex multi-dimensional concept. It reflects the favourable position of the national economy, mainly in the field of international trade and, at the same time, its ability to strengthen this position (Kharlamova and Vertelieva, 2013).

Ulman (2013) stated that the extension of globalisation has had a direct impact on the increase in competitiveness between countries. Ulman (2013) also indicated that although the process of competitiveness is not new, the actual context and the sources that nurture it are different, and that no standard definition exists and that different authors tend to use the concept between different limits. Hickman (1992) defined international competitiveness in terms of the ability to sustain an acceptable level of growth within a global economy, leading to an improvement in the real standard of living of the population with an acceptable fair distribution, without reducing the growth potential in the standards of living of future generations. Haque (1995) defined the competitiveness of a country as the ability of the country to produce goods and services that meet the test of international markets and at the same time be able to maintain and expand the real income and raise the welfare levels of its citizens. Arslan and Tatlidil (2012) defined competitiveness in general as a share of the world trade volumes that a country owns.

International competitiveness is viewed in broad terms as the capability to achieve economic growth in the long run, and to also be able to achieve an economic structure that is able to easily adapt to changes in demand on world markets (Stanovnik and Kovačič, 2000). Competitiveness is also defined as the ability to create added value and thus increase the national wealth by managing assets and processes, attractiveness and aggressiveness, global and local matters and by integrating these relationships into an economic and social model (Institute for Management Development, 2017). The Organisation for Economic Cooperation and Development (2017) defined international competitiveness as the level at which a country can, under free and fair market conditions, produce goods and services which meet the test of international markets, while simultaneously maintaining and expanding the real incomes of its people over the long term. The World Economic Forum (WEF) Global Competitiveness Report defines competitiveness as the set of institutions, policies, and factors that determine the level of productivity of a country (WEF, 2017). Competitiveness is defined as the ability of a region to export more in value added terms than it imports (International Technology and Innovation Foundation, 2013). Porter (1998) equated the meaning of the concept of competitiveness to productivity, meaning that the ability to be competitive depends on the productive use of resources and not just on their availability.

In their report, the Irish National Competitive Council (2016) discussed the two main competing ideas on the definitions of competiveness covered in academic literature. The two ideas are the cost or market share view of competitiveness and the productivity-based view of competitiveness. The cost or market share view defines competitiveness as a location's unit cost level, which drives the ability of companies to compete successfully on global markets. This definition has been criticised for a number of reasons, with many of these reasons linked to the translation of a concept initially created to understand the rivalry of individual companies to a different use. The challenge with extending this definition from companies to specific locations or places is that unlike companies, places do not go out of business; they can adjust their prices or prosperity levels whereas companies can lose the ability to mobilise production factors when revenues drop. The productivity-based view defines competitiveness as the productivity level of a specific place; this is the inherent ability of a place to create value based on the production factors that it has at its disposal. The productivity-based view of competitiveness is focused on the medium to long-term horizon and looks at the fundamentals and how they are improved; in this case wages and costs are assumed to eventually revert to their equilibrium levels. The productivity-based definition of competitiveness has not met much fundamental criticism as the literature is clear that productivity is the ultimate driver of differences in the prosperities of different locations (Irish National Competitive Council, 2016).

The International Technology and Innovation Foundation (2013) stated that while competitiveness and productivity are related terms, they should not be equated. The importance of not equating these terms is evident when traded and non-traded sectors are differentiated. A traded industry is the one where the companies sell a significant share of their output outside a particular geographical area. For example, a mining company from the Mpumalanga Province that sells its products to customers across South Africa is a traded company from the perspective of the Mpumalanga Provincial economy, but a non-traded company from the perspective of the South African economy. In contrast, a mining company in the Northern Cape Province that sells its products throughout the world is a traded company from both the provincial and the national perspective. Competitiveness relates only to the economic health of a region's or a nation's traded sectors (International Technology and Innovation Foundation, 2013).

2.1.2. The measurement of competitiveness

Siudek and Zawojska (2014) stated that despite the fact that competitiveness is an ubiquitous term in economic research, there are still troubles with understanding its meaning and its measurement. The lack of a uniform definition for competitiveness also results in the lack of a uniform method to measure it. Siudek and Zawojska (2014) indicated that in the absence of a uniform approach researchers have proposed different methods to estimate competitiveness, and these methods range from one-dimensional measures such as using net exports to measure competitiveness to a multi-dimensional measure such as the global competitiveness index.

There are a number of authors that have measured competitiveness as a one-dimensional measure. Arslan and Tatlidil (2012) measured competitiveness as a share of trade volumes in world trade that a country owns. Fagerberg (1988) developed and tested a model of differing trends in international competitiveness and economic growth across countries, and used market share as a measure of competitiveness. Turner and Golub (1997) used relative unit labour costs (RULC) as a key underlying determinant of competitiveness for traded goods. The reason unit labour cost is used as a measure of competitiveness is that it is less subject to direct exchange rate effects when compared to prices of traded goods. Mulatu et al (2004) investigated the responsiveness of international trade to an increase in the stringency of environmental legislation. The aim of the investigation was to establish whether more stringent environmental laws would impair the competitiveness of the domestic industries. In this instance, the net exports were used as a measure of competitiveness.

There are also a number of authors that have used multi-dimensional measures to estimate competitiveness. The Institute for Management Development has been publishing the world competitiveness report on an annual basis since 1989. The world competitiveness report uses an index to measure competitiveness. The calculation of the index uses more than 260 variables, classified into 20 distinct sub-factors such as international trade, societal framework, productivity and education (Institute for Management Development, 2017).

The World Economic Forum has based its competitiveness analysis on the Global Competitiveness Index (GCI) since 2005. The GCI is a comprehensive tool that measures the microeconomic and macroeconomic foundations of national competitiveness. The many determinants of the GCI drive productivity and competitiveness. These determinants of the GCI emanate from theories that have occupied the minds of economists for hundreds of years, with theories ranging from Adam Smith's focus on specialisation and the division of labour to the neoclassical economists' emphasis on investment in physical capital and infrastructure and, more recently, to interest in other mechanisms such as education and training, technological progress, macroeconomic stability, good governance, business sophistication, and market efficiency. The GCI is a weighted average of the different components, each measuring a different aspect of competitiveness. These components are grouped into 12 pillars of competitiveness: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labour market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation (WEF, 2013).

The Global Innovation Index (GII) recognises the key role of innovation as a driver of economic growth and prosperity, and adopts an inclusive, horizontal vision of innovation applicable to both developed and emerging economies. The GII has established itself as a leading reference on innovation for researchers and for public and private decision makers. The GII relies on two sub-indices, the innovation input sub-index and the innovation output sub-index, and each of the sub-indices is built around pillars. The innovation input sub-index has the following five input pillars that capture the elements of the national economy that enable innovation: (1) institutions, (2) human capital and research, (3) infrastructure, (4) market sophistication, and (5) business sophistication. The innovation output sub-index has the following two output pillars that measure the innovation outputs of an economy: (1) knowledge and technology outputs and (2) creative outputs. The overall GII score is a simple average of the Input and Output sub-indices (Cornell University, 2013).

Stanovnik and Kovačič (2000) measured international economic competition using internal and external factors such as human and natural resources, infrastructure, management, capital, government intervention and the technological capability of companies. Porter's theory uses a framework known as the 'diamond model' to assess the different aspects of competitiveness and also considers the interactions of the different aspects. The diamond model comprises of factors that affect the competitiveness of a national industry. The factors that are considered are the factor conditions, demand conditions, company strategy, structure and rivalry, related and supporting industries, and the role of government and chance events (Porter, 1998).

In general, competitiveness is measured at the following different levels of economic analysis: mega- (global), macro- (nations, regions), meso- (economic sectors and industries) and micro- (company) level. The competitiveness measures can be classified into two categories: static measures that assess competitiveness level at a point in time and dynamic measures that assess competitiveness over a period of time (Siudek and Zawojska, 2014).

2.1.3. Competitiveness used to compare regions, countries, and industries

Broadbent (2001) used the concept of competitiveness to compare the competitiveness of coal as an energy source with that of gas, nuclear, and renewables. Competitiveness in this instance was treated as more than cost and price, but considered different factors such as environmental acceptability, security, and image. Rouvinen (2002) used an e-competitiveness index to measure the ability of a nation to exploit information and communication technology (ICT) to the fullest. Liu and Xu (2017) used competitiveness to measure the importance of education to national competitiveness. In this study, the efficiency of educational resources of a country within the scope of its financial capacity is measured. The measured educational efficiency is then used to determine its effects on national competitiveness. Budeba et al (2015) used competitiveness to differentiate between surface coal mines, using cost estimation as a measure. The premise of this study is that low cost producing mines are more competitive and have a higher chance of survival in a low-price environment. The Arab World Competitiveness Report uses competitiveness to compare the economies that are considered to be within the Arab world (WEF, 2018).

Kareska and Marjanova (2010) used competitiveness to compare the organisations in Macedonia against the rest of the world; this in order to determine what the Macedonian organisations need to do in order to be globally competitive. INSEAD (2018) used the concept of competitiveness and the global talent competitive index (GTCI) measure to compare talent between different countries. The index uses a set of policies and practices that enable a country to be competitive in developing, attracting, and empowering human capital that contributes to productivity and prosperity (INSEAD, 2018). Tomas (2011) used competitiveness to compare countries such as the United States, Japan, and twenty-seven (27) European Union countries. The main goal of the research paper was to determine if expenditure on higher education, research and development would lead to higher competitiveness for each of the countries (Tomas, 2011). Dogan (2016) used the concept of competitiveness to compare member and candidate countries of the European Union on being innovative.

The concept of competitiveness is used widely to compare different regions, countries, industries, and sectors of the economy. Competitiveness can be used in a static manner to measure the competitiveness at a point in time or in a dynamic manner to measure the evolution of competitiveness over a period (Siudek and Zawojska, 2014). The concept can be used to compare competitiveness on the basis of a single measure or using multi-dimensional measures. The concept is useful for strategic mine planning as it can be used to compare different mines on the basis of a single measure or on the basis of multiple measures. In terms of single measures, different mines can be compared on production unit costs, profit margins, employee turnover, and others. In terms of using multiple measures, single measures such as resource type, unit labour costs, and level of skills can be combined into a weighted index, and then this index be used to compare different mines. The long-term nature of mining operations means that it is important to understand the current state of competitiveness (static) and how this current state will progress with time (dynamic).

2.2. Comparison of different methods to measure competitiveness

The methods that have been used to estimate competitiveness range from the ones that use a one-dimensional measure to the ones that use multi-dimensional measures (Siudek and Zawojska, 2014). The most common approach that is used in competitiveness analysis is to focus on an individual sub-topic, which then later creates a challenge on the intervention actions as the linkages are ignored. The most popular and influential measure of international competitiveness of a country that has been used is the growth in the RULC. In the small open economies of Western Europe this measure seems to be as important for policy-making as certain monetary aggregates have been in the United States and the United Kingdom in recent years. Arguably, if unit labour costs grow more than in other countries, this will reduce the market shares at home and abroad, hamper economic growth and increase unemployment (Fagerberg, 1988). Turner and Golub (1997) raised a concern with the use of RULC as a measure as often the data that is needed is not readily available or reliable. The current models that are used select and group different competitiveness factors and include them into a general system or an index. This means the competiveness results can vary depending on the models used for measurement (Ulman, 2013). The performance of a country is evaluated using the many different indicators of competitiveness, so that the general evaluation of a country is based on different groups of indices. This approach is believed to provide a more comprehensive evaluation, but the disadvantage of using many indicators is the difficulty in interpreting the outcomes (Stanovnik and Kovačič, 2000) and the fact that the factors are not often mutually exclusive (WEF, 2013).

In addition to the plethora of criteria that can be used to measure competitiveness, the nature of competitiveness is that it is continuously evolving. In an effort to keep up with this evolution, every edition of the world competitiveness report incorporates a number of new indicators that enable the index to reflect better the competitiveness of countries. There are also instances, however, when a more drastic approach is required such as introducing a new ranking altogether. This happens when there are structural changes in the economic environment that demand attention to better understand their involvement and implications. For instance, in the last decade or so, economies have experienced technological changes in rapid succession when compared to previous developments; these types of transformation need to be quantified and assessed so that decision makers in both public and private sectors can address them (Institute for Management Development, 2017).

Porter's theory is an index-based framework that uses a model known as the 'diamond model' to assess the different aspects of competitiveness and its main advantage is that it also considers the interactions of different aspects. The diamond model comprises of factors that affect the competitiveness of a national industry. The factors that are considered are the factor conditions, demand conditions, company strategy, structure and rivalry, related and supporting industries, and the role of government and chance events (Porter, 1998). Wu et al (2017) used Porter's theory to conduct an assessment on the competitiveness of China's coal industry. Their main reason for using Porter's theory is that they found it to be comprehensive in its analysis of the competitive advantage of a particular industry.

2.3. The use of Porter's diamond model

A nation is most likely to succeed in industries or industry segments where Porter's diamond model is the most favourable. If a nation's 'diamond' is favourable, it does not mean that all the companies of that nation will achieve a competitive advantage; instead it means that those companies that manage to emerge from such a national environment will prosper even in the midst of international competition. The effect of one determinant or factor is contingent on the state of others, and the advantages in one determinant can also create or upgrade advantages in others. Competitive advantage based on one or two determinants is possible in natural resource-dependent industries or industries involving little sophisticated technology or skills (Porter, 1998). Siudek and Zawojska (2014) and Porter (1998) stated that a great deal of the empirical research refers to the determinants of competitiveness at the enterprise level, probably due to the conviction that companies, not individual nations, compete in international markets.

Wu et al (2017) used Porter's theory on the competitive advantage of nations to conduct an assessment on the competitiveness of China's coal industry. Jarungkitkul and Sukchroensin (2016) used the diamond model to conduct a study on the logistics cluster competitiveness among Asia's main countries. Zhao et al (2011) used the model to conduct an analysis of the factors that influence Chinese solar photovoltaic industry. Linnell (2014) used Porter's diamond model to analyse the competitiveness of the South African mining industry and assess the viability of mineral beneficiation. Van der Berg (2008) used Porter's diamond model to redefine the competitive advantage in the South African platinum market. These studies demonstrate how Porter's diamond model has been used previously to assess the different industries. In this research, Porter's diamond model was used to assess the competitiveness of the South African manganese industry relative to other manganese producing countries.

2.4. Competitiveness analysis of the South African manganese industry

The prominent legislation in South Africa that governs the extraction of minerals is the Mineral and Petroleum Resources Development Act (MPRDA) of 2002. The assessment of current competitiveness of the South African manganese industry needs to be conducted within the limits of what is permissible in terms of the MPRDA. This means that when the South African manganese industry is considered competitive; it is within the context of having an approved mining right and meeting all the requirements of the mining right licence.

There is little work that has been done in order to understand the competitiveness of the South African manganese industry. The DMR in South Africa conducted a mineral economic study to understand the potential impact of introducing a new entrant into the South African manganese industry (Department of Mineral Resources, 2006). At the time when the study was conducted, there were two main producers in South Africa. The aim of the study was to understand the possible impact of introducing a third producer to the domestic manganese industry. The study was limited in that it did not explore in detail the impact on South Africa's competitiveness as results of the new entrant (Department of Mineral Resources, 2006).

Although there is little work that has been done on the competitiveness of the South African manganese industry, there have been studies that have been conducted in the past on the competitiveness of the South African mining industry. These studies and their conclusions are useful to consider as some of their conclusions are applicable to the South African manganese industry. Edwards and Golub (2004) assessed South Africa's international cost competitiveness and exports in manufacturing. The outcome of their study indicated that unit labour costs in South Africa are higher when compared to those of other developing countries.

Tom (2015) examined the key factors affecting the beneficiation of minerals in South Africa. The research concluded that the level of mineral beneficiation in South Africa is low in relation to the mineral endowment of the country. In addition, Tom (2015) also highlighted that labour laws, lack of adequate skills, corruption, unstable labour force, research and development, the lack of entrepreneurship activity, inadequate infrastructure, and energy problems were factors that are deterring the beneficiation industry from becoming more competitive. Neingo and Tholana (2016) studied the aspect of productivity within the South African gold mining industry. Their study concluded that the country has a comparative advantage, which it has not managed to turn into a competitive advantage. The reasons cited for this failure were categorised into global and local challenges. The global challenges mentioned were price volatility, declining prices, and declining grades. The local challenges were industrial action, increasing electricity costs, political, environmental, and social issues. Cawood (2011) studied the minerals sector and identified six (6) factors that need to be addressed in order to ensure that the South African mining industry is sustainable in the long-term; these factors are insufficient spending on research and development, general standards of education, fears of nationalisation, inadequate infrastructure, AIDS prevalence, and an inefficient labour force.

In his report on the opportunities and challenges facing the South African mining industry, Baxter (2011) highlighted that infrastructure (electricity, rail), social licence to operate, human capital/skills, and institutional capacity as key threats to the short-term and long-term competitiveness of the South African mining industry. Rossouw and Baxter (2011) indicated that South Africa was failing to exploit the economic benefits inherent in its mineral wealth due to constraints. For example, the research paper indicates that South Africa will not be able to achieve the desired levels of mineral beneficiation if the projected increase in electricity prices and the proposed carbon tax are implemented. A 2012 report by the Development Bank of Southern Africa (“DBSA”) on the state of the South African economic infrastructure identified infrastructure development as a key aspect to enable economic development (DBSA, 2012). The report reviewed infrastructure opportunities and challenges within rail, ports, roads, electricity, water, and telecommunications sectors and concluded that making the right infrastructure investment choices and ensuring their effective delivery distinguishes high-growth economies from the low-growth ones.

Budeba et al (2015) assessed the cost estimation methods that are used to estimate the costs of surface coal mines, and then proposed a data envelopment analysis method to develop a frontier for efficient surface coal mines using a parametric method to model the costs and productivity of surface coal mines. This approach compares the competitiveness of the different mines on the basis of their costs using cost-curves. Mutemerwerwa and Ericsson (2000) investigated the role of vertical integration between chrome ore mines and ferrochromium smelters in the location of ferrochromium production capacity in South Africa and Zimbabwe. The study was important to conduct as earlier observations had shown that a larger share of the global market has increasingly been coming from integrated producers. The paper argued that the increased vertical integration between the mines and smelters in South Africa and Zimbabwe had led to a lower cost of chrome ore as an input compared to other producers. The study used an ordinary least squares model to test the relationship between low chrome ore costs and vertical integration, and this relationship showed a statistically significant relationship. The findings of the report also partially supported the notion that the control of sources of chrome is a major source of competitiveness (Mutemerwerwa and Ericsson, 2000). Linnell (2014) analysed the competitiveness of the South African mining industry in order to assess the viability of mineral beneficiation. The study also aimed to establish the requirements for the mining industry to provide an environment that enables better competitiveness going forward. The study was conducted using Porter's Diamond Model to assess the mining industry's competitiveness. The research found that the mining industry is not competitive and will not be able to provide an environment that is conducive to beneficiation in South Africa (Linnell, 2014).

2.5. Description of Porter's model and its use

Figure 2.1 illustrates the different aspects of Porter's diamond model. The diamond model comprises of factors that affect the competitiveness of a national industry. The factors are the factor conditions, demand conditions, company strategy, structure and rivalry, related and supporting industries. The solid lines as illustrated in Figure 2.1 represent the mutual influences between the different factors. Government policies and chance events are the other influencing factors, which also interact with all the other aspects.

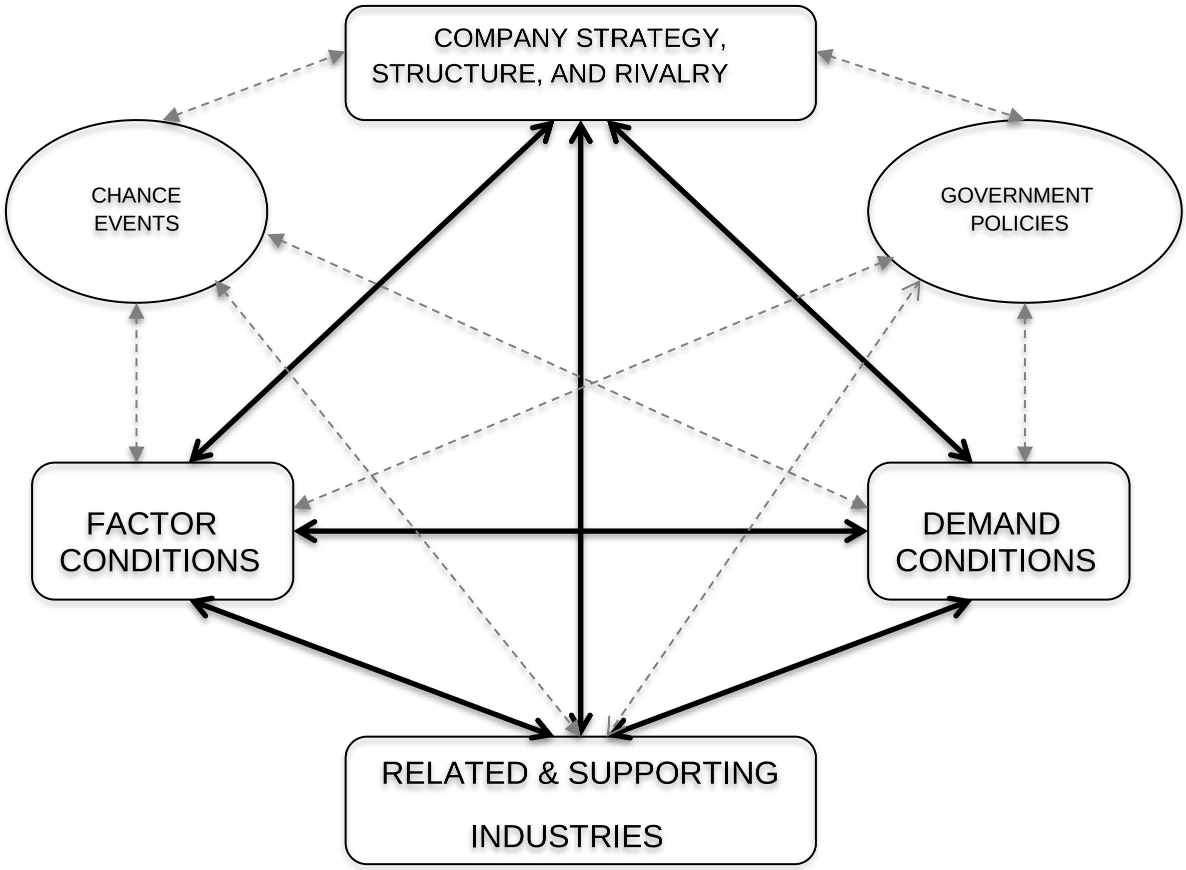

Figure 2.1: Porter's diamond model (Adapted from Porter, 1998)

The brief definitions of each of the aspects of Porter's diamond model are as follows:

- The company strategy, structure, and rivalry aspect refer to conditions in a particular country that govern how companies are created, organised, and managed, and the nature of the domestic rivalry.
- The demand conditions are the nature of the domestic demand for the particular product or service.
- Related and supporting industries refer to the presence or absence in a specific country of supplier industries and related industries that are internationally competitive.
- The factor conditions refer to factors of production, such as skilled labour and/or infrastructure, necessary to compete in a particular industry.
- The element of chance events refers to those events and developments that are outside the control of a country's government. These are events such as pure inventions, breakthroughs in basic technologies, wars, external political developments, and major shifts in foreign market demand.

- The factor of government is the policies that the government sets in place to enable the local companies to be competitive. These policies either improve or detract from the national advantage (Porter, 1998; Frăsineanu, 2008; Huggins and Izushi, 2015).

These elements of the model are further explained individually in more detail in the next sub-sections.

2.5.1. Company strategy, structure, and rivalry

The company strategy, structure, and rivalry aspect of the diamond model considers the goals, the strategies, and ways of organising companies. It also looks at the pattern of rivalry at home which is able to drive innovation and ultimate prospects for international success (Porter 1998).

2.5.2. Demand conditions

The demand conditions are grouped into three broad categories. These categories are the composition of the domestic demand, the size and pattern of growth of the domestic demand, and the internationalisation of the domestic demand. The composition of the domestic demand looks at the mix and character of the domestic customer. The composition of the domestic demand determines how the industry perceives, interprets, and responds to the needs of the customer. A country is able to gain competitive advantage when the domestic demand is able to provide the local industry a clear or early indication of the needs that a foreign customer can have, and also when domestic customers are able to put pressure on the local industry to innovate faster compared to foreign rivals. The three characteristics of the composition of the domestic demand are the segment structure of demand, sophisticated and demanding customer, and anticipatory customer needs. The demand size and pattern of growth looks at aspects such as the size of the domestic market, the number of independent customers, the rate of growth of the domestic demand, early domestic demand, and early saturation of the domestic market. The internationalisation of the domestic demand looks at mobile or multinational buyers, and the influences on foreign needs due to domestic demand conditions (Porter, 1998).

2.5.3. Related and supporting industries

The aspect of related and supporting industries investigates the strength of both the related and supplier industries to the industry being investigated. This is to assess if the related and supplier industries of a particular country are internationally competitive and able to provide efficient, timely, and preferential access to cost-effective inputs relative to other countries (Porter, 1998).

2.5.4. Factor conditions

The factor conditions of production are grouped into a number of broad categories such as human resources, physical resources, knowledge resources, capital resources, and infrastructure. The human resource element looks at the availability of skilled personnel, the cost of the personnel, and the productivity of personnel needed for a particular industry. The physical resource element looks at the availability, abundance, quality or grade, accessibility, and cost of the land, water, mineral, electricity, and other physical resources that are needed to be able to compete in an industry. A country's climate conditions, location, time zone, and its geographic size are considered as part of its physical resources. The knowledge resources are the scientific, technical, and market knowledge repositories that a country possesses. These knowledge repositories reside within universities, government research institutes, private research facilities, business and scientific literature, market research reports and databases, trade associations, and other sources. The capital resources are the amount capital available to finance the industry and the cost of that capital. Infrastructure resources are the type, quality, and cost of the infrastructure that is available. These are the infrastructure resources that affect competition such as transportation systems, communication systems, health care, and so on. The infrastructure resources also include those things that contribute to the quality of life, and making a particular nation an attractive place to live and work (Porter, 1998).

2.5.5. Chance events and government policies

The determinants of national advantage that have already been discussed shape the environment for competing in particular industries. It has been found in the histories of most of the successful industries that chance events also played a role. Chance events are events that occur and have little to do with the circumstances in a nation, and these are often outside the power of individual companies and governments to influence. Chance events are important as they create discontinuities that allow a shift in competitive position. Chance events can cause discontinuities in all the other determinants of national competitiveness that have already been discussed (Porter, 1998). Linnell (2014) stated that market failures are an inherent process of industrial upgrading and diversification, so chance events are unavoidable. Naude et al (2010) suggest that instead it is best to mitigate the risk of chance events such as market failures through diversification.

The real role of government in national competitive advantage is in influencing the four determinants. Government's role is often discussed within the context of international competitiveness. Government can influence or be influenced by each of the four determinants in a positive or in a negative manner (Porter, 1998). Porter (1998) indicated that although it is tempting to put government as the fifth determinant, it is not the correct and most useful way to understand the role of governments. Governments often intervene when implementing and managing industrial policy. These can fundamentally change the competitiveness of the industry and, in turn, affect the supporting environment (Hay, 2012). Countries such as Japan and Korea are an example of those countries that have enjoyed success as a result of government intervention through policy (Porter, 1998).

3. RESEARCH METHODOLOGY

3.1 Introduction

The objective of this research project was to determine the competitiveness of the South African manganese industry relative to other manganese producing countries outside of China, and to also recommend actions that must be taken by the different stakeholders to the South African manganese industry to ensure the industry improves to become the most competitive country relative to other manganese producing countries outside China. This chapter describes the research methodology that was followed to achieve the objectives of this research project.

3.2 Research approach

The research approach followed is summarised below:

- The landscape on the competitiveness of the South African manganese industry was described, and then the problem statement, the research aim, and the objectives of the research project were defined.
- The existing literature relevant to the research project was reviewed to establish the extent of the published information. The literature review focused on the concept of competitiveness, a comparison of different methods used to measure competitiveness, the current body of research on the competitiveness of the South African manganese industry, and a detailed description of Porter's diamond model.
- An analysis of the competitiveness of the manganese producing countries that have a significant amount of mineral resources outside of China was conducted using Porter's diamond model. The countries that were compared to each other are South Africa, Australia, Brazil, India, Ukraine, and Gabon. These countries were compared on the four aspects of Porter's diamond model; the factor conditions, demand conditions, related and supporting industries, and the company structure, strategy and rivalry.
- The research used published information, and supplemented the published information with information and data from industry bodies and individual company websites to conduct the competitiveness analysis. The research

used both quantitative and qualitative research methods to analyse the available data. Saunders and Lewis (2012) stated that the reliability and validity of the research data or information is crucial to ensure that the research is credible. In an effort to mitigate the highlighted risk on research data, most of the information that was used in this research project is from books, peer-reviewed journals, and industry bodies.

- Conclusions and recommendations were made based on the analysis conducted. The recommendations made are focused on the actions that need to be taken by the different stakeholders of the South African manganese industry to ensure the industry is the most competitive one relative to other manganese producing countries.

4. APPLICATION OF PORTER'S DIAMOND MODEL

The competitiveness analysis of the South African manganese industry covered the four aspects of the diamond model, which are the factor conditions, the demand conditions, related and supporting industries, and the company structure, strategy and rivalry. These different aspects of the diamond model were compared among South Africa, Ukraine, Australia, India, Gabon, and Brazil.

4.1. Factor conditions

4.1.1. Human resources

The analysis conducted considered the core skills that are required for the manganese industry, the availability and cost of these core skills. These were compared among South Africa, Ukraine, Australia, India, Gabon, and Brazil.

4.1.1.1 Skills required along the manganese industry value chain

The manganese value chain consists of three main segments: the production of ore, the smelting of ore, and speciality processing of ore to make batteries or manganese chemicals. Figure 4.1 illustrates some of the aspects of the manganese value chain.

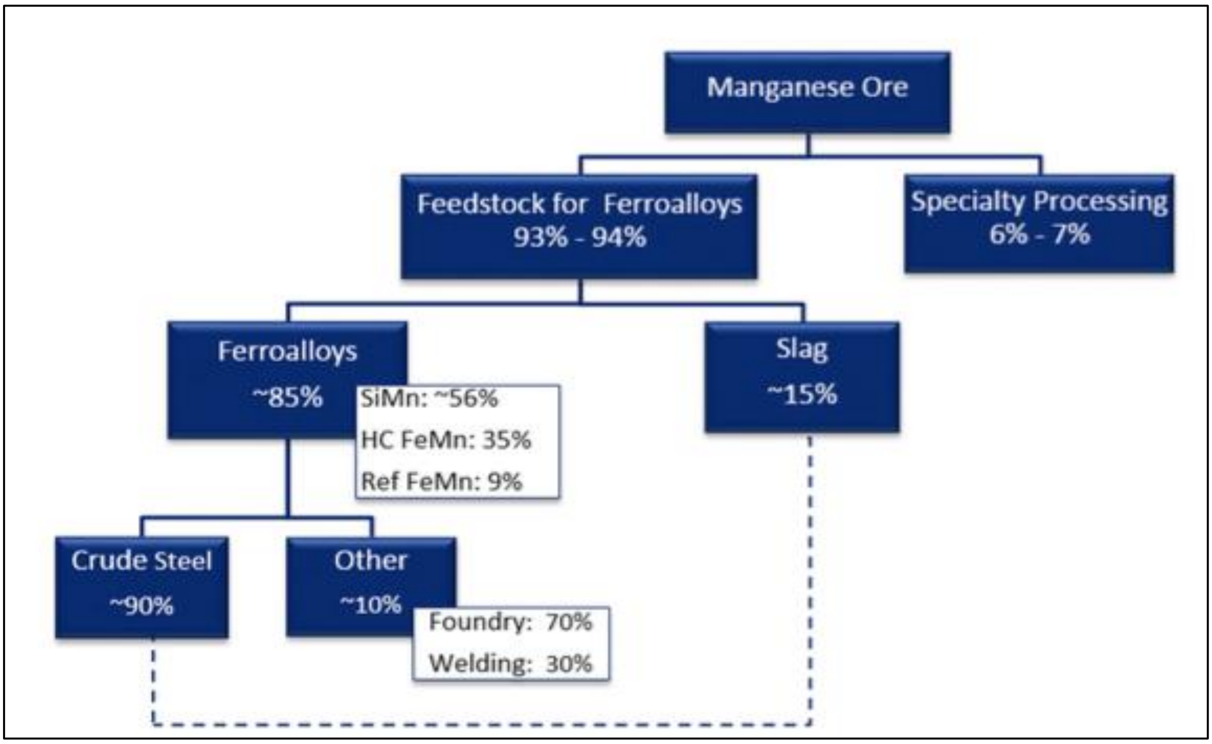

Figure 4.1: Aspects of the manganese value chain (Source: Risk and Policy Analysts, 2015)

The core skills required for the production of ore are geology, mining engineering, mine survey, and mineral processing. The core skills required for smelting, speciality processing to make batteries and chemicals, and production of steel are metallurgical engineering, chemical engineering and chemistry skills.

4.1.1.2 Skills available for manganese industry in comparison countries

Stacey et al (2008) indicated that there is a worldwide shortage of technical skills in all areas of the mining industry. The long-term implications of this worldwide shortage if not addressed is that there will be deficiencies in the safety, design, operation, and productivity of the mines.

The Mining Qualifications Authority (MQA) of South Africa (2016) reported that vacancies of mine manager, mine planner, mining engineer, rock engineer, surveyor, rigger ropesman, diesel mechanic, boilermaker, instrumentation mechanician, and the fitter positions are the ten most difficult vacancies to fill. The report attributes the shortage of these critical skills to the low levels of maths and science education at a basic education level. The report also highlighted deficient practical training and out-dated curriculum at technical and vocational education and training colleges, and a mismatch between skills and career opportunities as other key challenges that needed to be addressed (Mining Qualifications Authority, 2016). Neingo and Tholana (2016) highlighted labour availability, utilisation and the poor education of the workforce in South Africa as concerns that impacted on the productivity of gold mines. They also indicated that the prevalence of AIDS, absenteeism, and industrial action in the form of strikes all worsened this issue of labour availability (Neingo and Tholana, 2016). Musingwini et al (2013) made observations regarding the supply of mining graduates in South Africa. The first observation is that there is a shortage of skills in many of the disciplines that are necessary for the future health of the industry. The second observation is that the skills shortfall in South Africa used to be covered through the recruitment of overseas graduates, but due to a global shortage of engineers and other mining industry professionals, there has been a reversal of this trend. The third observation was that professionals constitute about 4 per cent of the total employees within the mining sector in South Africa, and these professionals are employed in technical skills areas and supporting functions within the mining value chain. The low percentage of professionals has meant that despite an increase in the number of graduates, the increases are not adequate to address the overall shortage of skills (Musingwini et al, 2013).

Almeida and Packard (2018) stated that Brazil is emerging from a stage in its development where labour has been abundant. The reason for this abundance is the private and public investment in education that has equipped its labour force with basic education, and also reaping the rewards of its demographic dividend. In terms of this demographic dividend, there was a time in Brazil when the working age people were substantially higher than that of children and the elderly, and through ensuring widespread access to primary and secondary education this advantage was sustained. The most recent and prolonged period of high growth, fuelled by an external demand for commodity exports managed to draw new workers into the commodities labour market, and this resulted in overall positive economic outcomes for the commodities sector (Almeida and Packard, 2018).

Lowry et al (2006) conducted a study to enable them to project the demand for labour in key occupational groups required by the mineral resources sector for the nine major commodities in Australia from 2006 to 2015. The main finding was that labour shortage is likely to be a major constraint on the growth of the mineral sector in Australia over the next decade. In addition, the projected supply-demand gaps were expected to be the largest in occupations that require low levels of skill. This meant that the identified labour shortage problem could not be addressed through an education and training policy; it required that more people should be attracted towards a career in the mining industry (Lowry et al, 2006). Hays Global Skills Index (2018) later indicated that the trend identified by Lowry et al (2016) had reversed, such that even though a shortage of the low skill level workforce in Australia persisted, the demand for highly skilled professionals and in high-skill industries has surpassed the need for low-skill workers and in low-skill industries. The reason for this trend is the fact that an increasingly automated world of work needs professionals to continuously upskill themselves to remain relevant and employable (Hays Global Skills Index, 2018).

Das (2015) stated that for India to achieve a faster, more sustainable and inclusive growth, and at the same time be able to provide decent employment opportunities and sustainable livelihood to the growing young population, skills development is critical. Das (2015) stated that India has a skills challenge and if it is not addressed in the next few years, India will not be able to sustain the current growth it is experiencing in its non-agricultural output. The Ministry of Skills Development and Entrepreneurship was set up in 2014 to address the challenges that have been outlined within the non-agricultural sectors (Das, 2015). Hays (2018) stated that the reforms that the Government of India has embarked on to address the skills challenge have had a recognisable impact. For example, India has for the first time moved into the top 100 countries in the World Bank's Ease of Doing Business global ranking for the first time. The talent strategies of the corporates in India are also increasingly visible, with a focus on innovative ways to retrain and reskill key talent resources as opposed to just hiring new skills. These strategies on retention and reskilling of talent are deemed to be even more important as the world moves more towards technologies like artificial intelligence, robotic process automation, data sciences, and block chain (Hays, 2018).

The World Economic Forum (2017) report stated that in general Africa is far from making optimal use of its human capital potential and is under-prepared for the impending disruption to the jobs market as a result of education and skills brought about by the fourth industrial revolution. The World Economic Forum's human capital index measures the extent to which countries and economies optimise their human capital through education and skills development. The human capital index of Gabon was measured to be 57%, and comparatively the human capital index of South Africa was measured to be 63%. This means that in relative terms, South Africa is better at capturing its human capital through skills and development relative to Gabon. The human capital index for the Ukraine was measured to be 71%, higher than both South Africa and Gabon respectively (World Economic Forum, 2017).

Table 4.1 summarises the information on the availability of skills within the comparison countries. Brazil is the highest ranked country of all the comparison countries in terms of the availability of skills because it has an abundant labour force, and this labour force has also been attracted to the commodities sector during a period of growth in this sector. Australia and India are ranked second and third in terms of the comparison countries as they both have labour available, but need to address some issues to ensure that their future growth is not restricted if these issues are not addressed.

Table 4.1: Comparison countries ranked in terms of availability of skills for the mining industry

Rank	Country	Status
1	Brazil	Abundant labour due to investment in education and the demographic dividend. The growth in commodity exports attracted skills to the sector.
2	Australia	The labour is available, but the mining industry needs to be made more attractive to this available labour. There is a need to upskill current workforce for a world of work that is continuously being automated.
3	India	The skills are available but insufficient for a faster and more sustainable growth. There are mechanisms in place to address the issue, and these are already yielding positive results and need to be sustained.
4	Ukraine	Human capital index is 71%, higher than that of South Africa.
5	South Africa	There is a shortage of skills, especially technical and support functions. Human capital index is 63%, higher than Gabon but less than Ukraine.
6	Gabon	Human capital index is 57%, less than that of South Africa.

South Africa and Gabon are the lowest ranked countries of all the countries compared. South Africa is slightly better than Gabon, with Ukraine being better than both South Africa and Gabon. Brazil, Australia and India have better availability of skills of all the countries compared, with Australia and India having some important issues to resolve to ensure that the availability of skills support their respective growth potential.

4.1.1.3 Skills costs for the manganese industry in comparison countries

In addition to considering the availability of skills, it is also important to consider the cost of the available skills for all the comparison countries. Figure 4.2 shows the labour market efficiency of South Africa against the top 10 ranked emerging economies and also against the average of the top 10 world economic forum global competitive index. The labour market efficiency index gives an indication of the cost of labour relative to productive output.

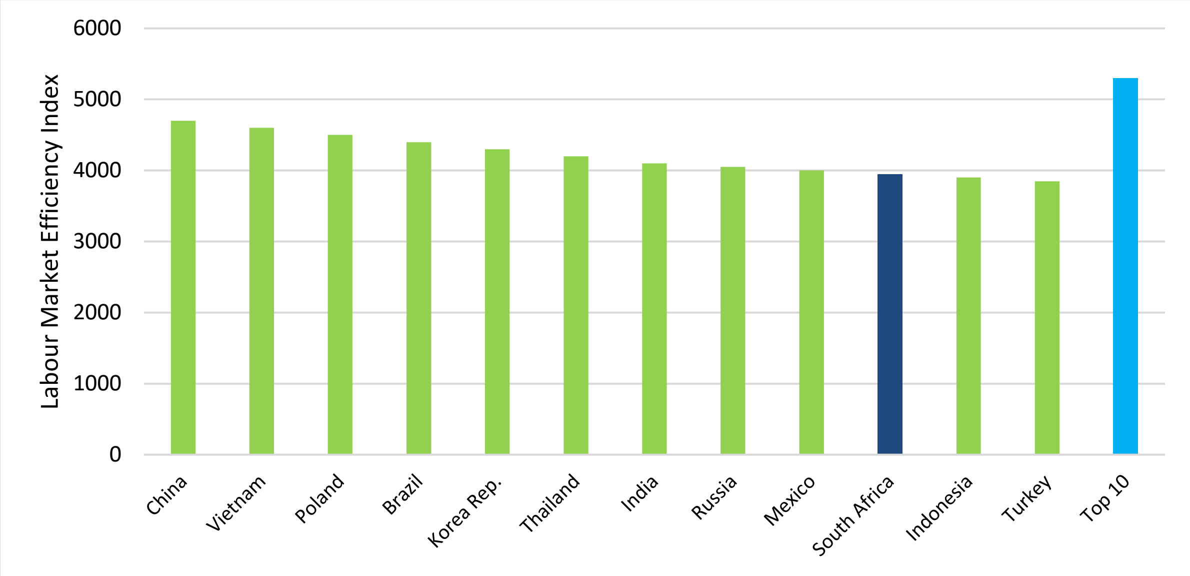

Figure 4.2: Labour market efficiency - Emerging economies (Source: Deloitte & Touché, 2013)

Figure 4.2 shows that South Africa's labour market efficiency is slightly less than that of India, and less than that of Brazil in terms of the comparison countries. The graph also illustrates that South Africa has one of the lowest labour efficiencies of the emerging economies; and its labour efficiencies are also lower than those of the developed countries as indicated through the average of the top 10 world economic forum global competitive index average. Edwards and Golub (2004) who assessed South Africa's international cost competitiveness further confirmed that the unit labour costs in South Africa are high when compared to those of other developing countries.

As already discussed, South Africa has a better availability of core skills that are required for the manganese industry when compared to Gabon, but has relatively lower availability of skills when compared to Brazil, Australia, India, and Ukraine. In addition, South Africa has relatively lower labour market efficiencies when compared to both India and Brazil. There is no information on the labour market efficiencies of both Gabon and Ukraine. Gabon has the lowest availability of skills of all the comparison countries according to the human capital index, and is it expected that in order to compensate for the shortage of skills, it will have to import these skills at relatively higher costs when compared to other comparison countries. South Africa has a labour market efficiency that is less than that of Brazil and India as emerging economies, and less than that of both Australia and Ukraine as part of the developed countries. South Africa in terms of both availability and cost of labour is less competitive when compared to Ukraine, Australia, India, and Brazil, but is more competitive when compared to Gabon.

4.1.2. Physical resources

The physical resources that are deemed critical will depend on the type of industry. In terms of the manganese industry; the physical resources that are deemed critical are the mineral resources to be extracted, water to be used for the processing of the ore, and hydroelectric power sources to be used for equipment operation. The issue of land is critical, but not separate from the mineral resource as the two are linked when applications are made for mineral tenement rights. The issue of location, although important, is treated as a cost element as there is no choice of where the mineral resources occur.

4.1.2.1 Manganese mineral resources in the comparison countries

Table 4.2 shows data on the global manganese resources and reserves. The resources are that part of the identified mineral deposit that meets the specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. The reserves represent that part of the resource that could be economically extracted or produced at the time of determination (U.S. Geological Survey, 2009).

Table 4.2: Global manganese resources and reserves (Source: U.S. Geological Survey, 2009 & 2018)

Country	2009 Resource (Kt)	2009 Reserves (Kt)	2017 Reserves (Kt)
Australia	160,000	68,000	94,000
Brazil	151,000	35,000	120,000
China	100,000	40,000	48,000
Gabon	90,000	52,000	20,000
India	150,000	56,000	34,000
Mexico	8,000	4,000	5,000
South Africa	4,000,000	95,000	200,000
Ukraine	520,000	140,000	140,000
Other countries	Small	Small	Small
World Total	**5,179,000**	**490,000**	**661,000**

Figure 4.3 shows the percentage of global manganese resources for each of the comparison countries. The manganese resources that are located in South Africa constitute about 77% of the total global manganese resources. The manganese resources located in the Ukraine make up about 10% of the total global manganese resources, and are the second largest concentration of manganese resources in the world. The remaining comparison countries constitute about 11% of the world manganese resources distributed as follows: Australia (3%), India (3%), Gabon (2%), and Brazil (3%).

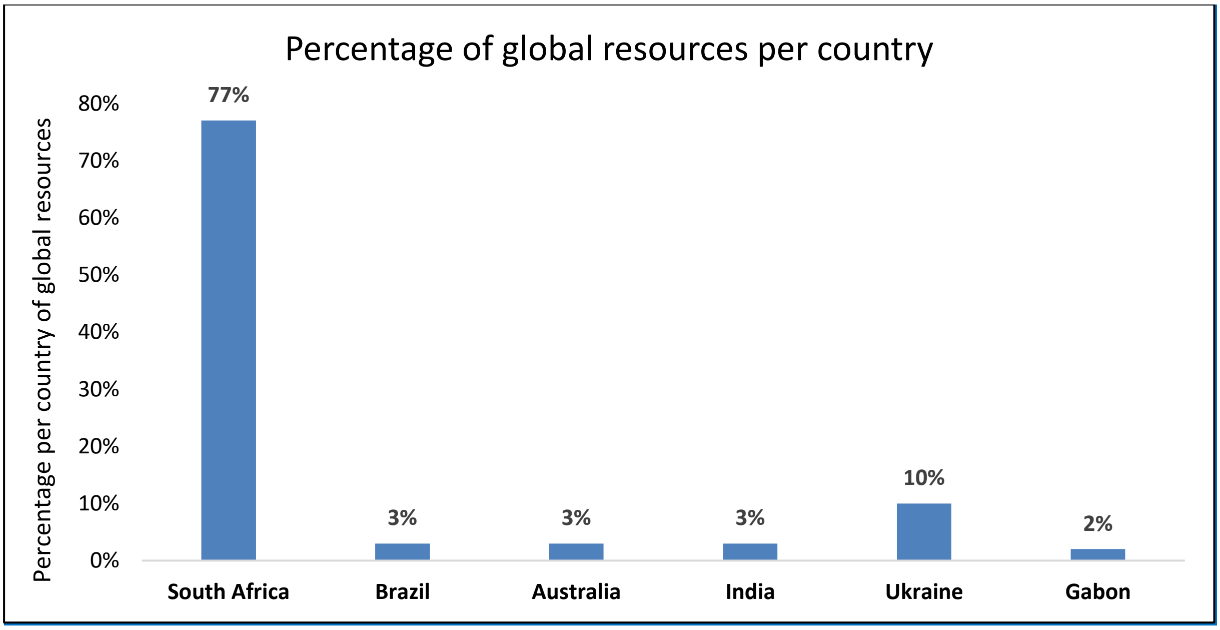

Figure 4.3: Percentage of global resources for each of the comparison countries (Source: U.S. Geological Survey, 2009 & 2018)

South Africa has the highest manganese resources relative to all the other countries that are compared. The Ukraine has the second highest amount of manganese resources, with Australia, India and Brazil having the third highest amount of global resources, and Gabon having the least amount of manganese resources of all the comparison countries. This means that South Africa has a superior comparative advantage in terms of its mineral resources when compared to other countries.

Figure 4.4 shows the percentage of global manganese reserves for each of the comparison countries. The total global manganese reserves are currently estimated to be about 661 million tonnes.

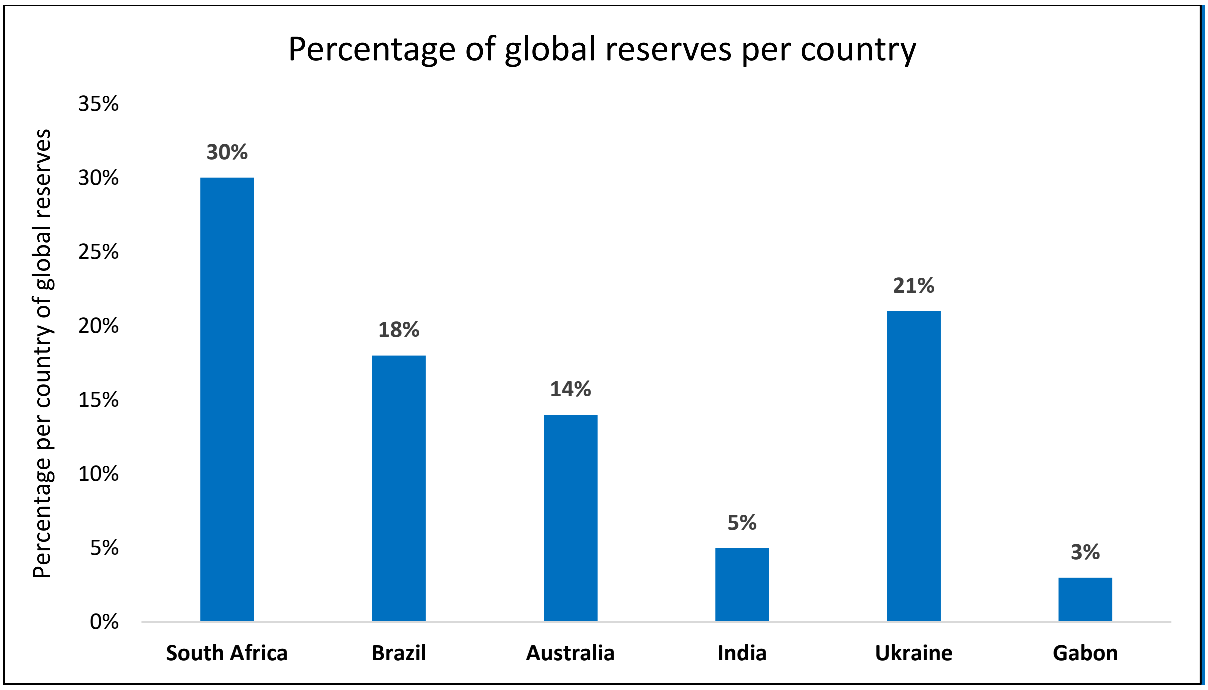

Figure 4.4: Percentage of global reserves for each of the comparison countries (Source: U.S. Geological Survey, 2009 & 2018)

The contributions of the different comparison countries to the current estimated global reserves are: South Africa (30%), Ukraine (21%), Brazil (18%), Australia (14%), India (5%), and Gabon (3%). South Africa has the highest amount of manganese reserves relative to all the other comparison countries, and Gabon has the least amount of reserves.

It is also important to compare all the countries in terms of the qualities or grades of their manganese resources. Table 4.3 shows the range of manganese grades that can be expected from each of the comparison countries.

Table 4.3: The range of manganese content of manganese ores produced (Source: Roskill Information Services, 2008).

Country	**Mn Content (%)**
Brazil	37-51
Australia	37-53
India	10-54
Ukraine	30-35
South Africa	30-48
Gabon	45-53

There are two main manganese ore product grades that are sold in the market, and these products are sold using the MB37 and MB44 indices. The MB37 index is used to price lower grade ores with a manganese content of 37%Mn, and the MB44 index is used to price the higher-grade ores with a manganese content of 44% Mn (Metal Bulletin, 2017). Table 4.3 indicates that for the requirements to produce 37%Mn and 44%Mn grade products, Brazil, Australia, and Gabon are able to sell their run of mine ore with no need to beneficiate the run of mine ore. This results in Brazil, Australia, and Gabon getting higher yields from their mined ore and their prices being more aligned to the respective price indexes for manganese, without the need to discount the prices to compensate for lower grades.

The Ukraine has the lowest grades of all the comparison countries. The manganese grades from both South Africa and India are comparable, although South Africa's grades are slightly better than India. In South Africa, the relatively lower-grade Mamatwan type resources have grades that are between 30 and 38% and make up about 97% of the resources. The remaining 3% is made up of higher-grade Wessel type ore resources with grades that range from 45 to 60% Mn (Roskill Information Services, 2008; Preston, 2001; Chetty, 2008). The manganese ore in India occurs in diverse geological environments and geographical locations. The states of Odisha, Karnataka, Madhya Pradesh, Maharashtra, Andhra Pradesh, Jharkhand, and Goa make up 97% of all the Indian resources (Indian Bureau of Mines, 2014), and the current production from these states are yielding manganese product grades greater than 25% Mn (Roskill information Services, 2008).

Open pit and underground mining methods are used to access and mine manganese reserves, and the method used depends on the depth and economics of extraction. The manganese resources across the globe are predominantly extracted using open pit methods (Roskill information Services, 2008). Groote Eylandt mine in Australia, the Mamatwan mine in South Africa and Moanda mine in Gabon are examples of open pit manganese operations. Underground operations use block-caving, room-and-pillar, modified cut-and-fill or longwall mining methods. The Wessels, Gloria and Nchwaning mining operations in South Africa are all underground operations. The mineral resources in South Africa, Ukraine, Australia, India, Gabon, and Brazil are physically accessible using either open pit or underground mining methods; the main limitation with accessing the ores is the economics of extraction (Roskill information Services, 2008).

South Africa has an abundance of manganese resources relative to the other comparison countries. The manganese grades of the South African resources are lower in comparison to those of Brazil, Gabon and Australia. The manganese grades of the South African resources are higher compared to both the Ukraine and India, as the current mining in India is yielding grades that are just above 25% Mn. The manganese resources of all the comparison countries are physically accessible through either open pit or underground mining methods, the only limitation is the economics of extraction of the individual mining projects.

4.1.2.2 The water resources of the comparison countries

The water resources for a country are measured using the concept of total actual renewable water resources. The total actual renewable water resources is the sum of all the internal renewable water resources and the natural incoming flow originating from outside the country, and takes into account the quantity of flow that is reserved for upstream and downstream countries through the formal or informal agreements. The total actual renewable water resources of a particular country are measured in terms of annual cubic meters per capita (Organisation for Economic Co-operation and Development, 2005).

Table 4.4 provides data for total renewable water resources per annum per capita and annual average rainfall for each of the comparison countries. The data indicates that there are differences in availability of water resources and average annual rainfall between the countries.

Table 4.4: Annual renewable water resources per capita and rainfall (Source: World Bank Group, 2014).

Countries	H_2O per capita (m^3)	Annual average rainfall (mm)
South Africa	821	495
India	1118	1083
Ukraine	1217	565
Australia	20 932	534
Brazil	27 721	1761
Gabon	87 433	1831

The data in Table 4.4 indicates that Gabon, Brazil, and Australia have a good amount of water resources available; with Ukraine, India, and South Africa having relatively lower resources. Rainfall is one of the natural methods through which the water resources of countries are replenished. The average rainfall data in Table 4.4 indicates that Gabon has the highest average annual rainfall together with its good water resources, and South Africa has the lowest average annual rainfall together with its relatively poor water resources of all the comparison countries. Brazil has the second highest average annual rainfall and water resources, with Australia in third place due to its good water resources and relatively low rainfall. India and Ukraine are in fourth and fifth place respectively due to India's better water resources and rainfall data when compared to the Ukraine.

The availability of water resources in South Africa is unfavourable when compared to all the other comparison countries. South Africa's position is further exacerbated by the fact that the low rainfall is the primary input to its water resources. The low water inputs or sources and the large population of South Africa makes it to be a relatively water scarce country and is therefore classified as a semi-arid area (WWF – SA, 2016). If the population of South Africa continues to increase, and there is no corresponding increase in its water resources, it will result in less water resources per capita and less water being available for industrial operations. An increase in demand for manganese products will result in a corresponding increase in demand for water resources to be used in industrial operations. If the scarcity of water is not addressed, it means the comparison countries are able take advantage of opportunities to increase production ahead of South Africa.

4.1.2.3 Hydroelectric power sources in comparison countries

There are countries that have hydroelectric power sources, and these sources provide these countries with a more sustainable and cost-effective source of energy. The installed and generation capacities of the comparison countries are compared with each other to determine which country has a competitive advantage with regard to hydroelectric power.

Table 4.5 indicates the installed hydroelectric capacities of each of the comparison countries. Table also highlights hydroelectricity generation figures for each country.

Table 4.5: Hydroelectric capacities (Source: International Hydropower Association, 2017)

Countries	Installed Capacity (MW)	Hydroelectric power (TWh)
South Africa	3 595	5.67
India	49 382	135
Ukraine	6 785	12.01
Australia	8 790	13.65
Brazil	100 273	401
Gabon	331	1.54

Brazil has the highest installed hydroelectric capacity, and India has the second highest installed capacity of all the comparison countries. South Africa has the second lowest installed hydroelectric capacity, with Gabon having the lowest installed hydroelectric capacity of all the comparison countries. Australia's installed hydroelectric capacity is higher than that of the Ukraine.

Table 4.5 also highlights the hydroelectricity generation figures for each of the comparison countries in 2017. The ranking of these comparison countries in terms of the hydroelectricity generated mirrors that of the installed capacity, with Brazil generating the highest amount and Gabon the lowest. Hydropower produces some of the lowest-cost electricity of any generation technology and is the largest source of renewable electricity generation today. The trend indicates that by 2020, all the mainstream renewable power generation technologies can be expected to provide average costs that are at the lower end of the fossil fuel cost range (International Renewable Energy Agency, 2018).

South Africa does not have a significant installed capacity for hydroelectricity compared to the Ukraine, Australia, India, and Brazil. South Africa has a higher installed capacity relative to Gabon, but the relative sizes of both their hydroelectric industries are very small compared to other comparison countries. The projected decrease in electricity costs that is associated with renewables will result in the South African manganese industry being at a disadvantage relative to Ukraine, Australia, India, and Brazil, and this due to its lower availability of hydroelectric power resources.

4.1.3. Capital resources

Ernst & Young (2017) highlighted access to capital as one of the high risks for the mining and metals industry. A measure that provides an indication on access to capital is the concept of Foreign Direct Investment (FDI). FDI is an investment by a company or an individual into business interests that are located in another country. Table 4.6 indicates the net inflows in FDI for all the comparison countries.

Table 4.6: The net inflows in foreign direct investment (Source: World Bank Group, 2017)

Countries	Foreign Direct Investment (FDI) US$ million
South Africa	1 374
India	39 966
Ukraine	2 827
Australia	45 100
Brazil	70 685
Gabon	1 498

The data indicates that Brazil, Australia, and India attracted relatively high amounts of FDI compared to South Africa, Gabon, and the Ukraine. The amount of FDI into Brazil is significantly higher than all the other comparison countries. The Ukraine attracted double the amount of FDI in comparison to both South Africa and Gabon. South Africa attracted the lowest amount of FDI, although marginally lower than the amount of FDI in Gabon.

Table 4.7 shows the sovereign credit ratings of the comparison countries as determined by Fitch ratings agency. The sovereign credit ratings are important to investors as they use them to determine whether or not to invest in a particular country. The sovereign credit ratings are also important to financial institutions as they are considered when determining interest to be paid on debt. The countries that have inferior sovereign credit ratings often attract higher interest rates.

Table 4.7: The Fitch sovereign credit ratings (Source: www.countryeconomy.com, 2018)

Countries	Sovereign Rating
	Fitch
South Africa	BB
India	BBB-
Ukraine	B-
Australia	AAA
Brazil	BB-
Gabon	B

Prime	High Grade			Upper Medium			Lower Medium			Non-Investment			Speculative		
AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-

Table 4.7 indicates that Australia has the best sovereign credit rating, which is a prime investment grade. India is a lower medium grade country, and is one rating higher than the non-investment grade. Brazil and South Africa are ranked as non-investment grade countries, with South Africa ranked one rating higher than Brazil. Gabon and the Ukraine are speculative, which means that they are below non-investment grade. It is evident from the data in Table 4.6 and Table 4.7 that the comparison countries that have relatively lower sovereign credit ratings have also attracted correspondingly lower FDI, with the exception of Brazil.

The raising of capital in the mining sector is becoming progressively difficult, the capital that was raised in 2015 had decreased by about 10% year-on-year. The banks are extending trade and long-term financing at an increased cost due to an increase in the risk of default. As a result, most mining companies are looking at their portfolios to divest non-core assets and explore options that will lower the capital requirements and maintain operational flexibility. Such a strategy will enable companies to weather the storm and over time convince lenders of long-term viability (Ernst & Young 2017).

4.1.4. Infrastructure resources in the comparison countries

The infrastructure resources that are critical for the manganese industry are electricity and logistics resources. The electricity infrastructure is critical in delivering the electrical power that is required to operate equipment and also for the beneficiation of manganese ores. The logistics infrastructure is critical in delivering the products from the location of the operations to both the domestic and export customers.

4.1.4.1 Electricity resources in comparison countries

Hydroelectric power sources have already been discussed in Section 4.1.2. There is limited information available in the public domain on hydroelectric infrastructure to enable a comparison between South Africa, Ukraine, Australia, India, Gabon, and Brazil. It can be inferred from the data in Table 4.5 that the infrastructure is in place to deliver the hydroelectricity that is currently being produced.

This section of the report discusses the broader electricity infrastructure that includes fossil fuel generated power. The information that is available in public domain on the broader electricity infrastructure is also limited. The limited information available is used to make inferences on the adequacy of the electricity infrastructure in the respective comparison countries.

Table 4.8 and Table 4.9 show the electricity production and population access data for the comparison countries. The electricity access data measures the extent to which the delivery of electricity has penetrated the population of a particular country.

Table 4.8: Total electricity production (Source: Enerdata, 2018)

Countries	**Electricity Generated**
	TWh
South Africa	254
India	1 541
Ukraine	158
Australia	255
Brazil	585
Gabon	2

Table 4.9: Electricity access (Source: World Energy Council, 2018a)

Countries	**Electricity Access**
	% of Population
South Africa	85.3
India	79.9
Ukraine	99.9
Australia	100
Brazil	99.5
Gabon	89.3

Table 4.8 and Table 4.9 indicate that India has the highest electricity production and the lowest electricity access by its population relative to all the comparison countries. This could be as a result of either insufficient generation capacity relative to the size of the population or inadequate distribution of the electricity that is produced, either factor is indicative of inadequate infrastructure. Brazil, Ukraine, and Australia have high electricity access numbers that indicate that almost all of their respective populations have access to electricity. This means that the electricity generation and distribution infrastructures in Brazil, Ukraine, and Australia are adequate for the needs of their respective countries. South Africa and Gabon have relatively lower access numbers compared to Brazil, Ukraine, and Australia. South Africa has generation numbers higher than the Ukraine and Gabon, but comparable to those of Australia. The electricity generation numbers from South Africa are significantly lower when compared to those of Brazil and India. Gabon has significantly lower generation numbers relative to all the comparison countries. It is concluded that based on the electricity generation and access data, South Africa and Gabon either have insufficient generation capacities or inadequate distribution networks relative to other comparison countries. This makes both South Africa and Gabon the two countries that possibly require the most improvement in terms of electricity infrastructure relative to other comparison countries.

The costs that are incurred on infrastructure are firstly the capital costs of setting up the infrastructure and then secondly the cost of maintaining the infrastructure. The building of electricity generation and distribution infrastructure is capital intensive. In Section 4.1.3 it was indicated that access to capital resources is a great challenge, and if capital is accessed, the overall costs of the capital for the infrastructure depends on the sovereign rating and the interest charged on the capital. It is difficult to compare the infrastructure capital costs of South Africa, Ukraine, Australia, India, Gabon, and Brazil as the infrastructure in all these countries was built at different times with different prevailing circumstances. The infrastructure costs are often reflected in the electricity tariff, although it is difficult to separate these costs out, as there is insufficient information in the public domain to be able to do so.

The industrial electricity tariffs of South Africa, Ukraine, Australia, India, Gabon, and Brazil are compared as an indication of the relative costs of operating and maintaining the electricity infrastructure. Table 4.10 shows a comparison of the industrial electricity prices for the different countries.

Table 4.10: Industrial electricity prices (Source: World Energy Council, 2018b)

Countries	**Industrial Electricity Prices**
	US$ per KWh
South Africa	4.7
India	9.8
Ukraine	12.5
Australia	33.4
Brazil	8.8
Gabon	22.2

South Africa has the most competitive industrial electricity prices relative to the other countries, and Australia has the most expensive prices. The industrial electricity prices of India and Brazil are marginally different, and the electricity prices of the Ukraine are above that of India and Brazil. Gabon has the least competitive industrial electricity prices after Australia.

South Africa’s electricity infrastructure costs less to operate and maintain, but has infrastructure that seems inadequate in terms of both the generation and distribution of electricity. This means that the electricity infrastructure in South Africa is supportive to industries in terms of energy economics, but not in terms of access to energy. Mogodi (2012) stated that South Africa’s electricity generation infrastructure is inadequate for its needs, and this is evidenced by electricity power cuts that have been prevalent in recent years.

4.1.4.2 Logistics resources in comparison countries

The management of the logistics and supply chain processes contribute significantly to the competitiveness of a country. These processes are critical as the demand for products is satisfied through the timely and cost-effective delivery of products to customers (Ittmann and King, 2010). The Logistics Performance Index (LPI) is used to determine the competitiveness of the logistics value chain of different countries. The LPI is measured using six areas that are considered important to determine the logistics environment. The six areas according to Ittmann and King (2010) are:

- Efficiency of the customs clearance process;
- Quality of trade and transport-related infrastructure;
- Ease of arranging competitively priced shipments;
- Competence and quality of logistics services;
- Ability to track and trace consignments; and
- Frequency with which shipments reach the consignee within the scheduled or expected time.

The six areas incorporate within the LPI quantitative and qualitative considerations on logistics infrastructure, efficiencies, quality, price, information availability and reliability. Table 4.11 shows LPI data for South Africa, Ukraine, Australia, India, Gabon, and Brazil.

Table 4.11: Logistics performance index (Source: World Bank Group, 2017)

Countries	Logistics Performance Index
South Africa	3.38
India	3.18
Ukraine	2.83
Australia	3.75
Brazil	2.99
Gabon	2.16

The LPI data indicates that Australia has the most competitive logistics performance relative to the other countries, and Gabon has the least competitive logistics performance. South Africa has the second most competitive logistics performance, with India and Brazil ranking third and fourth respectively. The Ukraine is in fifth position with an LPI of 2.83, which is higher than that of Gabon.

4.2. Demand conditions

4.2.1. Local demand composition

The aim of this section of the report is to present the local demand composition of all the comparison countries. In terms of Porter's diamond model, this means an analysis of the segment structure of demand, the nature of the local customers, the ability of the local customers to anticipate the needs of the other nations for all the comparison countries.

4.2.1.1 Segment structure of demand in comparison countries

In terms of the segment structure of demand, the primary product within the value chain is the manganese ore. The manganese ore is thereafter used as an input into the production of either manganese alloys or specialist manganese products. The manganese alloys and specialist manganese products are the secondary products within the manganese value chain. Manganese alloys are used as an input in the steelmaking process, and the specialist manganese products are either used to produce chemicals or batteries. Due to the structure of the value chain, the customers for manganese products are segmented into manganese ore customers, manganese alloy customers, and manganese metal customers (Roskill Information Services, 2008). The research methodology stated that the competitiveness analysis of the South African manganese industry will be limited to the use of manganese in steel making, therefore this means the segmented structure of the demand will be the demand for manganese ore products and the demand for manganese alloy products.

South Africa, Ukraine, Australia, India, Gabon, and Brazil all have local demand for manganese ores to use in the manganese smelting processes located in these respective countries (IMnI, 2013; Eramet, 2018). All the other countries, with the exception of Gabon, also have a local demand for manganese alloys in order to feed the steel industry located in the respective countries (IMnI, 2013).

4.2.1.2 Local customers and their anticipation of international needs

The nature of the local customers in South Africa, Ukraine, Australia, India, Gabon, and Brazil; and their ability to anticipate the needs of other nations are compared with each other. This is to determine the relative competitive advantage that the local customers provide for manganese industries located in their respective countries.

The data in Table 4.12 and Table 4.13 indicates that the manganese industries in South Africa, Ukraine, Australia, India, and Brazil all have local manganese ore and alloy markets. Gabon has since the year 2015 established the Moanda Metallurgical Complex (MMC) to process some of the locally produced ore in order to make manganese alloy for export (Eramet, 2018).

Table 4.12: Manganese ore consumption per country (Source: IMnI, 2013)

Manganese Ore Consumption (Kt)							
Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Australia	269	287	159	270	281	162	257
Brazil	673	754	197	551	260	296	258
India	929	949	940	1 021	1 676	1 856	2 082
South Africa	780	621	310	623	880	800	798
Ukraine	1 483	1 231	728	1 108	840	884	711
Gabon	-	-	-	-	-	-	-

Table 4.13: Manganese alloys consumption per country (Source: IMnI, 2013)

Manganese Alloy Consumption (Kt)							
Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Australia	73	71	53	72	52	39	37
Brazil	268	272	177	202	250	238	232
India	802	884	973	1 003	1 093	1 270	1 344
South Africa	89	82	67	71	67	57	54
Ukraine	342	362	232	218	267	246	276
Gabon	-	-	-	-	-	-	-

Table 4.14 indicates that the respective local markets of all the countries, with the exception of Gabon, import manganese ores from other countries for domestic consumption. This results in the local ore markets of these respective countries having exposure and experience in treating different types of manganese ores; this in addition to being able to treat the locally produced manganese ores. The manganese industries in the countries that import relatively less manganese ores such as South Africa, Australia, and Brazil might have relatively less exposure and experience compared to the Ukraine and India. Due to their relatively larger exposure in dealing with imported ores, both India and the Ukraine will be at an advantage in future as a result of the experience gained in dealing with the complexities of using different types of ores.

Table 4.14: Manganese ore imports per country (Source: IMnI, 2013)

Manganese Ore Imports (Kt)							
Year	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Australia	86	88	1	87	57	75	99
Brazil	143	135	12	23	8	32	31
India	500	709	777	1 639	1 817	2 367	974
South Africa	2	27	1	5	17	31	6
Ukraine	1 502	2 003	885	1 298	1 204	728	723
Gabon	-	-	-	-	-	-	-

Table 4.15 shows the crude steel production for all the countries that are being compared. The main producers of crude steel in each of the comparison countries are significant global producers.

Table 4.15: Crude steel production (Source: International Trade Administration, 2018)

Crude Steel Production	
Countries	**Mt**
Australia	5.3
Brazil	34.4
India	101.4
South Africa	6.3
Ukraine	21.3
Gabon	-

Arcelormittal is the largest global producer of crude steel, and it operates in Brazil, South Africa, and the Ukraine. Tata Steel is the tenth largest producer of crude steel in the world, and operates in different countries, and is one of the largest producers of crude steel in India. BlueScope is a multinational steel company, and the largest producer of steel in Australia. There is no production of crude steel in Gabon (World Steel Association, 2018). The local manganese alloy markets of South Africa, Ukraine, Australia, India, and Brazil differ in terms of their relative sizes; but all these countries deliver products to global leaders in the production of crude steel.

South Africa, Ukraine, Australia, India, Gabon, and Brazil all have differing degrees of local consumption with regard to manganese ores. All these countries, with the exception of Gabon, also have a history of importing ores from other countries. This history of importing different ores gives these particular countries an advantage as they are able to handle the complexities of treating ores from other countries, and are also able to understand the characteristics of these imported ores and what needs to be done in order to compete with them.

South Africa, Ukraine, Australia, India, and Brazil all have companies that are global leaders in steel production operating in their respective countries, and these global leaders in steel production use the manganese alloys in these respective countries as inputs. These steel producers due to their global footprint provide products to different international markets. The local alloy producers that provide the manganese alloy inputs to the steel industries in South Africa, Ukraine, Australia, India, and Brazil gain an advantage in that they provide manganese alloys to leading global steel producers. This puts them on the cutting edge of being able to anticipate the needs of international customers ahead of competitors.

4.2.2. Demand size and pattern of growth

The demand size and pattern of growth aspect of the diamond model analyses the size of the local demand, the number of independent customers, the rate of growth of the local demand, the early local demand, and the early saturation of the local demand. All these factors are compared among South Africa, Ukraine, Australia, India, Gabon, and Brazil in order to understand the size of the demand and the pattern of the growth and which of these countries have a competitive advantage.

4.2.2.1 The size of the local demand for manganese ore and alloys

The size of the local demand for both manganese ores and alloys is estimated using the consumption data for the respective manganese products. The manganese ores and alloys consumption data are presented in Table 4.12 and Table 4.13.

Table 4.12 and Table 4.13 show that India has the largest local market for both manganese ores and alloys relative to all the other comparison countries. The manganese ore consumption data from 2011 to 2013 indicates that the respective local markets of South Africa and the Ukraine are comparable with one another, and together can be regarded as the second largest local ore markets, considering year-on-year fluctuations. The local manganese ore market of the Ukraine has decreased over the period under review, whereas that of South Africa has remained fairly constant. The local manganese ore markets of Australia and Brazil are also comparable to each other, when considering year-on-year fluctuations; as a result, both these countries can be considered be having the third largest local manganese ore market of all the comparison countries.

The manganese alloy consumption data from 2011 to 2013 indicates that India has the largest local alloy market of all the comparison countries. The local manganese alloy markets of both Brazil and the Ukraine are comparable with each other and can be considered to be the second largest local alloy markets, with both Australia and South Africa having the third largest local alloy markets of all the comparison countries. The relative sizes of the local manganese alloy markets for South Africa and Australia are small relative to other comparison countries. South Africa has the second largest local ore market relative to all the other comparison countries, and a relatively small local market for manganese alloys.

4.2.2.2 The number of independent customers

The local manganese ore markets of South Africa, Ukraine, Australia, India, Gabon, and Brazil all have a number of independent customers. The customers for the local manganese ores are the local alloy smelters. There are three main independent customers of manganese ore in South Africa, and these are Samancor’s Metalloys smelter, Assmang’s Cato Ridge smelter, and Transalloys smelters. There is one main customer of the local manganese ore in Australia, and it is the Temco smelter that is also owned by Samancor. There are about eighteen different companies in India that are independent customers of local manganese ores. These companies have different production capacities and also produce different types of alloys. These local manganese ore customers in India are: Baheti Metals and Ferro-Alloys Ltd, Balasore Alloys Ltd, Chhattisgarh Electricity Co. Ltd, Ferro-Alloys Corp. (Facor), Hira Ferro Alloys Ltd, Jalan Ispat Castings Ltd, Karthik Alloys Ltd, KFA Corp, Maharashtra Elektrosmelt Ltd (MEL), Maithan Group, Manganese Ore India Ltd (MOIL), Nava Bharat Ventures Ltd (NBV), Sandur Manganese and Iron Ore Ltd, Shri Ganesh Ferro-Alloys, Sova Ispat Group, Srinivasa Ferro-Alloys Ltd, Sun Metal & Alloys, and Universal Ferro and Allied Chemicals Ltd. (Roskill Information Services, 2008).

The local manganese ore market for the Ukraine has a number of independent customers that are producers of different types of alloys. There are five local manganese ore customers in the Ukraine, and three that are owned by the same company, which is Privat. The independent local manganese ore customers within the Ukraine are: Konstantinovsky Metallurgical Plant, Kramatorsk Metallurgical Plant, JSC Nikopol (NZF), JSC Stakhanovsky (SFP), and JSC Zaporozh'e (ZFZ). Privat owns the alloy producers JSC Nikopol (NZF), JSC Stakhanovsky (SFP), and JSC Zaporozh'e (ZFZ). Brazil has one manganese smelter that produces about 75% of its total alloy output, and hence is the main local customer of manganese ore. The largest customer of manganese ore in Brazil is Companhia Vale do Rio Doce (CVRD). There are a large number of other independent customers of manganese ore in Brazil, due to limited reporting of these companies, some of them might be out of operation as Table 4.14 indicates that manganese ore consumption in Brazil has declined since 2010. There are about eight other independent customers of manganese ore in Brazil, and these customers are: Maringá SA Cimento e Ferro-Liga, Ferro-Ligas Maringá plant, Unidade Conselheiro Lafaiete plant in Minas Gerais, Puiatti & Filhos Comercio e Industria Ltd, Ferro Ligas Piracicaba, Cia. de Ferroligas da Bahia (Ferbasa), Companhia Ferroligas do Amapa (CFA), and Prometal Produtos Metalurgicos SA (Roskill Information Services, 2008).

South Africa, Ukraine, India, and Brazil all have a number of independent manganese ore customers; Australia and Gabon have mainly one local customer for their manganese ore products. The growth of the local manganese ore consumption in countries with multiple independent customers depends on the growth of the local independent customers and the growth of the export market, whereas the growth of the countries with one local customer is limited locally and depends more on the export market.

The local manganese alloy markets of South Africa, Ukraine, Australia, India, and Brazil also consist of a number of independent customers, with the exception of Gabon, which has no local alloy consumption. The steel producers are the customers for the local consumption of manganese alloys. There is one main independent customer of manganese alloys in South Africa, and that is ArcelorMittal. The main independent customers for the locally consumed manganese alloys in Australia are BlueScope Steel and Arrium (International Trade Administration, 2018).

Ukraine has three main independent customers for the local alloy market, and these customers are Metinvest Holding, PJSC Arcelormittal Kryvyi Rih, and Industrial Union of Donbass (ISD). There are six independent customers for the local Indian alloy market, and these customers are the JSW Steel Limited, Steel Authority of India, Tata Steel Group, Essar steel Group, Rashtriya Ispat Nigam, and Jindal Steel and Power. Brazil consists of a number of independent local customers for its alloy market. There are four main independent customers, and these are Gerdan SA, ArcelorMittal Brasil, Usinas Siderurgicas de Minas Gerais SA, and Companhia Siderurgica Nacional (CSN).

South Africa has one independent manganese alloy customer compared to the other countries that have more than one independent alloy customer. Gabon has no independent local customer for its alloy products, as all of them are exported.

4.2.2.3 Early local demand and saturation of the local demand

The local manganese ore and alloy customers in South Africa, Ukraine, Australia, India, and Brazil are mainly multinational companies that compete on the global manganese market. Samancor is a leading producer of both manganese ores and alloys, and operates mines and smelters in South Africa and Australia (IMnI, 2013). Arcelormittal is the largest producer of crude steel in the world, and it operates in Brazil, South Africa, and the Ukraine. Tata Steel is the tenth largest producer of crude steel in the world, and operates in different countries, and is one of the largest producers of crude steel in India. BlueScope is a multinational steel company, and the largest producer of steel in Australia (World Steel Association, 2018). These factors enable the respective local manganese markets for both ores and alloys in South Africa, Ukraine, Australia, India, and Brazil to be on the cutting edge of development and to anticipate early in the process and ahead of its competitors the changes in the demand needs of the different countries.

The IMnI data reports on the ore production and alloy production capacities of the different countries, and also on the actual production of the respective countries. The ratio of the actual production and the production capacity is known as a capacity utilisation factor for either the mine operation or the smelter. Table 4.16 shows the IMnI data for 2001 till 2013 for South Africa, Ukraine, Australia, India, Gabon and Brazil, indicating the respective average capacity utilisation factors for the mines and smelters.

Table 4.16: Capacity utilisation factor (Source: IMnI, 2013)

Countries	**Capacity Utilisation Factor**	
	Mine	**Smelter**
South Africa	0.8	0.7
India	0.8	0.7
Ukraine	0.5	0.7
Australia	0.9	0.6
Brazil	0.7	0.8
Gabon	0.9	-

The average capacity utilisation factors for both the manganese ores and alloys indicate that the local markets in all the comparison countries are saturated, if that was not the case, all the factors will be at 1 to indicate that the capacity is fully utilised. The availability of some idle production capacity also means that when there is an increase in demand, the response is more likely to be swift as the capacity is already installed, and the local market will revert quickly back to saturation.

4.2.2.4 Growth rate of the local demand

Table 4.12 indicates that the respective local demands for manganese ores for Australia and South Africa have remained at relatively consistent levels since 2007. The data also indicates that the local demand for manganese ore has increased in India, and has decreased for both the Ukraine and Brazil. Table 4.13 indicates that the local demand for manganese alloys in Brazil has remained relatively constant since 2007. The data also indicates that the local demand for manganese alloys in India has increased, and decreased for South Africa, Australia, and the Ukraine.

The rate of growth of both manganese ores and alloys have in general either remained constant or declined over time, with the exception of India. This could mean that the domestic markets of all the comparison countries are saturated, with growth in the future expected to come from export markets. The decline in both local manganese ore and alloys in the respective comparison countries could be due to production of these products being more favourable elsewhere, as it has already been discussed that demand for the manganese products is expected to grow into the foreseeable future.

4.2.3. Internationalisation of domestic demand

As discussed in Section 4.2.2, the local customers for both manganese ores and alloys in South Africa, Ukraine, Australia, India, and Brazil, with the exception of Gabon, are multinational companies. These multinational companies often have to produce products to the required customer specifications and also adhere to international standards such as ISO 9001 on quality management. The required qualities for steel, batteries, and chemicals lead to a demand for specific qualities and specifications of manganese ores and alloys, which makes the internationalization of the domestic manganese products inherent in the specific requirements of the end-use products (Risk and Policy Analysts, 2015). The presence of multinational companies in South Africa, Ukraine, Australia, India, and Brazil put them at an advantage in terms of having a domestic demand that is internationalised or has the same requirements as international markets. The multinational companies in these countries provide manganese products worldwide, and through having to produce products at certain specifications and also to adhere to international standards, are able to internationalise the local demand.

4.3. Related and supporting industries

The related and supporting industries in South Africa, Ukraine, Australia, India, Gabon, and Brazil are analysed to determine if they are internationally competitive and are able to provide efficient, timely, and preferential access to cost-effective inputs (Porter, 1998). The presence of an internationally competitive and efficient related supplier industry enables the local industry to be more competitive and sustainable, as the local industry does not have to rely on other economies for its critical inputs.

South Africa has one of the largest, most diversified and longest established mining and minerals sector in Africa. This has enabled South Africa to develop significant expertise in mining-related supplier industries over the years. There are a number of companies that are at the cutting edge of technology at a global scale, due to their long history in the sector (Kaplan, 2011). The level of growth of the exports of mining equipment and specialist services indicates that South Africa is globally competitive when it comes to the supply of equipment and specialist services (Kaplan, 2011).

There are representatives of companies that argue that although local supplier companies have been competitive on international markets in the past, this competitiveness is gradually being eroded. The erosion of the competitive advantage is attributed to both market related and company specific factors; and these are issues such as lack of skills, high input costs, lack of innovation, varying demand due to commodity price cycles, the volatility of the exchange rate, constraints on working capital, and others factors (Lydall, 2009). Walker and Minnitt (2006) used data from 678 suppliers to mining companies to investigate the competitiveness of the South African minerals input cluster. The outcome of the investigation indicated that South Africa has developed niche competencies and expertise in a number of key areas of the mining sector and that there are issues related to growth, access, knowledge development, and restructuring of the local inputs cluster to ensure greater competitiveness.

The Mining Equipment and Technology Services (METS) companies in Australia have a long history, and these companies have emerged over the years due to the need to support mining companies in their exploration, mining and ore refining activities. The first METS companies in Australia were established in 1859 (Francis, 2015). The METS sector in Australia has continued to grow over the years, with recent data indicating that the METS sector in Australia has increased five-fold for the decade that started in 2005. The growth is attributed to the flexibility of the companies and their ability to work across different commodities and phases of mining projects. A significant portion of the METS in Australia is made up of small-and-medium enterprises (SME), and 84% of METS companies are Australian owned. There are about 55% of the METS that are exporting their goods and services, with another 18% of them planning to export in future (Francis, 2015). Figure 4.5 shows the Australian METS industry, outlining the products and services. The size of the bubble gives an indication of the amount of work in that area and the overlaps between the bubbles indicate related areas of work.

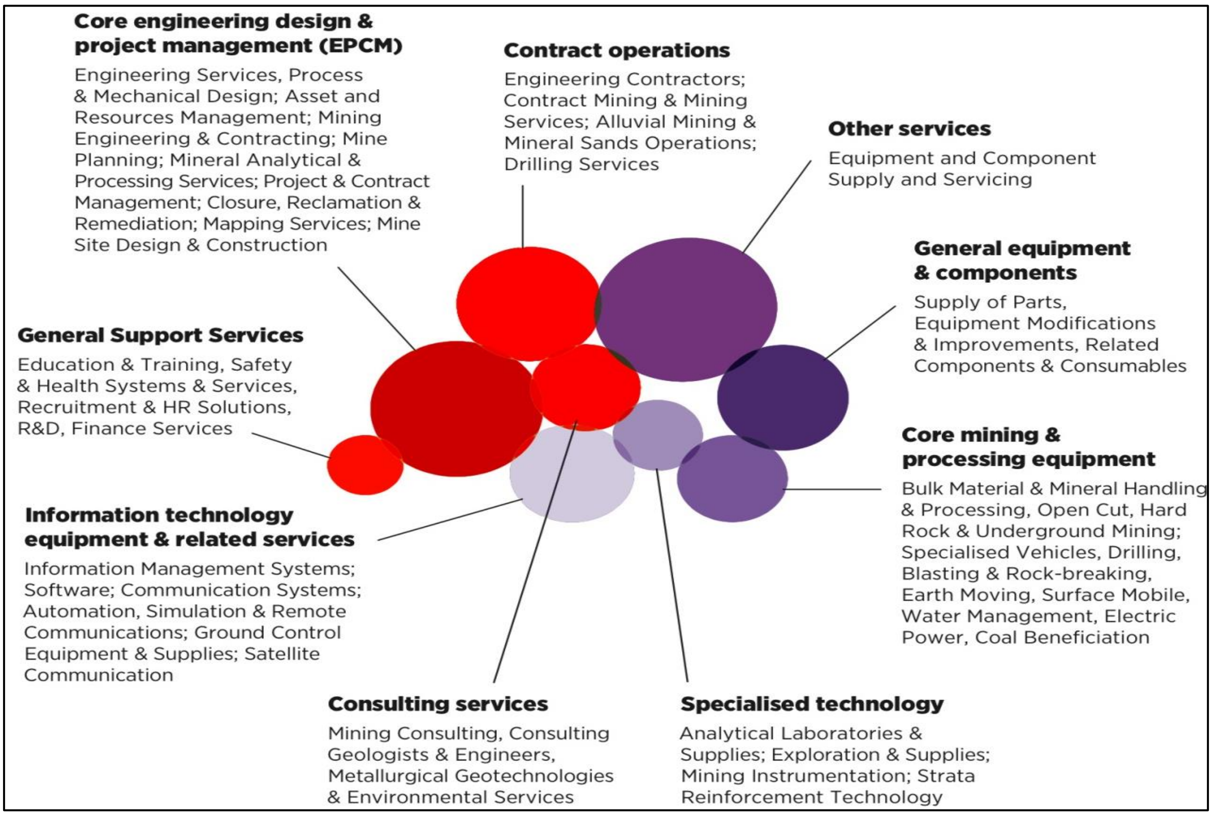

Figure 4.5 : Types of METS and examples of products and services (Source: Scott-Kemmis, 2013)

Brazil has a relatively developed industrial base, with a number of well-established companies that have a capacity to procure large quantities of goods and services to the mining industry. A recent study revealed that in the region of south-east Para, Vale which is the largest mining company in Brazil, procured close to 75% of its mining inputs from Brazilian companies (22% from the region, 48% from service providers outside the region but within Brazil, and 4% from the State); this is significant when compared to other developing economies (Korinek and Ramdoo, 2017). Brazil does not put emphasis on the nationality or ownership of the companies that supply the mining industry, but has actively supported the development of domestic engineering and services companies. This support for the development of engineering and services companies has also led to Brazil encouraging the establishment of key international players that are critical to service the existing market. The establishment of the international service providers within Brazil was encouraged within the context of forming joint ventures and partnerships between established international companies and domestic players, this being done with a view to combine international experience and technical expertise with the local knowledge of Brazilian companies. This initiative has been particularly effective in supporting the mining industry and ensuring that the inputs are procured locally. The equipment supply market in Brazil is relatively more mature than the services supply market. Brazil is considered to have relatively high levels of technical standards with regards to the manufacturing and supply of equipment (Korinek and Ramdoo, 2017).

The Ukraine was one of the key producers of energy and metallurgy equipment, machine tools, agricultural equipment, and railway cars when it was still part of the Soviet Union. The presence of these industries was due to Ukraine's comparative advantage, this as result of the Ukraine having significant amounts of natural resources such as iron ore that feed into the machinery industry (Naurodski and Dzmitry, 2016). There are key vulnerabilities of the machine building sector of the Ukraine. The vulnerabilities are the relatively low quality of products, out-dated equipment and technology due to underinvestment in the sector, and also the high dependence of the sector on the Russian market. The FDI statistics indicate that the machine-building sector remains relatively underinvested in Ukraine, attracting about 7% of all the investments within the equipment supply industry. The machine building sector is 5.5 times less likely to receive foreign investment when compared to investment in metallurgy and manufacturing of fabricated metals (Naurodski and Dzmitry, 2016).

Almost two thirds of domestic production of the mining and construction equipment in India is done by foreign multinationals, using either wholly-owned subsidiaries or joint ventures with Indian companies. The trend indicates that there are intentions to localize high volume and regular equipment, with the high value advanced equipment still being imported. The intent is for the market to gradually be transformed and eventually be fully localised. Figure 4.6 indicates that over 60% of the market demand for mining and construction equipment is fulfilled through locally produced products (Business Sweden, 2015).

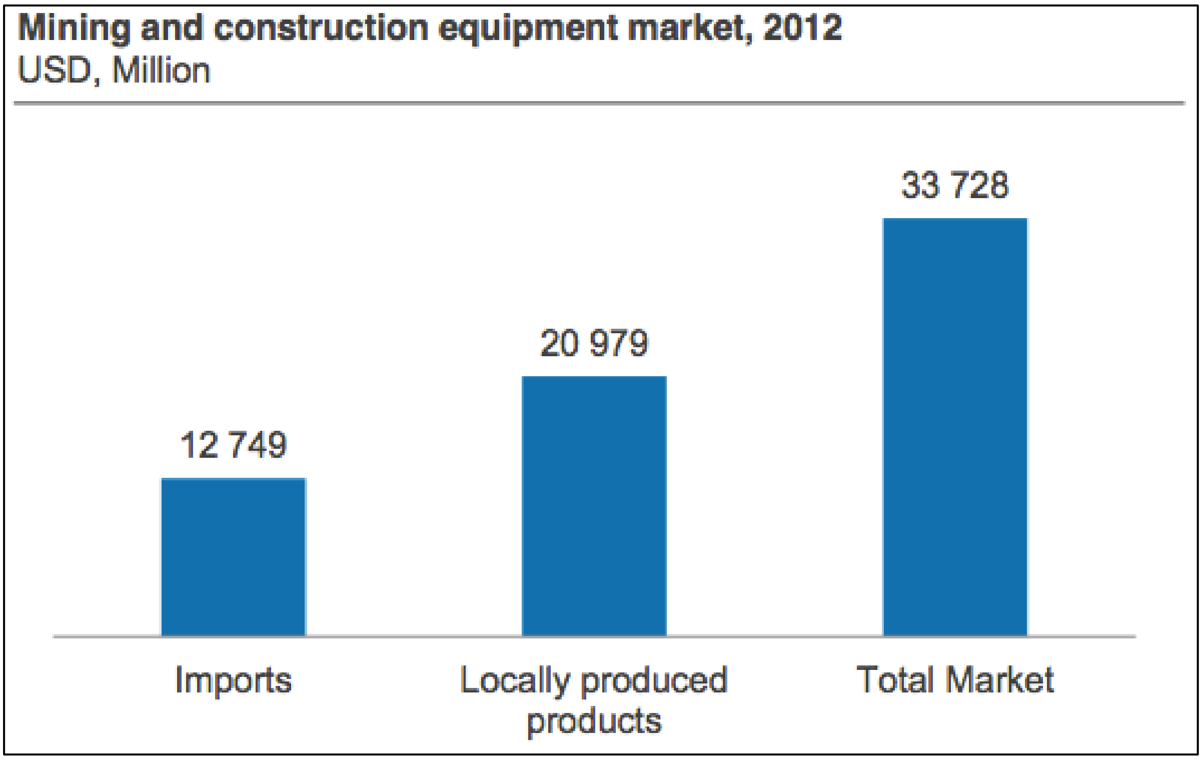

Figure 4.6: India's mining and construction equipment market (Source: Business Sweden, 2015)

To remain competitive, most of the global equipment giants have established their own manufacturing facilities in India. Caterpillar operates around seven manufacturing facilities across India for different products; including mining, quarrying, earthmoving and construction equipment. The facilities are also used to supply equipment globally. The Caterpillar facilities in India serve more than 40 business units across globe. Atlas Copco operates three manufacturing facilities in India, with about 22 offices spread across India, and this business generates revenue of about US$100 million through its construction and mining division in India. Terex with its wholly-owned subsidiary in India operates three manufacturing facilities in India. These facilities are used to serve the Indian market as well as to export to other Asian, African and Middle Eastern markets (Business Sweden, 2015).

Table 4.17 summarises all the information in Section 4.3 of this report. It provides a picture of how the different countries are ranked in terms of the state of their related and supplier industries.

Table 4.17: Comparison countries ranked in terms of state of the related and supplier industries.

Rank	Country	Status
1	South Africa	Well-developed related and supplier industry that supports both the local mining industry and also exports some of its products to other countries.
1	Australia	Well-developed related and supplier industry that supports both the local mining industry and also exports some of its products to other countries.
1	Brazil	Well-developed related and supplier industry that supports both the local mining industry and also exports some of its products to other countries.
1	India	Well-developed related and supplier industry that supports both the local mining industry and also exports some of its products to other countries.
2	Ukraine	Good supplier industry for the metallurgical industry, with equipment supply hampered by some underinvestment in the industry.
-	Gabon	No information on the related and supplier industry.

South Africa, Australia, Brazil, and India have well-developed related and supporting industries that support the local mining industries in these respective countries, and in addition are also able to export and support mining industries in other countries. The Ukraine has a relatively well-developed supplier base for the metallurgical industry, but an equipment supplier base that has been hampered by underinvestment. There is no information that is available on the related and supplier industry in Gabon.

4.4. Company strategy, structure, and rivalry

The company strategies, structures, and rivalry aspects for the manganese industries in South Africa, Ukraine, Australia, India, Gabon, and Brazil are analysed and compared between the countries. The goals, strategies, and the manner in which the companies have been organised are analysed to determine which of the countries has a competitive advantage on this aspect.

It has already been discussed that the main source of manganese ore and alloy demand is China. It was also indicated that the demand for both manganese ores and alloys from China is expected to continue to grow into the foreseeable future. Therefore, it is expected that the main goal of companies within the manganese producing countries is to strategically organise themselves in order to be able to competitively deliver manganese ores and alloys predominantly to China, and also to other markets.

The manganese industries in South Africa, Ukraine, Australia, India, Gabon, and Brazil have structured themselves as producers of both manganese ores and manganese alloys. South Africa, Ukraine, Australia, India, and Brazil have also structured themselves as producers of steel products. Mutemerwerwa and Ericsson (2000) investigated the effects of vertical integration within the chrome industry, and highlighted that vertical integration has resulted in integrated producers having lower ore costs and a larger market share compared to other producers.

The manganese industries in South Africa, Ukraine, Australia, India, Gabon, and Brazil have adopted a number of strategic positions in order to remain competitive. The first observation is that all the manganese industries in these countries sell beneficiated products; the only difference between these countries is the scale and diversity of products that are produced from manganese ore beneficiation. The second observation is that the manganese industries in these different countries export both manganese ores and alloys, this gives them a diversified exposure to the manganese value chain in case the margins are better in one part of the value chain compared to the other. The third strategy that is observed is that the manganese companies within the different countries are multinationals that operate in different geographic locations, and these multinationals also have exposure to other commodities in addition to manganese. This is in order to deal with the geographical risks and the cyclical nature of the manganese business.

The manganese company strategies, structures, and rivalry aspects for the manganese industries in South Africa, Ukraine, Australia, India, Gabon, and Brazil are similar and not easily differentiated. The differences between the different countries are on the extent of the vertical integration and on the extent to which the three observed strategies have been implemented. These differences are not significant enough to differentiate the comparison countries from each other as both the vertical integration and the three observed strategies are scalable.

4.5. Summary of analysis information using Porter's diamond model

Table 4.18 provides a summary rating of the data and information discussed in Sections 4.1 till 4.4 of this report. The data in Table 4.18 rates the different countries on the basis of the four aspects of Porter's diamond model, using a relative rating scale. The relative rating scale rates the different aspects using four categories; these four rating categories are best in class, competitive, less competitive, not competitive, and no information. The best in class category represents a benchmark performance that needs to be emulated by all the other comparison countries. The competitive category means that the country is competitive when compared to other comparison countries and has systems in place to remain competitive, but requires continuous improvement in order to remain competitive. The less competitive category means that the systems that ensure that the competitiveness is sustainable are not in place. The not competitive category means that the country is not competitive and the systems to ensure sustainable performance are also not in place, and the no information category means that there is insufficient information available to be able to rate a particular country.

The four aspects of Porter's diamond model and the elements that make up each aspect were assumed to have equal weighting. To calculate the average rating, numbers 1, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, and 5.5 were used as a proxy numbers for C-, C, C+, B-, B, B+, A-, A, A+, and AA+ ratings. To round up the resultant number; if the number is greater or equal to the sum of the proxy number plus 0.25, the resultant rating is the higher rating, and if not, the lower rating applies.

For example, using proxy numbers for each of the factor conditions ratings for South Africa, and assuming equal weighting of each element, the total average for the factor conditions is 3.13. To determine if 3.13 is either a B or B+ rating, the round up rule was applied. For the rating to be B+, the number needs to be equal to or greater than 3.25, otherwise, the rating is B. The average rating for the factor conditions for South Africa is a B rating. The average for the demand conditions for South Africa was calculated to be 4.67 or A rating using a similar process. The overall rating for South Africa assuming equal weighting for all four aspects of Porter's diamond model was calculated to be 4.45 or an A rating. Table 4.18 shows a summary of all the results.

Table 4.18: The ratings of all the comparison countries on the factor conditions.

Porter's diamond aspect		**South Africa**	**India**	**Ukraine**	**Australia**	**Brazil**	**Gabon**
Factor Conditions	Human resources	B	A	B+	A+	AA+	B-
	Physical resources	B+	B	B	A	A+	B+
	Capital resources	B-	A-	B+	A	A+	B
	Infrastructure resources	B+	B-	A-	A	A+	NI
Factor conditions ratings		B	B+	B+	A	A+	B
Demand Conditions	Local demand composition	A+	A+	A+	A+	A+	B+
	Demand size & pattern of growth	A	A+	A	A	A	B+
	Internationalisation of domestic demand	A	A	A	A	A	B+
Demand Conditions		A	A	A	A-	A-	B+
Related & Supporting Industries		A+	A+	B+	A+	A+	NI
Company strategies, structure, & rivalry		A+	A+	A+	A+	A+	A+
Overall ratings		**A**	**A**	**A-**	**A+**	**A+**	**A-**

Best in class	**Competitive**			**Less competitive**			**Not competitive**			**No information**
AA+	A+	A	A-	B+	B	B-	C+	C	C-	NI

Table 4.18 indicates that South Africa, India, Australia, and Brazil are all competitive, and Ukraine and Gabon are less competitive in terms of the four aspects of Porter's diamond model. Australia and Brazil are the most competitive of the competitive countries, with an A+ rating; and South Africa and India are less competitive among the comparison countries, with an A rating. Table 4.18 also shows that the comparison countries are rated differently for the different aspects of Porter's diamond model.

5. CONCLUSIONS AND RECOMMENDATIONS

A competitiveness analysis of the South African manganese industry was done using Porter's diamond model. Porter's diamond model was used to compare the competitiveness of all the major manganese producing countries outside of China using the four aspects of the model. The countries that were compared are South Africa, Australia, Ukraine, Gabon, Brazil, and India.

This section of the report uses the analysis conducted in Chapter 4 on the different aspects of the diamond model to make conclusions and recommendations. The conclusions are based on the analysis done and reflect the current state of competitiveness of the South African manganese industry relative to the manganese industries in Australia, Ukraine, Gabon, Brazil, and India. The relative competitiveness between the manganese industries in South Africa, Australia, Ukraine, Gabon, Brazil, and India are important due to the significant resources and reserves that they possess; and the fact that they will also be the main competitors in capturing the growing market demand from China. The recommendations outline the actions that need to be taken by the different stakeholders of the South African manganese industry, in order to improve competitiveness relative to Australia, Ukraine, Gabon, Brazil, and India.

5.1. Factor conditions

5.1.1. Human resources

The South African manganese industry is relatively less competitive in terms of its human resources when compared to Brazil, Australia, India, and the Ukraine. These countries have relatively highly educated labour force and better labour market efficiencies. The human resource aspect of competitiveness needs careful planning in order to address the required improvements as the results are often not immediate. There is effort required to address current challenges whilst also investing in the future human resource needs of the South African mining industry.

The main issues that need to be addressed by the role players within the South African manganese industry are the shortage of specific critical skills within the mining value chain, improvements in labour productivity or labour market efficiencies, and development of innovative mechanisms to retain skills within the country in the face of global competition for skills.

5.1.2. Physical resources

South Africa has an abundance of manganese mineral resources and mineral reserves when compared to Australia, Ukraine, Gabon, Brazil, and India. This resource potential is significant and indicates that South Africa has a significant future role in the global supply of manganese products. The average manganese grades of the South African resources are lower in comparison to those of Brazil, Gabon and Australia. In order to enhance the competitive advantage that comes with South Africa’s natural endowment of manganese resources, South Africa needs to invest in cost-effective technologies and processes that are able to upgrade or beneficiate run of mine ore material below the marketable Mn grade.

South Africa is a water scarce country when compared to all the other comparison countries. This position is further exacerbated by the fact that rainwater is the primary input to South Africa’s water resources, and rainfall data indicates that South Africa has the worst rainfall data of all the comparison countries. The low water inputs or sources, a growing South African population, and the requirement of water in order to industrialise, makes water a significant risk for South Africa to manage so that it does not limit its growth potential. An issue that needs to be considered in the short term by all the South African manganese industry role players is water preservation strategies, and in the medium to long term invest in technologies and initiatives that will enable water conservation.

Hydroelectric power sources provide countries that have them in abundance with a more sustainable and cost-effective source of energy. South Africa does not have significant capacity for hydroelectricity generation when compared to the Ukraine, Australia, India, and Brazil. The projected decrease in electricity costs associated with renewables indicates that the South African manganese industry will progressively become less competitive in terms of electricity costs as it relies on fossil fuel generated electricity. The manganese industries in Brazil and India are expected to increase their competitiveness with time as the cost of renewables is expected to continue to decrease. The South African manganese industry role players need to investigate renewable energy options to either replace or augment the fossil fuel generated electricity, in order to have more sustainable and cost-effective energy in the future.

5.1.3. Capital resources

Brazil, Australia, and India attract relatively higher amounts of FDI when compared to South Africa, Gabon, and the Ukraine. South Africa has the lowest amount of FDI for all the comparison countries. The sovereign ratings of both South Africa and Brazil rate the respective countries at non-investment level, with Gabon and the Ukraine rated even below the non-investment level. The potential for the South African manganese industry to grow into the future will depend on South Africa's ability to attract capital and provide a good return on the capital investment. The issue that needs to be addressed by the South African manganese industry role players is to collaboratively work with all stakeholders to improve the investment environment, and make it easier to attract more FDI ahead of competitors.

5.1.4. Infrastructure resources

The electricity generation and population access data for South Africa and Gabon in comparison with the other countries indicates that these two countries have inadequate electricity infrastructure, either due to insufficient generation capacities or inadequate distribution networks. These two countries require the most improvement in terms of electricity infrastructure relative to other comparison countries. South Africa has the most competitive industrial electricity prices relative to all the other comparison countries. South Africa's electricity infrastructure is competitive in terms of the costs to operate, but its infrastructure requires some improvement in terms of both electricity generation and distribution to enable the manganese industry to be more competitive.

The logistics performance index (LPI) is used to determine the competitiveness of the logistics value chain of different countries and regions. The LPI data indicates that Australia has the most competitive logistics performance relative to the other countries, and Gabon has the least competitive logistics performance. South Africa has the second most competitive logistics performance, with India and Brazil ranking third and fourth respectively. The Ukraine is in fifth position, higher than Gabon.

South Africa’s logistics performance is fairly competitive compared to other comparison countries, but will need to continuously improve in order to be able to compete with Australia.

5.2. Demand conditions

5.2.1. Local demand composition

South Africa, Ukraine, Australia, India, Gabon, and Brazil all have demand for manganese ores to use within the manganese smelting processes located in these respective countries. In addition, all the other countries except Gabon have differing degrees of demand for manganese alloys to feed the steel industries that are located in their respective countries. In terms of the market segments that are available along the manganese value chain, Gabon has a disadvantage relative to all the other comparison countries as it has no steel industry. There is no relative difference or competitive advantage that can be deduced between all the other comparison countries. The South African manganese industry role players need to note that in order to remain competitive, continuous participation of the South African manganese industry in the different market segments needs to be maintained and increased in order to diversify the market risks.

The manganese industries in South Africa, Ukraine, Australia, India, Gabon, and Brazil all have local manganese ore markets. In addition, the respective local markets of all the countries, with the exception of Gabon, also import other manganese ores for domestic consumption. This means that all the different countries have exposure in processing manganese ore that is destined for the steel industry, with others having the added advantage of also having exposure in processing manganese ores from other countries. The manganese industries in countries that import relatively less ore such as South Africa, Australia, and Brazil might have relatively less exposure in dealing with the complexities of using different types of ores. In terms of the manganese alloys, the main producers of crude steel in each of the comparison countries also have significant global market share of production. This makes the South African manganese industry to be well placed together with all the other comparison countries, to anticipate global customer needs due to the structure of both its local ore and alloy demand. The South African manganese industry role players need to work towards maintaining this status quo and ensuring that it grows further.

5.2.2. Demand size and pattern of growth

The manganese ores and alloys consumption data indicated that India has the largest local market for both manganese ores and alloys relative to all the other comparison countries. The size of the manganese ore consumption in South Africa and the Ukraine are similar to each other, and can be regarded as the second largest local ore markets respectively. The relative sizes of the local manganese alloy markets for South Africa and Australia respectively are small when compared to other comparison countries.

South Africa, Ukraine, India, and Brazil all have a number of independent manganese ore customers; Australia and Gabon have mainly one independent customer for their manganese ore products. The countries with multiple independent customers are considered to be more competitive as their growth and development is not dependent on one party remaining viable. There is one independent customer of manganese alloys in South Africa, and that is ArcelorMittal. The other comparison countries have more than one independent alloy customer; with Gabon as the only country with no independent local customer for its alloy products.

The local manganese markets for ores and alloys in South Africa, Ukraine, Australia, India, and Brazil are well placed to be on the cutting edge of development and able to anticipate early in the process and ahead of competitors the changes in the demand needs of other countries. This is as a result of the customers being multinational companies that compete on the global manganese market.

The average capacity utilisation factors for all the countries in terms of both the manganese ores and alloys indicate that the local markets in all the comparison countries are saturated. The idle production capacities in all the comparison countries for ores and alloys create an environment where the local demand will remain saturated until the demand becomes higher than the available capacity. The rate of growth of both manganese ores and alloys have either remained constant or declined with time, except for India. The local markets of all the other countries are considered saturated, with growth in future expected to come from export markets.

5.2.3. Internationalisation of domestic demand

The local customers for both manganese ores and alloys in South Africa and other countries are multinational companies that often produce products to the required customer specifications and also adhere to international standards, such as ISO 9001 on quality. The specific requirements of steel, batteries, chemicals lead to a demand for specific qualities and specifications of ores and alloys, which will enable the production of the required downstream product to specification at international standards.

5.3. Related and supporting industries

The South African mining industry is an established sector with a long history, as a result has over time developed significant expertise in mining related supplier industries. The growth in the mining related supplier industries has resulted in the South African mining industry being able to export both mining equipment and specialist services. This makes the South African supplier industries to be competitive on the global scale. This competitiveness benefits the South African manganese industry and other mining industries in South Africa.

South Africa has related and supporting industries that are well-developed and as competitive as those of Australia, Brazil, and India. There are also concerns that have been raised that factors such as lack of skills, high input costs, the lack of innovation, varying demand due to commodity cycles, the volatility of the exchange rate, constraints on working capital, and others are leading to the gradual decline of the South African mining supplier industry. The South African manganese industry role players will need to address these concerns to ensure that this competitive position is not lost over a period of time.

5.4. Company strategy, structure, and rivalry

The manganese industry in South Africa has structured itself as a producer of both manganese ores and manganese alloys. It has further structured itself as a steel producer. The South African manganese industry sells both manganese ores and alloys and has a diversified exposure along the manganese value chain. The companies that operate in South Africa are multinationals that also operate in different geographic locations, and in addition to manganese these companies have a portfolio of other commodities. This enables the South African manganese to weather the storm during challenging times due to the cyclical nature of the manganese business. The company strategies, structures, and rivalry aspects of the manganese industries in South Africa, Ukraine, Australia, India, Gabon, and Brazil are similar. The manganese industry in South Africa needs to maintain its current position and be able to change swiftly should the market demand structure dictate a different structure and strategies to optimise value for the industry.

5.5. The diamond model for the South African manganese industry

The South African manganese industry has competitive demand conditions, related and supporting industries, company strategy, structure, and rivalry in comparison to Australia, Brazil, India, Ukraine, and Gabon. These three areas of Porter's diamond model require continuous improvement in order to maintain competitiveness and avoid eroding competitiveness over time. The area of Porter's diamond model that requires significant improvement is the factor conditions. South Africa has significant manganese resources; but issues such as the need to upgrade the ores before selling, management of the water resources, access to electricity and the threat of renewables to electricity costs, the limited capital resources and low FDI, and the logistics competitiveness need to be improved to be better than that of Australia.

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