ZIMBABWE ECONOMIC POLICY ANALYSIS AND RESEARCH UNIT

ENGINEERING AND METALS INDUSTRY VALUE CHAIN ANALYSIS

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ACRONYMS

ZISCO	Zimbabwe Iron and Steel Company
NRZ	National Railways of Zimbabwe
CZI	Confederation of Zimbabwe Industry
SADC	Southern Africa Development Community
ZEPARU	Zimbabwe Economic Policy Analysis and Research Unit
SIRDC	Scientific and Industrial Research and Development Centre
NFM	Non Ferrous Metals
PGMs	Platinum Group Metals
UNCOMTRADE	United Nations Commodity Trade Statistics Database
FM	Ferrous Metals
MDG	Millennium Development Goals
CoM	Chamber of Mines
UNIDO	United Nations Industrial Development Organisation
ZIE	Zimbabwe Institute of Engineers
ZIMRA	Zimbabwe Revenue Authority
RGM	Reference Group Meeting
FGD	Focus Group Discussion
VW	Validation Workshop
ECZ	Engineering Council of Zimbabwe
EISAZ	Engineering Iron and Steel Association of Zimbabwe
ZERA	Zimbabwe Energy Regulatory Authority
ZESA	Zimbabwe Energy Supply Authority
IVC	Industrial Value Chain
J&B	Jacob and Bethel
EU	European Union
GDP	Gross Domestic Product
USD	United States Dollar
RBZ	Reserve Bank of Zimbabwe
UDI	Unilateral Declaration of Independence
ZACE	Zimbabwe Association of Consulting Engineers
AAZ	Automobile Association of Zimbabwe
CMA	Chrome Miners' Association
FAZ	Founders' Association of Zimbabwe
CPA	Chrome Producers' Association
GMAZ	Gold Miners' Association of Zimbabwe
AMM	Association of Mine Managers
ZNCC	Zimbabwe National Chamber of Commerce
NECF	National Economic Consultative Forum
NEWU	National Engineering Workers' Union
ZARWU	Zimbabwe Amalgamated Railway Workers' Union

ZEWU	Zimbabwe Energy Workers' Union
AMWUZ	Associated Mine Workers' Union of Zimbabwe
EMA	Environmental Management Authority
NSSA	National Social Security Authority
SAZ	Standard Association of Zimbabwe
MMCZ	Minerals Marketing Corporation of Zimbabwe
AfDB	African Development Bank
IDBZ	Infrastructure Development Bank of Zimbabwe
BAZ	Bankers' Association of Zimbabwe
MW	MegaWatts
SAPP	Southern Africa Power Pool
kWhr	kilowatt-hour
ZINWA	Zimbabwe National Water Authority
UZ	University of Zimbabwe
NUST	National University of Science and Technology
HIT	Harare Institute of Technology
CUT	Chinhoyi University of Technology
BUSE	Bindura University of Science Education
PTC	Posts and Telecommunications Corporation
ZIMDEF	Zimbabwe Manpower Development Fund
OECD	Organisation for Economic Co-operation and Development
TNC	Trans-National Companies
AMA	Agricultural Marketing Authority
GMB	Grain Marketing Board
EPO	Exclusive Prospecting Order
NTB	Non Tariff Barriers
WTO	World Trade Organisation
GATT	General Agreement on Tariffs and Trade
UNCTAD	United Nations Conference on Trade and Development
ZECO	Zimbabwe Engineering Company
MSME	Micro to Small and Medium Enterprises
BNC	Bindura Nickel Corporation
UK	United Kingdom
PPAZ	Platinum Producers' Association of Zimbabwe
CAD	Computer Aided Design
CAPP	Computer Aided Process Planning
SCADA	Supervisory Control and Data Acquisition
ISO	International Organisation for Standardisation
OHSAS	Occupational Health and Safety Standard
MNC	Multi National Company
NGO	Non Governmental Organisation
KVA	Kilovolt- ampere

MVA	Megavolt-ampere
HIV	Human Immunodeficiency Virus
CAM	Computer Aided Manufacturing
CDP	Carbon Disclosure Project
MSDS	Material Safety Data Sheet
IDC	Industrial Development Corporation
CKD	Complete Knocked Down Kit
DRC	Democratic Republic of Congo
MTAZ	Motor Trade Association of Zimbabwe
ACMAZ	Automobile Component Manufacturers Association of Zimbabwe
MIDC	Motor Industry Development Council
MIEAZ	Motor Industry Employers' Association of Zimbabwe
VIC	Vertically Intergraded Companies
ESAP	Economic Structural Adjustment Programme

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EXECUTIVE SUMMARY

SIRDC was contracted by ZEPARU to carry out the engineering and metals value chain diagnostic study for the country. The broad objective of the diagnostic study was to make an assessment and map the viability of value chains in selected subsectors of Zimbabwe's engineering and metals industry with the goal of identifying policies, measures or strategies to enhance competitiveness of these industries. The UNIDO 7 diagnostic dimension approach formed the core of the research methodology whilst supported by some elements of the conventional approach.

The engineering and metals sector was divided into 8 major levels, namely; Level 1 (mining/raw material extraction), *Level 2 (metal/mineral processing), Level 3 (metal forming), Level 4 (metal fabrication), Level 5 (machine/equipment assembly)*, Level 6 (product distribution), Level 7 (retailing) and Level 8 (end market). The main study was carried out on the core actors in the engineering and metals sector who include Levels 2 to Level 5. Other sectors in the business enabling environment were also assessed.Gold was not a major component of the study despite it being a metal since it has been generally studied widely in the country. A field study was carried out on 94 actors around Zimbabwe which included engineering and metals sector core actors and other stakeholders in Harare, Chegutu, Kadoma, Kwekwe, Gweru, Shurugwi, Bulawayo, Bindura, Ruwa, Marondera and Mutare. The main instrument for data collection was the Industrial Value Chain Diagnostic Tool based on the UNIDO IVC concept. The instrument was tested and administered to 64 active players distributed in the engineering and metals sector of Zimbabwe. An overall response rate of 69% was achieved. Vital information was obtained from key stakeholders like Chamber of Mines, ZimStat, Zimbabwe Iron and Steel Company (ZISCO), Engineering Iron and Steel Association of Zimbabwe (EISAZ) and Engineering Council Zimbabwe (ECZ) amongst others. Key documents reviewed for comparative analysis included documents on similar studies for China, South Africa, Zambia, South Korea and India amongst others.The excel package was used for analysis of data.

The analysis found out that the engineering and metals sector of Zimbabwe contributed more than 64% by value of total exports in 2011, backed by a strong metal production background. The main value addition activities contributing to the Gross Output of the sector by rank were i) mining of non ferrous metals, ii) manufacture of structural metal products, tanks, reservoirs and steam generators, iii) manufacture of general purpose machinery, radios, TVs, electronic equipment, etc, iv) manufacture of motor vehicle bodies (coachworks), v) manufacture of jewellery, vi) manufacture of electric machinery, vii) manufacture of iron and steel, manufacture of complete civil construction parts and viii) manufacture of nonferrous basic metals. It was noted that the manufacture of engineering goods contributed about 17% of the sector's Gross Output for the period 2009 to 2011, implying that the value addition in the sector was minimal. The mineral processing subsector dominated the contribution to the sector's Gross Output for the same period at 38%. Therefore the Platinum Group Metals (PGMs), gold, chrome and nickel were found to be the major contributors to the Gross Output. However, value chain analysis of

the nonferrous metals showed that there was limited value addition before export, as they were usually shipped as concentrates or mattes before refining. Despite the abundance of reserves of iron ore, the production of iron and steel products was very low for the period due to the challenges facing ZISCO. On the engineering sector, the manufacture of structural metal products, tanks, reservoirs and steam generators was the major contributor to the sector's gross output followed by manufacture of general purpose machinery and equipment, and then manufacture of bodies for motor vehicles as well as jewellery and electric machinery manufacture. Sadly the manufacture of iron and steel did not compete despite the fact that iron and steel are basic ingredients for any engineering sector. This was attributed mainly to the ceasing of operations at ZISCO Steel and its upstream actors.

On export competitiveness, an overall ratio of 59% imports to 41% exports for the engineering and metals sector for the period 2008 to 2012 shows that the sector was import oriented rather than the desired export bias. Further analysis however shows that for the metals and metal products subsector, the imports to export ratio was 22:78, implying that this particular subsector was export oriented. Despite this positive result, it also shows that the country exports products with minimal value added. The major imports of metals and metal products by value were iron and steel and articles thereof (54%), nickel and articles thereof (29%) and tools and implements amongst others. The high percentage by value of iron and steel and articles thereof shows how this commodity plays a significant role to the sector and ultimately the country's economy. About 43% of the exported metals and metal products were precious metals and articles thereof, whilst 26% nickel and articles thereof, 20% were ores and slags, 8% iron and steel. The nature of products exported further cements the factor that the country's exports are minimally value added. In the case of the engineering goods, the ratio of exports to imports was 5:95, showing that the domestic engineering goods manufacturing sector was on the brink of total collapse unless urgent proactive measures were taken. Of the engineering goods by value imported between 2008 and 2012, 49% were vehicles, 27% being machinery and equipment and 19% being electrical machinery. On the other hand, vehicles constituted 30% of the exported engineering goods by value, electrical machinery 30%, general machinery and equipment 29% and aircraft components and parts thereof 8%. The export competitiveness analysis ultimately showed that the engineering subsector was not self sufficient and relied heavily on imported products, whilst the metals subsector did little value addition before exportation. The two sectors usually intertwined were also disjointed and were not mutually benefiting from each other. The notable value chains from the analysis of exports and imports were therefore the PGMs, base metals (chrome and nickel), iron and steel, automobile, machinery and equipment and electrical machinery.

The field data analysis using the 7 diagnostic dimensions approach showed that the engineering and metals sector was severely distressed with very low capacity utilisation for the period 2011 to 2013. For the period 2011 to 2013, Mineral/Metal (Level 2) processing capacity utilisation decreased from 89 – 33%. This was mainly attributable to the poor general performance by the chrome smelting companies. However the PGM processors had high capacity utilisations of over

77%. It was also noted that one major player in base metal smelting had average capacity utilisation of 70%. The capacity utilisation for Metal forming (Level 3) increased from 15 to 30%, Metal fabrication (Level 4) averaged 33% whilst Assembled Goods (Level 5) increased from 40–15% during the same period. However, notable outliers existed, e.g. the main actors in the automobile sector operated at capacity utilisations below 5%. It was also noted that about 31% of the visited actors and different levels of the value chain were not operational. For example, in the chrome sector, one out of more than 5 actors was operational and the iron and steelmaking giant, ZISCO was still non operational. The operating environment was also very tough for the players with the main problems cited being working capital constraints, political instability, lack of financing mechanisms, antiquated machinery, corruption, low demand on the market, high production costs, stiff competition from imports and labour issues amongst others. More work is also required on downstream actors to ensure compliance to environmental laws. Power and water shortages and a dysfunctional railway network also worsened the operating environment leaving the sector on the brink of collapse.

Whilst Level 2 appeared competitive on the international market due to strengths like high demand for end products, use of competitive technologies, good manufacturing principles and use of sustainable production techniques as well as belonging to dominant global value chain, none of these strengths could be found in most of the locally owned actors in Levels 2 to 5. A notable strength of the engineering and metals sector were the high percentages of Value Added, 60% for metals and metal products and 51% for engineering goods. These high Value Added figures suggest that the sector produces niche products since the global averages for value added in the sector ranged between 22 and 39%

Opportunities also existed in the mineral sector which has contributed significantly to GDP. The projected mining expansion and infrastructural development projects in the region, as well as India and China were seen as possible markets for end products from the sector which can revive the sector. A combination of sound policies, injection of funds for recapitalisation and a sound business operating environment will be prerequisites for the revival of the engineering and metals sector, else the country becomes an end market for all engineering and metal products from all over the world. The sector according to estimates from this diagnostic study has the potential to contribute over US$13billion dollars in revenue to the economy.

There were several recommendations proposed by stakeholders which included the resuscitation of the iron and steel-making industry as the backbone of engineering sector revival, decentralization of iron and steelmaking to minimize risks and avoid monopolistic tendencies of one player, establishment of stainless steel production capacity and PGM and base metal refinery amongst others. Identification and selection of integrated and interlinked national champions along the value chain to spearhead sector revival was also proposed. To encourage export growth of value added products whilst simultaneously discouraging importation of value added products export incentives like tax rebates and high import tariffs for imports were proposed. Export

market growth was also identified as the key driver for the sector. In that regard identification of strategic joint ventures with countries with high demand for end products was proposed.

A Sales and Marketing Organ to specifically market the engineering and metal products on the export market was also suggested to ensure a significant market share to benefit from the economies of scale. The revision of the implementation of the Indigenisation Policy to accommodate strategic joint ventures with Multi National Companies with strategic markets and funding was also proposed. As the presence of several substandard product was noted establishment of antidumping laws and systems was recommended. The Motor Vehicle Development Policy was also proposed as a matter of urgency to prevent the industry from total collapse and ensure its sustainable recovery.

A clear policy on Scrap beneficiation was also proposed considering the huge unaccounted for volumes of scrap in the country and its significance on the engineering and metals value chain. Public Private Partnerships on strategic infrastructure like railroad, power and water must be established as they are fundamental to the viable operation of the engineering and metals sector. Clear policies on the use of competitive technologies in new investments for global competitiveness must also be spelt out.

It was also within the interest of the sector to reinvigorate collaboration between academia and the sector to ensure alignment of curricula, research and development activities to sector development as well as human resources capacity development. Along the same lines, a clear policy on technology transfer and research and development in the engineering and metals sector was proposed. It was also proposed that labour laws must be aligned to productivity to ensure sustainability of the sector.

PART 1: INTRODUCTION

1.1 Context

The Zimbabwean Engineering and Metals industry, like any other sector, significantly declined to its lowest ebb in 2008. During the period, several dominant actors like Zimbabwe Iron and Steel Company (ZISCO), Morewear Industries andNational Railways of Zimbabwe (NRZ) amongst others,either closed down, reduced operations or relocated to other countries for their survival. Dollarization and the formation of the inclusive government brought hope to the collapsed sector as the surviving companies increased capacity utilisation from below 10% in 2009 to peaks of around 50% in 2011. Liquidity challenges, strong competition from low cost imports from China, India and South Africa amongst several other challenges have resulted in a decline in capacity utilisation to around 36.9% (CZI 2013 report), company closures and massive retrenchments. Despite the fact that prior to the decade long economic melt down, Zimbabwe had a vibrant and diversified engineering and metals sector which dominated the SADC region except for South Africa, the business environment has completely changed with new technologies, products, globalisation and trade treaties having completely changed the field of play.

1.2 Significance of the study

The value chain approach, intensively being used by governments, private sector agents and development agencies to both identify options for industrial development and implementation was adopted by the Zimbabwe Economic Policy Analysis and Research Unit (ZEPARU) for the national engineering and metals industry competitiveness analysis. The attractiveness of the value chain approach, among other things, originates from its capacity to deal with a new business environment prevalent in industrial development in the Zimbabwean context described above.A value chain is defined as a set of businesses, activities and relationships engaged in creating a final product (or service). It comes from the fact that a product which is rarely consumed in its original form must be transformed, combined with other products, transported, packaged and marketed until it reaches the final consumer. Thus the engineering and metals value chain describes howproducers, processors, buyers, sellers, and consumers, separated by time and space graduallyadd value to products as they pass from one link to the next. It was against this background that SIRDC was contracted by ZEPARU to carry out the engineering and metals value chain diagnostic study for the country.

1.3 Objectives of the Study

The broad objective of the diagnostic study was to make an assessment and map the viability of value chains in selected subsectors of Zimbabwe's engineering and metals industry with the goal

of identifying policies, measures or strategies to enhance competitiveness of these industries. The sub-objectives, derived from the broad objectives were as follows;

- To provide the complete picture of the engineering and metals value chain from mineral processing to the end market
- To describe the current situation in the engineering and metals value chain sector
- Identify specific dynamics in the value chain, induced or automatic by government or development agents
- Identify constraints, technological and market opportunities relating to the engineering and metals value chain
- Ultimately provide recommendations for policy making and implementation.

1.4 Scope of the Study

The engineering and metals industry in Zimbabwe is intertwined, as the metals subsector is a key source of inputs for the engineering subsector. The metals industry involves a range of beneficiation activities along various levels of the value chain which include upstream operations like mining, smelting, recycling and refining. The down stream activities include secondary processing, fabrication of intermediaries and the machine/ equipment building and assembly. Thus the engineering subsectors form the downstream component of the study. The in-depth analysis of the mining stage was not part of the value chain diagnostics since it has been covered in the mining sector policy study (Jourdan et al., 2012). The Zimbabwean metals section was further divided into the ferrous and non ferrous metals (NFM) groups. The NFM sector was further classified into the following subsectors;

- Base metals (***copper***, ***nickel***,aluminium, zinc, lead,)
- Precious metals (*gold,* ***PGMs***, silver,)
    - PGMs (***platinum, palladium, rhodium***, ruthenium, osmium)
- Speciality metals (***cobalt***, germanium, indium, tellurium, antimony, gallium)
- Minor metals including refractory metals (**chromium,**tungsten, molybdenum, tantalum, niobium,)*(Bold and italicised metals were of significance to the Zimbabwean study because of availability)*

The NFMs are non-magnetic, electricity conductive and corrosion resistant metals. Due to their special characteristics, they constitute a strategic input for various products and sectors. They find application in chemical processing, catalytic processes, engineering, transport equipment, automotive, electronics, packaging, construction and jewellery,aerospace, lasers, lighting, medical equipment, fibre optics transmission, military radarand missile guidance, solar energy and others. The NFM group of products are classified as articles of NFMs with product codes ranging from 73 - 81 (ITC and UN COMTRADE classification; www.trademap.org).The same product classification is used in the Zimbabwean context and is consistent with ZimStat product classification.

The Ferrous Metals (FM) group refers to iron based materials which also forms the major component of different types of steels used in the engineering sectors. Small percentages of NFMs and carbon are added to steels in alloying processes resulting in metal products with special electrical, mechanical and chemical properties for speciality applications. The ferrous group of products are classified under iron and steel, product code 72 (ITC and UN COMTRADE classification). The range of products include pig iron, ferroalloys, ferrous wastes, flat rolled products, bars and rods, sections, wires and stainless steels with product codes ranging from 7201 to 7229 ((ITC and UN COMTRADE classification).

The diverse engineering subsectors in Zimbabwe involve a wide range of transformational activities aimed at coming up with a number of products. These transformational activities (casting, fabrication, forging, stamping, extrusion, etc) utilise metals and their intermediary products, energy, water, technology and speciality skills to produce the classified products (ITC and COMTRADE: www.trademap.org) presented in Table 1.

Table 1: Engineering products categories (Source: www.trademap.org)

Code	Engineering Product Category
82	Tools, implements, cutlery, etc
84	Machinery, nuclear reactors, boilers, etc
85	Electrical, electronic equipment
86	Railway, tramway locomotives, rolling stock equipment
87	Vehicles other than railway tramway
88	Aircraft, spacecraft and parts thereof
89	Ships, boats and other floating structures
90	Optical, photo, technical, medical, etc apparatus
91	Clocks and watches and parts thereof
92	Musical Instruments, parts and accessories
93	Arms and ammunition, parts and accessories thereof

1.5 Methodology

There are several value chain study approaches that can be used for the engineering and metals value chain studies namely the *integrated/ holistic,* the *generic* and the *rapid* approaches. The *generic approach* can be applied to any given industrial value chain regardless of the nature of the product and the actors engaged, giving it a major draw back of not adequately addressing key issues of sector specific value chain studies. The *rapid approach*, though simple, quick and cost effective also fails to adequately assess the status of a value chain for policy making purposes. The *integrated* approach was therefore adopted for the study. It considers the dynamics in all segments/levels of the chain and the many possible implications that development within these segments would have for the value chain. It also assesses the effects of these dynamics from a broad development perspective in line with Millenium Development Goals (MDGs). Further diagnostic analysisof the value chain can be done using five different approaches namely the *Strategic/Business Management, Industrial Cluster Development, Global Value Chain, Innovation systems and the UNIDO 7 diagnostic dimensions approaches.* The *strategic management approach* (supply chain management and development of an individual firm) is usually applicable to individual firms looking at actors that hold key positions, contractual

relationships amongst buyers and suppliers of major inputs, logistical services and level of competitiveness of the chain and its actors. The *industrial cluster approach* assumes that spatial organisation, strategic firm alliances and networking are sources of systematic competitiveness whilst the *global value chain approach* emphasises on economic returns and governance structures as key competitive factors. The *innovation systems* approach assumes that access to knowledge and technology, and opportunities to use them allow actors to competitively participate in value chains. The main limitations of the four approaches described are their failure to address aspects of i) finance and investment, ii) cleaner production and iii) macroeconomic and policy framework conditions.

The UNIDO 7 Diagnostic dimensions integrated tool for value chain analysis was used as it holistically addresses all the issues within the engineering and metals value chain. This tool is based on the seven diagnostic dimensions namely sources of inputs and supplies, production capacity and technology, end markets and trade, value chain governance, sustainable production and energy use, value chain finance and business environment and socio-economic context. Each diagnostic dimension is supported by clearly defined parameters as diagnostic indicators. The diagnostic tool formed the basis for project design and instruments development for the value chain studies. Nevertheless the other approaches were also considered in the analysis and recommendations. The study also involved a multidisciplinary team of engineers, marketers, finance experts, economist, business analyst and environmentalist to adequately assess the diagnostic dimensions. The list of the team members is attached in Annex 1.

The implementation road map from inception to final submission is summarised in the operational framework in Annex 2.The overall approach to the study was enhanced by initially establishing the structure of the engineering and metals sector in Zimbabwe as shown in Figure 1.

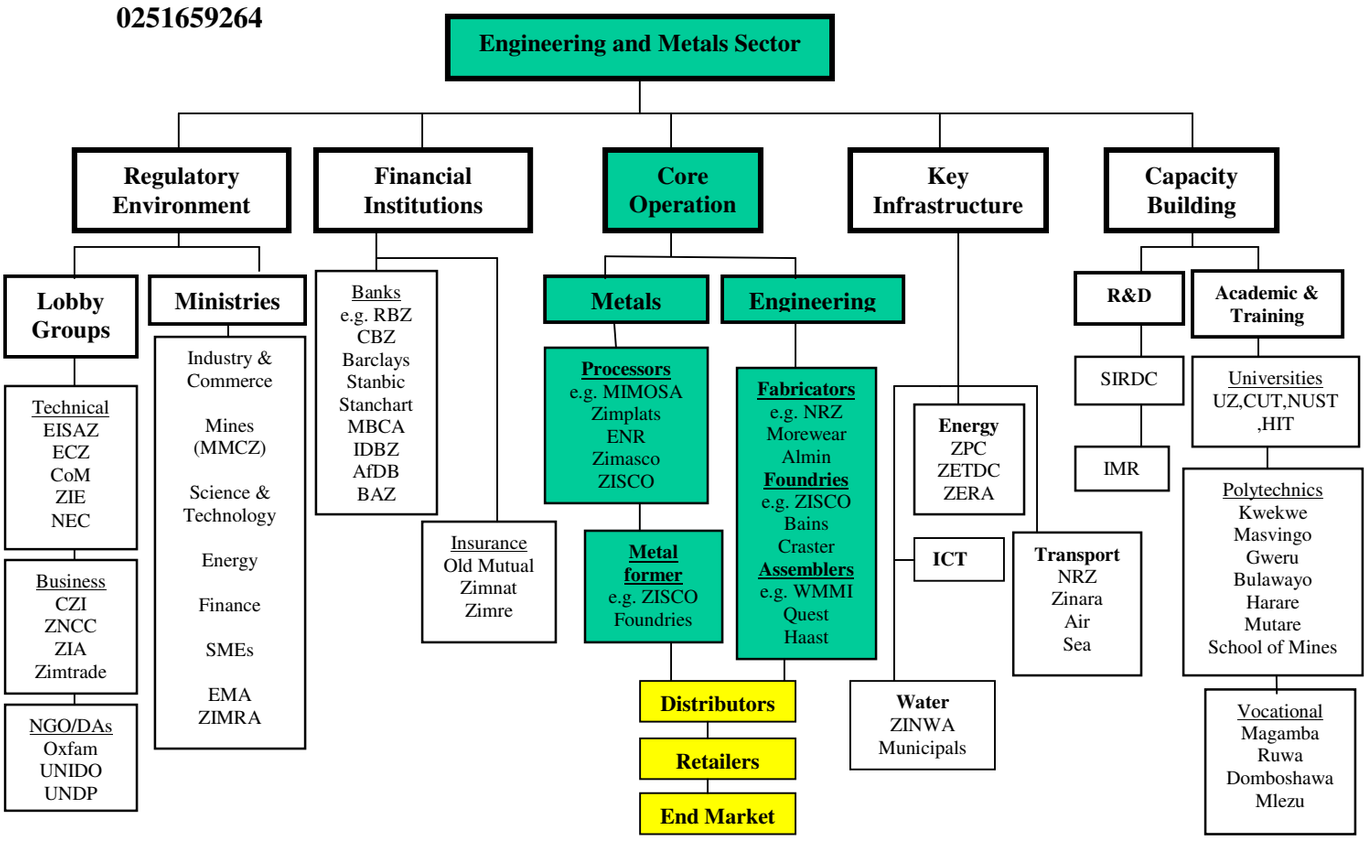

Figure 1: Structure of the Engineering and Metals sector in Zimbabwe (Source: SIRDC Analysis)

1.5.1 Value Chain Mapping

The basic value chain maps were selected guided by the data collected from CZI, Chamber of Mines, ZimStat and UN Comtrade documents on the engineering and metals sector of Zimbabwe. A total of 7 and 11 subsectors were identified for the metals and engineering subsectors respectively from ZimStat and Chamber of Mines (CoM) documents. The basic raw materials included chrome, iron and steel, copper, nickel, cobalt and PGMs amongst others. The subsectors were further streamlined based on chosen selection criteria to remain with the most significant subsectors in the engineering and metals value chain. The value chain maps were therefore created based on the selected subsectors.

1.5.2 Short-listing of subsectors, stakeholders and actors

Due to the fact that the value chain spectrum for Engineering and Metals industry was very broad and too large for the given time frame of the study, the most critical sub-sectors and products were selected using criteria described in the following section. The initial list of actors was mainly compiled from sources such as the Engineering Iron and Steel Association of Zimbabwe (EISAZ), the Engineering Council of Zimbabwe (ECZ), the National Employment Council

(NEC) and the Chamber of Mines. The UNIDO approach, widely used in similarand successful value chain studies was adopted and adapted for the short listing exercise(UNIDO IVC Tool, 2011). The following activities were involved in the short listing exercise:

- Listing of subsectors in the engineering and metals value chains from reliable national source documents from informants like ZimStat, ZIE, CZI, Chamber of Mines, ZIMRA and other country reports and surveys
- List of products/product categories in the engineering and metals value chains from reliable national source documents from informants like ZimStat, ZIE, CZI, Chamber of Mines, ZIMRA and other country reports and surveys
- Initial short-listing of the main value chain actors and stakeholders
- Establishing the relevant value chain selection criteria for subsectors
- Final list of selected subsector value chains and products

1.5.3 Value Chain Selection Criteria

The adopted value chain selection criteria are specified in Tables2and 3. It was further refined with further engagement with the industrial actors and key stakeholders during the Reference Group Meeting (RGM), Focus Group Discussions (FGDs) and Validation Workshops (VW). For the initial phase of the survey, field survey targets were shortlisted based on the magnitude of their activities, presence and impact in the Zimbabwean context. The initial list of actors is attached in Annex 3.

Table 2: Value chain selection criteria

Criteria	Description
1. Market Demand and growth potential	- Evidence of strong effective demand for products being produced - Suppliers have ready market for products but are unable to meet demand - Unmet demand from municipal authorities or large public works projects
2. Potential Increase in Income and Wealth	- Potential for increased revenues at all levels of value chain - Projected increases in sales, profits or returns to labour
3. Opportunities for linkages	- Potential forward/backward linkages between large and small enterprises - Large enterprises are overlooking MSMEs as a source of supply or are unable to organise them to meet their demands
4. Potential for employment generation	- Potential for enterprise to create new employment as value chain develops/expands
5. Number of MSMEs	- Number of MSMEs operating in the value chain
6. Value added potential	- Potential of MSMEs to add value to raw materials and get higher earnings
7. Potential for increase in productivity	- Potential for technologies/management systems to increase productivity and earnings of enterprise in the value chain

8. Government/Donor Interest/Existing support programmes	- Government interest in value chain can lead to favourable linkages with government services and favourable policies - Existing programs that can provide synergies and complementary linkages within actors
9. Competitiveness	- Competitiveness of the value chain on the world market and/or of the MSMEs in the value chain

Table 3: Critical subsector characteristics in the value chain study

Subsector Characteristic	Criteria for Assessment
Subsector Attractiveness	- Historical production growth rate - Size of domestic demand - Labour intensity
Self Sufficiency	- Import/Domestic demand - Growth in imports versus growth in market
Export Competitiveness	- Share of Zimbabwe in global exports - Growth of Zimbabwean exports versus growth in global exports

Since stakeholder management is key and integral to the successful implementation of value chain study, stakeholder analysis was done using the standard stakeholder assessment grid. This assessment uses two major criteria namely the influence of the stakeholder in the study as well as the interest of the stakeholder in the study. The Engineering Council of Zimbabwe (ECZ),the Engineering Iron and Steel Association of Zimbabwe (EISAZ), the Chamber of Mines (CoM), the Industrial Development Corporation, Zimbabwe Iron and Steel Company (ZISCO), ZimStat, Zimbabwe Energy Regulatory Authority (ZERA), Zimbabwe Electricity Supply Authority (ZERA) and the Ministries of Industry and Trade and energy were amongst the engaged stakeholders. The full list of engaged stakeholders are listed in Annex 4.

1.5.4 Sampling

The population of industries involved in the value chain study included all the identified subsectors of the engineering and metals value chain and the study population was stratified according to the following;

i) Subsector of activity
ii) Level of activity
iii) Firm size and geographical location

The sample size determination for the selected industries for the different levels of the value chain was dependent on the populations of participants at different levels. For population sizes greater than 50 (i.e. N > 50), 30% sample size (randomly selected) wasused, whilst for 10<N<50; a50% sample size was used whilst 100% sample size was used for N < 10. In an ideal environment, where most companies are operating normally, a pure random sampling approach would have been applicable. However, in this study, a hybrid approach which combined both concepts of random and targeted sampling was adopted considering the strategic nature of

certain actors in the value chain. The response rate varied for different levels (Levels 2 to Level 5) with the average being 57%. These sample sizeswere exclusive of informal sector enterprises and main policy participants in Zimbabwe who were interviewed using different instruments.

1.5.5 Instruments Development

Instruments were developed to assist in data collection from various stakeholders who included direct industry players, policy makers, focus groups, regulatory bodies, associations representing industry, banking and financial institutions, other services industry, research and academia and government stakeholders. The major instrument used was the Value Chain Industrial Diagnostic Questionnaire (see Annex 5).The instruments developed were guided by the UNIDO value chain approach based on the 7 diagnostic dimensions(UNIDO IVC Tool, 2011). Instruments for the FGDs were guided by two documents namely "Guide to Focus Group Discussions by R Campbell, 2008 and 'Local Value Chain Development (ILO) by M.L Herr, 2007. The industrial questionnaire instrument was taken for field testing from the 25th of October to the 30th of October 2013 to 5 respondents who included 3 industrial players, 1 research and academic organisation and one service firm. The comments were incorporated in the reviewed questionnaire instrument.

1.5.6 Data Collection Methods

1.5.6.1 Instruments Distribution and Key Informant Interviews

Relevant instruments/ questionnaires were distributed to shortlisted stakeholders and key informants after observing the formal introductory procedures for engagement. Prior to field surveys and key informant interviews, appropriate communication channels which included emails, phone calls and direct channels were used to engage the stakeholders.Soft and hard copies of instruments were distributed to the stakeholders/respondents and appointments for administration of the instruments were scheduled, where necessary.

The field work for Harare spanned from the 6th of November 2013to the 22nd of November 2013. The Harare field teams covered all the industrial areas in Harare namely Workington, Granite side, Willowvale, Ardbennie, Aspindale, Southerton and Masasa. Parallel teams covered targeted areas outside Harare which included Chegutu, Kadoma, Kwekwe, Gweru, Zvishavane, Shurugwi, Bulawayo, Bindura, Marondera and Mutare. The field surveys outside Harare commenced on the 12th of November 2013 and ended on the 5th of December 2013. Key actors visited included Unki Mine, Empress Nickel Refinery, Zimasco, ZISCO, J&B, Quest Manufacturing and Maranatha ferrochrome amongst others.

1.5.6.2 Reference Group Meeting and Focus Group Discussion

A joint Reference Group Meeting (RGM)for three value chain studies (Agro-processing, Engineering and Metals and Chemical industries),aimed at fostering stakeholder participation in the value chain was held on the 12th of November, 2013. The different actors along the value chain were clustered into relevant focus groups for discussion purposes. The inputs from the RGM are documented in Annex6.

1.5.6.3 Desk Research

Major economic indicators for the engineering and metals sector of the Zimbabwean economy were obtained from the UN COMTRADE, World Bank, ZimStat, Zimtrade, ZIMRA, country reports and publications on the internet. These documents included case studies of similar value chain work in the developing as well as the developed world. The South African, India, Chinese, EU value chain study documents were also reviewed for comparisons and benchmarking purposes.

1.6 Limitations

The major limitation to this study was the timing of the study and the fact that some of the major actors in the sector had folded, forcing the assessment to be based on a limited number of actors and historical information in some cases. The study was done at the close of the year when most companies were embarking on annual shutdown preparations. These annual shutdowns preparations along with unavailability of key personnel and key informants were some of the challenges encountered. The existence of other competing studies in the same industries also negatively impacted on the response rate. Whilst a majority of our respondents welcomed the questionnaire as comprehensive in assessing the key issues in the value chain study, a few viewed the questionnaire as too long and hence time consuming. As a result, some pertinent issues in the field surveys were discussed with the key personnel, whilst they requested for more time to complete the questionnaire. It was also our observation that there was a general reluctance of companies to divulge certain information, especially financial and ownershipstructure. The perception seems to be that the information will be used to their disadvantage by the relevant authorities.

1.7 Structure of the engineering and metals value chain diagnostics report

The structure of the report is in five major parts namely i) the introduction, ii) the economic overview and the business operating environment, iii) the value chain selection,iv) value chain analysis and lastly v) the economic policy implications, recommendations and conclusions. The introduction describes the significance, scope, objectives and the methodology used in the value chain diagnostics study whilst the economic overview describes the performance and significance of the engineering and metals sector in economic terms for the country. The section also contains the engineering and metals industry overview, which gives the general map of actors and stakeholders as well as the business operating environment. Since there is a wide range of commodities in the Engineering and Metals value chain, the Value Chain Selection chapter streamlines the subsectors and commodities in the value chain. This is based on given economic indicators and leads to the Value Chain Analysis. The first section of value chain analysis section used the UNIDO 7 diagnostic dimensions approach to analyse the field data from questionnaires on a Level by Level basis. The second section uses the diagnostic dimension approach to analyse the special value chains based on several source documents and key informants. Discussions of key findings form a major component of this section leading to the last section – the Economic policy implications, recommendations and conclusions.

PART 2: ECONOMIC OVERVIEW AND BUSINESS ENABLING ENVIRONMENT

2.1 Overview of Zimbabwe's Economy

Since 2009, Zimbabwe's economy started to recover from a decade of economic crisis that saw economic output cumulatively declining by more than 45%. According to information obtained from the World Bank, Real Gross Domestic Product (GDP) grew by 20.1% between 2009 and 2011. This was supported by the strong growth recovery of domestic demand and government consumption. GDP growth was led by strong growth in mining (107%), agriculture (35%) and services (51%) while recovery in manufacturing sector (22%) has been less vigorous. Annual average inflation remained moderated at 5.1% in 2012 despite rising international prices of grain and oil. Under the multi-currency regime, inflationary developments, in the short to medium term, will continue to be influenced by the USD/rand exchange rate, inflation developments in South Africa, and local utility charges.

Despite the strong 2009-2011 economic rebound, GDP growth in 2012 moderated to an estimated 4.4% largely supported by mining. The rate of economic growth continues to slow down with GDP projected to grow by 3.4% in 2013. The GDP of Mining and quarrying grew by 18.9%, 60.1% and 43.2% in 2009, 2010 and 2011 respectively. The GDP of mining and quarrying grew by approximately 8% in 2012 and was projected to grow by 5.3% in 2013. The GDP of manufacturing sector, which covers both engineering and chemical industries, grew by 17%, -4% and 14.4% in 2009, 2010 and 2011 respectively. The growth for 2012 was about 2.3% whilst the projection for 2013 was 1.5% (Ministry of Finance and ZimStat).

Statistics indicate that agriculture contributes 60% of the inputs needed in the Zimbabwean manufacturing sector while 40% comes from mining. The mining sector has rebounded dramatically from the hyperinflation economic crisis and, with dollarization; the value of mineral production has increased six-fold to about $3 billion in 2011. The mining sector has become the leading export sector accounting for 64% of total exports. Strong external demand for primary commodities, particularly platinum and gold, underpinned higher production levels. However, the benefits of the mining sector to the economy are still held back by the lack of downstream value addition and beneficiation to the raw minerals that are within Zimbabwe. The manufacturing sector remains in crisis with capacity utilisation declining from an average of 57% in 2011 to 44% in 2012 and 39% in 2013 (CZI Manufacturing Sector Surveys). Capacity utilization in the Engineering and Metals sub sector has declined from 36.7% in 2012 to 27.7% in 2013. Capacity utilisation remains constrained by erratic power supplies, lack of capital, higher input costs, obsolete machinery and dilapidated infrastructure. Consequently, manufactured products have failed to compete both locally and internationally. Increasing presence of imported products on retailers' shelves poses potential competitive quagmire to the local industry when full scale production resumes again. In addition to the challenges listed above, the Engineering Iron and Steel sub sector also noted the challenges posed by the non-operation of ZISCO Steel Company.

The external position remains under pressure as merchandise exports slumped by 10.5% to reach US4 billion in 2012 while imports reached US6.7 billion in 2012, driven by fuel (20%), food (11%), machinery (13%) and manufactured good (15%) (RBZ Statistics). In terms of the composition of exports in 2012, declared mineral export shipments accounted for 64%, followed by tobacco (19.4%), agriculture (9.1%), manufacturing (7%), horticulture (0.3%) and hunting (0.2%). In 2013, imports will continue to grow while exports remain compressed, thus worsening the current account. South Africa is the single largest trading partner in Zimbabwe, accounting for at least 40% of total exports and 60% of total imports.

The country is ranked 172 out of 185 countries according to the World Bank report (*Doing Business 2013)*. This low ranking means that starting and operating a business is relatively more difficult in Zimbabwe than the countries ahead of it on the ranking. For example, the lack of conducive regulations or the opposite, inhibitive regulations in Zimbabwe, mean that, on average, exporting a standard container of goods requires eight documents, takes 53 days and costs USD 3 280 while importing the same container of goods requires nine documents, takes 73 days and costs USD 5 200. For companies that are already operating, key challenging factors to doing business cited in various publications include policy instability, lack of funding, corruption, excessive or poorly functioning government bureaucracy and inadequate infrastructure.

2.2 Significance of the Engineering and Metals Industry Sector

Despite limited contribution to government revenue, Zimbabwe's mining sector continues to lead in economic performance, contributing an estimated 16% to GDP in 2012, up from 13% in 2011. The sector's export earnings also rose from USD1.8 billion in 2011 to USD2 billion in 2012. Diamonds, platinum and gold were the major drivers of this growth in export earnings. An estimated 100 – 300 000 informal miners are active throughout Zimbabwe. In 2009, the Gross Output from the Engineering and Metals Industry of Zimbabwe was $US418.5million with value added of $US260.8million. The mining of non ferrous metal ores constituted 57% of the engineering and metals gross output with a total value added of $US145million. The manufacture of structural metal products including tanks, reservoirs and steam generators was second, contributing 23% of the engineering and metals industry with value addition to the value of $US73.4million. In 2011, the Gross Output of the Engineering and Metals sector more than doubled to $US1.1billion with value added of $596.4million (ZimStat). The mining of non ferrous metals continued to dominate the contributions to the Engineering and Metals Gross Output at 38%, whilst manufacturing of structural products contributed 24%. The manufacture of general purpose machinery, manufacture of automotive components and jewellery also picked up in 2011, contributing 13, 6.2 and 6.3% of the Engineering and Metals Gross Output respectively. Engineering gods contributed about 17% of the engineering and metals Gross Ouput according to the analysis of ZimStat data from 2009 to 2011. Value added engineering and metals products outside mining contributed about 49% to the combined Gross Output for the engineering and metals sector for the period 2009 to 2011. The Value Added for the sector for the combined period 2009 to 2011 was very high at about 59% implying that the sector could be producing

niche products for the market. Despite the fact that the contribution of iron and steel manufacturing industry to the engineering and metals gross output was still less than 5% for the 2009 to 2011 review period, the resuscitation of ZISCO Steel (now ZimSteel) can trigger this subsector into one of the mainstays of the sector. The investment in new plant and equipment was very minimal, constituting less than 5% of the gross value of the capital acquisitions in the period 2009 - 2011. The summary of the engineering and metals sector Gross Output, Intermediate Consumption and Value Added is presented in Table 4.

Table 4: Engineering and metals Gross Output, Intermediate Consumption and Value added for the period 2009 to 2011(Source: Zimstat, 2012)

Subsectors		USD Million	
Metals and metal products	**Gross Output**	**Intermediate Consumption**	**Value Added**
Mining of non-ferrous metal ores, except uranium and thorium ores	941,256,317	341,897,637	599,358,680
Manufacture of basic iron and steel	87,951,967	50,680,660	37,271,307
Manufacture of non-ferrous basic metals	26,741,017	16,446,736	10,294,280
Manufacture of structural metal products, tanks, reservoirs and steam generators	483,276,795	204,716,389	278,560,406
Metals and metal products total	**1,539,226,095**	**613,741,421**	**925,484,674**
Engineering products			
Manufacture of general purpose machinery; radio, television and communication equipment and apparatus; watches & clocks	230,583,546	87,076,488	143,507,058
Manufacture of electric motors , generators and transformers	89,010,064	60,064,104	28,945,959
Manufacture of bodies (coachwork) for motor vehicles; Manufacture of trailers and semi-trailers	147,775,778	65,550,997	82,224,781
Manufacture of jewellery and related articles	114,722,115	66,397,031	48,325,084
Building of complete construction parts of civil engineering	48,312,993	28,476,645	19,836,348
Engineering products Total	**318,695,755**	**152,750,802**	**165,944,954**
Engineering and Metals Sector Grand Totals	**1,857, 921, 850**	**766,492,223**	**1091429628**

2.3 Engineering and Metals Industry overview

The Engineering and Metals industry in Zimbabwe is classified into several categories covering the key processes involved in value addition from the raw materials source to the end products (ZimStat). These categories include the i) mining of ferrous and non-ferrous metal ores, except uranium and thorium ores, ii) manufacture of basic metals including iron and steel, iii) manufacture of non-ferrous basic metals, iv) manufacture of structural metal products, tanks, reservoirs and steam generators, v) manufacture of general purpose machinery; manufacture of radio, television and communication equipment and apparatus; manufacture of watches and clocks, vi) manufacture of electric motors, generators and transformers, vii) manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers, viii)

manufacture of jewellery and related articles and ix) building of complete construction parts of civil engineering.

2.3.1 Engineering and Metals Value Chain Mapping

The conventional engineering and metals industry was designed, planned and implemented in the colonial era as a matter of national policy during the UDI period to substitute imports as sanctions were imposed on the ruling regime. Large mining activities (especially iron ore) and agricultures were the nodes around which a network of suppliers of infrastructure and services came to be established. The abundant supply of coal made beneficiation a possibility. The businesses that consequently emerged provided specialized services to the core operations of these mining, agricultural and infrastructural development activities. The metal and engineering firms found markets in the agricultural, transport, infrastructural and manufacturing sectors that created opportunities to expand operations beyond maintenance and repair. This policy influenced the geographical location of the Iron and Steel industry cluster in Kwekwe, backed by the abundant resources of iron ore; the Bulawayo engineering hub to support vast mining activities and the Harare engineering and manufacturing clusters influenced by both agricultural activities, mining and urban infrastructural development. The generic map for the Engineering and Metals value chain is shown in Figure 2.

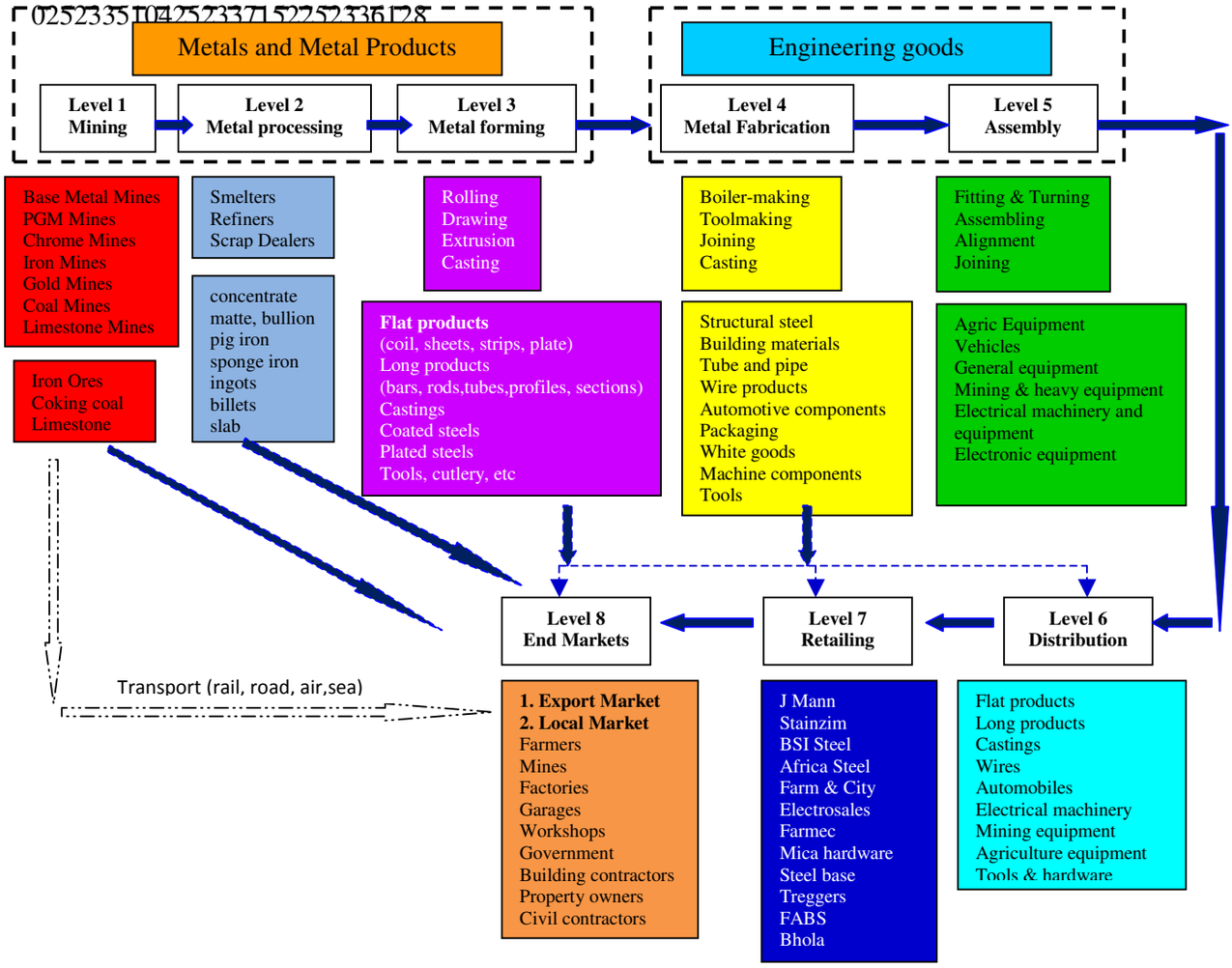

Figure 2: Generic Engineering and Metals Value Chain Maps (Source: SIRDC Analysis, 2013)

2.3.2 Sources of metals (ferrous and non ferrous)

The mining of metals forms part of the major sources of inputs for the Engineering and Metals value chain. The background to the sources of metals were summarised in a presentation by Professor Arthur Mutambara in 2013 in Nyanga on the *"Development and Managing of the Mineral Wealth of Zimbabwe for tomorrow"*.Jourdan et al., 2012 also did a comprehensive study on the Mining Sector Policy in Zimbabwe, which was published by the Zimbabwe Economic Policy Analysis and Research Unit (ZEPARU). The major sources ofmetals according to the studies are mainly found in the following geological formations and bodies: The Greenstone Belts: gold and silver, iron ore, nickel, copper, cobalt and podiform chromite, also chrysotile asbestos (Mashaba Igneous Complex), limestone, pyrite and antimony; The Great Dyke: PGMs & gold with associated copper, nickel and cobalt. Inputs also found are chromium (chromite seams), as well as minor asbestos and magnesite; The Magondi Supergroup: Copper and silver (Dewera Group); Pegmatites: and Lithium minerals, columbite-tantalite, cassiterite. There are also Hwedza iron ore deposits which are yet to be exploited. Of the US$52 billion worth of

Platinum along the Great Dyke, only US$5 billion has been allocated. In the other Great Dyke (550km) there are plenty minerals. Other sources of supplies include imports (e.g. aluminium) and recycling of used/scrap metals.

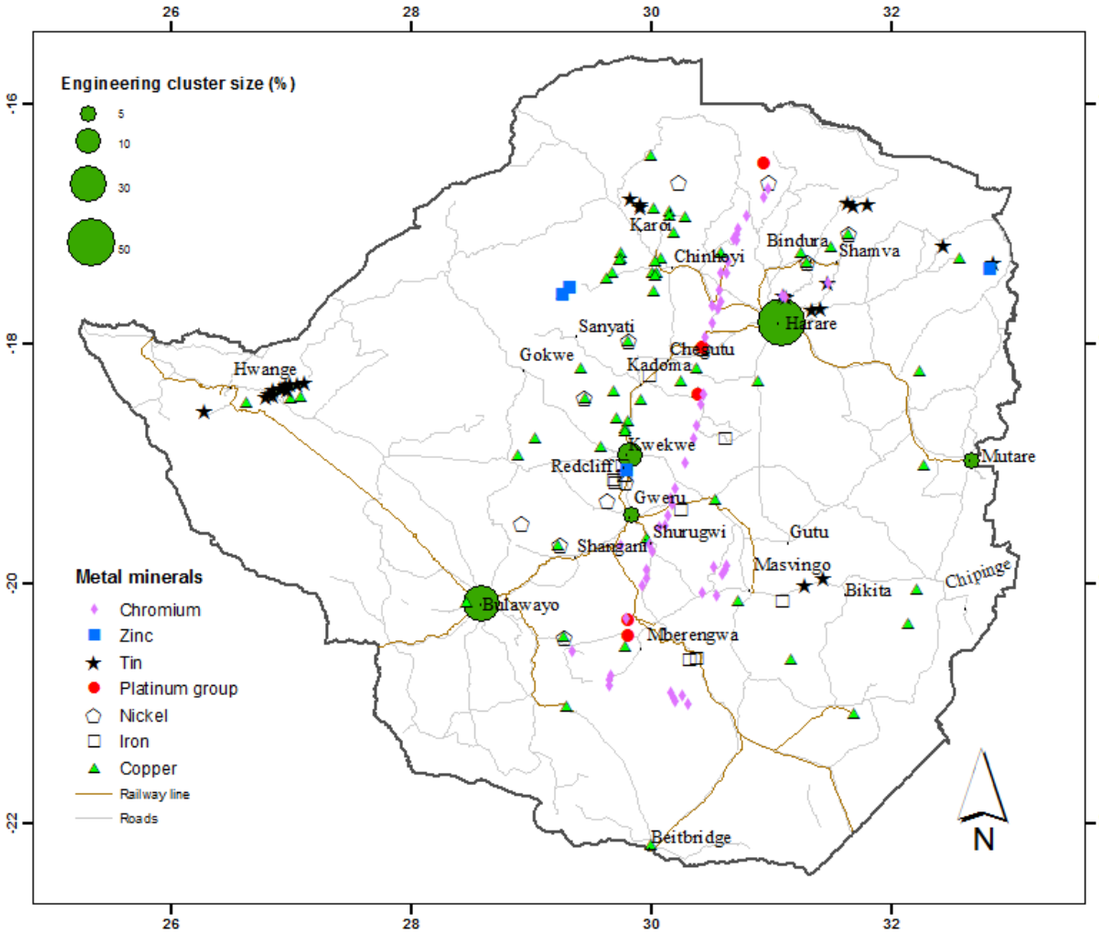

Figure 3: Metal minerals and engineering clusters distribution in Zimbabwe*(Excluding gold)* (Source: Zimbabwe Geological Survey, 1988)

Figure 3 shows the geographical layout of the Zimbabwean Engineering and Metals industry. The metal industry in Zimbabwe comprises the non-ferrous and the ferrous groups. The non ferrous metals include the **base metals** (aluminium, copper, zinc, lead, nickel, tin and chrome); **precious metals** (silver, gold); Platinum Group Metals [PGMs](platinum, palladium, ruthenium, rhodium); the **minor metals** including refractory metals (e.g. tungsten, molybdenum, tantalum, niobium, chromium) and **specialty metals** (e.g. cobalt, germanium, indium, tellurium,antimony, gallium).Of the base metals involved in the country's value chain, nickel and copper are the significant ones. Aluminium is imported or obtained from scrap dealers. Although some deposits of zinc were noted in the geological survey, no actor is currently extracting the ore.

2.3.3 Engineering industry background

The engineering industry takes from the sources of raw materials, largely being the mines, smelters and refineries and feeds into various sectors which include the manufacture of non ferrous basic metals, manufacture of basic iron and steel, structural metal products including tanks, reservoirs and steam generators, manufacture of general purpose machinery including radios, television, communication equipment and apparatus, watches and clocks, manufacture of electric motors, generators and transformers, manufacture of automotive components, bodies (coachworks), trailers and semi trailers and assembly, manufacture of jewellery and related articles and building of complete parts of civil engineering (ZimStat classification).The major end-user industries for heavy engineering goods are power, infrastructure, steel, cement, petrochemicals, oil and gas, refineries, fertilisers, mining, railways, automobiles, and textiles industry.The engineering industry in Zimbabwe is further classified into two categories namely heavy and light engineering. Light engineering goods are essentially used as inputs by the heavy engineering industry.The engineering goods classified under the two categories are listed in Table 5 below.

Table 5: Classification of heavy and light engineering subsectors in Zimbabwe

Heavy Engineering	Light Engineering
Mining machinery industry	Industrial fasteners
Industrialmachinery industry	Process control instruments
Material handling equipment industry	Medical and surgical instruments and apparatus
Railway related components	Ferrous castings
Metallurgical industry	Steel forgings
Agricultural machinery	Seamless steel pipes and tubes
Machine tool industry	ERW steel pipes and tubes
Boilers and steam generating plants	SAW pipes
Electrical machinery	Miscellaneous mechanical and engineering industries

The heavy engineering sector is further divided into two broad segments namely the capital goods/machinery and equipment. The capital goods/machinery category is further classified into electrical machinery/equipment and non electrical machinery equipment. The electrical machinery includes power generation, transmission and distribution equipment such asgenerators and motors, transformers and switchgears. Non electrical machinery includes machines/equipment such as material handling equipment (earth moving machinery, excavators and cranes) and boilers. The key players in the high value heavy engineering goods sector like Morewear industries use high end technology. However, a myriad of challenges affected their operations resulting in the closure of most of these companies. The equipment used is generally obsolete and near obsolete resulting in higher production costs that are not viable on the global market. The resuscitation of such heavy industries requires huge recapitalisation investments, which are not feasiblein the current environment of short term loans with high interest and the unavailability of long term loans. Consequently, small and unorganised firms have little market presence.

The light engineering subsectors manufacture low-technology products including the assembly of small-scale units whilst at times incorporating imported components. Light engineering goods manufacturers use medium to low-end technology which requires lower capital. Several small and unorganised players are involved in this sectorand manufacture low value added products. A considerable number of medium and large scale firms producing high value-added products also exist.

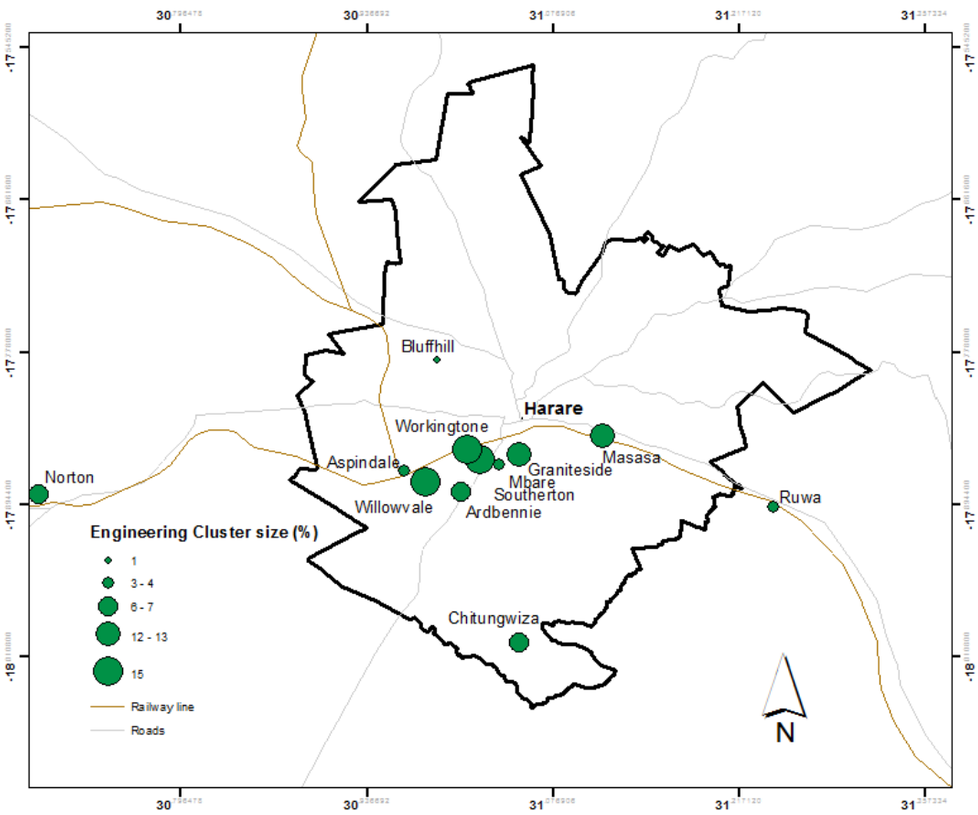

Figure 4: Engineering clusters distribution in Harare (Source: GRSI, SIRDC, 2013)

The engineering industry is dominated by actors in the Harare region. Figure 3 (previous section) shows the overall distribution of engineering clusters in the country whilstFigure 4shows the spatial distribution of engineering clusters in Harare. Historically, about 47% of the engineering industry was clustered in the Harare region whilst 22% was located in Bulawayo and the rest shared between Kwekwe, Gweru, Mutare, Masvingo and Marondera (Kaliyati, 1991).

Growth in the domestic engineering industry has been hampered by the lack of funding for new projects in core industries such as power, railways and infrastructure. The prospects look good, however with big power projects on the cards, as well as the possibility of expansion in the mining and roads construction sector. The resuscitation of ZISCO through the expected partnership with Essar is also expected to drive the growth in the engineering subsector.

2.4 Business Enabling Environment

The business enabling and policy environment facilitates the efficient and effective operation of a value chain. The government is the major key stakeholder through its various policies, instruments and institutions in ensuring that the environment is favourable to the viable and competitive operation of the engineering and metals sector. Thus the enabling environment is made up of policies, business lobby groups, regulatory authorities, power providers, transport and communication infrastructure providers, academic and research and development bodies, financial services providers as well as technical consultancy and advisory groups amongst others.

2.4.1 Business representative bodies

The business interactive bodies in the Engineering and Metals sector include Chamber of Mines the Platinum Producers Association, the Engineering Council of Zimbabwe (ECZ) and the Zimbabwe Institution of Engineers (ZIE), Engineering Iron and Steel Association of Zimbabwe (EISAZ), Zimbabwe Association of Consulting Engineers (ZACE)the Automobile Association of Zimbabwe (AAZ), Chrome Miners Association (CMA), Chrome Producers Association (CPA), Founders Association of Zimbabwe (FAZ), Gold Miners Association of Zimbabwe (GMAZ), Association of Mine Managers (AMM), the Confederation of Zimbabwe Industries (CZI) and the Zimbabwe National Chamber of Commerce (ZNCC) and the National Economic Consultative Forum (NECF) amongst others. These lobby groups protect and advocate for the interests of the engineering and metals sectors.

The labour representative bodies include the National Engineering Workers Union (NEWU), Zimbabwe Amalgamated Railway Workers Union (ZARWU), Zimbabwe Energy Workers Union (ZEWU), Associated Mine Workers Union of Zimbabwe (AMWUZ) and Engineering Employers Association of Zimbabwe amongst others. The Zimbabwe Congress of the Trade Unions is the national body representing the workers interest.

2.4.2Regulatory authorities

The regulatory authorities heavily involved in the engineering and metals industry include the Environmental Management Authority (EMA), National Social Security Authority (NSSA), Standard Association of Zimbabwe (SAZ), Minerals Marketing Corporation of Zimbabwe (MMCZ) and the Zimbabwe Energy Regulatory Authority (ZERA) amongst others.

2.4.3Financial Services

The national financing system under which the Engineering and Metals industry operates is summarised in Figure 5 below. The banks that normally support the engineering and metals industry included the African Development bank (AfDB) and the Infrastructure Development Bank of Zimbabwe (IDBZ). Funds were also sourced from the International Monetary Fund (IMF). However, there is currently no financing institution particularly dedicated to the Engineering and Metals sector as was the case with Agriculture where there are institutions like the Agribank of Zimbabwe.According to a Mining Sector study by Jourdan et al., 2012, the banking sector was sound and safe. Nevertheless challenges did exist which included liquidity shortages, limited interbank lending between strong and weak banks, lack of an effective lender of the last resort facility at the Central bank, limited bank sources of income, wide spreads

between deposit and lending rates, limited external lines of credit and money circulation outside the formal banking system amongst others.

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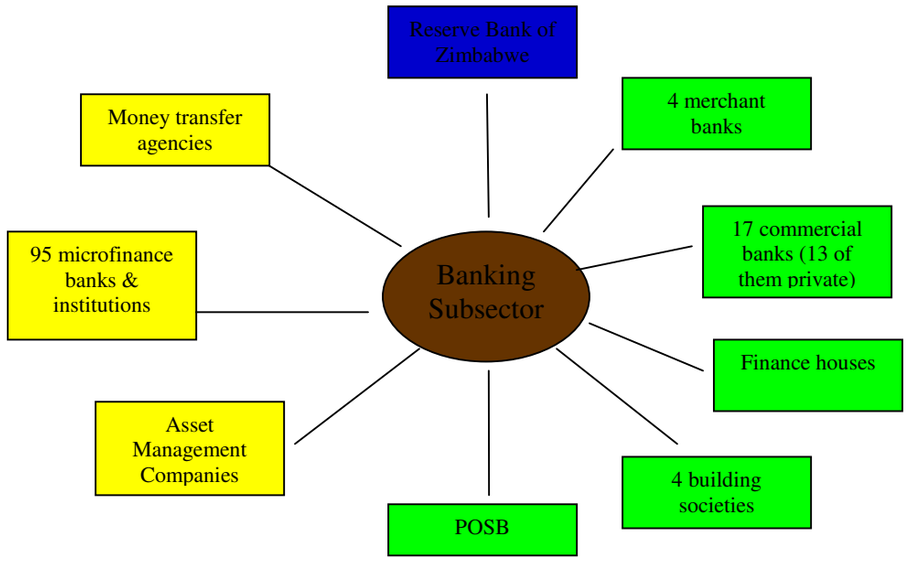


Figure 5: Financial Sector Overview of Zimbabwe (Source: Zimbabwe Agriculture Sector Market Study, 2010)

The most notable challenges in the current financial system is liquidity, high interest rates on loans (short term) and unavailability of long term loans for recapitalisation. The high lending interest rates averaged 12% for commercial banks and 18.8% for merchant banks for the period 2011 to 2012 (ZEPARU Economic Barometer, 2012). Although 98% of total domestic credit was advanced to the private sector (ZEPARU Economic Barometer, 2012), the positive impacts were yet to be seen in the engineering and metals sector.About 20% of the advanced credit was allocated to the manufacturing sector and it was unclear on the amount lent to the engineering and metals subsectors. The Engineering and Metals sector has also for long been perceived as high risk in the absence of clear cut policies to ensure industrycompetitiveness. Many of the indigenous banks have either collapsed or are under curatorship due to issues of undercapitalisation and poor corporate governance. The shrinking Zimbabwean market was also considered too small for the many banks. The Banks are represented through the Bankers Association of Zimbabwe (BAZ).

2.4.4 Transport and Logistics

The rail road networks linking the Engineering and Metals sectors are presented in Figure 3 from the previous section, which clearly shows that the infrastructure was strategically designed and constructed to provide effective transportation of goods and services within the Engineering and Metals value chains.The development of the railways in Zimbabwe was principally based on the need to establish a line to serve the mining and agricultural enterprises which were fast being established along the Zimbabwean watershed and elsewhere, as well as to link the land locked

country with sea-ports in Mozambique and South Africa. Ultimately the line was linked with the other railways in the SADC region to enhance trade within the region (NRZ website).

The National Railways of Zimbabwe (NRZ) operates about 3400km of railway lines, which provide both passenger and freight services (NRZ website). The railway gauge is standard for the region and linked to the Zambian Railways through Victoria Falls, toward the Indian Ocean through the Beira Railroad Corporation of Mozambique and another line linked to Maputo through Chiredzi. Botswana is linked up through Plumtree as Botswana Railways takes over and another one linking South Africa through Beitbridge to the sea port of Durban. The Gweru Harare section was electrified (electricity infrastructure now dysfunctional) whilst the rest depended on diesel as fuel. However, the functionality of the railway system in Zimbabwe has been affected by several challenges. Power shortages led to the unreliable operation of the electrified railway system, whilst the general decline of the economy resulted in neglect of maintenance due to shortage of spare parts and overdue replacement of equipment. As a result, a small fraction of the railway network remains functional, thus reducing goods transport from 18million tonnes in 1998 to 2 million tonnes in 2010. This has led to the use of haulage trucks that use the national road network which is three times more expensive and pushing up the production costs in the Engineering and Metals sector. The road infrastructure has also deteriorated leading to high maintenance costs. Competing industrial sectors have better logistical infrastructure and hence have a competitive edge on the global market. The most affected sector is the iron and steel and the smelting companies that rely heavily on bulky inputs (for example,coal) for their production.

2.4.5 Power generation and transmission

The Zimbabwe Electricity Supply Authority is the dominant national electricity supplier for the country. Although the energy sector has been liberalized, few independent power producers have been licensedby the Zimbabwe Energy RegulatoryAuthority (ZERA). Their contribution to the grid is insignificant at less than 5MW in total compared to the installed capacity of 1900MW. Electricity supply is the backbone of the power intensive Engineering and Metals industry of Zimbabwe. Information from key informant interviews (see Annexes 7 and 8) show that the prevailing shortage of electricity is one of the major reasons for the poor performance of the engineering and metals sectors as its consequences cut across the subsectors. The current capacity utilisation ranges from 51% to about 77% depending on availability of the production plant. The most reliable plant is at Kariba. The current production status is presented in Table 6 below.

Table 6: Current power production status ***(Source: Ministry of Energy and Power Development, Annex 8)***

Power Station	Source of Energy	Installed Capacity (MW)	Send Out Power (MW)
Kariba	Hydro	750	750
Hwange	Coal	920	650
Harare	Coal	100	
Munyati	Coal	100	100
Bulawayo	Coal	90	
Total		**1960**	**1,500**
IPPs-Triangle, Hippo Valley, etc			Less than 5MW

The key informant interviews (Annexes7 and 8) revealed a national power deficit of energy and electrical power in general. Industry is battling to have access to adequate power for their operations. The problem is manifested in perennial load shedding, planned and unplanned, as well as system breakdowns that increase the unavailability of electricity to the economic production sectors.The average daily normal production ranges between1,160 to 1,300 MW with the worst case situation of less than 1,000 MW per day. The send out power is power that is transmitted and distributed after accounting for the internal power usage. National power deficit can go up to 800 MW per day and the country does not have the capacity to import this magnitude of a shortfall at any given time.The national deficit is made up by importing power from HCB in Mozambique. Hardly any power is coming from other neighbouring countries such as Zambia and South Africa. The Power Purchase Agreement with HCB entitles ZESA to import 50 MW with provisions for more when an excess is available and ZESA has the capacity to import. Althoughthere is an electrical power market managed by the Southern Africa Power Pool (SAPP), the country is not participating because upfront payments are required. Power sourced on this platform is also very low or non-existent at the moment.

Although there is a shortfall during daytime when the load factor is high, the load factor is very low during the night (off-peak) to the extent that production units of up to 450MW have had to be switched off. A market for the off-peak excess has been found but the prices are very low.The tariffs have been structured as an incentive to industry to produce during off-peak periods. However industries are reluctant to shift their production time to off-peak periods.They cite reasons of high labour and logistical costs during off-peak periods. Typical energy tariffs prevailing at the moment for industrial and mining companies are as follows

- Standard 7c/kWhr
- Peak 13c/kWhr
- Off peak 4c/kWhr

The tariffs are higher than the regional prices (e.g. Zambia – 4c/kWhr, South Africa – 6c/kWhr) (Zambia Development Agency Report, 2012). The high energy tariffs are therefore a major hindrance to the competitiveness of the power intensive Engineering and Metals sector. ZESA has also incentivised industry by way of dedicated lines to industrial and mining companies. In this voluntary arrangement the companies guarantee that the customers between it and the ZESA

point of supply would get access to the power at an agreed flat rate. Although functional, the arrangement is not energy efficient. ZESA has also intensified its demand side management programme as it rolls out the prepaid metering system as well as training and awareness programmes aimed at energy efficiency.Several measures and projects, short, medium and long term, have been lined up for implementation to address the current challenges in the power sector. The projects, on completion, are expected to generate over 3900MW of electricity in addition to existing capacity. The full details of the projects are listed in Annexes7 and 8.

2.4.6 Water provision

The key informant interviews (Annex 9) revealed that theshortage of water was a key obstacle to the efficient operation of strategic players in the Engineering and Metals industry like ZISCO. It was revealed in the key informant interviews (see Annex 9) that a 24 hr water outage triggered the catastrophic break down of the integrated iron and steel production facility in the country. Local authorities are faced with financial challenges to refurbish ageing water reticulation systems, resulting in erratic water supplies to critical operations in the Engineering and Metals sectors.The Zimbabwe National Water Authority (ZINWA) is responsible for the regulation of water use in the country. Currently, it is limited in capacity and funding to fully exercise its mandate. Key informant interviews also revealed serious conflicts amongst stakeholders as far as water allocations are concerned.

2.4.7 Capacity building, education, research and development

Growth strategy development efforts typically end up futile in the absence of sufficient andcapable manpower, and effective institutions. Across all sectors of the minerals and metalssector – administration, regulation, training, research & development, and commercialoperations (from production to consultancy services); the need for capacity development isrecognized as a fundamental platform without which the vision for the sector cannot be realised.Strategies were therefore proposed to strengthen and deepen institutional and human capacityacross every aspect of the sector.Thus the Engineering and Metals industry is supported by an education system which starts from primary education, secondary education, technical colleges and universities. Information on the educational environment was obtained from key informant interviews in the technical faculties of universities and polytechnics (see Annexes10 and 11) as well as the comparative study carried out by Afonja et al., 2005 on engineering education for industrial development based on Zimbabwe, Ghana and Nigeria.

2.4.7.1 Overview of the technical education sector

The educational system in Zimbabwe initially followed the traditional pattern adopted from the colonial government and comprises primary education (7years), secondary education *(6 years – 2years for junior level, additional 2years to Ordinary Level and further 2 years to Advanced Level)* and different years depending on degree programme at university level (typically 3 – 5 years). Capacity building for the Engineering and Metals industry begins at primary level as a matter of policy with the government emphasizing on integrated theory and practice in primary education.

2.4.7.1.1 Primary and Secondary education

Primary education covers 7 years with emphasis on Mathematics, English, Shona/Ndebeleand a General paper covering different aspects of knowledge from science, geography, health, environment and social studies amongst others. Several primary schools are distributed throughout the country, backed by the government policy on universal primary education for all, which resulted in Zimbabwe becoming the most literate country in the continent with a literacy rate of over 92%.

At secondary school, the integrated theory and practice policy continued with the introduction of some technical and vocational courses into the curricula (Afonja et al., 2005). Each pupil was therefore expected to taketwo practical subjects such as woodwork, metalwork and technical graphics at the junior secondary level with the aim of instilling positive and favourable attitudes towards practical and technical subjects to bridge the gap between academic and practical knowledge. The impact of this policy resulted in around 8% of the population of school leavers having done technical subjects. Thus the implementation of this policy required further impetus to yield intended results in supporting the technical sectors of the country including the Engineering and Metals subsectors. The secondary education ends at advanced level where students are allowed to specialise in eitherArts, Sciences or Commercial subjects. The sciences, especially Mathematics, Physics, Technical Graphics and Chemistry are critical to the Engineering and Metals sector of the economy. The research by Afonja et al., 2005 noted the major weaknesses in the education curriculum in-order to support technical/ engineering education were as follows; i) limited practical education at primary level, ii) a few practical courses in the education curriculum, iii) inadequate equipment and facilities and iv) lack of training for self employment including entrepreneurial skills development

2.4.7.1.2 Tertiary education

The Ministry Education, Science and Technology is responsible for setting up and designing policyon higher education, planning, organizing and developing theentire Zimbabwe's higher education system as well as technical capacity building in science and technology development. Tertiary education hence includes teacher training, technical and vocational education at post secondary level as well as professional training and development at university level. The key objectives in the tertiary education policy aligned to the Engineering and Metals value chain are as follows; i) development of local human resources that make Zimbabwe as self reliant as possible, ii) facilitation of the development of globally competitive local technological capacity, and iii) establishment and development of an educational system and the requisite infrastructure to meet the intellectual development aspirations of the individual in Zimbabwe.

As a result of the policies the number of universities and technical colleges increased significantly from 3 in1980 to more than 18 in 2013. There are 13 universities in Zimbabwe, 5 (38%) of which support technical education. All of the universities supporting technical education are funded by the Government. These are the University of Zimbabwe (UZ), the National University of Science and Technology (NUST), Harare Institute of Technology (HIT), the Chinhoyi University of Technology (CUT) and Bindura University of Science Education

(BUSE). The universities of technology offer the four to five year Bachelor of Technology (BTech) or Bachelor of Engineering honours (BEng Honours) degrees in fields such as production engineering, industrial engineering, water engineering, chemical engineering, electronics engineering, energy and fuels amongst others. One year is allocated to industrial attachment in the relevant disciplines. On the other hand the University of Zimbabwe through the faculties of engineering and sciences offer Bachelor of Science honours (BSc Honours) degrees in engineering and sciences. According to key informant interviews (Annex 11), the Faculty of Engineering has 6 departments offering 4 year degree programmes in civil engineering, electrical engineering, mechanical engineering, metallurgical engineering, mining engineering, and geo-informatics and surveying. These universities also offer MSc programmes in mechanical, electrical, civil and water, renewable energy as well as manufacturing systems and operations management. The UZ alone has been noted to have produced over 1000 engineers over the years and are currently producing about 200 engineers every year according to the key informant (Annex 11).

There are also six technical colleges and a School of Mines supporting the Engineering and Metals industry in Zimbabwe. These include Harare Polytechnic, Mutare Polytechnic, Gweru Polytechnic, Kwekwe Polytechnic, Masvingo Polytechnic and Kushinga Phikelela College. The technical teachers colleges, like Belvedere were also established to increase the number of teachers teaching technical subjects at schools. These institutions, offer diplomas, higher national diplomas and bachelor of technology degrees in similar disciplines to those by universities. Vocational training centres which include Masasa, Westgate, Magamba, Ruwa and Domboshawa amongst others were also established to develop the human technological resource base at lower levels. The technical training centres are supported by the national trade testing centre which classifies technical hands on personnel according to the level of skilling. Before the economic melt down in the economy, several big companies in Engineering and Metals used to offer apprenticeship programmes in the engineering disciplines. These companies include Morewear, ZISCO, ZESA, Delta, PTC and NRZ amongst others. Companies like ZISCO and Morewear were nolonger training apprentices due to financial and operational challenges.

When the national economy was in better shape in the 1990s, it was noted that there were major gaps in the technical education sector as well as shortages of technicians, engineers and scientists in the country (Afonja et al., 2005). Thus all the universities, polytechnics and technical colleges, vocational schools and teachers colleges were required to produce manpower with skills aligned to industry needs. As a result the Zimbabwe Manpower Development Fund (ZIMDEF) was introduced at policy level to resource the training of students on attachment for practical skills development.The ZIMDEF funding was drawn from various industries to meet the cost of attaching students for industrial internship.Graduate traineeship and on the job trainingprogrammes were also encouraged to support the skills development programme. To support technological transfer agreements with other countries, the Scientific and Industrial Research and Development Centre (SIRDC) was set up under the Research Act of 1986 to promote the research and development need of industries in the country.

It was also vitally noted in the study by Afonja et al., 2005 that industry participated in academic institutions through their services on advisory committees of faculties and departments. Some industries as noted in the key informant interviews also provided facilities for practicals and industrial training to students in universities and polytechnics. However, more industrial players needed to be involved. Despite technology friendly policies, it was noted that the pace of technological development remained poor. This was attributable to poor funding, lack of industrial support, poor technology appreciation by policy makers, lack of co-operation between university and industry, little stakeholder involvement, lack of equipment and infrastructure, inadequate students field exposure, inadequate industrial experience for trainers, misaligned training and manpower needs and understaffing due to brain drain amongst others.Despite the well structured and established academic institutions, the interviews also revealed the following challenges in the education and academic system of the country;

- Digression of academic institutions from their original mandate causing unnecessary competition and redundancy in the academic output (graduands and industry contribution)
- Compromised quality of graduands between 2008 and 2010 due to the economic challenges
- Limited levels of interaction between industry and some academic institutions
- Lack of funding for research
- Lack of coverage of science and technology through the media
- Poor coordination amongst academic and research stakeholders creating counterproductive competition

The detailed challenges and recommendations presented by stakeholders are documented in Annexes 10 and 11.

2.4.8 Marketing and trading capacities and policies

Our study on the Engineering and Metals sector indicates that growth and value addition process in the mining, metal and engineering sector has been largely hampered by pricing and marketing policies, little access to international marketing information, sanctions, trade policies and regulatory framework, logistical challenges, shortage of skills, physical infrastructure, macroeconomic policies, corporate and national governance, national sustainability strategy.

2.4.8.1 Marketing and Pricing

In Zimbabwe, the international marketing of minerals is done through the Minerals Marketing Corporation of Zimbabwe (MMCZ) formed in 1981 through the MMCZ Act Chapter (21:04 of 1981) whose specific mandate is to market and export all minerals produced in the country. While there is little restrictions and control on the international marketing of engineering end

products to the regional and international markets, there is still more controls on the sale and marketing of metals and minerals. Prior to 1983 the marketing of minerals and metals was done by the corporate companies, usually through agents in the Organisation for Economic Cooperation and Development (OECD) countries. Up until the beginning of 1980 sanctions were imposed to the then Rhodesia, so the marketing methods tended to be clandestine. Since 1983 however, all mineral exports, except gold, have been done and controlled by the Minerals Marketing Corporation of Zimbabwe (MMCZ) that was set up by the government in 1982 to rationalize selling arrangements, remove restraints on mineral trade and to reduce costs to producers, and to eliminate transfer pricing.

This new arrangement was initially received by the mining industry especially the Trans-national Corporations (TNCs) with great resistance and they fought unsuccessfully against the establishment. However in the mid 1980s and 90s they came to terms with it. Although the initial establishment of the MMCZ was seen as a victory of the government's socialist policies immediately after independence, there appears to be good evidence that the inefficiency of the MMCZ may be more expensive than the losses through transfer pricing. A confidential assessment of the MMCZ in 1990 concluded that millions of dollars were being lost, not only through inefficiency but also possibly through corruption. The range of Zimbabwe's mineral exports and the generally small quantities of any one mineral make it difficult for MMCZ to have people proficient in all aspects of all minerals traded. Minerals marketing monitoring commission might possibly be a more appropriate strategy given the skills constraints of the MMCZ, where spot checks have to be made on random deals, possibly using outside consultants, with heavy penalties for transfer pricing.

For most metals and minerals, Zimbabwe is a price taker given that the country sells its range of minerals to the international buyers where there are so many players and competitors. Most medium to small scale mining and mineral production systems in the country are not well equipped with state-of-the-art machinery resulting in high production cost per unit. This reduces the competitiveness of the country's minerals on the international market. A case in hand is the production of gold which has currently slowed down due to the falling international buying price per ounce. This leaves most medium to small scale who are estimated at 3,000 and who meaningfully contribute to total mineral output, in a wait and see attitude hoping that market conditions may turn favourable in the short to medium run. For the engineering sector, it is also important to note that, unlike the MMCZ, the Agriculture Marketing Authority (AMA) or the Grain Marketing Board (GMB), there is no significant body available for the marketing of engineering products in Zimbabwe. During the colonial era, RhoSales was responsible for the sales and marketing of iron and steel products (Kaliyati, 1991).

2.4.8.2 Mining fees review

The government has made substantial efforts to promote investment in mining mainly through reduction of mining fees and levies particularly for small miners. According to the Government Gazette of 08 March 2013, application fees for registering as an approved prospector were reduced by 20% from US$5,000 to US$4,000 in every five year period. Ordinary prospecting

license fees have been reviewed downwards from US$1,000 to US$750 which represents a 25% reduction. Levies for inspections of gold claims were reduced by 50% from US$100 for every 5 hectares to US$100 for every 10 hectares. Base claims fees are down from US$200 to US$100 per every five hectares which is a 50% decrease. Registration fees for gold claims remain unchanged at US$200. First inspection fees for gold claims were 50% down from US$200 to US$100 per hectare while second inspection fees were reduced from US$100 to US$50. Unmined grounds protection fees have been reduced from US%1,000 to US$100 for two months. This is a 90% reduction. The fees for platinum and gold remained unchanged mainly because these are usually mined by medium to large scale miners who can afford the fees. This is a positive effort by the government to promote investment and growth in the mining sector although miners especially small scale miners still feel the fees are still on the high side since they were substantially increased in January 2012.

2.4.8.3 Mineral Legislation

The Mines and Minerals Act was enacted in 1961 and a number of amendments have been made since then. All minerals are vested in the President. One acquires rights to work on mining mineral deposits through an application to the Minerals and Mining Commission. Mining activity is open to both local and foreign individuals and companies.Prospective license holders are entitled to peg and register claims. The claim then becomes a registered mining location where mining activity can take place. Prospecting licenses are valid for two years while an approved prospector's license is valid for five years and can be renewed after every five-year period. Mining claims which are worked continuously do not have an expiry date. An Exclusive Prospecting Order (EPO) confers the exclusive right to prospect for specified minerals in any defined area. This is obtained through application made to the Mining Affairs Board. The maximum possible period for operating an EPO is six years. License holders are obliged to submit from time to time work programs to be carried out in the coming six to twelve months.

2.4.8.4 Mining Claims

The permit to mine is called a Mining Claim. Usually several claims are grouped to form a block of claims since a claim covers a small area. There are two types of claims: precious metal / mineral claims and base metal claims. The claim confers on the holder the exclusive right to mine the mineral resource for which the claim was registered and of prospecting for other minerals on the claim. Holders of claims are required to fulfil minimum conditions. These are commitment to development work program or production or capital expenditure. Claims are inspected annually.

The government does not participate in managing projects of local or foreign firms in the private sector. Presently government participation in mining is through Zimbabwe Mining Development Corporation (ZMDC) and through the Minerals Marketing Corporation of Zimbabwe (MMCZ). The ZMDC was formed in 1982 for government to participate in the mining sector and to save companies that were being threatened to close. It is active in exploration, mining and giving assistance to cooperatives and small scale miners. The MMCZ, formed in 1992 is responsible for marketing all the country's mineral and metal products except gold and silver which are sold

through the Reserve Bank. It finances its operations through a commission charge and sales conducted for its clients.

2.4.8.5 Non-Tariff Charges controls

Non Tariff Barriers (NTB) today are most similar to tariffs with the exception of export subsidies and quotas. Tariffs for goods production were reduced during the eight rounds of negotiations in the World Trade Organisation (WTO) and the General Agreement on Tariffs and Trade (GATT). After the lowering of tariffs, the principle of protectionism demanded the introduction of new NTB. NTB can thus be regarded as a protectionist measure against imports and/or exports. According to statements made at United Nations Conference on Trade and Development (UNCTAD, 2005), the use of tariff as on the amount and control of price levels has decreased significantly from 45% in 1994 to 15% in 2004, while use of other NTBs increased from 55% in 1994 to 85% in 2004.

The need to protect sensitive markets to import industries, as well as a wide range of trade restrictions, available to governments of countries, has forced countries to resort to use the NTB. While NTB are widely viewed as having dampened world economic growth, they are still widely considered necessary in the Zimbabwean metals and engineering economy as a form of hedging and protection to allow the domestic industry to grow.

Zimbabwe's engineering companies have been badly affected by the economic decline in the past one and half decade. This has left most companies in the engineering sector operating below 30% to date. Critical companies in the metals and engineering economy such as the National Railways of Zimbabwe (NRZ), Lancashire Steel, Zimbabwe Iron and Steel Company (ZISCO)which is operating below 20% capacity and Morewear Engineering that has since closed.

These challenges have resulted in domestic engineering companies raising great concerns on the need for the local industry to be protected and promoted by the government through non-tariff barriers against imported end-use metals and mineral products from regional competitors such as South Africa, China and India. These countries import metals and engineering components and spares at prices that domestic suppliers cannot match due to various factors notably, low capacity utilisation, inadequate and in most cases obsolete production equipment and machinery, shortage of skilled manpower, shortage of foreign currency to import new machinery, unavailability of medium to long term loans for recapitalisation, poor inbound and outbound logistics supply infrastructure, and irregular power supply cuts among other challenge.

Thus suggestion from industry is that the government has a big role to play in revamping the engineering sector, and overwhelming responses pointed out to the need for non-tariff controls to imports into Zimbabwe from regional and international giants such as China, India and South Africa who can supply metal and engineering products at much lower prices than local companies can do. Such international competitors derive their competitiveness from economies.

2.4.8.5.1 Proposed Non-tariff Regulations

The current position is that less that 5% of value adding metal, engineering and foundry companies are exporting mainly due to low competitiveness. Engineering companies suggest that the revival of the engineering economy should start by recapitalisation of the upstream supply side – for example the resuscitation of ZISCO to supply quality and affordable iron and steel that can then be used by the engineering players. The availability of quality and affordable iron and steel will then enhance the competitiveness of value adding engineering companies. Examples of such NTB that companies suggested include but are not limited to the following:

Specific Limitations on Imports

This can be done in the form of licensing. This should apply to regional and international companies that wish to import into the country. If well introduced, licensing restrictions limits the number of importers of metals. This forces end users to source metal and engineering products locally thereby stimulating local demand. This in turn exerts pressure on local companies to perform. The use of licensing systems as an instrument for foreign trade regulation should be based on a number of international level standards agreements such as provisions of the General Agreement on Tariffs and Trade (GATT) and the Agreement on Import Licensing Procedures.

Proportional restrictions

Foreign domestic goods should have a certain percentage of local content to encourage the use of domestic suppliers of raw materials such as minerals and chemicals. This has a ripple effect as it also stimulates upstream industries including, the mining sector, semi-processing companies, chemicals companies and agro-processing companies. Some engineering companies feel that minimum import price limits should be introduced to try and protect domestic companies whose average capacity utilization is below 30%. This is meant to enhance domestic productivity and competitiveness. Minimum import price limits can also be used to control the level of imports. Most companies feel that embargoes / complete distraints should however not be considered as they have an effect on domestic-foreign relations.

The implementation of non-tariff barriers is not unique to Zimbabwe. It is used in the developing and developed world as well as trade blocks. Japan, for example, has stringent NTBs on non-agricultural products to protect their market. These are as listed in the Table 7 below:

Table 7: NTBs on non-agricultural products in Japan

a	Tariff quotas
b	Variable charges
c	Antidumping duties
d	Automatic licenses
e	Authorisation for wildlife protection
f	Authorisation to ensure national security
g	Global quotas
h	Quotas for seminar products
i	State monopoly of imports
j	Product characteristics requirements to protect human health

k	Product characteristics to protect the environment
l	Product characteristics to protect wildlife

Source: Mehta R (2003) "WTO liberalisation and industrial sector: The case of market access" RIS Occasional page No. 63

The European Union also has stringent rules to their market as listed in Table 8

Table 8: NTBs to guard against product dumping in the EU

Antidumping investigations	Quota to protect human health
Antidumping duties	Quota to protect environment (Montreal Protocol)
Countervailing duties	Prohibition
Retrospective surveillance	Prohibition for human health protection
Prior surveillance	Prohibition on the basis of origin (Embargo)
Prior surveillance to protect human health	Technical requirements
Prior surveillance to protect the environment	Product characteristic requirements to protect human health
Non-automatic license	Product characteristic requirements to ensure human safety
Authorisation to protect wildlife (CITIES)	Labelling requirements to protect human health
Authorisation to protect environment	Labelling requirements
Authorisation to control drug abuse	Testing, inspection and quarantine requirements
Allocated quotas	

Source: UNCTADs TRANS Database

2.4.8.6 Regional Structured Trading System Platform

The metals and mineral industry is of strategic importance not only for Zimbabwe but for Southern Africa. Roughly half of the world's vanadium, platinum, and diamonds originate in the region, along with 36% of gold and 20% of cobalt. These minerals contribute greatly to several Southern African Development Community (SADC) member states gross national product and employment, and many of them depend on mineral exports for their foreign exchange earnings. Recognizing the significance of the mineral industry within the region, SADC launched the Protocol on Mining in September 1997 which came into effect in February 2000, and has come to form the basis for SADC's work programme on mining. This protocol aims to develop the region's mineral resources through international collaboration, in turn improving the living standards of the people engaged with the mining industry.As part of the protocol on mining SADC member states have been engaged to harmonise their policies and procedures for mineral extraction, cooperating on improving technical capacity and sharing knowledge. With a goal to grow the mineral industry in Southern Africa, member states also agree to encourage private sector developments, including small-scale mining projects that promote economic empowerment of those who have been historically disadvantaged in the mining sector. This is very much in line with the indigenisation policy in Zimbabwe that has seen the birth of over 3,000 small to medium scale miners. The mining protocol also requires member states to observe internationally-recognised health and safety and environmental protection standards.

In order to facilitate these goals, the protocol on mining also calls for an organisational structure consisting of a Committee of Mining Ministers, a Technical Committee of Officials, and a Mining Coordinating Unit to oversee mining operations and ensure that applicable standards are upheld. This is being followed in Zimbabwe. Since releasing the protocol on mining in 1997,

SADC has organised several activities to promote mining investment, such as the SADC-EU Mining Investment Forum – Mines 2000 and the Australia-SADC Forum. Both forums successfully boosted awareness of the region's mineral abundance and directly spurred investment in the region. Likewise, the protocol on mining prompted several member states to sign bilateral agreements with countries outside SADC, which has boosted investment. A recent success story regarding investment comes from Tanzania, which attracted considerable investment after it modernised its mining legislation, following encouragement and support from SADC. It is now one of the SADC region's leading gold producers.

2.4.8.7 Standards

Most foreign companies that dominate the importation of metal and engineering products take advantage of economies of scale as they produce in large quantities. They take advantage of economies of scale and marginal costing to produce additional units of products even below cost using the concept of positive contribution. These extra or additional products may be of lower quality but targeted at financial distressed developing economies and markets including Zimbabwe. Domestic industry views this as a form of dumping. Most domestic companies have raised complains about the standards and quality of most imported products but they keep buying for lack of options. Domestic suppliers who can otherwise provide high quality alternatives are incapacitated. This brings in the need for government to intervene using standards as a way of reducing product dumping. The government should come up with minimum required standards for products that can be imported into the country either on classification or testing.

2.4.8.8 Government participation in trade

Zimbabwe is endowed with over forty types of minerals that are exploited by medium to small scale miners. These miners remain depressed due to import competition and lack of financing. Companies and miners therefore feel that the government should come up with export subsidies as well as domestic assistance programs to enhance growth and exports. A case at hand is the use of revolving capital finance scheme. The government should also monitor the process of customs clearance with the ministry of mines (department of metallurgy) and ZIMRA to ensure that customs clearance for export takes the shortest possible time. Renewal of export licenses and permits should also be done expeditiously by MMCZ. The validity period of export licences should be lengthened.

2.4.8.9 Customs clearance for metals and engineering products

The clearance of metals and engineering products follows a procedure that is required by ZIMRA to ensure that metals and engineering products that are exported are vetted and certified as value added. This is also to control smuggling. The general export procedure is as follows:

i. Application letter and submission of the metal specifications to the department of metallurgy specifying the value added to the metal in order to be vetted
ii. Obtaining the export permit / licensing from MMCZ
iii. Drawing of export contract between the exporting company, MMCZ and the foreign client specifying the terms and conditions that bind the parties involved

iv. Preparation of export invoice and sending it to MMCZ attaching both the export license and the contract
v. MMCZ produces a commercial invoice
vi. The commercial invoice is send to the exporter's bank for stamping and production of CD1 form; exchange control form as required by ZIMRA
vii. The commercial invoice and the CDI are send back to MMCZ for customs clearance of the goods to be exported
viii. After exportation and payment by the foreign client, the exporting company goes to ZIMRA to clear and close the CD1 Form

2.4.8.10 Administrative and bureaucratic delays of import clearance and entry

At national level, administrative regulation can be is carried out mainly within a framework of bilateral agreements, which include a clear definition of the legal regime and the procedure for the admission investors. Administrative non-tariff measures are seen by the domestic industry as a way to reduce or discourage imports by delaying import products at entry. This increases uncertainty as well as cost of maintaining inventory. Another non-tariff measure is import deposits which the importer must pay the bank for a definite period of time (non-interest bearing deposit) in an amount equal to all or part of the cost of imported goods.

PART 3: VALUE CHAIN SELECTION

Since the engineering and metals sub-sector comprises many subsectors of varying potential and attractiveness, a value chain selection criterion was necessary to streamline, optimise and synchronise the sub-sector value chains. Key criteria as already mentioned in the methodology (Tables 2 and 3 in Part1) include market demand and growth potential, potential increase in income and wealth, opportunities for linkage, potential for employment generation, number of Micro to Small and Medium Enterprises (MSMEs), value added potential, potential increase in productivity, government/donor interest/existing support programmes and competitiveness of the value chain on the global market. For a fair assessment of these value chains document reviews, key informant interviews and field surveys were done with key information coming from ZimStat, UNCOMTRADE (www.trademap.org), the Chamber of Mines and CZI amongst others. After the preliminary data analysis, the weighted objective method based on the above mentioned criteria was used to select strategic value chains in the engineering and metals sector.

3.1 Subsector attractiveness

The attractiveness of the engineering and metal products subsectors was determined by assessing the revenue size, production growth rate. The key sources of data for this assessment was obtained from ZimStat, UNCOMTRADE (www.trademap) and the Chamber of Mines. Other source documents included country documents for Zambia, China, South Africa and the EU as well as Ernst and Young Global for benchmarking purposes.

3.1.1 Metals and metal products revenues

From the Chamber of Mines documents, PGMs, gold, chrome, copper, nickel, cobalt and iron pyrite were the key metals contributing to the national revenues. High carbon ferrochrome was also a notable intermediate product in the chrome value chain.

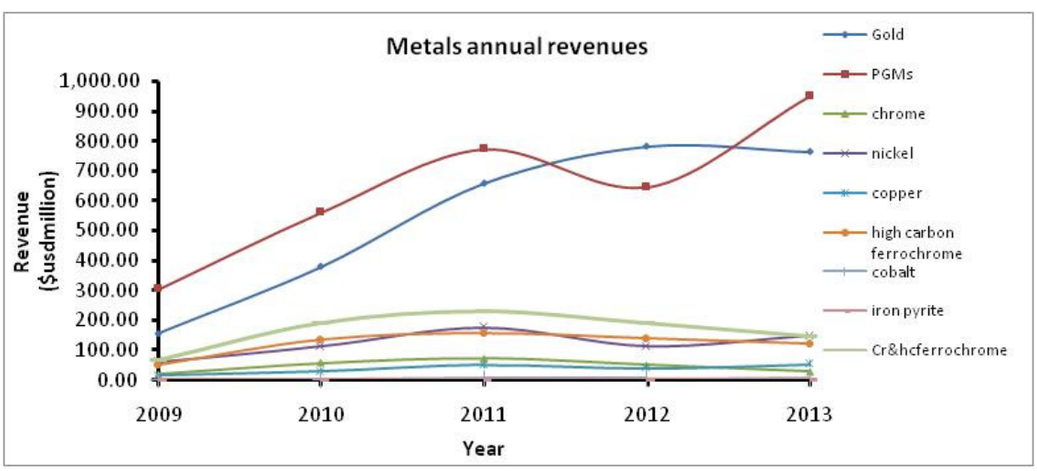


Figure 6: Metals and metal products revenue growth profiles (2009 to 2013) (Source: CoM)
(N.B 2013 figures are projected from the half year reports)

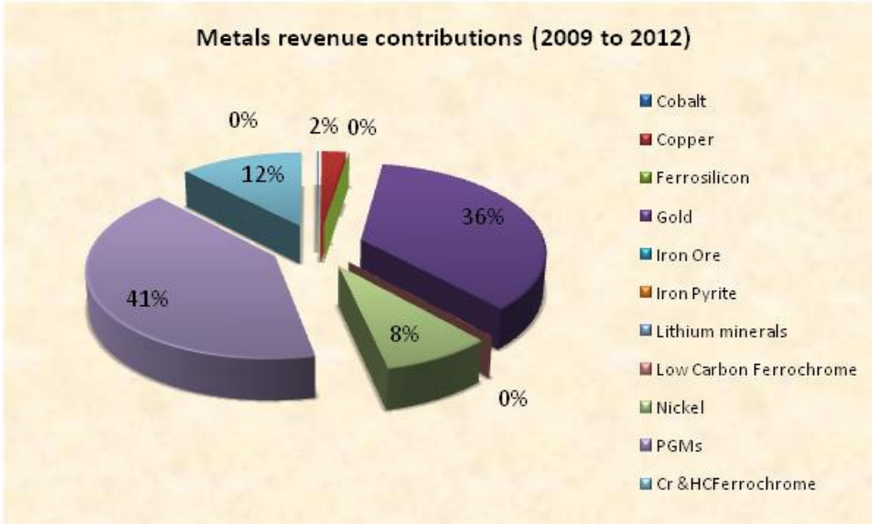


Figure 7: Total Revenue proportions by different metals and metal products (2009 – 2012)

Figure 6 shows the metals and metals products growth profiles by value for the period 2009 to 2013. Since half year results were provided for 2013, a projected estimate was given for that year. The precious metals (PGMs and gold) showed significant contribution to national revenue and significant growth. The PGMs revenue grew from about USD$300million in 2009 to a projected revenue of USD$900million in 2013. Gold also showed marked growth from about USD$150million in 2009 to a projected value of just over USD$700million in 2013. Figure 7 shows that PGMs had the highest share of the metals and metal products revenue at 41%, followed by gold (36%), then chrome and high carbon ferrochrome (12%) and nickel (8%). The feasibility of beneficiation of PGMs and gold beyond the concentrates and the matte is therefore worthy assessing considering the great growth potential and contribution to the national economy.

Table 9: Metal Ore Reserves in Zimbabwe

Mineral	Est. resource (tons)	extraction rate (est) (tons/yr)	Est. years to extinction
Gold	13 million	150000	87
Platinum	2.8 billion	10 million	280
Chromite	930 million	1million	930
Nickel	4.5 million	9000	500
Iron ore	30 billion	3million	10000
Copper	5.2 million	-	-

Source: (SIRDC Analysis based on RBZ Monetary policy 2009 and CoM figures, 2013)

Table 9 shows that the precious metal reserves are quite huge for the precious metals (gold and PGMs), chromite, nickel, iron ore and copper. Copper is also notable and significant ore reserves

are available. The iron value chain did not constitute much of the revenue generated for the assessed period despite the fact that huge reserves are available in the country. The same applies for copper despite significant ore reserves. This information further strengthens the strategic place that these metal sources take in the national economy. It also implies that upstream and downstream beneficiation and investment must be seriously considered considering the significant number of years to extinction.

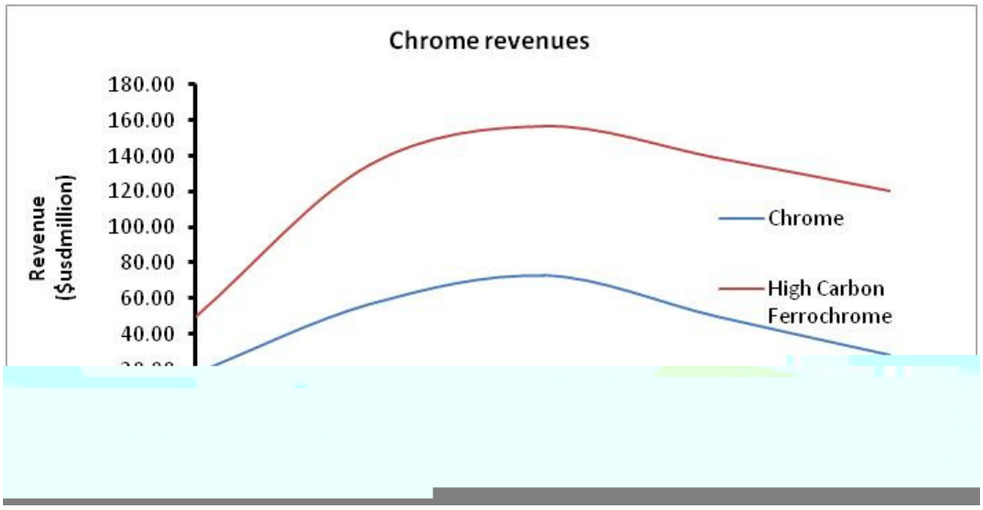


Figure 8: Benefits of chrome beneficiation (chrome to high carbon ferrochrome) (Source: CoM)

The government of Zimbabwe introduced a policy which prohibits the exportation of raw chrome to promote exportation of value added products like high carbon ferrochrome with higher returns. Figure 8 shows the impact of beneficiation. The returns from high carbon ferrochrome are significantly higher than the revenues for chrome. Nevertheless after reaching peak revenues in 2011 (Figure 8), the revenues from high carbon ferrochrome and chrome dropped in 2012. There is great potential for the growth of the chrome value chain and further analysis of the dynamics in the chrome value chain was therefore necessary.

3.1.2 Engineering goods revenues

The gross output profile for the local engineering and metals industry by USD value is critical to value chain diagnostics and selection. The notable value chain activities in the engineering sector of Zimbabwe include the manufacture of i) structural steel metal products, tanks and steam generators; ii) general purpose machinery, equipment, apparatus, etc; iii) electric equipment, generators, etc; iv) coachworks (vehicles), trailers, etc; v) jewellery and precious metal articles and vi) civil engineering construction parts.

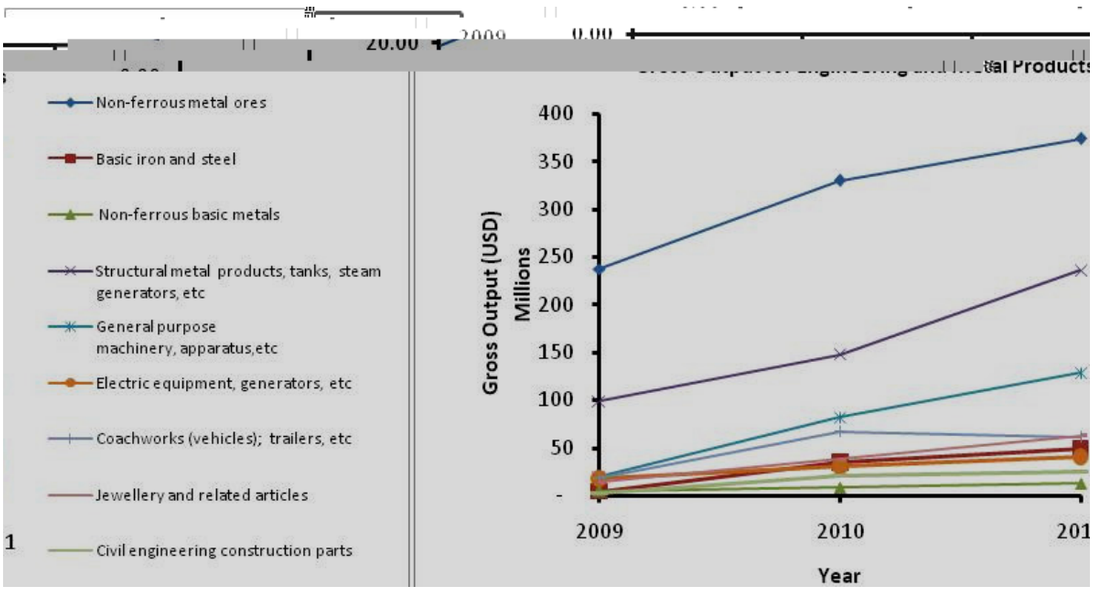


Figure 9: Gross output for engineering and metals products for the period 2009 to 2011 (Source: ZimStat, 2012)

Figure 9 shows the gross output profile by value (USD) for the local engineering and metal products for the period 2009 to 2011. The non-ferrous metal ores significantly contributed to the gross output as compared to the other value chain products (USD$250million to USD375million). This profile is consistent with the fact that PGMs and gold production has been increasing since 2009. The structural metal production growth is also notable increasing from USD100million in 2009 to about USD225million in 2011. The basic iron and steel sector was also notable for its poor performance despite the great potential and its historical high performance during the pre-economic crisis era. The engineering goods growth profiles and size significantly lagged behind the metals and metal products despite great potential shown by the general purpose machinery, vehicle coach works and trailers, electrical equipment and jewellery sectors. The significant differences by value and size between the metal ores and engineering and metal products imply significantly low value addition in the engineering and metals sector of Zimbabwe.

3.1.3 Production growth trends for metals and metal products

The critical information on production trends for metals and metal products were obtained from the Chamber of Mines. There were mixed trends for different types of metals as portrayed in the sections that follow.

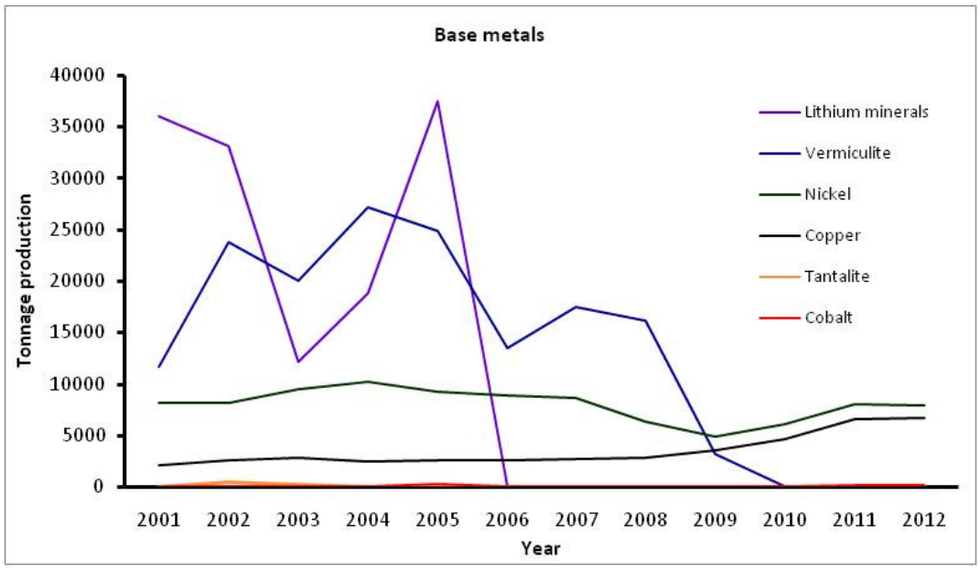


Figure 10: Base metal production growth trend in Zimbabwe (Source: CoM)

The base metal production profile has not seen any significant growth for the period 2001 to 2012 as shown in Figure 10.In fact the production levels for lithium and vermiculite have significantly gone down; from 35000tons (2001) to 0tons (2012) and about 26000tons (2004) to 0tons (2012) for lithium and vermiculite respectively. The production levels for nickel and copper did not show any significant change along the profile from 2001 to 2012. It implies that there was no significant investment in these subsectors. The producers also faced serious challenges during the economic meltdown, thus hindering production growth.

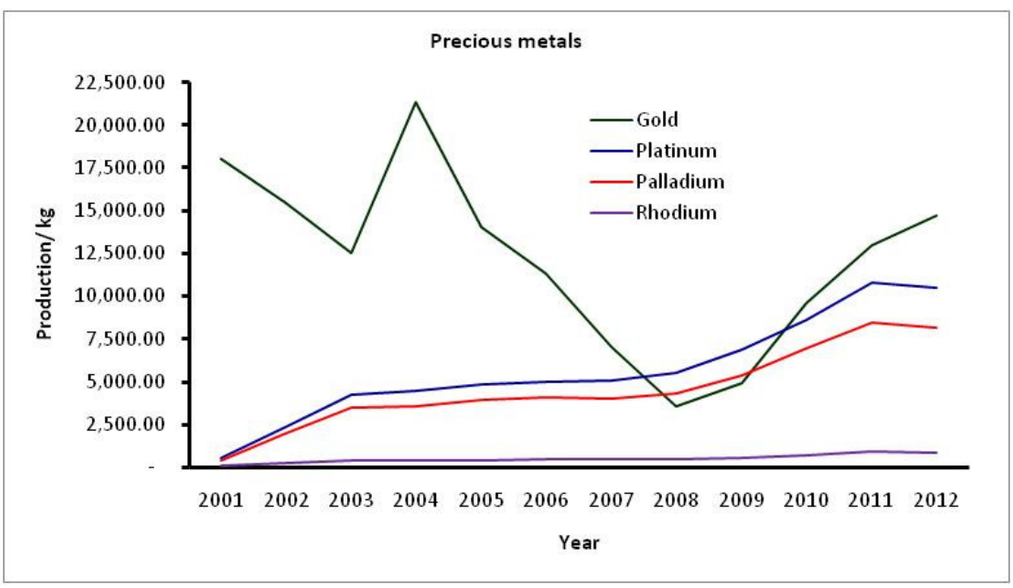


Figure 11: Precious metals production growth trend in Zimbabwe (Source: CoM)

Figure 11 shows that there was significant growth in the PGMs production from volumes under 1ton in 2001 to about 20tonnes in 2012. This major growth in production levels points combined with the other factors observed earlier points to strong attractiveness of this subsector. Gold output, despite reaching peak production of over 20tonnes in 2004 plummeted to about 3tons in 2008 before a significant growth to over 13tons in 2012. The gold value chain is also notable for the great participation of small scale and artisanal miners who are estimated to be over 200000 in number.

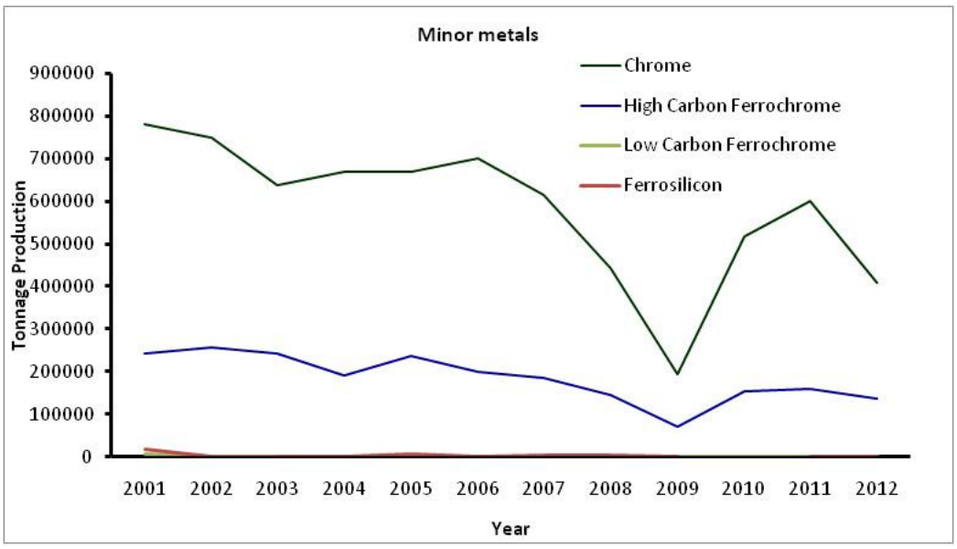


Figure 12: Minor metals production growth trend in Zimbabwe (Source: CoM)

Minor metals production profile is shown in Figure 12 for the period 2001 to 2012. Chrome and high carbon ferrochrome were the two significant subsectors according to the results. Production of chrome decreased from about 800000tons in 2001 to about 500000tons in 2012 as shown by the production profile. The production of high carbon ferrochrome followed a similar trend, with a high of just under 250000tons in 2001 to just under 200000tons in 2012. A common dip is noted for both products in 2009 attributable to the worst effects of the economic meltdown during that time. There is therefore need to analyse the different factors affecting the chrome value chain with the aim of increasing its competitiveness and hence its contribution to national development.

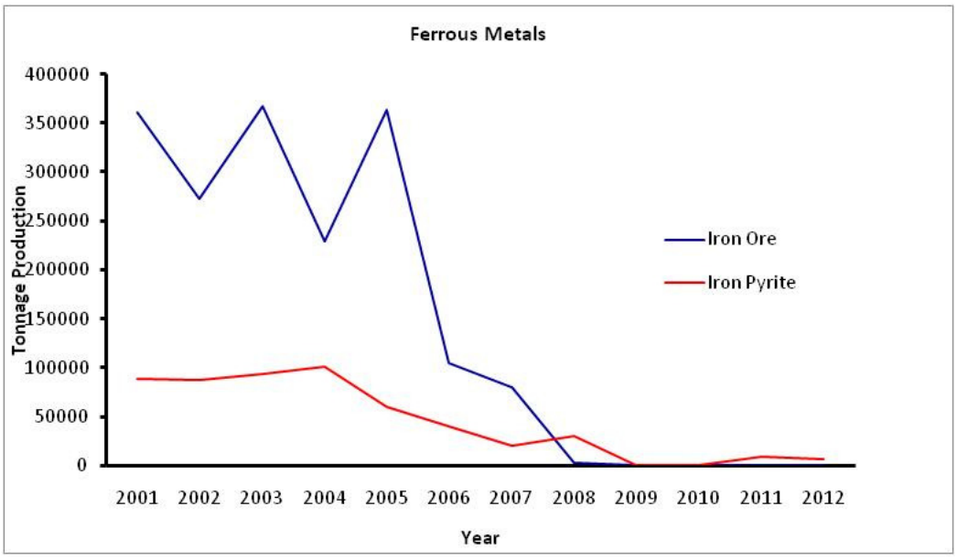


Figure 13: Ferrous metals production growth trend in Zimbabwe (Source: CoM)

The production profile for the ferrous group of metals for the period 2001 to 2012 is shown in Figure 13. Production level for iron ore, which averaged about 325000tons between 2001 and 2005, nosedived to 0tonnes in 2008. Iron pyrite production has also decreased significantly over the period from just under 100000tons in 2001 to insignificant volumes in 2012. The drastic decrease in production levels for the critical ferrous group resources was attributable to the economic challenges that led to ZISCO Steel shutting down its operations around the 2008 and 2009 as captured during the key informant interviews. Resuscitation of this broken down value chain is critical to the revival of the engineering and metals sectors as well as employment creation and national growth.

3.2 Self-sufficiency and export competitiveness

The choice of value chains is determined by its contribution to the country's self-sufficiency, export competitiveness and potential for market growth. Self-sufficiency is determined by the ratios of imports versus exports, whilst the share of Zimbabwe's engineering and metals exports in global exports gives an indication of the export competitiveness.

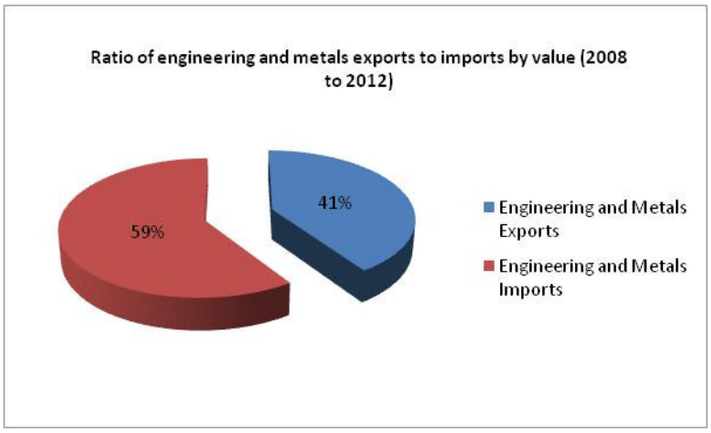
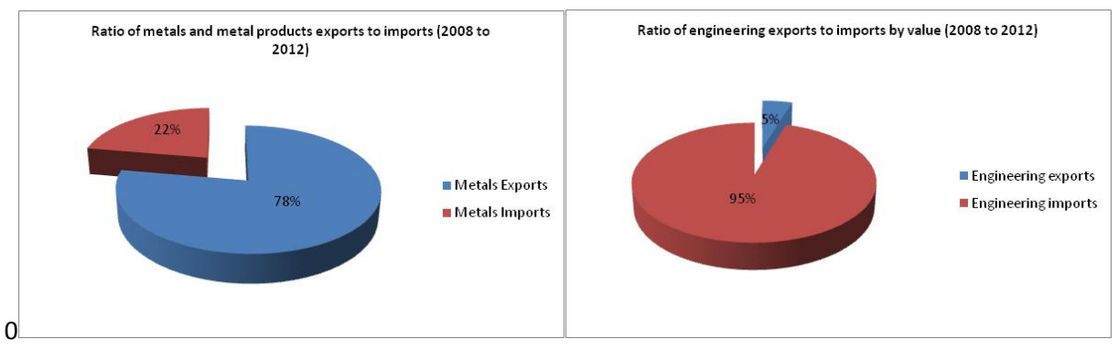


Figure 14: Ratio of engineering exports to imports by value (2008 to 2012) (Source: UNCOMTRADE)

Figure 4 shows that the overall ratio of engineering and metal products exports to imports by value was 41%: 59% for the period 2008 to 2012, implying a trade deficit. There is therefore great weakness in the competitiveness of the domestic engineering and metals value chain necessitating thorough assessment for upgrading.



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i) ii)

Figure 15: Ratio of i) metals and metal products ii) engineering goods exports to imports by value (2008 to 2012)

The analysis of the export to import ratios was further pursued by dividing the engineering and metals sector into i) metals and metals products and ii) engineering goods subsectors. Figure 15i shows that the ratio of metals and metal products exports to imports by value for the period 2008 to 2012 was 78%:22%, implying that Zimbabwe exported more of these commodities than the ones imported. This ratio is indicative of the fact that the country exports more semi manufactured products than imported. The high ratio in favour of exports is attributable to the PGMs and gold, which are currently fetching high prices in their semi refined states. Figure15iishows the drastically opposite case for engineering goods subsector where the ratio of exports to imports by value for the same period was 5%:95%. It implies that the engineering subsector has either collapsed or it is overwhelmed by the domestic demand. Indications from the field surveys and reviewed documents were that the local engineering industry was faced with several challenges that affected its competitiveness against low cost imports from South

Africa, Asia, EU and the region. There are therefore opportunities to for improving the competitiveness of the engineering subsector as well as upgrading the metals and metal products subsector towards more value added products for export.

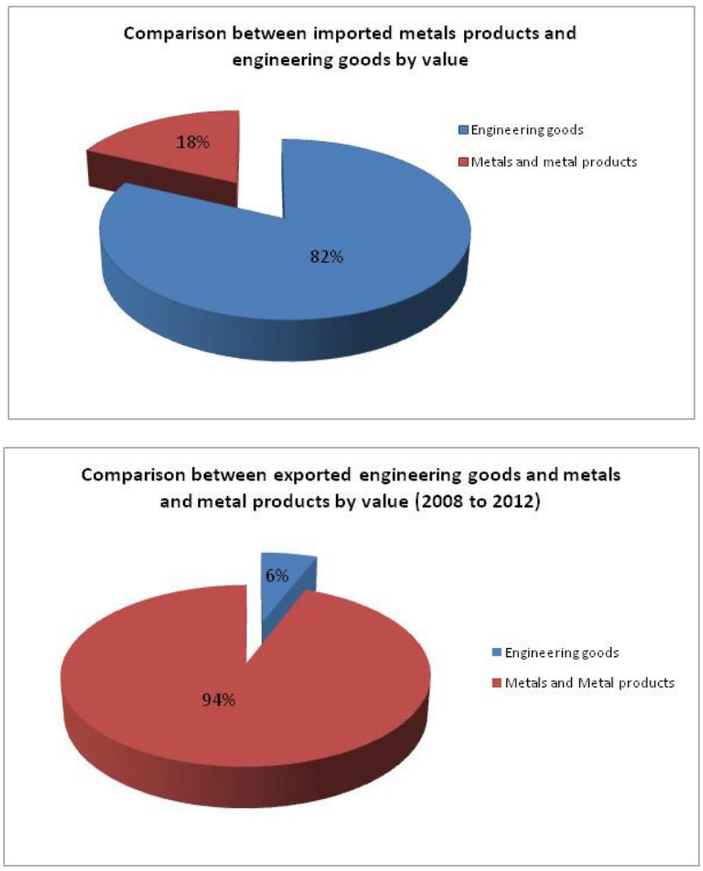


Figure 16: Proportions of i) Imported metals and metal products to engineering goods and ii) Exported metals and metal products and engineering goods by value for the period 2008 to 2012

Figure 16i shows that engineering goods constituted 82% of the imported value whilst metals and metal products contributed 18%. The country must therefore initiate an aggressive shift from an import oriented engineering sector to a value added manufacturing oriented one. Figure 16ii shows that the metals and metals products constituted 94% of the exported engineering and metals products by value whilst the engineering sector contributed a paltry 6%. A thorough analysis of the engineering subsectors is therefore critical to enhance competitiveness of the engineering and metals value chain.

3.2.1 Import trends in the engineering and metals industry

3.2.1.1 Metals and metal products import trends

The UNCOMTRADE statistics (www.trademap.org) also documented metals and metal products imported to Zimbabwe namely i) articles of iron and steel; ii) Iron and steel; iii) nickel and articles thereof; iv) tools, implements, cutlery, etc. of base metals; v) aluminium and articles thereof; vi) miscellaneous articles of base metals; vii) copper and articles thereof; viii) lead and

articles thereof, ix) ores, slag and ash; x) zinc and articles thereof; xi) other base metals, cermet's articles thereof; xii) tin and articles thereof.

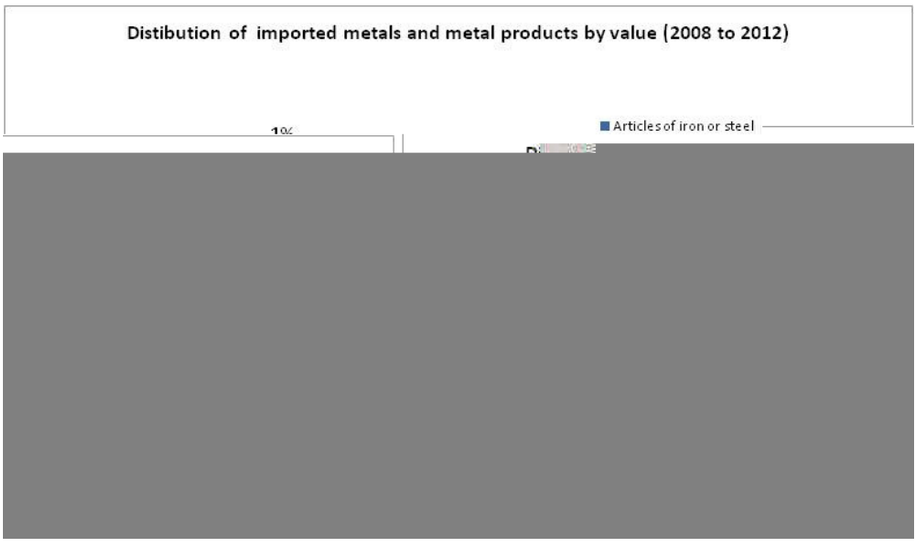


Figure 17: Proportions of metals and metal products imported by value into Zimbabwe for the period 2008 – 2012 (Source: UNCOMTRADE)

Figure 17 shows the distribution of imported metals and metal products by value for the period 2008 to 2012. The results show that iron and steel combined with articles of iron and steel held the biggest share of imported value at 54%, followed by nickel and articles thereof at 29%, then the other base metals with a combined share of 10% and then tools, implements and cutlery at 5%. Most significant commodity is iron and steel demand as indicated by the high share of imports. This is against the background that the country has huge iron ore reserves as well as infrastructure for value addition. Nevertheless, the iron and steel value chain broke down and urgent and aggressive resuscitation might be worthwhile.

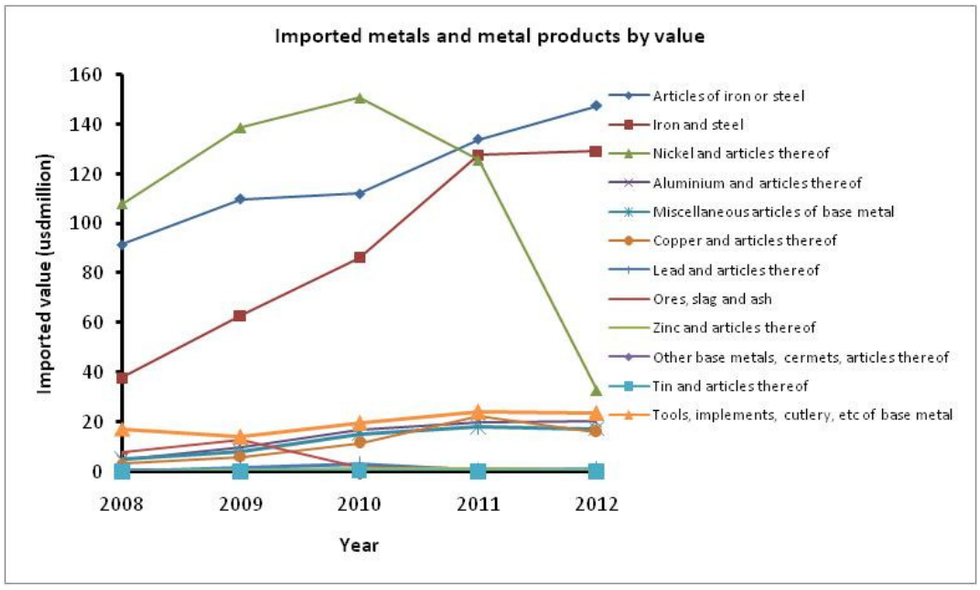


Figure 18: Imported metal and metal products by value into Zimbabwe (Source: UNCOMTRADE)

Figure 18 shows the import profiles for the metals and metal products by value for the period 2008 to 2012 (UNCOMTRADE Statistics). The importation of iron, steel and articles thereof grew from about USD130million in 2008 to about USD280million in 2012.The significant increase in imports of iron and steel and article thereof was attributable to the sharp decline in the production of iron and steel in the country. Nickel imports reached a peak of around USD150million in 2010, from just above USD100million in 2008. After the 2010 peak there was a sharp decline to under USD40million in 2012.

3.2.1.2 Engineering products import trends

The engineering goods imported into the Zimbabwean engineering sector according to the UNCOMTRADE statistics (www.trademap.org) include i) vehicles other than railway, ramway, etc.; ii) machinery, nuclear reactors, boilers, etc.; iii) electrical, electronic equipment, etc.; iv) Optical, photo, technical, medical, apparatus, etc.; v) Aircraft, spacecraft and parts thereof; vi) railway, tramway locomotives, rolling stock equipment, etc.; vii) Ships, boats and other floating structures; viii) Arms and ammunition and accessories thereof.

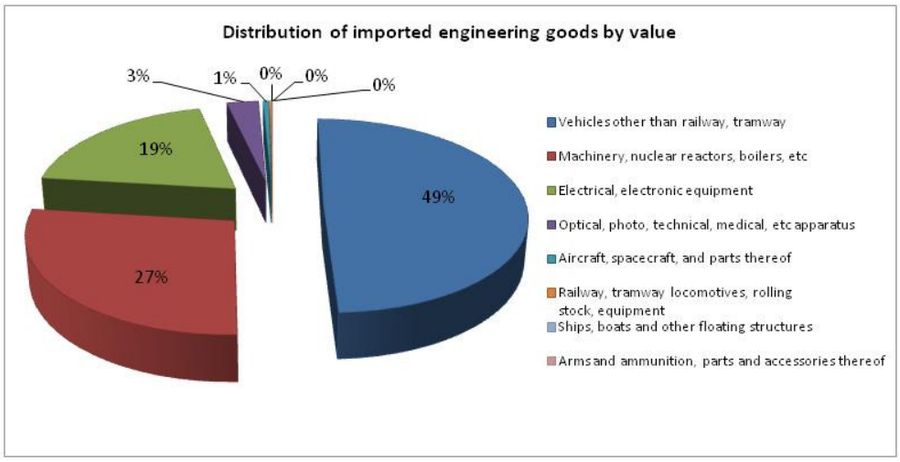


Figure 19: Proportions of engineering goods imported by value into Zimbabwe for the period 2008 – 2012 (Source: UNCOMTRADE)

Figure 19 shows the distribution of imported engineering goods for the period 2008 to 2012 by value. The statistics are an approximate indication of domestic demand for various engineering goods considering that domestic production was marginal. It is also shown that the vehicles sector held the major share of imported engineering goods at 49% followed by machinery, nuclear reactors, boiler, etc. at 27%, electrical machinery at 19% and optical, photo, technical, medical and apparatus at 3%. Thus it was implied that the demand for these products on the local market was significant and the domestic engineering manufacturing sector could not meet the national demand.

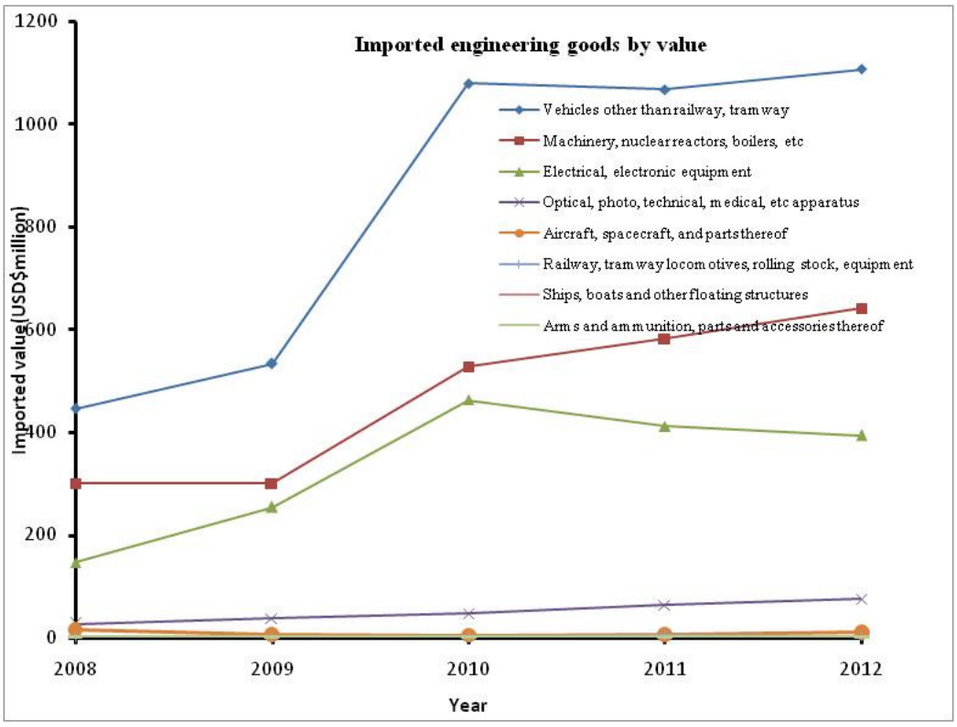


Figure 20: Imported engineering goods by value for the period 2008 to 2012

Figure 20 shows the import profile of engineering goods by value from 2008 to 2012. Four subsectors namely the vehicles other than railway; machinery, nuclear reactors, boilers, etc.; electrical, electronic equipment and optical and photo, technical, medical, etc. apparatus. The imported vehicles increased from just above USD400million in 2008 to about USD1.1billion in 2012. There was no significant growth between 2010 and 2012. Machinery, nuclear reactors, boilers, etc. imports increased form about USD300million in 2008 to over USD600million in 2012. The electrical equipment increased from about USD150million in 2008 to a peak of about USD450million in 2010 and a gentle decline to about USD400million in 2012. These growth trends in imports indicate growing domestic demand for these engineering goods, requiring further assessment.

3.2.2 Export trends in the engineering and metals sector

3.2.2.1 Metals and metal products export trends

The UNCOMTRADE statistics (www.trademap.org) also documented metals and metal products exported from Zimbabwe namely i) pearls, precious stones and metals thereof; ii) articles of iron and steel; iii) iron and steel; iv) nickel and articles thereof; v) tools, implements, cutlery, etc. of base metals; vi) aluminium and articles thereof; vii) miscellaneous articles of base metals; viii) copper and articles thereof; ix) ores, slag and ash; x) other base metals, cermet's articles thereof; xi) tin and articles thereof and x) lead and articles thereof and xi) zinc and articles thereof.

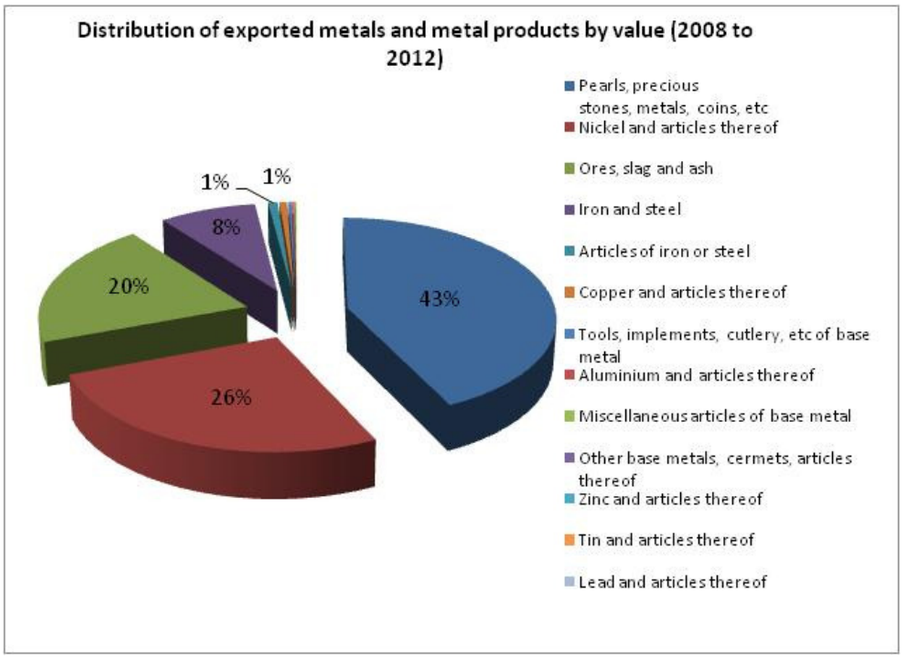


Figure 21: Proportions of exported metals and metal products by value for the period 2008 to 2012 (Source: UNCOMTRADE)

Figure 21shows that pearls, precious stones and metals (43%); nickel and articles thereof (26%); ores, slag and ash (20%) and Iron and Steel (8%). The high share of the pearls and precious metals is attributable to gold and PGMs export. The significant share of nickel and articles thereof is attributable to the production of refined nickel from Bindura Nickel Corporation (BNC) in Bindura and Empress Nickel Refinery in Kadoma. There is great potential for the iron and steel industry which awaits the resuscitation of ZISCO steel.

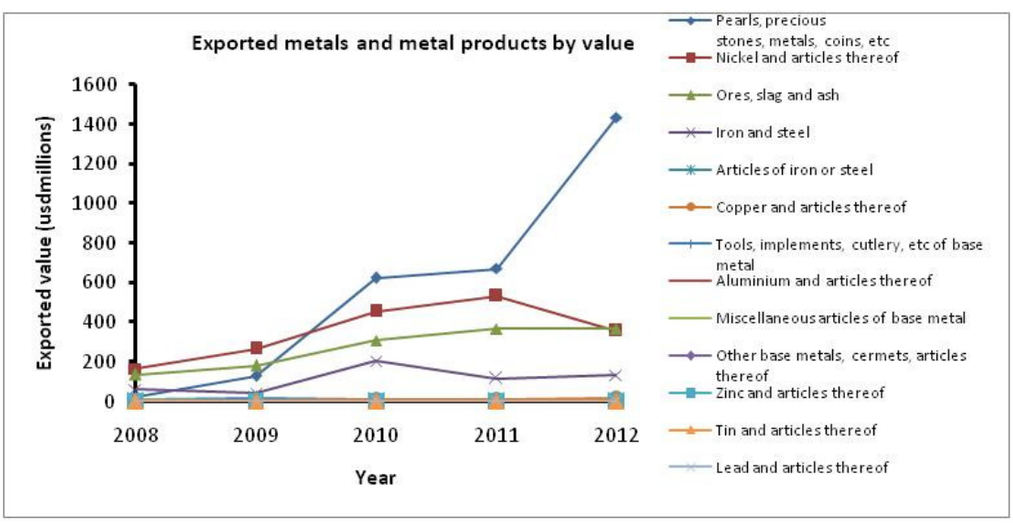


Figure 22: Metals and metal products export trends by value for the period 2008 to 2012

Figure 22 shows the export trends for metals and metal products for the period 2008 to 2012. There was significant growth in exports of pearls, precious metals and stones *(USD10million to USD1.4billion)*, nickel and articles thereof *(USD180million to about USD500million)*, ores, slag and ash *(USD120million to just under USD400million)* and iron and steel *(USD100million to USD150million)*. Export growth in the metals and metal products is currently very attractive and investment into expansion of projects in this sector has the potential to significantly improve the national economy. Thorough value chain analysis of precious metals, base metals and the ferrous group of metals is therefore critical.

3.2.2.2 Engineering goods export trends

The engineering goods exported from Zimbabwe according to the UNCOMTRADE statistics (www.trademap.org) include i) vehicles other than railway, ramway, etc; ii) machinery, nuclear reactors, boilers, etc.; iii) electrical, electronic equipment, etc.; iv) Aircraft, spacecraft and parts thereof; v) railway, tramway locomotives, rolling stock equipment, etc.; vi) Arms and ammunition and accessories thereof and vii) Clocks and watches, etc.

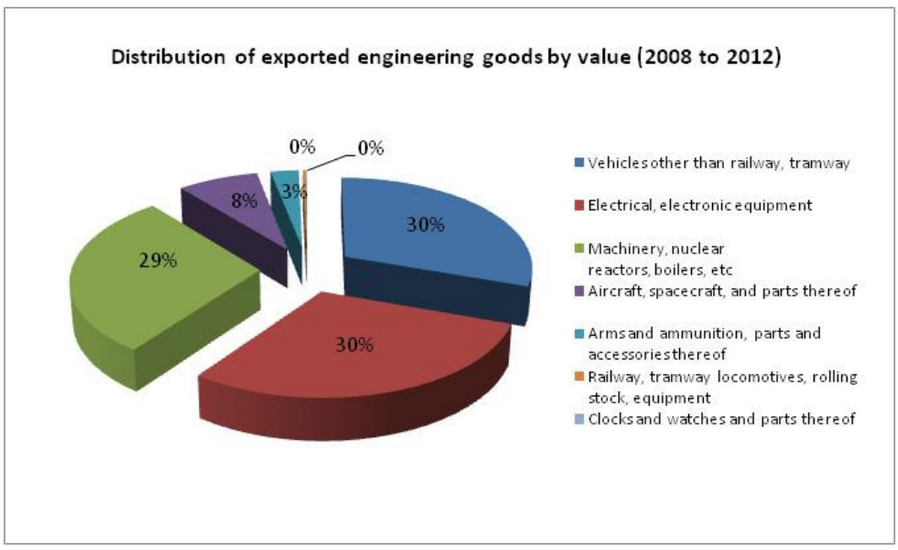


Figure 23: Proportions of exported engineering goods by value for the period 2008 to 2012 (Source: UNCOMTRADE)

Figure 23 shows that vehicles and electrical equipment held the significant share (30% for both subsectors) of exported goods by value for the period 2008 to 2012. Electrical machinery and equipment followed at 29% with aircraft, spacecraft and parts thereof at 8%. The vehicle industry has potential to grow considering both the indicative local and export demands. The electrical machinery sector has the potential to grow considering several regional and domestic power projects on the cards. The railway, tramway locomotives, rolling stock equipment despite being currently insignificant has the potential to grow when the National Railways of Zimbabwe (NRZ) is resuscitated.

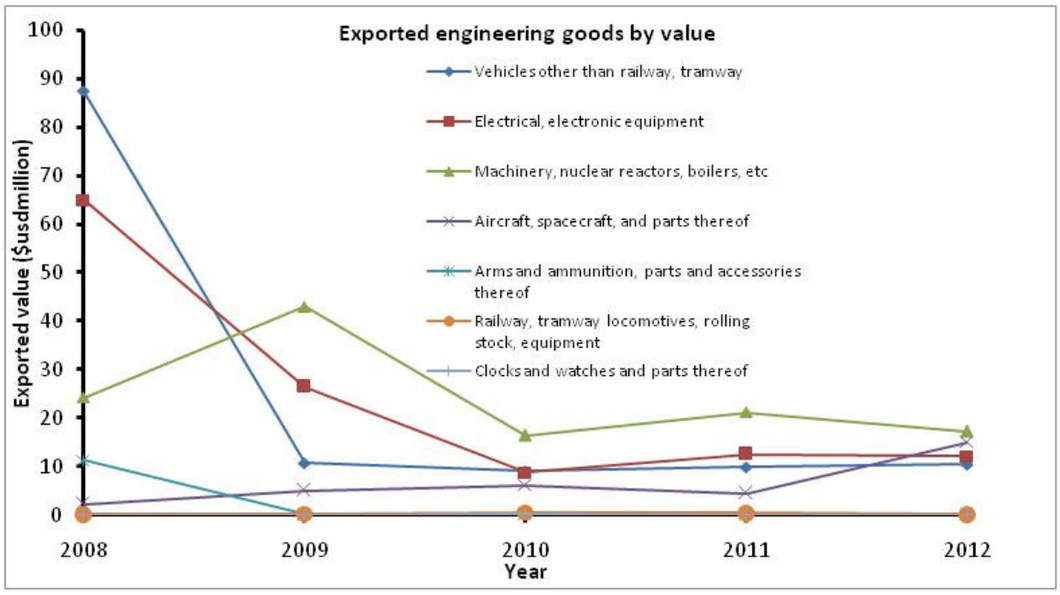


Figure 24: Engineering goods exports trends by value from Zimbabwe for the period 2008 to 2012

Figure 24 shows sharp declines of vehicle and electrical machinery exports from the country. Vehicle exports decreased from about USD90million in 2008 to about USD10million in 2009 which has remained stagnant since then. The sharp decline is attributable to the influx of low cost second hand vehicles from Japan, China and the UK. Electrical machinery exports also declined from about USD65million in 2008 to an average of about USD14million between 2010 and 2012. The cause of the decline is competition from low cost imports from South Africa, Asia and China. The major area of concern has been the lack of growth in the exports of engineering goods and a thorough analysis of this situation is critical.

3.3 Value added potential

Value addition refers to the value added on a commodity as it is transformed from its raw state to the final product. As the transformation processes involves many inputs and conversion processes which translate to intermediate consumption. Data on gross output, intermediate consumption and value added for the engineering and metals sector was obtained from ZimStat for the period 2009 to 2011.

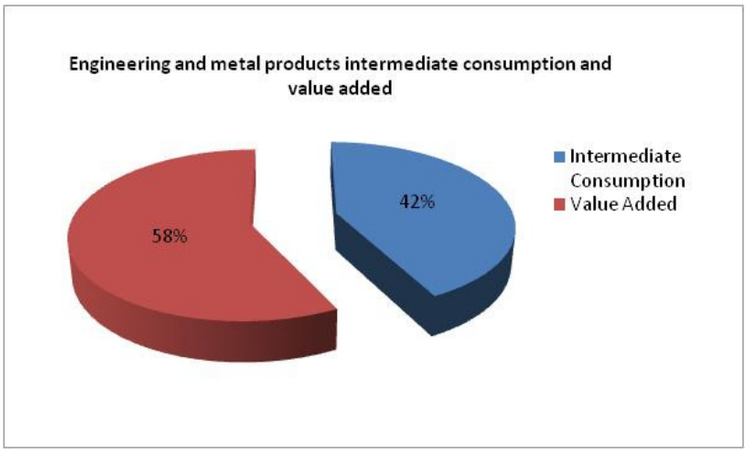
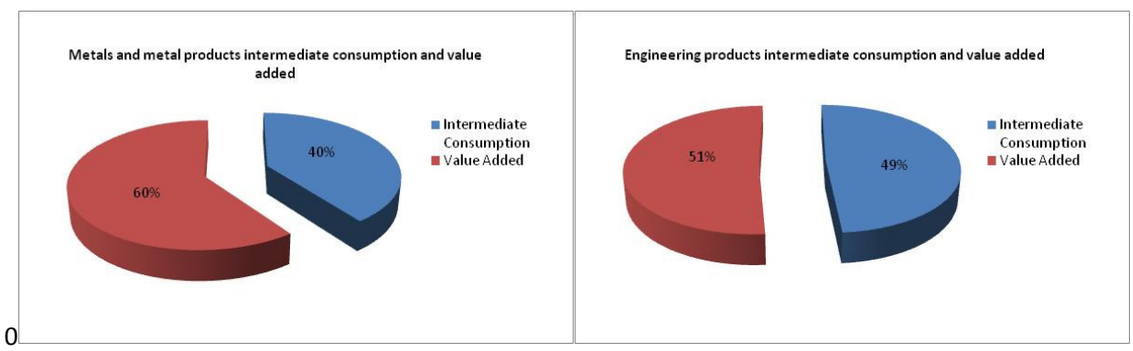


Figure 25: Engineering and metal products intermediate consumption and value added as % of Gross Output (2009 to 2011) (Source: ZimStat)

Figure 25 shows that value added was 58% of the gross output for engineering and metals sector for the period 2009 to 2011. Intermediate consumption constituted 42% of the gross output. The sub sectorial analysis of the engineering and metals sector was further analysed.



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i) ii)

Figure 26: Intermediate consumption and value added for i) Metals and metal products; and ii) Engineering products as % of Gross Output (2009 to 2011)

Figure 26i and ii show the intermediate consumption and value added for the metals and engineering subsectors. For the metals and metal products subsector, value added was 60% of the gross output whilst intermediate consumption was 40% for the period 2009 to 2011 (Figure 26i). For the engineering subsector, value added percentage was slightly lower at 51% whilst intermediate consumption was 49% (Figure 26ii). The high percentages of value added show that the engineering and metals sector has potential to compete on the global market.

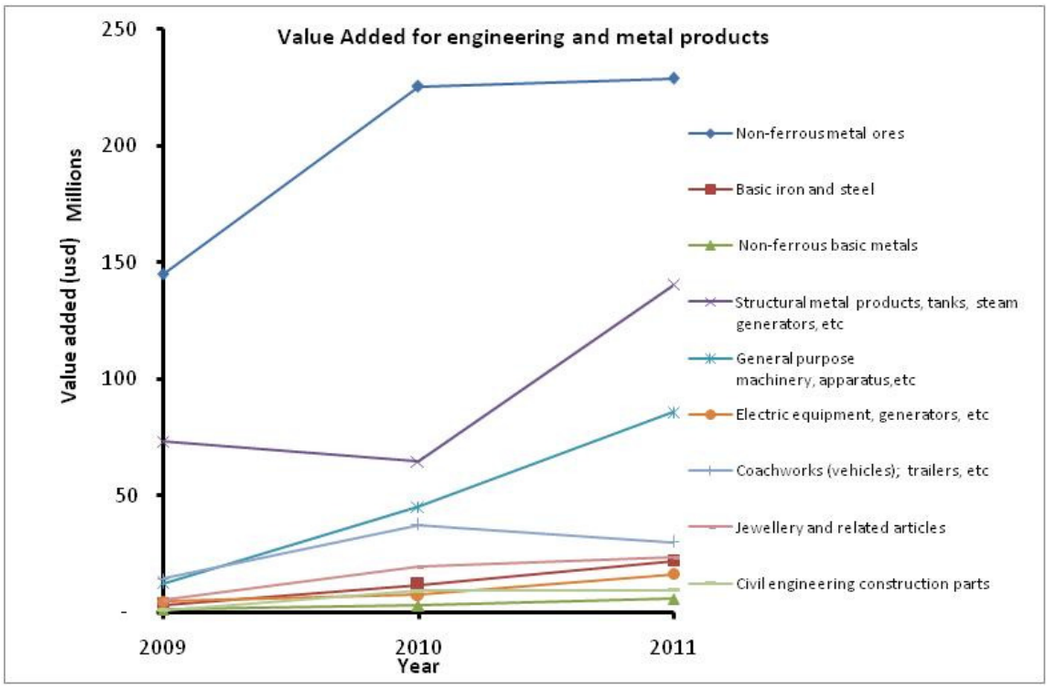


Figure 27: Value added for engineering and metals subsectors for the period 2009 to 2011(Source: ZimStat)

Figure 27 shows the value added trends for the different products in the engineering and metal subsectors. Significant value added growth was experienced in the non-ferrous metal ores (USD140million to USD230million), structural metal products (USD75million to USD140million) and general purpose machinery (USD14million to USD85million). Growth of value added for vehicle coach works, jewellery and electric machinery was moderate.

3.4 Value chain selection criteria

Based on the background analysis of the engineering and metals industry, value chain selection was carried out using the weighted objective method. The selection criteria were described in the methodology section. The market growth and potential is evidenced by strong effective demand for products being produced, ready market for products with demand exceeding supply and unmet demand from municipal authorities and large public works projects. From the key informant interviews, large infrastructural projects like the expansion of thermal and hydropower plants, transmission and distribution, mining projects and agricultural mechanisation projects come into mind. The notable increasing demand for vehicles was also of great interest. The demand for iron and steel in India, noted in the ongoing Essar – Government of Zimbabwe deal negotiations on ZISCO Steel, gives an indication of a ready market for products.

The iron and steel industry, PGMs and gold show great potential for increase in income and wealth at all levels in the value chain. There are also great opportunities for linkages amongst the iron and steel value chains, PGMs, chrome and nickel. The iron and steel industry is also expected to link well with the engineering value chains that manufacture different machinery and equipment for agriculture, mining and manufacturing. Together with gold, the iron and steel

industry also offers opportunities for linkages with SMEs, thus encouraging national participation in value adding activities and hence complementing the indigenisation and empowerment policy. The railway, equipment and rolling stock, automotive subsectors as well as the iron and steel offer great employment opportunities along the value chains and hence tallying well with ZimAsset goals.

The analyses done in the previous section clearly showed that little value addition is occurring in the engineering and metals sector and hence activities that add value to the raw materials will be very attractive. In this regard the beneficiation of the vast mineral resources is of great interest to the government and is supported by the indigenisation policy. The major mineral resources targeted for beneficiation are PGMs, chrome, nickel and iron ore.

The railway industry has always been a strategic engineering subsector of any country since it forms a cost effective transportation link for various goods and services to any value chain. The export competitiveness of PGMs make them the most attractive metallic group to invest in considering the high demand against the fact that Zimbabwe is one of the few countries that have significant exploitable reserves. The comprehensive selection of value chains in the engineering and metals using the weighted objective method is presented in Annexes 12 and 13.The final selection of value chains according to rank is presented in Tables 10 and 11below.

Table 10: Selected metals and metal products value chains by rank

Rank	Value Chain	Score (%)	Rating
1	Iron and steel and articles thereof	79	most attractive
2	Precious metals and articles thereof	79	
3	Chrome and articles thereof	69	attractive
4	Nickel and articles thereof	64	
5	Copper and articles thereof	48	marginally attractive

Table 11: Selected engineering goods value chains by rank

Rank	Value Chain	Score (%)	Rating
1	Vehicles other than railway & parts and accessories thereof	79	most attractive
2	Machinery, boilers, and mechanical parts and accessories thereof	67	
3	Electrical machinery & equipment & parts thereof		attractive
4	Railway, ramway, rolling stock equipment, mechanical parts and accessories thereof	64	
5	Aircraft, spacecraft & parts thereof	48	marginally attractive
6	Arms & ammunition, parts & accessories	47	

A more detailed value chain analysis was therefore carried out for the attractive subsectors namely iron and steel, precious metals, chrome and nickel for the metals and metals products; and vehicles (other than railway), and machinery and mechanical parts, etc. for the engineering goods subsectors. The railway and ramway subsector was also considered as it completed the critical link in value chains by complementing the transport sector.

PART 4: VALUE CHAIN ANALYSIS(7 Diagnostic dimension approach)

After value chain selection, the 7 diagnostic dimension approach (UNIDO IVC Tool, 2011) was used in the analysis of the most attractive value chains. Data from key informants, questionnaires, field surveys and document reviews was used for the analyses. Consistent with the tool, 7 diagnostic dimensions namely sources of inputs and supplies, production capacity and technology use, end markets and trade, value chain governance, sustainable production and energy use, value chain finance and the business and socioeconomic context formed the backbone of the analysis. The diagnostic tool was applied to levels of the engineering and metals value chain guided by the generic value chain map presented in Figure 2 of Part 2. These levels are metal processing (Level 2), metal forming (Level 3), metal fabrication (Level 4) and equipment manufacture/assembly (Level 5). Level 1 (mining) was not part of the study since a lot has been done by Jourdan et al., 2012 in their Mining Sector Policy Study report. Table 12 below shows the summary of the field visits and their geographical distribution. The full list of visited actors is presented in Annex 14.The respondents were engineers, senior managers, directors and chief executive officers.

Table 12: Field visits statistics by Level and Geographic Location

Location	Number of actors visited							
	Level 2	Level 3	Level 4	Level 5	Levels 6&7	Other	Totals	%ge
Harare	1	8	23	9	3	1	45	**48**
Bulawayo	0	5	11	0	0	1	17	**18**
Kwekwe	3	0	4	0	0	1	8	**9**
Gweru	0	1	2	0	0	1	4	**4**
Redcliff	0	3	0	0	0	0	3	**3**
Mutare	0	3	3	1	1	0	8	**9**
Kadoma	2	0	0	0	0	0	2	**2**
Chegutu	2	0	0	0	0	0	2	**2**
Shurugwi	1	0	0	0	0	0	1	**1**
Ruwa	0	1	1	0	0	0	2	**2**
Marondera	0	0	0	0	1	0	1	**1**
Bindura	1	0	0	0	0	0	1	**1**
Totals	**10**	**21**	**44**	**10**	**5**	**4**	**94**	**100**
%ge	**11**	**22**	**47**	**11**	**5**	**4**	**100**	

Table xxxx: Field Survey Response rate

Level	Industrial Actors Visited	Non Operational Actors	Active Actors	Questionnaires distributed	Actors who completed questionnaires	Other responses	Total Respondents	Response Rate (%)
2	10	4	6	6	4	1	5	83%
3	21	7	14	12	4	5	9	64%
4	44	11	33	29	18	4	22	67%
5	10	4	6	6	4	2	6	100%
6&7	5	0	5	0	0	2	2	40%
Total	**90**	**26**	**64**	**53**	**30**	**14**	**44**	**69%**

A total of 94 actors were visited as presented in Table 12, inclusive of 85 core industrial actors of the sector (Level 2 to Level 5) and 5 distributors and retailers (Levels 6 and 7). The overall response rate was 69% and it was also shown that about 31% of the sampled industrial actors were not operational (Table xxx). There were two types of responses from the field surveys. Some actors completed questionnaires whilst others responded through personal interviews and focus group discussions (FGDs) (see Table xxx above). Special sections were dedicated to the detailed analysis of attractive value chains like the PGMs, chrome and iron and steel subsectors. In these special sections, extensive document review was done. Comparisons with regional and global value chains were also included in the discussion of results.

4.1 LEVEL 2 (Metal/Mineral Processing) VALUE CHAIN ANALYSIS

The mineral processing stage involves the concentration, smelting and refining processes of mineral ores to produce products such as concentrates and matte, ingots, billets, slabs, pig iron and sponge iron amongst others. Based on the selected value chains for metals, PGMs, chrome and nickel processors were targeted for the field surveys using the 7 diagnostic dimensions questionnaire. Key informant interview of stakeholders like the Platinum Producers Association of Zimbabwe (PPAZ), Chrome Miners Association (CMA), Chrome Producers Association, Zimbabwe Mining Development Corporation and the Minerals Marketing Corporation of Zimbabwe were still pending as their schedules were tight up to the end of the year. Little attention has been given to gold since various studies have been done elsewhere. Iron and steel has also been excluded in this particular section and a special subsection under Level 3 (Metal forming) was dedicated to it. Key subsections on discussion was dedicated to special value chains like PGMs, chrome and nickel due to their perceived attractiveness in the Zimbabwean economy.

During the field surveys 10 major actors in **Level 2** involved in PGMs, gold, chrome and nickel value chains were visited. These actors are distributed around Zimbabwe and located in Bindura, Chegutu, Kadoma, Kwekwe and Shurugwi. Out of the ten, four (40%) had ceased their operations due to viability challenges, with one of them under judiciary management, one was a new plant in the process of being commissioned and the rest were operational. Six questionnaires (60%) were successfully distributed to the actors and four (67%) completed the questionnaires and a FGD was done with one actor.The diagnostic dimension approach was used to analyse the indicative results from the thus far collected data using the excel software package.

4.1.1 Dimension 1: Sources of Inputs and Supplies

4.1.1.1 Characteristics of inputs, supplies and nature of suppliers

The inputs noted in the study were PGMs, nickel and chrome ores; coke, anthracite, felsite, electricity, water, storage facilities and transport facilities. The analysis showed that all the investigated actors received 64 – 90% of their inputs locally (77% average), whilst about 23% of the inputs were imported. Of those who imported, they sourced 100% of their inputs from SADC. 75% of the respondents imported their inputs directly whilst the rest used agents.The lead time to clearance of inputs ranged from 5 to 42days (average of 20days). The analysis also

showed that 100% of the respondents required storage and transport facilities for their inputs. Only 33% of the respondents said their raw materials can be substituted, siting the substitution of anthracite with coke and felsite with coke.

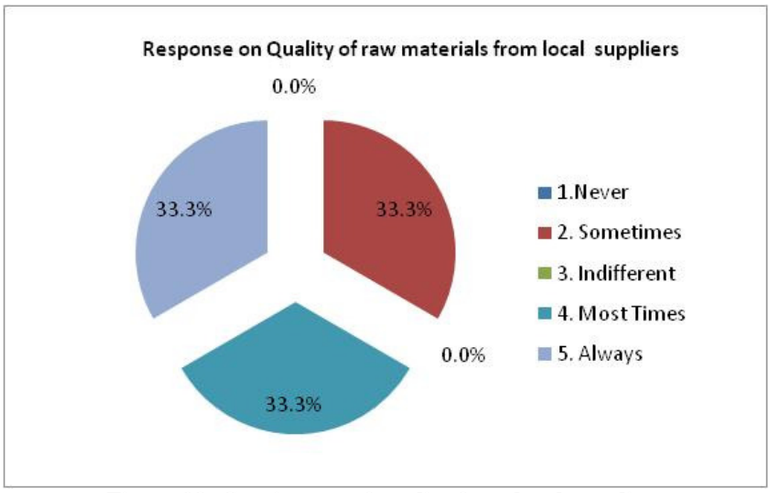


Figure 28: Consistency of quality from local suppliers

There was an even distribution of responses on the quality of inputs from local suppliers with 33.3% apiece saying it was good most times, always and sometimes (Figure 28). The responses also show that the quality of locally sourced inputs was generally high.

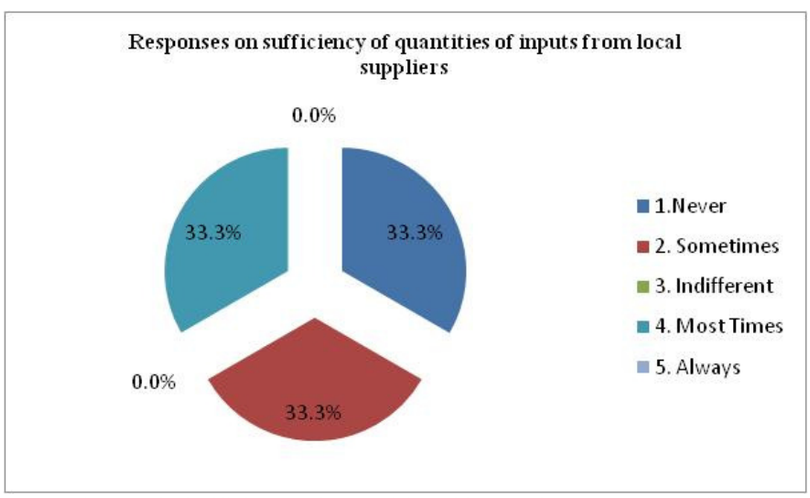


Figure 29: Sufficiency of quantities of inputs from local suppliers

From the responses of the survey, 33.3% apiece said the quantities of inputs were either never, sometimes or most times sufficient from local suppliers (Figure 29). This implies that the reliability of local suppliers in delivering the expected quantities was generally low.

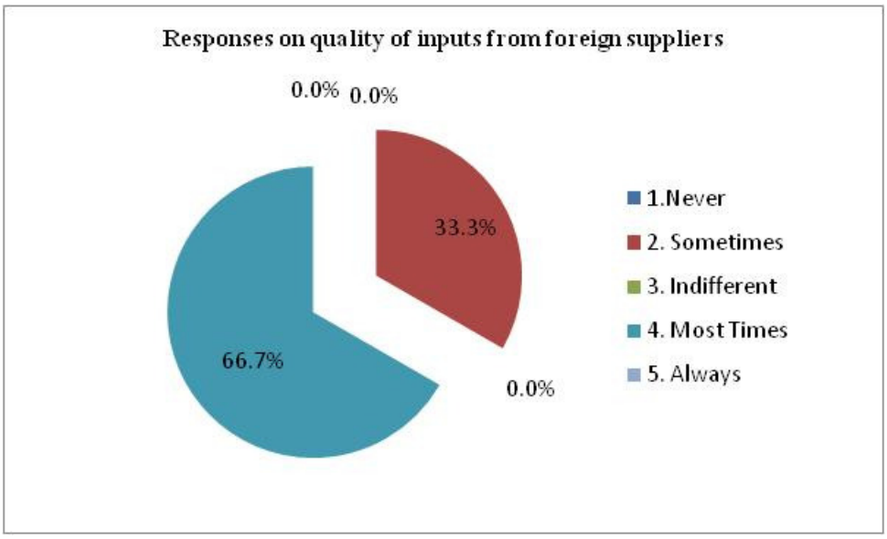


Figure 30: Consistency of quality of inputs from foreign suppliers

Figure 30 above shows that, of the responses on the quality of inputs from foreign suppliers, 66.7% said the quality was good most of the times whilst 33.3% said it was sometimes. It generally implies that the quality of foreign sources inputs was generally high.

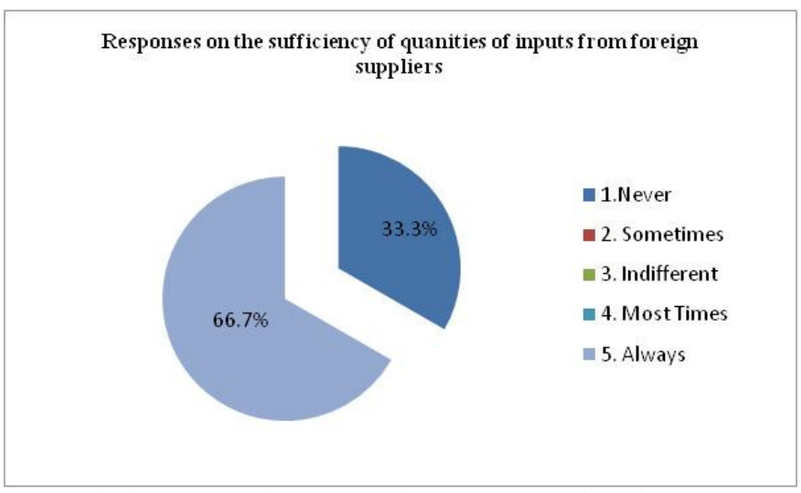


Figure 31: Consistency of quantities of inputs supplied from foreign sources

Figure 31 shows that 66.7% of the respondents said that the quantities of inputs from foreign supplies were adequate most times, whilst 33.7% said the quantities were never sufficient. Although a higher percentage indicated adequacy of quantities of inputs imported from suppliers, a significant portion sighted unreliable supply from foreign sources. Alternative sources can be considered seriously since the unreliability of supply has serious consequences to capacity utilisation. According to information from respondents, the key inputs sourced locally were chrome, coke and fluxes whilst the imported inputs included carbon paste, coal, chemicals and grinding media.

4.1.1.2 Transport and Logistics

Transport was a moderate obstacle to current operations as 66.7% of the respondents said so whilst 33.3% said it was a minor obstacle. The stockholding period for raw materials ranged between 30 and 60 days (45 days average) according to respondents. It implies that storage costs could be a significant factor in the value chain.

All respondents said that they were offered no bribes when dealing with customs. The responses on customs and trade regulations indicate that this factor is a major obstacle to current operations since 66.7% said it was either major or severe whilst 33.7% said it was a minor obstacle. The order system was used for the payment and delivery of goods from suppliers. All responses also show that the operations always specify the quality dimensions of raw materials on purchasing. 66.7% of the respondents cited ISO standards as prerequisite certification requirements for their inputs whilst 33.7% used others. Accordingly, transport and logistical issues were not major in Level 2.

4.1.2 Dimension 2: Production capacity and technology use

4.1.2.1 Production capacity and technology use

From the responses, the common working pattern is was as follows: 5 to 7 days per week; 2 shifts per day and a 24 hr day. The production capacity ranged from 4800 to 1440000 tonnes per annum with an average of 490 404 tonnes per annum.

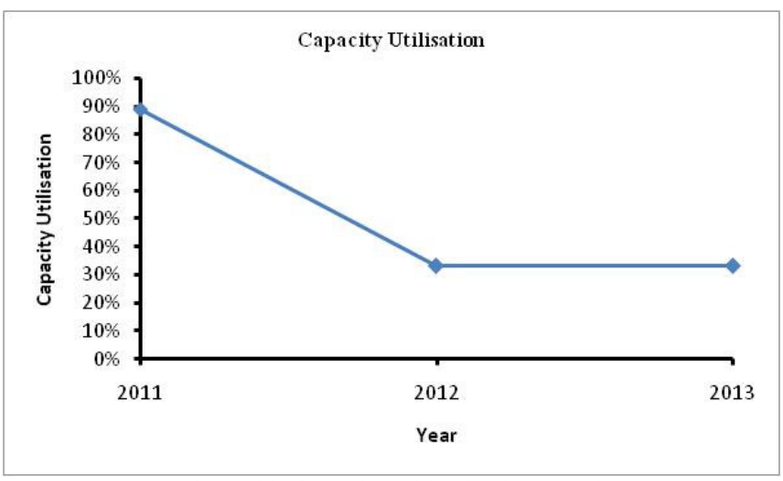


Figure 32: Capacity utilisation in Level 2

Capacity utilisation dropped from 89% in 2011 to 33% in 2013. All respondents said that they performed short, medium and long term capacity reviews. 50% of the respondents said that they subcontracted some processes/operations especially alloy from slag recovery process. The two mentioned subcontractors were Special Metallurgical Projects (SMP) and Tufrate services. It is worth noting that the high capacity utilisation in 2011 was due to the fact that all the players (chrome, nickel and PGMs) had favourable prices on the international market and hence production was promoted. The significant decline in capacity is attributable to the decline in

capacity utilisation in the chrome sector owing to several reasons including power outages, high costs of production and low prices of chrome products on the market. The other reasons cited are presented in Table 13.

Table 13: Reasons for decline in capacity utilisation

Reason for Decline of Capacity Utilisation	Responses
1. Low Local Demand	0
2. Lack of raw materials	0
3. Working Capital Constraints	66.70%
4. Antiquated Machinery & Breakdowns	0
5. Power & Water Shortages	100%
6. High Cost of Doing Business	100%
7. Competition from Imports	0
8.Drawbacks from the Current Economic Environment	33.30%
9.Other (Please Specify)	33.30%

The major reasons for the decline in capacity utilisation were power and water shortages, high cost of doing business, working capital constraints and drawbacks from the current economic environment. In 2012, 66.7% said that they managed to reduce their operating costs through process improvements, material and design changes.33.3% said they managed to incorporate new manufacturing approaches to their operations.

The average cost of replacing machinery was about USD 1.5million. 50% of the respondents said that their production facilities were not adequately equipped with plant and equipment for production. They cited lack of capital for investment in modern technologies as the main reason for the insufficiency. 75% of the respondents replaced machinery and equipment in the last three years. The equipment included furnace shells, plant automation, transformers and forklifts. 50% of the respondents used manual and semi-automatic technologies whilst 25% used automatic technologies. 50% of the respondents said that the technologies they used were between 50 and 75% effective whilst 50% said that theirs were above 75%.

Table 14: Comparison of technologies used with best practices

Region	Score/10	Level of competitiveness
1. Local	8.5	Very competitive
2. Low Income Africa	8	Competitive
3. Medium Income Africa	4.5	Not competitive
4.High Income Africa	4.75	Not competitive
5.International	2.25	Not competitive

Key: Very competitive (9 – 10); Competitive (7 – 8); marginally competitive (5-6); not competitive (<5)

From the responses presented in Table 14, the technologies used in mineral processing despite being very competitive locally are not competitive regionally and internationally. The poor competitiveness of technologies used as compared to medium income to international best practice is of great concern considering that the critical markets that come with economies of

scale are either in medium income Africa (e.g. South Africa) and the international market. Opportunities for upgrading lay in full automation and smelting furnaces upgrades as sited by respondents.50% of the respondents used CAD, 25% CAPP whilst 75% used SCADA computer systems. 75% of the respondents said that they faced challenges in maintaining and upgrading their equipment. The major challenge sited was capital constraints.

4.1.2.2 Knowledge Use

The respondents indicated that the tertiary education system was strongly aligned to industry requirements as 50%, 25% and 25% said that the tertiary education was very suitable, suitable and moderately suitable to industry requirements respectively (see Figure 33).

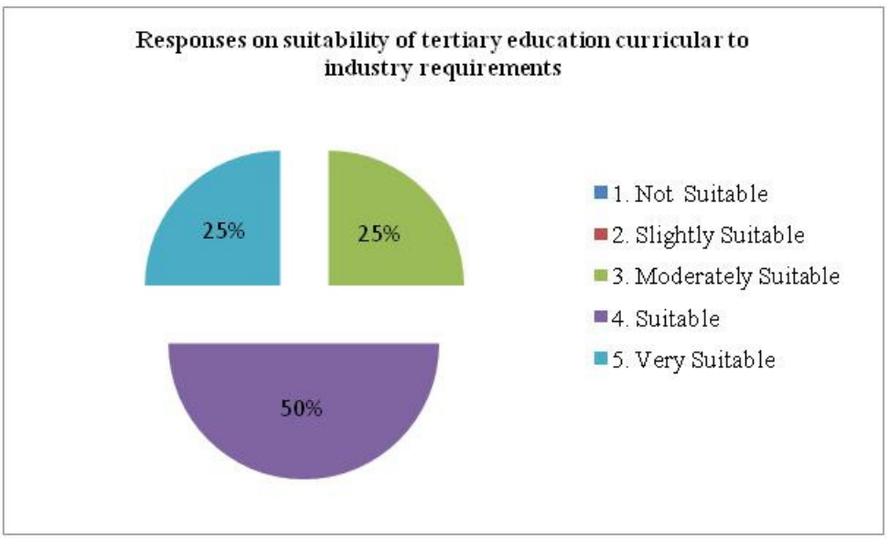


Figure 33: Suitability of tertiary education curricular to industry requirements

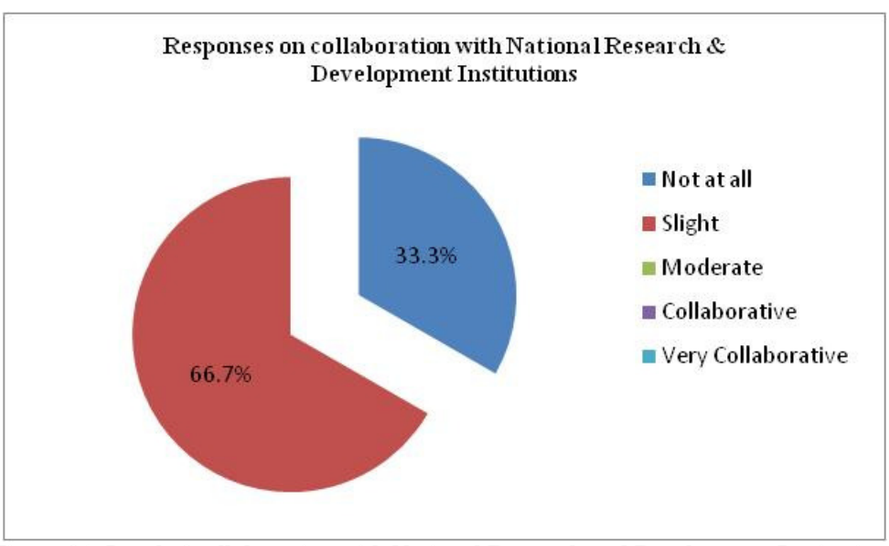


Figure 34: Level of collaboration with National Research and Development Institutions

There exist very low levels of collaboration between the industry and national research and development institutions as evidenced by the fact that 66.7% and 33.3% of the respondents said that there was slight and none of such collaborations respectively (see Figure 34). Figure 35 below shows that the respondents indicated low relevance of local research and development for operation improvement. 50% said that the relevance of local research and development institutions was poor whilst 25% apiece said it was slightly effective and effective.

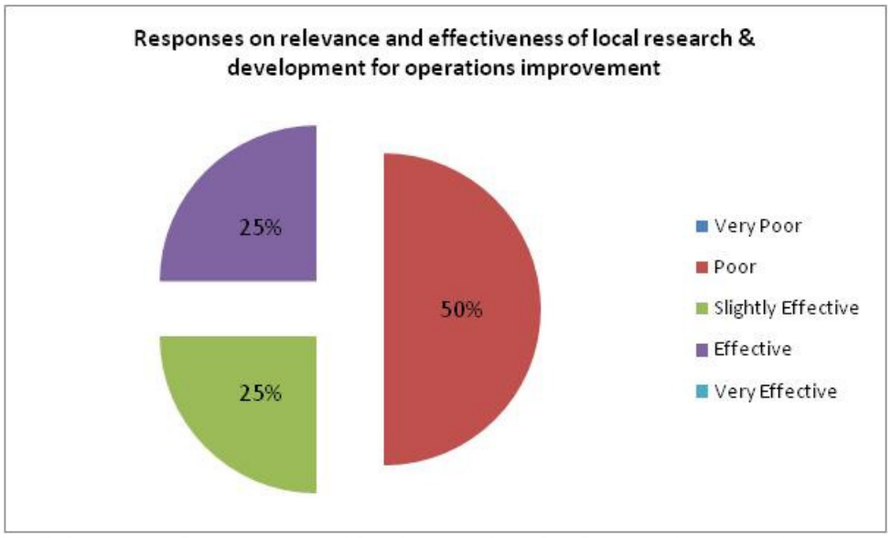


Figure 35: Relevance and effectiveness of local research & development for operations improvement

4.1.3 Dimension 3: End markets and Trade

4.1.3.1 End products characteristics

The analysis revealed that 50% of the end products sited were ores and minerals, 25% semi processed goods and the other 25% being metal products. The largest component of sales volumes sited was PGM concentrate and ferrochrome. 75% said that their main product represented above 75% of their total sales whilst 25% said that the main product represented between 50 and 75% of the total sales. Since the major component of sales was ores and minerals, it implies that there is minimal value addition taking place in Level 2.

4.1.3.2 Consumer Demand

According to the field data analysis, 25% of respondents (PGMs) indicated a strong demand for their products whilst 75% indicated low demand (chrome and nickel). The major reason for low demand was that most consumers of products on the export market (e.g. ferrochrome) were still recovering from the economic recession.

4.1.3.3 Marketing, trade capacities and standards

The analysis revealed that the annual sales for the respondents ranged between 36000 and 61000 tonnes, generating annual revenues of between US$17million and US$174million for the period

between 2011 and 2013. All respondents said that 99.5% of their sales were direct exports and there were no local or indirect sales. The respondents said that their establishments started exporting between 1999 and 2011. The time taken from point of exit to clearance at the customs was 3 days. 25% of the respondents said that the customs officials solicited for a bribe during the process of exporting goods. All respondents said that there were no transit losses during the process of exportation.

Table 15: Obstacles to growth of export market

Obstacles	Responses
1.Lack of foreign demand for its products	66.7%
2.High costs of transport	33.3%
3.Red tape in customs	0
4.Insufficient production capacity to expand exports	33%
5.Lack of financing mechanisms to sell abroad	33%
6.Non-price restrictions on foreign markets	0
7.Lack of knowledge of foreign markets	0
8.Any other Specify _____POWER_____	33.3%

According to the analysis presented in Table 15, most of the respondents (66.7%) sited lack of foreign demand for its products as the main obstacle to growth of the export market (chrome sector). 33.3% apiece of the responses sited high costs of transport, insufficient production capacity to expand exports, lack of financing mechanisms to sell abroad and shortage of power as the main obstacles to export growth (Table 15).

As far as the regional market is concerned, 50% of the respondents said that they export less than 50% to the SADC market whilst the other 50% exported more than 75% of their products within the SADC market. This fact shows that the SADC market could be critical in the value chain. 33.3% of the respondents cited the region as the destination for their product whilst 66.7% sited the international market as the main market. 33.3% apiece rated competition on their main market as very intense, moderate and low intensity. This implies that competition on the market is quite stiff and hence the need to upgrade the value chain to remain competitive and increase the market share. It was also noted that the actors were not in competition with unregistered or informal companies. Practices of such informal actors posed no obstacle to the operations of the formal companies. Only 25% of the respondents indicated that they have dedicated marketing teams. To compete on the global market more actors have to dedicate competent marketing teams considering the low demand sited by some actors in the sub-sector.

Accreditation and compliance to international standards has become one of the key competitive advantages on the market. All interviewed companies said they complied with local and international standards namely, ISO4001 and OHSAS 18025. About 66.7% of the respondents complied with international standards.

4.1.4 Dimension 4: Value Chain Governance

4.1.4.1 Actor domination

The nature and structure of ownership in modern value chains determine the level of competitiveness. MNCs have tended to dominate considering the competitive edges of access to capital and traditional markets as well as economies of scale. The analysis revealed that the legal status (ownership) of the companies which responded was a shareholding company with non-traded shares or shares traded privately in all cases. Only 25% of the respondents reported a sole proprietorship status. The ownership structure reported was 100% private in all responses. The largest shareholder in one of the responses owned 100% of the shares. In all the firms that responded, there were female shareholders and all the firms indicated to the non-existence of subsidiaries outside Zimbabwe.

Table 16: Core competencies that making the actor stand out in the value chain

Core competence	Response rate
1. Market dependence	33.3%
2. Sales concentration	0
3. Knowledge asymmetry	33.3%
4. Price setting ability	0
5. Product/service specificity	66.7%
6. Strategic Management Plans	66.7%
7. Other, (Mining and metallurgy)	33.3%

The respondents revealed that strategic management plans, and product/service specificity at 66.7% response rate apiece were the key competencies in the value chain (see Table 16 above). Other core competencies were knowledge asymmetry and market dependence at 33.3% apiece. It is also worth noting that price setting ability and sales concentration were not core competencies, implying that currently cost reduction initiatives were critical to profitability and viability. The other option would be to add more value to the products and hence get closer to the end market and hence create the capacity to set prices. Joint ventures with big companies located close to the markets can create competences as well. All the companies interviewed began operations between 1999 and 2010.

4.1.4.2 Participation in and distribution in the value chain

All the respondents said that they regularly engaged stakeholders(community groups, employees, NGOs, and government) on their sustainability strategies, disclosure and performance on monthly and quarterly basis.All the respondents also said that they publicly disclose their environmental policies, programs, and performance eitheronline or in a sustainability report. Some of the programs indicated were safety awareness campaigns and first aid trainings. All the companies interviewed said that they publicly disclosed results of their stakeholder engagement.All respondents also said that procedures did exist to incorporate stakeholder input into its business and operational strategies. One of the main stakeholders mentioned was the

MMCZ which was involved in the marketing of production for export done under a tripartite arrangement.

4.1.5 Dimension 5: Sustainable production and energy use

4.1.5.1 Use of materials, energy and water

Based on the field data analyses, all the respondents said that they kept inventories of all chemical substances used, stored, processed,and manufactured and that they had programs and/or procedures to reduce the use of resources, and promote sustainable natural resource practices. All the respondents used electricity, whilst 25% used coal and 50% had generators. About 50% of the respondents applied for a power demand upgrade between 2011 and 2013, which they did not receive. All the respondents experienced power outages of varying magnitude between 2011 and 2013. 25% apiece of the firms interviewed experienced minor, moderate, major and severe outages. The average length of the power outage was 10, 8 and 5 hours per day for 2011, 2012 and 2013 respectively. 75% of the firms indicated that they own a generator whose sizes vary from 2.5KVA to 2.5MVA. The field data analysis shows that power availability was a major constraint to the value chain actors which negatively impacts on their production capacity and production costs.

Water is a key resource in Level 2, where it is mainly used in the processes and for cooling purposes. 75% of the respondents used boreholes as their major water sources, whilst 50% received municipal supplies as their major source and 25% used their own water works as the major source. 50% of the respondents experienced no water outage whilst 25% apiece experienced moderate and major outages.

4.1.5.2 Emissions

Table 16 shows the responses on ownership of licenses and permits for emissions. The analysis shows that 75% apiece of the respondents owned a license for air emissions, storage or use of hazardous substances and wastewater management.All respondents said that they monitored energy consumption and regularly tested their air emissions (mainly carbon monoxide from the smelting furnaces). 50% of the respondents said they owned pollution prevention devices. All of the respondents also said that they set targets for air emissions reduction (5 tonnes/month,5mg/m^3).

Table 17: Ownership of necessary license and permits for environmental management

Emission license type	Response rate
1. Air emissions	75%
2. Storage or use of hazardous substances	75%
3. Wastewater management	75%
4. Waste issues	100%

The analysis of respondents presented in Table 18 below reveals that 25% apiece of the respondents have either been fined, prosecuted or warned by regulators in relation to preventing

soil and groundwater, contamination, wastewater management and waste issue. This is consistent with the fact that only 25% did not have an EMS in place.

Table 18: Fines, prosecution, or warnings by regulators

Emission type	Response rate
1. Air emissions	0%
2. Storage or use of hazardous substances	0%
3. Preventing soil & groundwater	25%
4. contamination	25%
5. Wastewater management	25%
6. Waste issues	25%

4.1.5.3 Waste Management

75% of the respondents said that they were in compliance with applicable environmental laws and regulations and had an up to date Environmental Management System / certification in place. All respondents said that their employees were trained in environmental matters and environmental policies, practices and expectations were communicated to all employees and suppliers in all languages. All the respondents said that they had programsand/or procedures to reduce or eliminate waste in its operations.

Table 19: Programs and/or proceduresto manage disposal of waste

Waste type	Response rate
1. Air borne emissions	66.7%
2. Hazardous waste	66.7%
3. Wastewater	66.7%
4. Solid waste	100%

Table 19 above shows that 66.7% apiece of respondents had programs in place for airborne emissions, hazardous waste and wastewater disposal. All respondents had programs for solid waste disposal in place.

Table 20: Maintenance of records of waste disposal

Waste Disposal type	Response rate
1. Off-site transfer	66.70%
2. Treatment	100%
3. Disposal of waste.	100%

Table 20 presented above shows that all respondents maintained records for waste treatment and disposal while 66.7% had records for off-site transfer. It was generally noted that the compliance rate as far as environmental issues are concerned was very high. This was attributable to the fact that this sector of the value chain is controlled by MNCs governed by global standards. The

small percentage that did not usually comply was as a result of local actors who are normally faced by several challenges in associated with the state of the economy.

4.1.6 Dimension 6: Value Chain Finance

During the field surveys and administration of questionnaires, many respondents regarded certain sections of this dimension as confidential and hence did not divulge all the information we wanted to get. The analysis of this section is therefore based on the limited information we managed to get.

4.1.5.1 Availability of finance

The annual operational requirements according to the respondents varied from US$2.4 to 107million (average of US$54.7million). The average annual capital requirement was about US$67million. None of the respondents borrowed for capitalised, they relied on their own internal resources. One of the actors used own funds to the tune of US$463million for capital requirements. The analysis generally shows that the sectors are financially attractive. Since the main respondents were from the PGMs and chrome subsectors, it further cements the attractiveness of these subsectors to national prioritisation.

4.1.5.2 Financial risks,Norms and practices

All the respondents had their financials regularly checked by an external auditor. All of the respondents cited access to finance as the major obstacle threatening operations.

4.1.7 Dimension 7: Business and Socio-economic context

4.1.7.1 Business environment

The major and severe obstacles in the business environment as mentioned by the respondents were licensing and permits; tax rates; political instability; corruption and crime; theft and disorder (see Table 21 below). The moderate obstacles included inadequately educated workforce and customs and trade regulations.

Table 21: Impact of business operating environment on the operation within the sub-sector

	No Obstacle	Minor Obstacle	Moderate Obstacle	Major Obstacle	Severe Obstacle
1. Tax Rates	0	0	33.3%	66.7%	0
2. Tax Administration	33.3%	0	33.3%	0	0
3. Licensing and permits	0	0	33.3%	33.3%	33.3%
4. Political Instability	0	0	66.7%	0	33.3%
5. Corruption	0	33.3%	33.3%	0	33.3%
6. Courts	33.3%	33.3%	0	33.3%	0
7. Crime, theft and disorder	33.3%	33.3%	0	0	33.3%
8. Customs and trade regulations	33.3%	0	66.7%	0	0
9. Inadequately educated workforce	33.3%	33.3%	0	33.3%	0
10. Labour regulations & health issues	66.7%	0	0	33.3%	0
11. Practices of competitors in the informal sector	66.7%	33.3%	0	0	0
12. Other (Please Specify)	0		0	0	0
13. Other (Please Specify)	0		0	0	0

The analysis also showed that all of the respondents were inspected by tax officials for four times last year. For companies that sought an import license over the last two years, the lead time to processing took about 7 days.

4.1.7.2 Social and cultural context

In one typical company in the chrome sector which responded, the total number of permanent employees was 89 of which 5.6% (5) were skilled; 12% (9) were semiskilled and 84% (75) were unskilled. In 2013, 42 contract workers were employed with the longest contract spanning eight months. Female employees constituted 40% (2) of the skilled; 44% (4) of the semi-skilled, 2.7% (2) of the unskilled and 38% of the contract personnel. All respondents said that ordinary level was the most common level of education for employees.As part of skills development, 66.7% of the respondents had formal training programs for its employees.

All of the responding firms indicated that they carried out pre-employment health checks for new employees. All of them indicated that HIV affected their workers over the past two years. Prevention interventions practiced by all respondents included HIV prevention messages andfree condom distribution. Only 50% of the firms carried anonymous HIV testing.

4.1.8 Summary of key findings and issues in Level 2

The major findings were as follows

- Major raw materials and inputs are available locally or in the region
- The major actors are privately owned and are MNCs
- Decline in capacity utilisation due to power and water shortages, high cost of doing business, and drawbacks of the current economic environment

- Lack of access to cheap finance for recapitalisation
- Strong alignment of education curriculum to industry needs
- Low levels of collaboration between research and development and industry
- Low relevance of local research and development to industrial needs
- Minimal value addition to mineral ores and other raw materials
- Limitations of marketing and trading capacities due to low product demand, lack of financing mechanisms to export abroad, high cost of transport and insufficient production capacity to export abroad
- The region is the major market for products and products not highly competitive on international market
- Lack of price setting ability
- MNCs dominate the sector
- Major obstacles in the business environment include inadequately educated labour force, labour regulations and health issues, high tax rates, licensing issues and permits, corruption and political instability

4.1.9 Concluding remarks

The analysed value chains have the potential to compete on the global market considering the huge raw material base, the uniqueness of the raw materials and the relatively high demand for value added end products on the global market. If the major challenges of power and water shortages and deteriorated railroad networks were addressed through rehabilitation and upgrading, this sub-sector could become the foundation for economic revival and growth for the country. Attractive value chains such as the PGMs and Chrome Value Chains shall be further studied in detail as special case studies in Section 4.5.

4.2 LEVEL 3 (Metal forming) VALUE CHAIN ANALYSIS

The metal forming stage involves processes like iron and steelmaking, casting (the foundry industry), rolling, forging and extrusion to produce products like castings, long products (bars, rods, tubes, profiles, sections) and flat products (coils, sheets, strips, plates). The iron and steel making and foundries were the main participants in the field surveys as they constituted a significant number at this level. Key informant interview of stakeholders like the Founders Association of Zimbabwe (FAZ) was still pending. The Engineering Iron and Steel Association of Zimbabwe (EISAZ) and the Engineering Council of Zimbabwe and ZISCO were interviewed as key informants. A special subsection was dedicated to iron and steelmaking with particular reference to ZISCO considering its significance in the Zimbabwean engineering and metals value chain.

During the field surveys 21 major actors in **Level 3** were visited. These actors are located in Harare, Marondera, Redcliff, Mutare, Gweru and Bulawayo. Out of the twenty oneactors, seven (33%) were not operational due to viability challenges.Out of the 14 active players, nine (64%) responded.Five of the responses were through FGDs and personal interviews.

4.2.1 Dimension 1: Sources of Inputs and Supplies

4.2.1.1 Characteristics of inputs, supplies and nature of suppliers

The inputs noted in the study were cast iron, aluminium, bronze, fluxes, coke, sands, ferrochrome, ferronickel, ferromanganese, ferrosilicon, tungsten, electricity, water, storage facilities and transport facilities. About 66.7% of the respondents required storage facilities for their raw materials. The analysis showed that all the investigated actors received 100% of their inputs locally. The analysis also showed that 100% of the respondents required storage and transport facilities for their inputs. None of the respondents said their raw materials can be substituted.

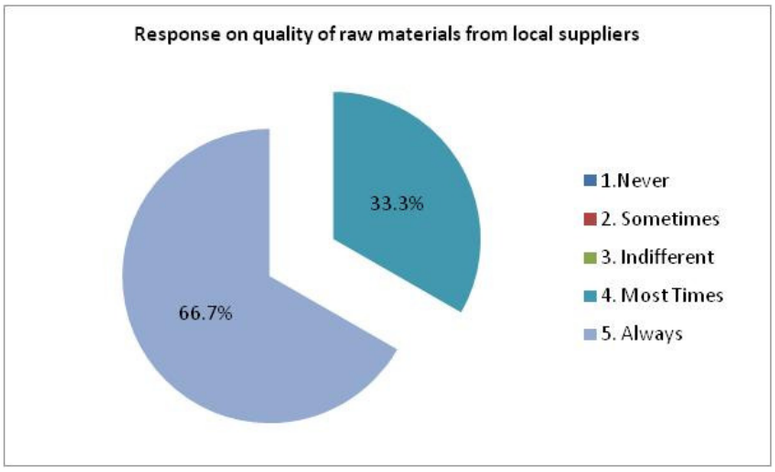


Figure 36: Consistency of quality from local suppliers

The analysis shows that the actors were satisfied with the quality of raw materials from local suppliers as 66.7% and 33% of the respondents said that the quality was always and most times good respectively (Figure 36 above)

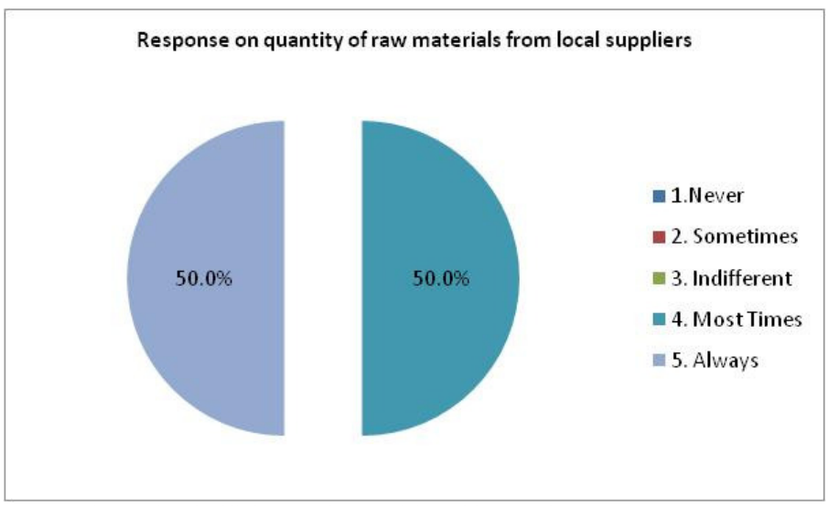


Figure 37: Sufficiency of quantities of inputs from local suppliers

From the responses of the survey, 50% apiece said the quantities of inputs were always and most times sufficient from local suppliers (see Figure 37 above). This implies that the reliability of local suppliers in delivering the expected quantities was high.

4.2.1.2 Transport and Logistics

None of the respondents sighted transport, customs and trade regulations as obstacles to their current operations. About 33.3% of the respondents had formal contractual agreements with suppliers and used the 'Cash on Delivery' (COD) ordering system.

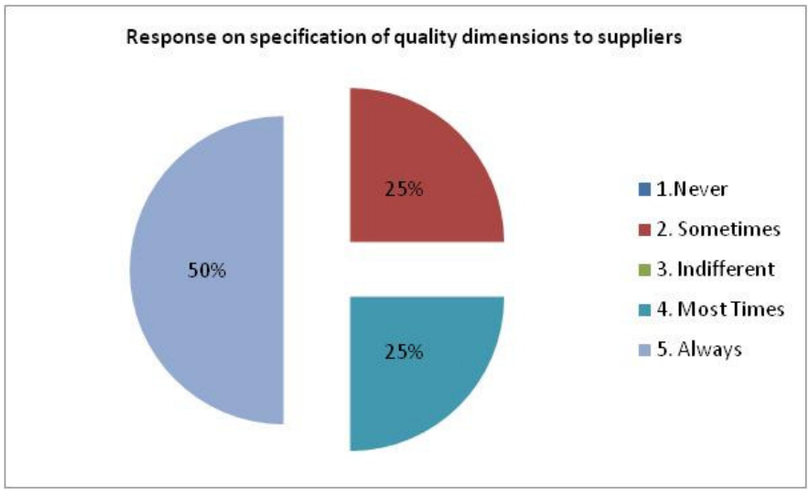


Figure 38: Response on specification of quality dimensions for raw materials

All responses also show that 50% of the respondents always, 25% most times and 25% sometimes specify the quality dimensions of raw materials on purchasing (Figure 38 above). All respondents cited ISO standards as prerequisite certification requirements for their inputs. It implies that the actors in the sector generally specific their requirements to the suppliers.

The analysis has shown there are no major issues in sources of inputs and supplies in Level 3. It is also worth noting that local suppliers are capable of supplying competitive inputs to actors in Level 3, which tallies well with the national policy of indigenisation and empowerment.

4.2.2 Dimension 2: Production capacity and technology use

4.2.2.1 Production capacity and technology use

From the responses, the working pattern has been distorted due to the prevailing economic drawback and hence most of the actors were on an 8hr/day working pattern. The average production capacity was about 140 tonnes per annum.

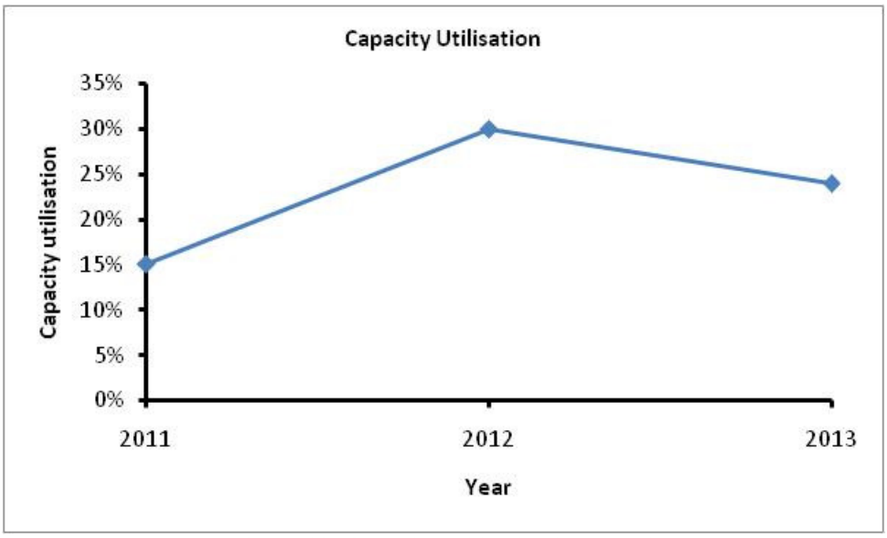


Figure 39: Capacity utilisation in Level 2

Capacity utilisation was very low, ranging between 15 and 30% for the period between 2011 and 2013 (See Figure 39). The major reasons for the decline in capacity utilisation from 2012 to 2013 are presented in Table 22 below.

Table 22: Reasons for decline in capacity utilisation

Reason for Decline of Capacity Utilisation	Responses
1. Low Local Demand	50%
2. Lack of raw materials	50%
3. Working Capital Constraints	100%
4. Antiquated Machinery & Breakdowns	75%
5. Power & Water Shortages	50%
6. High Cost of Doing Business	75%
7. Competition from Imports	50%
8.Drawbacks from the Current Economic Environment	50%
9.Other (Please Specify)	0%

The major reasons for the decline in capacity utilisation according to rank were working capital constraints, antiquated machinery and breakdowns, high costsof doing business, low local demand, lack of raw materials, power and water shortages; competition from imports and drawbacks from the current economic environment.

Table 23: Reasons for increase in capacity utilisation

Reason for increase in Capacity utilisation	Response rate
1. High Local Demand	100%
2. Availability of raw materials	50%
3. Availability of working capital	50%
4. State of the art machinery	50%
5. Other (Please Specify)	0%

The main reasons for the increase in capacity utilisation between 2011 and 2012 are presented in Table 23 above. They were high local demand, availability of raw materials, availability of working capital and state of the art machinery.

In 2012, 33.3% of the respondents said that they managed to reduce their operating costs through process improvements and none have incorporate new manufacturing approaches to their operations. About 66.7% of the respondents said that they performed short and long term capacity reviews, whilst 33% did mid-term capacity reviews. About 33% of the respondents said that they subcontracted some processes (steel castings). The mentioned subcontractor was William Bain Industries.

The average cost of replacing machinery according to the respondents was about USD 100, 000.00 per annum. All respondents said that their production facilities were not adequately equipped with plant and equipment for production. They mentioned that they owned antiquated and slow processing machines. The respondents cited lack of capital for investment in modern technologies as the main reason for the insufficiency. The equipment included furnace shells, plant automation, transformers and forklifts. About 67% of the respondents used manual technologies, 33% used semi-automatic and none used automatic technologies. About 67% of the respondents rated the effectiveness of their technologies at between 50 and 75%, whilst 33% rated theirs below 50%. None rated the effectiveness of their technologies above 75%. Efficiency wise, 67% of the respondents rated their technologies at between 50 and 75%, whilst 33% rated theirs below 50%. None rated the efficiency of its technologies above 75%. This analysis shows that antiquated technology is one of the major draw backs to the competitiveness of Level 3 actors.

Table 24: Comparison of technologies used with best practices

Region	Score/10	Level of competitiveness
1. Local	6.3	Marginally competitive
2. Low Income Africa	2	Not competitive
3. Medium Income Africa	1.7	Not competitive
4.High Income Africa	1.3	Not competitive
5.International	0.7	Not competitive

Key: Very competitive (9 – 10); Competitive (7 – 8); marginally competitive (5- 6); not competitive (<5)

From the responses presented in Table 24, the technologies used in metal forming were marginally competitive locally are not competitive at the regional and international scale. The low competitiveness of technologies used as compared to medium income to international best practice is of great concern considering that the critical markets that come with economies of scale are either in medium income Africa (e.g. South Africa) and the international market. Opportunities for upgrading noted included the purchase of induction furnace and fully automated plants. 75% of the respondents said that they faced challenges in maintaining and upgrading their equipment and sited capital constraints as the major one.

4.2.2.2 Knowledge Use

The respondents indicated that the tertiary education curricular was generally aligned to technical requirements as 67% and 33% of the respondents said that the tertiary education was very suitable and moderately suitable respectively. (See Figure 40 below).

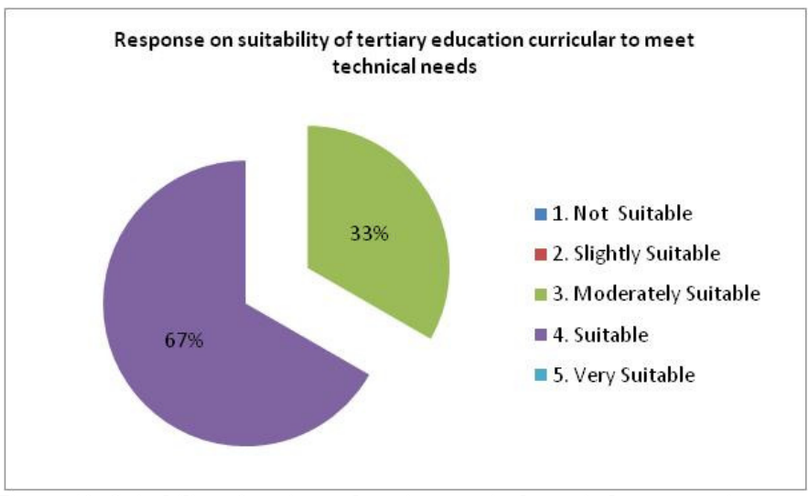


Figure 40: Suitability of tertiary education curricular to industry requirements

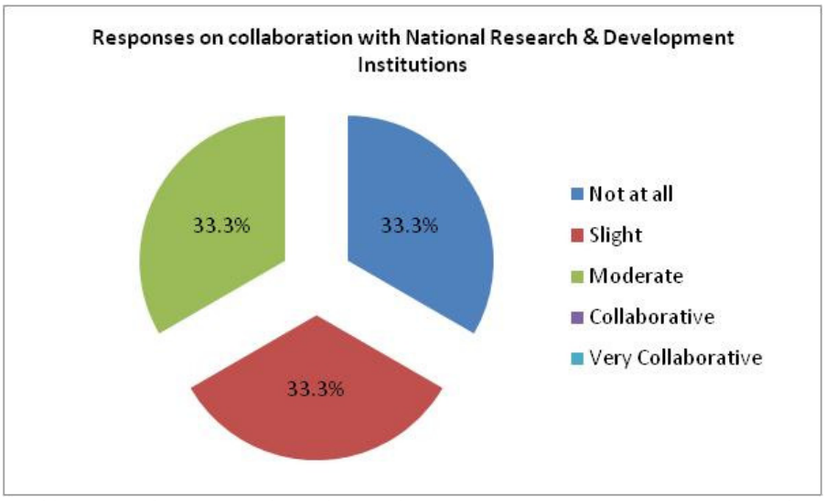


Figure 41: Level of collaboration with National Research and Development Institutions

There exist very low levels of collaboration between the industry and national research and development institutions as evidenced by the fact that 33.3% apiece of the respondents said that there was moderate, slight and none of such collaborations (see Figure 41 above). Figure 42 below shows that the respondents indicated low relevance of local research and development to sector requirements. This was evidenced by the fact that 33% apiece rated the relevance and effectiveness as poor and very poor whilst 67% rated the same parameter as slightly effective.

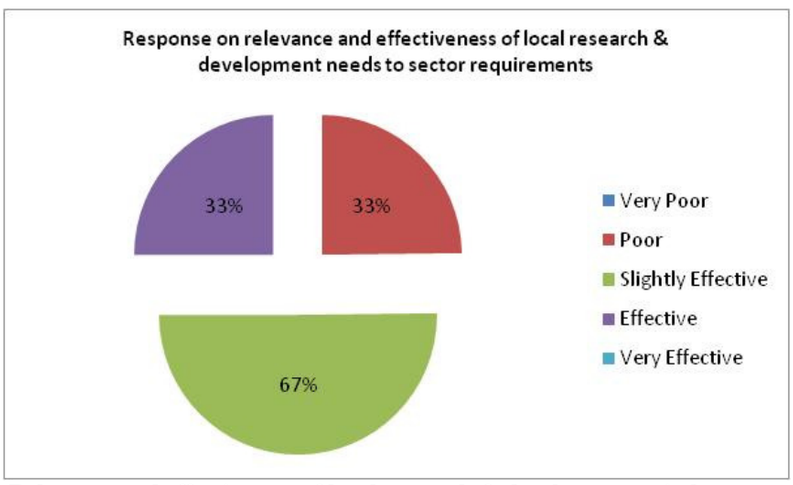


Figure 42: Relevance and effectiveness of local research & development toindustry requirements

4.2.3 Dimension 3: End markets and Trade

4.2.3.1 End products characteristics

The analysis revealed that the end products sited by all respondents were metal products. The end products mentioned were pump spares, brake drums, domestic appliances and plumbing materials.

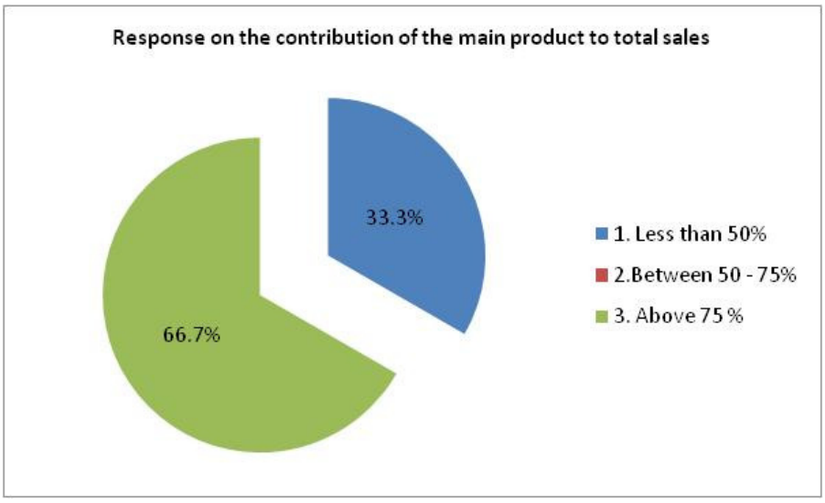


Figure 43: Contribution of the main product to total sales

About 67% of the respondents revealed that their main product represented above 75% of their totals sales whilst 33% said that their main product represented less than 50% of their total sales (Figure 43). It is therefore generally observed that there is a high dependence on the main product which is advantageous if the product is unique and has a niche market. However in the presence of serious competition, the sector could be at high risk.

4.2.3.2 Consumer Demand

All the respondents revealed that there was strong demand for their end products emanating from farmers and mines with operational environments that use metal products, machinery and equipment susceptible to rapid wear and tear. Nevertheless, the respondents cited stiff competition from cheap Chinese products, which are often inferior in quality to the locally produced metal products.

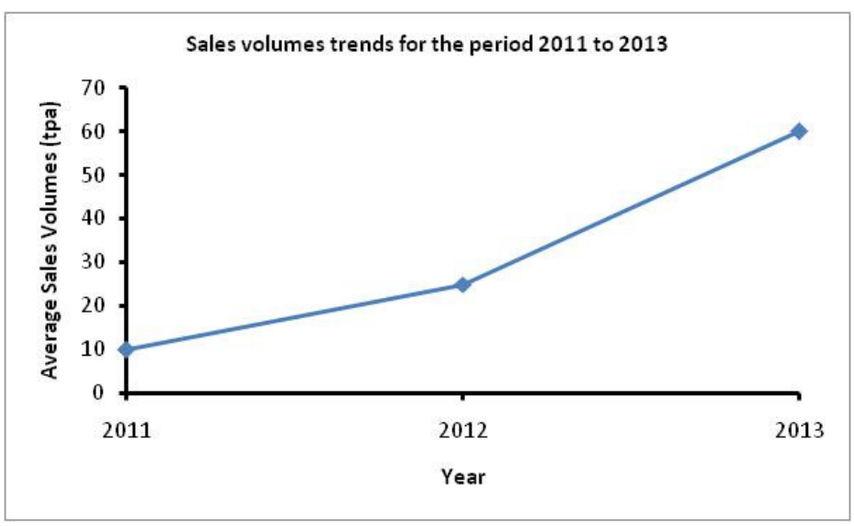


Figure 44: Average Sales Volume per actor (2011 to 2013)

The analysis revealed that the average annual sales per actor ranged between 10 and 60 tonnes per actor (Figure 44), generating average annual revenues of between US$280thousand and US$384thousand for the period between 2011 and 2013. The sales have also grown by about 6 fold from 2011 to 2013 (Figure 44), implying great potential for sector growth. As compared to the sales volumes of Level 2 actors, the sizes of the actors in Level 3 are significantly smaller. About 93% of the respondents sold all their products to the local market, whilst 7% indirectly exported their products through third parties. None of the respondents directly exported their products. The analysis therefore shows that there are huge opportunities in developing the export market since little value added product is exported.

4.2.3.3 Marketing, trade capacities and standards

Since there was little exportation of goods in the sector except through third parties, there were no responses associated with customs.

Table 25: Obstacles to growth of export market

Obstacles	Responses
1.Lack of foreign demand for its products	33.3%
2.High costs of transport	33.3%
3.Red tape in customs	0
4.Insufficient production capacity to expand exports	66.7%
5.Lack of financing mechanisms to sell abroad	66.7%
6.Non-price restrictions on foreign markets	0
7.Lack of knowledge of foreign markets	0
8.Any other Specify _____POWER_____	0

According to the analysis presented in Table 25, the main obstacles to growth of the export sited by the respondents were insufficient production capacity to expand exports (66.7% response rate) and lack of foreign demand for its products (66.7% response rate). About 33.3% apiece of the respondents cited high costs of transport and lack of financing mechanisms to sell abroad (Table 25). About 33% of the respondents sold their main products within the same community of establishment whilst all respondents sold their main product across the country of origin.

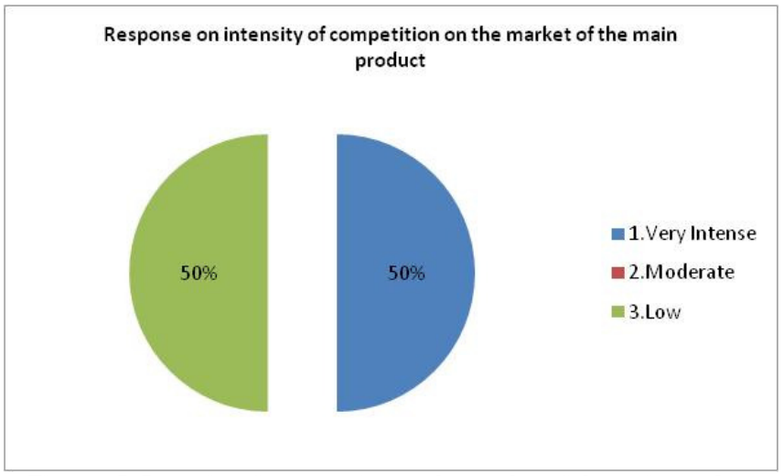


Figure 45: Intensity of competition on the market of the main product

Analysis of responses on intensity of competition on the main product market reveals significant competition since 50% of the responses alluded to very intense competition whilst the other half sited very low competition (Figure 45). About 33% of the respondents indicated competition with informal and unregistered players. However, their activities generally posed no major obstacle to operations in the sector as shown in Figure 46 below.

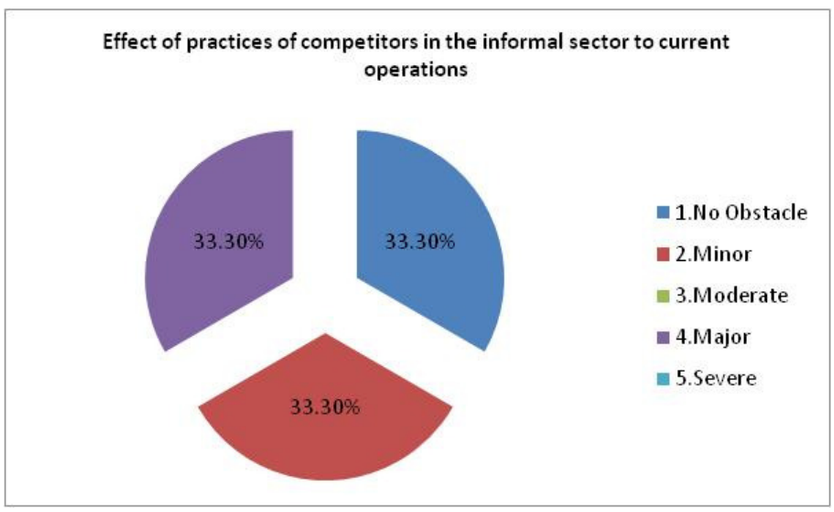


Figure 46: Effect of practices of informal sector to current operations

The average marketing budget per organisation was about US$260thousand per annum. About 67% of the respondents had a dedicated marketing team in place. The majority of the actors (66.7% response rate) did not comply with local and international standards. This factor disadvantages the actors on the global competitive market where compliance to such standards is highly regarded. The reason for non-compliance could be due to the fact that compliance was

voluntary rather than mandatory. Accreditation and compliance might be key success factors in developing the export market for the products.

4.2.4 Dimension 4: Value Chain Governance

4.2.4.1 Actor domination

The analysis of field revealed different ownership models for firms. About 33% apiece of the respondents' firm structure was a shareholding company with non-traded shares or privately traded shares, sole proprietorship or partnership as shown in Figure 47.

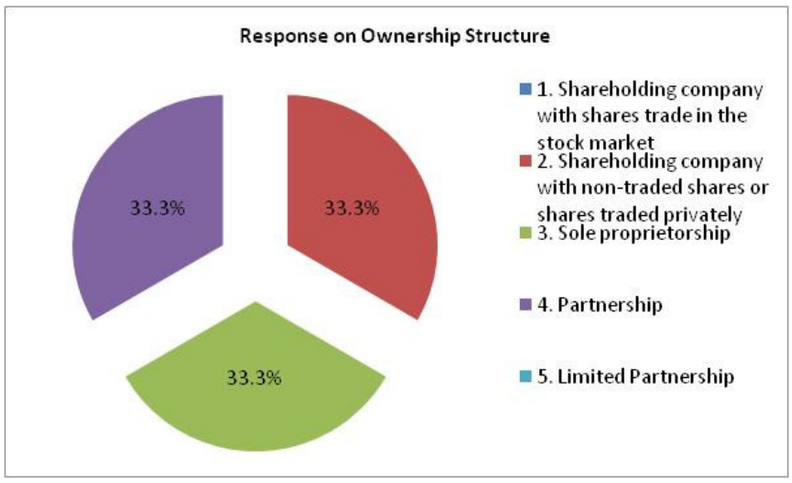


Figure 47: Ownership structure of Level 3 actors

The ownership structure reported was 100% private in all responses with the largest shareholder owning 34% of the shares. In 25% of the firms that responded, there were female shareholders and all the firms indicated to the non-existence of subsidiaries inside or outside Zimbabwe.

Table 26: Core competencies that making the actor stand out in the value chain

Core competence	Response rate
1. Market dependence	0
2. Sales concentration	0
3. Knowledge asymmetry	0
4. Price setting ability	33.3%
5. Product/service specificity	33.3%
6. Strategic Management Plans	33.3%
7. Other, (Mining and metallurgy)	0

The respondents revealed that price setting ability (33.3% response rate), product/service specificity (33.3% response rate) and strategic management plans (33.3% response rate) were the core competencies enhancing competitiveness in the sector (see Table 26 above). It is also worth noting that strong marketing teams were necessary to improve competitiveness on the global

market. The government or private sector can also intervene through creating a marketing authority/facilitator for metal products to increase dominance and visibility on the regional and global market.

4.2.4.2 Participation in and distribution in the value chain

The oldest company was formed and registered in 1940 whilst the youngest company was registered in 2004 implying that there is continuous participation across generations. About 67% of the respondents did not regularly engaged stakeholders(community groups, employees, NGOs, and government) on their sustainability strategies, disclosure and performance on monthly and quarterly basis. The 33% who did engage stakeholders did so thrice a year. None of the companies had procedures to incorporate stakeholder input into the business and operational strategies. Engagement of other stakeholders in business and operational strategies could enhance competitiveness. At policy level, the Government, lobby groups and the financial sector can intervene to make the business environment friendly to this sub-sector.None of the respondents disclosedtheir environmental policies, programs, and performance eitheronline or in a sustainability report. About 33% of the respondents publicly disclosed results of their stakeholder engagement.All respondents also said that procedures did exist to incorporate stakeholder input into its business and operational strategies. One of the main stakeholders mentioned was the MMCZ which was involved in the marketing of production for export done under a tripartite arrangement.About 67% of the respondents factored in supplier performance on key environmental indicators when making purchasing decisions. It can generally be concluded that there is minimal stakeholder engagement at this level. There seem to be no active body fully representing the interest of actors at this level of the value chain.

4.2.5 Dimension 5: Sustainable production and energy use

4.2.5.1 Use of materials, energy and water

Based on the field data analyses, all the respondents said that they kept inventories of all chemical substances used, stored, processed,and manufactured and that they had programs and/or procedures to reduce the use of resources, and promote sustainable natural resource practices. Only 33.3% of the respondents assessed whether substances stored, used or handled on site were prohibited by national and international laws or protocols. About 50% of the firms maintained up to date material safety data sheets according to respondents.

All the respondents used electricity, whilst 25% apiece used coal, generators and gas as sources of energy. All the respondents experienced power outages of between 2011 and 2013 with 25% apiece having experienced minor, moderate, major and severe outages (Figure 48).

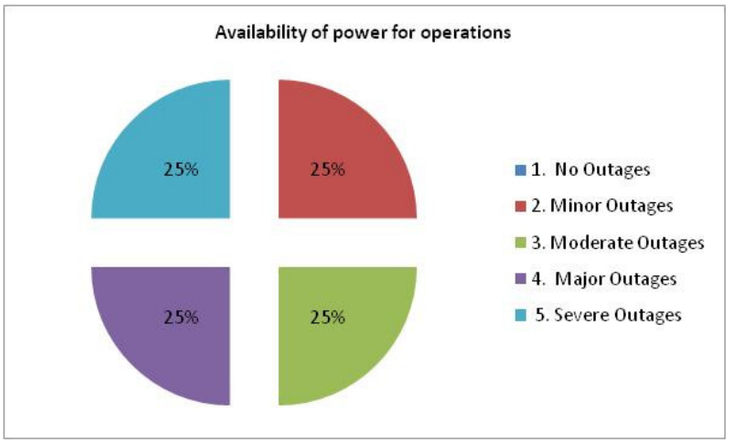


Figure 48: Availability of power for operations

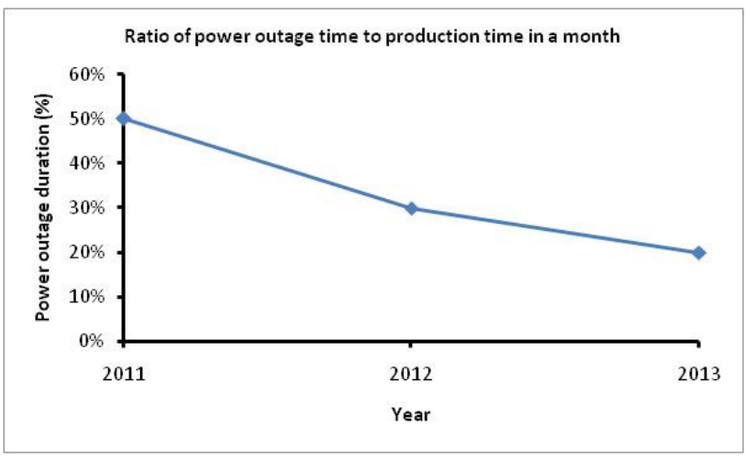


Figure 49: Responses on duration of power outages in a typical month

As shown in Figure 49 above, the duration of power outages decreased from about 50% of production time in 2011 to an average of about 20% in 2013. Despite this trend the power outage duration is still big and is one of the major causes of low capacity utilisation in the sector. About 33% of the firms owned a generator over the period 2011 to 2013. The field data analysis shows that power availability was a major constraint to the value chain actors which negatively impacts on their production capacity and production costs.

Water is a key resource in Level 3, where it is mainly used in the processes and for cooling purposes. All respondents used local municipal water as one of their major sources of water whilst 25% apiece also used boreholes and private dealers (Figure 50 below).

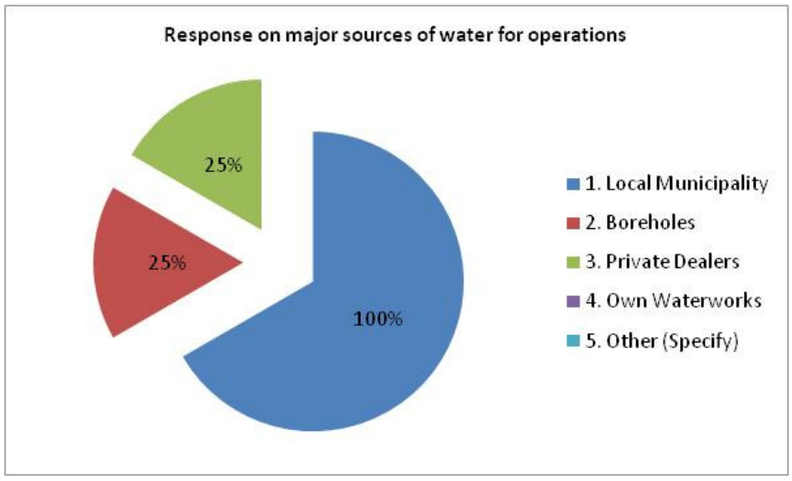


Figure 50: Major sources of water for operations

The high dependence on local municipality for water implies that strong links and engagement of private players in this sector with the local councils must be fostered to ensure reliability of supply. Analysis on adequacy of water for operations reveal that 25% apiece of the respondents experienced minor, moderate, major outages and severe as shown in Figure 51.

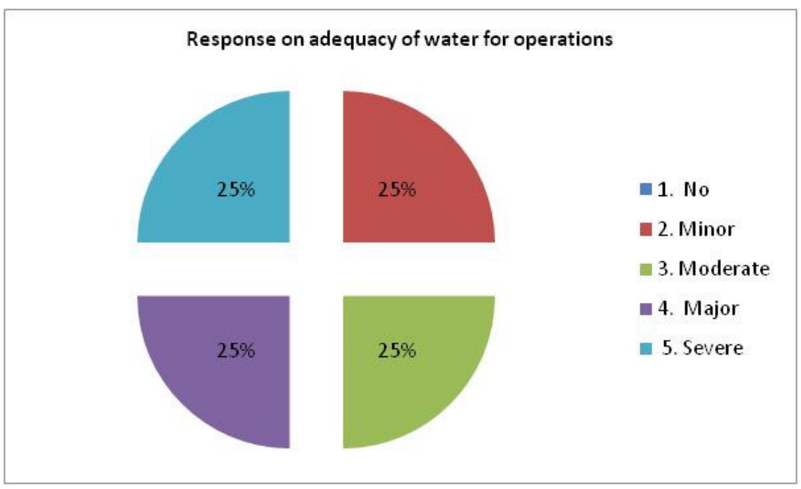


Figure 51: Adequacy of water for operations

About 33% of the respondents had a system in place to manage water consumption, whilst none had programs or procedures to reuse/recycle water. None of the respondents had systems in place to address wastewater management as well as facilities to treat wastewater prior to offsite discharge. It can be concluded that issues regarding water use and management reveal that they are a major weakness in the sector.

4.2.5.2 Emissions

Table 27 shows the responses on ownership of licenses and permits for emissions. The analysis shows that 50% apiece of the respondents owned a license for air emissions and health issues.None had any other license or permit for other waste related issues.

Table27: Ownership of necessary license and permits for environmental management

Emission license type	Response rate
1. Air emissions	50%
2. Storage or use of hazardous substances	0
3. Wastewater management	0
4. Waste issues	0
5. Other. Health	50%

The analysis of respondents presented in Table 28 below reveals that 50% apiece of the respondents had been fined, prosecuted or warned by regulators in relation to air emissions and health issues.

Table 28: Fines, prosecution, or warnings by regulators

Emission type	Response rate
1. Air emissions	50%
2. Storage or use of hazardous substances	0
3. Preventing soil & groundwater	0
4. contamination	0
5. Wastewater management	0
6. Waste issues	0
7. Other. Health issues	50%

None of the respondents regularly tested for air emissions and pollution prevention devices. The diagnostics also revealed that only 50% of the respondents had systems in place to manage air emissions as well as set targets to reduce the emissions. The above analysis shows that the area of emissions is a weakness that threatens the industry which has to be addressed to ensure sustainable operations.

4.2.5.3 Waste Management

About 67% of the respondents had programs and procedures in place to reduce or eliminate waste in operations. Some of the actors gave rubbles for free to customers. Only 33.3% of the respondents had a recycling program in place to reduce or eliminate pollution and waste in its operations. All respondents had no programs in place to manage and dispose other types of waste except for solid waste (see Table 29 below)

Table 29: Programs and/or proceduresto manage disposal of waste

Waste type	Response rate
1. Air borne emissions	0
2. Hazardous waste	0
3. Wastewater	0
4. Solid waste	100%

All respondents indicated that they were in compliance with applicable environmental laws and regulations whilst 66.7% had an up to date Environmental Management System / Certification in place. All respondents said that their employees were trained in environmental matters and environmental policies, practices and expectations were communicated to all employees and suppliers in all languages. All respondents monitored energy consumption and had systems in place to reduce the environmental impacts of greenhouse gases.

4.2.6 Dimension 6: Value Chain Finance

During the field surveys and administration of questionnaires, many respondents regarded certain sections of this dimension as confidential and hence did not divulge all the information we wanted to get. The analysis of this section is therefore based on the limited information we managed to get.

4.2.6.1 Availability of finance

The annual operational requirements according to the respondents averaged about US$240, 000.00 with an annual requirement of about US$ 660, 000.00. The average annual capital requirement was about US$310,000.00. About 85% of the respondents indicated that their capital requirements were financed from within the company whilst 15% indicated shareholders as the source of funds. This parameter shows the difficulty that stakeholders in this sector have in getting funding from banks and related financial institutions.None of the respondents have any loan with any lender or other sources. The two main and only reasons cited for not borrowing were unfavourable interest rates (50% response rate) and high collateral requirements (50% response rate). The field data analysis also revealed that none of the actors were operating at full capacity and required and average of about US$340,000.00 to reach full capacity. It was also noted that in all cases, the customers wanted credit facilities from the firms. About 33% of the respondents had their annual financial statements checked and certified by an external auditor. This implies that the financial risk was generally high for any lender. About 67% of the respondents cited access to finance as a major obstacle to current operations whilst 33% considered the same parameter as a severe obstacle. Thus the financing of the sector was a major challenge according to the diagnostic study. The main impediment to accessing finance from the banks was collateral. Several financing models could be developed for the financing of this level of the value chain since it is almost in the state of collapse. The magnitude of funding required is not very huge implying that local players with the requisite skills and entrepreneurial aptitude can be encouraged to participate in this value chain with the facilitation of the government, financial institutions and other relevant stakeholders.

4.2.7 Dimension 7: Business and Socio-economic context

4.2.7.1 Business environment

The main obstacles sited by respondents in the business environment were political instability; corruption, finance and practices of competitors in the value chain (see Table 30 below). The moderate obstacles included courts, crime, theft and disorder, tax administration and tax rates.

Table 30: Impact of business operating environment on the operation within the sub-sector

	No Obstacle	Minor Obstacle	Moderate Obstacle	Major Obstacle	Severe Obstacle
1. Tax Rates	33.3%	0	33.3%	0	0
2. Tax Administration	33.3%	0	33.3%	0	0
3. Licensing and permits	0	33.3%	66.7%	0	0
4. Political Instability	0	0	0	33.3%	33.3%
5. Corruption	33.3%	0	0	33.3%	0
6. Courts	33.3%	0	33.3%	0	0
7. Crime, theft and disorder	33.3%	0	33.3%	0	0
8. Customs and trade regulations	33.3%	0	0	0	0
9. Inadequately educated workforce	33.3%	33.3%	0	0	0
10. Labour regulations & health issues	33.3%	0	33.3%	0	0
11. Practices of competitors in the informal sector	33.3%	0	0	33.3%	0
12. Finance	0	0	0	0	33.3%
13. Other (Please Specify)	0	0	0	0	0

The analysis also showed that all of the respondents were inspected by tax officials with a frequency ranging from once to 3 times per year. About 33% of the respondents applied for an import license over the last two years with a processing lead time of about two weeks.

4.2.7.2 Social and cultural context

The average number of employees per actor according from the analysis was as follows: the total number of permanent employees was 38 of which 34% (13) were skilled; 29% (11) were semiskilled and 37% (14) were unskilled. Over a period of three years spanning from 2011 to 2013, an average of 27 contract workers were employed per annum with the longest contract spanning two months. Female employees constituted 15% (2) of the skilled workers and about 4% of the contract personnel. No skilled or semi-skilled female personnel were employed. Thus it was clearly seen that there was no gender balance in the metal forming sector. All respondents said that ordinary level was the most common level of education for employees.All respondents had no formal training programs for its employees.

All of the responding firms indicated that they did not carry out pre-employment health checks for new employees. About 50% of the respondents indicated the use of HIV prevention messages and free condom distribution to fight HIV and aids. None of the firms the firms carried out anonymous HIV testing.

From the analysis, it can be concluded that the business environment is still not conducive to actors at this level of the chain.

4.2.8 Summary of key findings and issues in Level 3

The major findings were as follows

- Low capacity utilisation due to power and water shortages, low local demand, lack of raw materials, working capital constraints, high cost of doing business, antiquated machinery and breakdowns and drawbacks of the current economic environment amongst others
- Lack of access to cheap finance for recapitalisation
- Low levels of collaboration between research and development and industry
- Low relevance of local research and development to industrial needs
- Limitations of marketing and trading capacities due to low product demand, lack of financing mechanisms to export abroad, high cost of transport and insufficient production capacity to export abroad
- Products not competitive on the regional and international market
- Major obstacles in the business environment include political instability; corruption, finance and practices of competitors,courts, crime, theft and disorder, tax administration and rates.

4.2.9 Discussion: The significance of the Level 3 to the Zimbabwean context

The discussion in this section is based on key informant interviews, focus group discussions during field surveys and desk reviews during the course of the value chain study. Useful insights on desk review also came from Zimtrade documents (Mafu, 2011) and value chain studies from other regional and international players like China and South Africa. Two major subsectors are subject to discussion in this section namely the iron and steel making and foundries sector in Zimbabwe. Currently, it was generally noted that the engineering and metals value chain broke down due to the challenges faced by these two sectors and hence the need for a more detailed analysis of these special sectors.

4.2.9.1 The Foundry industry in Zimbabwe

Foundriesare key players in the third level of the metal beneficiation process which produce intermediate goods as critical inputs to most manufacturing sectors, with mining, agriculture, automotive, and general engineering being the largest consumers of foundry products.It was gathered that just a decade ago, Zimbabwe had more than twenty functional foundries.These included Marondera foundries, Zimcast, Anollie Castings, Crasters International, Four Jays Engineering, NIMR and Chapman, ABJ Engineering, Sirmet Founders and Engineers, Eastern District Engineers, T & A Founders, Specialised Castings, Mackemeekan, Clarson, Kons Engineering, Unlimited Founders, Stian Valves, Bain, Almin Metal Industries and many more. Over 50% of these companies no longer exist today. This tells a true story of the challenges facing the engineering sector.

Companies such as Zimcast, Crasters International, and the then Macmekeen (now Quad Foundries), used to produce and survive on grinding media / mill balls as a cash cow in their product portfolios. Quad Founders has since stopped stocking mill balls due to reduced domestic

demand. Zimcast has since liquidated. Crasters International is still running but at a far low capacity due to the lower demand for low chrome mill balls in the country. Some of these foundries used to export to offshore markets such as the Democratic Republic of Congo, Zambia, Mozambique, Botswana and South Africa. The economic challenges that started over a decade ago paralysed the export capacity and competitiveness in terms of product quality and price. The major clients for low chrome mill balls in the past years including Sabi Gold Mine, Jena Mine, Duration Gold, Zimchem Refineries and most small to medium scale gold producers have either closed or significantly scaled down operations. This has directly affected the producers of grinding media and other upstream as well as downstream companies. Small to medium scale miners have no capital to buy the required mill balls. They also wait for government support to boost their operating capacity.

4.2.9.2.1 Foundry products and agriculture

Foundries, engineering companies and agricultural entities are intertwined. Over 30% of foundry and engineering semi products and end products were sold to agricultural related entities. Agriculture has been the backbone of Zimbabwe's industry that earned the country the bread basket status for Africa. The backbone to agriculture is engineering that is key at primary and secondary levels of agriculture. The engineering sector supplies irrigation equipment, iron and steel structures as well as processing machinery and equipment for agriculture.

Thus agricultural components, machinery and equipment looks attractive from the market growth and potential's view considering the vast number of new farmers (small and large scale) who are yet to be mechanised to improve productivity on their farms. The agricultural sector is projected to continue to improve thus triggering expansion and value added activities that create demand for processing machinery, equipment and parts thereof. The sector can also leverage on the fact that agricultural mechanisation does also have the backing of the government, the donor community and NGOs. The regional market which was traditionally the major export market for foundry products can be explored with a strategically well organised marketing approach to sell niche products that have significant impacts on GDP and MDGs. It is therefore a fact that engineering companies, foundries, steel merchants, depend significantly on agricultural entities as end markets.

4.2.9.2.2 Foundry products and heavy engineering capital goods

The local manufacture of heavy engineering, factory and mining equipment is limited in Zimbabwe despite the fact that infrastructure for such scale of manufacturing is available. Traditionally, Zimbabwe has never been a key manufacturer of heavy engineering capital goods due to low technological levels, and stiff competition from experienced and traditional strongholds in the sector like German, France, the USA, Italy and Japan. The situation was further worsened by the economic crisis which forced many key actors to close shop or reduce operations. Key players in the field included Morewear Industries, NRZ, T & A Foundries, Metal Components, Alstom and Arthur Garden Engineering amongst others. Nevertheless, low hanging fruits of significant value relevant to the foundry industry exist in the mining industry. The foundry products of interest to the miners are the grinding media *(high chromium and forged steel media)*; wire rode products (ropes, chains and slings); and casts products *(mantle, bowl, mill*

liners, locomotive wagons, frames, slagpots, ladles). It is worth noting that Zimbabwe does have existing infrastructure which is capable of producing these products if upgraded and well supported by an enabling environment.

It is also critical to note that most mining giants in the country are the greatest consumers of medium and/or high chrome mill balls. These end markets include Zimplats, Unki Mine, Freda Rebecca, Dorowa Minerals, Mimosa Mine and Metallon Group of Mines among others. Zimbabwean mining companies and cement producers cumulatively consume over 2,000 tonnes of mill balls per month at an average of $1,100 per tonne. All cement manufacturing companies in the country notably Lafarge, PPC, Sino Zimbabwe also use medium to high chrome mill balls of varying quantities.Sadly all the companies mentioned and many others use imported medium to high chrome mill balls from mainly China, India and South Africa against the background that the chrome required for the mill balls is also available in large quantities in Zimbabwe. Local foundries also do not have technical capacity and expertise to produce such mill balls although they know the technical composition of the mill balls. In addition, these importing countries are landing the grinding media at a cost that local companies cannot match even if they were to produce the mill balls.

Most mining and engineering companies in the country use manganese mill liners which are consumables that need replacements in every 4 – 6 months. This brings the total tonnage of manganese and white iron liners to over 200 tonnes per month. Of all this lining material, Zimbabwean foundries and engineering companies supply less than 5%. The other 95% is being imported mainly from South Africa and China. It was noted, the problem was not so much on quality for local engineering companies, but on competitiveness in the presence of foreign competitors especially coming from an economy that has been depressed for over a decade. Quality and price competitiveness in view of decadent obsolete equipment and shortage of human skills is evidently become a constraining factor for competitiveness. Regionallythe foundry industry is concentrated and dominated by a small number of large groups or individual companies which include Murray & Roberts, Ozz Industries, Scaw Metals, Tiger Wheels, Guestro Castings, Auto Industrial, and Hayes Lemmerz, all in South Africa. They account for around 60% of production tonnage cast each year (Lundall et al., 2008) with an annual capacity of over 500000 tonnes (Source).Global competitors have even significantly larger capacities,e.g. China had 12 000 foundries and India had 4 500in 2003(Source). Zimbabwe must therefore shrewdly face this competitive scenario head on to get a share of the market.

Locally and regionally, mining expansion projects, brown field and green field projects are projected to increase especially in the PGMs, chrome, iron ore and energy sectors hence triggering demand for mining machinery, equipment and parts thereof. In turn, the demand for foundry products is expected to increase significantly.Thus the government must consider this subsector strategically in view of regional and international competitors.

4.2.9.2.3 Potential contribution to the economy

Based on the average production volumes and capacity utilisation presented in section 4.2.2.1, estimate end product prices per tonne and the average number of actors in the sector, projected volumes and revenues can be estimated for full capacity operation. The value added can also be approximated from the percentages calculated from the Zimstat data in Part 3. In this case, the average capacity utilisation from the respondents was 23% and the average production tonnage per annum per actor was 140tonnes. Assuming 80% capacity utilisation, usually typical of the iron and steel sector at this level, the projected production tonnage per actor becomes 487 (80*140/23) tonnes per annum per actor. Assuming about 20 actors in the subsector, then the sector can produce close to 10000 tonnes per annum. Based on the mill ball price of US$1100/tonne, the existing capacity can bring in US$11million revenue to the national economy. The other way to look at it is to assume the regional market share, say based on mill ball consumption of at least 144000tonnes per annum (assuming that Zimbabwe, Angola, Zambia, Mozambique, Namibia and DRC each consume 24000 tonnes per annum from Zimbabwe). The projected revenues will then be $US158.4million and a value added of US$81million (assuming a value added potential of 51% - see Figure 26ii of section 4.3). The power, water, railroad and capital constraints issues have to be definitely addressed to achieve such targets. The government can also leverage on the good relationships it has with India, Mauritius and China to form win-win joint ventures so as to expand production as well as the market. The almost agreed deal with the Essar Group of India can strengthen the position of Level 3 in the value chain.

4.3 LEVEL 4 (Metal Fabrication) VALUE CHAIN ANALYSIS

The metal fabrication stage (Level 4) involves several actors involved in the machining and fabrication of components usually used for equipment and machine building. Some of the actors in this sub-sector are both fabricators and machine builders whilst others, though few, can be integrated from metal forming, fabricators as well as machine builders. This is usually the case with certain foundries and iron and steel making entities. The processes commonly used in this section include welding, machining, drilling and all the common fabrication and joining processes. This level takes inputs from Level 3 (metal forming) which include steel plates of different grades and thicknesses, angle irons, channel irons, castings, electricity, water, storage and transport facilities for conversion to finished metal products like shafts, roofing sheets, coated plates, tools, implements and cutlery and subassemblies for Level 5. Field surveys were carried out in Harare, Mutare, Kwekwe, Bulawayo and Gweru. Out of about 44 sampled players in the metal fabrication sector, 11 (25%) were not active. As a result out of 33 active players, 22 responded, a response rate of 67% of which four of the responses were through FGDs and personal interviews.Key informant interviews done in this sector survey included the Engineering Council of Zimbabwe (ECZ), the Engineering Iron and Steel Association of Zimbabwe (EISAZ) chief executive officer and a focus group discussion with the Industrial Development Corporation (IDC) team of managers as well as the CEO and ZISCO. The diagnostic dimension approach was used to analyse the results from using the excel software package.

4.3.1 Dimension 1: Sources of Inputs and Supplies

4.3.1.1 Characteristics of inputs, supplies and nature of suppliers

The inputs noted in the study were copper, aluminium, PVC, steel, lead and zinc, electricity, water, storage facilities and transport facilities. About 53% of the respondents required storage facilities for their raw materials. The storage facilities mentioned were store rooms, billet bins and tanks. About 95% of the respondents required transportation facilities for their raw materials. The transport facilities mentioned were road, trucks and rail. On average, 39% of the total raw materials were locally supplied and 61% were imported. However, some firms within the sector completely relied on imports for their raw materials, whilst others completely relied on local supplies for their inputs. About 56% of the respondents directly imported raw materials whilst 44% used an agent. The value of all imported inputs in 2012 ranged between 0 and US$18million with an average of US$1.9million. In 2012, all respondents imported their raw materials from SADC. About 33% of the respondents had options for raw material substitution. The number of days taken to import goods ranged from 5 to 42 days with an average of 20days according to the respondents.

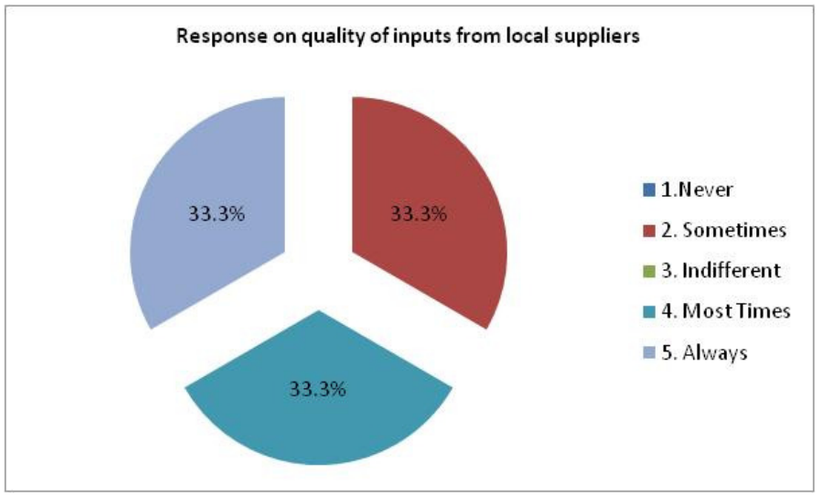


Figure 52: Consistency of quality from local suppliers

There was an even distribution of responses on the quality of inputs from local suppliers with 33.3% apiece saying it was always, most times, and sometimes good (Figure 52).The responses therefore show that the quality of locally sourced inputs was generally high.

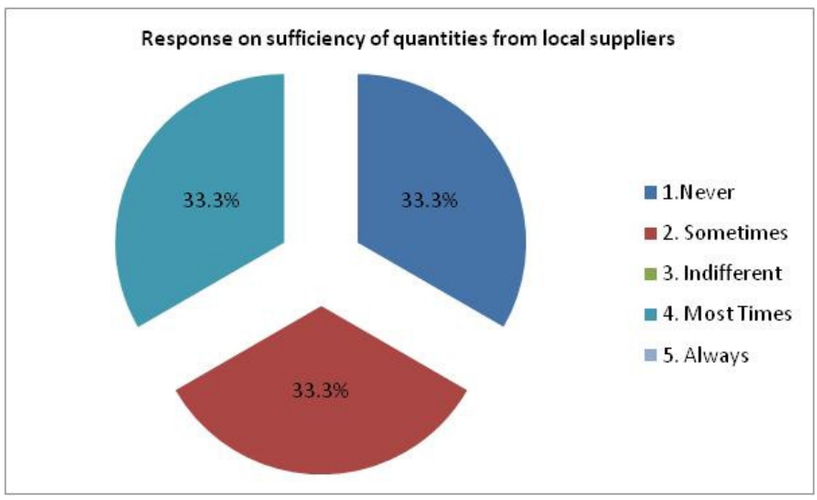


Figure 53: Sufficiency of quantities of inputs from local suppliers

From the responses of the survey, 33.3% apiece said the quantities of inputs from the local suppliers were sometimes and most times sufficient whilst 33% said never (Figure53). This implies that the reliability of local suppliers in delivering the expected quantities needed to be improved.

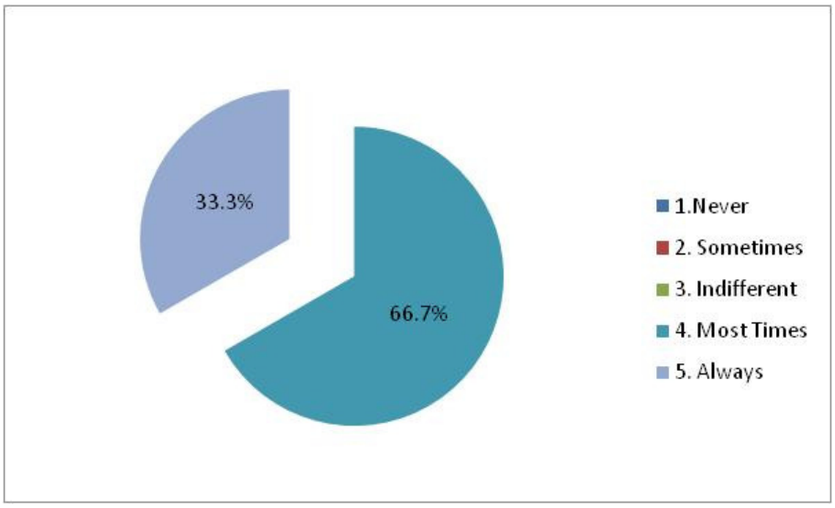


Figure 54: Consistency of quality of inputs from foreign suppliers

Figure 54 above shows that, of the responses on the quality of inputs from foreign suppliers, 67% said the quality was good most of the times, whilst 33% said it was always good. It generally implies that the quality of foreign sources inputs was generally high although there is need for improvement in some cases.

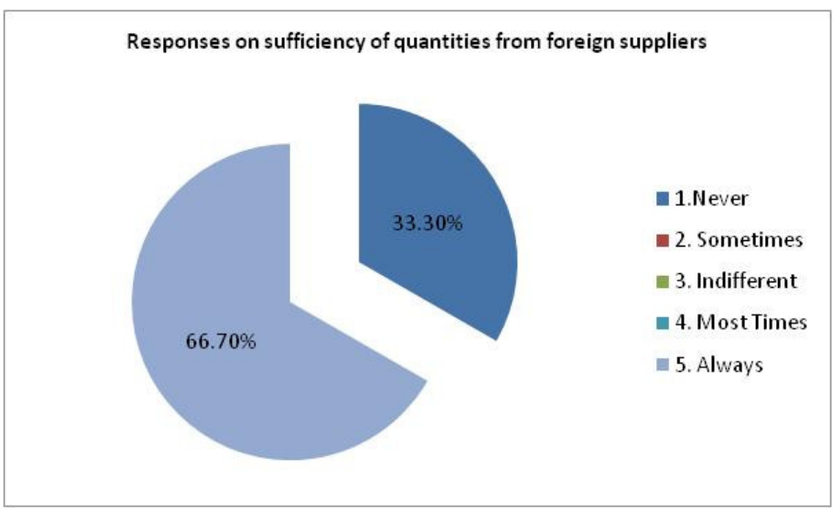


Figure 55: Consistency of quantities of inputs supplied from foreign sources

Figure 55 shows that 67% of the respondents said that the quantities of inputs from foreign supplies were adequate most times, whilst 33% said the quantities were never adequate. The analysis therefore shows that although the consistency of quantities supplied was generally satisfactory, there was need to improve the supply quantities.

4.3.1.2 Transport and Logistics

Transport was not a major obstacle to current operations as 67% of the respondents said it was moderate whilst it was minor for 33% of the respondents. The stockholding period for raw materials ranged between 30 and 60 days (45 days average) according to respondents. It implies that storage costs could be a significant factor in the value chain.

None of the respondents were offered bribes when dealing with customs. About 33% of the respondents perceived customs and trade regulations as minor whilst 33% regarded it as severe. About 33% apiece of the respondents found import tariffs to be minor and severe. About 67% of the respondents were in formal contractual agreements with their suppliers. All responses also show that the operations always specify the quality dimensions of raw materials on purchasing. About 67% of the respondents cited ISO standards as prerequisite certification requirements for their inputs whilst 33% used others. Accordingly, transport and logistical issues were not major in Level 4.

4.3.2 Dimension 2: Production capacity and technology use

4.3.2.1 Production capacity and technology use

From the responses, the common working pattern was as follows: 6 days per week; 2 shifts per day and a 24 hour day. The production capacity ranged from 400 to 120000 tonnes per month with an average of about 491000 tonnes per annum. The capacity utilisation was very low and remained at 33% for the period 2011 to 2013. All respondents said that they performed short, medium and long term capacity reviews. For the respondents who experienced a decline in capacity utilisation, they attributed it to working capital constraints, power and water shortages, and high cost of doing business and the drawbacks from the current economic environment as the major causes. Table 31 summarises the reasons for low capacity utilisation.

Table 31: Reasons for decline in capacity utilisation

Reason for Decline of Capacity Utilisation	Responses
1. Low Local Demand	0
2. Lack of raw materials	0
3. Working Capital Constraints	66.7%
4. Antiquated Machinery & Breakdowns	0
5. Power & Water Shortages	100%
6. High Cost of Doing Business	100%
7. Competition from Imports	0
8.Drawbacks from the Current Economic Environment	33.3%
9.Other (Please Specify)	33.3%

The major reasons for the decline in capacity utilisation were low local demand, working capital constraints, and competition from imports and drawbacks from the current economic environment. About 67% of the respondents said managed to reduce their operating costs

through process improvements, material and design changes. About 33.3% of the respondents managed to incorporate new manufacturing approaches to their operations.

The average cost of replacing machinery was about USD 1.5 million and 50% of the respondents said that their production facilities were not adequately equipped with plant and equipment for production. They cited lack of capital for investment in modern technologies as the main reason for the insufficiency. About 75% of the respondents replaced machinery and equipment in the last three years. About 50% apiece of the respondents used manual and semi-automatic technologies whilst 25% used automatic machines. It was also noted that none of the technologies used operated below 50% effectiveness whilst 50% apiece were between 50 and 75% and above 75% effective. It shows that the technologies used in this level of the value chain were generally effective. Similarly, the technologies used were all above 50 % efficient with 50% of them operating above 75% efficiency.

Table 32: Comparison of technologies used with best practices

Region	Score/10	Level of competitiveness
1. Local	8.5	Very competitive
2. Low Income Africa	8	Competitive
3. Medium Income Africa	4.5	Not competitive
4.High Income Africa	5	Marginally competitive
5.International	2.25	Not competitive

Key: Very competitive (9 – 10); Competitive (7 – 8); marginally competitive (5-6); not competitive (<5)

From the responses presented in Table 32 above, the technologies used in Level 4 (metal fabrication) were competitive locally and regionally outside South Africa. Nevertheless the technologies were not competitive internationally and in High Income Africa. The poor competitiveness of technologies used as compared to medium income to international best practice is of great concern considering that the critical markets that come with economies of scale are either in high income Africa (e.g. South Africa) and the international market. Opportunities for upgrading lay in incorporation of new technologies such as high precision equipment and single digit set up production lines. About 80% of the respondents used CAD systems whilst 20% of the respondents used CAM. The main constraints faced by the respondents were capital constraints, technical expertise and procurement of spare parts.

4.3.2.2 Knowledge Use

The respondents indicated that the tertiary education system was satisfactorily aligned to industry requirements as 42%, and 16% and 22% said that the tertiary education was moderately suitable, suitable and very suitable to industry requirements respectively (see Figure 56 below).

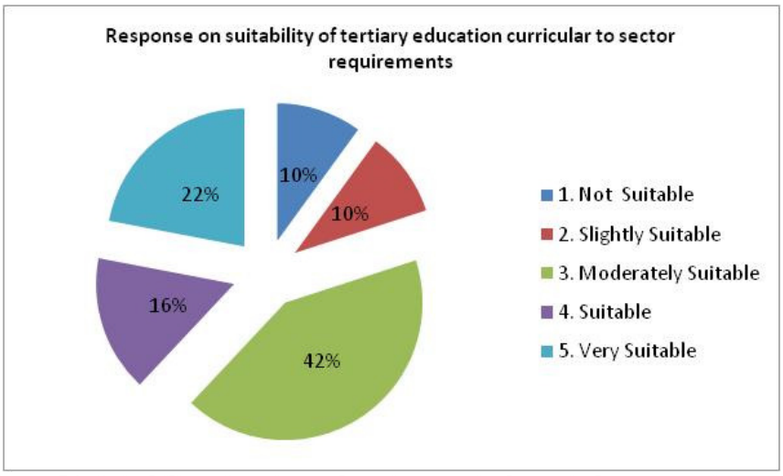


Figure 56: Suitability of tertiary education curricular to industry requirements

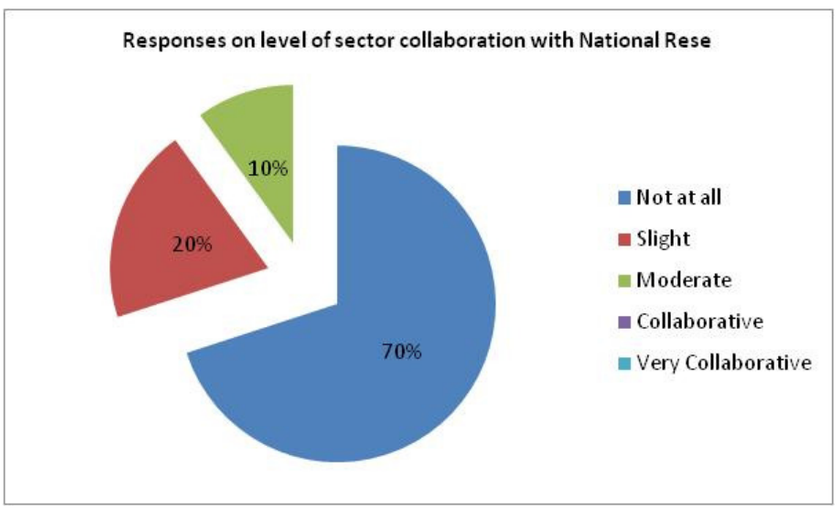


Figure 57: Level of collaboration with National Research and Development Institutions

Very low levels of collaboration between the sector and national research and development institutions was evidenced by the fact that 90% of the respondents said that there was none and slight of such collaborations respectively (see Figure 57). Figure 58below shows that the respondents indicated very low relevance of local research and development for operation improvement. About 65% of the respondents cited insignificant to no relevance of local research and development institutions whilst 35% considered it effective and very effective. This analysis therefore noted that the levels of knowledge use were very low in Level 4 of the engineering and metals value chain of Zimbabwe.

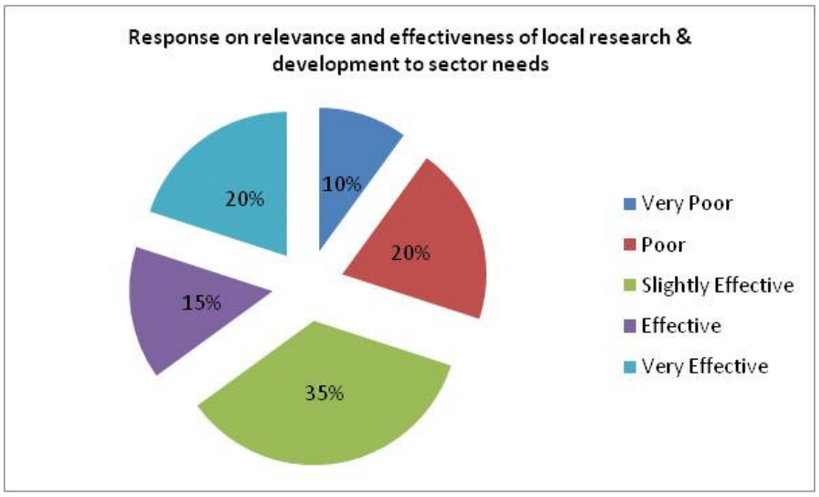


Figure 58: Relevance and effectiveness of local research & development for operations improvement

4.3.3 Dimension 3: End markets and Trade

4.3.3.1 End products characteristics

The analysis revealed that the end products sited were metal products and machine components (80%); electrical cables and wire products (10%); semi processed products (5%) and machinery and equipment (5%). The main products were the steel products as shown in Figure 59 below.

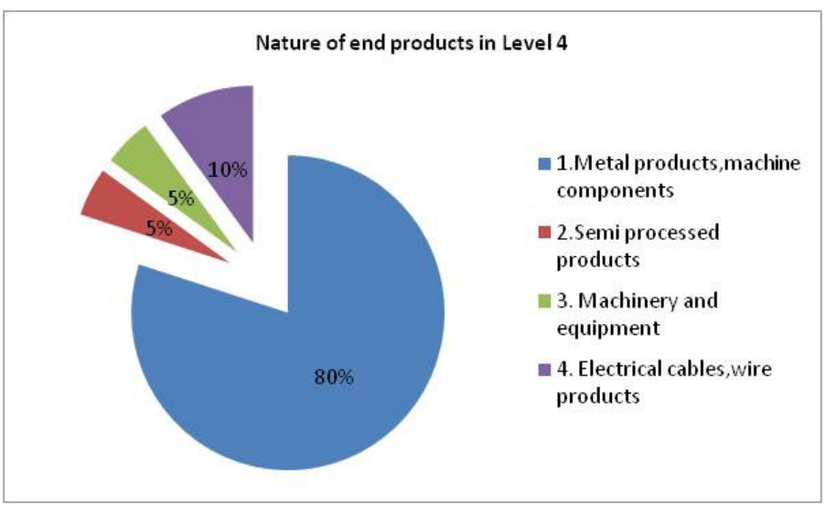


Figure 59: Distribution of end products in Level 4

Figure 60 below shows that 40% of the firms had their main product constituting between 50 to 75% of the main product, 47% of firms constituting above 75% of sales and 13% of the firms with the main product contributing less than 50% of the total sales. There is therefore high dependence on the main product in most of the firms implying high risk if a more competitive

actor enter the market. There is need to diversify on the end products as well as to continuously improve on competitive issues of the sector.

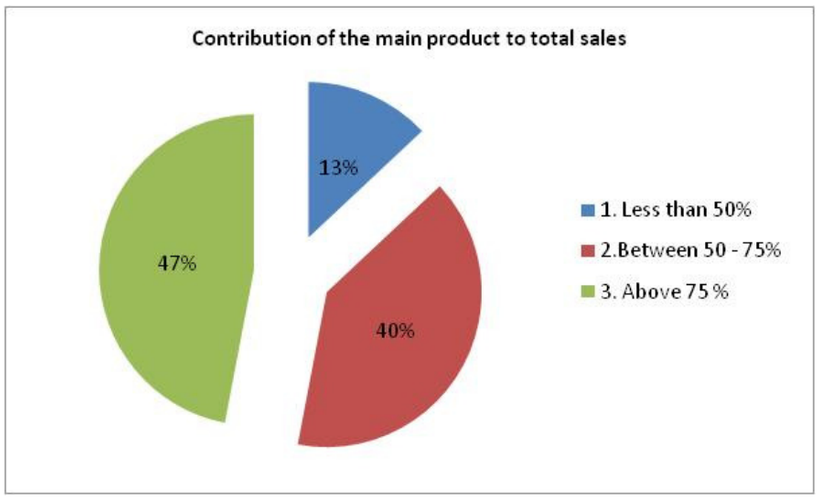


Figure 60: Contribution of the main product to total sales

4.3.3.2 Consumer Demand

According to the field data analysis, about 82% of respondents indicated a strong demand for their products due to high quality and brand. According to respondents, the major contributions to high product prices were labour and imported raw materials.

4.3.3.3 Marketing, trade capacities and standards

According to respondents annual volumes generated ranged between 183000 and 336000tonnes (268000tonnes average), generating annual revenues of between US$3million and US$64million for the period between 2011 and 2013. The direct export of products started in 1999. According to all respondents, clearance of products from point of exit at customs took 24 days and the customs officials did not solicit for a bribe during the process of exporting goods. There were no significant losses encountered in transit of goods.

Table 33: Obstacles to growth of export market

Obstacles	Responses
1.Lack of foreign demand for its products	25%
2.High costs of transport	25%
3.Red tape in customs	31%
4.Insufficient production capacity to expand exports	38%
5.Lack of financing mechanisms to sell abroad	19%
6.Non-price restrictions on foreign markets	0
7.Lack of knowledge of foreign markets	19%
8.Any other Specify _____	38%

The main obstacle to growth of the export market was found to be insufficient production capacity to expand exports (38%), red tape in customs (31%), high costs of transport (25%) and

lack of foreign demand for products (25%). The other obstacles sited to a lesser extent were lack of financing mechanisms (19%) to sell abroad and lack of knowledge of foreign markets (19%) (See Table 33 above). It was however generally noted that the obstacles to growth of export markets in Level 4 were not very significant relative to Level 3 and 5.

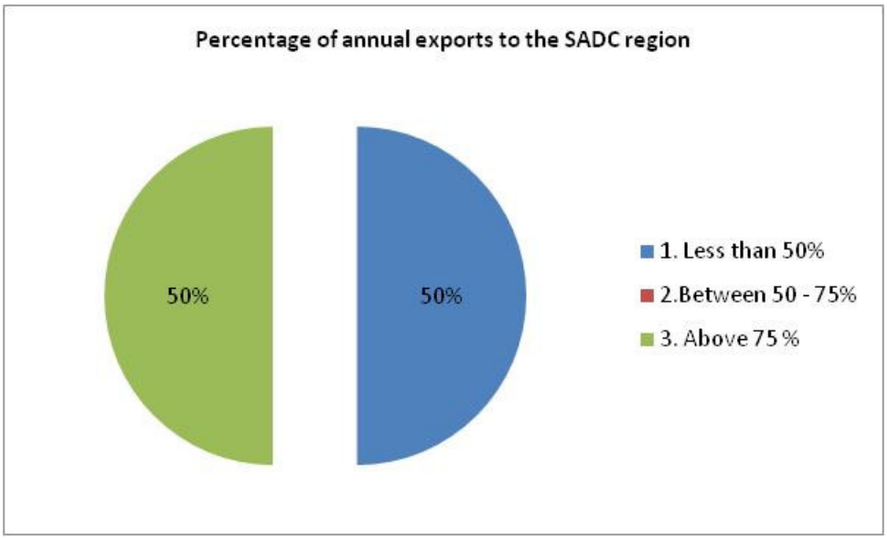


Figure 61: Percentage of exports to the SADC region

Of the respondents, 50% exported more than 75% of their products within the SADC region whilst the other 50% exported less than 50% to the SADC market (Figure 61). The SADC market is therefore a critical market to the sector.

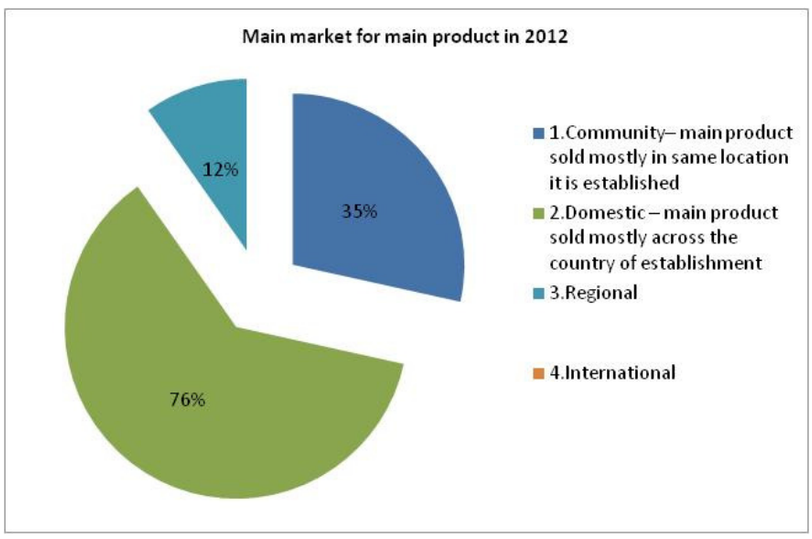


Figure 62: Destination of main product sold in 2012

Figure 62 shows that 76% of the respondents indicated that the main product was sold in the domestic market mostly across the country of establishment in 2012. About 35% of the respondents indicated selling the main product in the community where the firm is established.

Only 12% of the respondents sold their main product to the region in 2012 and none exported to the international market implying that the regional and international market has not yet grown.

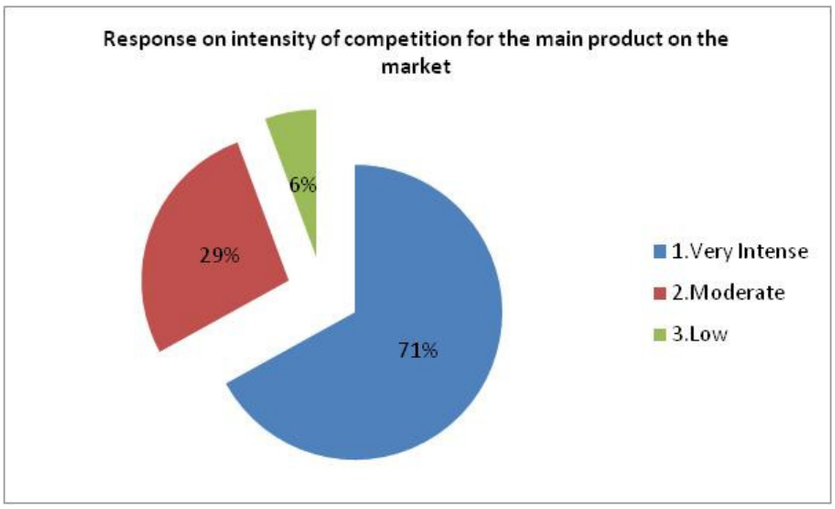


Figure 63: Intensity of competition on the market for the main product

Competition on the main market was said to be very intense by 71% of the respondents, with the other 29% regarding it as moderately intense whilst 6% said it was low (Figure 63). This implies that competition on the market is quite stiff. The majority of the respondents (89%) competed against unregistered or informal companies.

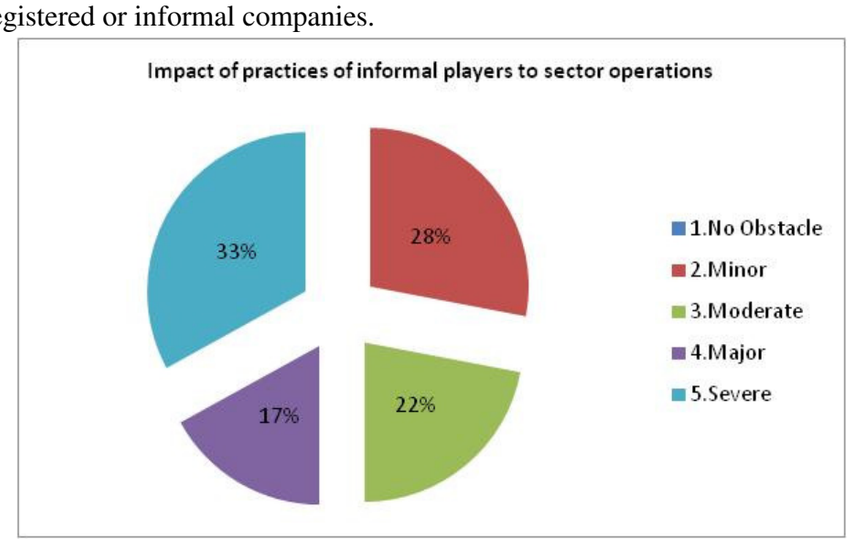


Figure 64: Impact of practices of informal sector player to sector operations in 2012

A significant number of respondents (72%) were significantly affected by the practice of informal players (see Figure 64 above).

The estimated annual marketing budget average for the sector was about US$9million. About 67% of the respondents had dedicated marketing teams in place. Existence and/or expansion of dedicated marketing teams are essential for penetration into the global market.

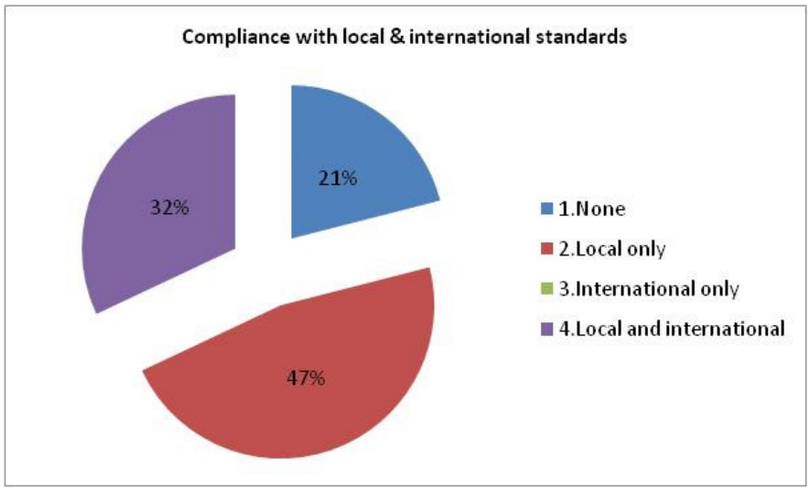


Figure 65: Response on compliance with local and international standards

About 32% of the respondents comply with both local and international standards whilst 79% were compliant with either local or international standards (Figure 65). About 21% of the respondents were not compliant with any standards. About 57% of the respondents stated that compliance to standards was mandatory. The standards relevant to the sector include SAZ, ISO 9001:2008,ISO 14001,OSHAS 18001 and SABS 1507. Only 22% of the respondents were accredited to international standards.Accreditation and compliance to international standards has become one of the key competitive advantages on the market and hence the sectors Level 3 must be assisted to comply in-order to be more competitive.

4.3.4 Dimension 4: Value Chain Governance

4.3.4.1 Actor domination

About 68% of the firms were shareholding companies with non-traded shares or shares traded privately, 16% shareholding companies with shares traded on the stock market and the remaining 11% were a partnership (Figure 66). The firms according to the respondents were formed between 1931 and 2001.

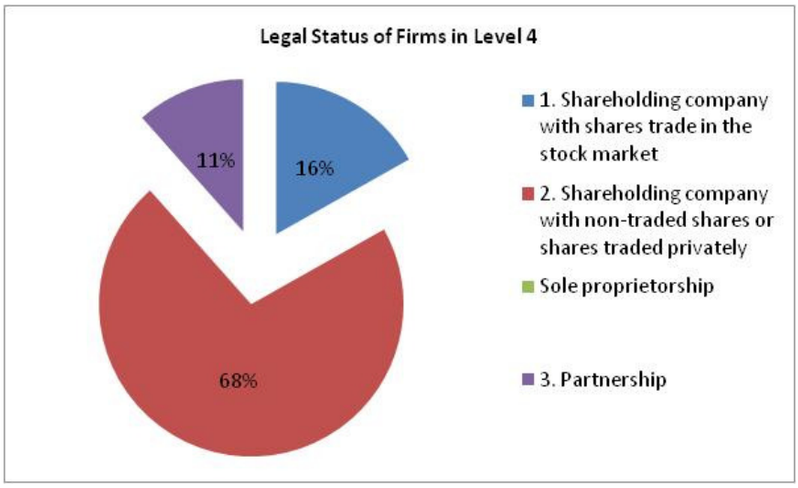


Figure 66: Legal Status of Firms in Level 4

About 84% of the firms that responded were, whilst 5% were state/ public entities (Figure 67) with the largest shareholder owning up to 73% of the shares. About 35% of the firms had female shareholders and 26% of the firms had subsidiaries outside Zimbabwe.

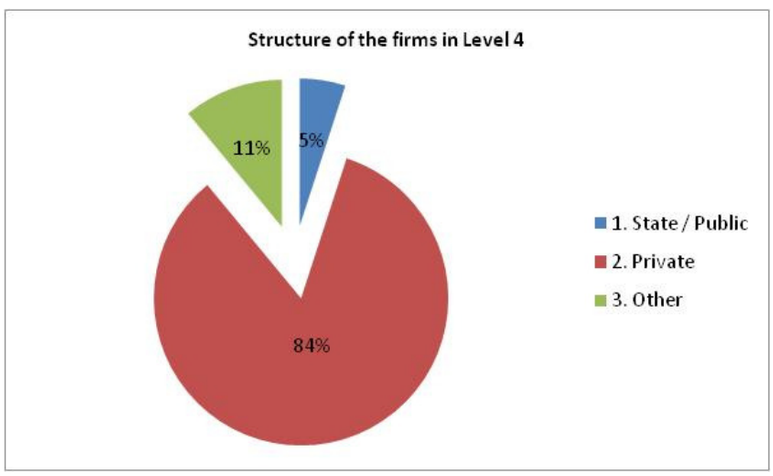


Figure 67Structure of firms in Level 4

The respondents revealed that product/service specificity (59%), price setting ability (53%) knowledge asymmetry (41%) and strategic management plans (41% were the core competences in the value chain (see Table 34below).

Table 34: Core competencies that making the actor stand out in the value chain

Core competence	Response rate
1. Market dependence	6%
2. Sales concentration	24%
3. Knowledge asymmetry	41%
4. Price setting ability	53%
5. Product/service specificity	59%
6. Strategic Management Plans	41%
7. Other	6%

4.3.4.2 Participation in and distribution in the value chain

The number of employees per firm ranged from 5 to 1,012. The top manager was female in 5% of the firms. Of the companies interviewed, 29% said that they engaged stakeholders on a monthly basis to discuss their sustainability strategies, disclosure and performance.According to the analysis, 17% of the respondents publicly disclose their environmental policies, programs, and performance eitheronline or in a sustainability report. 25% of the respondents said they source input from stakeholders on business and operational strategies via Carbon Disclosure Project (CDP). About 41% of the respondents factor supplier performance on key environmental indicators on purchasing decisions.

4.3.5 Dimension 5: Sustainable production and energy use

4.3.5.1 Use of materials, energy and water

The use of material, energy and water based on the field data analyses, 50% of the respondents said that they kept inventories of all chemical substances used, stored, processed, and manufactured and 25% had programs and/or procedures to reduce the use of resources, and promote sustainable natural resource practices. About 56% assessed whether substances stored, used or handled on-site are prohibited by national or international laws or protocols whilst 61% maintained up-to-date material safety data sheets (MSDS) for all hazardous substances used on-site. About 78% of the respondents did not conduct tests to identify impact on soil and groundwater from facility operators. About 69% of the respondents stated that the company did not have a program to reduce the use of resources and promote sustainable natural resource practices.

About 93% of the respondents used electricity, whilst 11% used gas, 13% had generators and 5% used coal. About 12% of the respondents applied for a power demand upgrade between 2011 and 2013. All respondents experienced power outages of varying magnitude between 2011 and 2013, 39% experienced moderate outages, 22% experienced minor outages, 28% major outages and 11% experienced severe outages. The average power outages per month were 12%, 20% and 13% for the year 2011, 2012 and 2013 respectively. The average length of the power outage was 12%, 20% and 28% for 2011, 2012 and 2013 respectively. 56% of the firms indicated that they owned a generator which ranged from 5KVA-600KVA (average size128KVA). The field data analysis showed that power availability was a major constraint to the value chain actors which negatively impacts on their production capacity and production costs.About 67% of the respondents monitored energy consumption whilst 65% did not have a system in place to reduce the environmental impact of greenhouse gases. Generally 62% of the respondents did not have set targets in relation to increased energy efficiency whilst 38% had targets for 50% cost reduction.

In the metal fabrication(Level 4) stage, water is a key resource which is mainly used for the processes and cooling purposes. About 95% of the respondents used local municipality supplies as their major source whilst 25% used boreholes. About 39% of the respondents experienced no

water outage whilst 17% experienced minor outages, 38% moderate outage, 6% major outage and 17% severe outages. The average company's total water requirement was 502,000liters per month with the major usage being for human consumption. The average company's monthly production was about to about 115 tonnes.About 65% of the respondents did not have a system in place to manage water consumption and 71% had no program in place to recycle water. Approximately 41% of the respondents had a system in place to address wastewater management whilst 59% did not. It was not that a significant number of respondents of 80% did not treat wastewater prior to off-site discharge. The 20% of respondents who did treat highlighted complied with standard pH range of 6.8 to 9. Table 34 below highlights the type of water used by the respondents and it indicates that 95% used municipal water whilst 30% used borehole water.

Table 35: Sources of water used

Water source	Response rate
1. aquifers	0%
2. municipal water	95%
3. harvested rainwater	0%
4.borehole	30%
5. other	0%

Results show that 29% of respondents highlighted that the company does not assess quality risks related to these water sources.

4.3.5.2 Emissions

Table 36 below shows the responses on ownership of licenses and permits for emissions. The analysis shows that 60% of the respondents owned a license for air emissions, 70% storage or use of hazardous substances,60% waste issues and 90% wastewater management licence. Respondents highlighted that the company's management systems were 100% compliant with applicable environmental laws and regulations and 79% did not have up-to-date environmental management system in place whilst the other remaining 21% ISO 14001:2004 certification.

Table36: Ownership of necessary license and permits for environmental management

Emission license type	Response rate
1. Air emissions	60%
2. Storage or use of hazardous substances	70%
3. Wastewater management	90%
4. Waste issues	60%
5. Other…. Certificate of reg of a company	30%

The analysis of respondents presented in Table 37 below reveals that the firms received fines, prosecution and warnings by regulators in relation to the following, 33% on air emission, 33% on storage or use of hazardous substances and 100% on wastewater management.

Table 37: Fines, prosecution, or warnings by regulators

Emission type	Response rate
1. Air emissions	33%
2. Storage or use of hazardous substances	33%
3. Preventing soil & groundwater	0%
4. contamination	0%
5. Wastewater management	100%
6. Waste issues	0%

About 82% of the respondents pointed out that their firms did not regularly test air emission whilst 18% did test for lead fumes, acid fumes and carbon dioxide. It was highlighted by 74% respondents that they did not have a system in place to manage air emission. About 65% of the respondents did not have pollution prevention devices on extraction systems. Currently 81% have set targets in relation to reducing air emission.

4.3.5.3 Waste management

Approximately 63% of the respondents had programs to reduce or eliminate waste in their operations which included reduction of scrap levels and substitution of certain processes. About 56% of the respondents did not have a recycling program to reduce pollution and waste in its operations.

Table 38: Programs and/or procedures to manage disposal of waste

Waste type	Response rate
1. Air borne emissions	56%
2. Hazardous waste	56%
3. Wastewater	56%
4. Solid waste	67%

Table 38 above shows that 56 apiece of respondents had programs in place for airborne emissions, hazardous waste and wastewater; whilst 67% had programs for solid waste disposal. About 53% used external waste contractors. It was also noted that 56% of the respondents did not conduct regular audits. About 70% of the respondents highlighted that the contractors had relevant certification and 50% stated that their contractors had not complied within the past 3years.

Approximately 59% of the respondents trained their employees on environmental matters which included training on health and safety and 82% confirmed that environmental policies, practices and expectations were communicated to all employees and suppliers in all languages.About 33% of the respondents did not have established environmental targets to improve environmental performance whilst the other 67% had set targets in place. About 39% of respondents reviewed their environmental performance annually whilst the remaining 61% did not because of lack of an environment management system.

4.3.6 Dimension 6: Value Chain Finance

This section was sensitive as of the respondents did not fill it in due to the confidential nature of financial issues.

4.3.6.1 Availability of finance

From the analysis of the survey, the annual operational requirements in the automobile industry had an average of US$1.2million. The average annual capital requirement was about US$100 million. The respondents indicated that they borrowed funds amounting to US$1million from banks which they used for capitalisation. The range of the capital required was between US$60,000.00 to US$500,000.00 and the average was US$200,000.00. They highlighted that the capital requirements are financed by shareholders (16%), 81% from within the company and 15% from banks. About 92% of the respondents stated that they have a checking or savings account. Respondents indicated that when borrowing from banks, the lenders availed funds (29%) always on time, not always (43%) and not at all (14%).

It was indicated that only 27% of the respondents had running loans with lenders whilst 73% of the respondents did not have any. About 50% of the companies did not apply for lines of credit because they had sufficient capital whilst 20% apiece mentioned the following; application procedures were complex, interest rates were not favourable, collateral requirements were too high and others did not think it would be approved. However, respondents who applied for loans borrowed funds amounting to US$900 000 and all of their loans were granted by private commercial banks. According to the information from respondents, loans which required collateral of land and buildings under ownership of the establishment were 75% and those which required machinery and equipment including movables as collateral were 25%. The range of interest on the borrowed funds was 10-16% with an average of about 13% and the repayment period for these funds was 12months. According to the respondents, only 25% of the financial institutes always provided the funds requested, the other 25% not always provided, whilst the remaining 50% did not provide funds at all.

All of the establishments were not operating at full capacity and, they needed about US$3.1 million to reach to their full capacityaccording to the information given. About 81% of their customers required credit facilities whilst the rest did not.

4.3.6.2 Financial risks, Norms and practices

About 67% of the respondents had their financial statements checked and certified by an external auditor. It is to a greater extent that access to finance for the current operations of this company was viewed as a moderate obstacle which reached to 25% whilst the other obstacles apiece reached to 19% which included minor obstacles, major obstacle, severe obstacle and no obstacle.

A number of impediments to access finance were highlighted which included lack of collateral and depressed demand-repayment would be difficult. Other comments also sited liquidity challenges and unavailability of market.

4.3.7 Dimension 7: Business and Socio-economic context

4.3.7.1 Business environment

The major and severe obstacles in the business environment as mentioned by the respondents were political instability, corruption, labour regulations and health issues, practices of competitors in the informal sector and tax rates and administration (see Table 39 below). The moderate obstacles included licensing and permits, crime, theft and disorder and inadequately educated workforce

Table 39: Impact of business operating environment on the operation within the sub-sector

	No Obstacle	Minor Obstacle	Moderate Obstacle	Major Obstacle	Severe Obstacle
1. Tax Rates	6%	22%	33%	6%	11%
2. Tax Administration	11%	11%	39%	17%	17%
3. Licensing and permits	22%	28%	28%	6%	11%
4. Political Instability	11%	0	33%	17%	39%
5. Corruption	11%	17%	28%	17%	28%
6. Courts	50%	22%	11%	0	0
7. Crime, theft and disorder	17%	44%	17%	6%	6%
8. Customs and trade regulations	28%	6%	22%	6%	6%
9. Inadequately educated workforce	44%	22%	11%	11%	6%
10. Labour regulations & health issues	17%	11%	22%	39%	0
11. Practices of competitors in the informal sector	6%	0	33%	17%	22%
12. Other (Please Specify)	0	0	0	6%	0
13. Other (Please Specify)	0	0	0	0	0

The analysis purport that 80% of the respondents were inspected by tax officials thrice times last year. About 44% of the firms secured government contracts.

4.3.7.2 Social and cultural context

In one typical company results show that, the total number of permanent employees was 78 of which 44% (34) were skilled; 19% (15) were semiskilled and 37% (29) were unskilled. In 2013, 34 contract workers of which 6 (18%) apiece were skilled and semi-skilled and 22 (65%) were unskilled. The longest contract spanned four months. Female employees constituted 9% (7) of the permanent employees and also 9% (3) of the contract personnel. About 71% of the respondents said that most employees had at least ordinary level qualification, whilst 24% and 6% had diplomas and degrees respectively.As part of skills development, 42% of the respondents had formal training programs for its employees. Results show that 53% of the respondents carried out pre-employment health checks for new employees. An average of about US$6000 was spent in 2012 on HIV awareness and prevention programs. About 83% used HIV prevention messages whilst 61% and 28% used free condom distribution and anonymous HIV testing respectively.

4.3.8 Summary of key findings and issues in Level 4

The major findings were as follows

- Very low capacity utilisation and decline in capacity utilisation due to working capital constraints, high costs of doing business, and power and water shortages.
- Inferior technologies not competitive on the regional and international playing field
- Low levels of collaboration between industry and national research and development institutions
- Little relevance of local research and development to industrial needs
- Insignificant export market share for products
- Major obstacles to export market growth were lack of foreign demand for products, insufficient production capacity to expand exports and high costs of transport
- Poor compliance with international standards
- Low levels of engagement with relevant stakeholders
- Power outages were a major constraint
- Poor compliance to environmental laws
- Tax rates and administration, corruption, political instability and labour regulations and health issues seen as major obstacles in the business environment.
- Gender imbalance

4.3.9 Discussion: The significance of the Level 4 (Metal Fabrication) to the Zimbabwean context

The discussion in this section is based on key informant interviews, focus group discussions during field surveys and desk reviews during the course of the value chain study. Useful insights on desk review also came from country documents such as ZimStat, UNCOMTRADE Statistics as well as value chain studies from other regional and international players like China, India, the EU and South Africa.

Key actors on the domestic marketincluded heavy engineering companies such as ZECO, Cochrane Engineering, Metal Components Manufacturers, ABJ Engineering, PM Manufacturing, NRZ, Steel makers, Zimbabwe Spring Steel, Lancashire Steel, CAFCA, Haggie Rand, Mike Apple, Precision Grinders, WARRAP Engineering, KSK Engineering, Essar Tube and Towers, DM Cartwright, Oliken Engineering, etc.The integrated iron and steel making plant at ZISCO provided a wide range of long and flat products used by most of these fabricating workshops. The demise of ZISCO led to the importation of the bulk of the inputs and hence threatening the viability of this sub-sector of the value chain. The gap left by ZISCO has been filled by imports

mainly from South Africa, China and India. Several small to medium scale players are also involved in the fabrication of several components for downstream needs.

4.3.9.1 Background of the capital goods industry in Zimbabwe

The equipment manufacture and assembly industry dates back to the UDI period in the then Rhodesia, during the period of sanctions which forced the country to implore import substitution measures to abate the effects of the punitive measures. The development of this industry was in tandem with the upgrading of the integrated iron and steel making at Redcliff. The different subsectors operating in the country are listed in Table 40 below.

Table 40: Classification of capital goods in Level 5 in the Zimbabwean context

Metal fabrication products	Products in the category
Structural Steel products	Sections, angles, frames
Building materials	Roofing sheets, plumbing materials, flanges, valves, etc., window sections, door frames, panels, etc.
Welded tubes and pipes	Pipes, tubes, etc.
Welded and seamless pressure vessels and tanks	Boilers, tanks, reactors, etc.
Wire and rod products	Fences, deformed bars, rods, etc.
Coated plates and sheets	Stainless steel products, galvanised steels, electroplated steels, etc.
General purpose tools and components	Machining tools, workshop tools, gearboxes, shafts, bolts, etc.
Packaging materials	Containers, drawers, etc.

As noted from desk study, export (US$6.7billion) in this sector compared to imports (US$1.9billion) for the period 2008 to 2012 (Tables 41 and 42). Thus exported metals and metal products were 3.5 times more than the important ones which could either be positive or negative depending on the way one perceives different scenarios.

Table 41: Exported metals and metals products (million US$) by rank (Source: UNCOMTRADE Statistics)

Code	Product label	2008	2009	2010	2011	2012	Totals
'71	Pearls, precious stones, metals, coins, etc.	23.5	129.6	623.4	671.9	1436.3	**2884.7**
'75	Nickel and articles thereof	166.3	266.3	454.5	534	357.3	**1778.4**
'26	Ores, slag and ash	137.3	181.2	310.1	366.3	368.7	**1363.6**
'72	Iron and steel	61.4	43.7	204.6	117.5	134.2	**561.4**
'73	Articles of iron or steel	10.8	16.6	7.7	9.3	10.1	**54.5**
'74	Copper and articles thereof	0.68	8.1	10.8	7.4	15.5	**42.48**
'82	Tools, implements, cutlery, etc. of base metal	9.1	5.1	1.5	1.4	1.5	**18.6**
'76	Aluminium and articles thereof	1.3	3	0.94	3	3.5	**11.74**
'83	Miscellaneous articles of base metal	8.8	0.14	0.13	0.37	0.66	**10.1**
'81	Other base metals, cermets, articles thereof	0.001	0.007	0	0.004	0.143	**0.155**
'79	Zinc and articles thereof	0.02	0.13	0	0	0.005	**0.155**
'80	Tin and articles thereof	0	0	0	0.006	0.003	**0.009**
'78	Lead and articles thereof	0	0	0	0	0	**0**
Totals		**419.201**	**653.877**	**1613.67**	**1711.18**	**2327.91**	**6725.839**

The figures presented in Table 41 and 42 show that the precious metals, nickel and ores dominated the exports by value, which imply that raw materials which are not value added dominated the exports. The gap left by the closure of ZISCO is clearly seen as there is significant amount spent on imported iron and steel products.

Table 42: Imported metals and metal products (million US$) by rank (Source: UNCOMTRADE Statistics)

Product label	2008	2009	2010	2011	2012	Totals
Articles of iron or steel	91.6	110	112.1	134.1	147.6	**595.4**
Nickel and articles thereof	108	138.7	150.7	125.6	33	**556**
Iron and steel	38	62.9	86.4	127.8	129.2	**444.3**
Tools, implements, cutlery, etc. of base metal	17.4	14	19.6	24.1	23.7	**98.8**
Aluminium and articles thereof	4.7	10	16.8	20.2	20.4	**72.1**
Miscellaneous articles of base metal	5	8.4	15.4	18.1	17.3	**64.2**
Copper and articles thereof	3.2	6.1	11.5	22.6	16.1	**59.5**
Ores, slag and ash	7.9	13.1	1.8	1.2	0.66	**24.66**
Lead and articles thereof	0.3	1.7	3.2	0.7	0.9	**6.8**
Zinc and articles thereof	0.53	0.48	1.2	1.1	0.5	**3.81**
Other base metals, cermets, articles thereof	0.39	0.16	0.05	0.08	0.2	**0.88**
Tin and articles thereof	0.08	0.12	0.37	0.14	0.1	**0.81**
Totals	**2285.1**	**2374.66**	**2429.12**	**2486.72**	**2401.66**	**1927.26**

4.3.9.2 Metal Fabrication Value Chain Map

The structure of the value chain map for Level 4 is summarised in Figure 68 below. The inputs are taken from the iron and steel making industries, base metal refiners, scrap dealers, foundries and imports mainly from South Africa, India and China. After ZISCO ceased operations, most of the steel is coming through distributors like Africa Steel, BSI Steel and J Mann amongst others. Therefore the cost of inputs was pushing the products of fabricated components up due to transportation and import tariff cost. Most fabricators were therefore either closed or operated at very low levels of capacity utilisation (33%) due to competition from imports mainly coming through distributors and agents.

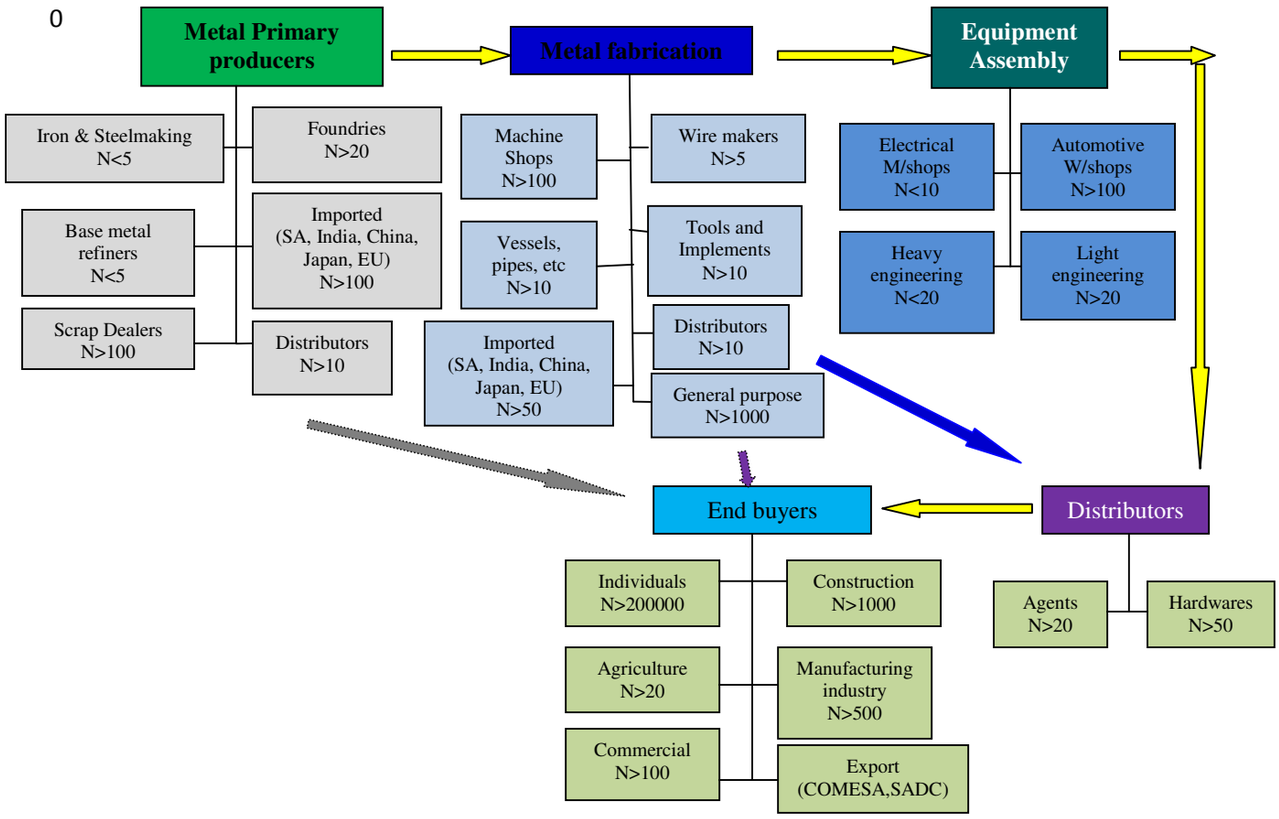


Figure 68: Structure of Level 4 value chain in Zimbabwe (Source: SIRDC Analysis, 2014)

As Level 4 has many actors, with the major actors employing over a 100 people each at full capacity, the resuscitation of the sector create significant employment opportunities. Small to medium scale players are also significant in the metal fabrication subsector, numbering over a 1000. However, most of them are informal and their operations do not adhere to standards that make them competitive. Strategic restructuring with the help of government and financial institutions at policy level could be key to improve operations of this subsector.

4.3.9.3 Concluding remarks

The conventional Level 4 actor has struggled to compete on the regional and international market and there is need for radical changes in approach to competitiveness. Current global competitiveness in the subsector is technology based. Zimbabwe at policy level has to ensure that competitive technologies are adopted for the industry to survive. The informal sector must also be regularised and structured in a sustainable manner. This sector could become a success story considering the flexibility of manufacturing, quick response to customer needs and minimal overheads. Apart from the resuscitation of ZISCO, new smaller scale iron and steel making

plants can be established to spread the risk in case of collapse of the giants. Whilst the general trend favours giant integrated plants which benefit from the economies of scale, Zimbabwe can take a leaf from the fairly successful small scale plants in India. It also requires innovation and collaboration of industry and research and development in coming up with niche products of high demand on the regional and international market.

4.4 LEVEL 5 (Machine/Equipment Building & Assembly) VALUE CHAIN ANALYSIS

The machine/equipment building and assembling stage involves several actors in the light and heavy engineering goods subsectors. The light engineering goods sector includes agricultural, medical and food processing equipment/machine manufacturers and assemblers. The heavy engineering goods sub-sector is involved in the manufacture and assembly of heavy duty equipment for mining, infrastructural development including power generation and rail, and automotive industry for the assembly of vehicles amongst others. This stage is typified by engineering processes like automated assembly lines using advanced technologies in material handling, welding, machining and painting amongst others. This level takes inputs from Level 3 (metal forming) and 4 (metal fabrication) which include steel plates of different grades and thicknesses, angle irons, channel irons, castings, electricity, water, storage and transport facilities for conversion to finished assembled machinery or equipment like passenger vehicles, tractors, ploughs, conveyor systems, etc. Out of 10visited players in Level 5, 4 (40%) were not active and all of the active players responded. In the light engineering sector, field data was collected from one typical actor based in Harare as a case study. The actors in Level 5 were distributed around Zimbabwe and located mainly in Harare, Mutare, Kwekwe, and Bulawayo. The diagnostic dimension approach was used to analyse the indicative results from the thus far collected data using the excel software package. Key informant interviews done in this sector survey included the Engineering Council of Zimbabwe (ECZ), the Engineering Iron and Steel Association of Zimbabwe (EISAZ) chief executive officer and a focus group discussion with the Industrial Development Corporation (IDC) team of managers as well as the CEO.

4.4.1 Dimension 1: Sources of Inputs and Supplies

4.4.1.1 Characteristics of inputs, supplies and nature of suppliers

The inputs noted in the study were mild steel plates, angle irons, channel irons, castings, electricity, water, storage facilities and transport facilities. The analysis showed that all the investigated actors received 20 – 87% of their inputs locally (37% average), whilst 13 – 80% are being imported (18.25% average). Of those who imported, they sourced 28.75% of their inputs from SADC and 43.75% from Asia. About 50% of the respondents imported their inputs directly whilst the other half used agents for importation. The lead time for clearance of the inputs ranged from 1 to 90 days (average of 24 days).The analysis also showed that 100% of the respondents required storage and transport facilities for their inputs. 50% of the respondents said their raw materials can be substituted local if the Zimbabwean iron making industry and other chemicals industries are fully operational.

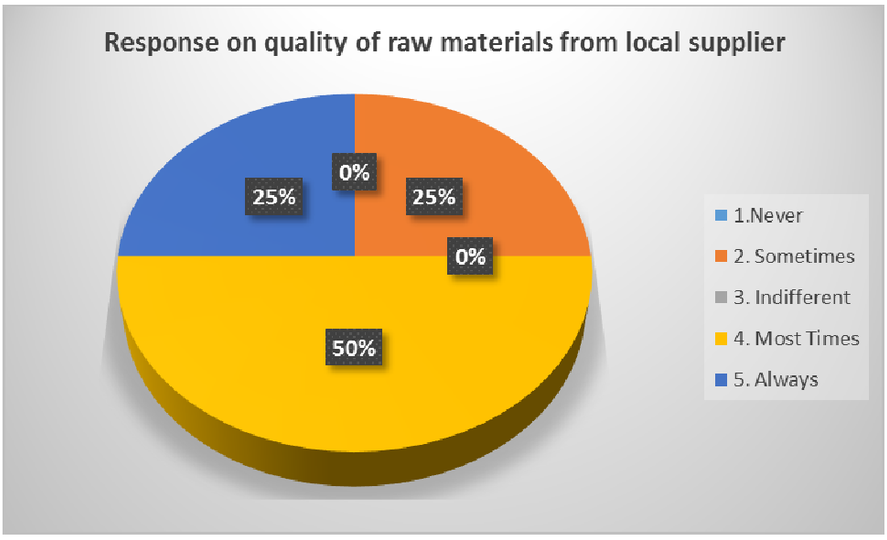


Figure 69: Consistency of quality from local suppliers

There was an even distribution of responses on the quality of inputs from local suppliers with 25%, 50% and 25% saying it was always good, most times, and sometimes respectively (Figure 69).The responses also show that the quality of locally sourced inputs was generally high.

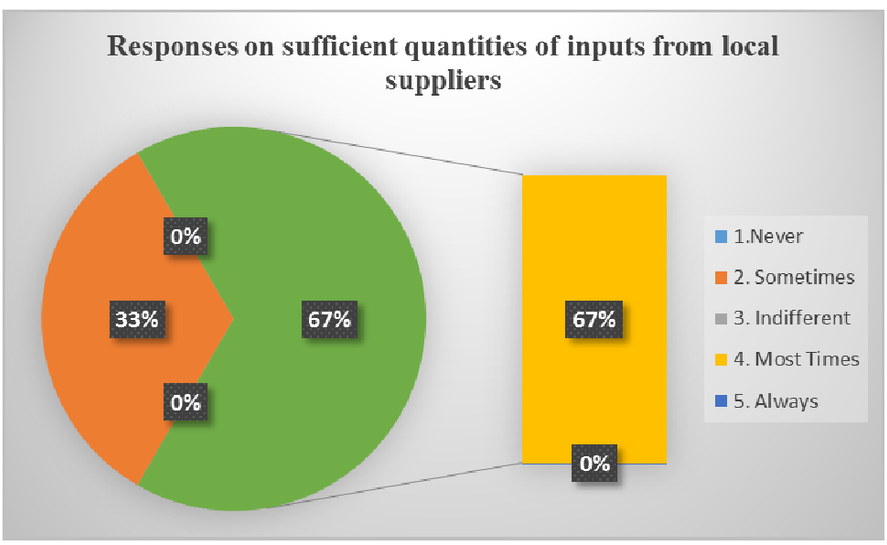


Figure 70: Sufficiency of quantities of inputs from local suppliers

From the responses of the survey, 67% said the quantities of inputs were most times sufficient from the local suppliers whilst 33% said sometimes. (Figure 70). This implies that the reliability of local suppliers in delivering the expected quantities was generally good.

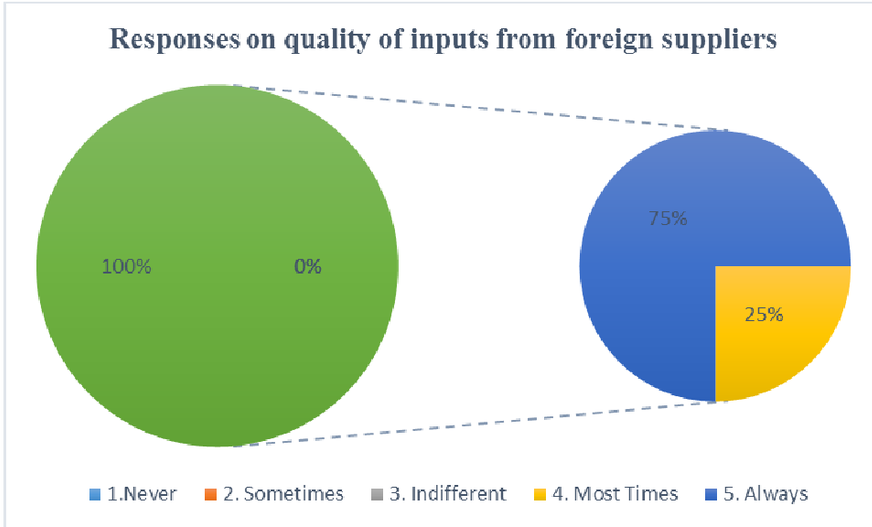
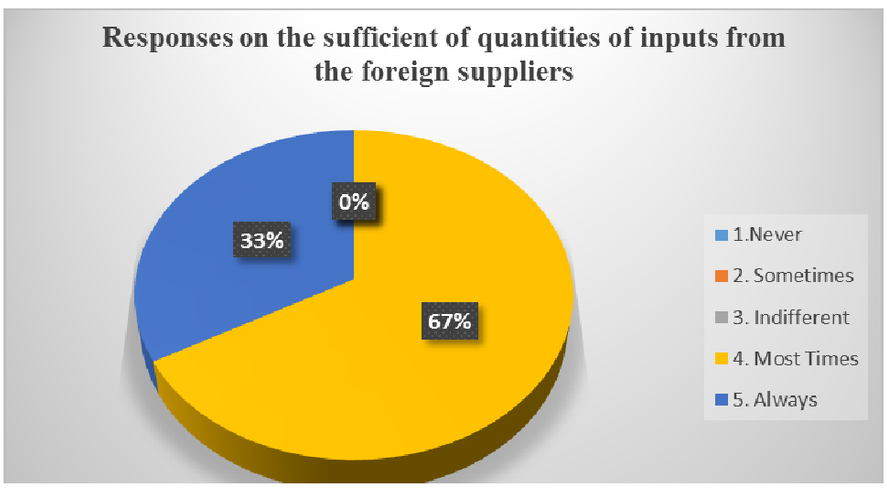


Figure 71: Consistency of quality of inputs from foreign suppliers

Figure 71 above shows that, of the responses on the quality of inputs from foreign suppliers, 75% said the quality was good most of the times whilst 25% said it was always. It generally implies that the quality of foreign sources inputs was generally high.



working capital constraints and lack of raw materials. The other reasons cited are presented inTable 43.

Table 43: Reasons for decline in capacity utilisation

Reason for Decline of Capacity Utilisation	Responses
1. Low Local Demand	100%
2. Lack of raw materials	50%
3. Working Capital Constraints	100%
4. Antiquated Machinery & Breakdowns	50%
5. Power & Water Shortages	50%
6. High Cost of Doing Business	25%
7. Competition from Imports	100%
8.Drawbacks from the Current Economic Environment	75%
9.Other (Please Specify)	0%

The major reasons for the decline in capacity utilisation were low local demand, working capital constraints, and competition from imports and drawbacks from the current economic environment. In 2012, 50% said that they managed to reduce their operating costs through process improvements, material and design changes. 33.3% said they managed to incorporate new manufacturing approaches to their operations.

The average cost of replacing machinery was about USD 100 million. 75% of the respondents said that their production facilities were not adequately equipped with plant and equipment for production. They cited lack of capital for investment in modern technologies as the main reason for the insufficiency. None of the respondents replaced machinery and equipment in the last three years. About 50% of the respondents used manual whilst 50% used semi-automatic technologies. None of the respondents used automatic technologies. 25% of the respondents said their technologies were below 50% in effectiveness and 50% of the respondents said that the technologies they used were between 50 and 75% effective whilst 25% said that theirs were above 75%.

Table 44: Comparison of technologies used with best practices

Region	Score/10	Level of competitiveness
1. Local	5.25	Marginally competitive
2. Low Income Africa	4.75	Not competitive
3. Medium Income Africa	3.50	Not competitive
4.High Income Africa	3.75	Not competitive
5.International	2.25	Not competitive

Key: Very competitive (9 – 10); Competitive (7 – 8); marginally competitive (5-6); not competitive (<5)

From the responses presented in Table 44, the technologies used in Level 5 (automobile) were marginally competitive locally were not at all competitive regionally and internationally. The poor competitiveness of technologies used as compared to medium income to international best

practice is of great concern considering that the critical markets that come with economies of scale are either in medium income Africa (e.g. South Africa) and the international market. Opportunities for upgrading lay in full automation and upgrades as sited by respondents. 100% of the respondents used CAD computer systems. 75% of the respondents said that they faced challenges in maintaining and upgrading their equipment. The major challenge sited was capital constraints.

4.4.2.2 Knowledge Use

The respondents indicated that the tertiary education system was strongly aligned to industry requirements as 67%, and 33% said that the tertiary education was moderate suitable and suitable to industry requirements respectively (see Figure 74).

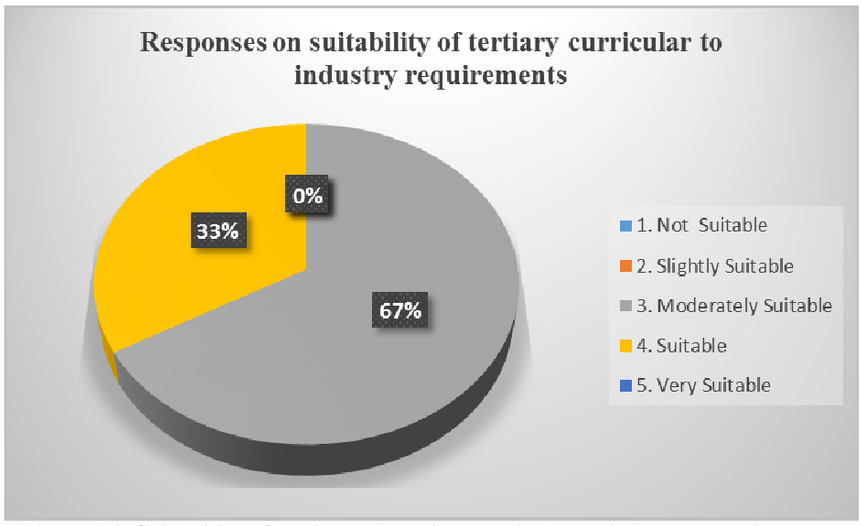


Figure 74: Suitability of tertiary education curricular to industry requirements

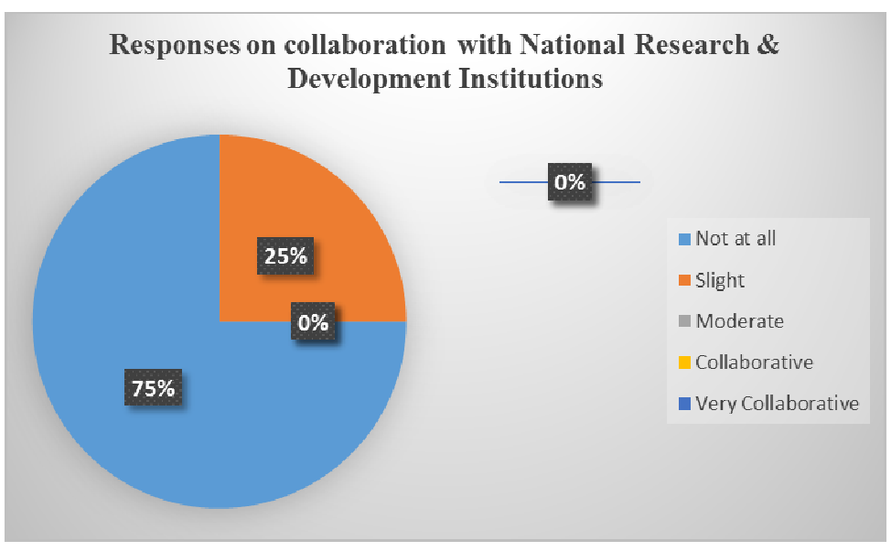


Figure 75: Level of collaboration with National Research and Development Institutions

There exist very low levels of collaboration between the industry and national research and development institutions as evidenced by the fact that 75% and 25% of the respondents said that there was none and slight of such collaborations respectively (see Figure 75). Figure 76below shows that the respondents indicated low relevance of local research and development for operation improvement. 50% said that the relevance of local research and development institutions was poor whilst 50% said it was effective.

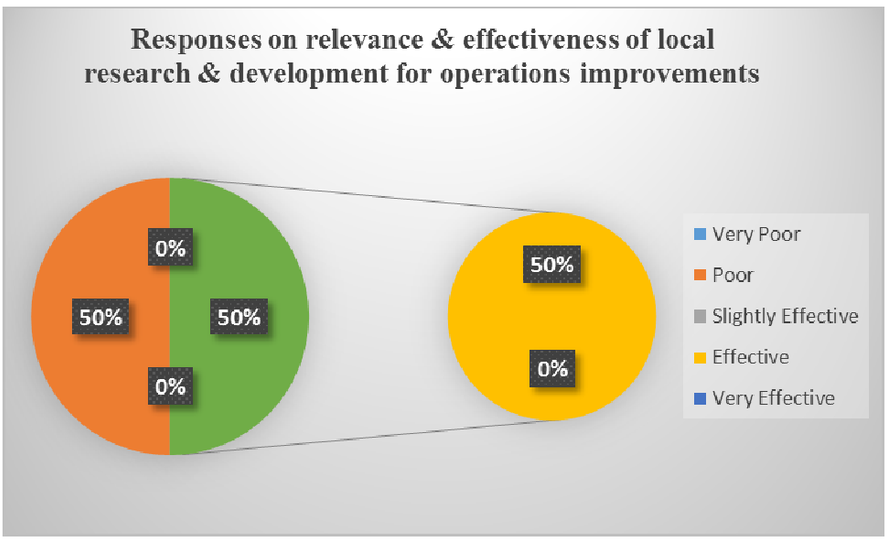


Figure 76: Relevance and effectiveness of local research & development for operations improvement

4.4.3 Dimension 3: End markets and Trade

4.4.3.1 End products characteristics

The analysis revealed that the end products sited of semi-processed products, machinery and equipment as well as truck and bus products are equally distributed. Spares and parts, motor vehicles and buses contributed the largest proportion to annual sales. Of the respondents, 25% revealed that their main product represented above 75% of their total sales whilst 50% of the population said that the main product represented between 50 and 75% of the total sales.

4.4.3.2 Consumer Demand

According to the field data analysis, 75% of respondents indicated a strong demand for their products. Despite the high demand for the products, uptake is being hampered by the high prices charged. According to respondents, expensive raw materials and high production costs contribute negatively to the price of their products.

4.4.3.3 Marketing, trade capacities and standards

According to respondents annual volumes generated ranged between 6 and 18tonnes, generating annual revenues of between US$53,600 and US$783,000 for the period between 2011 and 2013. Of all sales conducted, 97% were identified as being local sales, with the difference of 3% being attributed to direct exports. The direct export of products started in 1980. According to all

respondents, clearance of products from point of exit at customs was typically 1 day and the customs officials did not solicit for a bribe during the process of exporting goods.

Table 45: Obstacles to growth of export market

Obstacles	Responses
1.Lack of foreign demand for its products	50%
2.High costs of transport	0%
3.Red tape in customs	0%
4.Insufficient production capacity to expand exports	50%
5.Lack of financing mechanisms to sell abroad	75%
6.Non-price restrictions on foreign markets	0
7.Lack of knowledge of foreign markets	25%
8.Any other Specify _____	%

The main obstacle to growth of the export market was found to be lack of financing mechanisms to sell abroad. Insufficient production capacity to expand exports and lack of foreign demand for products were cited as obstacles to export growth by 50% of the respondents (Table 45). About 25% of the respondents said lack of knowledge of foreign markets contributed to the negative growth of export market.

Of the respondents, 33.3% export more than 75% of their products within the SADC region whilst the other 66.7% export less than 50% of their products within the SADC market. This shows the evidence of a viable local market as 100% of respondents said that their main products are sold in the domestic local market. Competition on the main market was said to be very intense by 75% of the respondents, with the other 25% citing it as moderately intense. This implies that competition on the market is quite stiff. 75% of the actors said unregistered or informal companies offer competition to the marketing of their products. However, the practices of such informal actors posed minor obstacles to the operations of the formal companies. Dedicated marketing teams exist in 50% of the respondents' firms. Existence and/or expansion of dedicated marketing teams are essential for penetration into the global market.

75% of the respondents were found to be non-compliant with local and international standards. The remaining 25% said to be compliant with both local and international standards that are manufacturer specified. None of the interviewed companies are accredited with international standards that enable them to export their products. Accreditation and compliance to international standards has become one of the key competitive advantages on the market. The standards relevant to the sector include ISO 14000 Environmental Management Standards, ISO 9001 Quality Management and Assurance of the production process and SAZ Quality standards.

4.4.4 Dimension 4: Value Chain Governance

4.4.4.1 Actor domination

The analysis revealed that the legal status (ownership) of the companies which responded was 50% of respondents to shareholding with non-traded shares or shares traded privately, 25% to sole proprietorship and the remaining 25% of the respondents to limited partnership. In all cases the shareholding structure was reported as 100% private with the largest shareholder owning up to 97% of the shares. In 33.3% of the firms that responded, there were female shareholders and all the firms indicated to the non-existence of subsidiaries outside Zimbabwe.

Table 46: Core competencies that making the actor stand out in the value chain

Core competence	Response rate
1. Market dependence	50%
2. Sales concentration	0
3. Knowledge asymmetry	25%
4. Price setting ability	25%
5. Product/service specificity	75%
6. Strategic Management Plans	0
7. Other	0

The respondents revealed that product/service specificity and market dependence at 75% and 50% response rate respectively, were the key competences in the value chain (see Table 46 above). Other core competencies were knowledge asymmetry and price setting ability at 25% apiece. Strategic management and sales concentration were found to have no contribution as core competencies. All companies interviewed began business between the year 1957 and 1986.

4.4.4.2 Participation in and distribution in the value chain

Of the companies interviewed, 25% said that they engage stakeholders on a monthly basis to discuss their sustainability strategies, disclosure and performance.According to the analysis, 25% of the respondents publicly disclose their environmental policies, programs, and performance eitheronline or in a sustainability report. The programs indicated were to ensure compliance with EMA and city council regulations. 25% of the respondents said they source input from stakeholders on business and operational strategies via seminars and workshops with clients. However, none of the companies interviewed said that they publicly disclosed results of their stakeholder engagement.

4.4.5 Dimension 5: Sustainable production and energy use

4.4.5.1 Use of materials, energy and water

The use of material, energy and water based on the field data analyses, 50% of the respondents said that they kept inventories of all chemical substances used, stored, processed, and manufactured and 25% had programs and/or procedures to reduce the use of resources, and promote sustainable natural resource practices. All the respondents used electricity, whilst 25%

used gas and 50% had generators. About 25% of the respondents applied for a power demand upgrade between 2011 and 2013. All the respondents experienced power outages of varying magnitude between 2011 and 2013. 25% had no outages, 50% experienced moderate outages, 25% major outages and none experienced severe outages. The average power outages per month were 3, 3 and 6 for the year 2011, 2012 and 2013 respectively. The average length of the power outage was 1.8, 1.8 and 4.2 hours per day for 2011, 2012 and 2013 respectively. 50% of the firms indicated that they own a generator whose average size was 10KVA. The field data analysis shows that power availability was a major constraint to the value chain actors which negatively impacts on their production capacity and production costs.

In the production section Level 2, water is a key resource where it is mainly used in the processes and for cooling purposes. 100% of the respondents used local municipality supplies as their major source. 75% of the respondents experienced no water outage whilst 25% experienced minor outages.

4.4.5.2 Emissions

Table 47 below shows the responses on ownership of licenses and permits for emissions. The analysis shows that 50% apiece of the respondents owned a license for air emissions, storage or use of hazardous substances and waste issues and 100% hold wastewater management licence. 25% respondents said that they monitored energy consumption and regularly tested their air emissions (mainly carbon monoxide). None of the respondents said they owned pollution prevention devices. 25% of the respondents also said that they set targets for air emissions reduction.

Table47: Ownership of necessary license and permits for environmental management

Emission license type	Response rate
1. Air emissions	50%
2. Storage or use of hazardous substances	50%
3. Wastewater management	100%
4. Waste issues	50%

The analysis of respondents presented in Table 48 below reveals that 100% of the respondents have been fined, prosecuted or warned by regulators in relation to preventing wastewater management. This is consistent with the fact that only 75% did not have an EMS in place.

Table 48: Fines, prosecution, or warnings by regulators

Emission type	Response rate
1. Air emissions	0%
2. Storage or use of hazardous substances	0%
3. Preventing soil & groundwater	0%
4. contamination	0%
5. Wastewater management	100%
6. Waste issues	0%

4.4.5.3 Waste Management

About 25% of the respondents said that they were in compliance with applicable environmental laws and regulations and had an up to date Environmental Management System / certification in place. 75% have programs and procedures to reduce pollution but they are not certified. Approximately 25% of the respondents said that their employees were trained in environmental matters and 75% confirmed that environmental policies, practices and expectations were communicated to all employees and suppliers in all languages. All the respondents said that they had programs and/or procedures to reduce or eliminate waste in its operations.

Table 49: Programs and/or proceduresto manage disposal of waste

Waste type	Response rate
1. Air borne emissions	50%
2. Hazardous waste	50%
3. Wastewater	100%
4. Solid waste	50%

Table 49 above shows that 50% apiece of respondents had programs in place for airborne emissions, hazardous waste and solid waste disposal. All respondents had programs for wastewater disposal in place.

Table 50: Maintenance of records of waste disposal

Waste Disposal type	Response rate
1. Off-site transfer	50%
2. Treatment	50%
3. Disposal of waste.	100%

Table 50 presented above shows that all respondents maintained records for waste disposal while 50% apiece had records for off-site transfer and waste treatment. It was generally noted that the compliance rate as far as environmental issues are concerned was moderate. This was attributable to the fact that this sector of the value chain is controlled by MNCs governed by global standards. The percentage that did not usually comply was as a result of local actors who are normally faced by several challenges in associated with the state of the economy.

4.4.6 Dimension 6: Value Chain Finance

This section was sensitive, some of the respondents did not fill it in due to the confidential information it contained.

4.4.6.1 Availability of finance

From the analysis of the survey, the annual operational requirements in the automobile industry had an average of US$30.8 million.The average annual capital requirement was about US$100 million. The respondents indicated that they did not use borrowed funds for capitalisation; they relied on their own internal resources. They highlighted that capital requirements are financed 50% by shareholders and 50% from within the company. Most companies have not applied for

lines of credit, 75% indicated they had sufficient capital whilst 25% indicated they did not think it would be approved.

4.4.6.2 Financial risks, norms and practices

All the respondents had their financials regularly checked by an external auditor. A number of impediments to access finance were highlighted and these included lack of collateral security, lack of demand for the product and interest rates not favourable.

4.4.7 Dimension 7: Business and Socio-economic context

4.4.7.1 Business environment

The major and severe obstacles in the business environment as mentioned by the respondents were tax rates; tax administration and corruption (see Table 51 below). The moderate obstacles included practices of competitors in the informal sector and labour regulations & health issues.

Table 51: Impact of business operating environment on the operation within the sub-sector

	No Obstacle	Minor Obstacle	Moderate Obstacle	Major Obstacle	Severe Obstacle
1. Tax Rates	0	50%	25%	25%	0
2. Tax Administration	0	25%	25%	50%	0
3. Licensing and permits	0	75%	25%	0	0
4. Political Instability	0	75%	0	0	0
5. Corruption	0	75%	0	25%	0
6. Courts	0	100%	0	0	0
7. Crime, theft and disorder	0	75%	25%	0	0
8. Customs and trade regulations	25%	100%	0	0	0
9. Inadequately educated workforce	25%	75%	0	0	0
10. Labour regulations & health issues	0	50%	50%	0	0
11. Practices of competitors in the informal sector	0	25%	75%	0	0
12. Other (Please Specify)	0	0	0	0	0
13. Other (Please Specify)	0	0	0	0	0

The analysis purport that 75% of the respondents were inspected by tax officials twice times last year. For companies that sought an import license over the last two years, the lead time to processing took about 9 days.The automobile industry is represented by associations such as the Motor Trade Association of Zimbabwe (MTAZ), Automobile Component Manufacturers Association of Zimbabwe (ACMAZ – a division of MTAZ), Motor Industry Development Council (MIDC) – formed at the Kadoma strategic conference in December 1999 to create a development policy for the industry and to monitor progress and Motor Industry Employers'

Association of Zimbabwe (MIEAZ) (Saungweme, 2011). The key challenges in the sector have been noted in the previous section.

4.4.7.2 Social and cultural context

In one typical company results show that, the total number of permanent employees was 46 of which 72% (33) were skilled; 24% (11) were semiskilled and 4% (2) were unskilled. In 2013, 40 contract workers were employed with the longest contract spanning four months. Female employees constituted 7.5% (3) of the skilled contract personnel. 75% of the respondents said that most employees had at least ordinary level qualification.As part of skills development, 75% of the respondents had formal training programs for its employees. Results show that 75% of the respondents carried out pre-employment health checks for new employees.

4.4.8 Summary of key findings and issues in Level 5

The major findings were as follows

- High dependence on imports of raw material inputs due to the closure of the iron making industry in Zimbabwe and key actors in the preceding levels of the engineering and metals value chain
- Very low capacity utilisation and decline in capacity utilisation due to low local demand, working capital constraints, lack of raw materials, antiquated machinery, competition from imports and power and water shortages.
- Inferior technologies not competitive on the local, regional and international playing field
- Low levels of collaboration between industry and national research and development institutions
- Little relevance of local research and development to industrial needs
- Insignificant export market share for products
- Major obstacles to export market growth were lack of financing mechanisms to sell abroad, lack of foreign demand for products, insufficient production capacity to expand exports and lack of knowledge of foreign markets
- Non-compliance with international standards
- Low levels of engagement with relevant stakeholders
- Power outages were a major constraint
- Poor compliance to environmental laws
- Capital intensive sector

- Tax rates and administration, corruption, practices of competitors in the informal sector, labour regulations and health issues and licensing and permits seen as major obstacles in the business environment.

- Gender imbalance

- The significantly high cost of local vehicles beyond the reach of consumers
- Low cost second hand vehicles from Japan, UK and China are within the reach of local consumers

4.4.9 Discussion: The significance of the Level 5 (Equipment & Machine manufacturers) to the Zimbabwean context

The discussion in this section is based on key informant interviews, focus group discussions during field surveys and desk reviews during the course of the value chain study. Useful insights on desk review also came from Zimtrade documents (Saungweme, 2011) and value chain studies from other regional and international players like China, India, the EU and South Africa.

Key actors on the domestic marketincluded heavy engineering companies such as ZECO, Cochrane Engineering, Metal Components Manufacturers, ABJ Engineering, PM Manufacturing, Powerspeed electrical, Willowvale Mazda Motor Industries, ZENT, Load Engineering, Quest Motors, Deven Engineering, Morewear industries, ZISCO, NRZ, etc. The collapse of some of these companies led to the collapse of the others in a ripple effect relationship. The integrated iron and steel making plant at ZISCO provided a wide range of long and flat products used in machine building and machine shops. As a result, the demise of ZISCO led to the importation of the bulk of the inputs and hence affecting the viability of the domestic engineering goods value chain. It must be noted however that historically, Zimbabwe has never been a dominant regional player in the production of capital goods. Several small to medium scale players are also involved in the light engineering capital goods sector, with small workshops located within industrial and residential areas.

The National Railways of Zimbabwe has been the missing link on both inbound and outbound logistics. The slowdown of activity at NRZ has badly affected most engineering companies. Haulage trucking has become the major source of distribution of engineering inputs and supplies. This has made logistics allegedly three times more expensive and ultimatelycontributed to the low competitiveness of the end products on the market.

4.4.9.1 Background of the capital goods industry in Zimbabwe

The equipment manufacture and assembly industry dates back to the UDI period in the then Rhodesia, during the period of sanctions which forced the country to implore import substitution measures to abate the effects of the punitive measures. The development of this industry was in tandem with the upgrading of the integrated iron and steel making at Redcliff. The different subsectors operating in the country are listed in Table 52 below.

Table 52: Classification of capital goods in Level 5 in the Zimbabwean context

Engineering Capital goods	Products in the category
Automotive goods and vehicles	Light vehicles, Heavy vehicles, trailers, etc.

Agricultural machinery, equipment and parts thereof	Power machines and hand implements
Mining machinery and equipment	Ball mills, crushers, conveyers, Pumps, LHD, etc.), Hoisting equipment
Factory machinery and equipment	Cutters, refrigeration plants, compressors, tanks, boilers, conveyors, etc.
Electrical machinery and equipment	Electric motors and generators, transformers, switchgears, etc.
Workshop machinery and tools	Lathes, CNCs, cutting tools, spanners, jacks, etc.
Construction equipment, tools and materials	Loaders, Frameworks, etc.
Fabricated structural metal products	reinforcement wire and steels, scaffolding, windows and door frames, sections, roofing sheets
Processing equipment	Reactors, pressure vessels, tanks, mixers, pipes, etc.

As noted from key informant interviews and field data analysis, there was little export (US$421million) in this sector compared to imports (US$8.6billion) for the period 2008 to 2012 (Tables 53 and 54). Thus imported engineering goods were 20 times more than the exported ones implying a heavy dependence on imported capital goods.

Table 53: Exported engineering goods (million US$) by rank (Source: UNCOMTRADE Statistics)

Code	Product label	2008	2009	2010	2011	2012	Totals
'87	Vehicles other than railway, tramway	87.4	10.8	9.1	9.9	10.5	**127.7**
'85	Electrical, electronic equipment	65	26.4	8.8	12.5	12.1	**124.8**
'84	Machinery, nuclear reactors, boilers, etc.	24.3	43	16.4	21.2	17.3	**122.2**
'88	Aircraft, spacecraft, and parts thereof	2.2	5	6.2	4.5	15.1	**33**
'93	Arms and ammunition, parts and accessories thereof	11.3	0.11	0.02	0.02	0	**11.45**
'86	Railway, tramway locomotives, rolling stock, equipment	0.13	0.17	0.46	0.4	0.05	**1.21**
'91	Clocks and watches and parts thereof	0.01	0.09	0.2	0.03	0	**0.33**
	Totals	**190.34**	**85.57**	**41.18**	**48.55**	**55.05**	**420.69**

The figures presented in Table 53 and 54 show that the demand for vehicles, machinery, nuclear reactors, boilers, etc. and electrical and electronic equipment are on high demand within and outside the country. Competitiveness issues within the capital goods sector must be seriously implored considering the high demand and the increasing trends of importation.

Table 54: Imported engineering goods (million US$) by rank (Source: UNCOMTRADE Statistics)

Product label	2008	2009	2010	2011	2012	Totals
Vehicles other than railway, tramway	445.3	533.7	1079.4	1067.9	1106.9	**4233.2**
Machinery, nuclear reactors, boilers, etc.	299.9	300.8	527.8	581.6	641.7	**2351.8**
Electrical, electronic equipment	146.1	253.7	462.9	411.2	393.5	**1667.4**
Optical, photo, technical, medical, etc. apparatus	26.2	37.2	46.6	63.2	74.8	**248**
Aircraft, spacecraft, and parts thereof	15.7	6.2	4.7	6.3	10.4	**43.3**
Railway, tramway locomotives, rolling stock, equipment	2.1	2	1.8	5.4	3.3	**14.6**
Arms and ammunition, parts and accessories thereof	0.19	1	0.34	0.48	0.48	**2.49**

Ships, boats and other floating structures	0.14	0.45	0.67	0.36	0.62	**2.24**
Totals	**2943.63**	**3144.05**	**4134.21**	**4147.44**	**4243.7**	**8563.03**

4.4.9.2 Capital goods and the automotive industry

The government of Zimbabwe in the mid 80's the Government introduced the "Vertically Intergraded Companies" (VIC) policy for the motor industry based on the assembly plants being totally responsible for vehicle imports as well as the development of local content. This policy ledto the joint venture between Willowvale Motor Industries, Mazda Motor Corporation and Itochu Corporation (Saungweme, 2011). The policy was nullified by the Economic Structural Adjustment Programme (ESAP) in 1991 and the lack of forex resulted in continual shortage of vehicles to meet demand.There has not been any new policy since then resulting in low cost used cars and inferior quality spares imported from the UK, Japan, India, South Africa and consequently killing the domestic industry. High production costs during the economic meltdown worsened the situation, resulting in the precarious state of the domestic automotive industry.

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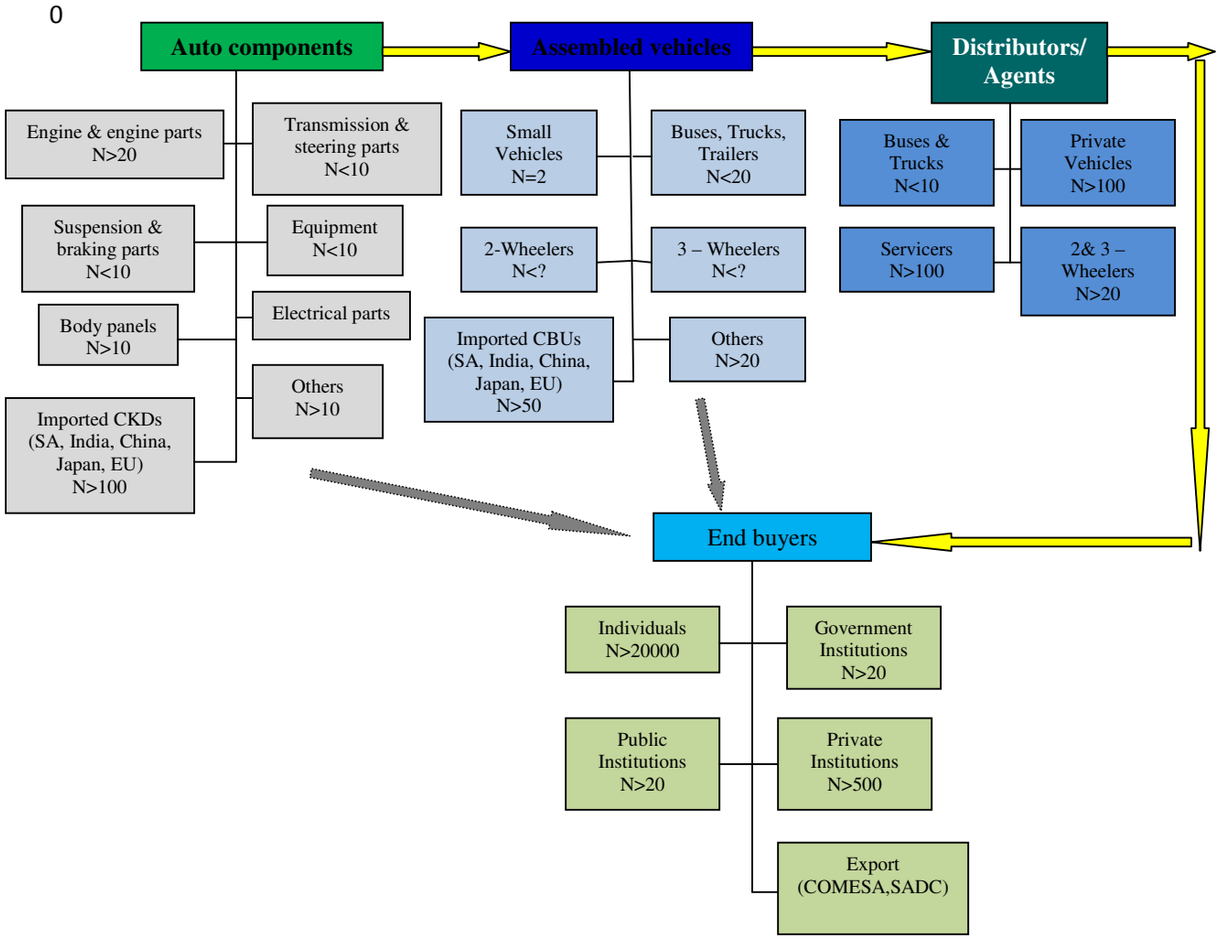

Figure 77: Structure of the automotive value chain in Zimbabwe (Source: SIRDC Analysis, 2014)

Figure 77 shows the automotive value chain map on Zimbabwe. The struggling domestic automotive industry is mainly confined to the assembly of limited car models and the manufacture of motor components such as rubber belts, filters, spark plugs, body parts, rims, tyres, batteries, electrical wiring, bolts, exhausts, plastic bottles for engine coolant and water, glass, seats, brake pads and some other process materials. The main engineering components include disc brake pad material, security devices, gearbox and engine mountings, steering and brake parts, suspension components, head restraints, tubes, brake lining materials, bull bars, upper control arm shafts, bushes, roll bars, vehicle silencers and other exhaust system parts, canopies, running boards, vehicle springs, cargo body linings, seat frames and wheel studs amongst others.

The automotive industry consumes steel, aluminium, chrome and PGM in fabrication and assembly processes. Aluminium finds application in cast and forged products, such as rims, while stainless steels (incorporating chrome) and PGMs are used extensively in various components of the exhaust system, mainly in catalytic converters (Lundall et al., 2008). Most of the manufacturers (and assemblers) of motor vehicles, trailers, parts and other automobile related accessories were located in Harare and Bulawayo (Saungweme, 2011). The Zimtrade report (Saungweme, 2011) indicated that 61% of the actors were located in Harare, 32% in Bulawayo whilst 7% were located in the minor cities. The list of the major actors in the country is presented in Annex 15.

Production capacity

The production capacity of the main vehicle assemblers is estimated to be over 20000 vehicles per year with one actor indicating a capacity of over 8000 vehicles per annum. However capacity utilisation was very low, with the actors operating below 5% capacity utilisation mainly due to suppressed local and export demand as well as operations constraints in the prevailing business environment.

End Markets and Trade

Historically, the effective local demand for new vehicles was 25 000 (1997), of which 18 000 were supplied by the four main assembly plants namely WMMI; Quest; WH Dahmer (now AVM Africa) and Deven Engineering (www.idc.co.zw). The demand for new vehicles has however reported to have contracted over the years to an approximate 6 000 in 2011 due to the effects of the economic crisis as well as the influx of cheap imports. Key informants revealed that the subsector has been grossly affected by the influx of low cost imported second hand CBUs and new CKDs from South Africa, China, Japan, Singapore and the UK.

An average of over USD$1billion dollars in value per annum of imported vehicles entered the Zimbabwean market between 2010 and 2012 (UNCOMTRADE statistics). Also statistics from ZimStat (Compendium of Statistics, 2012) shows that about 200000 vehicles were registered in

Zimbabwe between 2003 and 2010, translating into an annual average of about 25000 new vehicles per annum (Table 55 below). These average figures tally well with historical figures of

Table55: Number of registered vehicles per year (2003 to 2010): (Source: Compendium of Statistics, 2012: ZimStat)

		Year of registration									
Type of Vehicle	Class (kgs net mass)	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**	**Distbn**
Light vehicles	<2300	14567	14574	14241	12308	17615	19155	25135	38274	**155869**	79%
Heavy Vehicles1	2300 - 4600	1748	1891	1731	1500	1418	1814	1958	1712	**13772**	7%
Heavy Vehicles2	4600 - 9000	2391	1441	719	1001	833	764	1271	1177	**9597**	5%
Heavy Vehicles 3	>9000	406	271	324	377	512	378	472	606	**3346**	2%
Motor cycles 1 (<70cm)		191	121	267	56	173	148	228	350	**1534**	1%
Motor cycles 2 (>70cm)		725	549	363	243	1005	544	1015	976	**5420**	3%
Light trailers	<550	332	216	229	357	366	361	399	390	**2650**	1%
Heavy trailers		50	25	59	130	75	242	639	384	**1604**	1%
Tractors & Cons vehicles		1111	652	336	971	538	114	110	164	**3996**	2%
Totals		**21521**	**19740**	**18269**	**16943**	**22535**	**23520**	**31227**	**44033**	**197788**	**100%**

The analysis presented in Table 56 below shows that the automotive industry consumes about 83000 tons of materials per annum. Assuming that about 90% of the weight is derived from iron and steel, then 74700 tonnes of iron and steel is required per annum.

Table 56: Tonnage of vehicles registered in Zimbabwe (2003 – 2010) (Source: SIRDC Analysis)

Type of vehicle	AvgWt (tpv)	#ofveh. (2003 - 2010)	Total weight (t(2003-2010)	Wt Distb (%)	AvgWt/tons/yr
Light vehicles	2.3	**155869**	**358499**	54%	44812
Heavy Vehicles1	3.45	**13772**	**47513**	7%	5939
Heavy Vehicles2	6.8	**9597**	**65260**	10%	8157
Heavy Vehicles 3	18	**3346**	**60228**	9%	7529
Motor cycles 1	0.2	**1534**	**307**	0%	38
Motor cycles 2	0.4	**5420**	**2168**	0%	271
Light trailers	0.55	**2650**	**1458**	0%	182
Heavy trailers	18	**1604**	**28872**	4%	3609
Tractors & Cons vehicles	24	**3996**	**95904**	15%	11988
Totals		**197788**	**660208**	**100%**	**82526**

The main export destination for both completed vehicles and components are Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Uganda and Zambia (Saungweme, 2011). Assuming that these 8 countries consume the same tonnage of steel, then the regional market at the nation's disposal becomes about 700000tonnes. Further assuming that Zimbabwe has a 50% market share in the region, then about 350000tonnes (29% of ZISCO capacity) of iron and steel products would be consumed in the Zimbabwean automotive industry if it is operating at full capacity. This creates a positive interlinkage with primary iron and steel and secondary production which can realise revenues close to US$240million per annum because of the automotive interlinkage.

If automotive assembly plants are resuscitated through joint ventures with strategic partners especially from China and India, to produce approximately 25000 vehicle units per annum at say US$14000.00 per unit, then potential revenues of US$350million can be realised in the domestic market. The revenues can further be boosted up by tapping into the SADC and COMESA market which can raise the volumes by up to 6 fold (US$2.1billion). Niche Completely Knocked Down Kits (CKDs) can also be toll manufactured for automobile plants in China, South Africa and India. This is possible considering that the major ingredients for niche components are available in Zimbabwe. These special raw materials include the PGMs, chrome and nickel. The global demand of catalytic converters has grown enormously over the past ten years. Close by, neighbouring South Africa supplied about 12% of world demand of catalytic converters in 2003 (Lundall et al., 2008).Nevertheless, Zimbabwe does not produce catalytic converters despite having the major basic metals required for production.

Effect of Government Policies and trade regulations

The main actors in the subsector also noted government policy as affecting the competitiveness of the local automotive value chain (www.idc.com and The Financial Gazzette, January 23 – 29, 2014). The South African Motor Industry Development Policy Program (SAMIDPP), through which the South African government subsidized its vehicle exports, has positioned its vehicles to be price competitive on the regional market.In fact South African vehicles were retailing at a lower price in Zimbabwe than in their home territory. One case example revealed by a key informant was a major private player who bought a significant fleet of new vehicles from SA rather than local because the price difference was too big.Due to a more competitive policy position, SA's automotive value chain reportedly contributed about $US22billion to GDP (about 9% of GDP) in 2012 whilst employing 350000 people (The Financial Gazette, Jan 23 – 29, 2014). On the other hand the Zimbabwean equivalence currently contributed less than 0.5% to GDP. According to South African Motor Industry Framework (SAMIF), the local procurement was initially pegged at 25% and later increased to 65% after certain sector growth targets were met. In the Zimbabwean case, the local procurement is set at 40%, against the fact that most upstream actors were either operating at very low capacities or have folded resulting in limited supply of quality inputs to the automotive assemblers.

The actors proposed the urgent need to develop a Zimbabwean Motor Industry Development Policy to provide a roadmap for the resuscitation of the sector. The recommendations by the major actors included the reinstitution or adaptation of the VIC policy and other trade protocols, the instatement of the suspended higher duty rates on imported Complete Built Units (CBU's) and exports and or investment incentives for the automotive industry. A phased approach to the total ban of grey imports of motor vehicles was proposed.One of the major stakeholders also advocated for the awarding of importation licensefor second-hand vehicles to the respective franchise holders to ensure that vehicles received a mandatory pre-shipment inspection to prevent the grey imports.The implementation of such policies supported by other interventions like investment in new technology and strategy links with actors in huge markets has the potential to revive the once vibrant subsector with a potential to employ over 50000 people and contribute significantly to GDP.

4.4.9.3 Capital goods and agriculture

The capital goods andagriculture work hand in hand. Agriculture is significant in the Zimbabwean context as it contributes about 60% of the inputs needed in the Zimbabwean manufacturing sector.The engineering sector in Level 5 has the potential to support this agricultural sector through agricultural mechanisation at primary level, provision of harvesting and post harvesting as well as agro-processing technologies.

The agricultural equipment industry in Zimbabwe dates back to the Second World War Era were components were imported and assembled in then Rhodesia (Mafu, 2011). During the UDI period, the industry developed not only into full component manufacture but also the design and development of new equipment appropriate to the dynamic conditions and trends in Zimbabwe's agricultural sector (Mafu, 2011). The equipment is classified as; i) Land preparation/soil working equipment (ploughs, tillers, harrows, ridgers, rippers, etc), ii) Planting equipment (seed drills, fertiliser spreader, planters, seeders, etc), iii) Fertilising and pest control equipment (fertiliser spreaders, sprayers, cultivators with top dressing unit, etc.), iv) Harvesting equipment (combine harvesters, potato diggers, grain threshers, etc.), v) Transport equipment (trailers, tractors, etc.), vi) Animal drawn equipment (ploughs, harrows, cultivators, scotch carts, etc.) and vii) Other products (irrigation equipment and pipes, hammer mills, hand implements, hoes, sickles, etc.). Tables 57 and 58 summarise the number and type of equipment used in the different sectors of Zimbabwean agricultural industry in 2010. The total number of tractor units was over 16000 whilst the number of animal drawn equipment units was above 1.8million units implying great market potential for agricultural equipment market.

Table 57: Number of working tractors classified by size of tractor and sector, 2010 (Source: Compendium of statistics, 2012, ZimStat)

Type of Equipment	Communal	Old resettlements	A1	A2	SSCF	LSCF	Total
Less than 40kW	604	88	455	1146	168	558	**3019**
40 - 80kW	1486	196	1081	4862	300	1549	**9474**
Above 80kW	583	155	338	2273	171	544	**4064**
Total per sector	**2673**	**439**	**1874**	**8281**	**639**	**2651**	**16557**

Table 58: Number of Animal Drawn Equipment by type of equipment and sector, 2010(Source: Compendium of statistics, 2012, ZimStat)

Type of Equipment	Communal	Old resettlements	A1	A2	SSCF	Total
Ploughs	815713	82952	12133	14140	12657	**937595**
Cultivators	168481	26633	30932	6951	7446	**240443**
Planters	6857	1709	2248	850	1509	**13173**
Harrows	131038	19288	25809	5566	6520	**188221**
Scotch carts	350654	44595	64129	7154	6733	**473265**
Water carts	15046	1219	3684	902	679	**21530**
Total per sector	**1487789**	**176396**	**138935**	**35563**	**35544**	**1874227**

According to Zimtrade (Mafu, 2011), the operating capacity of actors in the agricultural engineering subsector ranged between 40% - 50% between 2010 and 2011 and could have reduced further in line with the general trend in the engineering and manufacturing sector. The value of production of the sector, which was estimated to have produced 2000 pieces of different types of agricultural equipment was about US$10million. Assuming full capacity utilisation, the value could increase to about US$20million. The regional market according to Zimtrade (Mafu, 2011) has the potential to generate US$6million dollars in export revenues. The major export markets noted were Zambia, Namibia, Mozambique, South Africa, Angola, DRC, Angola and Malawi whilst ploughs, cultivation machinery and spare parts were the main contributors to exports.

With the significant change in the structure of Zimbabwe's agricultural sector (see Table 56 – AI & A2 farmers), a potential market for the establishment of small-scale, appropriate and sustainable processing plants and businesses is poised to expand the agricultural engineering capital goods industry. Successful models can create further markets in the region were technology use in agriculture is still minimal. However, it is worth noting that the successful resuscitation of this subsector is realisable if the current challenges are overcome. These challenges include lack of long term financing by farmers, loss of market due to competition from cheap imported equipment, lack of export incentives causing uneven playing field on the export market, low productivity due to working capital constraints, antiquated machinery due to recapitalisation inability, high costs of raw materials, high transport costs to regional markets and shortage of skills due to brain drain (Mafu, 2011). Figure 78 illustrates the agricultural equipment value chain map in Zimbabwe. The list of actors in the agricultural equipment value chain is presented in Annex 16.

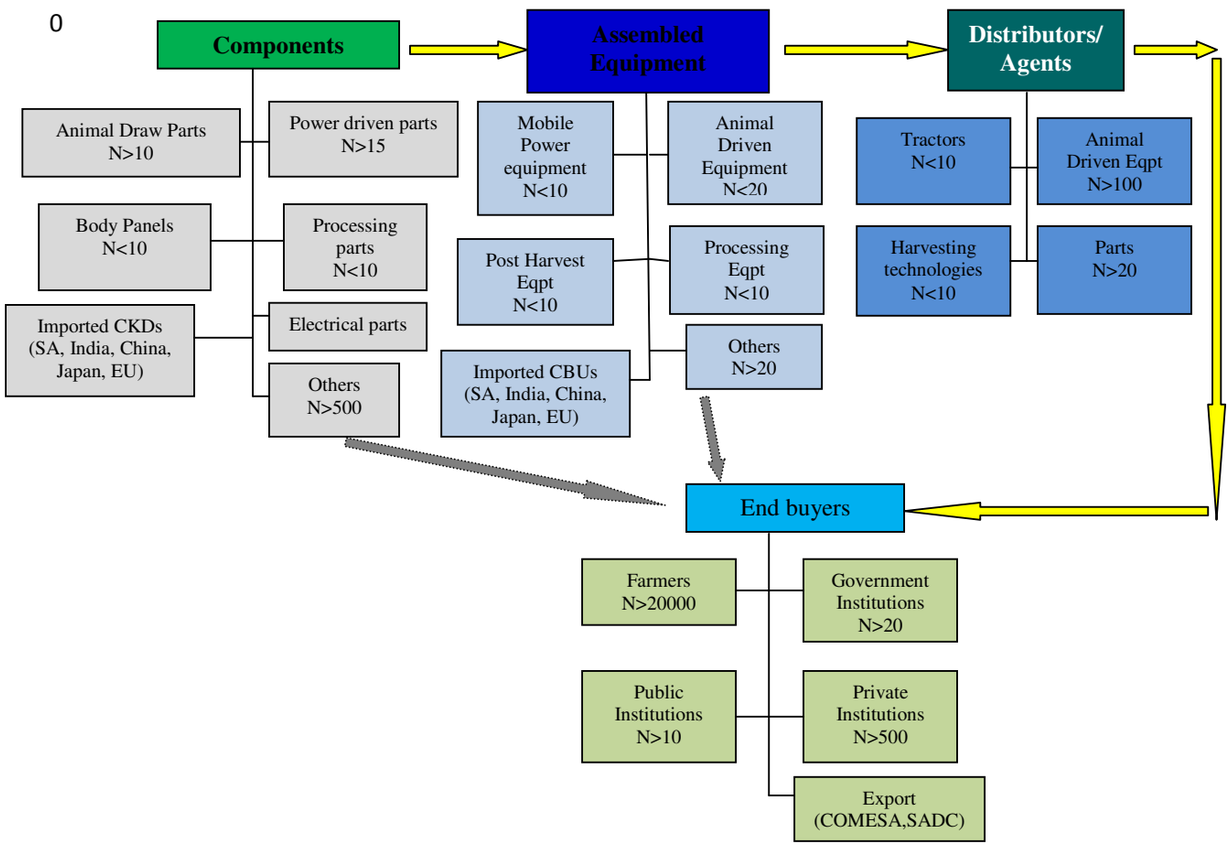

Figure 78: Agricultural equipment value chain map

4.4.9.4 The light engineering industry subsector

The light engineering goods subsector in the Zimbabwean context includes the light machinery assembling including reactors; fabricated metal finished products including tanks and reactors as well as electrical machinery.Engineering/machine shops and assembling firms use output derived from the metal forming and fabrication stages to build a wide range of products using workshops and factories of low capital intensity. The sector ranked second in terms of values of export and imports into the country, with US$246million worthy of exports and US$4.1billion worthy of imports (see Table 53 and 54 from previous section). The analysis showed that imports in this

sector are more than 16 times the exports. There are a fewmachine assembling actors at this level, sourcing parts and components from engineering or machine shops and control systems from electrical and electronics firms.

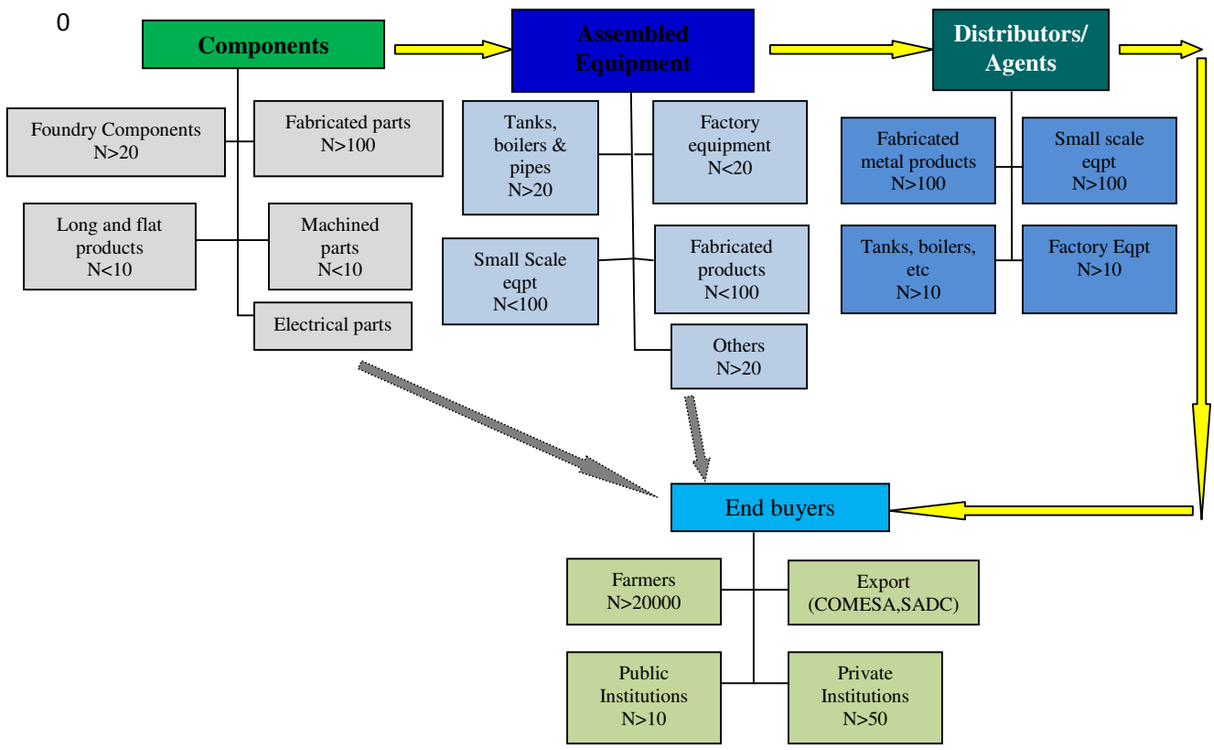

Figure 79: Light engineering goods value chain map

The range of employment opportunities is significantly larger at this stage and firms in this stage of production include small, medium and large manufacturers. As a result, this subsector is very important as far as the Small to Medium Enterprises are concerned. It is therefore in this sector that the government and relevant stakeholders must strongly encourage indigenous empowerment in conjunction with the MNCs. In the Zimbabwean context such firms are generally in the small (10 to 49 employees) and medium (50 to 199 employees) range, whilst a few lie in the larger employment size category (201 to 500 employees)(Lundall et al., 2008). ThusLevel5, the finished product and machine building stage is more labour intensive. Investment per job ranges from only USD 10thousand to USD 60 thousand while employment per 1000 ton of steel output ranges from 75 to 150(Lundall et al., 2008). As a result, the potential

for employment creation is far greater at the downstream finished product end of the metals beneficiation pipeline whilst the selling price per unit weight of steel increases dramatically.

The wide-ranging products including cutlery and hand-tools, bolts, nuts and screws, spring and wire products, hardware, construction and architectural metal products, boilers, tanks, steam generators and shipping containers are produced. Globally the metal products industry is characterised by clusters of firms developing niche capabilities and drawing on shared services, including technical and design services, skills development, and research and development (R&D) facilities(Lundall et al., 2008).In the manufacture of tank containers and automotive components, economies of scale are important.

4.4.9.5 Engineering Capital goods and the mining, and infrastructural development sector

The local manufacture of heavy engineering, factory and mining equipment is limited in Zimbabwe despite the fact that infrastructure for such scale of manufacturing is available. The low activity is attributable to the economic crisis which forced many key actors to close shop or reduce operations. Key players in the field include Morewear Industries, NRZ, T & A Foundries, Bains, O' Connoly, Arthur Garden Engineering, Tanroy Engineering, Alstom and Powerspeed amongst others. The power expansion projects, construction and mining expansion projects provide potential market for the Zimbabwean heavy engineering subsector. The National Railways Industry also provide potential market considering that currently about half of the 213 locomotives and 10 500 wagons are presently side-lined and require upgrading or replacement. The cost of rehabilitating the railroad network and irrigation infrastructure alone is estimated to be over a billion (Ward, 2012).

4.4.9.6 Concluding remarks

There is great potential to resuscitate the engineering capital goods subsector, interlinking it with the iron and steel and metal forming industries. The domestic and regional market can be tapped into by creating an enabling environment. The challenges in the export markets include cost of marketing overseas, negotiating a foreign purchase, transporting goods to foreign locations, tariffs and non-tariff barriers, distributing goods in foreign markets, adapting equipment and goods to foreign conditions and standards, installation in foreign production facilities, training foreign workers to use equipment and providing parts, maintenance and customer service from abroad.The cheapest producers of engineering capital goods are German, Japan, the United Kingdom and the United States whilst the most expensive producers of capital goods are Egypt, Kenya, Iran, Morocco, Nigeria and Zimbabwe.Germany dominated the export of equipment to almost all European destinations with the United States and Japan being the main supplier to the Pacific. Kenya, Malawi and Nigeria buy from the United States whilst Morroco and Mauritius import from France. Generally the growth in the sector in Africa has covered high and medium technology sectors, such as machinery and equipment, electrical and electronic goods and production of medical and optical instruments, unlike the past when it was restricted only to primary processing which also implies growing competition for the regional market.

4.5 SPECIAL VALUE CHAINS ANALYSIS

Although the sectorial value chain analysis has been done based on the levels in the engineering and metals value chain (Levels 2 to Level 5), this particular section has been dedicated to the special value chains, which according to the evaluation team were the most attractive and or of a strategic nature to the Zimbabwean economy. These subsectors include the Iron and Steel (ZISCO), the PGMs industry and the Chrome sector. Key informant interviews (Annex 8) as well as a more detailed document review were carried out as key sources of data to analyse the value chains.

4.5.1 Iron and Steel making in the Zimbabwean context

Information for the iron and steel sector was mostly obtained from the main key informants at ZISCO, who included the Works Director and the Group Metallurgist. A field visit to the ZISCO plant in Redcliff was also part of the field data collection. Comparative information was obtained from country documents from South Africa (Kumba Iron ore report, 2008), Zambia (Zambia Development Agency Report, 2012) and internationally from World Global Statistics for iron and steel amongst others. Another document with key historical information on the Zimbabwean iron and steel industry in the then SADCC context was done by Kaliyati, 1991. Zimbabwe has huge known **iron ore** reserves with grades higher that 40%Fe (CoM). The production of iron and steel, nevertheless has been affected by the challenges surrounding the resuscitation of ZimSteel (formerly ZISCO). No iron ore production has been realised since 2009 due to viability challenges of ZISCO and its subsidiaries. The processes applied in the production of iron and steel in Zimbabwe are summarised in Figure80.

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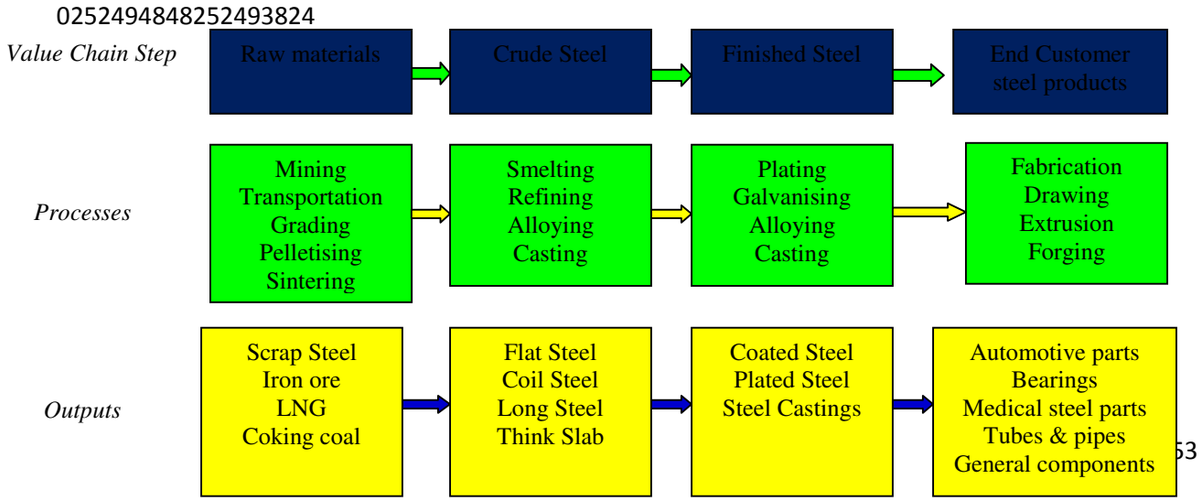

Figure 80: Steps, processes and products in the iron and steel value chain

The value addition process involves mining, concentration, smelting, converting and the production of ingots, sponge iron and billets.Iron ore is reduced to iron and then converted to steel.These primary products are then fed into secondary processing industries which include rolling, forging, drawing, extrusion and other foundry processes which produce products like angle irons, wires, sheets and plates, tubes and pipes and many other products and castings. The Zimbabwean iron and steel value chain map is summarised in Figure 81 below.

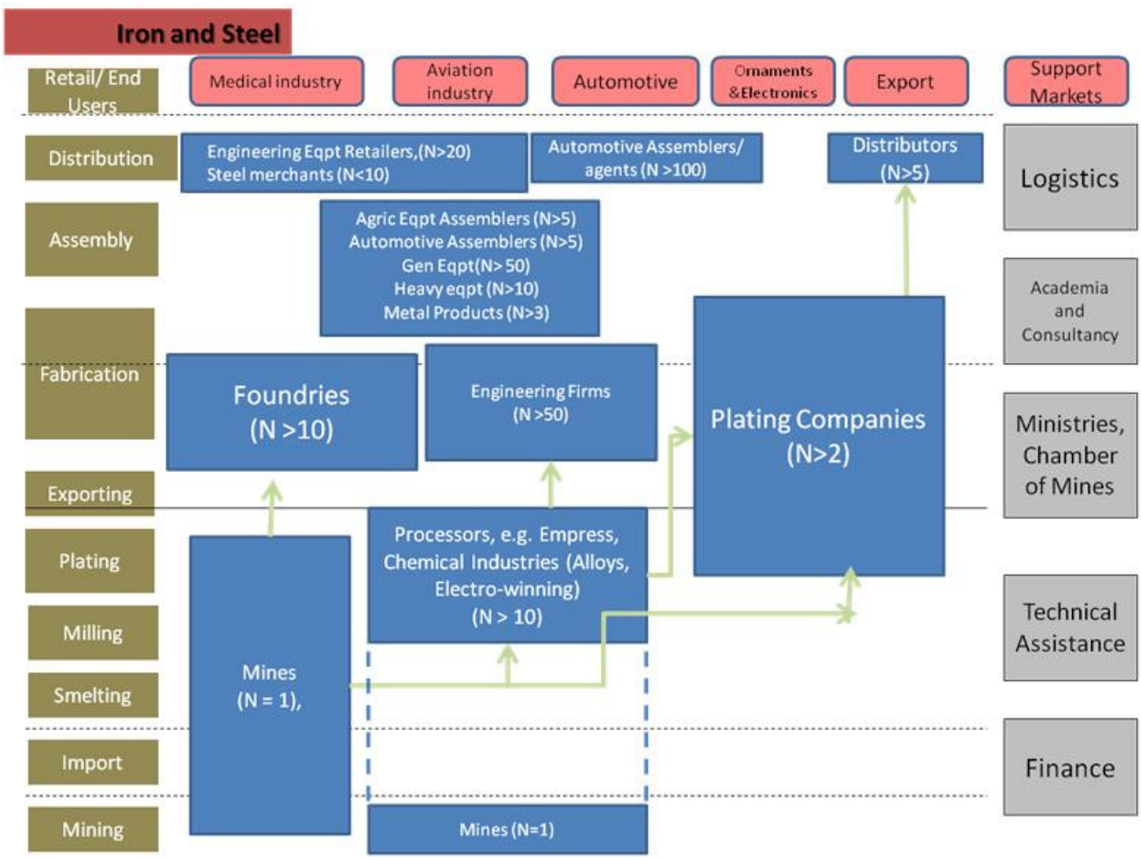

Figure 81: Iron and Steel Value Chain Map

4.5.1.1 Dimension 1: Sources of Inputs and Supplies

The major sources of inputs for this sub-sector were found to be iron ore, scrap metal, coal/coke, limestone, and fluxing materials like fluorspar, dolomite, manganese and corundum as well as alloying elements like ferrochrome, vanadium and nickel. Transport, logistics and storages facilities were also key inputs to this value chain.

4.5.1.1.1 Iron Ore

Iron ore-based steelmaking accounts for about 70% of world steel production (www.worldsteel.org). The known reserves of iron ore in Zimbabwe are high grade and estimated at to range between 3billion and 30billion tonnes with iron content ranging from 40% to 63% (Kaliyati, 1991, Mobb, 2011). These reserves exist around the Mberengwa (Buchwa), Kwekwe (Ripple Creek) and Chivhu (Mwanesi) areas. Comparatively, world resources are estimated to be around 800 billion tonnes of crude ore containing more than 230 billion tonnes of iron (U.S Geological Survey) implying that the country has about 3.8% of the global resource. Regionally, South Africa, Zambia, Angola and Mozambique share between them an estimated 5billion tonnes (Kaliyati, 1991) of high grade iron ore (35 – 69%) reserves implying that Zimbabwe has vast iron ore resources to tap. Only Zimbabwe, Angola and South Africa were the traditional iron ore producers, until recently when Mozambique and Zambia are venturing into production (Kaliyati, 1991 and Zambia Development Agency report, 2012). The relative abundance of iron ore resources in Zimbabwe gives a competitive edge in the region. However, stiff competition from South Africa, Angola and Mozambique is expected considering their coastal advantage as compared to the landlocked scenario of Zimbabwe for the export markets.

ZISCO, through its subsidiary, Buchwa Iron Mining Company (BIMCO) was the main producer of iron ore in Zimbabwe, producing between 0.4 and 4million tonnes during the span of its operation (1980 – 2010). The company depended heavily on ZISCO's integrated iron and steelmaking plant at Redcliff as the major market for its product and was hence affected by the closure of the plant. During the time of the economic crisis in Zimbabwe production of iron ore from BIMCOdeclined from about 350 000 tonnes in 2001 to zero in 2012 (CoM). Capacity utilisation in iron ore production dropped from an average of about 12% between 2001 and 2005 to 0% in 2008 due to the myriad of challenges experienced.

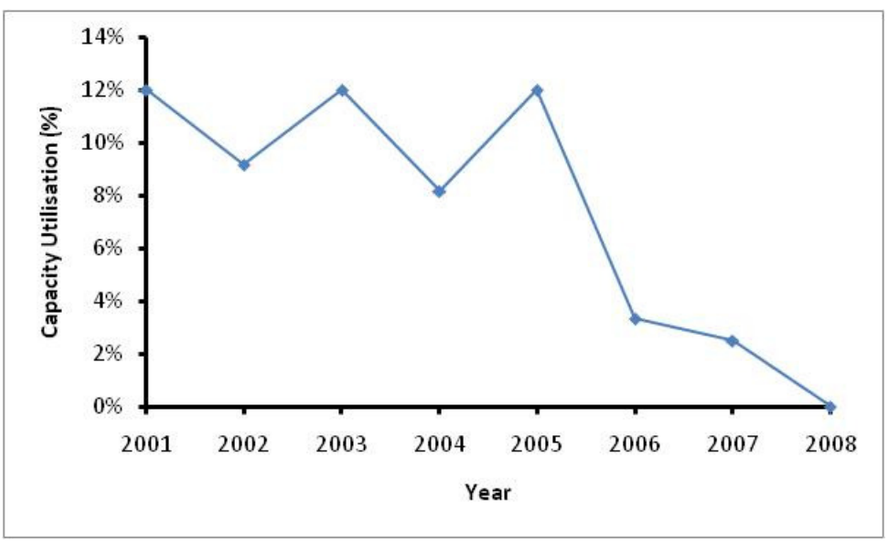

Figure 82: Capacity utilisation in Zimbabwean iron ore production (Source: SIRDC Analysis)

In comparison, South Africa produces over 53 million tonnes per annum of iron ore (USGS, 2009, Kumba Iron ore report, 2008)) – more than 13times the capacity of BIMCO 100 (Kumba report, 2008).Globally, Australia specialise in the production of iron ore for the global end markets.

4.5.1.1.2 Scrap Metal

Scrap metal has become a critical resource for recycling in downstream levels of the iron and steel value chain in Zimbabwe. It is increasingly being considered energy efficient and hence competitive substitute for the non-renewable and energy intensive iron ore resources. It is used by actors such as steel producers, smelters, foundries and tubing and wire manufacturers. The commonly used types of scrap metal are ferrous, aluminium and copper. Further downstream, it is also used in the manufacturing of various types of capital goods and equipment (e.g. agricultural machinery, automobiles, etc.).The abundance of obsolete machinery and scrap from old equipment and machinery scattered around the country may be a strategic raw material source for the industry.

Key informant interviews also revealed that there approximately more than 400 informal and individual scrap metal dealers in Zimbabwe, concentrated mainly in Harare, followed by Bulawayo, Kwekwe, Mutare, etc. The formal scrap dealers on the contrary were significantly fewer, with the notable ones in Harare being Metal Sales and Non-ferrous (for non-ferrous scrap like brass, copper, bronze, aluminium, etc.) and JBC for general iron and steel scrap. According to one key informant, despite a ban on the export of scrap metal, the commodity finds its way to the export market through other means, due to its high demand. Therefore the local prices for scrap become exorbitant for players at the next level of the value chain. Regionally, South Africa's scrap metal industry is well organised, supplying about 3.6million tonnes to the foundry and related industry for beneficiation in 2012 (Final technical report, EPP, 2013). Globally, the resource limited EU countries are resorting to recycling of scrap as a key source of raw materials as the prices of virgin metals from resource rich developing world continue to soar (Ecorys, 2011). Zimbabwe must therefore move with speed in the formalisation of the Scrap Metal Industry and establish sorting and marketing centres to ensure the optimal utilisation of this precious commodity in the engineering and metals value chain. Zambia is currently using scrap metal in its recently established iron and steelmaking plants whilst they build the iron ore production capacity (Zambia Development Agency Report, 2012).

4.5.1.1.3 Limestone

Zimbabwe has about 200 million tonnes of limestone. The biggest deposits are just afew hundred metres from the Redcliff steel works. From key informant interviews with the current ZISCO management, the limestone deposits are large enough to the extent that themanagement are confident they will not be exhausted in the near future.

4.5.1.1.4 Alloying elements

Information from questionnaires revealed that nickel and chrome products (e.g. ferrochrome, ferrosilicon, ferromanganese, ferronickel, etc.) as well as zinc and lead were the major alloys amongst other non-ferrous alloys used in the engineering and metals value chain. Most of the

alloying elements were imported from India, South Africa and China. On the other hand ferrochrome, ferrosilicon, etc. were mainly sourced locally from ZIMASCO, a subsidiary of SinoSteel of China amongst other smelters. Bindura Nickel Corporation Ltd.'s (BNC) nickel smelter, and refinery a subsidiary of Mwana Africa PLC, was also one of the sources of nickel for the iron and steel value chain. However, the volumes required by the domestic market are small for economic production and hence much of the nickel is exported as concentrate (e.g. the toll manufacturing agreement between BNC and Glencore International Plc of Switzerland) (Mobb, 2011).

The major consumption for the alloying elements (particularly nickel and chromium) in the iron and steel subsector is stainless steel production. However such a production facility is non-existent in Zimbabwe despite the fact that both the alloying elements and the iron ore resources are locally available in abundant quantities. A strong discussion point would be a comprehensive feasibility study for the establishment of a stainless steel production facility in Zimbabwe. It is also worth noting that a few electroplating and galvanising plants which utilise zinc, chrome and nickel in coating iron and steel intermediate products exist in the country. They are mainly used for the production of structural metal products as well as corrosion resistant sheets and roofing material. Some of such actors include Essar Tubes and Towers and Morewear amongst a few others. Zambia has recently established such plants (Zambia Development Agency Report, 2012) and hence can compete regionally alongside giants like South Africa. Therefore the possibility of expanding the electroplating industry must also be explored considering the huge regional demand for such products in the construction and household sectors. Although zinc deposits exist in the country (see Figure 3 of Part 2), the resource is not exploited locally.

4.5.1.1.5 Coal and Metallurgical Coke

Coking coal, though technically not a metal, is a key ingredient in the manufacture of iron and steel. Coke consumption in the blast furnaces is around 230-300kg per ton of hot metal (THM). Zimbabwe possesses 6.9 billion of commercially exploitable coal from reserves estimated at about 22 billion tonnes (Mhlanga et al., 2013). At projected extraction rates, the resource is expected to last over a 1 000 years.The SADCregion (excluding South Africa)was reported to have about 270 billion tonnes of known reserves of coal (Kaliyati, 1991). Botswana, Namibia, Lesotho and Swaziland have combined estimated reserves of about 80 billion tonnes of coal(Kaliyati, 1991). Mozambique, Tanzania, Malawi and Zambia possessed 200 billion, 1.5billion, 500 million and 38million tonnes of coal reserves respectively (Kaliyati, 1991).In terms of abundance of coal, Zimbabwe competes with Botswana, Namibia, Lesotho and Swaziland whilst the Mozambican coking coal reserves are estimated to be twice the combined reserves of the other countries. It implies that iron ore beneficiation is well backed by the abundance of the coal resource in vicinity.

Coal mining in Zimbabwe was previously dominated by Hwange Colliery Company Limited (HCCL). With the liberalization of the economy more players came in. The coal companies in Zimbabweare divided into coal mining companies and coke making companies. The coal mining

actors are namely; HCCL, WK Blasting (WK), Makomo Resources, Clidder and Liberation while the coke making companies are HCCL, Hwange Gasification, and South Mining (Mhlanga et al., 2013). The transportation of this bulky commodity to the end marketis currently seen as one of the major bottlenecks in the coal and energy supply chain affecting the iron and steel value chain. Coal production in the region shows that Zimbabwe has a competitive edge over the other SADC countries except for South Africa (Table 59). Zimbabwe's production, despite being the second to South Africa, is about 1.1% of the latter's production. The major supplier of limestone is BIMCO, whose capacity utilisation has decreased significantly since it heavily depended on ZISCO steelworks market for its sales.

Table 59: Regional production (000 tonnes) of coal for the period 2006 to 2010 (Source: Mhlanga et al., 2013)

Country	Year				
	2006	2007	2008	2009	2010
South Africa	269817	273005	278017	276219	280788
Zimbabwe	3800	3568	3350	3304	3304
Botswana	1060	913	1003	814	814
Mozambique	45	26	42	42	42
Namibia	0	0	0	0	0

4.5.1.1.6 Other Raw Materials

Fluxing materials like manganese, fluorspar, corundum and dolomite are known to existin Zimbabwe in fairly large amounts although the exact quantities are not known. Claysto produce refractory materials are also in abundance in Zimbabwe. A narrow range ofrefractories is being manufactured locally. A wide range of refractory bricks is importedfrom South Africa and Europe. This, however, does not mean that such bricks cannotbe manufactured locally. Production is not done locally simply because a subsidiary ofthe company which produces refractories in South Africa is currently operating inZimbabwe and the two sister companies may not want to compete against each other. Oxygen was supplied via a pipe from Sable Chemicals.

4.5.1.1.7 Electricity and water supplies

The main supplier of electricity is ZESA through ZETDC, whilst ZINWA administers and regulates the supply of water. The detailed nature of electricity and water production and supply has been covered earlier in Part 2.4 (Business Enabling Environment) with the major challenges being erratic supplies of power and high costs.The summary of actors involved in the sources of supplies and inputs are presented in Table 60 below.

Table 60: Summary of major players in the sources of supplies and inputs

Major Actor	Product Range	Location
BIMCO	Iron ore, limestone	Redcliff
ZISCO Steel	Pig iron, ingots, billets, bars, etc.	Redcliff,
Metal Sales	Non-ferrous scrap (bronze, copper, etc.)	Harare
Non-ferrous products	Non-ferrous scrap (bronze, copper, etc.)	Harare
JBC	All types of scrap	Harare
Informal scrap dealers (>400)	All types of scrap	All towns
ZIMASCO	Alloying elements (HCFCr, FeSi,etc)	Kwekwe
ZimAlloys	Alloying elements (HCFCr, FeSi,etc)	Gweru
Oliken	Alloying elements (HCFCr, FeSi,etc)	All towns
BNC	nickel	Bindura
Maranatha	Alloying elements (HCFCr, FeSi,etc)	Kadoma
Empress Nickel Refinery	Nickel	Kadoma
Hwange Colliery	Coal and coke	Hwange
Hwange Gasification	Coal and coke	Hwange
South Mining	Coal and coke	-
WK Blasting	Coal	-
Makomo Resources	Coal	-
Clidder and Liberation	Coal	-
National Railways of Zimbabwe	Transportation Services	All major towns
ZESA	Electricity	All major towns
ZINWA/Kwekwe municipality	Water	All major towns

The major findings were that

- the major inputs for the iron and steel value chain are available locally
- the reliability of locally supplied inputs is low due to capacity constraints
- the major input suppliers are big companies, often joint ventures with major shareholders being Multi-National Companies (MNCs)
- the main supplier of iron ore is currently non-operational thereby breaking the iron and steel value chain
- the major modes of transport are the rail and road networks which are currently in bad condition
- electricity and water shortages and costs have grossly hampered production and viability

4.5.1.2 Dimension 2: Production Capacity and Technology

Key informant interviews (Annex 9) and documents reviewed showed that Zimbabwe at one point owned the largest and only integrated iron and steel plant (1.2Mt/year plant) in Africa excluding South Africa(Kaliyati, 1991). The milling firm wasmainly involved in the production of pig iron and the conversion of pig iron into a range of wrought iron and steel materials.The product range produced during operational years included pig iron, billets, blooms,slabs, coils, sections, bars, flats, rounds, squares, angles, hoops and strips, rails and railwaytrack material, rods and plough beams (Kaliyati, 1991 and key informant interviews).ZISCO sadly ceased operations in 2008 due to a myriad of viability challenges which led to the eventual closure of the local integrated iron and steel making plant. The closure of ZISCO broke the local iron and steel value chain and opened the way for imports from South Africa, China and India. Several downstream processors in the iron and steel industry like Lancashire Steel, Haggie Rand, Steelmakers, Salwire, Steel base, the Automobile, Mining equipment and agricultural equipment manufacturers amongst others were severely affected by the closure of ZISCO.

4.5.1.2.1 Production capacity of iron and steelmaking in Zimbabwe

During the production period spanning between 1980 and 2008, the plant never operated to full capacity. The best capacity utilisation achieved was 58% (0.7Mtpa instead of 1.2Mtpa) according to key informants supported by the reviewed documents (Kaliyati, 1991).In contrast, the global capacity utilisation averaged around 81% for the period between 2000 and 2011 (Worldsteel Monthly Statistics). It is worth noting that the major capacity limitation at global level was the market demand rather than production challenges as in the Zimbabwean scenario (Bason, 2011). Regionally, Zambia and South Africa are important case studies in assessing the competitiveness of the iron and steel production capacity in Zimbabwe. South Africa's production capacity was reported to be over 10Mtpa (more than 10times the ZISCO capacity) (Kumba Iron Report, 2008), whilst Zambia's capacity was 0.12Mtpa (10% of ZISCO installed capacity) (Zambia Development Agency Report, 2012). It is critical to note that the South African production capacity met both its domestic and regional demand, with an excess capacity of over 40% (Kumba Iron Report, 2008). On the other hand, Zambia is planning to increase steelmaking capacity and backward integration into iron ore production from its resources close to Lusaka (Zambia Development Agency Report, 2012). The implications are that the competition on the regional market becomes very stiff for Zimbabwe, which has to leverage on its competitive advantages to remain viable as it plans to resuscitate the iron and steel plant. It is also worth noting that in both case studies (Zambia and South Africa), the iron and steelmaking plants are more diversified, and i.e. they do not rely on a sole player and hence reducing the risk of value chain breakdown in case one actor closes shop.

The global production volumes of crude steel ranged between 800Mtpa and 1400Mtpa the period 2001 to 2010 (Worldsteel Statistics, Yearbook, 2011) with Asia and Oceania and the EU being the dominant players. Africa and the Middle East are note dominant players in steel production and Zimbabwe's production at full capacity is not significant in global terms. Globally China contributed about 50% of global steel production whilst the other regions contributed remaining

the remainder over the past decade (Basson, 2011). The global dominant producers at company level with capacities of more than 30Mtpa are Baosteel and WISCO in China; ArcelorMittal in North America, the EU and CIS, POSCO and Nippon in East Asia and US Steel in North America amongst others (Lichtenstein, 2012, www.worldsteel.org). Other recognised steel makers at a lower scale include Tata Steel and the Essar Group. Thus Zimbabwe's steel production was about 4% or less of the major global actors' individual production capacity. It can therefore be fairly concluded that iron and steel production is not globally competitive. The global competitiveness is further worsened by the fact that there existed global overcapacity in steel production (Bason, 2011).

The major regional actors are Saldanha Steel, Arcelor Mittal (primary steel products (long and flat products), Highveld Steel (long and flat products), Scaw Metals (long products), Cape Gate and Cisco (long products) in South Africa. In Zambia, Good Time Steel, Safintra, Universal Mining and Chemical Industries Limited (UMCIL**),** MM Integrated Steel Mills (MMI)are major players in the milling industry (Lundall et al., 2008).

Major Capacity constraints

The operational challenges that faced ZISCO are in two parts – i) the constraints that limited capacity utilisation below 60% and ii) the events that led to the eventual closure of the integrated iron and steel plant. The major constraints limiting capacity utilisation were the inconsistent supply of critical raw materials like coal from Hwange due to the supplier's own constraints and the unreliable NRZ transport network; inconsistent quality of raw materials (coal) as well as erratic power and water supply. The other factor reported was the lack of adequate capital to purchase spares for maintenance and to upgrade the available equipment in line with global processing trends.The utilisation of the acquired 2million tonne per year sinter plant was also limited by the existing smaller capacity of Blast furnace No. 4 according to key informants.The shortage of experience and skilled human resources was also historically noted a constraint, especially during the Rhodesian era.

The events that led to the complete closure of the plant are worthy noting for the purposes of key strategic decisions on such strategic national operations. According to key informants (see Annex 9), the total unplanned shutdown of the integrated steelworks in 2008 was triggered by a long (24hr) shortage of the critical water supply consequently followed by a long power outage of 48hrs in the absence of power backup which led to plant failure. Water is continuously required to cool the furnaces and supply boilers for steam production. Devastatingly, the absence of power led to loss of heat in the coke ovens, blast furnaces, steel plant, sinter plant and rolling mills. The resuscitation of the plant since then has been seriously affected by the lack of finance until the ongoing joint venture deal talks between the Government of Zimbabwe (GoZ) and the Essar Group of India. According to Macquarie Research, the average cost for bringing production capacity online has more than doubled in the past five years. This trend has also affected New ZimSteel along with other mature operations of companies such as Rio Tinto plc and BHP Billiton Limited who are spending significant new amounts of capital to maintain existing levels of export volumes.

4.5.1.2.2 Technology Use

The highlights in the technological background of Zimbabwe's iron and steel industry include the 12000 tonne electric furnace in the 1930s, the installation of a second hand sheet and plate mill in 1961 (Kaliyati, 1991), commissioning of the sinter plant and blast furnace no. 4, replacement of steam locomotives with diesel ones, the coke crushing plant and the underground pipe carrying oxygen from Sables amongst others. It was noted that the products from the second hand mill from Scotland could not compete with South African products (from ISCOR) using more advanced technology leading to the decommissioning of the plant in 1965 (Kaliyati, 1991). Up to date technology is therefore noted as a key competitive factor that must not be ignored in this sector. Figure 83 shows the common technological routes in iron and steel making.

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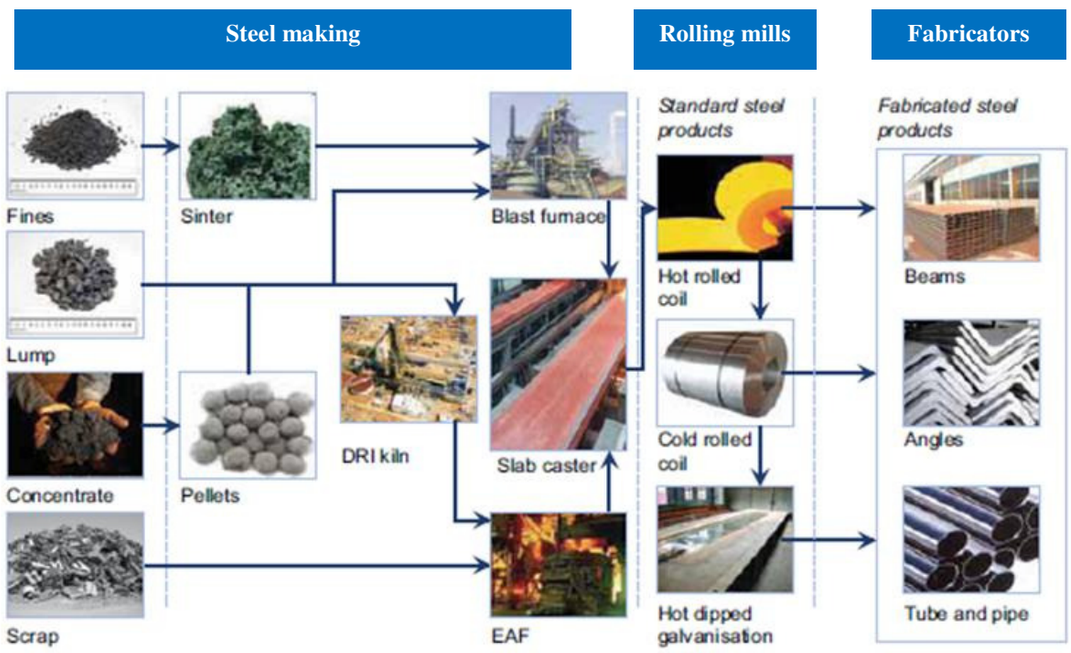

Figure 83: Metallurgical beneficiation and shaping in the iron and steel industry (Kumba iron report, 2008)

The two main technologies used to produce steel are i) iron making via the blast furnace (BF) followed by steelmaking in the basic oxygen furnace (BOF) and ii) iron making via direct reduction (DRI) followed by steelmaking in the electric arc furnace (EAF) (Kumba iron report). ZISCO employed the blast furnace and the BOF route. According to key informant, a 2Mt per annum sintering plant was purchased in 1997 to handle the fines whilst BF No. 4 was commissioned in 1999 to achieve the 1.2Mt per annum capacity. The capacity misalignment meant significant underutilisation and hence inefficient application of the sintering process. It is worth noting that the integrated steel production route based on the BF and BOF to reduce raw materials to iron and eventually to steel has been the favoured approach by 60 to 70% of the producers for the period 2001 to 2010 (Worldsteel Statistical Yearbook, 2011). The electric arc route (EAF), used in about 25 to 39% of the processes for the same period was less favoured owing to the high dependence on electricity supply which is typically scarce and costly in most

countries (Basson, 2011). Very few players used the Open Hearth Furnace (OHF) approach. Regionally both the BOF and EAF routes are in operation. Zambia uses 30tonne EAF in the production of long steel products like deformed bars and round bars from scrap metal. The beauty of the EAF route is the potential to establish several smaller scale mills and hence spread the risk in the value chain. Zimbabwe on the other hand did not use EAF technology which limits the use of ferrous scrap in local iron and steel making.A new iron making plant using the DRI technology was under construction in Zambia for the production of iron from their own iron ore (Zambia Development Agency Report, 2012). If the Zambian DRI technology is more competitive than the Zimbabwean BF and BOF technology route, then their value chain will be more competitive in the region and beyond.

Globally, the EU has led in the adoption of newer technologies for iron and steel production, followed by China and India (Elliott, 2013). Chinese and Indian steel companies have as a matter of national policy started replacing old technology with new ones. Large Chinese players such as Baosteel and others have entered into collaboration with global steelmakers such as ArcelorMittal and Nippon Steel, amongst others, to adopt the latest technologies and gain current technical know-how. The recently upgraded and commissioned plants in India were reported to have productivity levels of between 2 and 2.8/t/day/m^3, which is comparable to global standards (Elliott, 2013). In tandem with the 'economies of scale focus' for any major project start up in Asia's iron and steel industry, the two major Asian players namely Tata Steel and RINLrecently installed one of the largest furnaces (3,500m^3 capacity)to maximise on the economy of scale. China similarly approved mega-expansion projects for Baosteel (~10 million tonnes) and Wuhan Iron and Steel (Group) Corporation (WISCO) (~9.2 million tonnes) which were expected to use the latest technologies. The local government in Guangdong was expected to have closed 16.4 million tonnes of outdated technology by the time the Baosteel's Zhanjiang project was operational as a matter of policy (Elliott, 2013).

These case examples clearly show the importance of technology in the competitiveness of the iron and steel value chain which Zimbabwe must emulate starting from national policy. The Zimbabwean iron and steel production sector must therefore consider enhanced technologies, economies of scale and new innovations when considering new ventures and investments.

4.5.1.2.3 Knowledge use

According to key informant interview, there was limited use of knowledge in the history of Zimbabwe's iron and steel making sector. The documents reviewed also backed this standpoint, evidenced by the fact that part of the technology used was actually second hand from Japan and South Africa (Kaliyati, 1991). It was also noted that there existed no meaningful collaboration with R & D institutions in the past. The key informant, whilst acknowledging the theoretical strength of the graduands mourned their lack of professional and emotional maturity.

In contrast, South Africa, a regional competitor and giant has invested significantly in research and development. Kumba Iron and the IDC were reportedly involved in research and development in four emerging technologies namely ITMK3, Paired Straight Hearth (PSH),

Pellets and Circofer (Kumba Iron report, 2013). The IMBS and Finesmelt technologies, DRI, Finex, Midrex and Corex technology are all being investigated for the purposes of efficient and cost effective production of different grades of iron. The Finex technology was developed in South Korea by a full time research and development team of about 600 people from the Pohang University of Science and Technology and the Research Institute of Industrial Science and Technology. Globally Multi-National Companies like Anglo American and BHP are involved in collaborations with research and development institutions, colleges and universities in coming up with new technologies for the iron and steel sector.

4.5.1.2.4 Production Costs and Margins

Since there was no primary steel production due to the closure of ZISCO, downstream actors either directly imported steel products from countries such as South Africa, China and India or purchased from distributors who include BSI Steel, Africa Steel, Gilfun Steel as well as other smaller scale distributors. These primary steel products definitely come with additional costs of shipping which tend to price out the finished products from competing imported finished products. These circumstances forced most downstream actors in the subsector to either, fold operations, divert to importing for reselling or streamline operations to niche products. Since there was not much activity at the primary level of steel production, the analysis of production costs and margins could only be done based on documents review from global and regional actors as a benchmark considering that the country is in the process of resuscitating the Iron and Steel production subsector. Internationally, the cost and margins in the iron and steel industry have recently been determined by the dynamics of the Chinese economy (Elliott, 2013). The benchmarks for production costs in the conversion of iron ore to liquid carbon steel for both the BOF and EAF route are presented in Tables 60 and 61. The BOF route is currently the cheaper route (US$382.00/ton) than the EAF route ($US498.00/ton). However for Zimbabwe, where scrap metal is not fully utilised, the EAF route can also be viable if the Scrap Metal industry is well organised together with addressing the issues of efficient production of electricity. Any integrated iron and steel making plant must therefore aim for cost effective production which does not typically exceed US382.00/ton (see Table 61), taking advantage of the availability of iron ore and coking coal resources locally.

Table 61: Basic Oxygen Furnace Route Steelmaking Costs 2014 (Source: www.steelonthenet.com)

	Integrated steelmaking - crude steel cost model					
Item $/unit	**Factor**	**Unit**	**Unit cost**	**Fixed**	**Variable**	**Total**
Iron ore	1.508	t	98		147.8	147.8
Iron ore transport	1.508	t	9.25		13.95	13.95
Coking coal	0.877	t	142		124.5	124.5
Coking coal transport	0.877	t	13.25		11.6	11.6
Steel scrap	0.141	t	340		47.9	47.9
Scrap delivery	0.141	t	5		0.71	0.71
Oxygen	141	m^3	0.095		13.4	13.4
Ferroalloys	0.014	t	1175		16.45	16.45
Fluxes	0.497	t	50		24.85	24.85
Refractories	0.009	t	648		5.74	5.74
Other costs	1		15	3.75	12.25	15.00

By-product credits					-31.8	-31.8
Thermal energy, net	-7.69	GJ	15.0		-115.3	-115.3
Electricity	0.142	MWh	181	3.9	21.8	25.7
Labour	0.65	Man hr	37.7	6.1	18.4	24.5
Capital charges				56.4		56.4
Total				**70.1**	**311.4**	**381.5**

Table 62: Conversion costs for steel making through the EAF route (Source: www.steelonthenet.com)

Electric arc furnace liquid steel cost model						
Item $/unit	**Factor**	**Unit**	**Unit cost**	**Fixed**	**Variable**	**Total**
Steel scrap	1.085	t	340		369.0	369.0
Scrap delivery	1.085	t	5		5.4	5.4
Oxygen	15	m^3	0.095		1.4	1.4
Ferroalloys	0.011	t	1175		12.9	12.9
Fluxes	0.029	t	110		3.2	3.2
Electrodes	0.002	t	5800		13.9	13.9
Refractories	0.007	t	648		4.6	4.6
Other costs	1	unit	12	3.0	9.0	12.0
Thermal energy	0.454	GJ	15.0		6.8	6.8
Electricity	0.302	MWhr	94	4.3	24.2	28.4
Labour	0.579	Man hr	37.7	5.5	16.4	21.8
Capital charges	1		18.2	18.2		18.2
Total				**30.9**	**466.8**	**497.7**

Figure 84below shows the price volatility in the iron and steel industry from 2010 to 2012.The increasing raw material costs and price volatility have been major challenges for the steel industry. On the other hand steel prices have responded more gradually than production costs, leading to reduced margins or losses. Thus the prices of raw materials have increased fasterdue to the growth of raw materials demand exceeding supply growth, whilst that of steel mill products has been stalled or lowered due to the significant excess of steelmaking capacity.

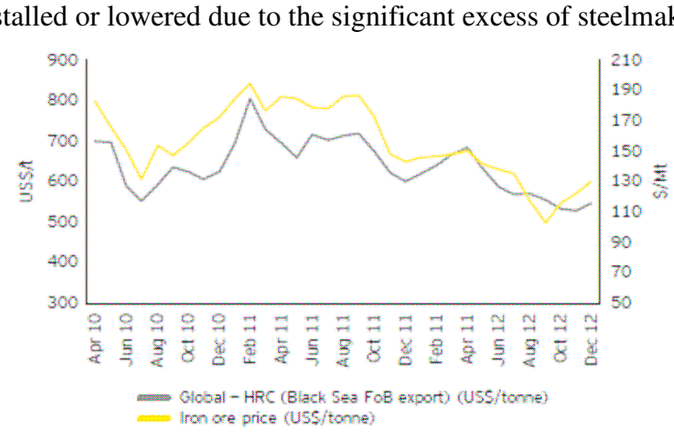

Figure 84: Price Volatility in the Iron and Steel industry for the period 2010 – 2012 (Source: CRISIL Research. Ernst & Young Analysis)

The price of steel was reported to have fluctuated significantly over the period 2001 to 2011, with a low of US$104.00 per ton in 2001, to a high of US$350.00 per ton in 2008 (Lichtenstein 2012). This situation was cited as the main cause of the decline in overall profitability of the 50 global leading steel companies analysed elsewhere (Lichtenstein 2012). Table 62 below estimates the costs per tonne for the various inputs and outputs in the iron and steel value chain. As shown, the costs of the major inputs vary significantly from region to region, based on the nature of processes of production, whether imported or locally supplied as well as other market forces.

Table 63: Cost estimates in the iron and steel value chain

Commodity	Level	USD/ton of steel	Employment per 1000ton/yr steel	Investment USDM/job
Coal	0	25 – 70.00	-	-
Coking coal	0	55 – 700.00	-	-
Iron ore	1	50 - 200	0.17	0.85m
Iron	2	500.00		
Hot rolled coil	3	585.00	0.8	0.73m
Cold rolled coil	3	685.00		
Pipe and tube	3	960.00	20	0.15m
Structural steel	4	3000.00	30	0.05m
Logistics*	All levels	20.00		
Rail transport*	All levels	12 – 16.00		

(Source: DTI, South Africa, Bason, 2011 and *Kumba Iron report, 2008)

The market power has therefore tilted in favour of the leading global raw material suppliers. Zimbabwe and the other SADC countries endowed with high quality iron ore reserves can leverage on this scenario on two ends. Figure 85 below presents the possible scenarios. First of all the attractive market price for raw iron ore can create the possibility of direct exportation of iron ore (Route 1) when the prices are more attractive than steel. Route 2 can be followed to make low cost intermediary steel products leveraging on the fact that the domestic iron ore price will be low; and technologies adopted will be cost effective and efficient resulting in profitability of steel products even if prices were lower. The other routes (Route 3 and 4) could be further beneficiation to fabricated niche products with great value. A hybrid model can also be adopted which blends the four different routes with the major route being the production of low cost intermediary products (e.g. long and short products).

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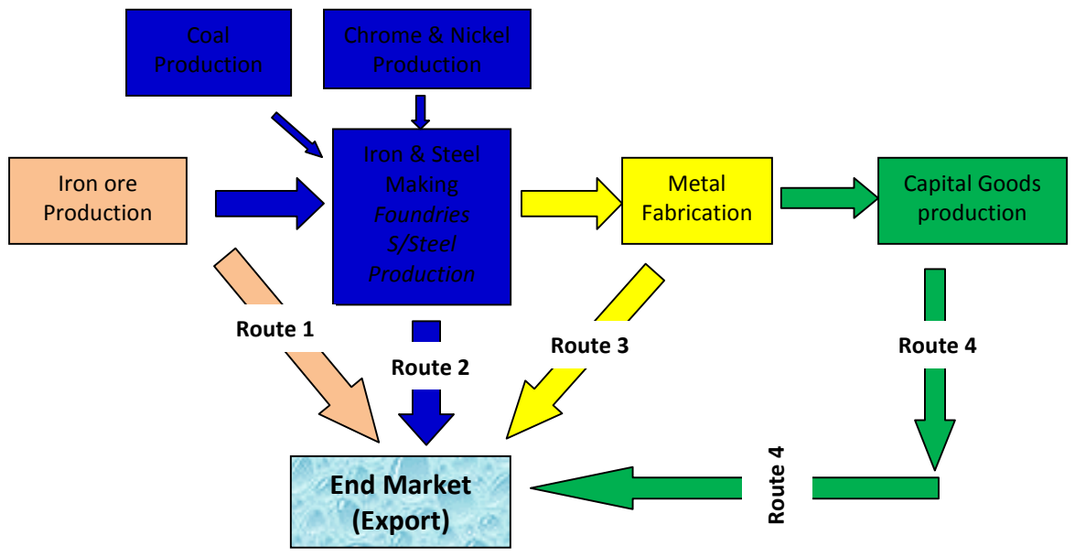

Figure 85: Possible iron and steel beneficiation routes depending on cost competitiveness

Table 64: Cost estimates in the iron and steel value chain

		USD/ton			Annual Revenues (US$/yr)	
Commodity	**Level**	**Price 1**	**Price 2**	**Production Capacity (Mtpa)**	**Worst Scenario**	**Best Scenario**
Iron ore	1	120.00	800.00	4	0.48Bn	3.2Bn
Iron	2	380.00	600.00	1.2	0.46Bn	0.72Bn
Carbon steel	2	600.00	736.00	1.2	0.72Bn	0.88Bn
Hot rolled coil	2	600.00	682.00	1.1	0.66Bn	0.75Bn
Cold rolled coil	2	685.00	800.00	1.1	0.75Bn	0.96Bn
Pipe and tube	3	960.00	1100.00	1	0.96Bn	1.1Bn
Stainless Steel	3	2500.00	3000.00	1	2.5Bn	3Bn
Structural Steel	4	700	900	1	0.7Bn	0.9Bn
Assembled goods	4	3000.00	4000.00	1	3Bn	4Bn

(Source: SIRDC Analysis, 2014, Prices from www.worldsteelprices.com)

Another interesting consideration is the feasibility of establishing Stainless steel production in Zimbabwe considering the great jump in revenue from iron ore to stainless steel products as shown in Table 64 above. The availability of chrome and nickel locally could make this route viable. A detailed feasibility study is therefore recommended for further assessment. Whilst a

policy position must exist on iron ore beneficiation, it must be conditional, proactively taking note of the dynamics on the global market. The possible scenarios on the global market are presented in Table 64.

Therefore Zimbabwe, South Africa, Zambia and Angola's competitiveness in the iron and steel industry is resource based and hence the country with the least iron ore, labour, power, coal and water costs has the edge. The labour competitiveness for Zimbabwe and Zambia is comparable with the average monthly salaries generally as follows; management – US$2500.00, fresh graduates – US$1400, technical workers – US$1000.00, unskilled/manual labour – US$150.00 (Ref; CV People Salary Survey, 2013 and Zambia Development Agency Report, 2012). However, South Africa's labour is more expensive, implying that Zimbabwe could leverage on that fact. The cost of power in Zambia at US$0.03 – US$0.04/kWh is one of the lowest in Africa (Zambian Development Agency Report, 2012), giving it a competitive edge over the South African one at about US$0.07/kWh and the Zimbabwean one over US$0.09/kWh. If Zimbabwe addresses the power, water and railroad network challenges, it has the potential to compete on low cost production. However, South Africa remains the regional giant with a production capacity able to meet the regional demand of steel and yet still remain with significant excess capacity (Kumba Iron Report, 2013).

4.5.1.2.5 Innovation

The performance parameters on technological levels and productivity of the old steel plants are much lower when compared to plants in developed countries. This was attributable to the poor quality of raw materials used in steelmaking (high impurities such as alumina and silica in iron ore, high ash content and variation of quality in coal) and the use of obsolete technology (hot blast temperature below 1000 ºC, lack of high top pressure operation, level of oxygen enrichment of hot blast, limited use of agglomerated feed such as sinter and pellet) in the older plants. The various critical performance parameters affected include blast furnace productivity, coke rate, energy consumption and blast furnace slag volume (See Table 65). The adoption of modern steelmaking technologies likeCorex, Finex and ITMk3 can utilisethe abundantly available iron ore fines and non-coking coal for iron-making instead of the expensive high grade iron ores and coking coal. Such technologies lead to significant improvements in raw material consumption, efficient energy use and compliance with environmental benchmarks and regulations.

Table 65: Performance of typical old plants as compared to global benchmarks (Source: IISAWorking Group Report, 2011)

Item	Unit	Typical Old Plant like ZISCO	Global benchmark
BF Productivity	(t/day/m^3 of working volume)	1.5 – 2.8	2.5 – 3.5
Coke Rate	(kg/t-HM)	500 - 600	350 - 400
PCI	(kg/t-HM)	50 - 100	150-250
BF Slag rate	(kg/t-HM)	300 - 400	200 - 300
Energy consumption	(G-cal/TCS)	6 – 6.5	4.4 – 5.5
SMS slag rate	(Kg/TCS)	180 - 200	Less than 100
CO_2 emission	(t/TCS)	2.8 - 3	1.7 – 1.9

N.B: t/day/m^3): tonnes of hot metal produced per day per cubic meter of blast furnace volume
(Kg/t-HM): kg consumed per tonne of hot metal
(Gcal/TCS):giga calorie per tonne of crude steel produced
(Kg/TCS): SMS slag consumed per tonne of crude steel

Table 65 shows that the innovative technologies recently introduced have the potential to double productivity, half the raw material costs, significantly reduce energy consumption and halve the environmental emissions. These technologies can in the longer term neutralise the resource based competitive edge of Zimbabwe to a technology centred global competitiveness. In this regard adoption of new technology is inevitable.

Another critical point of discussion is the decentralisation of steelmaking processes like steel milling. Whilst the conventional position is that the iron and steel industry survives on economies of scale, India is reported to have managed to innovatively establish successful small scale mills. Zimbabwe can also spread the risk by innovatively considering such smaller scale technology to minimise dependence on one huge integrated plant especially for the domestic market. Without such intervention, the iron and steel value chain breakdown similar to the existing one might recur without the necessary innovation.

4.5.1.3 Dimension 3: End Markets and Trade

4.5.1.3.1 End productsand consumer characteristics

Carbon steel is the most widely used engineering metal, despite its relatively limited corrosion resistance. It is a combination of iron and small quantities of carbon and other elements. Carbon steel finds application in marine construction, nuclear power and fossil fuel power plants, transportation, chemical processing, petroleum production and refining, pipelines, mining, construction, processing equipment, motor vehicles and household durables. The carbon steel is produced in two main forms namely flat and long steel products. Flat-rolled products consist principally of coils and plates while long products consist of wire rods and bars. ZISCO used to produce limited volumes of flat steel and long steel products for domestic as well as regional and international markets before closure.

The main consumers on the local market includedZISCO itself, Steelmakers, Lancashire Steel, Haggie Rand, NRZ, Morewear Industries, Hastt, Zimplow and the automotive industry amongst others. After ZISCO ceased operations primary steel products are imported from South Africa, China and India through distributors and agents with links to MNCs and regional giants. It is worth noting at this stage that most of the traditional actors and distributors ceased operations as a direct consequence of ZISCO's closure as they heavily depended on the steel plant for their raw materials. New distributors have though emerged on the local market. These distributors have become the key bridge closing the value chain gap created by the fall of ZISCO. According to our survey, the main distributors include BSI Steel, Africa Steel, Stainzim, Gilfun Steel amongst several others. Other smaller downstream actors import their own primary steel products using their own established linkages with global suppliers in China, India and South

Africa. The major industrial consumers of carbon steel have been building and construction, cables, wire products and gates, tube and pipe and automotive industry.

Stainless steelrefers to a group of corrosion resistant metals containing at least 10.5% chromium and varying amounts of nickel, molybdenum, titanium, and other elements. Although Zimbabwe produces some of the major metals and ingredients required to produce stainless steel, there is no single plant producing stainless steel resulting in downstream actors to rely heavily on imports from Asia and South Africa, which are also distributed through agents like BSI Steel, Stain Zim and Africa Steel amongst others. In the region, South Africa is a net exporter of stainless steel with Columbus Steel (part of the Spanish Acerinox Group, the third largest global producer) being the dominant producer. The global stainless steel industry is highly concentrated with the top ten producers (TK Steel; Arcelor; Acerinox Group; Avestra Polarit; Posco; Yusco, NSC, and three others) accounting for 60% of world output(Lundall et al., 2008).The stainless steel consumer goodssub-sector has been driven by the cookware and cutlery sector. The tank container subsectoris also a major consumer of stainless steel in Zimbabwe. The main use of tanks is for bulk transportation of foodstuffs, beverages and chemical liquids including petroleum. The industry has contracted mainly due to the entry of competitors into the market, mainly China and the increase in stainless steel prices.

Structural metal products (steels) are mainly linked to construction and building activities (where construction is seen as mainly civil projects and building refers to offices and residential housing). The products include frames, reinforcement steel bars, wires and ropes, windows, door frames, angle irons and sections, aluminium frames, tubes and pipes amongst others. In recent years, the global world trade in structural steel products grew at 11% per annum in value terms. Some of the local end markets for iron and steel making in Zimbabwe are presented in Table 66 below.

Table 66: Major end market actors for iron and steel making in Zimbabwe

Main Actor	Product Consumed	Location
ZISCO Steel	Long and flat products, sections, channels	Redcliff, Kwekwe
Steelmakers	Long and flat products, sections, channels	Redcliff, Kwekwe
Essar tubes and towers	Long and flat products, tubes, pipes	Harare
Scotia Steel	Long and flat products	Harare
Haggie Rand	Wires and rods	Kwekwe
Lancashire Steel	Wires and rods	Kwekwe
Almin Metals Industries	billets	Harare
Steelbase	Long and flat products, tubes, pipes	Harare, Bulawayo
DM Cartwright	Long products, sections, channels	Harare
Africa Steel	Long and flat products, sections, channels	Harare
BSI Steel	Long and flat products, sections, channels	Harare
Yeoman	Long products, sections, channels	Harare
Copper creations	Copper products	Harare
Cochrane Engineering	Plates and sheets	Harare
Stainless Steel Products	Stainless steel, long and flat products	Harare
Carnaud metal box	Plates and sheets	Harare
Henry Dunn Steel	Wires and rods	Harare

Lysaght and Company	Long and flat products	Harare
Nimr and Chapman	Billets, plates and sheets	Bulawayo
William Bain	Billets, etc.	Harare
Craster	Billets, ingots, etc.	Harare
Monarch Steel	Flat products	Bulawayo
Radar Metals	Angles, sections	Bulawayo

4.5.1.3.4 Consumer demand

Steel production is the driving force for almost all worldwide iron ore demand.Steel is a key input in the capital goods sector (construction and machine manufacture), for national development. The local (national), regional and global consumer demand perspectives are critical to the iron and steel value chain diagnostics.Value chain analysts have noted that thereis a strong correlation between iron and steel consumption and industrial production. The iron and steel industry is directly connectedto sectors that provide its inputs as well as those consuming its output as inputs. It is also indirectly linked with service industries such as transport, water supply, housing, hospitals and power supply amongst others. Therefore, the iron and steel industry as a pillar of a national economy and industrial development depends on its ability to generate industrial activities. In turn industrial development capability is depended on the degree and scale of interlinkages of the iron and steel industry in the national economy. The most significant link noted was with the capital goods sector whose output is critical in increasing productivity in other sectors of the economy. However, the iron and steel products must be of high quality and low cost to compete with similar imported products. Therefore growth in downstream industries will also reflect in the growth of the overall Zimbabwean economy.

During the RISCO era (1960s to early 70s), a wide range of products whichincluded light rods, window sections, fencing standards and droppers, light and heavy flats and angles, ploughshares and rounds were produced for both the domestic and export market. The main export products were pig iron, bar rod mill products and medium mill products which were mainly exported toBritain, Italy, Egypt, Japan and the Philippines. It was also noted that RISCO performed well during the federation days because of the expanded regional market which conveniently incorporated Zambia (then Northern Rhodesia) and Malawi (then Nyasaland) (Kaliyati, 1991).

During peak production in the 80s and 90s, about 80% of ZISCO's output was exported in the form of billets, blooms and pig iron. The20% consumed by the domestic marketfed into the various engineering and foundry firms for use in the production of various iron and steel products. These products included agricultural implements like groundnut shellers, hoes, axes, ploughs, harrows, etc, andtools like shovels, picks, etc., pipes, tubes, nails, bolts, etc. Ironically, at its peak production, Zimbabwe still imported a lot of iron and steel products (up to 58% of the consumed iron and steel products) (Kaliyati, 1991). The capital goods sector in Zimbabwe was also not highly developed thereby reducing the local demand of iron and steel products from ZISCO.

According to the key informants at ZISCO, the domestic consumption of iron and steel products within the last decade before closure was about 33% of total production tonnage. The major products were long products (construction and agricultural steel) and other products such as D Bars, channels, window sections, plough beams and shears. The major export products were billets which were exported mainly to South Africa and the Asian market. ZISCO also considered further value addition to the billets before export as well as the addition flat and stainless steel sheets later. The export market was lost with substitutes from South Africa and other markets. However, the key informants insisted that ZISCO could recover the market because of its comparative advantage which lay in the virgin steel which is not contaminated.

Regionally Zambia, Mozambique and South Africaare traditionally significant consumers of fabricated steel products such as steel fabricated structures, containers and vessels in the mining sector, construction and mining machineries, cars and trucks and electric appliances. The demand was estimated to be over 200,000 tons per year for Zambia alone (Zambia Development Agency Report, 2012), implying that the regional demand could be well over 600,000 tons per annum. The regional market demand for welded tubes and sections was projected to be 2.5 million tonnes by 2016. The mining equipment and steel products are also reported to be in high demand regionally. The high demand products include the grinding media (forged steel and high chromium), wire rod products (mining commodity ropes and mining chains) and cast products (mantles, bowls and mill liners; dragline parts; locomotive/ wagon frames and slag pots and ladles) (Kumba Iron Report, 2008). Considering the lost regional market for Zimbabwe, a strategically, effectively and optimally interlinked iron and steel value chain is required to regain the lost market. The new joint venture agreement with the Essar Group of India is expected to enhance the competitiveness of the iron and steel value chain through the opening up of marketing channels to increase exports.

The competition for the regional market must never be ignored in the resuscitation of the integrated iron and steel plant. Notable players in the field are South Africa and Zambia as the new entrant, Mozambique.The major iron and steel producers in Zambia include Good Time Steel (the first major steelmaking company formed in 2008 by Chinese investors), Universal Mining and Chemical Industries (UMCIL – the largest steel mill in the country) and MM Integrated steel mills (from Tanzania). These recent entrants produce hot rolled bars, deformed bars and long steel products for the local and regional market (Zambia Development Agency Report, 2012) from scrap metal unlike the case of Zimbabwe were iron ore is the major input. Although Zambia's current iron and steel making capacity at 0.12Mtpa is about 10% of the Zimbabwe's historical one, its self-sufficiency rating has increased implying that Zimbabwe may no longer export significant volumes into Zambia. Furthermore, Zambian expansion plants of the steel sector may imply increase market share in the region. South Africa on the other hand is a traditional power house, already with production capacity that exceeds the regional demand. Unlike Zimbabwe and Zambia, their production range is wide and also includes stainless steel of which it is a net exporter (Kumba Iron Ore Report, 2008). However, South Africa is not necessarily a low cost producer, whilst Zambia is due to low cost power, labour and water.

Zimbabwe must therefore re-enter this playfield tactfully, based on its competitive edge of abundance of raw materials as well as adopting reforms that transform the iron and steel sector into one of the most cost effective, efficient and lean systems in the world.

Globally steel demand grew at a CAGR of about 4.9 percent from 2007 to 2010 and was projected to continue along that trend for a considerable time (Basson, 2011). Zimbabwean production of steel at its peak is a paltry 0.09% of the global consumption (estimatedat 1400 million tonnes in 2011).During the period 2010 to 2011, China also accounted for 53% of the additional growth in steel demand (Bason, 2011).Comparisons of the net trade balances by some analysts for the years 2000, 2005 and 2010 alsoshowed that Africa and Middle-East were becoming large net importers of steel (Bason, 2011). This was attributable to the emergence of a young population and growing wealth from exports of oil and other mineral resources.However, the steel industry outside of these areas was reportedly strugglingand posting losses (Bason, 2011).There is hope that a prolonged strong demand in China and India will imply a prolonged period of stability and the opportunity for strong financial performance in the global steel industry. The existence of such global demand gives hope to the iron and steel industry in Zimbabwe, which must export and maximise on the economies of scale for it to survive. The joint venture with the Essar Group of India is therefore expected to come along with a sustainable export market considering the fact that India's demand for steel products has generally been increasing in the last decade.

4.5.1.3.5 End buyer perspectives

On the iron ore market, two iron ore prices exist; the spot price and the long-HS price. The spot price changes with the market, whilst the long-HS price is made at the beginning of a fiscal year, and has a long-term stability. However, the trading volume in the spot market is greater than in the long-HS market. The spot price is also based on the long-HS price. Although the spot price is sometimes higher than the long HS price, the ever increasing demand for the iron ore hasresulted in the long-HS price being significantly higher (Jiaqing and Lihui, 2010). Zimbabwe must therefore consider different marketing and trade agreements to ensure sustainable markets for iron and steel products.

4.5.1.3.6 Marketing and trade capacities

It was noted by several economist that the market in developing countries is not large enough to justify local iron and steel production even with substantial tariffs(Kumba Iron Report, 2008). It is therefore evident that in the Zimbabwean scenario, the size of the domestic demand for iron and steel does not necessarily give Zimbabwe's iron and steel industry a competitive edge on the global market. The dramatic changes to production costs with economies of scale mainly affect products such as sheets and plates.Common market initiatives amongst countries within the same region (e.g. COMESA) have been proposed to increase on the volumes. However challenges noted included location of the industry, unsuitable currencies, varying tax arrangements, existing contractual obligations with external stakeholders; differing political affiliations with developed countries (e.g. pro-West or pro-East inclinations) and conflicting country policies. Exploring ways of developing profitable small scale plants can be very relevant to the developing countries

with lower sizes of markets by taking a leaf from India, which is reported to have small steel mills operating efficiently and profitably. The global competitiveness of the local iron and steel industry was evaluated based on the ingredients for robust growth in the sector presented in Table 67.

Table 67: Evaluation of the global competitiveness of the iron and steel industry in Zimbabwe

	Requirements	Zimbabwe	South Africa	Australia	China	India	South Korea
Enablers of successful mining economies	Large scale, high quality iron ore reserves locally	√	√	√	x	x	x
	Sufficient global demand for iron ore	√	√	√	√	√	√
	Available and affordable infrastructure for mining	x	√	√	√	√	x
	Large scale, high quality coking coal locally	√	x	√	√	√	x
Enablers of successful steel economies	Steel production of global scale, exposed to local demand	x	x	x	√	√	√
	Coastal location of production, exposed to export markets	x	x	√	√	√	x
	Low input factor costs, vs competition, e.g. labour costs	x	x	x	√	√	x
	Capability to make high quality niche products	x	x	x	√	√	√

From Table 67 above, it can be shown that Zimbabwe's iron and steel industry is currently more inclined to the mining economy than a steel economy. It is only when the subsector becomes a low cost producer and also builds capacity to make high quality niche products that it could become a steel economy. In the South African case, it was noted that the cost of iron constituted an insignificant portion of input costs for downstream sectors to the extent that steel supplied to downstream actors for free would only yield a benefit of less than 1% (Kumba Iron Report, 2008). Despite having excess steel production capacity, South Africa was not able to export to the international markets since their production cost were 30 to 35% higher than global competitors. Zimbabwe can take a leaf from such a scenario and find ways of becoming cost competitive.

On the other hand, South Korea, without the key raw inputs have built a strong steel and manufacturing industry based on its closeness to large end user markets, high productivity and technological advancement. Thus the competitive advantages in the value added steel industry was found to emanate from proximity to markets, economies of scale (from large regional demand), coastal location of production to minimise rail costs and the ability to make high quality niche products (Kumba Iron Report, 2008). The daunting task in the Zimbabwean context is therefore to find answers of how such a landlocked country of low domestic demand and high input costs can play competitively on the global market. A great mountain for a competitive iron and steel value chain would therefore be the achievement of sustainable exportation of finished product (e.g. cold rolled product) of economic scale or cost structure. This transition to a steel economy could be further enhanced by the joint venture with India and Chinese and Asian actors who have the capacity to increase production facilities to global scales as well as expose the sector to large markets.The domestic market for steel products can then become a spin off driving the rest of the engineering and metals sector.

Due to the nature of the volumes required, significant capital investment from both government and private players is required. The new steel making plants must be of world class standards for competitiveness on the global market. Government subsidies and preferential support must also be considered in view of the state of competition in the value chain. Power generation expansion and refurbishment of the railroad network must inevitably be accomplished prior to such investment considering that Zimbabwe is landlocked and all routes to the ports, particularly Durban and Beira must be in the best conditions.

The country must also focus on the development of niche products with medium to long term competitive advantages on the global market. Since mining ad agriculture are the current mainstays of the economic, the manufacture of intermediate or finished steel components that support these industries and beyond can be attractive. As one analyst puts it, today's steel maker had to aim for one of the three strong positions namely "market share grabber", "value chain stretcher" or "niche player" and avoid being "struggler, "underdog" or "takeover target"(Ref).

4.5.1.4 Dimension 4: Value Chain Governance

4.5.1.4.1 Actor domination

The major decisions in a value chain depend mainly on the dominant actors who are usually the major shareholders in the value chain. The trends in the performance of the dominant player, ZISCO and its former owners (RISCO) can be easily linked to the major shareholders. Iron and steel production commenced in Zimbabwe in 1938 with a few private shareholders until the government took over in 1942 through the formation of the Rhodesian Iron and Steel Commission (RISCOM) which operated till 1956 (Kaliyati, 1991). Although RISCOM increased the production capacity during its reign, it experienced continuous losses for a period of seven years (from 1948 – 1955) and hence considered denationalisation which took place in 1957 to form the Rhodesia Iron and Steel Company (RISCO). It is worth noting that prior to

denationalisation in 1956, RISCOM had managed to turn around the fortunes based on government policy through the formation of the Federation of Rhodesia and Nyasaland and hence creating the market (Kaliyati, 1991).

A consortium of local and overseas interests formed the Rhodesian Iron and Steel Company (RISCO), thus taking over iron and steel production from RISCOM in 1957. The shareholding structure was government (10.7%); Messina Transvaal, South Africa (24.2%); Anglo American Corporation (22.6%); Stewards and Lloyds, South Africa (14.5%); Lancashire Steel, United Kingdom (14.5%), Roan Select Trust, United Kingdom (7%) and Tanganyika Concession (6.5%). The government, through the Rhodesian Steel Sales Corporation (Rhosales), in which the South African Iron and Steel Corporation (ISCOR) has shares, retained the marketing and distribution side. The diversified list of shareholders came with their links to finance as well as end markets that made RISCO viable throughout its operations. The shareholding structure changed again in the late 70s with the then government financing a significant portion of expansion programs for the plant. The government once again became the major shareholder.

This status quo remained intact till the recent joint venture deal with the Essar Group of India. It must be noted that the government domination in the iron and steel production has generally failed to yield sustainable results, probably due to the beaureocratic nature of government operations which limit the required proactive and quick decision making in a business environment. The new joint venture with the Essar Group to form New ZimSteel Private Limited is reportedly structured as follows (Mobb, 2011); Essar Africa Holdings (60% equity interest) and the Government (40% interest) to acquire and rehabilitate Zisco's steel facilities.Buchwa Iron Mining Company (BIMCO) was acquired through a joint venture of Essar Africa Holdings (80% equity interest) and the Government (20% interest) to form NewZim Minerals Private Ltd.The detailed ownership structure was reported to be Essar Africa Holdings, 53.4% interest; Government, 35.6%; Louth Mineral South Africa, 3%; Tonexon Investments, 2.79%; Lancashire Steel (Private) Ltd. of Zimbabwe, 1.76%; Stewards & Lloyds, 1.76%; Franconian Investments 0.81%; Amzim Iron and Steel Ltd., 0.75%, and Zambia Copperbelt Investment, 0.13% (Mobb, 2011). The dominance of the Essar Group is expected to bring along with it an export market that ensures full capacity utilisation as well as competitive technologies to sustain global relevance of the Zimbabwean iron and steel industry.

Globally China is the dominant actor in the steel sector. India has also increased its presence in the global steel market as a result of domestic steel consumption. The domestic demand in India is spurred by the rising middle class population, increased urbanisation, increased rural demand, automobile sectorgrowth and Indian railway expansion. India has now become the fourth largest producer of crude steel and the largest producer of iron in the world (Elliott, 2013). Since the dominant actors in steelmaking have been seriously affected by the high cost of raw materials (iron ore – 100% and coking coal 90% up since 2004) (Worldsteel Statistics, 2011), the steel makers have attempted to lock up the input costs through long term contracts, supplier acquisition or partnerships. As a result mergers and acquisitions beyond country and regional

borders have occurred all over the world in the steel industry in the last decade. The presence of excess capacity in the global steel market has also induced protectionist measures form a number of steel trading countries. China. The USA, EU, Canada and Thailand amongst others have also imposed measures against the importation of certain steel imports produced with excess capacity in their countries. However, new analysis by Ernst & Young suggests that despite the benefits in controlling raw material costs, it may not always have a positive benefit on enterprise value(Elliott, 2013). Thus steel mills have recently began to focus on their downstream supply chain to realize higher margins, thus helping to recover some of the profits lost in the market spread compression.

4.5.1.4.2 Participation in and distribution of value addition

The structures of the steel industry in a country have been found to affect sustainable profitability. Participation in iron and steelmaking has never been distributed amongst different players and generally was never at global scale. This heavy dependence on one major player can come with serious risks if not considered properly at policy level. A good case example was a conflict between the global giant, Arcelor Mittal South Africa and domestic consumer in South Africa (Financial Mail, 14 Sept 2007:12) It was alleged that the then suppressed downstream steel production was the pricing policy of the dominant supplier, which offered low prices to domestic consumers whilst offering higher prices to the export market. As a result the Competition Tribunal imposed a fine on Mittal for 'price fixing' and 'the manipulation of supply' in 2007 (Financial Mail, 14 Sept 2007:12). Such scenarios might occur in Zimbabwe considering the monopolistic nature of primary steel production characterised by a few dominant actors (New ZimSteel in Zimbabwe's case). Conflicts of interests between governments in the joint venture as well as individual companies must be addressed and win-win conclusive compromises reached for sustainable operation. The government policy and agreements between the supplier and downstream actors must fully address such potential conflicts.

Similar joint ventures in the iron and steel industry exist in the region, for example, SCAW, owned by South African shareholders has the largest steel foundry in Zambia (Zambia Development Agency Report, 2012). The Chinese have also invested heavily and established the first major steelmaking plant in Zambia (Zambia Development Agency Report, 2012), which supplies its products to more than 30 other downstream actors in the value chain. The Essar Group is also a dominant player in the iron ore production in Mozambique.

Globally, challenges were noted in the Chinese industry where a large number of traders and other intermediaries operating in the downstream supply chain control much of the industry. The steel mills only control about 35% of the supply chain. This case was similar to the Zimbabwean scenario where independent intermediaries, distributors and agents of foreign companies control the largest portion of the downstream steel supply chain since the collapse of ZISCO and its linkages. These companies simply buy and resell without adding value to the products. In Europe and America, steel mills control between 65 to 90% of the steel supply chain (Lichtenstein, 2012). The big question is the local business environment for the downstream actors when New

ZimSteel becomes fully operational. Zimbabwe can also follow the example of China which is targeting that its top 10 companies in the industry produce 60 to 70% of industry output by 2020.

4.5.1.4.3 Cluster concentration

In Zimbabwe, primary steel production was centred on ZISCO Steel, based in Redcliff as an optimal location for major inputs transportation. A cluster was then formed with downstream actors like Lancashire Steel, Haggie Rand and Steelmakers amongst others. This plant was also linked to the various actors in the iron and steel value located in the major cities through the railroad network. Consequently the challenges of the sole steelmaker drastically affected the direct downstream actors. Regionally, Zambia and South Africa have similar iron and steel sectors. Although primary steel production commenced recently in Zambia, three players are involved which reduces the consequences faced down stream by challenges to any one of the firms. These actors include Good Time Steel (the first major steelmaking company formed in 2008 by Chinese investors), Universal Mining and Chemical Industries (UMCIL – the largest steel mill in the country) and MM Integrated steel mills (from Tanzania). In South Africa the majority of primary steel production takes place in Mpumalanga due to the availability of raw material in the province, with quite a number of actors involved. Production plants also do exist in Newcastle and Saldanha near Cape Town (Merseta, 2006:32). On the other hand most value added production takes place in the Gauteng province due to extensive metals fabrication.

Globally, about 85% of production was still used in the region where it was produced signifying that the value chain is in the infancy stage of globalisation (ClaessensandHenderson 2007). Nevertheless a few companies have begun the transition approach to a global approach. The approaches adopted are i) production of crude steel in a low-cost region and selling it in a higher value market; ii) production of a semi-finished product in one region and finish it in another. It was found out that only 8 out of the top 40 steel companies in the world have “very strong” or “strong” production capabilities across multiple regions(ClaessensandHenderson, 2007). The steel industry concentration in China was found to lag behind that of other regions where the Top 5 producer share was already 60% or higher whilst the Chinese one was between 30 and 40% (Lichtenstein, 2012).

4.5.1.4.4 Type of governance

The type of governance in the Zimbabwean iron and steel industry will most likely be dependent on dependent based on the positions of the major shareholder, in this case Essar Group of India and the GoZ. In turn, the Essar Group strategic decisions will be greatly influenced by the Indian policies with regards to the iron and steel industry whilst GoZ’s will depend on Zimbabwean sectorial policies. The global approach of governance in iron and steel industry is one whereby iron ore producers generally set their own customer price contracts on the basis of global benchmark prices. Because transportation costs from the producers' port to the purchaser are generally paid for by the purchaser (referred to as freight on board), iron ore producers who ship their products over longer distances generally receive lower prices for their products than producers who ship to comparatively more proximate markets (www.northernironcorp.com).

4.5.1.5 Dimension 5: Sustainable Production and Energy Use

4.5.1.5.1 Use of materials, energy and water

The increasing volatility and levels in the cost of raw materials for steelmaking have been shown to have significant impact on the sustainability of the steel industry. The establishment of an efficient and productive Zimbabwean iron and steelmaking industry could have a competitive edge due to the availability of the raw materials which are the major cause for price volatility and high levels of intermediate consumption. Figure 86 which presents the composition of gross output in the global iron and steel value chain shows that the highest intermediate consumption and lowest value added occurs at Level 2, which is the steel making process due to the cost of raw materials.

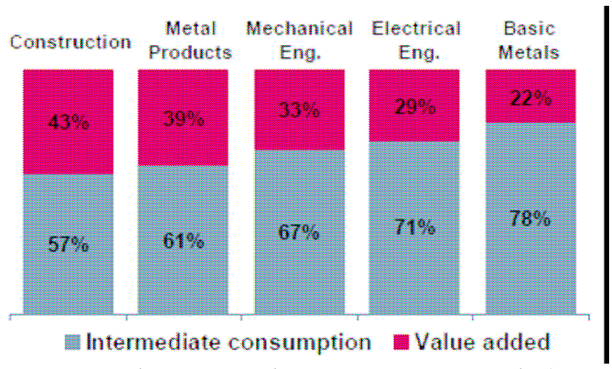

Figure 86: Composition of gross output in the global iron and steel value chain (Bason, 2011)

Electricity production is significant in the iron and steel sector. Currently Zimbabwe faces power shortages and the erratic supply of power. As earlier mentioned the insufficient supply of power was one of the major causes of low capacity utilisation as well as closure of the integrated steelmaking plant. It is important therefore to ensure that energy availability, energy efficient technologies as well as proper demand side management issues are incorporated in any new steelmaking investment at policy level. Parts of the waste gases stemming from the coke oven, the blast furnace (BF) or the basic oxygen furnace (BOF) can be used for electricity production. Power plants burning the waste gases can either be owned by the furnace operator or an external electricity producing company. Electricity production takes place at the site where waste gases occur and is usually consumed by the site itself. The overall electricity demand of the iron and steel sector can however not be covered by waste gas electricity alone. According to a survey on electricity consumption in the steel sector by Eurofer (Eurofer, 2009 report), hot metal production, the EAF route and steel milling were the major consumers of electricity (Table 68).Reliable supply of low cost electricity is therefore a must for sustainable steelmaking in Zimbabwe. A good benchmark on cost would be Zambia, whose electricity cost ranges between $US0.03 and 0.04/kWh.

Table 68: Approximate electricity consumption (average 2005-2008) from the iron and steel production chain in Europe (Source: Eurofer 2009 iron and steel sector report)

Activity	Production Vol. (EU) (Mt)	Electricity consumption (kWh/t/product)	Share in total sector consumption (%)
Hot metal	113	103	16.8
Coke	46	6	0.4
Sinter	128	27	5
EAF	81	440	51.6
Hot rolled steel	62	120	10.8
Processed steel	90		14.8
Cold rolled steel	50	185	13.4
Coated steel	40	25	1.5
Foundry products	4	100	0.6

The key informants (Annex 7 and 8) proposed preferential agreement with ZESA on tariffs and power supply. They also proposed investment in an independent local coal fired power plant to ensure continuous coal supply. For instance special agreements with HCCL and NRZ for coal supply and transport provision respectivelycan improve reliability of operations. Water was also another critical resource which led to the closure of the plant and hence similar agreements with Kwekwe Municipality must be sealed.

4.5.1.5.2 Environmental Management

According to the key informants, ZISCO has always upheld good environmental management practices when it operated through the effective implementation of an environmental management program which was backed with infrastructure and facilities to ensure a health and safe environment.

4.5.1.6 Dimension 6: Value Chain Finance

4.5.1.6.1 Financial attractiveness and risks

According to key informants (Annex 9), ZISCO was not financially supported by banks and financial institutions except for the Commercial Bank of Zimbabwe (CBZ).The major reasons were that it was a bad debtor with a chequered history and that it was loss making. Financial woes were worsened by the fact that it was on the sanctions list, and hence scaring away any financial investment and borrowing because of the high risk. The other risks noted the unreliability of supply of the major raw materials supplies in good quality and quantity. This situation was further worsened by the dysfunctional railroad network resulting in high logistical costs relative to the regional benchmarks. Policy uncertainty especially associated with the indigenisation laws and the general state of the business environment has also contributed to the lower attractiveness of the sector. Nevertheless, iron and steel production in Zimbabwe could be one of the most financially attractive sector in the region once the infrastructure and policy frameworks that ensure low cost production are established. This is due to the availability of almost all the resources required for primary steel production locally.

4.5.1.6.2 Availability of financing

The availability of funding has never been easy in the history of capitalising primary steel production in Zimbabwe. Although some private players injected some funds, the major financiers were usually big external steel actors with the involvement of governments. It was typically facilitated arrangements between the government of Zimbabwe (or then Rhodesia) and the developed nations like UK, German, Switzerland and Japan amongst others. Payment in kind through the shipment of iron ore, pig iron and steel products was the other traditional model of payment. Recently the conversion of debt into equity model was used in the Essar Deal (Mobb, 2011). The availability of funds for borrowing from the banks was also limited and not attractive to the sector as it was short term and the interest rates were very high (>14%).

In March 2010, Essar Africa Holdings agreed to invest $750 million in the New ZimSteel project which would pay off Zisco's debts and provide working capital for the steel operations. Essar Africa Holdings also agreed to restore the plant to a 500,000 ton/year production capacity initially and within three years to restore the steel plant's capacity to 1.2Mt per year.

Historically funding for the iron and steel industry has mainly come from government, some private consortiums as well as developed countries seeking to strengthen their value chains. Other forms of payment have been payments in kind as in the case of the Kawasaki Steel Corporation of Japan for the supply and installation of Blast Furnace No. 3 at RISCO, Redcliff in 1961 (Kaliyati, 1991). The payment terms were the shipment of 360 000 tons of pig iron and 600 000 tons of iron ore to Japan per annum until a total of 50 million tonnes been shipped. The same arrangement was used during the UDI period when financial institutions from the Federal Republic of Germany, South Africa, Austria, Switzerland and Rhodesia (including representatives from RISCO) funded the expansion programme at Redcliff. Steel was shipped to the concerned countries as payment according to Kaliyati (1991). After independence, the government injected funding into ZISCO, without realising significant financial returns due to several challenges both within and outside their control. The new investor's has come with the approach of turning debt into equity. It is hoped that the participation of a private player as the dominant shareholder can enhance financial performance of primary steel production.

4.5.1.7 Dimension 7: Business Environment and Socioeconomic context

The samebusiness environment that prevailed in the general Level 3 context applied to the iron and steel making sector. Little information was however availed from the key informants since ZISCO ceased operations a significant while ago. However the social impacts on the livelihoods of people living in Redcliff were quite severe according to the field survey observations and key informants. Employment levels dropped from about 5400 during peak production to about the current 2000. Because of the absence of production, workers have also not been paid for a long time. Business spin offs in Redcliff and Kwekwe have also been severely affected by the closure of one of the mainstay of Redcliff, Kwekwe and the Midlands province of Zimbabwe.

4.5.1.8 Key findings

The key findings are summarised as follows

- Low iron and steelmaking capacity utilisation (best achieved) as compared to global figures (58% vs. 81%) due to power and water shortages and inconsistent supplies of inputs due to infrastructural challenges and unreliable input suppliers
- Low installed capacity as compared to global producers making the chain less competitive
- Current technology inferior to emerging technologies and hence threat to competitiveness
- High cost of electricity as compared to global and regional players
- Unreliable supply of major raw materials in the required quantities and quality
- Dysfunctional railroad network increasing cost
- Low confidence of lenders with the sector

4.5.2 PLATINUM GROUP METALS (PGMs)

The major sources of information for this section have been the extensive documents that are available on this sector. The country has the second largest known deposits of PGMs in the world with three mines operating namely Zimplats in Selous (Ngezi), Mimosa in Zvishavane; and Unki in Shurugwi (Mobb, 2011). The three companies own over 200Moz. 4E (over 8000t) of PGM resources with Zimplats owning the majority of the reserves and resources (>80%), followed by Unki (~12%) and lastly Mimosa (~8%) (Company reports). The 4Es include platinum, palladium, gold and rhodium. However, copper, nickel and cobalt are the other by products of PGM refining. The major ore grades vary between 3.32 and 3.43 g/t 4E PGMs (Zimplats, Mimosa, and Unki Reports). The value addition process for the PGMs includes mining, concentration, smelting, converting and the converter matte is exported to South Africa for refining. Figure 87 shows the PGM value chain map in Zimbabwe.

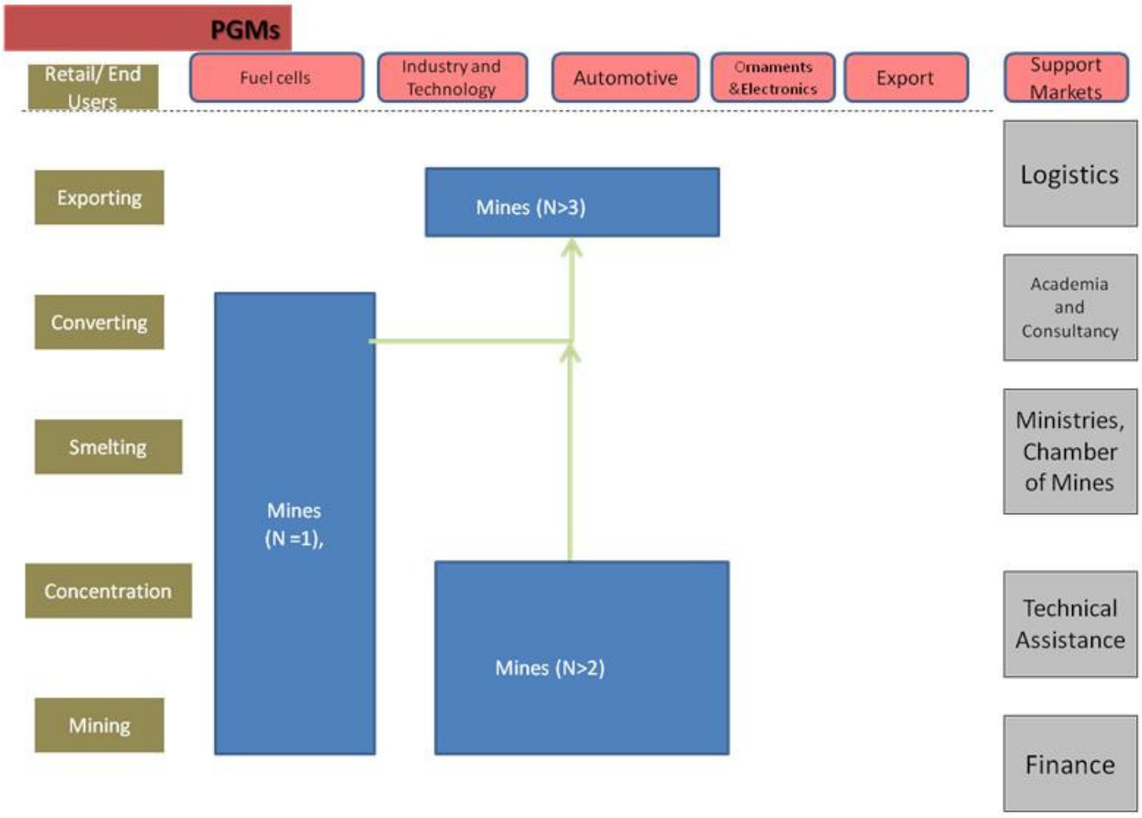

Figure 87: PGMs Value Chain Map

4.5.2.1 Dimension 1: Sources of Inputs and Supplies

4.5.2.1.1 Primary product characteristics

The platinum-group metals (PGMs) are extremely scarce by comparison, to other precious metals, which is due both to their low natural abundance and to the complex processes required for their extraction and refining. Relative to the other precious metals (Au and Ag) the PGMs have high technological properties which they possess. The six PGMs, ruthenium (Ru), rhodium (Rh), palladium (Pd), osmium (Os), iridium (Ir), and platinum (Pt), together with gold (Au) and silver(Ag) have been considered to be 'precious' metals. They are all sufficiently ductile and malleable to be drawn into wire, rolled into sheet or formed by spinning and sampling. Valuable for their resistance to corrosion and oxidation, high melting points, electrical conductivity, and catalytic activity, these elements have wide industrial applications. The major uses are found in the chemical, electrical, electronic, glass, and automotive industries. However, the application of platinum group metals in the automotive industry is fairly recent, resulting from emission-control legislation in the USA (Xiao and Laplante, 2004).

The primary inputs or raw materials for processing platinum group metals are: ore, milling consumables (steel balls), matte, oxygen, flotation reagents (frothers, collectors, modifiers, and regulators), smelting fluxes and other chemicals, and energy (coke, electricity and generators).PGMs are also obtained as by-products from nickel-copper refineries in Zimbabwe

from the RioZim Empress Nickel Refinery, which treats matte from Botswana. The products from the extraction of the PGMs in Zimbabwe are (1) PGMs concentrate (product from froth flotation), (2) PGMs matte (PGMs concentrate from smelting) and (3) PGMs by-product of base metal refining.

The chemical reagents are required to facilitate the chemistry in the extraction of PMGs. PGMs refining or separation of the metal elements is currently being done in South Africa. Most of the inputs required all the inputs requiredare supplied from SADC. The main actors locally procure more than 60% of their inputs locally (Zimplats Integrated Report, 2013) with one of the players reported to have procured about 92% of inputs locally (Mimosa Operational Review, 2013).The mineral processing activities rely heavily on electricity to fuel the various energy requirements for mineral extraction. Although power shortages exist in Zimbabwe, the PGM sector has secured a 5 year supply agreement with the national power supplier.

There are only three major companies that process PGMs in Zimbabwe. Of the three firms, two process up to a froth flotation concentrate, and exports the concentrate to South Africa for smelting and refining. The other firm processes up to the converter matte, after smelting the froth flotation concentrate, and the company exports the converter matte to South Africa for refining to recover the metal products. All the companies do not cover all functions of the value chain.Five other platinum projects where at different stages of resource identification and the platinum industry has the greatest prospect for immediate development(Mobb, 2011).The actors are summarised in Table 69 below.

Table 69: Major actors in the PGMs industry of Zimbabwe

Major Actor	Product Range	Location
Zimplats Mines	PGMs	Ngezi
Unki Mines	PGMs	Shurugwi
Mimosa Mine	PGMs	Zvishavane
Todal Mine	Project Development	Shurugwi
Ruschrome	Project Development	Darwendale

Globally, South Africa dominates production through Anglo Platinum, Impala Platinum and Lonmin amongst others. Russia is the second largest producer of platinum through Norilsk.

4.5.2.2 Dimension 2: Production Capacity and Technology Use

4.5.2.2.1 Production Capacity

The current ore extraction capacity from the three mining operations is over 8Mt of ore producing over 20t 4E of PGMs. Of the produced PGMs, about 52% is Platinum, 38% Palladium, 6% Gold and 4% Rhodium (Mobb, 2011 and company reports). The end product (matte and concentrate) are sent to South Africa, Anglo Platinum and Aquarius Platinum for refining. About 7500t and 6000t of nickel and copper respectively are also produced as by-products of PGM refining. The companies projected production period extending to between

2038 and 2055 depending on reserves and resources and the estimated extraction rates. Capacity utilisation in 2013 for the sector was over 77%.

The production of PGMstakes place in a few countries since the reserves are found in a few countries that include South Africa, Russia and Zimbabwe amongst a few others. South Africa has 88% of known world reservesof PGMs followed by Zimbabwe and then Russia. South Africa produced about 81% (213.9t) and 39% (226t) of world's platinum and palladium in 2006 respectively, whilst Russia produced 11% (29t) and 45% (261t) respectively (Steinweg, 2008). Worldwide, there are currently fewer than ten PGM mining companies. Russia is the world's largest source of palladium through Norilsk. Norilskwas also reported to be a significant producer of platinum (13%) and rhodium (11%), yielding 28% of the world's PGM supply (Steinweg, 2008). These comparative figures show that Zimbabwe's production of platinum is very small compared to the South African production. However, Russian production of platinum, though greater than Zimbabwe's is comparable (29t vs 11t). Zimbabwe's palladium is significantly lower than SAs and Russia's production (<4%). This is despite the fact that Zimbabwe's PGM reserves are reported to be larger than Russia's. Therefore Zimbabwe has the potential to overtake Russia in production through expansion of mining operations as well as increasing processing capacity.

4.5.2.2.2 Technology Use

Metallurgical processes for the extraction of PGE from sulfide ores consist of crushing, grinding, and froth flotation (Evans *2002*). The PGM grains usually float together with the sulfides, either as discrete grains or attached to or as inclusions within sulfide grains. The sulfide concentrate is treated by smelting and refining to recover the base metals (BM; e.g., Ni, Cu, and Co). Afterwards the PGE are extracted as a residual precious metal concentrate from the base–metal refinery (Evans *2002*). In Zimbabwe, one actor processes up to the converter matte, whilst the other two process up to the PGM concentrate. The process flows are summarised in Figure 88 below;

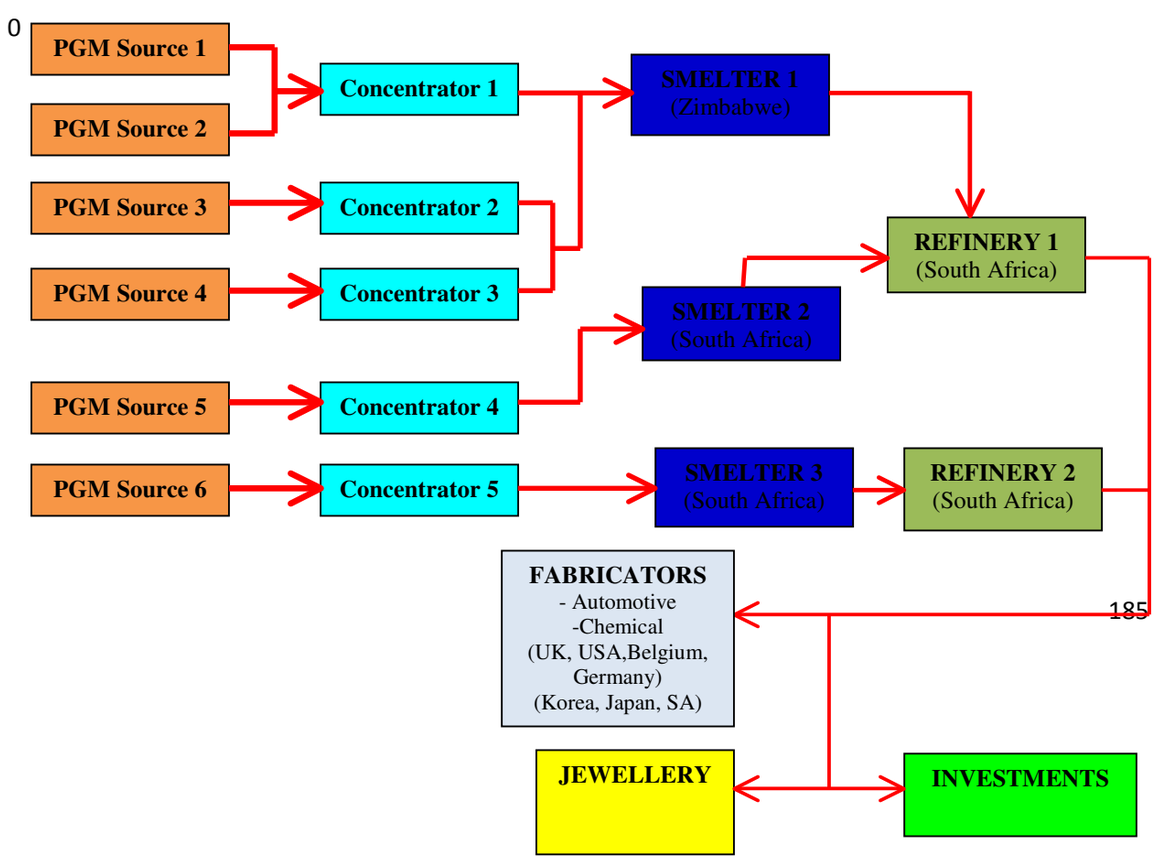

Figure 88: The Global Value Chain Map for Zimbabwean PGMs

The processing of PGMs from Zimbabwe follows a global value chain which begins with PGM ores from at least 6 sources in Zimbabwe. All the ores are concentrated in Zimbabwe, whilst all the concentrates from one actor are smelted in Zimbabwe whilst the concentrates from the other two actors are smelted in South Africa. All refining is done in South Africa whilst fabrication into various products like autocatalytic convertors and chemical catalysts is mainly done in the EU (Johnson Matthey in UK, UmiCore in Belgium, Haereus in Germany), China and Japan (Steinweg, 2008). It was also reported that South Africa produces about 12% of the world's catalytic convertors (Kumba iron ore report, 2013). Jewellery is mainly produced in Japan and China. South Africa also produces considerable quantities of jewellery due to the abundance of gold.

The GoZ through ZimAsset programs emphasises on metal beneficiation of which the introduction of a PGM refinery is the talk of the moment. As a result a more detailed analysis of the PGM beneficiation process was necessitated. A paper presented by Cramer, 2008 on the Third International Platinum Conference 'Platinum in Transformation' discusses platinum beneficiation in detail.

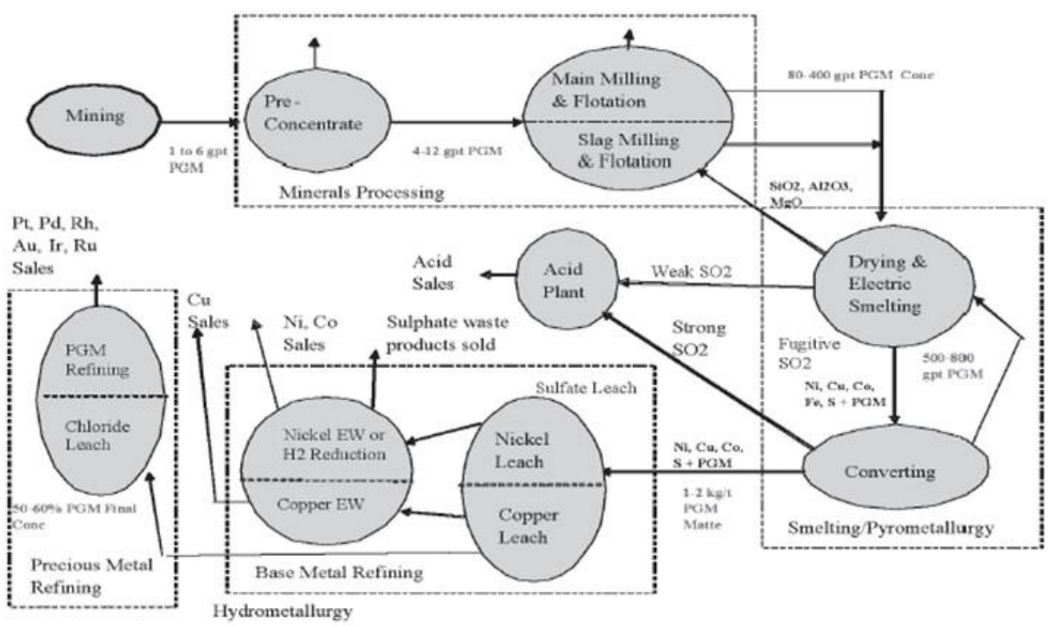

Figure 89: Typical PGM flow sheet (Source: Cramer, 2008)

Figure 89 above presents the typical PGM process flow sheet. Several steps are taken to extract and separate valuable metals from the PGM flotation concentrates as shown inFigure 89 above. The main steps are mineral processing (80-400gpt PGM concentrates), smelting/pyrometallurgy (1-2kg/t PGM matte), base metal refining/hydrometallurgy (Cu, Ni, Co, 50 -60% PGM conc.) and precious metal refining (Pt, Pd, Rh, Au, Ir, Ru). The smelting consists of concentrate drying to remove moisture, electric smelting to remove the silicates, aluminates, magnesia and most iron as slags, sulphur content reduction through conversion of the furnace matte and iron removal, gas cleaning and SO_2 capture as sulphuric acid and matte granulation or crushing. Base metal refining consists of milling, sulphate leaching, impurity removal (Se, Pb, and Zn), Cu electrowinning, cobalt removal and recovery, Ni electrowinning or hydrogen reduction and sulphur disposal. The residue from the base metal refining process is transferred to the process of PGM separation and refining. The processes involved at these last stages are leaching, solvent extraction, ion exchange, precipitation, distillation, effluent treatment and metal preparation. In base and precious metal refining forming, packaging, storage, marketing and shipment of the purified metals can be resource intensive. The high security levels in the precious metal sector also add significant costs.

Conventionally, rotary kilns, multiple hearth dryers, spray driers and flash driers have been used. These technologies are currently being replaced by flash driers. Circular and rectangular submerged arc furnaces with capacities ranging from 2MVA to about 65 MVA are commonly used to produce furnace mattes. Larger furnaces were generally found to be more energy efficient and hence having positive impact on the smelting costs. In converting the furnace mattes, Ausmelt process has replaced the Pierce – Smith conversion technology.Slag milling is also used to recover PGM value and recycle slag milling flotation concentrates to the smelter and in others slag cleaning furnaces to improve overall recoveries.

The refining processes are generally capital intensive and require higher levels of technical skills. The recovery process for the valuable metals (nickel, copper, cobalt, platinum, palladium, rhodium, gold, iridium, ruthenium, and osmium) and individual metal separationis considered a complicated and time - consuming technical process. As such high grade residues or intermediate products are shipped overseas to specialist refiners for treatment, therebyincreasing the operating cost and the process inventory of metals.

4.5.2.2.3 Production Costs and margins

According to reports from the main PGM actors in Zimbabwe, the cash cost of production ranged between US$1287.00/oz Pt (US$41516/kgPt and US$1 782/oz Pt (US$57, 483.00/kgPt).The gross revenue on the other hand ranged between US$2432.00/oz Pt (US$78452.00/kg Pt) and US$2 528.00/oz Pt (US$81548.00/kg Pt). The net profit for 2013 ranged between 3 and 14.5% (Zimplats, Integrated Report, 2013). The overall revenue from the three actors was over US$800million dollars according to the reports. Although the production costs generally increased for 2013, they were significantly lower for the previous two years and

one of the actors remained a low cost producer for platinum. Since it is within the interest of the government for the PGM actors to establish a refinery, it may be worthwhile to present some insights from a paper presented by Cramer in 2008.

4.5.2.2.4 Economic factors in concentrate treatment

The major factors affecting the economics of PGM floatation concentrates processing are i) operating costs for the metallurgical processes, ii) the capital costs of establishing the facilities for these processes, iii) the metallurgical process efficiencies of first pass and ultimate recoveries andiv) the costs of financing the significant inventory of the highly valued metals. The other factors are the chromite content of the concentrate, the form and purity of the final refined base metals, sales of waste products such as sulphuric acid and base metal refinery sulphates, and the level of discounts offered to final PGM purchasers (motor car manufacturers, etc.). Refining costs also depend upon the available capacity and the lower the capacity utilisation, then the lower the price given to concentrate suppliers.Cramer, 2008estimated fixed costs in smelting and refining to be very high. The smelting cost were approximated to be 50% fixed costs, base metal refining about 65% and the precious metals refining operations to be about 85%.

Operating costs – OPEX

The major cost driver of smelting was the tonnage of concentrate to be smelted whilst converting and acid plant costs were driven by base metal and sulphur content of the concentrate. Smelting average costs were estimated betweenUS$80.00 and US$140.00/t of concentrate smelted (average of US$120.00/t). Base metal refining cost aremainly driven by the cost of neutralizing the acid formed and sulphur disposal, electrical costs of electrowinning, cutting and packing of the final products; all of which are tonnage driven. The base metal refining costs in the industry varied between US$1000.00 and US$1400/t of matte (average of US$1300.00/t). Precious metal refining costs are typically fixed in nature and consumables such as power, chemicals, resins, etc. are a small part of the operating costs. Fixed costs items such as labour, security, administration, effluent treatment, maintenance costs, etc. are rarely affected by the volume of PGMs being processed. The refining costs for PGMs were noted to be much lower than those in Europe where labour costs are high and form a significant portion of the fixed cost component. TheSouth African PGM refining costswere estimated atUS$306451.00/t of 4E PGM (Cramer, 2008).

Table 70: Process operations investments (capital per unit of capacity per annum – Greenfield projects) (Source: Cramer, 2008)

Investment	Min. cost (US$million/ton)	Max cost (US$million/ton
Smelter – concentrate tons	700.00	900.00
Base metal refining – matte tons	8000.00	10000.00
Precious metal refining – 4Eoz	150.00	2000.00

The capital cost of establishing processing facilities is a significant cost adding affecting the price (see Table 70). If the investment finances are borrowed, then the cost of finance may contribute significantly to the cost of sales.The other minor factors are the holding cost of the metalinventory (notably the platinum and rhodium inventory), metallurgical efficiencies, and the sales discounts. The distribution of costs are as follows; Opex costs 10–12% of Metal value, Capex costs 2–14% Efficiencies 3–4%, Inventory costs 1–3% Discounts to LME 1–3%.

Russian and Canadian producers benefit greatly from a significant yield of nickel and copper by-products. For South African and Zimbabwean producers, which yield PGMs as their main source of revenue, the Western Limb of the BIC is estimated to have the highest net cash margin of $291/4E oz. The region's higher platinum to palladium ratio, compared to other local regions, achieves the most favourable basket price of $730/4E oz. Mining operations in Zimbabwe and the Eastern Limb are mostly in ramp-up and not all mines have reached steady state, making direct like-for-like comparisons difficult. However, with greater mining efficiency being achieved by reaching steady-state output, the economics of these regions will improve.

4.5.2.3 Dimension 3: End Markets and Trade

4.5.2.3.1 End products

The end products of the Zimbabwean processes are PGM concentrates and converter matte. It must be noted that the transportation cost are quite significant as they could be 6 times more costly due to the bulkier concentrates as compared to the refined metals. Globally, the final product will include platinum group metals (platinum, rhodium, ruthenium, osmium and palladium), precious metals (gold, silver) and base metals (copper, nickel, cobalt).Applications for the PGMs include chemical processing, catalytic processes and engineering to transport equipment, automotive, electronics, packaging, and construction and to jewellery, aerospace, lasers, lighting, medical equipment, fibre optics transmission, military radar and missile guidance, solar energy and many more. Most of these downstream applications of PGMs are located outside the country. The end products can be classified as refined metals, fabricated products and jewellery. One PGM fabricator, Johnson Matthey, based in UK and having divisions all over the world manufactures glass industry products, laboratory apparatus, crucibles, wire, tube and sheet products, catalyst gauze, jewellery alloys andbrazing alloys. It also fabricates PGM salts and precursors, emission control catalysts, process/petroleum catalysts, Passive component materials, fuel cell components, gas purification andplating salts (Steinweg, 2008). The fabricating plants are distributed in Siberia, South Korea, South Africa, Japan, UK, USA and Canada. The main fabricated products find application in catalytic convertors for automobiles, fuel cells and electronics.

4.5.2.3.2 Consumer demand

The outlook for the PGM sector is for overall demand to exceed supply due to continuing fundamental deficits in supply for platinum and palladium, as well as a possible deficit in supply for rhodium in the event of continued disruption to production in South Africa. Despite recent economic conditions resulting in a contraction of demand in certain sectors, the overall demand for PGMs has remained consistent and will continue to increase, driven by more stringent requirements for catalytic converters in automobiles and consumer demand for jewellery, while industrial action in the South African PGM sector during 2012 and increases in production costs will result in reduced supply.

Trends in PGM demand

Platinum

- Notwithstanding platinum's sustained high price, autocatalytic offtake (driven by increasing global regulation of exhaust emissions) remains firm. However, high prices are negatively affecting platinum jewellery sales.
- Global platinum demand is estimated to have grown by 3% in 2005 to 7.5 million oz.

Auto catalyst sector

The auto-catalyst sector is the most important end-user of PGMs. Increasingly stringent environmental legislation and the spread of regulation into more engine sectors globally have created a huge ongoing market for platinum, palladium and rhodium. Platinum competes with palladium for use in gasoline-powered vehicles, whilst only platinum is suitable for diesel engine systems. Platinum alone has the properties to deliver the required performance under the lean-burn, low exhaust temperatures of the diesel engine exhaust. Sales of platinum-based diesel engine catalysts are steadily increasing as lower running costs make diesel vehicles a more popular car choice. Looking ahead, tightening exhaust emission regulations worldwide for both light and heavy diesel engines will mean increased use of platinum-rich catalysts. Market penetration of diesel light vehicles in some parts of the world, notably North America, has been very low compared to that in Europe, but is expected to rise as fuel economy becomes a more important factor in car purchasing. Indeed, Europe saw a 17% increase in autocatalyst demand for platinum, reflecting the steep growth in diesel car sales, which is estimated to have made up just over 50% of the European car market for 2005. However, this pattern is not reflected elsewhere in the world. Japanese demand was down 3% at 590 koz in 2005, but this is due to considerable restocking in 2004 inflating the previous year's data.

Vehicle production in Japan still increased, owing mainly to new emission legislation affecting the heavy-duty vehicle sector. In North America, platinum demand was up 2.5% to 820 koz. Growth was restricted owing to the substitution of platinum by palladium in gasoline autocatalysts and poor sales from major domestic automobile manufacturers, but was offset by increasing sales of Japanese vehicles, where the diesel market remains very small. Chinese vehicle production was up 15%, along with increases in India, South Korea and Thailand. These output rises, coupled with the parallel tightening of emission standards, contributed to a growth in demand for platinum, up 13% in the rest of the world.

Jewellery sector

Global demand for platinum jewellery, accounting for 26% of total platinum utilization, is estimated to have declined by 200 koz in 2005, largely attributable to the sustained high platinum price of over $800/oz (double that of gold) over the past two years. European consumption (195 koz) has been steady and this is forecast to continue, while demand in China (875 koz), Japan (510 koz) and the USA (275 koz) has become more price elastic, resulting in lower sales. Chinese platinum usage (accounting for around 45% of world demand) has been particularly affected by the substitution of white gold and palladium, falling 13% since 2004. Over the next two years, global jewellery demand is estimated to rise by only a modest 2% (50 koz) annually.

Electronics sector

Platinum is used in the magnetic layers of all hard disks and, to achieve higher data densities and faster access times, the levels used in the cobalt-based magnetic alloy continue to increase. With the proliferation of hard-disk devices, such as recordable DVD players and personal digital music players, in addition to the more slowly growing established computer market, platinum usage rose by 20% in 2005 to 360 koz. This trend is expected to continue through 2006.

Glass and glass fibre manufacture

Demand for platinum in 2005 has risen by 22% to 355 koz, driven by the consumer products market. In Japan, Taiwan, South Korea and Singapore over 20 new production lines have been constructed for the manufacture of high-quality glass to meet the demand for flat-panel displays. These lines use platinum and rhodium to make stirrers and crucibles for molten glass handling. Continued growth is expected in 2006. In 2004, new glass fibre production capacity in China also helped to boost the glass sector's requirement for platinum. With the glass fibre industry known to be opaque, verifiable demand figures are hard to come by but, allowing for anticipated growth, combined glass and glass fibre utilization could equate to around 416 koz of platinum by 2008.

Petroleum refining industry

Consumption of platinum in the petroleum industry has risen 3% to 155 koz in 2005. Strong global demand and tight supply have meant that petroleum refineries have been operating at or very close to capacity in 2005, so catalyst beds have been topped up more frequently. The future prospects for platinum in petroleum refining were reported to be stable, with the sector demand steadying at around 170 koz per year. Attempts at reducing the platinum (and ruthenium) content of the bi-metallic catalysts used in reforming petroleum have shown that a loss in catalyst performance can occur. Limitations on PGM reduction in this sector have meant that PGM use is assured in the medium term. With no reason to believe that continued use of bi-metallic catalysts will be called into question, platinum's role in this area will be ongoing, without showing extraordinary growth and trailing the fortunes of the petroleum refining industry.

Investment sector

In North America and Japan (the major investment sectors), demand for coins and small and large bar investment have fallen because of the ongoing high price regime for platinum. In fact, total investment demand in 2005 reduced from 45 koz to 30 koz, according to ***Johnson Matthey***.

Palladium

- Autocatalyst demand remains stagnant from thrifting and increasing diesel car sales, which favour platinum over palladium.
- Palladium usage in jewellery has surged, as consumers take advantage of its lower cost than platinum or gold and higher purity than white gold.

- Jewellery offtake was largely responsible for global demand growth of 8% to 7.7 million oz in 2005.

4.5.2.4 Dimension 4: Value Chain Governance

4.5.2.4.1 Actor domination

In order to evaluate the power dynamics in the value chain, it is necessary to study the three major PGMs processing companies in Zimbabwe. Zimplats the major actor is owned by Anglo Platinum, a subsidiary of the Anglo American Group which owns more than 70% of the share. Mimosa is owned by Mimosa Investments of Mauritius, with links to Aquarius Platinum of South Africa, whilst Unki Mine is owned by Anglo American Platinum (Mobb, 2011), all MultiNational or regional companies. Therefore the PGM value chain is a global one cutting across continents and regions, with primary production occurring in Zimbabwe, secondary processing including refining taking place in South Africa and Europe whilst much of the fabrication and end products are manufactured in Europe, North America and Asia, closer to the major end markets. Regionally three mining companies in South Africa control more than 10% in the region's PGM production namely Anglo Platinum, Impala Platinum and Lonmin. Anglo American is the major shareholder (75%) of Anglo Platinum, whichproduces 40% of world production. Additional players in the region include Northam, Aquarius Platinum and Barplats play less significant role while several junior exploration companies exist.

Globally, the PGM Industry is represented by the International Platinum Association, whose members include the largest mining companies such as Anglo Platinum, Norilsk Nickel and Impala, as well as downstream actors like BASF Catalysts LCC28 (USA/Germany), Ishifuku Metal Industry Co. Ltd. (Japan), Johnson Matthey Plc. (UK), Tanaka Kikinzoku Kogyo K.K. (Japan), Umicore SA (Belgium) and W.C. Heraeus GmbH (Germany) (Cramer, 2008).

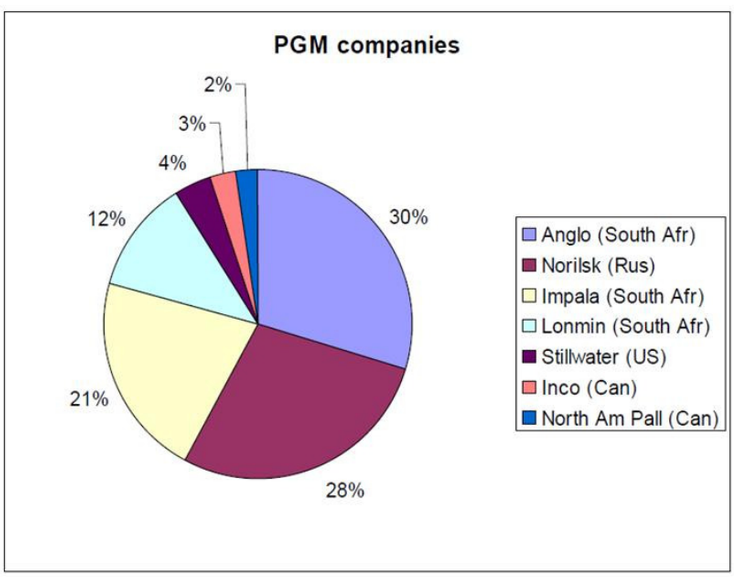

Figure 90: Relative PGM Production by company

Figure 90 above shows the dominant global players in the PGM industry. There exist three major channels through which mining and processing companies sell their products to downstream customers. Actors have direct supply contracts with fabricating companies, as well as with large end user companies, mainly car manufacturers. A portion of the supply was also sold through spot markets, like the London Platinum and Palladium Market and the Exchange Traded Funds of the Zurich Kantonal Bank in Switzerland. A high level of concentration in both the mining and fabrication phase of the PGM supply chain was reportedly observed (Cramer, 2008). The Anglo American Group and Johnson Matthey Company had a special marketing agreement where Johnson Matthey was responsible for marketing the Anglo Plats products. The major fabrication companies downstream of the supply chain are Johnson Matthey (UK), BASF (Germany/US), Tanaka (Japan), Umicore SA (Belgium), Heraeus (Germany), ToyoTa Motor Company (Japan), Honda Motor Company (Japan).

The governance of the value chain can be characterized as quasi-hierarchy. In such a set-up buyers in developed countries dictate condition to their suppliers in developing countries. The buyers influence the quantity, quality and price of the goods.

4.5.2.5 Dimension 5: Sustainable Production and Energy Use

According to the year-end reports for 2013, all of the major actors had sound environmental management systems aimed at sustainable use of resources that include water and energy. There was also a general decrease in toxic emissions like sulphur dioxide. The local actors were also retained their certification for ISO9001:2008 and OHSAS 18001:2007 and ISO14001.

4.5.2.6 Dimension 6: Value Chain Finance

Due to the gap that exists in terms of working capital and the available reserves that exist, numerous investment opportunities are present in the industry. Access to finance presents a major obstacle in the expansion of current operations. Funds are predominantly provided by banks and shareholders. Banks offer loans at moderate interest rates over periods of up to 36 months. Some of the actors were borrowing money at an interest rate of about 11.1% (Zimplats Integrated Report, 2013.

4.5.2.7 Dimension 7: Business Environment and Socioeconomic context

4.5.2.7.1 Business environment

The environment was reported to be tough with increasing production costs, uncertainty over land/ claim issues as well as the Indigenisation laws.

4.5.2.7.2 Social and cultural context

The PGMs sector employs a significant number of the people accounting for more than 5000 employees. The subsector has also completed several major community projects which include the building of schools and clinics as well as health campaigns.

4.5.3 CHROME VALUE CHAIN ANALYSIS

The minor metals include tungsten, molybdenum, tantalum, niobium and chromium. Chromium is the only significant metal in this group found in Zimbabwe. The world class **chrome ore resource**, mostly found along the Great Dyke, undergoes considerable value addition as it is processed into ferrochrome alloys before export(Chamber of Mines). Zimbabwe has adopted a policy of not exporting raw chrome despite the high demand for raw chrome on international markets. This move was aimed at encouraging local beneficiation(Chamber of Mines). The value addition process includes mining, crushing, smelting and production of high carbon ferrochrome. Document reviews, key informant interviews, field visits and focus group discussions were done to analyse the chrome value chain.Key players involved includedthe large scale chrome producers and smelters that included Zimasco, Zimalloys, Oliken and Maranatha, small-scale producers and Chinese companies operating in Zimbabwe. The visited operationsincluded Zimasco, Oliken, Zimalloys, Maranatha, Monachrome and the recently commissioned AfroChine Smelting. Only one actor was operational while the rest were down for various reasons. The major documents reviewed included the Chrome Mining Sector Report, 2013 prepared by the Parliamentary Committte on Mines and Energy, a report by Chirasha, 2011 on the investment in smelting capacity for the chrome sector in Zimbabwe as well as a presentation by Miso-Mbele et al., 2011 to the South African Institute of Mining and Metallurgy, Zimbabwe Branch on ferrochromium smelting in Zimbabwe. Information gathered was then collated using the Diagnostic dimension approach of analysis.

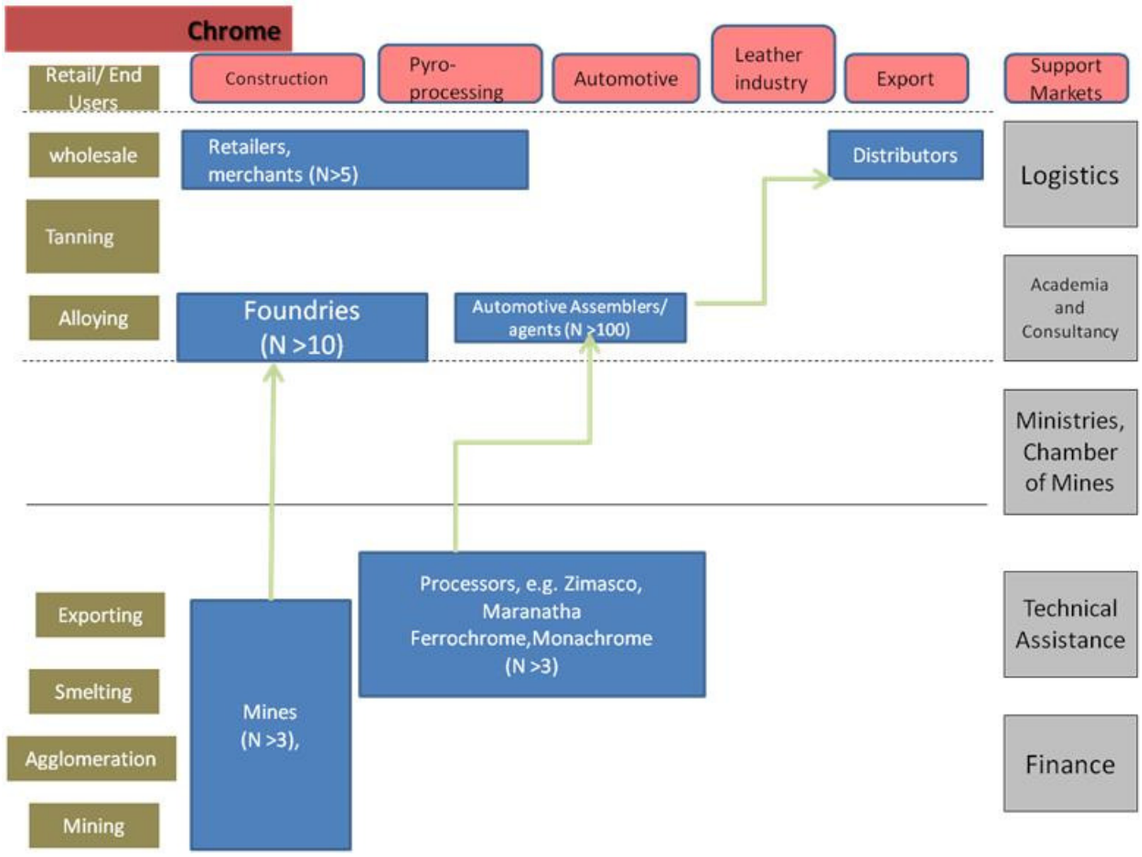

Figure 91: Chrome Value Chain Map

4.5.3.1 Dimension 1: Sources of Inputs and Supplies

4.5.1.1.1 Primary product characteristics

Chrome ore is a mineral resource for metallurgical industry, chemical industry and national defence. It finds application in the hardening of steel alloys and the production of stainless steels, in corrosion-resistant decorative platings, and as a pigment in glass. The chrome ore is mainly found in South Africa, Kazakhstan, Zimbabwe, Finland, India, Turkey, and Algeria. Limited resources are also found in the Tibet and Sinkiang regions of China (Miso-Mbele et al., 2011). Africa has the largest ore reserves in the world and it is estimated that Zimbabwe and South Africa have more than 80% of the world's ore reserves (Miso-Mbele et al., 2011). In the country, chrome ore is further beneficiated into ferrochrome, a vital ingredient for stainless steel production. The other key inputs include fluxes (quartzite), and carbon (coal, coke, charcoal) as reducing agent. The coking coal required as a reducing agent is a special one, containing low phosphorous and ash contents. Stainless steel scrap is another source of chrome that can be used in the chrome and stainless steel value chains. The classification of chrome ores is detailed in Table 71 below.

Table 71: Classification of chromium ores (Source: Chirasha, 2011)

Old Classification	Composition of ore	New classification
Metallurgical Grade	>46%Cr_2O_3 >2.1 Cr/Fe ratio	High chrome content
Chemical Grade	40-46%Cr_2O_3 <2.1 Cr/Fe ratio	High iron content
Refractory Grade	>20% Al_2O_3 >60% (Al_2O_3 + Cr_2O_3)	High aluminium content

The Great Dyke in Zimbabwe holds most of the world's high-grade chrome ore and high Cr/Fe ratio reserves estimated at 10 billion tonnes. About 95% of chromium resources are geographically concentrated in southern Africaand Zimbabwe is estimated to host over 80% of the world's resources of metallurgical quality chromite. The largest deposits, averaging10cm in thickness, and extending on both sides of the entire length of the Dyke are contained in 11 narrow seams (stratiform) (approximately 550 km long and 11 km wide). The neighbouring rock formations neighbouring the Great Dyke also contain disseminated chromite, which on weathering isconcentrated into rich alluvial deposition.About 80% of world production comes from India, Iran, Pakistan, Oman, Turkey and Southern Africa (Zimbabwe and South Africa). Southern Africa produces 32% of world chrome ore.

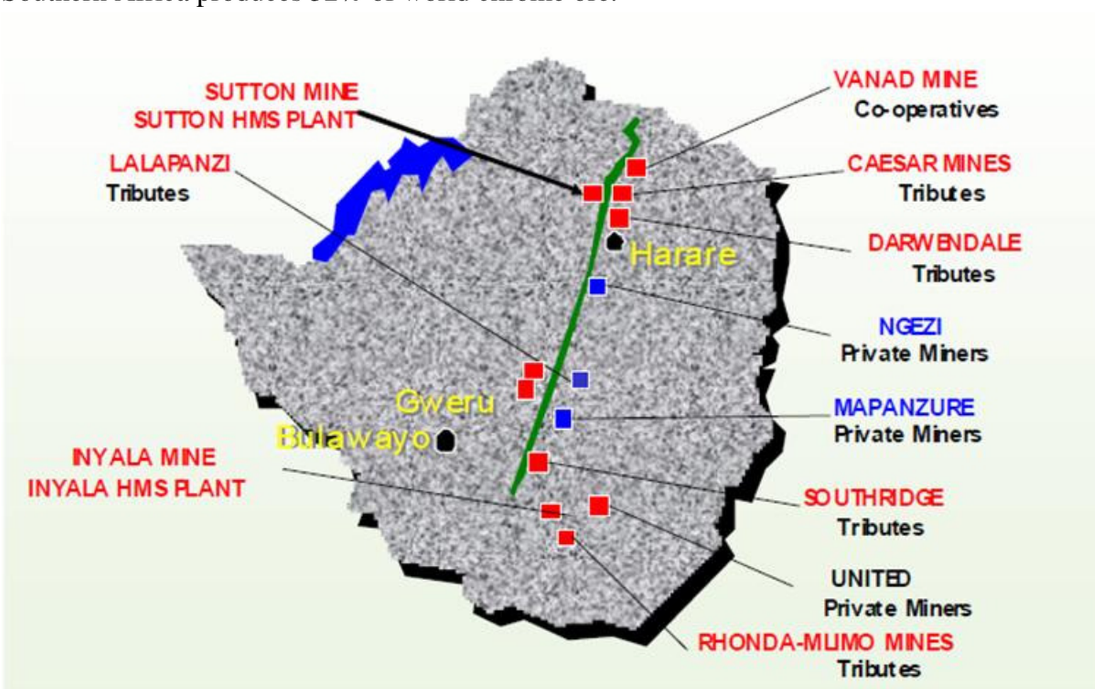

Figure 92: Geographical distribution of chrome ore reserves (Source: Chirasha, 2011)

Most of the Zimbabwean chrome ores are found along the Great Dyke which has therefore, the highest concentration of mining activities, as shown on the map (Figure 92). The distribution of the different grades of ore in Zimbabwe is presented in Table 72.

Table 72: Chrome Grades in Zimbabwe (Source: Chirasha, 2011)

Chrome Ore Location	Chrome Ore Grade
North Dyke	Very high grade (55% Cr_2O_3; Cr/Fe >3.3)
Middle Dyke	Average grade (40% Cr_2O_3; Cr/Fe >2)
Southern Zimbabwe (refractory and podiform)	High grade
South Africa	Low grade (Low Cr/Fe ratio)

The North Dyke possesses high grade chrome ores of up to 55% Cr_2O_3, with a Cr/Fe ratio greater than 3.3. The Middle Dyke ore grades, though lower in quality than the North ores, are still substantially better quality than most of the world reserves, with 40% Cr_2O_3 and a Cr/Fe of greater than 2.0. There exists also high grade chrome ores deposits of refractory and podiform nature found in southern Zimbabwe, off the Great Dyke. The Republic of South Africa has the largest low Cr/Fe ratio chrome ore reserves, which gives rise to the production of charge chrome as the main product. The high chrome to iron ratio of an ore implies higher ferrochromium alloy quality. Zimbabwe has the largest reserves of high grade chrome ore of 560million tonnes (Table 72), which at the current extraction capacity of 1.77million tons/ annum implies 300years of extraction before extinction. The country also has got adequate coal reserves (with low phosphorus) for the production of coke for chromium smelting if investment in 2M mining at Hwange is availed.

Table 73: World distribution of chrome ore reserves

Ore type	Reserves (million tonnes)		
	Zimbabwe	South Africa	Rest of the World
High chrome content	560	----------90----------	
High chrome content	56	1100	44

4.5.3.1.2 Characteristics of primary producers and input suppliers

The holding patterns for chrome claim are presented in Figure 93. There are 4359 registered blocks of chrome claims. About 70% of these claims, which are of high grade (58 – 62%Cr), are owned by Zimasco and Zimalloys (Benscore), formerly BHP.The chrome ore producers are categorised by the ore characteristics into i) refractory grade ore (>60% Cr); ii) metallurgical grade ore (>46% Cr); and iii) chemical grade ore producers (40% < Cr < 46%).Secondly, the alloy producers are classified into integrated alloy smelters and independent alloy smelters. Thirdly the end use customers include the primary stainless steel producers, the refractories and foundries and the chemical industries. The major consumer is the stainless steel industry, consuming about 90% of the chrome products. Stainless steel producers are further categorized into stainless steel, alloy steels, non-ferrous alloys and speciality mills. The four main players in Zimbabwean ferrochrome production comprise ZIMASCO in Kwekwe, ZimAlloys in Gweru, Maranatha Ferrochrome in Kadoma and Oliken Ferroalloys in Kwekwe, with the first two being the biggest and oldest producers. Field surveys revealed that only one of the major actors was operational. New players, at smaller scales include, Wel Mining,CINA, Jin An Corp & Xinyu in Gweru; and MonaChrome and the recently commissioned AfroChine Smelting in Chegutu (Miso-Mbele et al., 2011). Field surveys also revealed that almost all of the new players were also not operational due to several challenges.

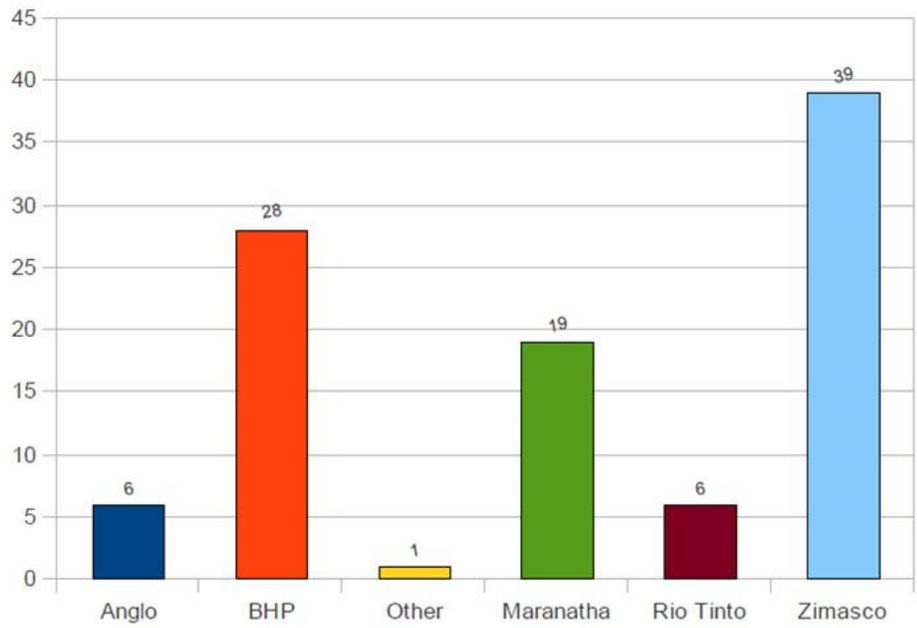

Figure 93: Chrome Resource holding patterns (Source: Chrome Mining Sector in Zimbabwe report, 2013)

The main international actors include ASA Metals Pty., Ltd., a joint venture between Sinosteel and South Africa Northern Company in early 1997, where sixty percent of the shares are held by Sinosteel. This joint venture has a chrome reserve of 45 Mt, which is four to five times the total chrome reserve in China.

4.5.3.2 Dimension 2: Production Capacity and Technology

4.5.3.2.1 Production Capacity

The current installed chrome smelting capacity of the country is about 500000 tons, while the two major players (Zimbabwe Alloys and Zimasco) own about 90% of the capacity. Three different ferrochrome products are produced from the smelters and are listed in Table 73 below. The production peaks were recorded in 1997, 2001 and 2002 when the sector produced over 750 000 tonnes per year. The dips were recorded in 2009 when the country produced less than 200 000 tonnes whilst 282 000 tonnes was projected for 2013 (Chamber of Mines). The current trends indicate a capacity utilization which is less than 50%. A new smelting company, AfroChine Smelting has invested USD25million in the construction of 2 smelters with a capacity of 50000tons of ferrochrome (informant interview). Additional capacity building of 250000 tons was in progress with an additional USD100million investment injected for projected completion in 2015. This implies a smelting capacity improvement of 60% (from 500000tons to 800000tons per annum). Employment creation was estimated at over a 1000 people. Zimbabwe Alloys is the only producer of Low Carbon Ferrochrome (with the best technology in the world) and ferrosilicon chrome in the country.Ferrochrome smelting is a labour and energy intensive process.

Table 74: Production volumes in the chrome sector of Zimbabwe (Source: Chirasha, 2011)

Product	Production in tonnes by the major actors			
	Zimasco	**Zim Alloys**	**Others**	**Total**
HCFeCr (High carbon ferrochrome)	220 000	146 000	55 000	**421 000**
FeSiCr (Ferrosilicon chrome)		29 200		**29 200**
LCFeCr (Low carbon ferrochrome)		40 150		**40 150**
Totals	**220 000**	**215 350**	**55 000**	**490 350**

The major smelting companies visited during the field surveys included Sino-Zim, ZimAlloys, Maranatha, Monachrome, AfroChine and Oliken. Three of the companies were not operational due to several viability challenges, and one was new and under construction. Of the two operational ones, one major actor was operating at about 70% capacity whilst the other one operated below 15% capacity. Country documents show that atotal of eight smelting companies with an available smelting capacity of about 370 000tonnes against an installed capacity of about 700 000 tonnes*(53% capacity utilization)* operated in the country's chrome value chain in 2012. Therefore there was an excess of about 330 000 tonnes of chrome ore lying idle. The situation was aggravated by theshut-down of four of the five smelting furnaces by one major actor. The estimated global capacity utilization for 2013 is 92.2% implying that the ferrochrome production industry in Zimbabwe is not yet competitive at the global scale.

Several challenges affecting production were noted as follows;

- Lack of investment for recapitalization
- Use of obsolete equipment resulting in high production costs
- High tariffs and power shortages (Oliken was once disconnected due to non-payment of electricity)
- Price fluctuations of chrome on the world market
- High mining fees and levies
- Claims lying idle and inaccessible to small scale participants
- Low smelting capacity as compared to chrome ore production capacity
- Perceived political/economic instability in the country (although investment in platinum production continues to increase)
- Transport, which is also a capital-related issue

It was also noted that one of the major actor in chrome mining and smelting has been non-operational for more than 10years, resulting in closure of all its mines. Recapitalisation of over USD20million is required to resuscitate the operations and rejuvenate the value chain. The smelting capacity at this major player had reduced to about 15% as only 1 smelter was operating out of a total of 7 smelters.Despite the thrust for value addition, it was noted that the local smelters have only a capacity to consume 53% of the total ore mined due to capacity constraints, thus leaving a lot of ore without a market.

The local smelting plants were also limited to the processing lumpy chrome ore and have inadequate technology to smelt fines and concentrates. From the field interviews, all the smelting companies mentioned that electricity was a huge operational cost threatening to completely

destroy the sector. The old technologies used by these smelting companies were also observed to consume more electricity at low productivity levels than modern smelting technologies currently used globally.

Zimbabwe's production at full capacity is only about 6.3% of world production, 14% of SADC production and about 16% of South Africa's production (2008 statistics). Ironically, Zimbabwe is not recognized as a significant producer on the world market despite the huge deposits of proven and unproven reserves. It implies that the country has potential to fully exploit chrome to its advantage. Table 75 shows the global perspectives of chrome production and the status of Zimbabwe.

Table 75: Position of Zimbabwe's chrome production in the global context ***[Source: International Chromium Development Association (ICDA)]***

Country	Proven Resource	World Rank	Output (Production)	World Rank
South Africa	72.7.%	1	39.3.%	1
Zimbabwe	13.2.%	2	2.0.%	6
Kazakhstan	4.2.%	3	14.8.%	2
India	0.9.%	5	16.0.%	3
Finland	1.6.%	4	2.5.%	7
Brazil	0.8.%	6	3.3.%	8
Turkey	0.3.%	7		5
Other Countries (Oman, Iran, Turkey and Albania	7.1.%	8	22.1.%	4
Total	100..%		100..%	

In 2008, 7.446MMT of ferrochrome was globally produced, with South Africa, China, Kazakhstan and India constituting 45%, 18%, 13% and 10% of the global production respectively. Zimbabwe only accounted for 2% of global production despite being ranked second globally in owning the resource. This is against the background of high demand of the chrome metal and abundances of high grade chrome ores in the country. The South African companies, Samancor Chrome and Xstrata Alloys are the biggest ferrochrome producers in the world.

4.5.3.2.2 Technology Use

The technologies used in ferrochrome production are summarised in Figure 94 below. ASubmerged AC Electric Arc Furnace and reductants (coke, coal and quartzite) are typically used in the production of ferrochromefrom chrome ore of different sizes. The energy intensive smelting process requires up to 4,000 kWh per tonne of material weight (ICDA). Slag is separated from the liquid ferrochrome and tapped into ladles for further processing. Theliquid ferrochrome is then cast in moulds, cooled and crushedinto sizes required by the customers.

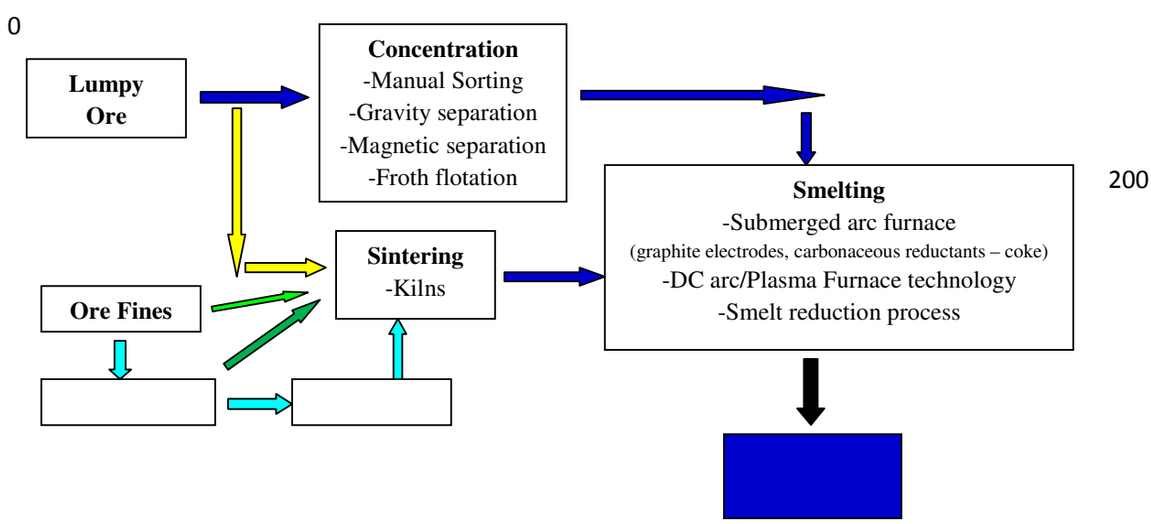

Figure 94: Technologies used in ferrochrome production

The concentration of lumpy chromite ores have usually been either manual, by gravity separation, magnetic separation or froth floatation techniques. After concentration, high temperature smelting technology is used to produce ferrochrome alloys through the reduction of chrome. The ferrochrome alloy typically contains chromium, iron with little amounts of carbon and silicon depending upon grade or type. The conversion process is dominated by the electric (AC) submerged arc furnace (SAF) smelting with carbonaceous reductants, predominantly coke, and fluxes to form the correct slag composition (ICDA). The other conversion processes mainly dedicated to ore fines and low grade ores are DC arc, or plasma, furnace technology(Figure 94). The SAF furnaces have three equally spaced consumable graphite electrodes in a cylindrical, refractory-lined container with a bottom tap-hole. The SAFs can be open, semi-closed or closed with correspondingly better thermal efficiency and have the ability to use the energy in the off-gases from the closed furnaces. The advantages of this technology are as follows;

- Relatively easy to control when the charge is properly sorted
- Self-regulating with power input determining the rate of consumption of charge
- Pre-heating and pre- reduction of the overburden due to the ascending hot gases.

The major drawback of the technology was its inability to process ore fines. In Zimbabwe, SAF method has been in use for a long time for production of high-carbon ferrochromium due to the availability of high grade lumpy chromite ore. Zimbabwe had a competitive advantage over countries with low grade ores like South Africa due to the facttheir ferrochrome product was more costly to use in stainless steel making because of the high percentage of carbon. The advent of the argon-oxygen decarburising (AOD) and vacuum-oxygen decarburising (VOD) processes radically changed the scenario, enabling the steelmakers to remove carbon from the stainless meltswithout excessive oxidation and losses of chromium(ICDA).

The introduction of the DC arc, or plasma, furnace technology enabled the production of ferrochromium from ore fines. The DC arc furnace uses a single, central hollow graphite electrode as the cathode, with an electrically conducting refractory furnace hearth as the anode. The furnace, which is closed at the top, operates with an open bath, with the chromite fines, together with coal and fluxes fed directly into the bath through the hollow electrode. The

advantages of this type of furnace operation are: fine ores consumption without agglomeration, cheaper reductants and greater choice of reductants, higher chromium recoveries, deliberate changes in the charge composition are reflected rapidly in the slag or metal, and furnace off-gas energy recovery due to closed top operation.

Another technology developed to handle friable ores is palletisationwith binder, reductant and fluxes followed by sintering in a rotary kiln for hardening purposes. The intermediate product is pre-heated and pre-reduced before smelting in a submerged arc furnace. High degrees of reduction (80-90%) were reportedly achieved to the extent of making the downstream electric furnace (DC arc) merely a melting furnace. Other modern technologies using the palletisation technique are being implemented in new installations. In this approach, coke is included in palletisation charge followed bysintering and partial pre-reduction on a steel belt sintering system. Pre-heating in shaft kilns above submerged arc furnaces follows taking advantage of the off-gas heat from the furnaces. Lump ore, coke and fluxes are also directed to the feed bins before the smelting process. Other innovative approaches include rotary hearth sintering and pre-reduction of pellets, and fluidised bed pre-heaters for chromite fines. Japan is carrying out developmental workon coal/oxygen based smelting processes using no electrical energy, which is sometimes referred to as smelt-reduction processes.

The Zimbabwean plants using the conventional submerged arc smelting route no longer enjoy the historical competitive edge of high grade lumpy ores. One plant is currently operating, having been established over 40 years ago. Two other plants were established over 10 years ago. There has been no expansion by the two biggest smelters in the past 25 years of operation. Small (1.1 MVA) Chinese furnaces have been installed all over the central part of the Great Dyke with negligible contribution to capacity improvement. A wholly owned indigenous company (Oliken) has built a second 2MVA furnace.

In fact, the presences of ore fines and low grade ores (especially in small scale claims), require the actors to have smelting technologies that can handle these type of ores. ZimAlloys, a major player has upgraded the 31 MVA and the 2 x 24 MVA furnaces, and were reportedly constructing of a DC arc furnace to handle the fines. Unfortunately ZimAlloys were not operational during the field survey due to viability challenges. ZIMASCO was also investing in a sinter plant and additional smelting furnace to handle ore fines and low grade chromite.In contrast, South Africa, despite having lower-grade chromite, established bigger capacity smelter units, with better technology compared to the early plants, currently accounting for about 75% of the global ferrochromium production. Investment in the metals industry is currently being driven by the need for energy efficient and environmentally friendly production processes to ensure profitability. China is leading the pack in the construction of large energy efficient smelters and refineries. The EU is investing significantly in recycling technology for scrap to reduce cost according to the report by Ecorys Research and Consulting on the *"Competitiveness of the EU Non Ferrous Metal Industries, 2011"*. They also noted that investments were also being sited

close to power energy sources like hydro considering the energy intensive nature of metal processing.

4.5.3.2.3 Production Cost and Margins

The main costs in the chrome value chain are i) cost of labour and labour productivity; ii) power (electricity and fuel) costs; iii) transportation and logistical cost; iv) capital costs; v) corporate, administrative and overhead costs; vi) safety, health and environmental costs and vii) social responsibility costs. The costs are also shaped by management practises, technology used and supply chain and procurement practices. The margins are affected by commodity prices and currency volatility. Productivity is affected by several factors including human capital, regulatory, geological, production and infrastructure. In the Zimbabwean context, the availability of power and input resources particularly water as well as an effective, efficient productive workforce are the cornerstones of overall productivity and performance.

The availability of low cost sufficient and reliable electricity is a key competitive advantage in the global chrome value chain.Due to challenges regarding the availability of electricity, companies have had to supplement their electricity supply with back-up generators which increase the costs of electricity. The rising costs of diesel and petrol, which play critical roles in the transportation and power back up significantly contributed to the production cost of the chrome value chain. Zimbabwe's electricity costs are not competitive globally, which affects the competitiveness of the energy intensive chrome value chain as shown in Table 76.The transport costs for Zimbabwe are also comparatively higher than competitors in the chrome value chain as shown in Table 77.

Table 76: Cost of Electricity in BRICS and some regional countries

Country	Electricity price (US$/kWh)
Russia	0.04
Zambia	0.04
India	0.06
China	0.09
South Africa	0.09
Zimbabwe	0.10
Brazil	0.18

Table 77: Cost of gasoline in BRICS and some regional countries

Country	Gasoline price (US$/litre)
Venezuela	0.013
Russia	0.76
China	1.04
India	1.10
South Africa	1.11
Brazil	1.19
Zimbabwe	1.50

The general value chain structure in dollars is illustrated in Figure 95.

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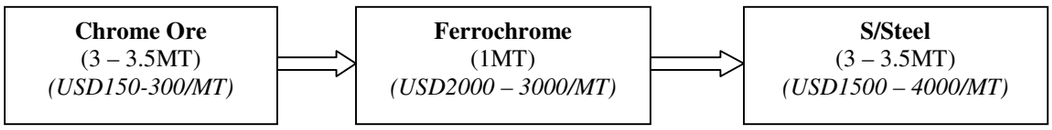

Figure 95: Value chain in dollar terms for chrome

Figure 95 clearly shows that there is a great jump in value between chrome ore and ferrochrome implying that investment into ferrochrome production in Zimbabwe is very attractive and must be supported. Therefore feasibility studies must be carried out for the establishment of stainless steel production plants in Zimbabwe. Current innovation is looking at the possibility of direct production of stainless steel from chrome ore or liquid ore.

4.5.3.3 Dimension 3: End Markets and Trade

4.5.3.3.1 End product characteristics

The main products include: foundry chrome sand,metallurgical grade chrome sand, metallurgical chrome lump,metallurgical chrome fines and chrome chips and high quality charging high carbon ferrochrome, which are sold to Japan, South Korea, Europe, USA and China amongst others.The three ferrochrome products produced in Zimbabwe are High Carbon Ferrochrome (HCFeCr), Ferrosilicon Chrome (FeSiCr) and Low Carbon Ferrochrome (LCFeCr) (Miso-Mbele et al., 2011). The major application for chromium is as an alloying element in cast irons and steels. Chromium is a strong carbide-forming element, and as such it is an important alloying element in tool and die steels, and high speed steels.The major markets include foundries and refractories (steel making, alloy steels and non-ferrous alloys), kitchen and medical utensils, and chemical industries (plaiting, adhesives and tanning). The application areas along the chrome value chain are illustrated in Figure 96

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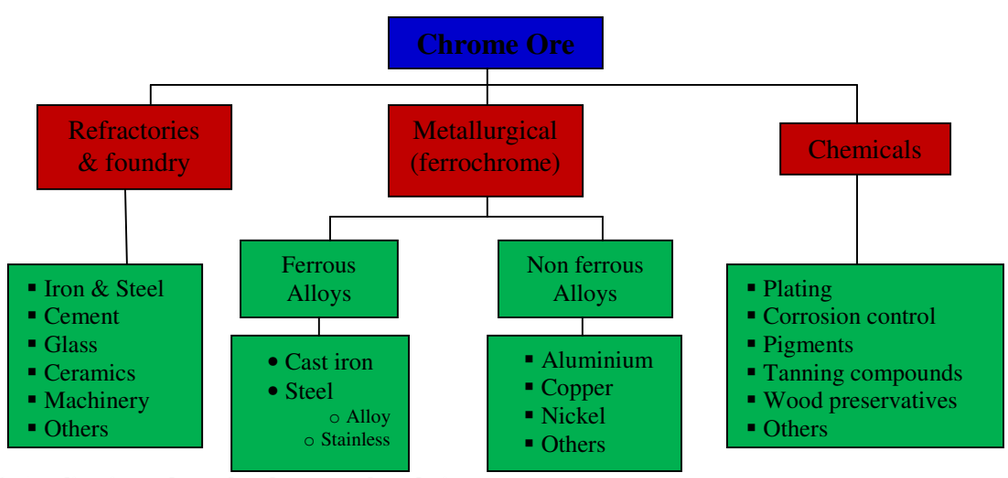

Figure 96: Applications along the chrome value chain

4.5.3.3.2 Consumer demand

The demand for chrome is driven by the metallurgical industry which consumes about 94% of the produced chrome. About 90% of the chrome used in the metallurgical industry is consumed

by the stainless steel industry. One tone of ferrochrome is required to produce 3 to 3.5 tonnes of stainless steel, with a minimum of 10.5% chromium required in low carbon steel. Since the demand of stainless steel was reported to remain higher for a considerable period of time, the supply dynamics of chrome become critical. Whilst the global chrome reserves stood at 11 billion tonnes, only 24.4 million tonnes were extracted by 2008. South Africa, Zimbabwe and Kazakhstan own over 95% of the global ore reserves and 90% of the global resources. China and Asia consume 65% of the world's ferrochrome. Europe, USA, Japan and South Korea are also major consumers of ferrochrome for their stainless steel production.

It is important to note that owning the virgin chromium metal is of no use since it is neither used in stainless steel production nor traded on a public exchange. Thus the best way of investment is in the production of ferrochrome. Due to power challenges in Zimbabwe, 53% capacity utilisation was realized in ferrochrome production despite the rising global demand for the commodity and the attractive prices. As a result of more chrome ore production than smelting, a lot of ore lay idle. Similarly, South Africa, the largest global producer of chrome ore and ferrochrome faces power shortages resulting in lower capacity utilisation which have forced them to export the excess raw chrome ore mainly to China. Thus China imports 50% of its chrome ore from South Africa.

On the ferrochrome production side, Zimbabwe faces competition from South Africa, Kazakhstan and India. South Africa's competitive advantage is the availability of the resource in large volumes, high quality coke and low labour cost. Kazakhstan's advantages are the availability of the resource, low cost power, finance availability and high quality coking coal. China's competitiveness lies in low cost labour and power as well as availability of finance. Zimbabwe's competitiveness on the other hinges on the abundant high grade chrome ore resources and low labour cost. However power availability, poor quality coking coal, lack of finance and poor logistics have affected our competitiveness as a producer.

4.5.3.3.4 Marketing and trade capacities

The producers of ferrochrome, which include Kazakhstan, India and South Africa introduced export duty on chrome ore to promote local beneficiation. On the other hand the stainless steel producers without chrome resources have reduced import duties of chrome ores to enhance their production capacities.

Lower commodity prices have had adverse effects on both small and large operations resulting in the closure of several operations. Since the prices of refined metals are determined in the global market, the erosion of profit margins affects high-cost producers, generally located in more mature market economies, more severely than suppliers located in regions with abundant resources and energy.The Government participation in mining is through Zimbabwe Mining Development Corporation (ZMDC) and through the Minerals Marketing Corporation of Zimbabwe (MMCZ).The ZMDC is active in exploration, mining and gives assistance to cooperatives and small-scale miners. The MMCZ is responsible for marketing all the country's minerals and metal products except gold and silver which are sold through the Reserve Bank. Currently, there is very limited local beneficiation and value addition of minerals in Zimbabwe,

resulting in about 90% of the minerals being exported raw or semi-processed, and this is cause for concern.Removal of the restrictions to export ores has put a lot of pressure to shed off reserves to other small mining ventures who need to earn a living exporting ores and fines. Therailway infrastructure network can be reliable if re-capitalized.

4.5.3.4 Dimension 4: Value Chain Governance

4.5.3.4.1 Actor domination

The chrome sector report indicated the existence of 4 359 registered blocks of chrome of which approximately 70% of these claims are held by two companies namely Zimasco and Zimalloys (Benscore). These claims, some pegged as far back as 1904 have high grade ores with chrome contents of between 58 and 62%.On the other hand, new entrants, who are small scale indigenous participants have difficulties in acquiringclaims with high chrome ore content to effectively participate in the economy.The two major actors mine chrome but the bulk of the ore is mined by contractors or tributary miners who work on their claims and supply the companies with the ore.

The government also plays a key role in chrome value chain governance. The government opened an 18month window for miners to export chrome in 2009 by lifting the ban on chrome ore exports. This move was aimed at giving struggling actors to raise finances for recapitalization and for small scale producers to raise capital to put up smelters and hence promote value addition and create more employment for the country. As a result the majority of small scale and independent miners began operations.However, it was noted that neither the small scale nor large scale producers had any plans to invest in smelters.Exporters of the chrome ore also made substantial profits whilst the country lost significant revenues due to lack of value addition.

4.5.3.4.1 Participation in and distribution of value addition

The small scale miners are reported to own about 46% of the claims. However, most of their claims are low grade ores whilst the major two companies own the majority of the high grade ore claims. The large three players own smelters where the small scale players bring their ore for smelting and in the process getting low prices of between USD55.00 to US80.00 as compared to the world market price of between USD100 and USD235.00/ton. This price disparity and minority control of smelting has created a standoff between small scale producer and large scale smelters as well as pushing the small scale players out of business. The Mines and Minerals Act amendments aimed to address unfair practices in the mining sector have been delayed and hence affecting full exploitation of chrome to the development of the economy.

During the export window for chrome ore in 2009, government's expectations were not realized due to several reasons. The small scale miners were not well co-ordinated to set up joint smelters since it was very expensive and unsustainable for each small-scale producer to invest in a smelter. The electricity shortages as well as the high tariffs also discouraged aspiring actors to invest in the energy intensive smelting operations

The majority of small scale miners are independent producers who find it difficult to sell their ore to the local smelters since the smelters prefer to buy ore from their own contractors or tributaries. Most small scale producers own claims with lower chrome grades (<40%) which is not accepted by the local smelters despite the fact that the same ores have a good market in Asia.

4.5.3.4.3 Cluster concentration

Since the majority of the chrome claims are located in Mutorashanga, Guruve, Darwendale, Mapanzure, Chegutu, Kadoma, Kwekwe and Lalapanzi, processing facilties follow the same geographical locations with the major smelters in Chegutu, Kadoma, Kwekwe and Gweru (Chirasha, 2011).

4.5.3.4.4 Type of governance

On the global market, most of the major actors are vertically integrated, owning chromite mines as well as factories that produce chromium chemicals, ferrochromium and chromite. Although there are many small scale players in the chrome sector, the dominant players determine the price due to their relatively big smelting capacity which the small scale players do not have. The government through policy has also banned the export of raw chrome ore to promote local beneficiation.

4.5.3.5 Dimension 5: Sustainable Production and Energy Use

4.5.3.5.1 Energy use

Ferrochrome manufacturing is a power intensive process that requires plenty and reliable supply of energy. For example, the production of charge grade ferrochrome requires an average of 3700kwh/tonne of production. Zimbabwe's chrome sector has been affected by the erratic power supplies as well as high tariffs which have forced some companies like Oliken, a wholly owned indigenous company to stop operations. South Africa, the largest producer of ferrochrome in the world has also been affected by power shortages leading to a rising demand against supply as well as high prices of ferrochrome on the global market.

4.5.3.5.2 Environmental management

During the export window for the exportation of non value added chrome ore, huge profit margins made from exports were realized when compared with selling to the local smelter. As a result, there was a rush to mine chrome on the Great Dyke without following proper mining procedures leading to sterilization of mining ground and serious environmental degradation.It was noted that the small scale contractors were expected to rehabilitate the environment by the claim holders. However their revenue from the claim holder for the ore produced could not sustain environmental rehabilitation. Some of the huge open pits excavated still lie un-rehabilitated more than 20 years after abandonment by contractors. It was also noted that there was no plan in place for the rehabilitation of chrome extraction operations after exhaustion of the ore. It was also noted that the legal responsibility of rehabilitating the environment lies with the claim holder rather than the contractor. A person was reported to have died after falling into one of the open pits in Zvishavane, whilst communities have also lost a lot of cattle into these pits. Grazing land was also depleting in the affected areas.

4.5.3.6 Dimension 6: Value Chain Finance

Chrome attracts a royalty of 2% and a 20% levy and for the period 2009 to 2011. Treasury received, about US1 million dollars and US6.1 million dollars from the levy and royalties respectively. It was recommended that the Ministry of Finance and Industry and Trade be pro-active in ensuring that the levy was channeled for the development of sector. The financing must also help the small-scale miners who are in a more precarious position than the large scale producers. The sector also lacked financial mechanisms to increase smelting capacity.

4.5.3.7 Dimension 7: Business Environment and Socioeconomic context

4.5.3.7.1 Public and private service provision

The chrome sector study by the Parliamentary Committee on Mines and Energy found that there was lack of communication between government institutions and the key actors in the chrome value chain. The committee also noted fierce rifts between government institutions like EMA and Ministry of Mines and the chrome producers.

4.5.3.7.2 Social and cultural context

The chrome sector currently employs about 2 865 people and it is has the potential to employ over 7 000 people in a conducive environment(*Chrome Mining Sector in Zimbabwe, 2013: Portfolio Committee on Mines and Energy)*. It was generally noted in the same report that mining companies did little in terms of real corporate social responsibility (CSR) with most CSRs conducted reactively when a need arose in the community. The communities were reported to have higher expectations for bigger projects like electrifying community institutions, rehabilitating roads and provision of educational materials in schools. The mining companies, had no respect for traditional authority, represented by the chiefs, because they began operating without consulting the chiefs without getting an insight into the cultural values and practices of the area.

The existence of several conflicts between miners and farmers over the taking over of futile agricultural land by the former, resulting in the creation of food insecurity in communities was reported in the Chrome Sector report by the Portfolio on Mines and Energy (Chrome Sector Report, Zimbabwe, 2013).

Key issues in the chrome sector

The challenges found in the chrome sector include;

- Unevenly balanced claim structure
- Low smelting capacity to meet local chrome ore requirements
- Unfavourable prices on both local and international markets
- High electricity tariffs and power shortages
- Environmental degradation by small scale chrome miners dotted around the country
- Huge unsaleable stock piles of chrome dotted around the country following the ban of chrome exports by government in 2011
- Lack of investment in the sector
- Conflicts between miners and farmers over land

- Disempowerment of mining committees

4.6 Overall Discussion of the Engineering and Metals Sector Value Chain Analysis

From the value chain analysis carried out, it can be shown that the engineering and metals value chain in Zimbabwe is currently disjointed as a result of the economic crisis. The existing scenario depicts a virtually non existent local value chain, leaving Zimbabwe as mostly an end market for finished product for regional and global value chains, and a source of inputs for the same value chains. The major point of discussion is, "Can Zimbabwe's engineering and metals sector transform to into a sustainable and competitive export driven economy which sufficiently produces for its domestic needs? Different models in an attempt to answer this question against the results of the study are presented in Fig 97on the next page.

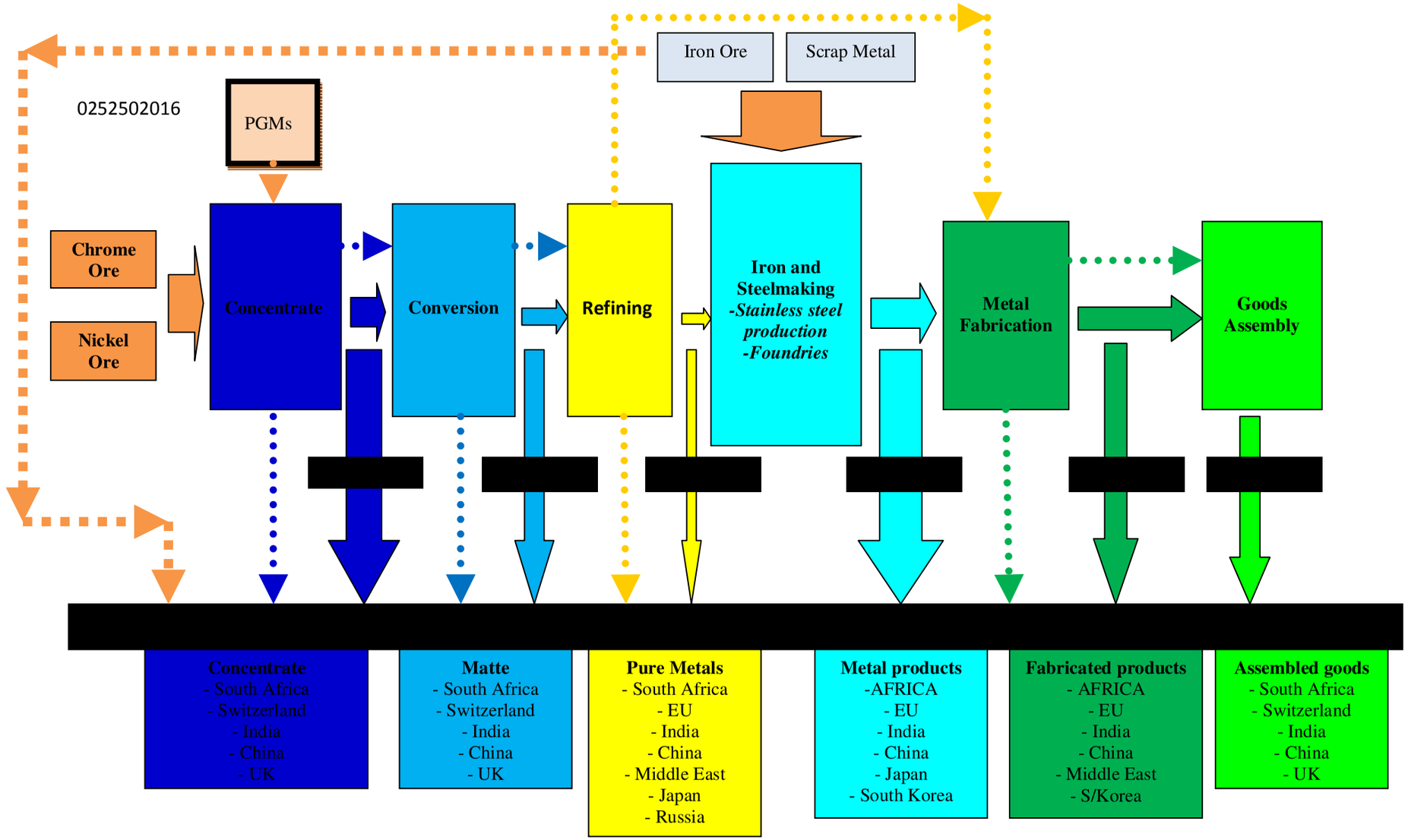

Figure 97: Integration of the Engineering and Metals Industry in Zimbabwe(N.B Dotted circular lines for the PGM flow, and the brown dotted square arrow for iron ore)

The engineering and metals can leverage on the fact that the major raw materials required for the sector are all abundantly found in the country (iron ore, chrome, nickel, PGMs and coal). Therefore the central hypothesis is that integrating all levels in the engineering and metals value chain to produce value added finished products for both the domestic and export market is the best model for Zimbabwe. As shown in Figure 97 above, the existing scenario is that of Route 1, 2 and 3. The brief description of the different routes/ models of structuring is presented in Table 78 below.

Table 78: Different models for structuring the engineering and metals value chain in Zimbabwe

Model/Route	Description/Assumption	Weaknesses
Route 1	Metal ores are semi processed and exported in huge volumes to export markets, the downstream actors in the domestic market import refined metals and products for their consumption	- Transparency and security issues in deliverying concentrates - High transport costs - Minimal value added - Deprives country of employment and other spinoff benefits downstream - unsustainable depletion of non renewable resources
Route 2	Slightly different from route one but similar	- Less transport costs than R1 but similar weaknesses
Route 3	All metal ores are refined and exported to end markets with just a little retained for domestic consumption	- Far much better than R1 and R2 - Requires high capital investment in infrastructure (energy, water and railroad) - Need to secure markets - Price fluctuations
Route 4	Metal products are targeted for satisfying both local and export market with emphasis on supplying the whole world with niche products. Iron and steel making capacity including stainless steel production and foundries using advanced technology is a prerequisite. Therefore all refined metals must first of all meet the needs of the iron and steel making sector, and the excess exported to end markets.	- Capital intensive - Stiff competition on the market - Threat of substitutes in the dynamic materials engineering sector
Route 5	Fabricated metal products give the country value added benefits and hence exportation of metal products must only be allowed after meeting the needs of the fabrication sector	- Stiff competition on the export market - Low local demand - Investment in modern technology required
Route 6	Engineering capital goods give the most value added and benefits to the country and hence all upstream activities must prioritise supplying the needs of this sector and export the excess	- Stiff competition on the export market - Low local demand -Long distances from high volume markets - High capital requirements for new technologies
Route 7	Hybrid Model incorporating the strengths of the different routes and supported by sound policy	

4.6.1 Model 1 (Specialise on Minerals beneficiation without integrating it with the engineering subsector

Model 1 leverages on the fact that Zimbabwe has abundant mineral resources like PGMs, chrome, iron ore, nickel, gold anddiamonds. Therefore priority must be given to the expansion of projects to increase production capacity. Local beneficiation must end at Route 3 (Refining) with the aim of making Zimbabwe a global competitor in the production of refined metals, especially PGMs, chrome, iron ore and diamonds. For example trebling the production of key resources will translate into 60tonnes of PGMs, 3.6Mt of iron and steel products, and 1.5Mt of chrome. The projected from revenues this Model are summarised in Table 79 below.

Table 79: Model 1: Expansion of Metal Production capacity to the Refining Stage

Base material	Level	Qty of Output (t)	Unit Price US$/t	Gross Revenue (US$million)
Iron and Steel	Refined	3600000	635.00	2286
PGMs	Refined	60	53,032,000.00	3182
Chrome	Refined	1500000	2, 500.00	3750
Nickel	Refined	31500	14,300.00	450
Copper	Refined	18000	7,285.00	131
Gross Revenue Model 1	**Route 1-3**			**9799**

Therefore as presented in Table 79, Route 3 via Route 1 and 2 has the potential of bringing in US$9.8billion dollars in revenue per annum, provided that there is significant investment in production capacity by 3 times. Funding is critical and hence joint ventures with dominant Multi-National Companies located in high volume markets can be a good option. There must also be significant investment in the railroad network as well as power infrastructure. The sector is also a high employer and hence can contribute to the reduction of unemployment in Zimbabwe. The major risks of this model are i) price volatility, ii) extinction of ore resources iii) viability challenges when payback period becomes longer than useful life of the resource, iv) conflict of interest between seller and buyer countries of end product, v) environmental pollution and vi) material substitution. A concrete plan must therefore be put in place to ensure that the returns of this sector are invested in a more sustainable manner after the extinction of the non renewable resources.

4.6.2 Model 2: Beneficiation to Metal products and fabricated metal products

In this model, the emphasis is on beneficiation to formed and fabricated metal products. Only the excess after fabrication and forming is exported as refined metal. The introduction of a stainless steel production line is envisaged in this model, considering that the major inputs like chrome, iron and nickel are all found locally. The jewellery fabrication and catalytic converter sectors are also established taking advantage of the availability of PGMs, gold and diamond in the country. Table 80 is the summary of projected revenues using Model 2.

Table 80: Model 2: Beneficiation to fabricated metal products

Metal products	Level	Qty of Output (t)	Unit Price US$/t	Gross Revenue (US$million)
Foundry	fabricated	500000	1,000.00	500
Pipes &tubes	fabricated	1000000	960.00	960
Stainless Steel	fabricated	1700000	2, 725.00	4633
Structural steel	Fabricated	500000	1,000.00	500
Metal components	fabricated	400000	2,000.00	800
Catalytic converter	fabricated	1000000units (1.5t)	200.00	200
Jewellery	fabricated	100000 (1kg)	2,900.00	290
PGMs	refined	18	53,032,000.00	955
Chrome	refined	1000000	2500.00	2500
Copper	refined	18000	7285.00	131
Gross Revenue Model 2	**Route 1-4**			**11469**

Model 2 as presented in Table 80 will result in the increase of revenue from US$9.8billion to US$11.5billion (17% increase). This increase comes along with employment in the downstream sectors as well as potential to expand the downstream actors. One of the major challenges of this model, besides capital investments and stiff competition on the global market is the conflict of interest that may arise due to possible attractive prices on the refined metal market forcing the producer to export rather than meet the domestic demand for fabrication. Government policy must be very flexible and optimal in addressing such scenarios. Niche products have to be identified in this model and a well organised aggressive marketing model must be adopted by the engineering and metals sector for it to succeed.

4.6.3 Model 3: Beneficiation to Finished Capital goods (Automobile, Agriculture, etc)

This model assumes that there is a huge market for the capital goods in the country, region and the global market. Therefore all the upstream actors must first of all satisfy the manufacturing needs for these goods before exporting intermediate products.

Table 81: Model 3: Beneficiation to Finished Capital goods

Metal products	Level	Qty of Output (t)	Unit Price US$/t	Gross Revenue (US$million)
Foundry products	fabricated	1000000	1, 000.00	1000
Pipes &tubes	fabricated	1000000	960.00	960
Vehicles	assembled	1000000	4,000.00	4000
Machinery/equipment/etc	assembled	1000000	3,000.00	3000
Metal components	fabricated	400000	2,000.00	800
Catalytic converter	fabricated	1000000units (1.5t)	200.00	200
Jewellery	fabricated	100000 (1kg)	2,900.00	290
PGMs	refined	18	53,032,000.00	955
Chrome	refined	1000000	2500.00	2500
Copper	refined	18000	7285.00	131
Gross Revenue Model 3	**Route 1-3**			**13836**

Table 81 above shows that Model 3, which incorporates capital goods manufacturing; has the potential to increase the revenue side to about US$13.8billion. This Model is expected to come along with benefits of high employment levels that support the ZimAsset program as the automobile value chain alone with its down and upstream actors was reported to employ over 50000 people when fully operational. Since the domestic market can not sustain the level of production presented, this model must be export driven. The competition however, is stiff on the global market and hence investment in competitive technologies as well as relevant infrastructure is necessary for competitiveness. The engineering and metals sector can therefore leverage on the availability of the basic inputs in large quantities as well as a productive workforce.

PART5: ECONOMIC POLICY IMPLICATIONS, RECOMMENDATIONS AND CONCLUSIONS

5.1 Key constraints

5.1.1 Sector Specific Issues

5.1.1.1 Mineral/Metal Processing

The sector specific issues in the subsector were summarised as follows

- Major raw materials and inputs are available locally or in the region
- The major actors are privately owned and are MNCs

- Strong alignment of education curriculum to industry needs
- Minimal value addition to mineral ores and other raw materials
- Lack of price setting ability
- MNCs dominate the sector
- Major obstacles in the business environment include inadequately educated labour force, labour regulations and health issues, high tax rates, licensing issues and permits, corruption and political instability

Capacity utilisation dropped from 89% in 2011 to 33% in 2013. The significant decline in capacity is attributable to the decline in capacity utilisation in the chrome sector owing to several reasons including power outages and costs, high costs of production and low prices of chrome products on the international market. It is worth noting that despite the overall low capacity utilisation in 2013, specific subsectors within the Level performed well. For example, the capacity utilisation of platinum producers was well over 70%. One major player in chrome processing operated at a capacity of about 70% against the general trend of the subsector.

The absence of a PGM and limited base metal refining has limited the beneficiation of metals. The smelting capacity for chrome ores is limited in size and range since ore fines and low grade ores cannot currently be processed. The production capacity for ores is also greater than the smelting capacity leading to large stock piles of ore subject to deterioration.

5.1.1.2 Metal forming (steelmaking and foundries) subsector

The sector specific issues in the subsector were summarised as follows;

- Limitations of marketing and trading capacities due to low product demand, lack of financing mechanisms to export abroad, high cost of transport and insufficient production capacity to export abroad
- Major obstacles in the business environment include political instability; corruption, finance and practices of competitors, courts, crime, theft and disorder, tax administration and rates.
- Underutilisation of scrap due to an unorganised Scrap Industry

Capacity utilization was very low, ranging between 15 and 30% for the period between 2011 and 2013. The major reasons for the decline in capacity utilization according to rank were working capital constraints, antiquated machinery and breakdowns, high costs of doing business, low local demand, lack of raw materials, power and water shortages; competition from imports and drawbacks from the current economic environment.