Zimbabwe Economic Policy Analysis and Research Unit

ENGINEERING AND METALS INDUSTRY VALUE CHAIN ANALYSIS

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ACRONYMS

AAZ	Automobile Association of Zimbabwe
ACMAZ	Automobile Component Manufacturers Association of Zimbabwe
AfDB	African Development Bank
AMA	Agricultural Marketing Authority
AMM	Association of Mine Managers
AMWUZ	Associated Mine Workers' Union of Zimbabwe
BAZ	Bankers' Association of Zimbabwe
BNC	Bindura Nickel Corporation
BUSE	Bindura University of Science Education
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CAPP	Computer Aided Process Planning
CDP	Carbon Disclosure Project
CKD	Complete Knocked Down Kit
CMA	Chrome Miners' Association
CoM	Chamber of Mines
CPA	Chrome Producers' Association
CUT	Chinhoyi University of Technology
CZI	Confederation of Zimbabwe Industry
DRC	Democratic Republic of Congo
ECZ	Engineering Council of Zimbabwe
EISAZ	Engineering Iron and Steel Association of Zimbabwe
EMA	Environmental Management Authority
EPO	Exclusive Prospecting Order
ESAP	Economic Structural Adjustment Programme
EU	European Union
FAZ	Founders' Association of Zimbabwe
FGD	Focus Group Discussion
FM	Ferrous Metals
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
GMAZ	Gold Miners' Association of Zimbabwe
GMB	Grain Marketing Board
HIT	Harare Institute of Technology
HIV	Human Immunodeficiency Virus
IDBZ	Infrastructure Development Bank of Zimbabwe
IDC	Industrial Development Corporation
ISO	International Organisation for Standardisation
IVC	Industrial Value Chain
J&B	Jacob and Bethel
KVA	Kilovolt- ampere
kWhr	kilowatt-hour
MDG	Millennium Development Goals
MIDC	Motor Industry Development Council
MIEAZ	Motor Industry Employers' Association of Zimbabwe
MMCZ	Minerals Marketing Corporation of Zimbabwe
MNC	Multi National Company
MSDS	Material Safety Data Sheet
MSME	Micro to Small and Medium Enterprises

MTAZ	Motor Trade Association of Zimbabwe
MVA	Megavolt-ampere
MW	MegaWatts
NECF	National Economic Consultative Forum
NEWU	National Engineering Workers' Union
NFM	Non Ferrous Metals
NGO	Non Governmental Organisation
NRZ	National Railways of Zimbabwe
NSSA	National Social Security Authority
NTB	Non Tariff Barriers
NUST	National University of Science and Technology
OECD	Organisation for Economic Co-operation and Development
OHSAS	Occupational Health and Safety Standard
PGMs	Platinum Group Metals
PPAZ	Platinum Producers' Association of Zimbabwe
PTC	Posts and Telecommunications Corporation
RBZ	Reserve Bank of Zimbabwe
RGM	Reference Group Meeting
SADC	Southern Africa Development Community
SAPP	Southern Africa Power Pool
SAZ	Standard Association of Zimbabwe
SCADA	Supervisory Control and Data Acquisition
SIRDC	Scientific and Industrial Research and Development Centre
TNC	Trans-National Companies
UNCOMTRADE	United Nations Commodity Trade Statistics Database
UDI	Unilateral Declaration of Independence
UNCTAD	United Nations Conference on Trade and Development
USD	United States Dollar
UK	United Kingdom
UZ	University of Zimbabwe
VIC	Vertically Intergraded Companies
VW	Validation Workshop
WTO	World Trade Organisation
ZACE	Zimbabwe Association of Consulting Engineers
ZARWU	Zimbabwe Amalgamated Railway Workers' Union
ZECO	Zimbabwe Engineering Company
ZEPARU	Zimbabwe Economic Policy Analysis and Research Unit
ZERA	Zimbabwe Energy Regulatory Authority
ZESA	Zimbabwe Energy Supply Authority
ZEWU	Zimbabwe Energy Workers' Union
ZIE	Zimbabwe Institute of Engineers
ZIMDEF	Zimbabwe Manpower Development Fund
ZIMRA	Zimbabwe Revenue Authority
ZNCC	Zimbabwe National Chamber of Commerce
ZINWA	Zimbabwe National Water Authority
ZISCO	Zimbabwe Iron and Steel Company

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EXECUTIVE SUMMARY

Zimbabwe had a vibrant and diversified engineering and metals sector which dominated the SADC region (except for South Africa) prior to the decade long economic crisis which saw the closure of many actors in the sector. The economy stabilised after dollarization in 2009 and the stage is set for economic recovery. The business environment has however completely changed with the emergence of new technologies, products, globalisation and trade treaties amongst other macroeconomic factors. 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. A value chain is defined as a set of businesses, activities and relationships engaged in creating a final product (or service). 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. SIRDC was therefore contracted by ZEPARU to carry out the engineering and metals value chain diagnostic study for Zimbabwe. 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. The UNIDO 7 diagnostic dimension approach formed the core of the research methodology.

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 diagnostic value chain analysis was mainly focused on Levels 2 to 5 where most of the core actors are centred. Other sectors in the business enabling environment were also assessed. A field study was carried out on 94 actors and stakeholders around Zimbabwe's Harare, Chegutu, Kadoma, Kwekwe, Gweru, Shurugwi, Bulawayo, Bindura, Ruwa, Marondera and Mutare areas. The main instrument for data collection and analysis was based on the UNIDO Industrial Value Chain Diagnostic Tool. An overall response rate of 69% was achieved on the questionnaire. 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. Comparative analysis and benchmarking was done through desk review of similar studies done in countries such as China, South Africa, Zambia, South Korea and India amongst others.

The sector commodities were classified into two categories – the metals and metal products and the downstream engineering products. The metals and metal products include nonferrous and ferrous product categories and articles thereof with iron and steel, the platinum group metals, nickel and chrome being significant contributors to the value chain. The engineering commodities classification followed the international codes and focused oni) manufacture of structural metal products, tanks, reservoirs and steam generators; ii) manufacture of general purpose machinery, radios, TVs, electronic equipment, etc.; iii) manufacture of motor vehicle bodies (coachworks); iv) manufacture of jewellery; v) manufacture of electric machinery and components; vi) manufacture of iron and steel; and vii) manufacture of complete civil construction parts.

The study results showed that the Zimbabwean engineering and metals sector was generally not competitive globally. The sector had an overall trade deficit of about USD3.3billion for the period 2008 to 2012, translating into an average deficit of about USD660million per year. It was also revealed that the exports constituted 41% (USD 7billion) of trade against 59% (USD10billion imports) over the same period. The overall trade deficit was attributed to the engineering goods subsector which had a trade a huge trade deficit of about USD 8.1bn (1.6bn/yr) despite a trade gain of USD4.8billion (USD 960million/yr) for the metals and metal products sector. Whilst the metals and metal products contributed about 94% (USD 6.7billion) of the exported engineering and metals commodities, engineering goods constituted 82% (USD 8.6billion) of imports. The main exports were precious metals; base metals; ores and iron and steel; whilst the main imports were vehicles and components;

machinery, boilers, equipment, parts, etc. and electrical and electronic machinery and parts. The trade figures therefore showed that the engineering sector has almost collapsed whilst the primary production is flourishing. The resuscitation of the engineering sector as well as an export led industrial growth to maximise value addition and beneficiation as well as turn around the trade deficit in-line with the national trade policy must be done urgently.

The analysis of Gross Output, Intermediate Consumption and Value Added for the period 2009 to 2011 revealed that the engineering and metals sector produced about USD 1.9billion to Gross Output (~USD 600million/yr) and a Value Added of about USD 1.1billion (~USD 367million/yr). The overall Value Added was about 58%, implying that the actors involved in value addition performed well. The metals and metal products contributed about 79% (~ USD 1.5billion or USD 500million/yr) and 82% (USD 900million or USD 300million/yr) of the engineering and metals sector Gross Output and Value Added respectively. The mining of non-ferrous metal ores and manufacture of structural steel products, tanks, etc., contributed over 95% of the metals and metal products Gross Output. General purpose machinery, vehicle body manufacturing and electrical machinery were the main contributors to engineering goods Gross Output. These results again showed the dominance of the primary metals and metal products over value added engineering goods in the Zimbabwean manufacturing sector. The high percentages of Value Added showed that the domestic manufacturing sector has great potential to spearhead the national economic recovery and growth. The study also revealed that the iron and steel, PGMs, chrome, automobile and the foundry sectors were strategic subsectors for sustainable economic growth of the Zimbabwean economy.

The diagnostic study showed that the engineering and metals sector was severely distressed with a very low average capacity utilisation of about 28%. For 2013, the capacity utilisations for Levels 2, 3, 4 and 5 were 33, 30, 33 and 15% respectively. However outliers did exist, with the PGMs performing well with capacity utilisation of over 80%. On the other hand, the automotive sector capacity utilisation was below 5%. The study also revealed that about 31% of the sampled actors at different levels of the value chain had ceased operations. The sector is therefore threatened with total collapse unless urgent interventions were implemented.

The non-operation of ZISCO was the major missing link in the chain, depriving the metals and metal products sector of over USD3billion in revenue per annum. The study also showed that the resuscitation of the iron and steel production alone had the potential to turn the trade deficit into gain. The operating environment was very tough for the players with the main problems 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 was also required on downstream actors to ensure compliance to environmental laws. Power and water shortages and a dysfunctional rail network also worsened the operating environment leaving the sector on the brink of collapse.

It was also concluded that growth of the sector was not possible without exports. The major challenge on the global export market was the excess capacity especially of engineering goods and iron and steel products. Penetration of such markets was impossible without strategic collaboration with the huge markets in Asia and Europe. Zimbabwe could bargain on the strength of abundant primary products and an educated workforce whilst the targeted end markets in the region, Asia, India, China and the EU leverage on their closeness to huge markets, advanced technologies and access to value chain finance. Policies that facilitate regional and global integration whilst promoting local participation in value added manufacturing were necessary to promote economic growth. The study revealed that Zimbabwe had good policy documents like ZimAsset, the Industrial Development and National Trade Policy to spearhead economic growth. Nevertheless, the implementing frameworks were not coherent and the implementing vehicles were not synchronised.

Great resuscitation opportunities existed for the engineering and metals sector backed by investments in metals refineries, increasing chrome smelting capacity, resuscitation of the iron and steel, the foundry and the automotive value chains. 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. The proposed new investments include stainless steel production, PGM refinery and catalytic converters and other niche production lines of fabricated metal products. The industrial cluster approach which blends well with the ZimAsset economic blue print was proposed as the backbone of the engineering and metals sector recovery. The identified clusters include the iron and steel, precious metals and the automobile cluster. These clusters would be interlinked to the chemical industry, diamond and agricultural clusters whilst supported by strong infrastructural and technology and innovation clusters.

The sector according to estimates from this diagnostic study has the potential to contribute over USD14billion dollars per annum in revenue to the economy; at least USD800million fiscal revenue; employment creation, trade gain benefits as well as significant contribution to the GDP of the country. An investment of USD 14.5billion was found to be adequate to achieve the USD14billion target.

Further work is recommended for in-depth feasibility studies for the Revival of the Automotive Cluster in Zimbabwe and the capital goods value chain upgrading. Further study on the electrical and electronic equipment value chain was also recommended considering its significant trade volumes over the past five years. Value Chain finance options for viable engineering and metals value chains are also recommended.

The engineering and metals sector could therefore become the backbone of the Zimbabwean economy if supported by export oriented policies and adequate financial mechanisms. 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 sectors, else the country could become an end market for all engineering and metal products from all over the world.

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 and National 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*(National Trade Policy, 2012 – 2016)*. 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)*, 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 Zimbabwe Economy, 1987)*, the business environment has completely changed with the emergence of new technologies, products, globalisation and trade treaties amongst other macroeconomic factors.

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. A value chain is defined as a set of businesses, activities and relationships engaged in creating a final product (or service)*(UNIDO, 2011)*. It originates 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 how producers, processors, buyers, sellers, and consumers, separated by time and space gradually add 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 downstream 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***, ***cobalt,*** aluminium, zinc, lead,)
- Precious metals (*gold,* ***PGMs***, silver,)
  - PGMs (***platinum, palladium, rhodium***, ***ruthenium***, osmium)
- Speciality metals (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. Gold was not included as it was studied in detail elsewhere)*

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 radar and 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 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

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

Source: www.trademap.org

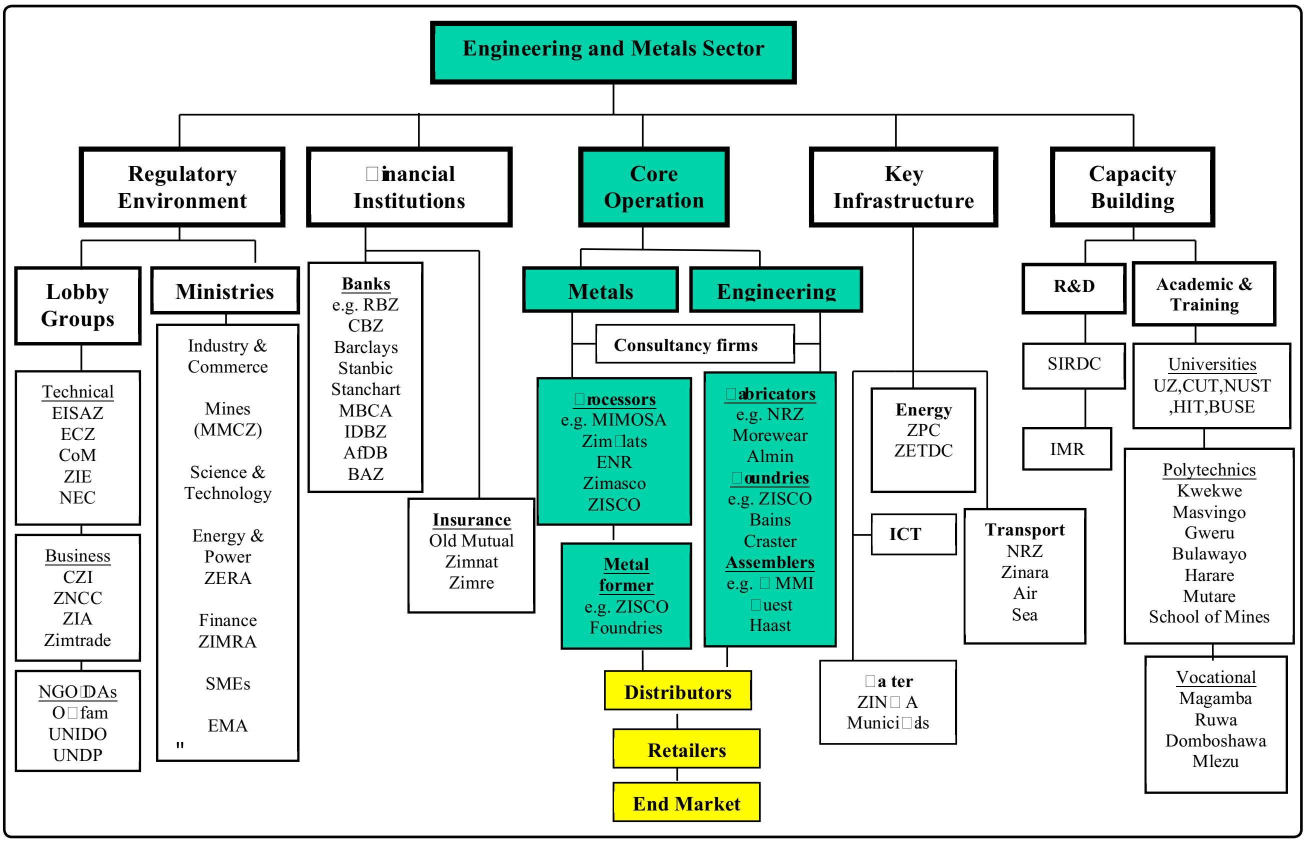
1.5 METHODOLOGY

There are several value chain study approaches that can be used for the engineering and metals value chain studies namely the *integrated or 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 drawback of not adequately addressing key issues of specific value chain studies. The *rapid approach*, though simple, quick and less costly 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 Millennium Development Goals (MDGs). Further diagnostic analysis of 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 a value chain by integrating the strengths of the other value chain approaches. 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. Thus the diagnostic tool formed the basis for project design and instruments development for the value chain studies. Nevertheless, the other approaches were also used in the analysis, discussions of results as well as in the formulation of recommendations. The study 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* below.

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 United Nations (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 industries 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.

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 similar and 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 of 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 Micro to Small and Medium Enterprises (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 (ZESA) and the Ministries of Industry and Trade 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 each level. For population sizes greater than 50 (i.e. N > 50), 30% sample size (randomly selected) was used, 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 69%. These sample sizes were exclusive of informal sector enterprises.

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 five respondents who included three industrial players, one 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.

1.5.6.2 Reference Group Meeting, Focus Group Discussion and Validation Workshop

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. The findings contained in the first draft report were presented at the Stakeholder Validation Workshop held on the 6th of February 2014.The comments from stakeholders were captured and incorporated into the final document.

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, Chamber of Mines, ZimStat, Zimtrade, ZIMRA, country reports and publications. These documents included case studies of similar value chain work in the developing as well as the developed world. The South African, Zambian, Indian, Chinese and European Union (EU) value chain study documents were also reviewed for comparisons and benchmarking purposes. The list of documents reviewed and websites visited is provided under the References section.

1.6 LIMITATIONS

The major limitation to this study was the timing (approaching festive season) and hence some actors were busy preparing for annual shutdowns. 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 existence of other competing studies in the same industries also negatively impacted on the response rate. A general reluctance of companies to divulge certain information, especially on financials and ownership structure was noted. The perception seemed to be that the information could be used to their disadvantage by the relevant authorities or their competitors. Due to the large number of products in the engineering and metals value chain diagnostics study, a comprehensive diagnostics of all products was not feasible in the period specified. As a result, the study was limited to level based value chain diagnostics except for a few special value chain diagnostic studies which included the iron and steel, chrome, PGMs and the automobile subsectors. The levels covered in the value chain study were four – Mineral/Metal processing (Level 2), Metal forming (Level 3), Metal fabrication (Level 4) and Capital goods assembly (Level 5).

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; (iii) value chain selection; (iv) value chain analysis and (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. Since there is a wide range of commodities in the engineering and metals value chain, the value chain selection part streamlines the subsectors and commodities based on desk review. The value chain selection ultimately leads to the value chain analysis section.

The value chain analysis sector begins with engineering and metals industry mapping, followed by describing the methodology used for the field survey. The analyses of the field data on a Level by Level basis using the UNIDO 7 diagnostic dimensions approach follows. Subsections are dedicated to special value chains at each level and the last subsection on value chain analysis discusses the findings of the study. The last section – economic policy implications, recommendations and conclusions begins with condensing sector specific and crosscutting issues. The assessment of implications of policies like ZimAsset and the National Trade Policy on the sector follows, culminating into policy recommendations and the ultimate conclusions. The references, documents and websites used are also listed in the references sector and annexes containing raw data are also provided.

PART 2: ECONOMIC OVERVIEW

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 *(National Trade Policy 2012 – 2016)*. Annual average inflation remained moderately 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, continued 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 continued 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, 2013)*.

Statistics from the National Trade Policy document 2012 - 2016 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*(Chamber of Mines)*. 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 remained in crisis with capacity utilisation declining from an average of 57% in 2011 to 44% in 2012 and 39% in 2013 *(CZI, 2013)*. Capacity utilization in the engineering and metals 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%) *(National Trade Policy 2012 - 2016)*. 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 continued to grow while exports remained compressed, thus worsening the current account. South Africa was the single largest trading partner in Zimbabwe, accounting for at least 40% of total exports and 60% of total imports *(National Trade Policy 2012 - 2016)*.

The most notable challenges in the financial system was 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, 2012)*. Although

98% of total domestic credit was advanced to the private sector *(ZEPARU, 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 industry competitiveness. 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).

2.2 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. The export and import data for the Zimbabwe engineering and metals sector is summarized in *Annex 7*. Diamonds, platinum and gold were the major drivers of this growth in export earnings. Gross Output data is presented in *Annex 8*.In 2009, the Gross Output from the engineering and metals industry of Zimbabwe was USD 418.5 million with value added of USD260.8million. The mining of non-ferrous metal ores constituted 57% of the engineering and metals Gross Output with a total value added of USD145million. The manufacture of structural metal products including tanks, reservoirs and steam generators was second, contributing 23% of the engineering and metals industry Gross Output with value added of USD73.4million. In 2011, the Gross Output of the engineering and metals sector doubled to USD1.1billion with value added of USD596.4million (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 goods contributed about 17% of the engineering and metals Gross Output 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 products for niche 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

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	11,472,115	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**	**1, 091,429,628**

Source: Zimstat, 2012

Thus the engineering and metals sector is significant to the Zimbabwean economy, considering the Value Added of USD 1billion for the period 2009 to 2011 as shown in Table 4.

TABLE 5: TRADE GAIN/DEFICIT DATA FOR ZIMBABWEAN METALS AND METAL PRODUCTS FOR 2008 TO 2012

		2008 to 2012 (USD Million)			
Code	**Product label**	**Exports**	**Imports**	**Trade Gain**	**Av. Gain /yr**
'71	Pearls, precious stones, metals, coins, etc	2884.7	0	2,884.70	576.94
'75	Nickel and articles thereof	1778.4	556	1,222.40	244.48
'26	Ores, slag and ash	1363.6	24.66	1,338.94	267.79
'72	Iron and steel	561.4	444.3	117.10	23.42
'73	Articles of iron or steel	54.5	595.4	(540.90)	(108.18)
'74	Copper and articles thereof	42.48	59.5	(17.02)	(3.40)
'82	Tools, implements, cutlery, etc of base metal	18.6	98.8	(80.20)	(16.04)
'76	Aluminium and articles thereof	11.74	72.1	(60.36)	(12.07)
'83	Miscellaneous articles of base metal	10.1	64.2	(54.10)	(10.82)
'81	Other base metals, cermets, articles thereof	0.155	0.88	(0.73)	(0.15)
'79	Zinc and articles thereof	0.155	3.81	(3.66)	(0.73)
'80	Tin and articles thereof	0.009	0.81	(0.80)	(0.16)
'78	Lead and articles thereof	0	6.8	(6.80)	(1.36)
	Totals	**6725.839**	**1927.26**	**4,798.58**	**959.72**

Source: www.trademap.org

The trade gain/ deficit for the metals and metal products for the period 2009 to 2012 is presented in *Table 5*. There was a cumulative net trade gain of about USD 4.8billion, translating to an average yearly trade gain of about USD 960million. This positive trade gain was as a result of the exportation of precious metals (gold and PGMs) and stones as well as nickel and ores. The metals and metal products is therefore a key driver of export competitiveness for the country.

TABLE 6: TRADE GAIN/DEFICIT DATA FOR ZIMBABWEAN ENGINEERING PRODUCTS FOR 2008 TO 2012

		2008 to 2012 (USD Million)			
Code	**Product label**	**Export**	**Import**	**Trade Gain**	**Av. Gain /yr**
'87	Vehicles other than railway, tramway	127.7	4233.2	(4,105.50)	(821.10)
'85	Electrical, electronic equipment	124.8	1667.4	(1,542.60)	(308.52)
'84	Machinery, nuclear reactors, boilers, etc	122.2	2351.8	(2,229.60)	(445.92)
'88	Aircraft, spacecraft, and parts thereof	33	43.3	(10.30)	(2.06)
'93	Arms and ammunition, parts and accessories thereof	11.45	2.49	8.96	1.79
'86	Railway, tramway locomotives, rolling stock, equipment	1.21	14.6	(13.39)	(2.68)
'91	Clocks and watches and parts thereof	0.33	248	(247.67)	(49.53)
	Ships, boats and other floating structures	0	2.24	(2.24)	(0.45)
	Totals	**420.69**	**8563.03**	**(8,142.34)**	**(1,628.47)**

Source: www.trademap.org

The trade gain/deficit for engineering products for the period 2008 to 2012 in presented in *Table 6* above. There was a cumulative trade deficit of about USD 8billion for the period 2008 to 2012 translating into an average deficit of about USD1.6 billion per year. This huge trade deficit contributed to the overall cumulative trade deficit of about USD 3.3billion for the engineering and metals sector which translated into an average yearly trade deficit of USD 669million.

This scenario implies that there is limited value addition of metals and metals products into value added engineering products for both the local and export market. It also shows points to a missing link between the metals and metals products and the downstream engineering industry. It is therefore within the interest of this study to assess the existing map for beneficial inter-linkages between the two intertwined subsectors. Export growth must also be targeted to transform the trade deficit into gains.

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 Part I)* 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, 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.

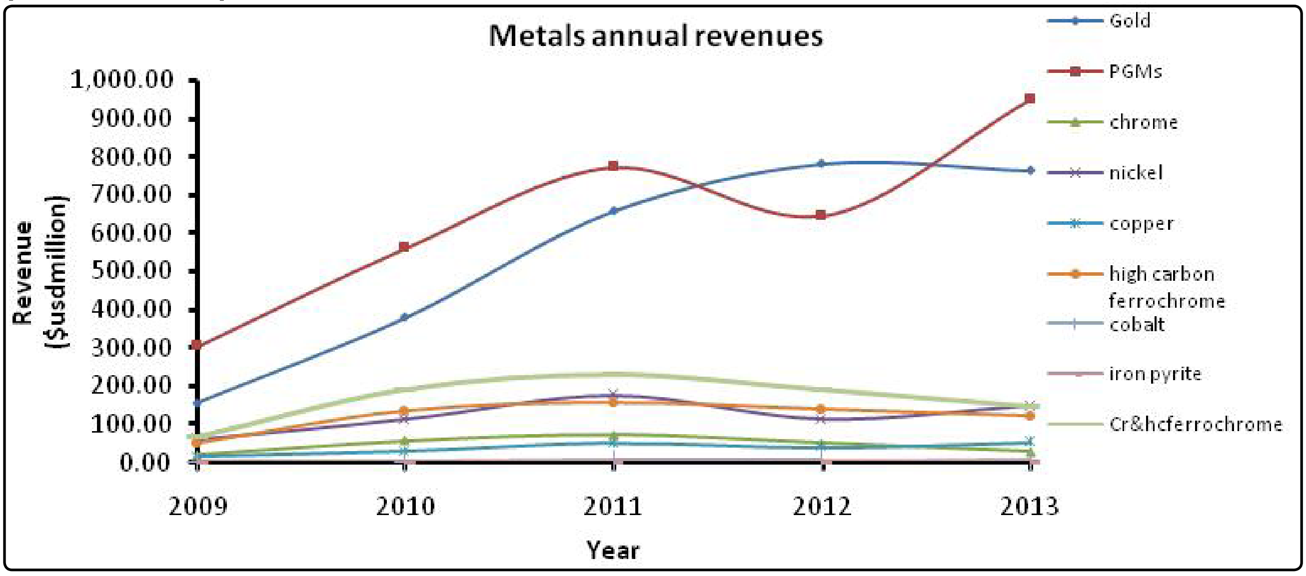
3.1 SUBSECTOR ATTRACTIVENESS

The choice of the engineering and metal products subsectors was determined by assessing the revenue size and production growth rate. The key sources of data for this assessment were 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 2: METALS AND METAL PRODUCTS REVENUE GROWTH PROFILES (2009 TO 2013)



Source: CoM

(N.B: 2013 figures were projected from the half year reports)

Figure 2 above 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 3: TOTAL REVENUE PROPORTIONS BY DIFFERENT METALS AND METAL PRODUCTS (2009 – 2012)

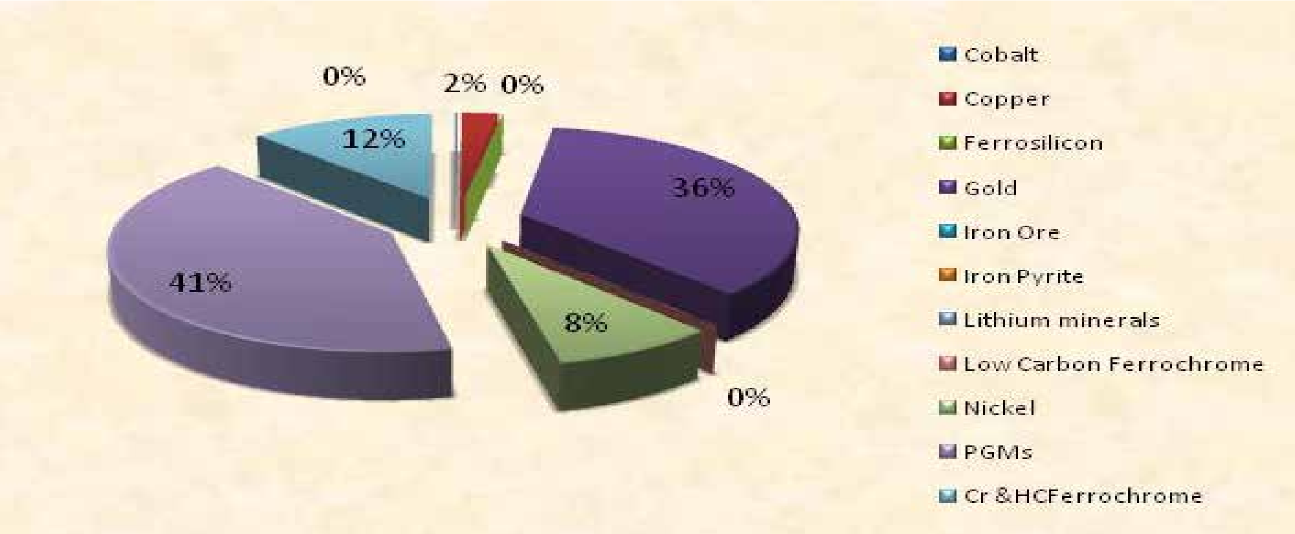


Figure 3 above shows that PGMs had the highest share of the metals and metal products revenue at 41%, followed by gold (36%), then chrome and high carbon ferrochrome (12%) and nickel (8%). The feasibility of beneficiation of PGMs and gold beyond the concentrates and the matte is therefore worthy assessing considering the great growth potential and contribution to the national economy.

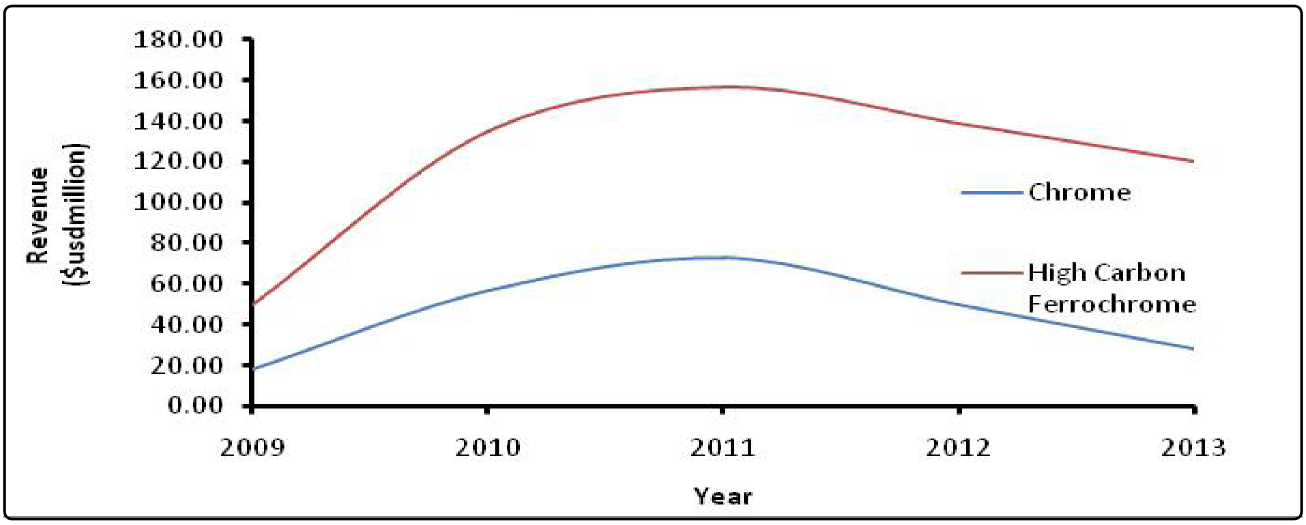
TABLE 7: METAL ORE RESERVES IN ZIMBABWE

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 7 shows that the precious metal reserves were quite significant for the precious metals (gold and PGMs), chromite, nickel, iron ore and copper. Copper was also notable and significant ore reserves were 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 4: BENEFITS OF CHROME BENEFICIATION (CHROME TO HIGH CARBON FERROCHROME)



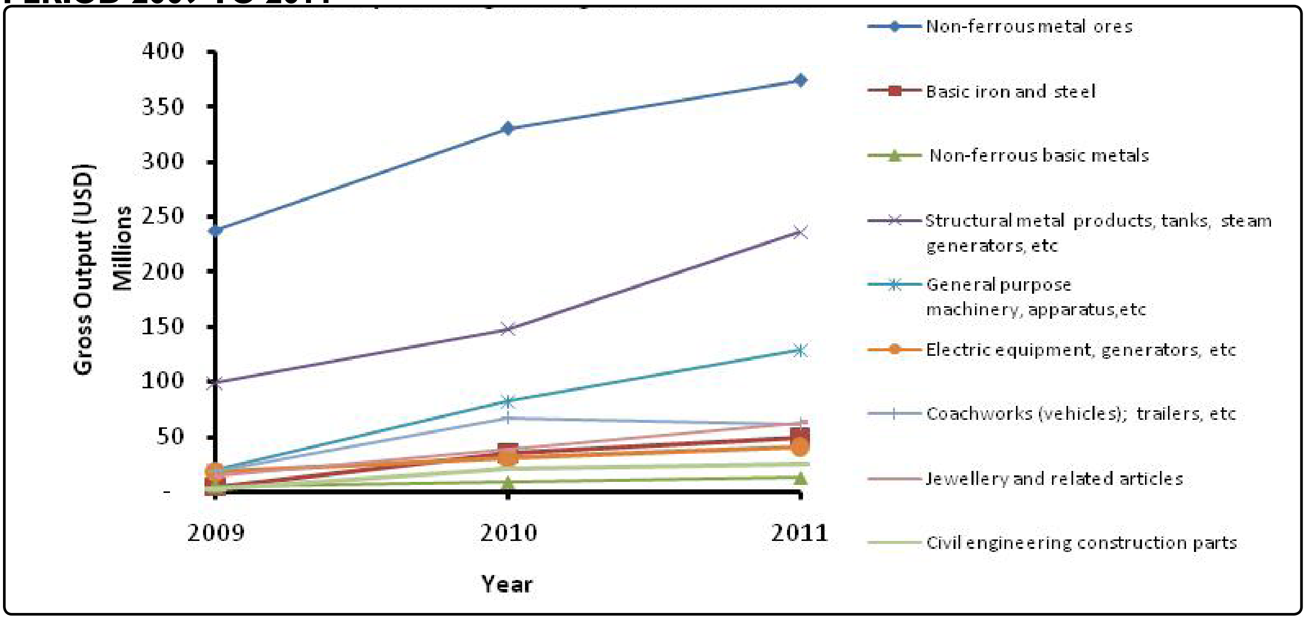
Source: CoM

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 4* shows the impact of beneficiation. The returns from high carbon ferrochrome were significantly higher than the revenues for chrome. Nevertheless after reaching peak revenues in 2011 *(Figure 4)*, 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 done.

3.1.2 ENGINEERING GOODS REVENUES

The Gross Output profile for the local engineering and metals industry by value was 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 5: GROSS OUTPUT FOR ENGINEERING AND METALS PRODUCTS FOR THE PERIOD 2009 TO 2011



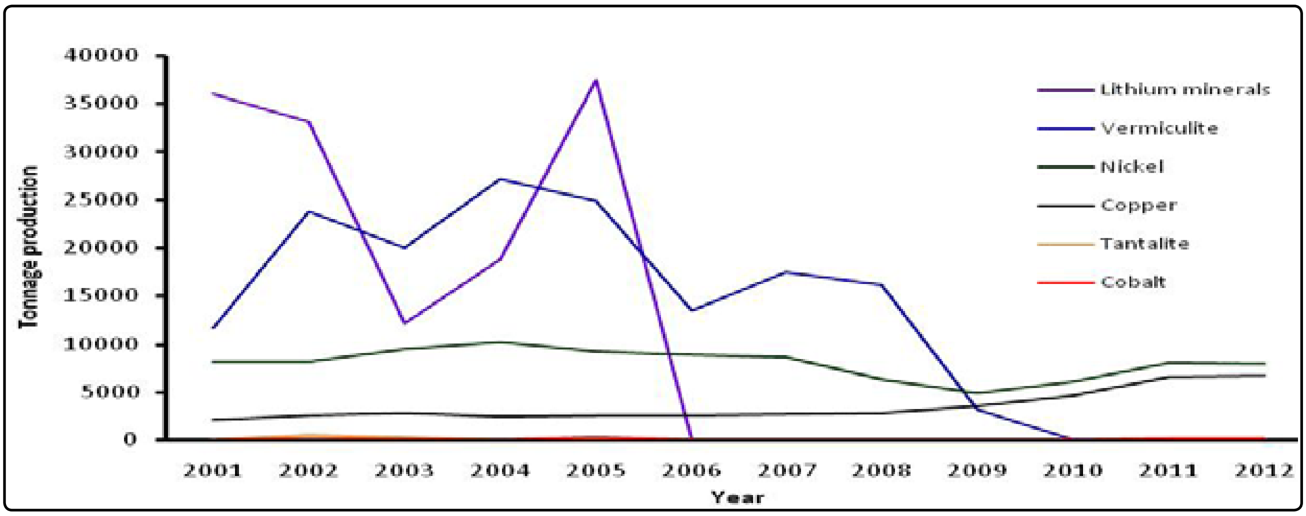
Source: ZimStat, 2012

Figure 5 above 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 was consistent with the fact that PGMs and gold production was increasing since 2009. The structural metal production growth was 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. Further details of Gross Output, Intermediate Consumption and Value Added are presented in *Annex 8*.

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.

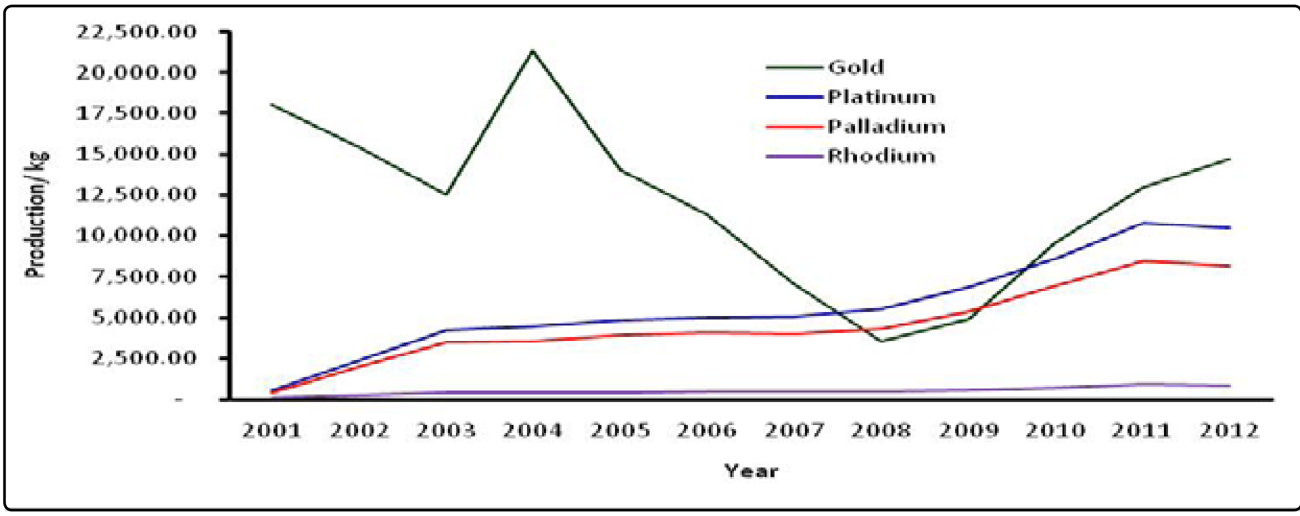
FIGURE 6: BASE METAL PRODUCTION GROWTH TREND IN ZIMBABWE



Source: CoM

The base metal production profile has not seen any significant growth for the period 2001 to 2012 as shown in *Figure 6* above. 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.

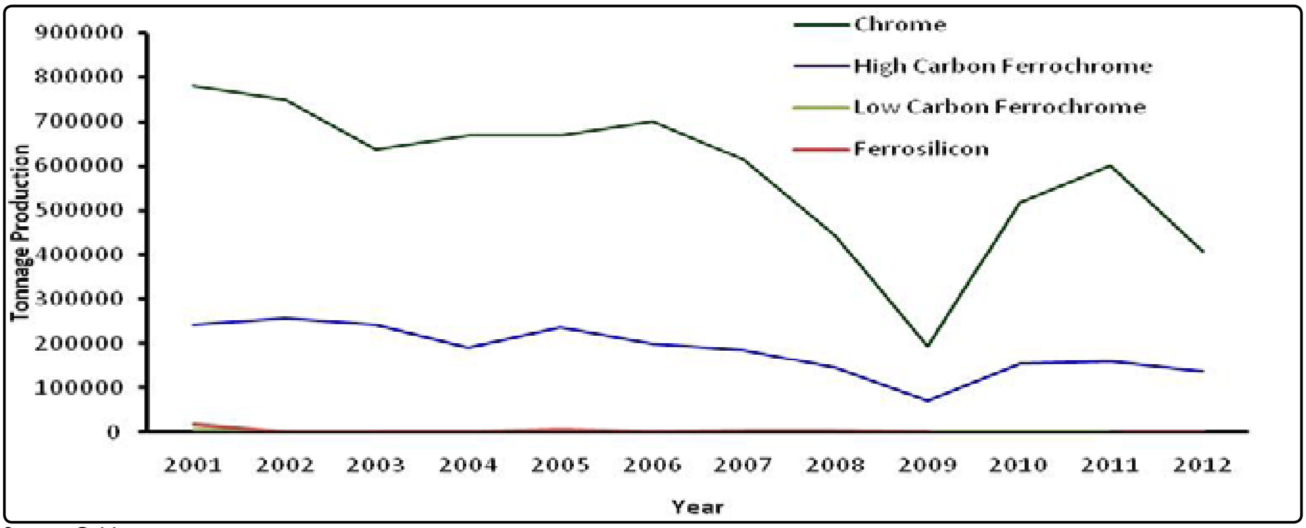
FIGURE 7: PRECIOUS METALS PRODUCTION GROWTH TREND IN ZIMBABWE



Source: CoM

Figure 7 above 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 combined with the other factors observed earlier point 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 was also noted for the great participation of small scale and artisanal miners who were estimated to be over 200000 in number.

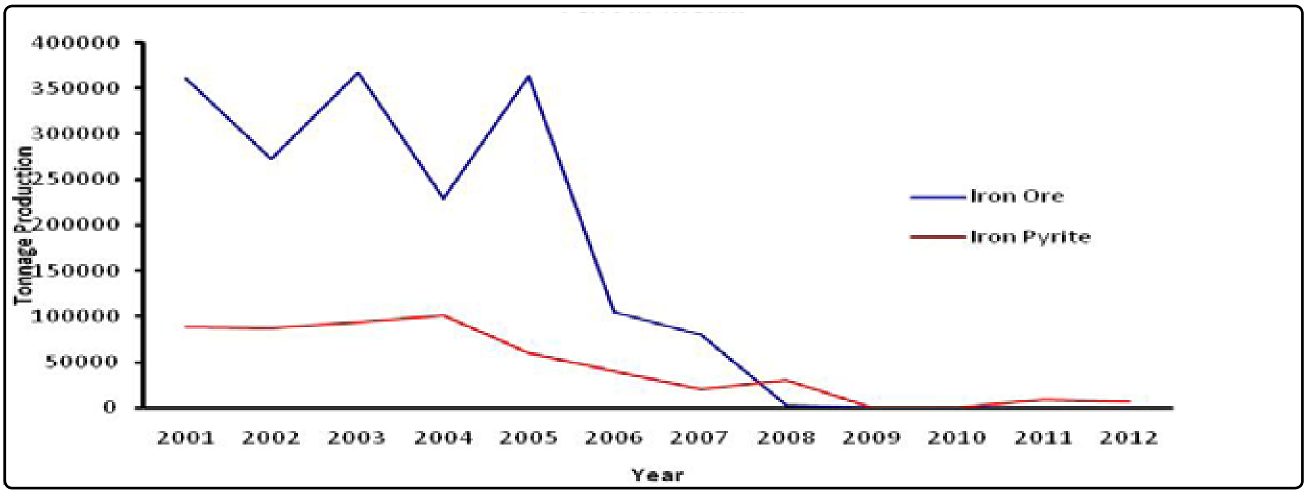
FIGURE 8: MINOR METALS PRODUCTION GROWTH TREND IN ZIMBABWE



Source: CoM

Minor metals production profile is shown in Figure 8 above 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 9: FERROUS METALS PRODUCTION GROWTH TREND IN ZIMBABWE



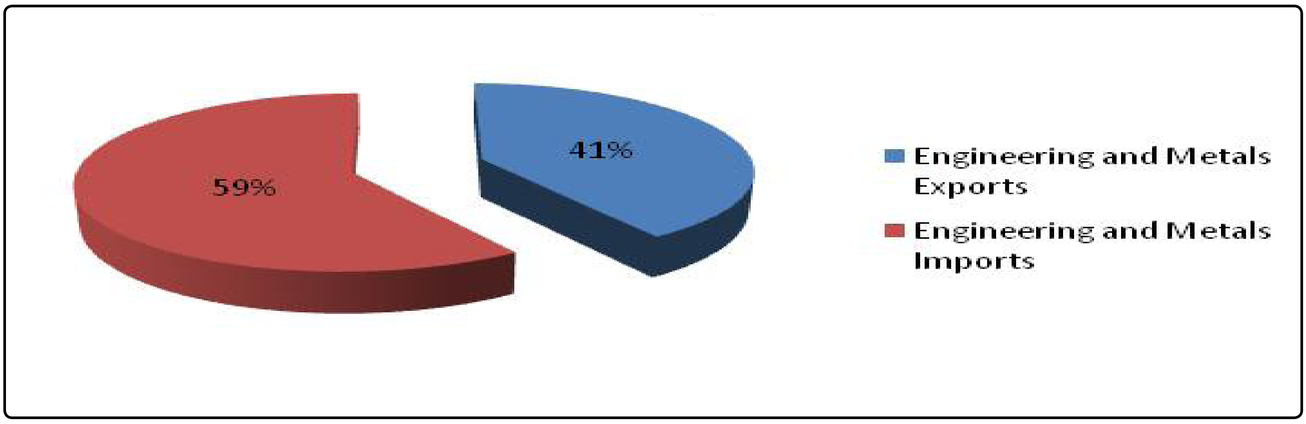
Source: CoM

The production profile for the ferrous group of metals for the period 2001 to 2012 is shown in Figure 9. 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 era 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.

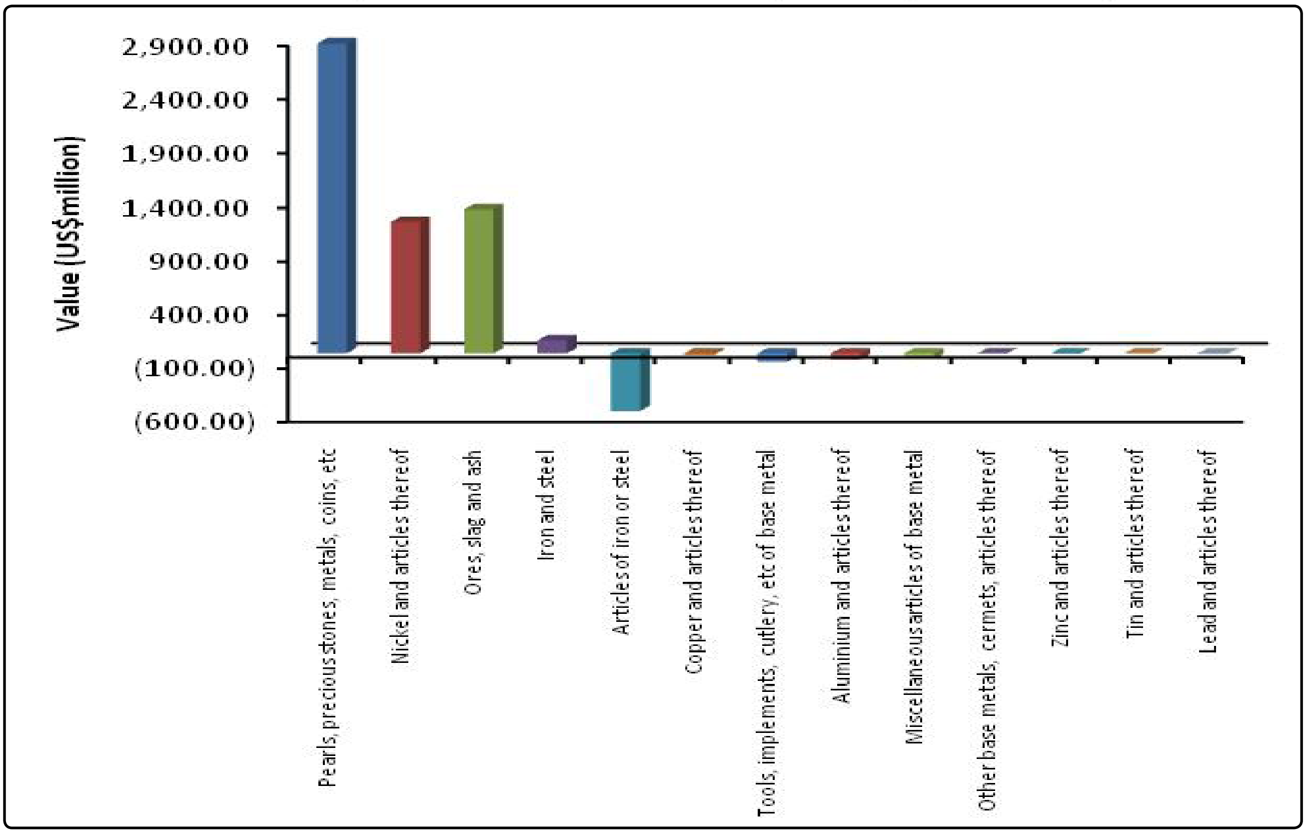
FIGURE 10: RATIO OF ENGINEERING EXPORTS TO IMPORTS BY VALUE (2008 TO 2012)



Source: UNCOMTRADE

Figure 10 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 an overall trade deficit. There is therefore great weakness in the competitiveness of the domestic engineering and metals value chain.

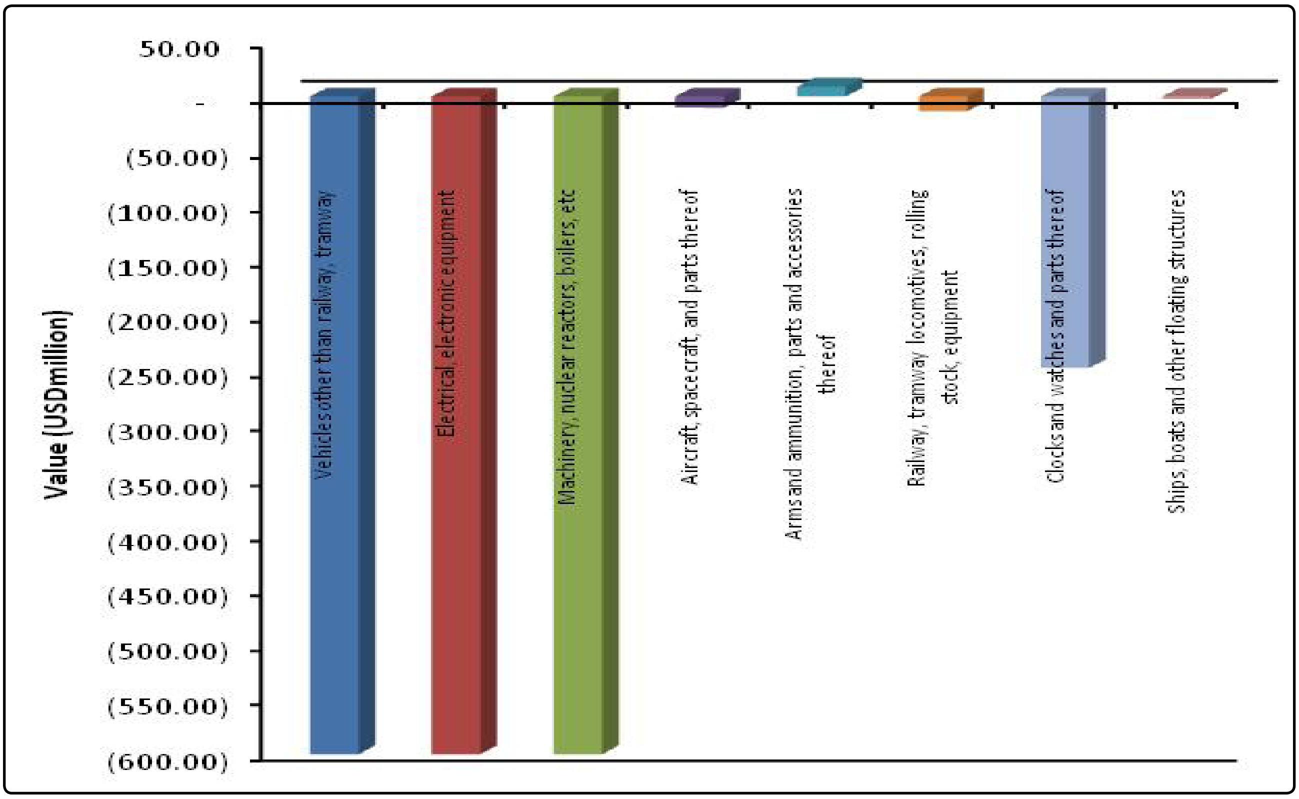
FIGURE 11: TRADE GAIN/DEFICIT IN THE METALS AND METAL PRODUCTS OF ZIMBABWE (2008 TO 2012).



Source: SIRDC Analysis, 2013

According to *Figure 11*, there was a net trade gain in the metals and metal products sectors attributable to huge trade gains in the pearls and precious metals, ores and slag and nickel and articles thereof. The iron and steel subsector was the only notable industry with a trade deficit for the period 2008 to 2012.

FIGURE 12: TRADE GAIN/DEFICIT IN THE ENGINEERING PRODUCTS OF ZIMBABWE (2008 TO 2012).



Source: SIRDC Analysis, 2013

As presented in *Figure 12* above, the engineering subsector had huge trade deficits for the assessed period. It implies that the domestic engineering subsector heavily depended on imported products despite a significant domestic demand. The notable trade deficit contributors were vehicles and parts thereof; electrical machinery and equipment; machinery and equipment as well as clocks, watches and parts thereof. Indications from the field surveys and reviewed documents revealed that the local engineering industry faced several challenges that affected its competitiveness against low cost imports from South Africa, Asia, EU and the region. Opportunities therefore lay in 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 13: COMPARISON OF METALS AND METAL PRODUCTS TO ENGINEERING GOODS BY VALUE FOR THE PERIOD 2008 TO 2012

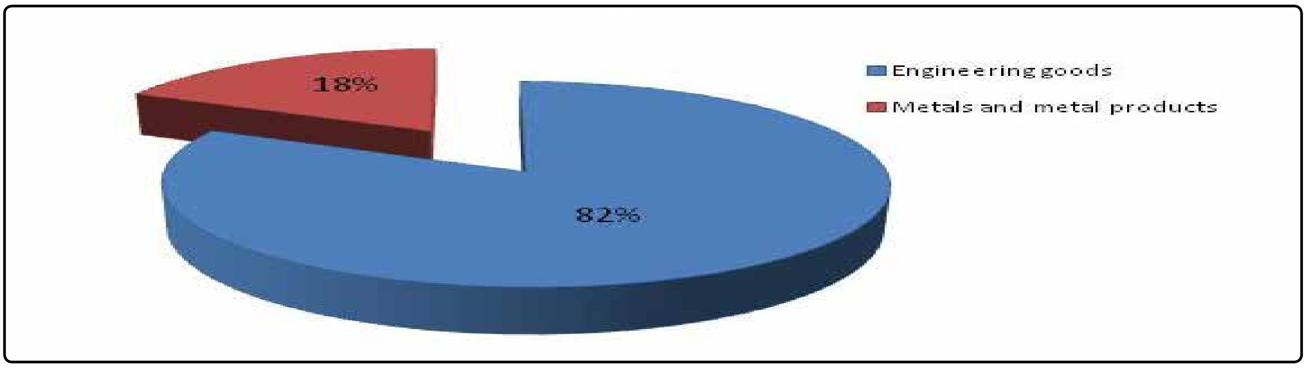


Figure 13 above shows that engineering goods constituted 82% of the imported value whilst metals and metal products contributed 18%.

FIGURE 14: COMPARISON OF EXPORTED METALS AND METAL PRODUCTS AND ENGINEERING GOODS BY VALUE FOR THE PERIOD 2008 TO 2012

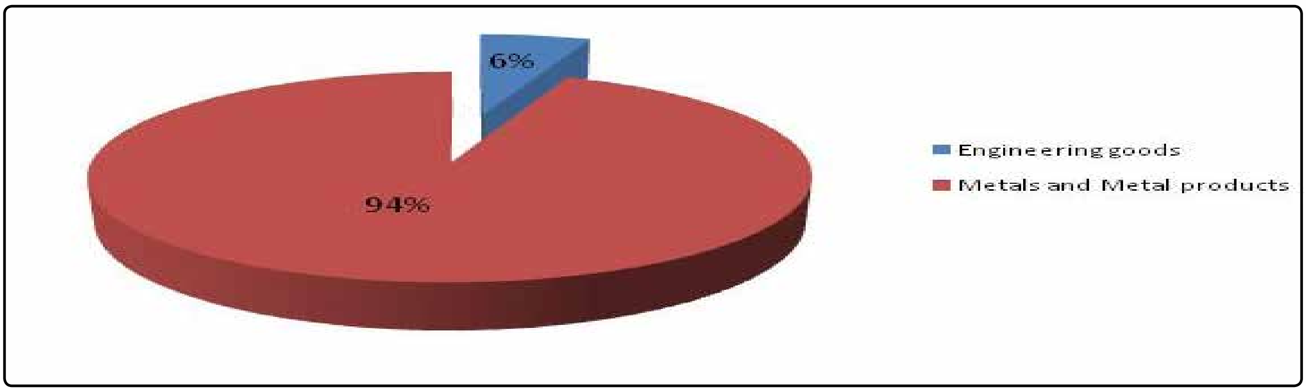


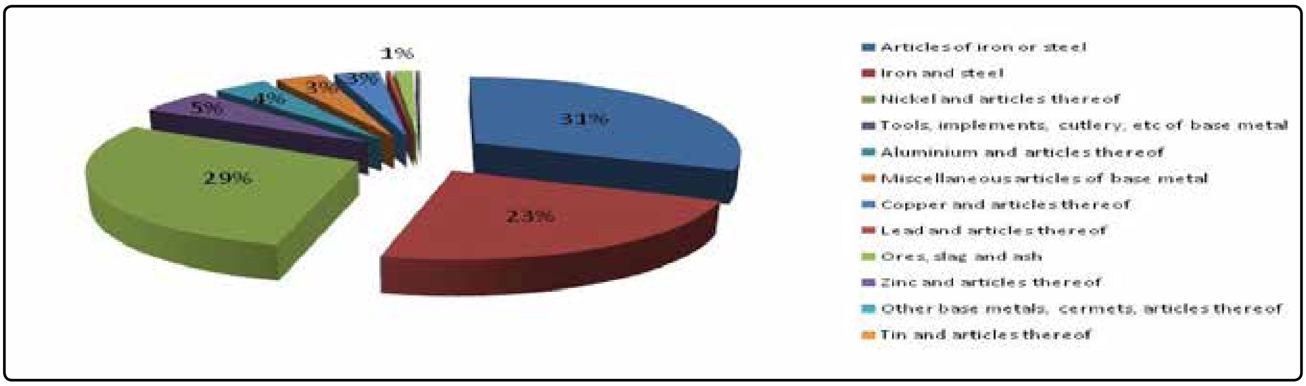
Figure 14 above shows that the metals and metals products constituted 94% of the exported engineering and metals products by value whilst the engineering sector contributed a paltry 6%. The country must therefore initiate an aggressive shift from an import oriented engineering sector to a value added manufacturing oriented one.

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.

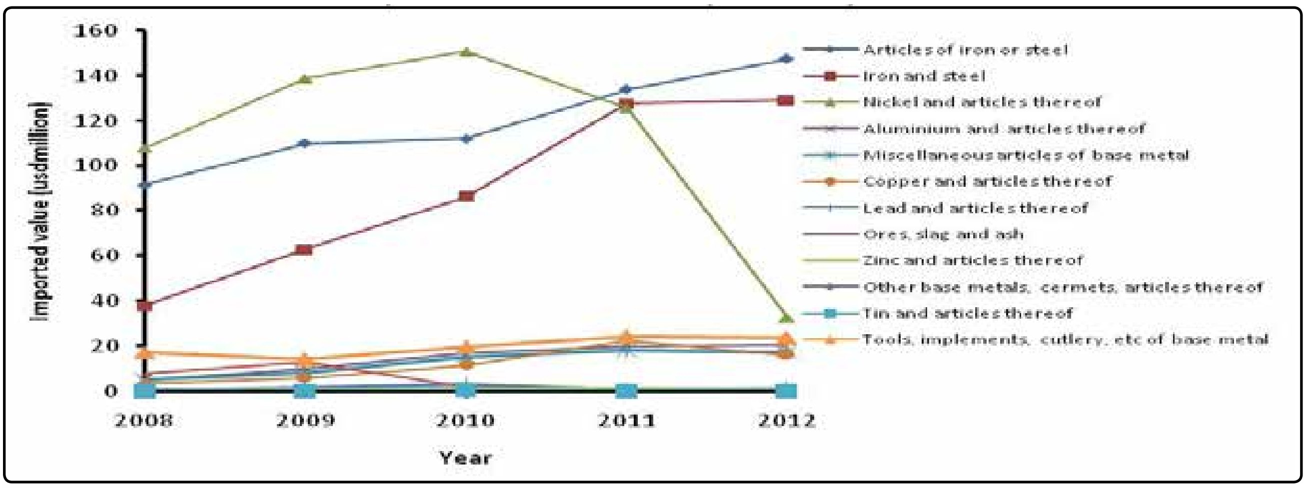
FIGURE 15: PROPORTIONS OF METALS AND METAL PRODUCTS IMPORTED BY VALUE INTO ZIMBABWE FOR THE PERIOD 2008 – 2012



Source: SIRDC Analysis, 2013

Figure 15 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 16: IMPORTED METAL AND METAL PRODUCTS BY VALUE INTO ZIMBABWE



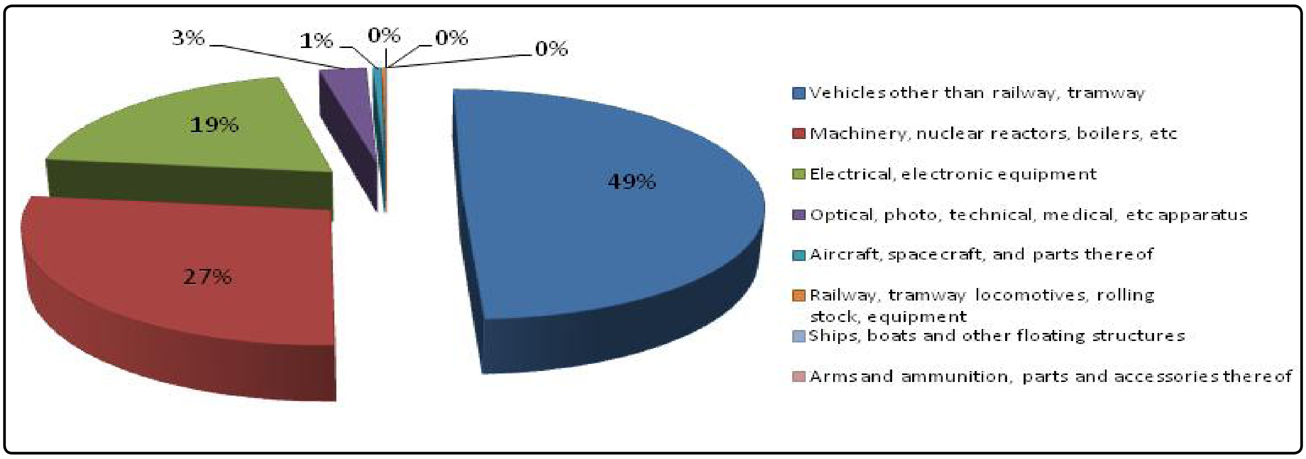
Source: SIRDC Analysis, 2013

Figure 16 above shows the import profiles for the metals and metal products by value for the period 2008 to 2012. 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.

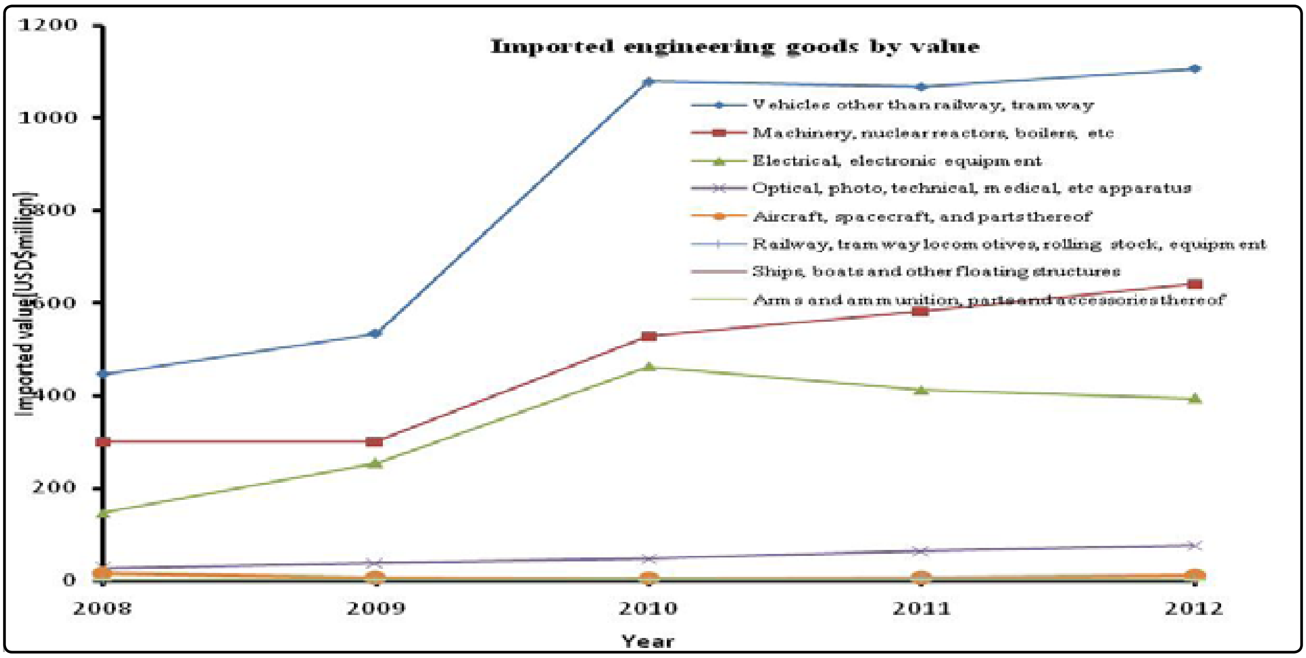
FIGURE 17: PROPORTIONS OF ENGINEERING GOODS IMPORTED BY VALUE INTO ZIMBABWE FOR THE PERIOD 2008 – 2012



Source: SIRDC Analysis, 2013

Figure 17 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 18: IMPORTED ENGINEERING GOODS BY VALUE FOR THE PERIOD 2008 TO 2012



Source: SIRDC Analysis, 2013

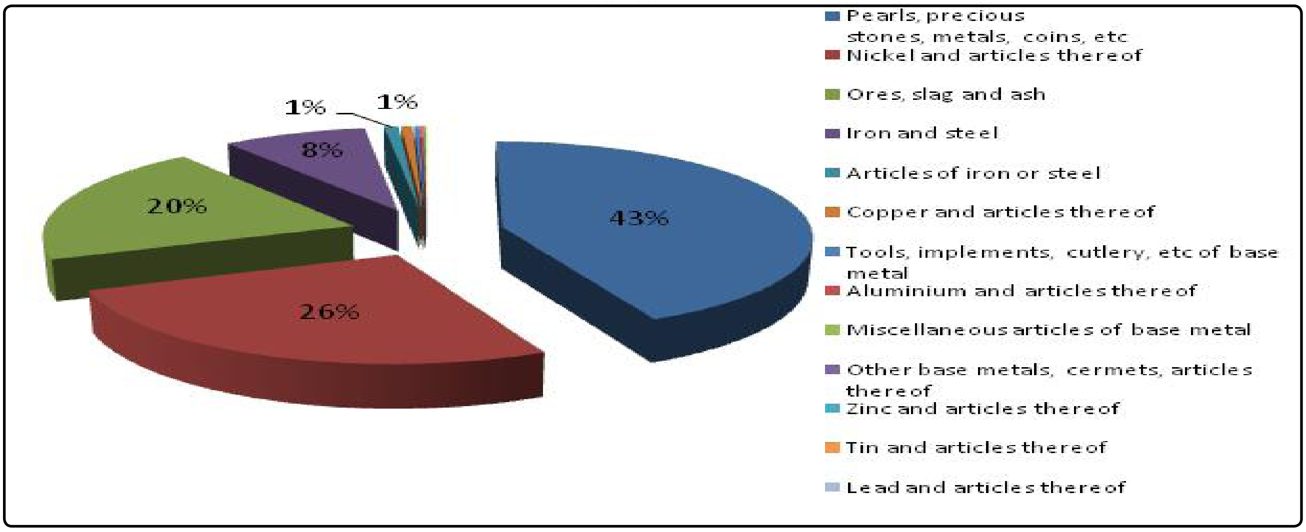
Figure 18 above presents the import profile of engineering goods by value from 2008 to 2012. Four subsectors namely the vehicles other than railway; machinery, nuclear reactors, boilers, etc.; electrical, electronic equipment and optical and photo, technical, medical, etc. apparatus. The imported vehicles 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

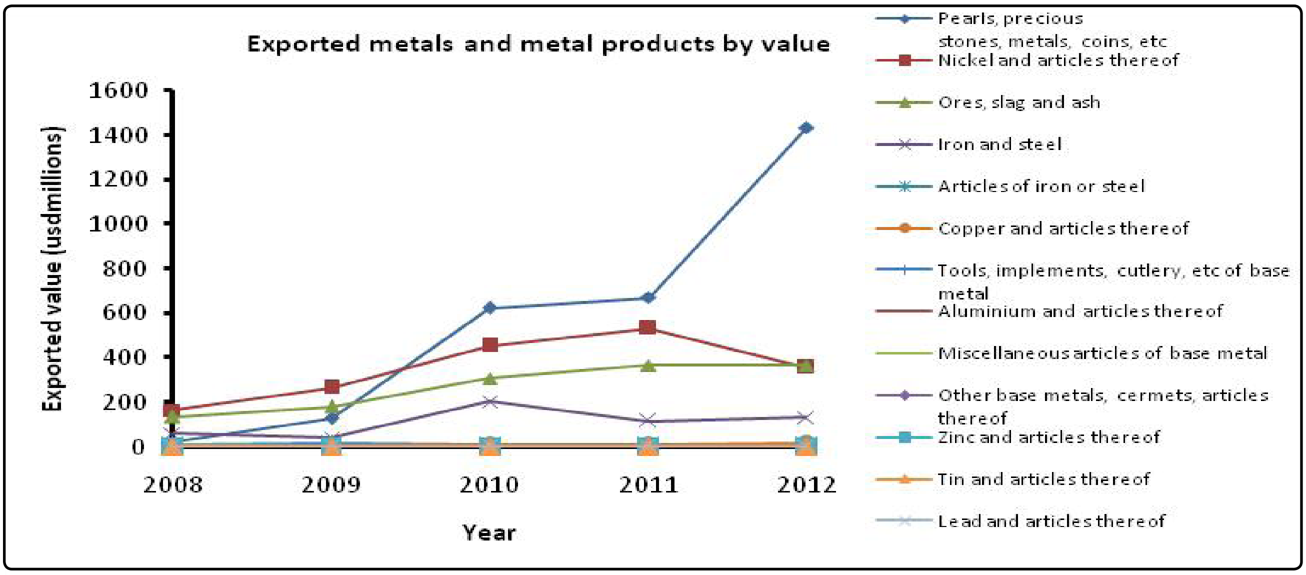
Figure 19 below shows that pearls, precious stones and metals (43%); nickel and articles thereof (26%); ores, slag and ash (20%) and Iron and Steel (8%). The high share of the pearls and precious metals is attributable to gold and PGMs export. The significant share of nickel and articles thereof is attributable 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 19: PROPORTIONS OF EXPORTED METALS AND METAL PRODUCTS BY VALUE FOR THE PERIOD 2008 -12



Source: SIRDC Analysis, 2013

FIGURE 20: METALS AND METAL PRODUCTS EXPORT TRENDS BY VALUE FOR THE PERIOD 2008 -12



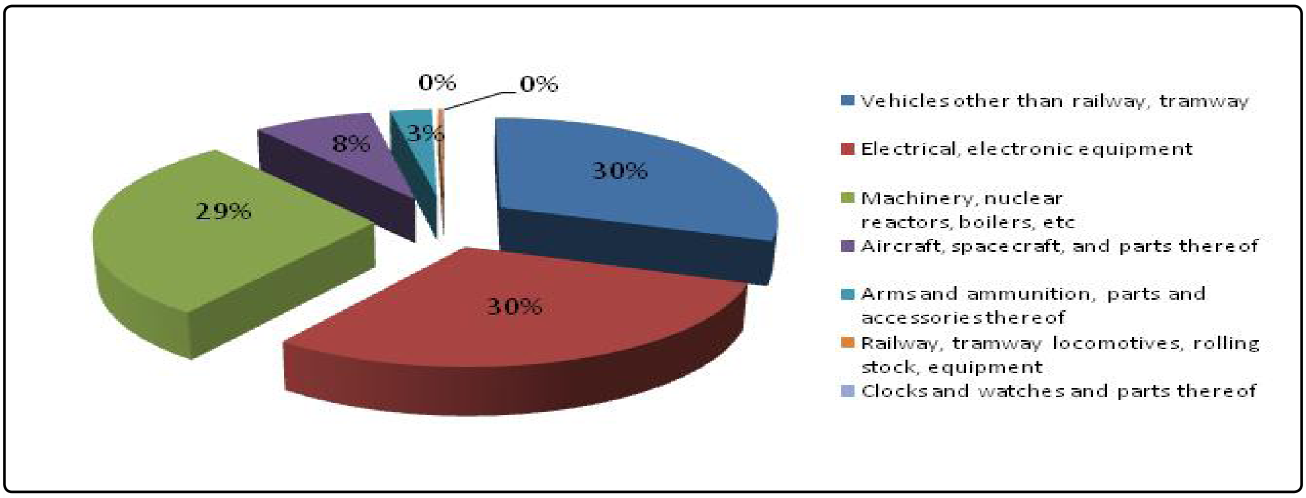
Source: SIRDC Analysis, 2013

Figure 20 above 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, 2013 (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.

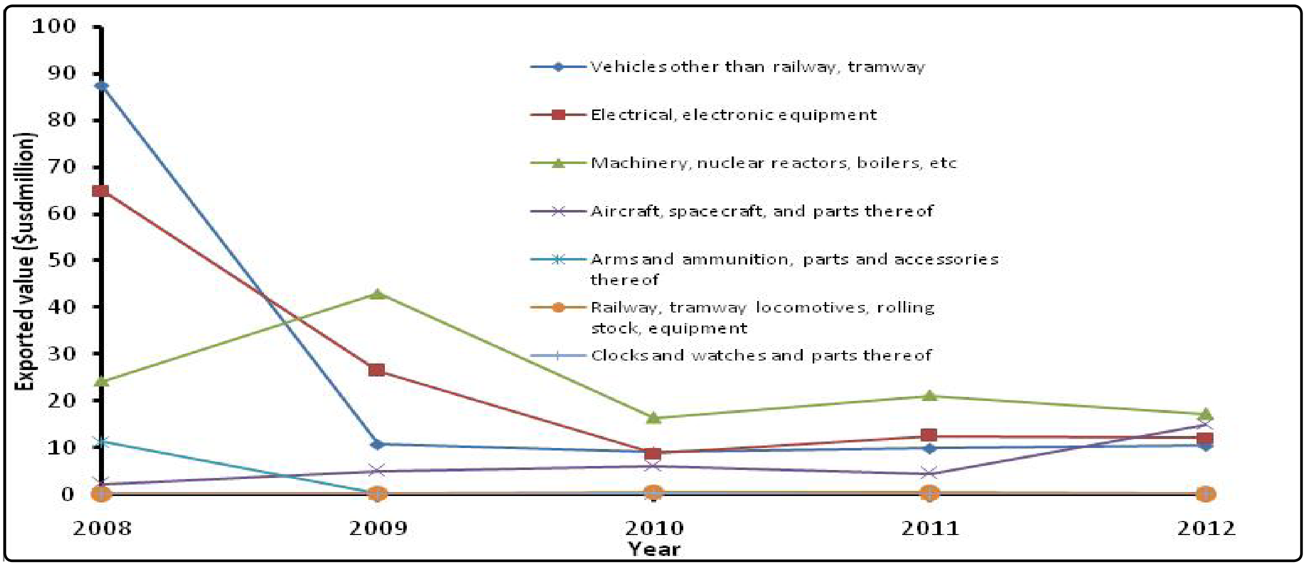
FIGURE 21: PROPORTIONS OF EXPORTED ENGINEERING GOODS BY VALUE FOR THE PERIOD 2008 - 12



Source: SIRDC Analysis, 2013

Figure 21 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 22: ENGINEERING GOODS EXPORTS TRENDS BY VALUE FROM ZIMBABWE FOR THE PERIOD 2008 - 12



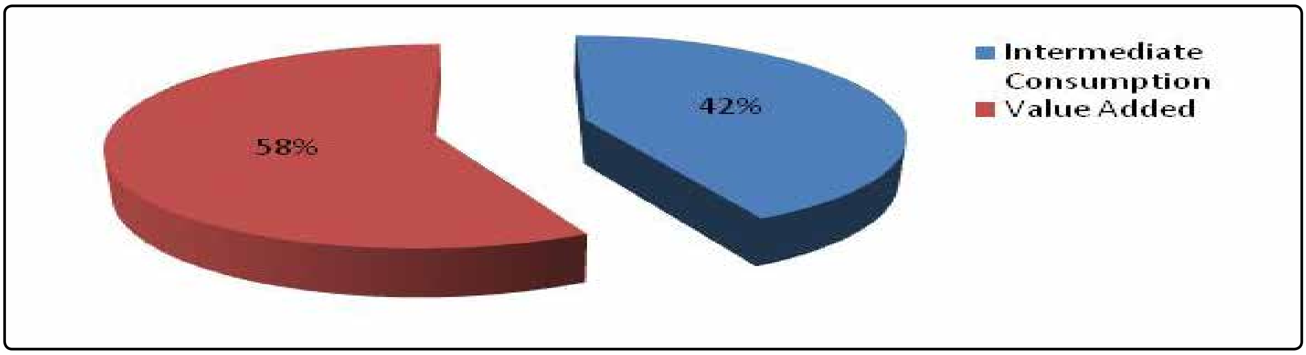
Source: SIRDC Analysis, 2013

Figure 22 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.

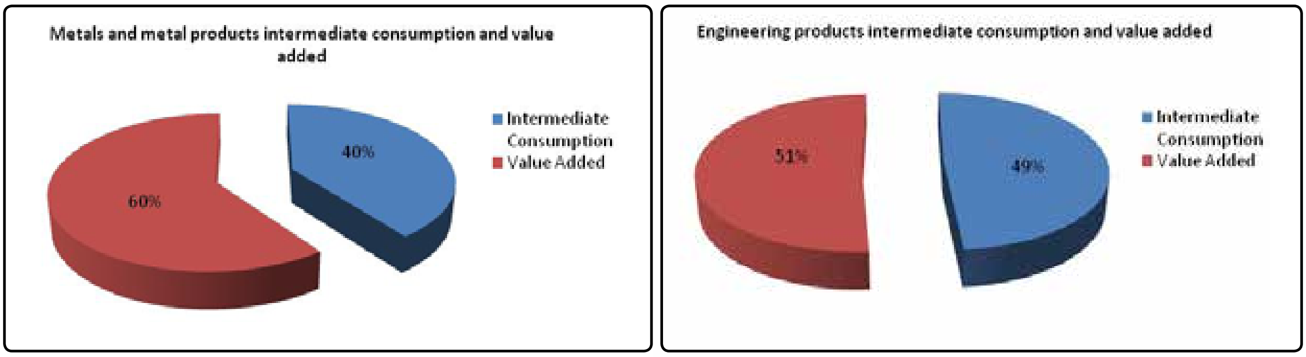
FIGURE 23: ENGINEERING AND METAL PRODUCTS INTERMEDIATE CONSUMPTION AND VALUE ADDED AS % OF GROSS OUTPUT (2009 TO 2011)



Source: SIRDC Analysis, 2013

Figure 23 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 high Value Added percentage implies that the engineering and metals sector has great potential for competitiveness.

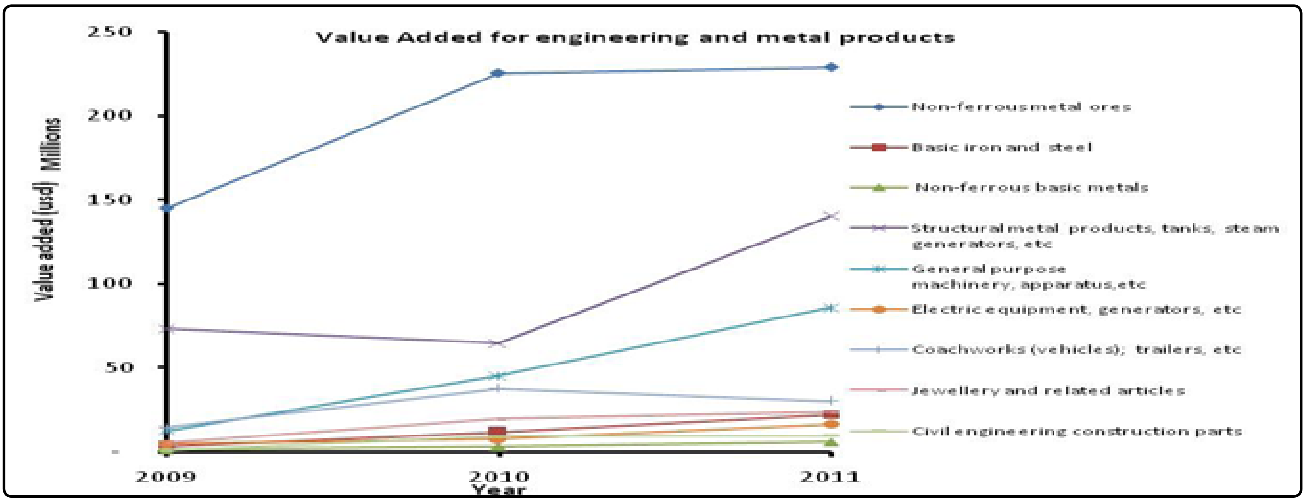
FIGURE 24: INTERMEDIATE CONSUMPTION AND VALUE ADDED FOR I) METALS AND METAL PRODUCTS; AND II) ENGINEERING PRODUCTS AS % OF GROSS OUTPUT (2009 TO 2011)



SIRDC Analysis, 2013

Figure 24i and ii, above 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 24i)*. For the engineering subsector, value added percentage was slightly lower at 51% whilst intermediate consumption was 49% *(Figure 24ii)*. Despite the low production activities on the local industry, the high percentages of value added show that the engineering and metals sector have potential to compete on the global market.

FIGURE 25: VALUE ADDED FOR ENGINEERING AND METALS SUBSECTORS FOR THE PERIOD 2009 TO 2011



Source: ZimStat

Figure 25 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

The results of the preliminary value chain selection process using desk review are presented in *Tables 8 and 9*. 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.

TABLE 8: 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

Source: SIRDC Analysis, 2013

TABLE 9: 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	

Source: SIRDC Analysis, 2013

The preliminary value chain selection process therefore provided the guideline for the field study.

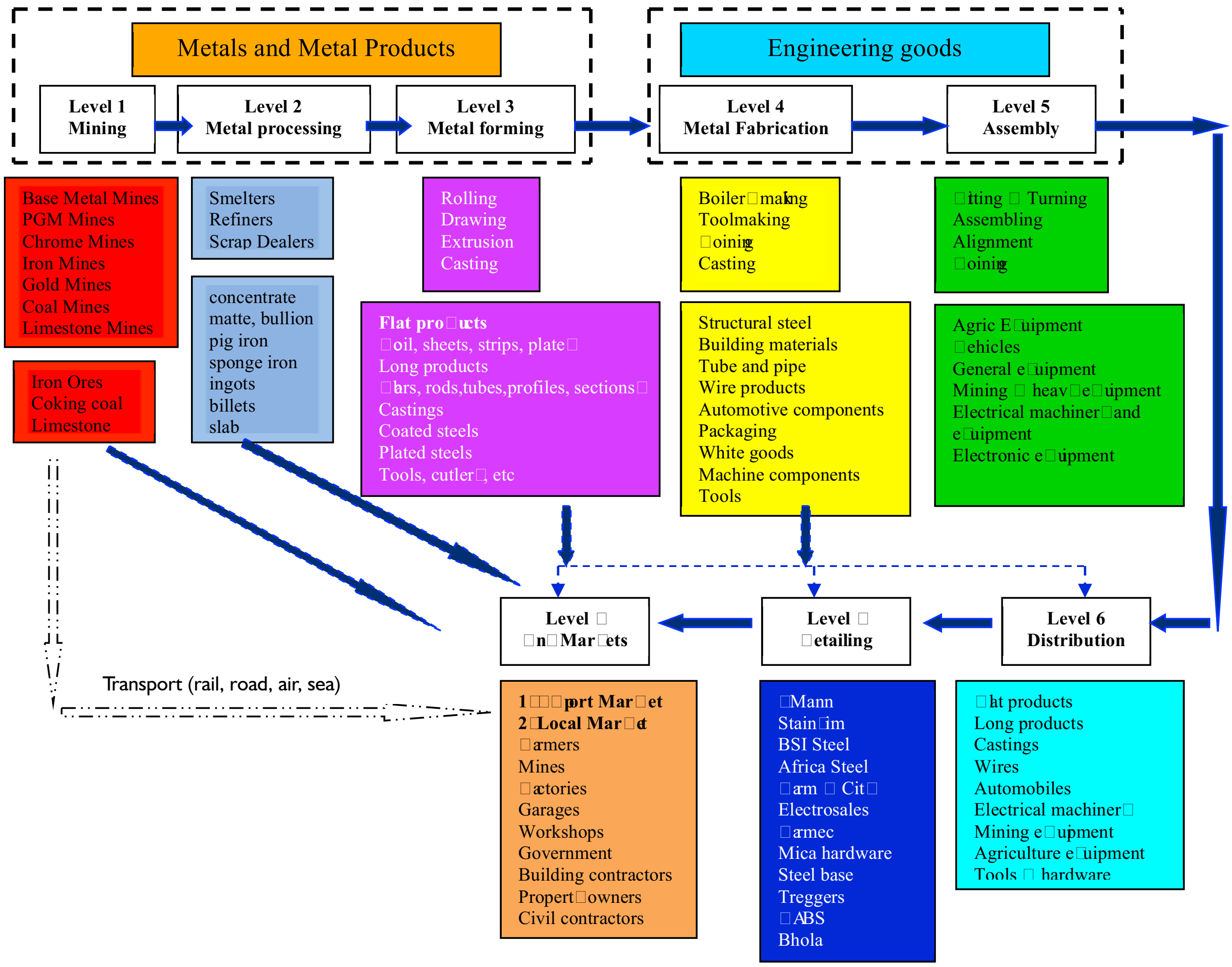
PART 4: VALUE CHAIN ANALYSIS (7 DIAGNOSTIC DIMENSION APPROACH)

After value chain selection, the 7 diagnostic dimension approach (UNIDO IVC Tool, 2011) was used in the analysis of the most attractive value chains. The Engineering and metals industry value chain mapping provided a guideline for a level based diagnostic study. Data from key informants, questionnaires, field surveys and document reviews was used for the analyses. The 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.

4.1 ENGINEERING AND METALS VALUE CHAIN MAPPING

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. The generic map for the engineering and metals value chain is shown in Figure 26.

FIGURE 26: GENERIC ENGINEERING AND METALS VALUE CHAIN MAPS

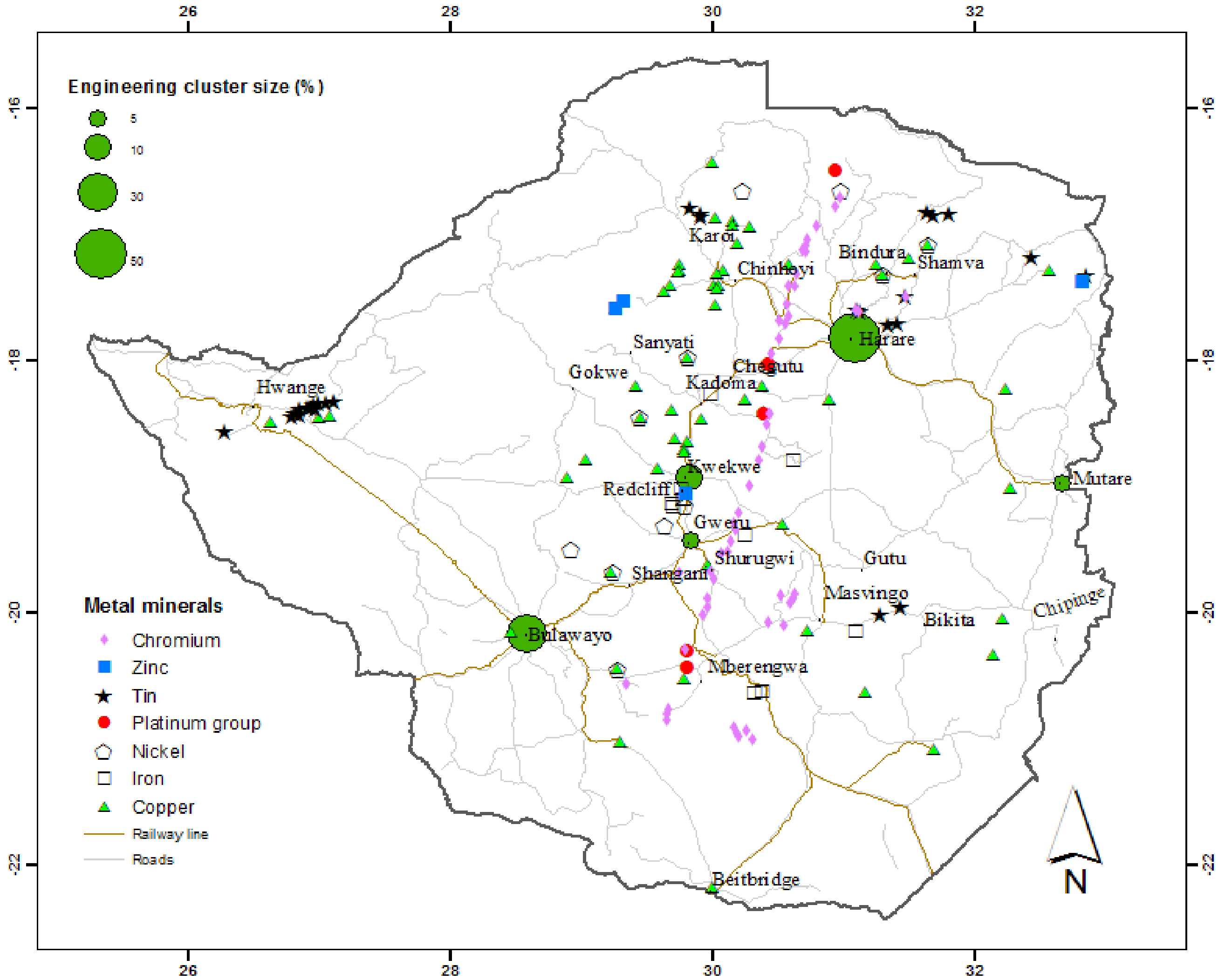


Source: SIRDC Analysis, 2013

4.1.2 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 of metals 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 Super group: 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 USD52 billion worth of Platinum along the Great Dyke, only USD5 billion has been allocated. Other sources of supplies include imports (e.g. aluminium) and recycling of used/scrap metals.

FIGURE27: METAL MINERALS AND ENGINEERING CLUSTERS DISTRIBUTION IN ZIMBABWE *(EXCLUDING GOLD)*



Source: Zimbabwe Geological Survey, 1988 (Data coded by SIRDC – GRSI, 2013)

Figure 27 above 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, cobalt, 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. 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.

4.1.3 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 10* below.

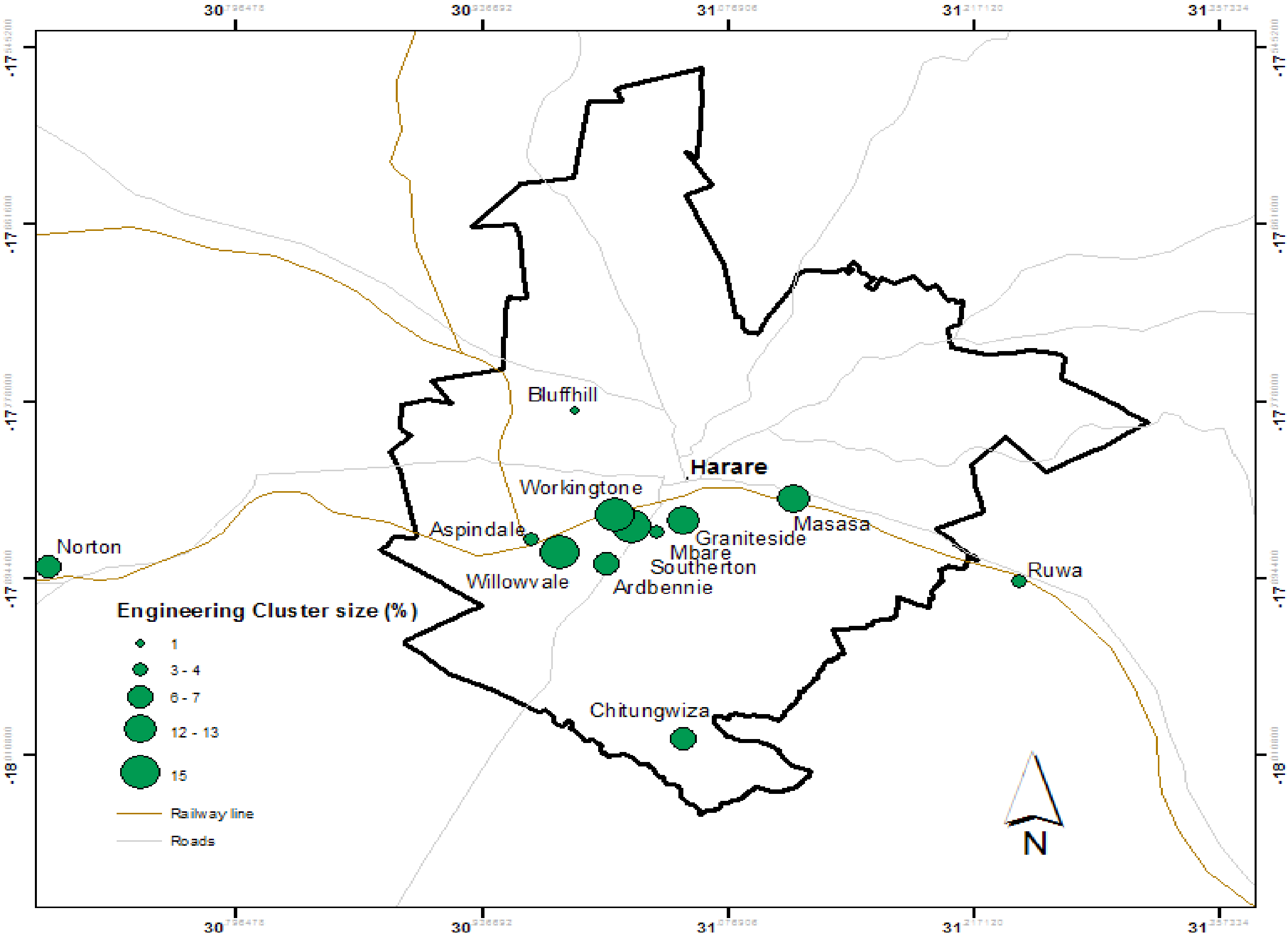
TABLE 10: CLASSIFICATION OF HEAVY AND LIGHT ENGINEERING SUBSECTORS IN ZIMBABWE

Heavy Engineering	**Light Engineering**
Mining machinery industry	Industrial fasteners
Industrial machinery 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 as generators 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 More wear 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 feasible in 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 sector and manufacture low value added products. A considerable number of medium and large scale firms producing high value-added products also exist.

FIGURE 28: ENGINEERING CLUSTERS DISTRIBUTION IN HARARE



Source: GRSI, SIRDC, 2013

The engineering industry is dominated by actors in the Harare region. *Figure 27* (previous section) shows the overall distribution of engineering clusters in the country whilst *Figure 28* above shows 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)*.

4.1.4 LEVEL BASED ENGINEERING AND METALS VALUE CHAIN DIAGNOSTIC STUDY APPROACH

The diagnostic dimension approach was applied to 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. Levels 6, 7 and 8 (Distribution, Retailing and End Markets) were not covered in detail in this study and hence recommended for further study. *Table 11* below shows the summary of the field visits and their geographical distribution. The full list of visited actors is presented in *Annex 9*. The respondents were engineers, senior managers, directors and chief executive officers.

TABLE 11: 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 12: 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 11*, 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 12)*. 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 12 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.

4.2 LEVEL 2 VALUE CHAIN ANALYSIS (METAL/MINERAL PROCESSING)

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. 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. Special subsections were dedicated to the PGMs and chrome value chains as case studies.

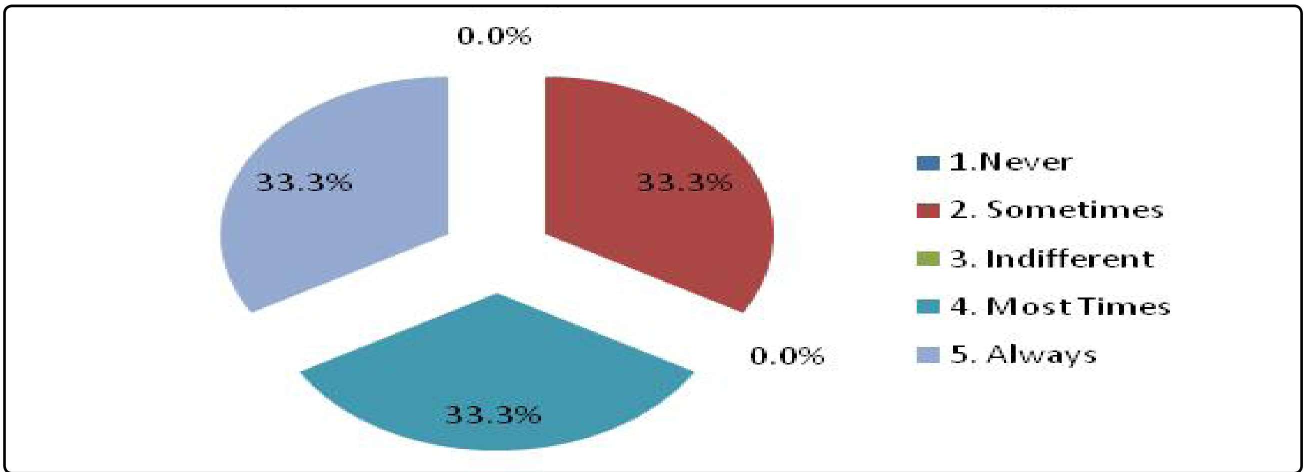
During the field surveys 10 major actors in **Level 2** involved in PGMs, gold, chrome and nickel value chains were visited. These actors are distributed around Zimbabwe and located in Bindura, Chegutu, Kadoma, Kwekwe and Shurugwi. Out of the ten, four (40%) had ceased their operations due to viability 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.

4.2.1 DIMENSION 1: SOURCES OF INPUTS AND SUPPLIES

4.2.1.1 Characteristics of Inputs, Supplies and Nature of Suppliers

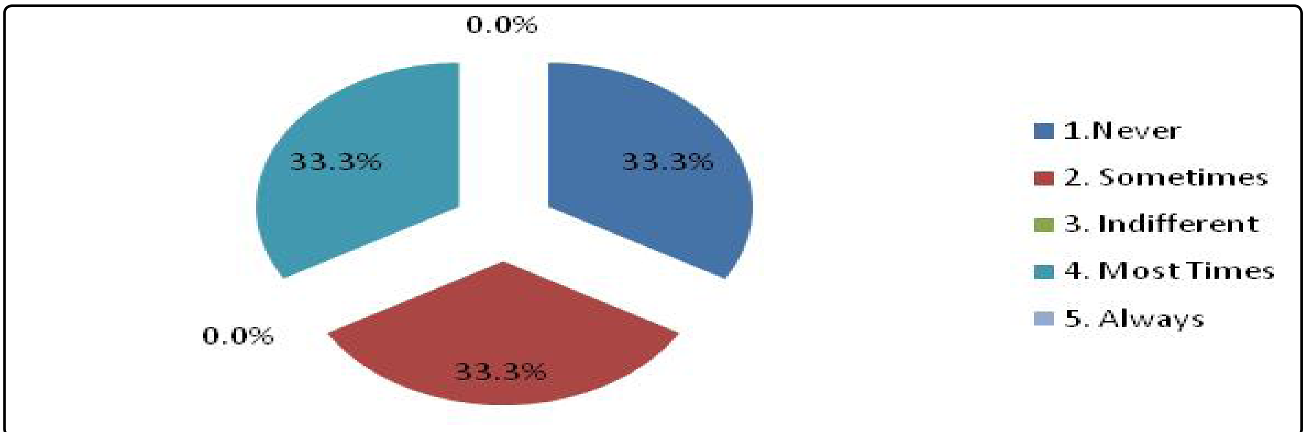
The inputs noted in the study were PGMs, nickel and chrome ores; coke, anthracite, felsite, electricity, water, storage facilities and transport facilities. The analysis showed that all the investigated actors received 64 – 90% of their inputs locally (77% average), whilst about 23% of the inputs were 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, citing the substitution of anthracite with coke and felsite with coke.

FIGURE 29: 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 29)*. The responses also show that the quality of locally sourced inputs was generally high.

FIGURE 30: 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 30)*. This implies that the reliability of local suppliers in delivering the expected quantities was generally low.

FIGURE 31: CONSISTENCY OF QUALITY OF INPUTS FROM FOREIGN SUPPLIERS

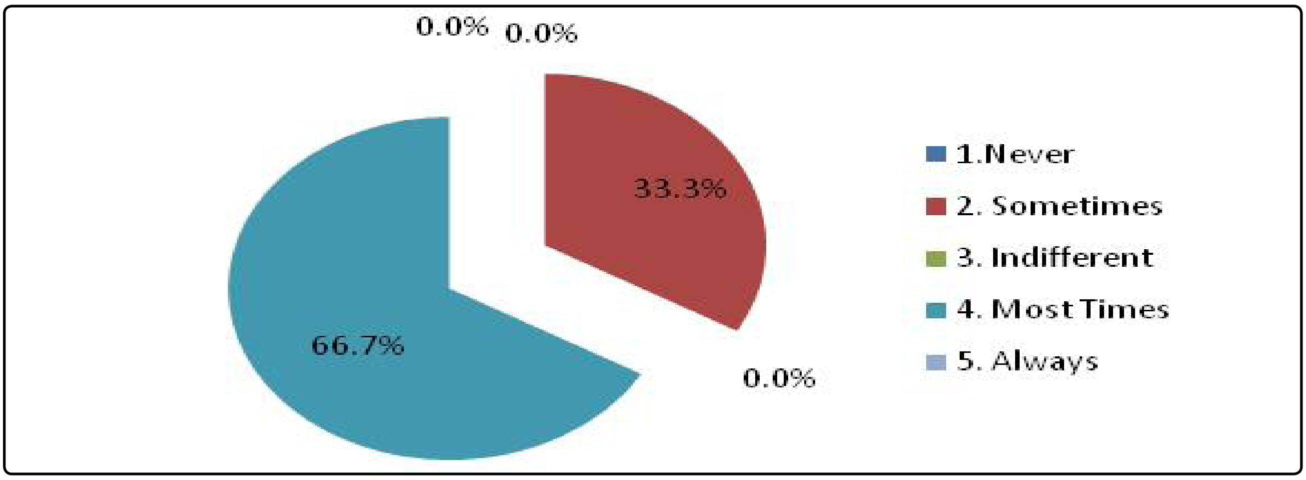


Figure 31 above shows that, of the responses on the quality of inputs from foreign suppliers, 66.7% said the quality was good most of the times whilst 33.3% said it was sometimes. It generally implies that the quality of foreign sources inputs was generally high.

FIGURE 32: CONSISTENCY OF QUANTITIES OF INPUTS SUPPLIED FROM FOREIGN SOURCES

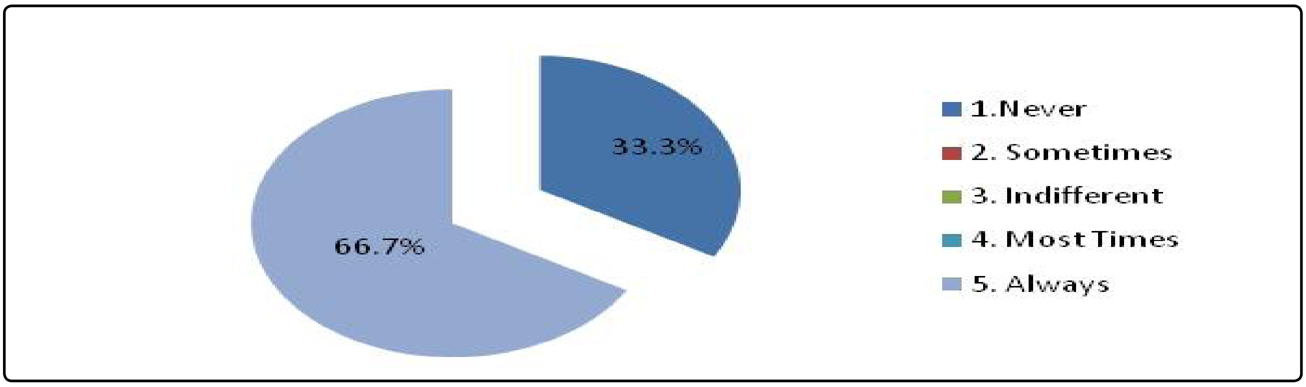


Figure 32 shows that 66.7% of the respondents said that the quantities of inputs from foreign supplies were adequate most times, whilst 33.7% said the quantities were never sufficient. Although a higher percentage indicated adequacy of quantities of inputs imported from suppliers, a significant portion 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.

4.2.1.2 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.

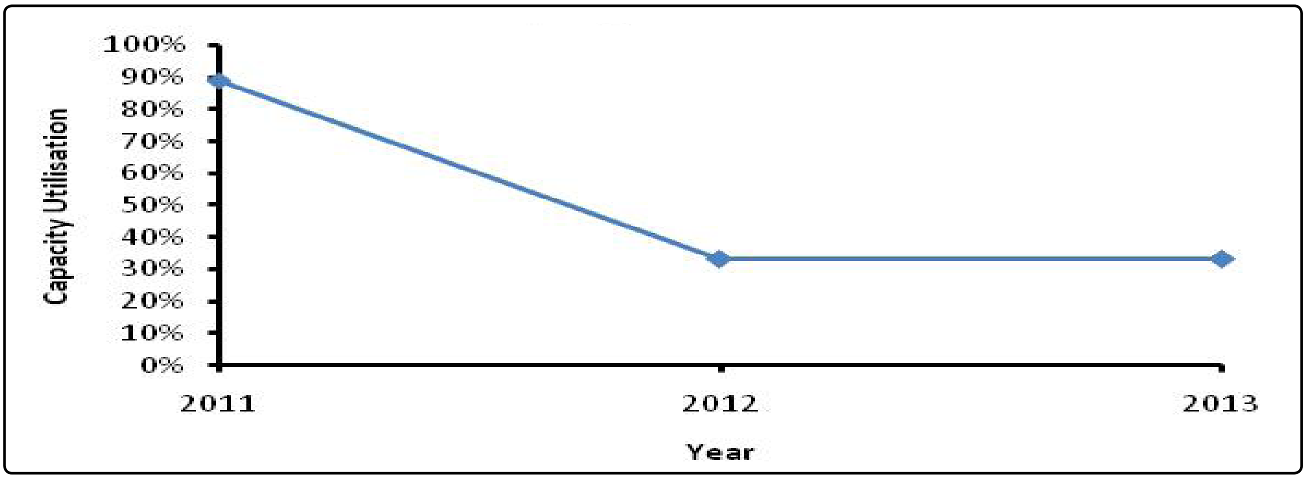
All respondents said that they were offered no bribes when dealing with customs. The responses on customs and trade regulations indicate that this factor is a major obstacle to current operations since 66.7% said it was either major or severe whilst 33.7% said it was a minor obstacle. The order system 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.

4.2.2 DIMENSION 2: PRODUCTION CAPACITY AND TECHNOLOGY USE

4.2.2.1 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 33: CAPACITY UTILISATION IN LEVEL 2



Capacity utilisation dropped from 89% in 2011 to 33% in 2013*(Figure 33)*. 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* below.

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	66.7%
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 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* above, 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.

4.2.2.2 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 34 below)*.

FIGURE 34: SUITABILITY OF TERTIARY EDUCATION CURRICULAR TO INDUSTRY REQUIREMENTS

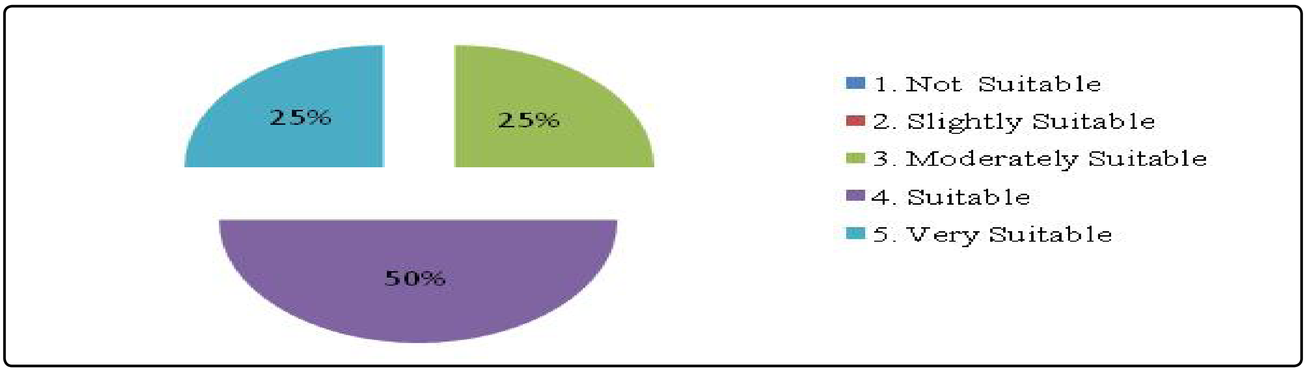
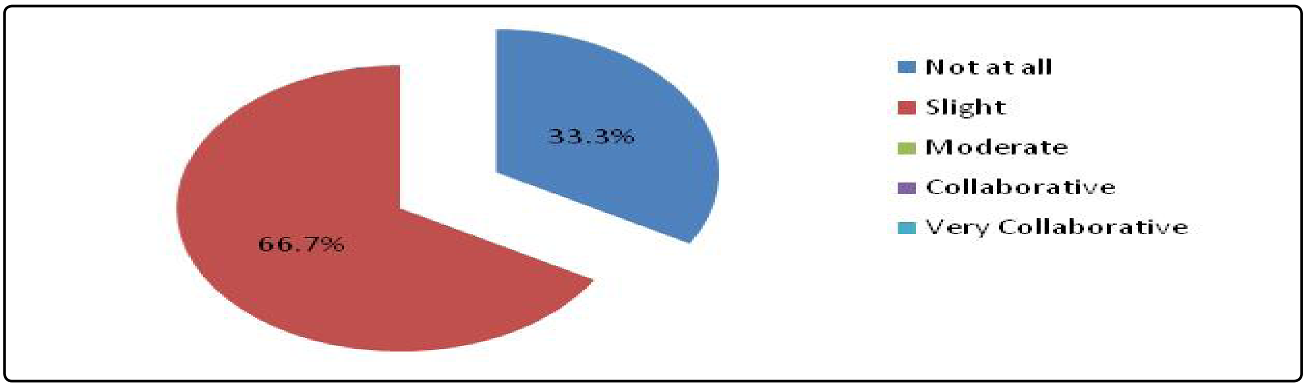
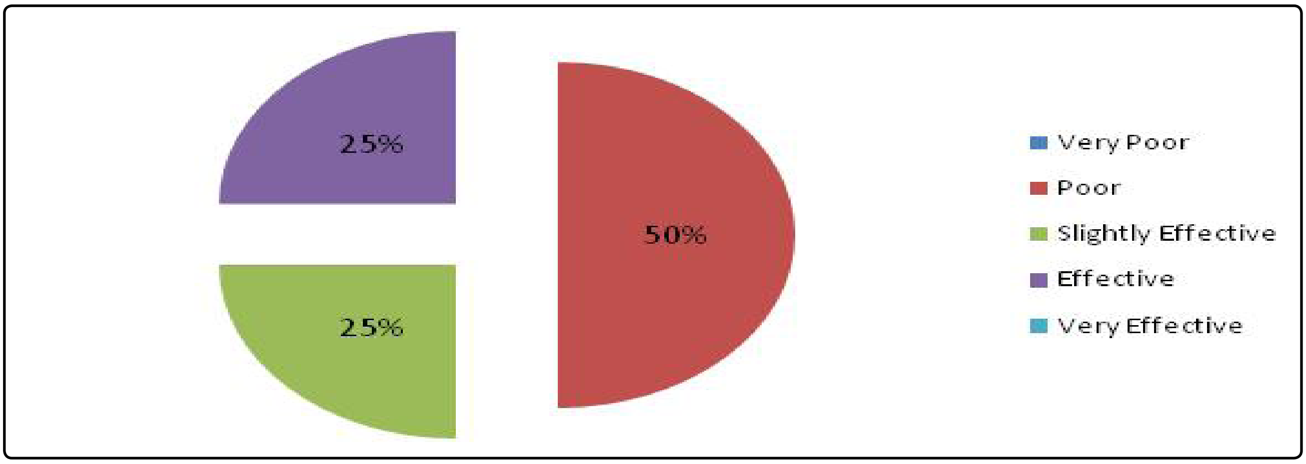


FIGURE 35: LEVEL OF COLLABORATION WITH NATIONAL RESEARCH AND DEVELOPMENT INSTITUTIONS



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 35)*. *Figure 36* 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 36: RELEVANCE AND EFFECTIVENESS OF LOCAL RESEARCH & DEVELOPMENT FOR OPERATIONS IMPROVEMENT



The strength of the tertiary education system is strongly backed by a report by *Afonja et al., 2005* which indicated that the educational policy of Zimbabwe promoted technical education as well as the integration of theory and practice from primary to higher education. Key informant interviews also show that the number of universities and colleges increased significantly from 3 in 1980 *(Afonja et al., 2005)* to more than 18 in 2013. The survey also revealed that of the 13 universities in Zimbabwe, 5 (38%) supported technical education which directly fed into the engineering and metals sector. The universities included University of Zimbabwe (UZ), National University of Science and Technology (NUST), Harare Institute of Technology (HIT), Chinhoyi University of Technology (CUT) and Bindura University of Science Education (BUSE). According to key informants and information from official websites, the universities offer four to five year Bachelor of Technology (BTech) or Bachelor of Engineering (BSc Eng Honours) degrees in fields such as mechanical and production engineering, industrial engineering, water engineering, chemical engineering, electronics engineering, energy and fuels amongst others. Other degree programmes uniquely offered by UZ included civil engineering, electrical, mining and metallurgical engineering as well as geo-informatics and surveying. It was noted that all the universities aligned to the engineering and metals industry were state funded and no private university offered programmes directly supporting the sector. There is an opportunity to attract private university to consider technical curricular. The major colleges contributing skills to Level 2 are the School of Mines and Kwekwe Polytechnic.

4.2.3 DIMENSION 3: END MARKETS AND TRADE

4.2.3.1 End products characteristics

The analysis revealed that 50% of the end products cited were ores and minerals, 25% semi processed goods and the other 25% being metal products. The largest component of sales volumes cited 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.

4.2.3.2 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.

4.2.3.3 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. About 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*above, most of the respondents (66.7%) cited 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.

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.

4.2.4 DIMENSION 4: VALUE CHAIN GOVERNANCE

4.2.4.1 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.

4.2.4.2 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 either online 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.

4.2.5 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. 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.

4.2.5.2 Emissions

Table 17 below 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%

4.2.5.3 Waste Management

About 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 programs and/or procedures to reduce or eliminate waste in its operations.

TABLE 19: PROGRAMS AND/OR PROCEDURES TO 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.

4.2.6 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 varied from USD2.4 to 107million (average of USD54.7million). The average annual capital requirement was about USD67million. 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 USD463million 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.

4.2.6.2 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.

4.2.7 DIMENSION 7: BUSINESS AND SOCIO-ECONOMIC CONTEXT

4.2.7.1 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.

4.2.7.2 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.

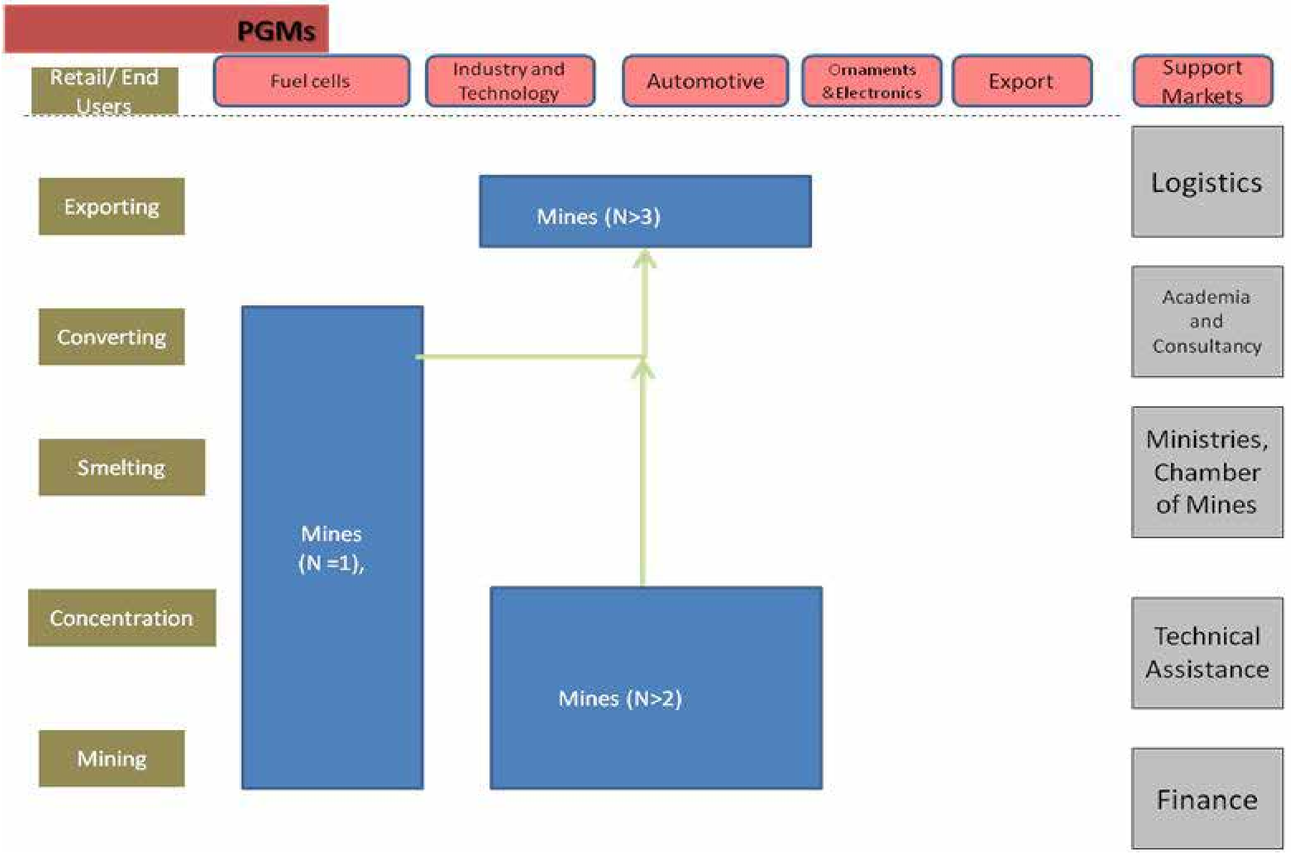
All of the responding firms indicated that they carried out pre-employment health checks for new employees. All of them indicated that HIV affected their workers over the past two years. Prevention interventions practiced by all respondents included HIV prevention messages and free condom distribution.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

The analysis of Level 2 shows that the subsector has 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 were discussed in the following section as special case studies.

4.2.8 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 (approximately 12%) and lastly Mimosa (~8%) *(Compan 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 37* shows the PGM value chain map in Zimbabwe.

FIGURE 37: PGMS VALUE CHAIN MAP



4.2.8.1 Dimension 1: Sources of Inputs and Supplies

4.2.8.1.1 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 required are 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 22* below.

TABLE 22: 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.

4.2.8.2 Dimension 2: Production Capacity and Technology Use

4.2.8.2.1 Production Capacity

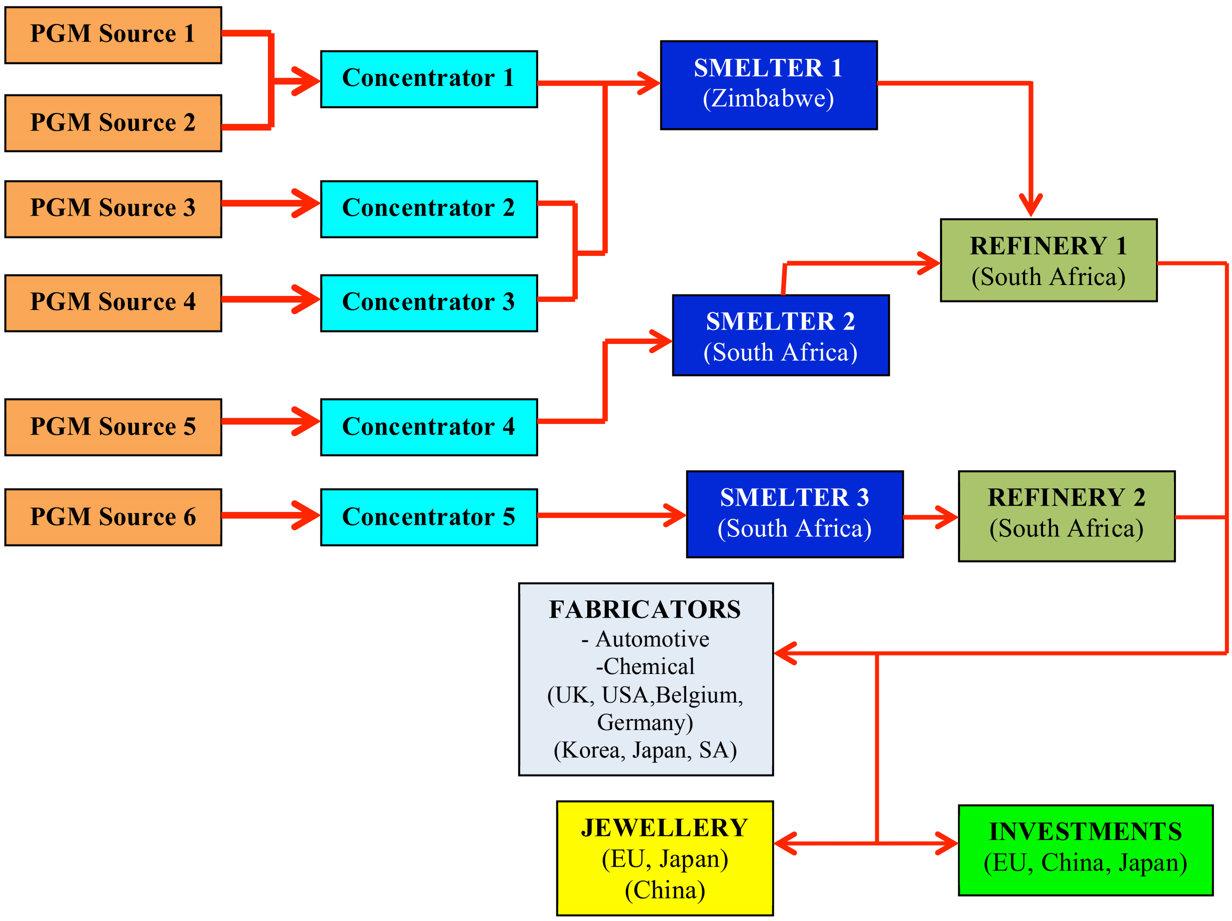
The current ore extraction capacity from the three mining operations is over 8Mt of ore producing over 20t 4E of PGMs. Of the produced PGMs, about 52% is Platinum, 38% Palladium, 6% Gold and 4% Rhodium *(Mobb, 2011 and company reports)*. The end product (matte and concentrate) are sent to South Africa, 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 PGMs takes 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 reserves of 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. Norilsk was 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.

4.2.8.2.2 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 38* below;

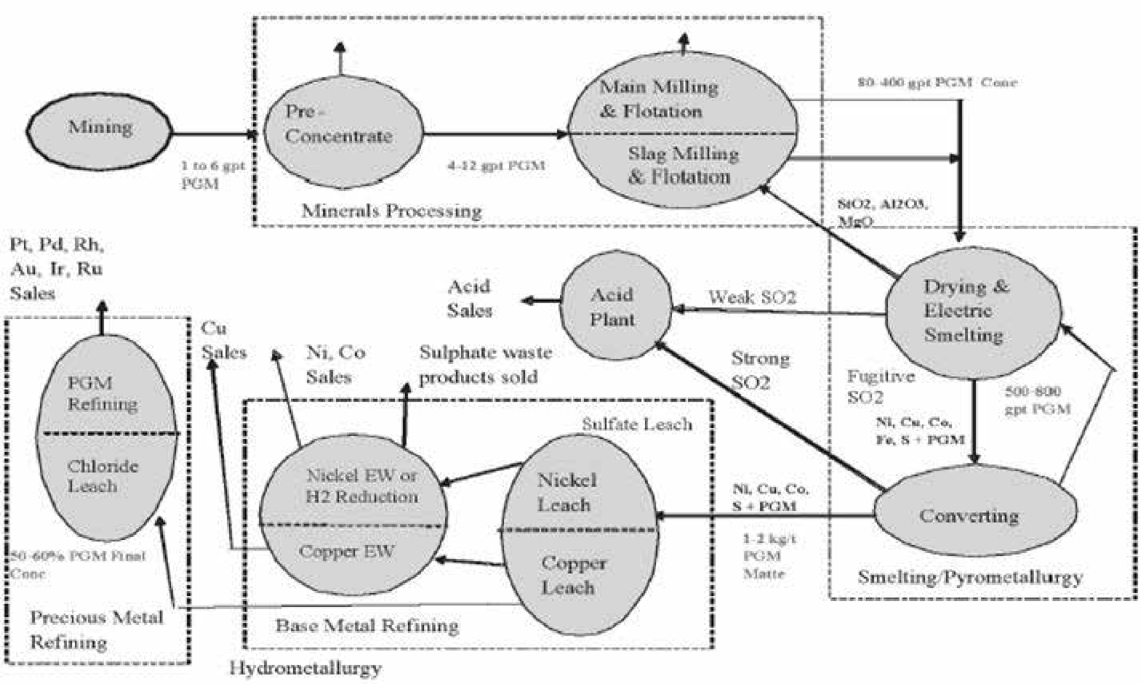
FIGURE 38: THE GLOBAL VALUE CHAIN MAP FOR ZIMBABWEAN PGMS



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 was 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 produced about 12% of the world's catalytic convertors *(Kumba iron ore report, 2008)*. 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 39: TYPICAL PGM FLOW SHEET



Source: Cramer, 2008

Figure 39 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 in Figure 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 separation is considered a complicated and time - consuming technical process. As such high grade residues or intermediate products are shipped overseas to specialist refiners for treatment, thereby increasing the operating cost and the process inventory of metals.

4.2.8.2.3 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.

4.2.8.2.4 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 and iv) 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, 2008 estimated 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 are mainly 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. The South African PGM refining costs were estimated atUS$306451.00/t of 4E PGM *(Cramer, 2008)*.

TABLE 23: PROCESS OPERATIONS INVESTMENTS (CAPITAL PER UNIT OF CAPACITY PER ANNUM – GREENFIELD PROJECTS)

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

Source: Cramer, 2008

The capital cost of establishing processing facilities is a significant cost adding affecting the price *(see Table 23 above)*. 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.

4.2.8.3 Dimension 3: End Markets and Trade

4.2.8.3.1 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 and brazing alloys. It also fabricates PGM salts and precursors, emission control catalysts, process/petroleum catalysts, Passive component materials, fuel cell components, gas purification and plating 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.

4.2.8.3.2 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.

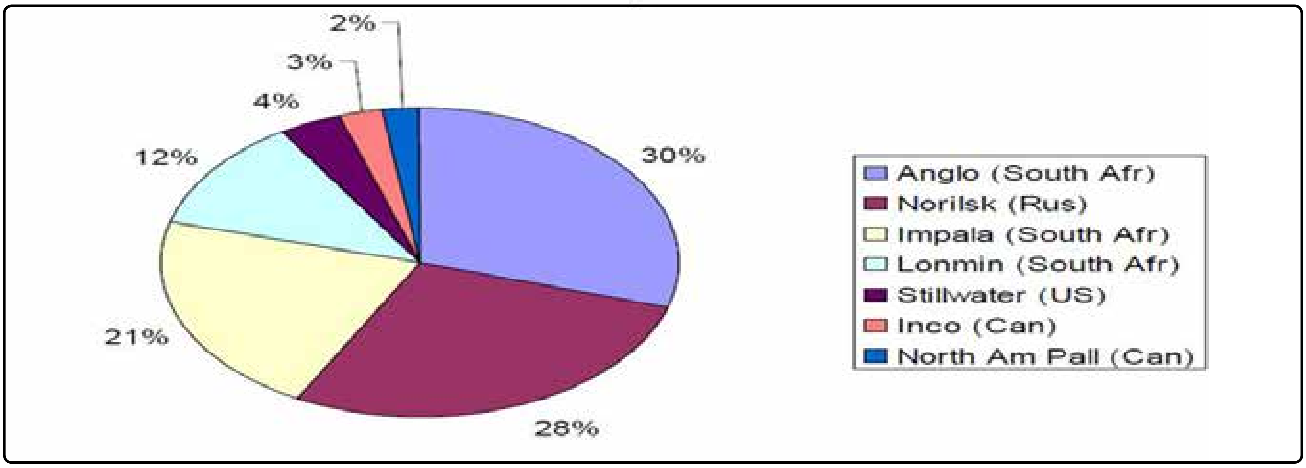
4.2.8.4 Dimension 4: Value Chain Governance

4.2.8.4.1 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 MNCs 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, which produces 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 40: DOMINANT ACTORS IN THE PGM GLOBAL VALUE CHAIN BY PRODUCTION CAPACITY



Source: Cramer, 2008

Figure 40 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). Since Zimbabwean's PGM sector is owned by the major global players including Anglo American, it implies that the sector belongs to a global value chain. The setup is therefore quasi-hierarchichal with buyers in developed countries influencing the quantity, quality and price of the goods.

4.2.8.5 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.

4.2.8.6 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)*.

4.2.8.7 Dimension 7: Business Environment and Socioeconomic context

4.2.8.7.1 Business environment

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

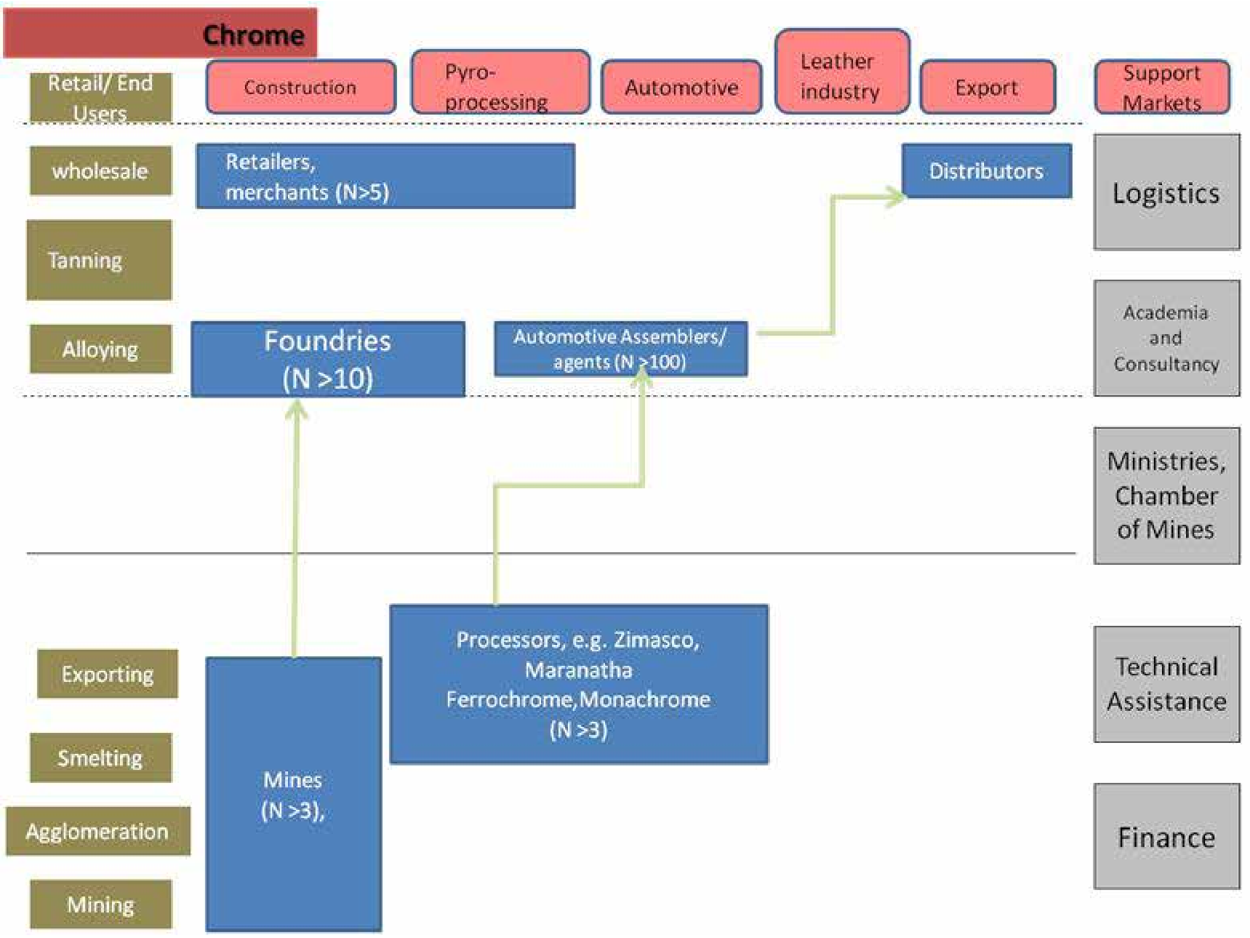
4.2.8.7.2 Social and cultural context

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.

4.2.9 CHROME VALUE CHAIN

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 included the large scale chrome producers and smelters that included Zimasco, Zimalloys, Oliken and Maranatha, small-scale producers and Chinese companies operating in Zimbabwe. The visited operations included 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. The chrome value chain map is presented in *Figure 41* below.

FIGURE 41: CHROME VALUE CHAIN MAP



4.2.9.1 Dimension 1: Sources of Inputs and Supplies

4.2.9.1.1 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 24* below.

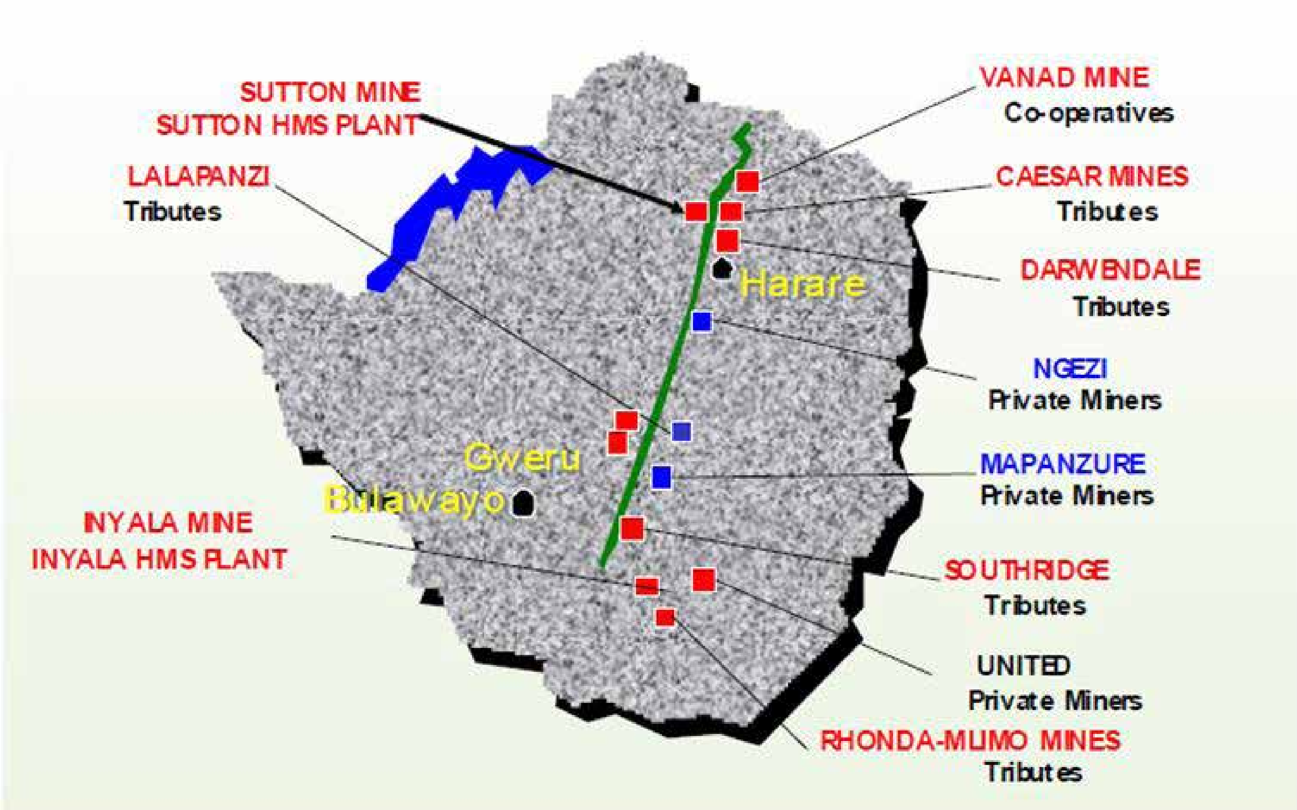
TABLE 24: CLASSIFICATION OF CHROMIUM ORES

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

Source: Chirasha, 2011

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 Africa and 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 is concentrated 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 42: 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 42). The distribution of the different grades of ore in Zimbabwe is presented in *Table 25* below.

TABLE 25: CHROME GRADES IN ZIMBABWE

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)

Source: Chirasha, 2011

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 26: 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

Source: Chirasha, 2011

4.2.9.1.2 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.

4.2.9.2 Dimension 2: Production Capacity and Technology Use

4.2.9.2.1 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 27* below. The production peaks were recorded in 1997, 2001 and 2002 when the sector produced over 750 000 tons per year. The dips were recorded in 2009 when the country produced less than 200 000 tons whilst 282 000 tons 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 27: PRODUCTION VOLUMES IN THE CHROME SECTOR OF ZIMBABWE

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**

Source: Chirasha, 2011

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 a total of eight smelting companies with an available smelting capacity of about 370 000tons against an installed capacity of about 700 000 tons*(53% capacity utilization)* operated in the country's chrome value chain in 2012.

Therefore, there was an excess of about 330 000 tons of chrome ore lying idle. The situation was aggravated by the shut-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. 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 28*below shows the global perspectives of chrome production and the status of Zimbabwe.

TABLE 28: POSITION OF ZIMBABWE'S CHROME PRODUCTION IN THE GLOBAL CONTEXT

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..%	

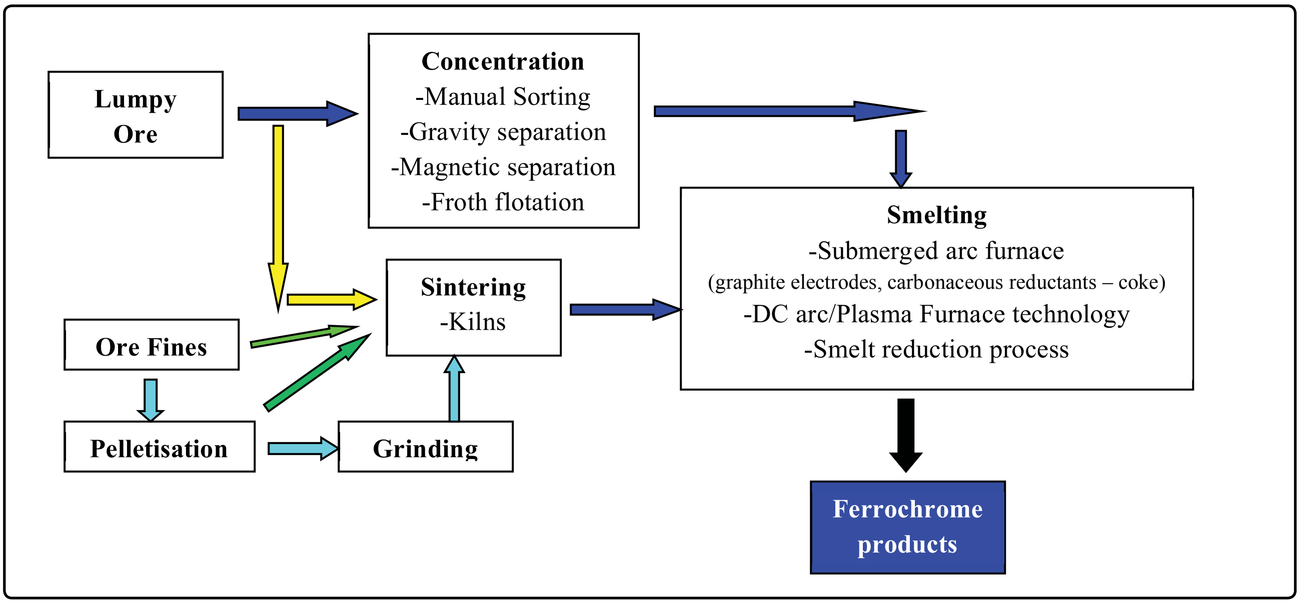
Source: International Chromium Development Association (ICDA)

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.

4.2.9.2.2 Technology Use

The technologies used in ferrochrome production are summarised in Figure 94 below. A Submerged AC Electric Arc Furnace and reductants (coke, coal and quartzite) are typically used in the production of ferrochrome from chrome ore of different sizes. The energy intensive smelting process requires up to 4,000 kWh per tonne of material weight *(ICDA article)*. Slag is separated from the liquid ferrochrome and tapped into ladles for further processing. The liquid ferrochrome is then cast in moulds, cooled and crushed into sizes required by the customers. *Figure 43* below presents the technologies used in ferrochrome production.

FIGURE 43: 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 43)*.

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 fact their 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 melts without 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 palletisation with 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 by sintering 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 work on 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 was 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.

4.2.9.2.3 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 29. The transport costs for Zimbabwe are also comparatively higher than competitors in the chrome value chain as shown in *Table 30*.

TABLE 29: 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 30: 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

CHROME BENEFICIATION INTO STAINLESS STEEL PRODUCTION

Significant value added benefits can be realised if the chrome value chain was linked to stainless steel production. A significant proportion of ferrochrome (~30% by weight) is consumed in stainless steel production.

FIGURE 44: VALUE CHAIN IN DOLLAR TERMS FOR CHROME

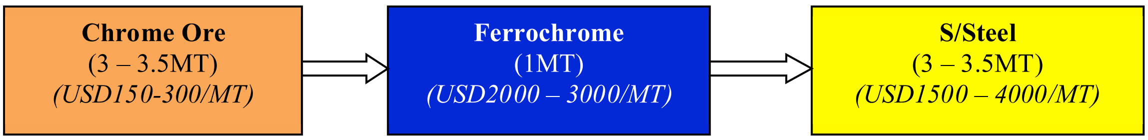


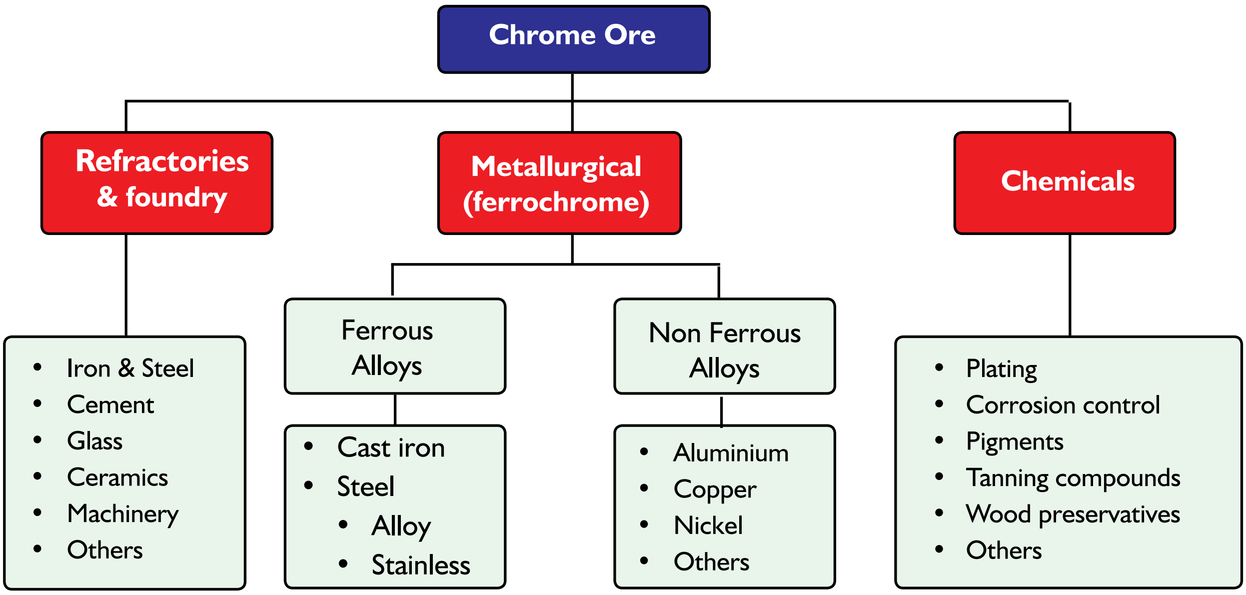
Figure 44 above shows that there is a great jump in value added between chrome ore and ferrochrome implying that investment into ferrochrome production in Zimbabwe is very attractive and must be supported. Feasibility studies for the establishment of stainless steel production plants in Zimbabwe must be carried out. Current innovation is looking at the possibility of direct production of stainless steel from chrome ore or liquid ore.

4.2.9.3 Dimension 3: End Markets and Trade

4.2.9.3.1 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 45* below.

FIGURE 45: APPLICATIONS ALONG THE CHROME VALUE CHAIN



4.2.9.3.2 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 tons 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.

4.2.9.3.4 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.

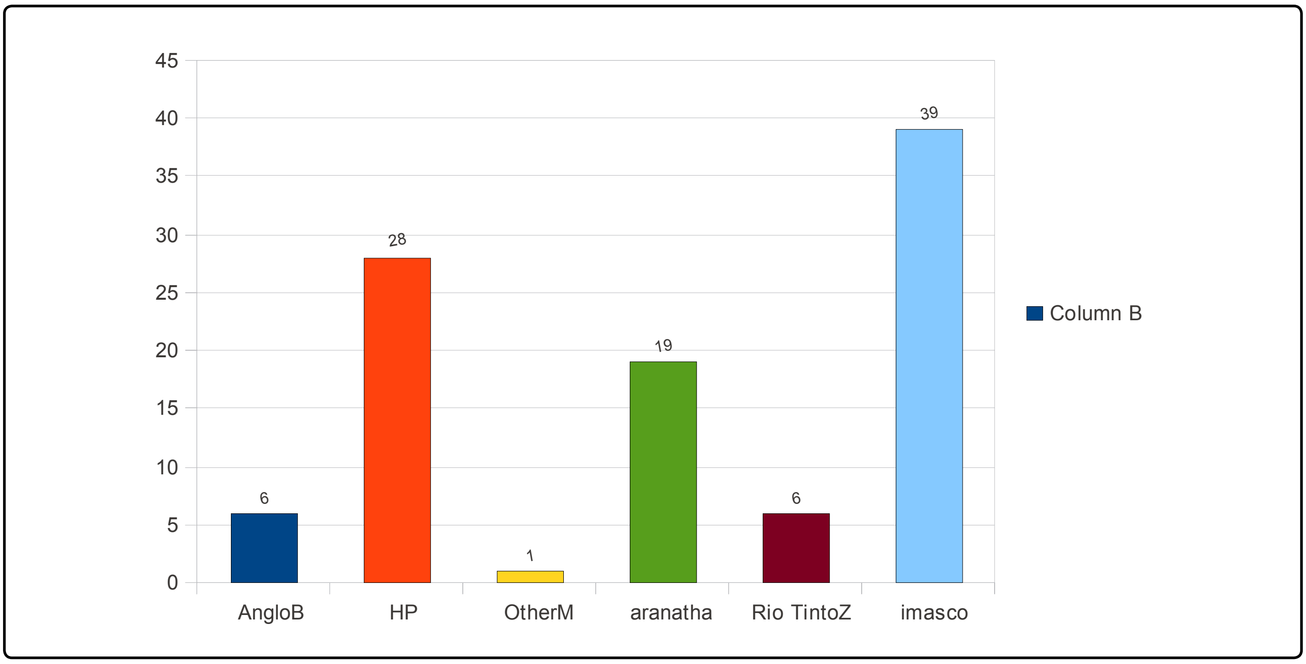
Lower commodity prices have had adverse effects on both small and large operations resulting in the closure of several operations. Since the prices of refined metals are determined in the global market, the erosion of profit margins affects high-cost producers, generally located in more mature market 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. The railway infrastructure network can be reliable if re-capitalized.

4.2.9.4 Dimension 4: Value Chain Governance

4.2.9.4.1 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). The chrome resource holding pattern is presented in *Figure 46* below *(Chrome Sector Report, 2013)*

FIGURE 46: CHROME RESOURCE HOLDING PATTERNS



Source: Chrome Mining Sector in Zimbabwe report, 2013

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 acquiring claims with high chrome ore content to effectively participate in the economy *(Chrome Sector Report, 2013)*.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.

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.

4.2.9.4.2 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.

4.2.9.4.3 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)*.

4.2.9.4.4 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.

4.2.9.5 Dimension 5: Sustainable Production and Energy Use
4.2.9.5.1 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.

4.2.9.5.2 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.

4.2.9.6 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.

4.2.9.7 Dimension 7: Business Environment and Socioeconomic context

4.2.9.7.1 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.

4.2.9.7.2 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 favourable 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).

4.3 LEVEL 3 VALUE CHAIN ANALYSIS (METAL FORMING)

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.

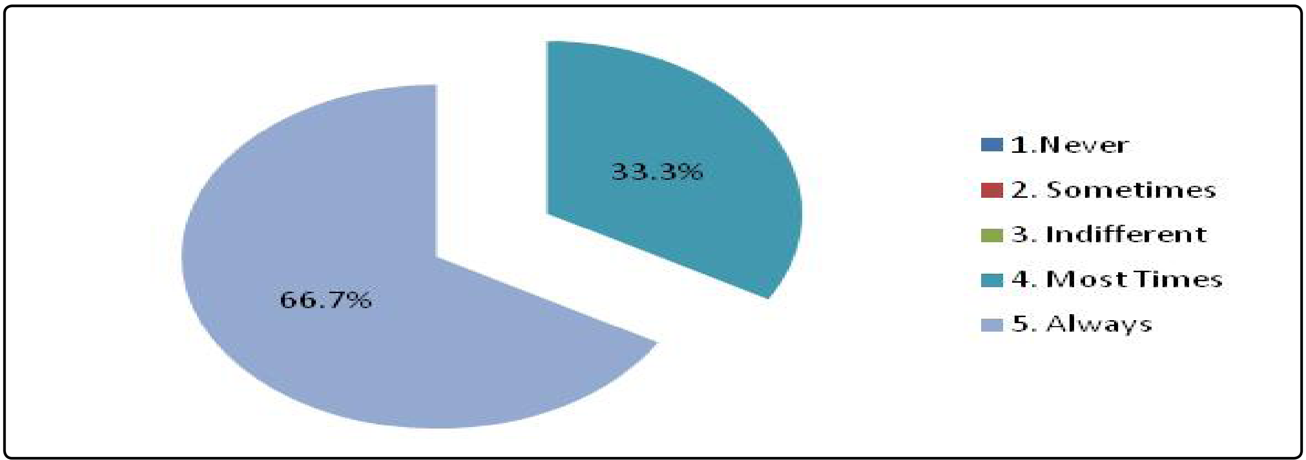
During the field surveys 21 major actors in **Level 3** were visited. These actors are located in Harare, Marondera, Redcliff, Mutare, Gweru and Bulawayo. Out of the twenty oneactors, seven (33%) were not operational due to viability challenges. Out of the 14 active players, nine (64%) responded. Five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

4.3.1 DIMENSION 1: SOURCES OF INPUTS AND SUPPLIES

4.3.1.1 Characteristics of inputs, supplies and nature of suppliers

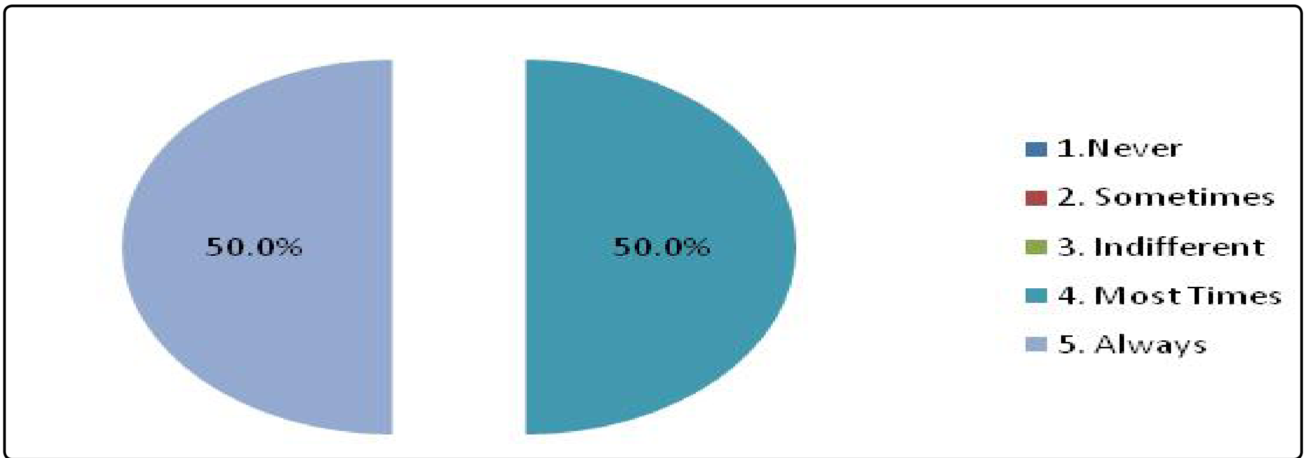
The inputs noted in the study were cast iron, aluminium, bronze, fluxes, coke, sands, ferrochrome, ferronickel, ferromanganese, ferrosilicon, tungsten, electricity, water, storage facilities and transport facilities. About 66.7% of the respondents required storage facilities for their raw materials. 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 47: 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 47 above)*.

FIGURE 48: SUFFICIENCY OF QUANTITIES OF INPUTS FROM LOCAL SUPPLIERS

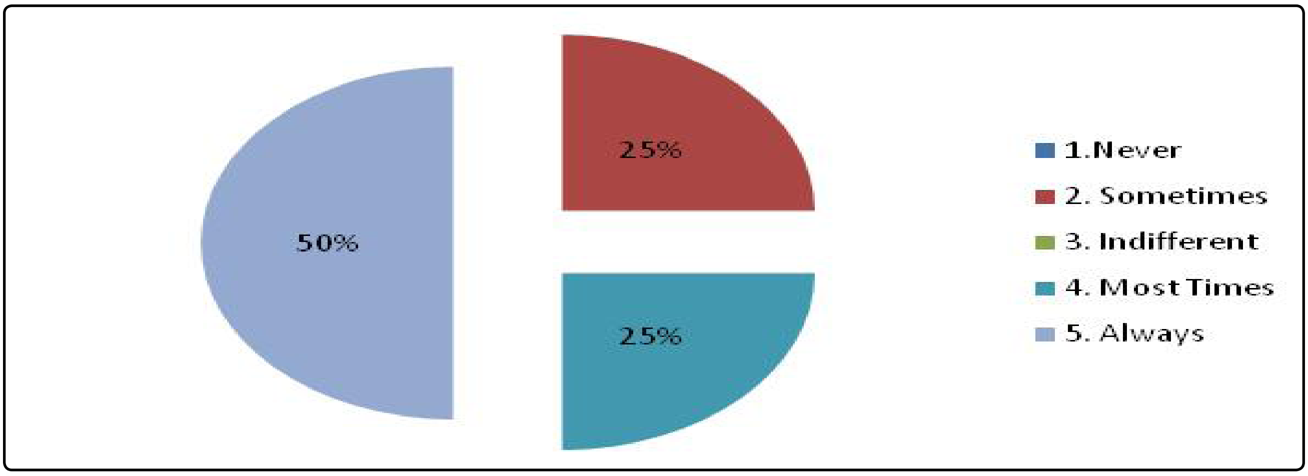


From the responses of the survey, 50% apiece said the quantities of inputs were always and most times sufficient from local suppliers *(see Figure 48 above)*. This implies that the reliability of local suppliers in delivering the expected quantities was high.

4.3.1.2 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 49: 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 49 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.

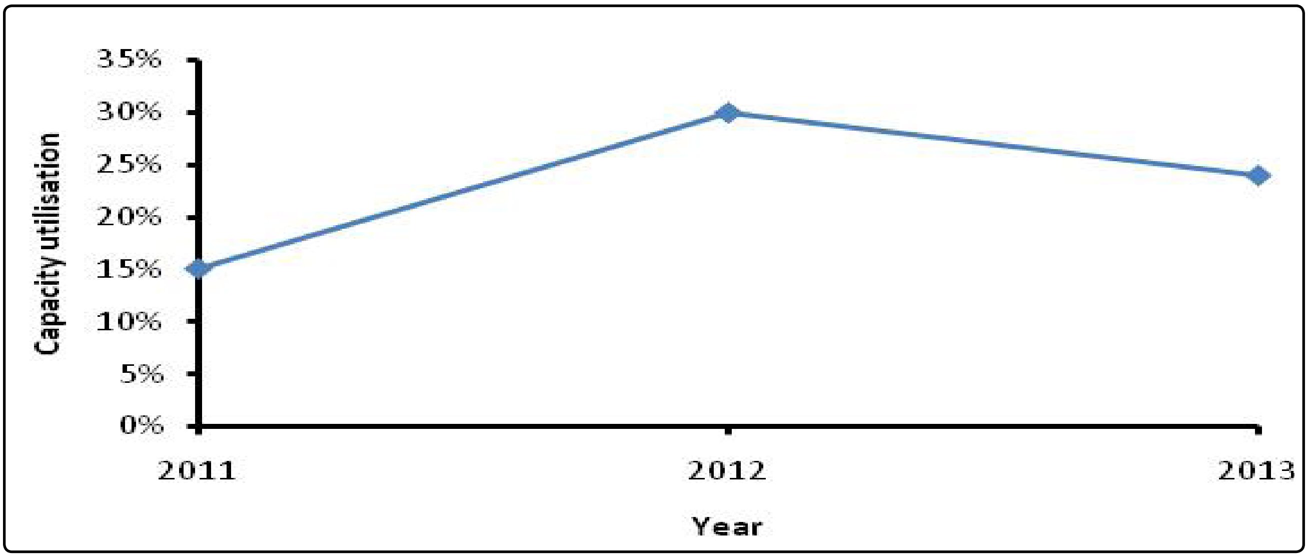
The analysis has shown there are no major issues in sources of inputs and supplies in Level 3. It is also worth noting that local suppliers are capable of supplying competitive inputs to actors in Level 3, which tallies well with the national policy of indigenisation and empowerment.

4.3.2 DIMENSION 2: PRODUCTION CAPACITY AND TECHNOLOGY USE

4.3.2.1 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 50: CAPACITY UTILISATION IN LEVEL 2



Capacity utilisation was very low, ranging between 15 and 30% for the period between 2011 and 2013 *(See Figure 50 above)*. The major reasons for the decline in capacity utilisation from 2012 to 2013 are presented in *Table 31* below.

TABLE 31: 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 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.

TABLE 32: 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 32* 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 33: 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 33* above, 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.

4.3.2.2 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 51 below).

FIGURE 51: SUITABILITY OF TERTIARY EDUCATION CURRICULAR TO INDUSTRY REQUIREMENTS

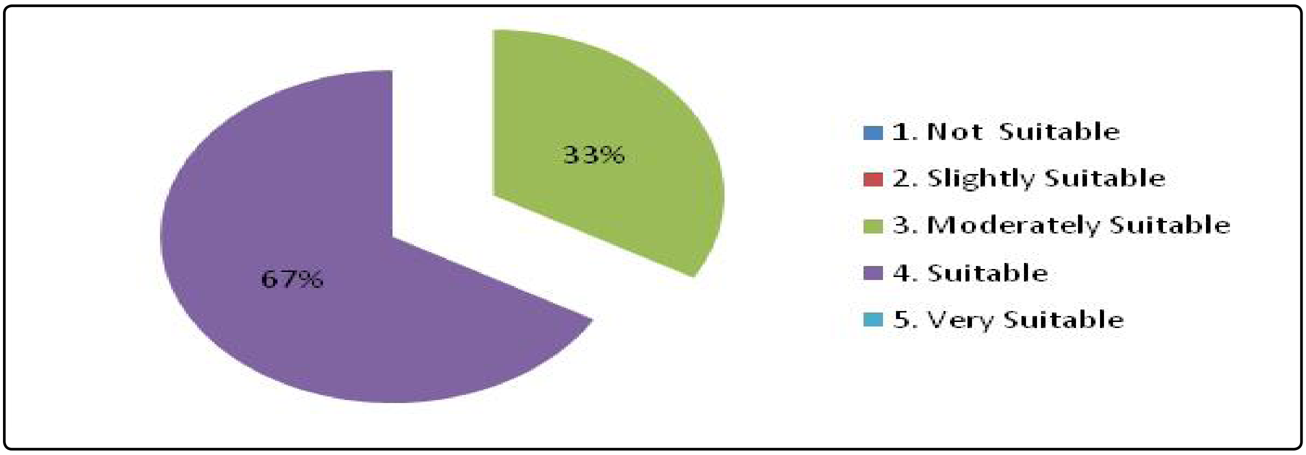
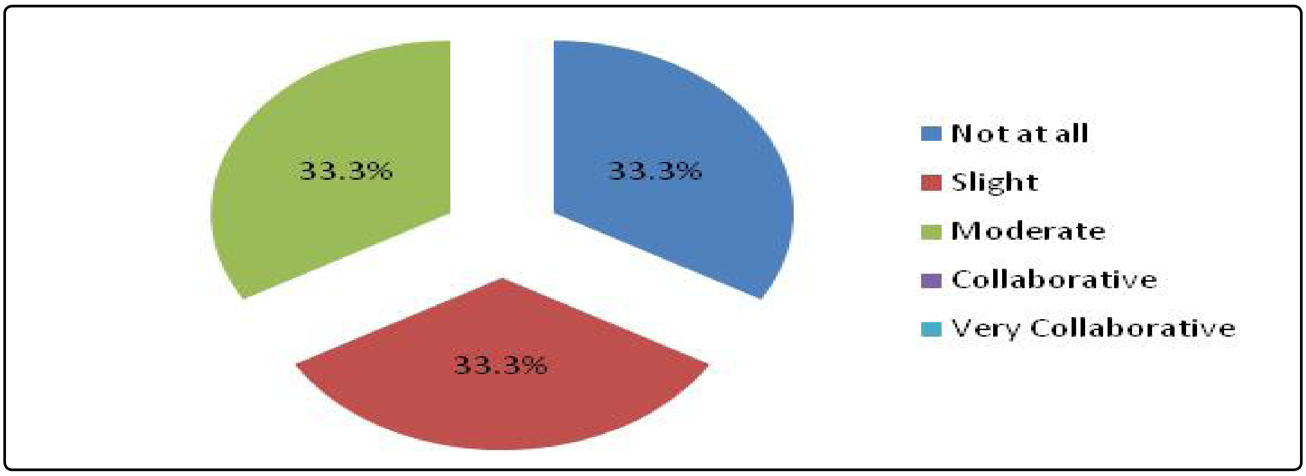
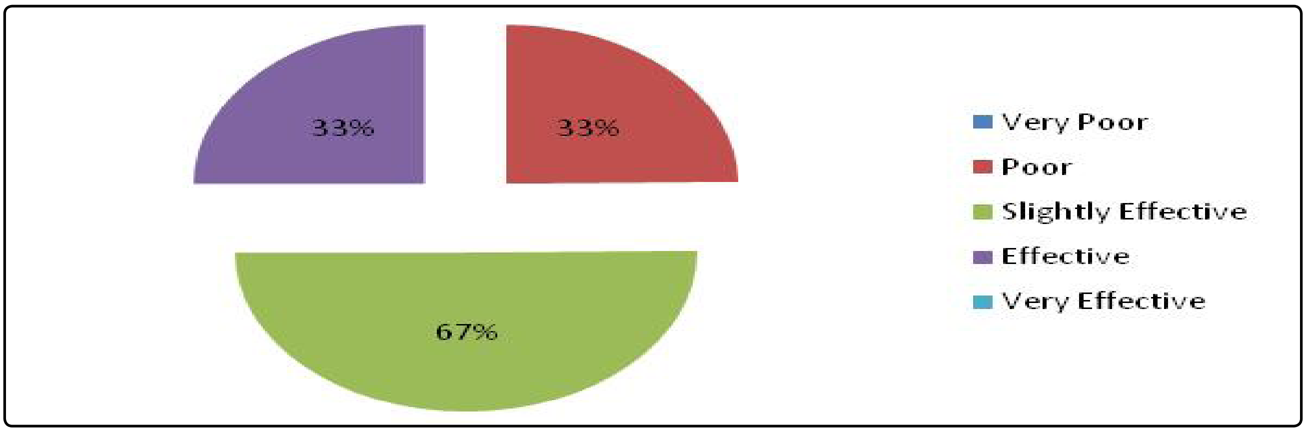


FIGURE 52: LEVEL OF COLLABORATION WITH NATIONAL RESEARCH AND DEVELOPMENT INSTITUTIONS



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 52 above)*. *Figure 53* 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 53: RELEVANCE AND EFFECTIVENESS OF LOCAL RESEARCH & DEVELOPMENT TO INDUSTRY REQUIREMENTS

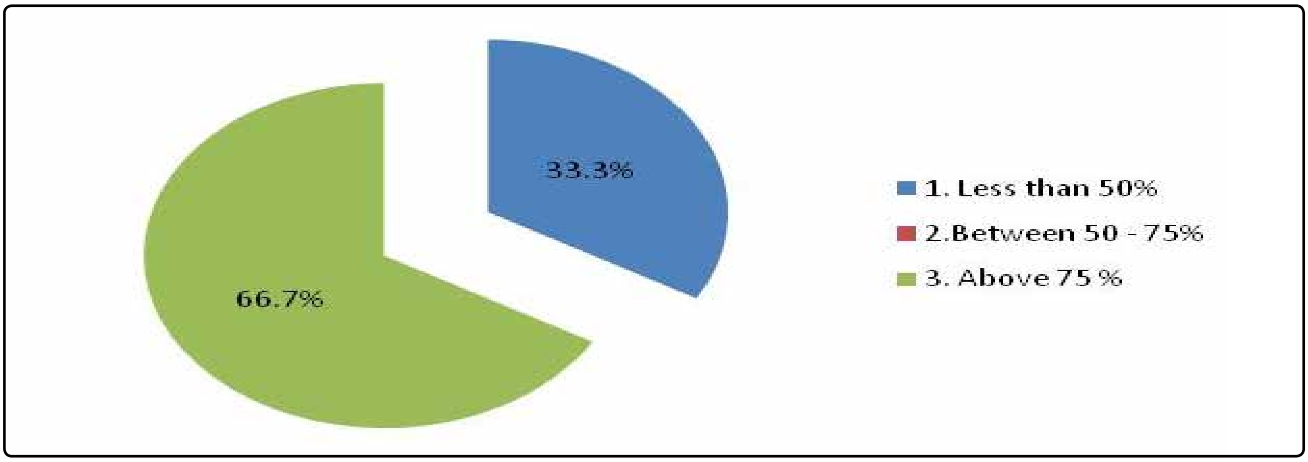


4.3.3 DIMENSION 3: END MARKETS AND TRADE

4.3.3.1 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 54: CONTRIBUTION OF THE MAIN PRODUCT TO TOTAL SALES

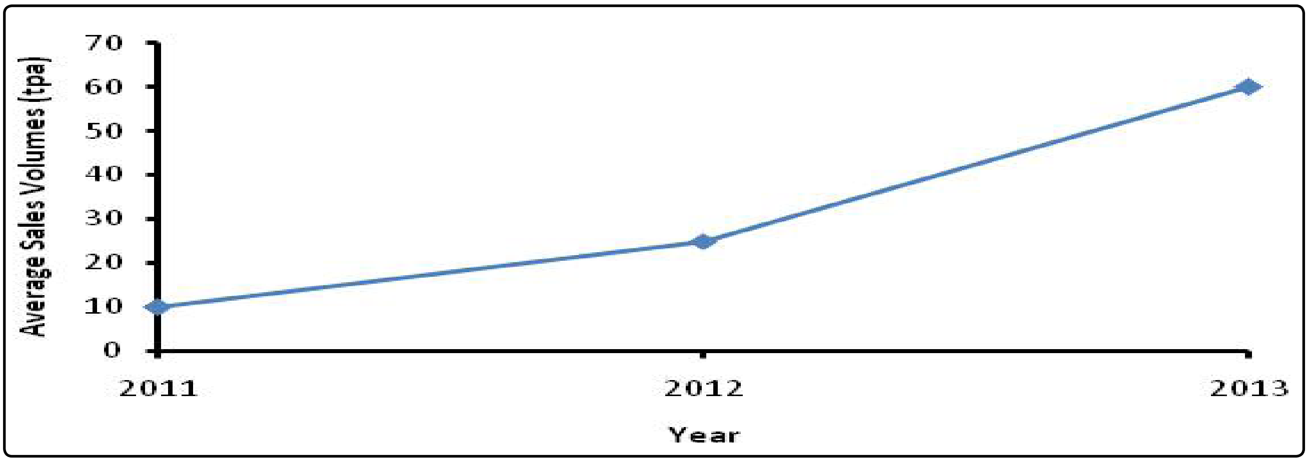


About 67% of the respondents revealed that their main product represented above 75% of their totals sales whilst 33% said that their main product represented less than 50% of their total sales *(See Figure 54 above)*. It is therefore generally observed that there is a high dependence on the main product 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.

4.3.3.2 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 55: 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 55 above)*, generating average annual revenues of between USD280,000 and US$384,000 for the period between 2011 and 2013. The sales have also grown by about 6 fold from 2011 to 2013 *(Figure 55)*, 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.

4.3.3.3 Marketing, trade capacities and standards

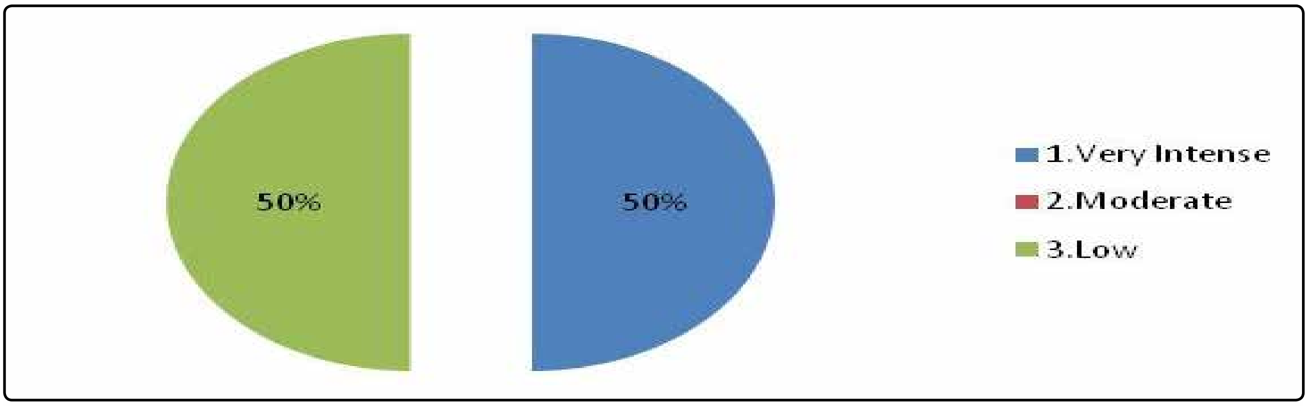
Since there was little exportation of goods in the sector except through third parties, there were no responses associated with customs.

TABLE 34: 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

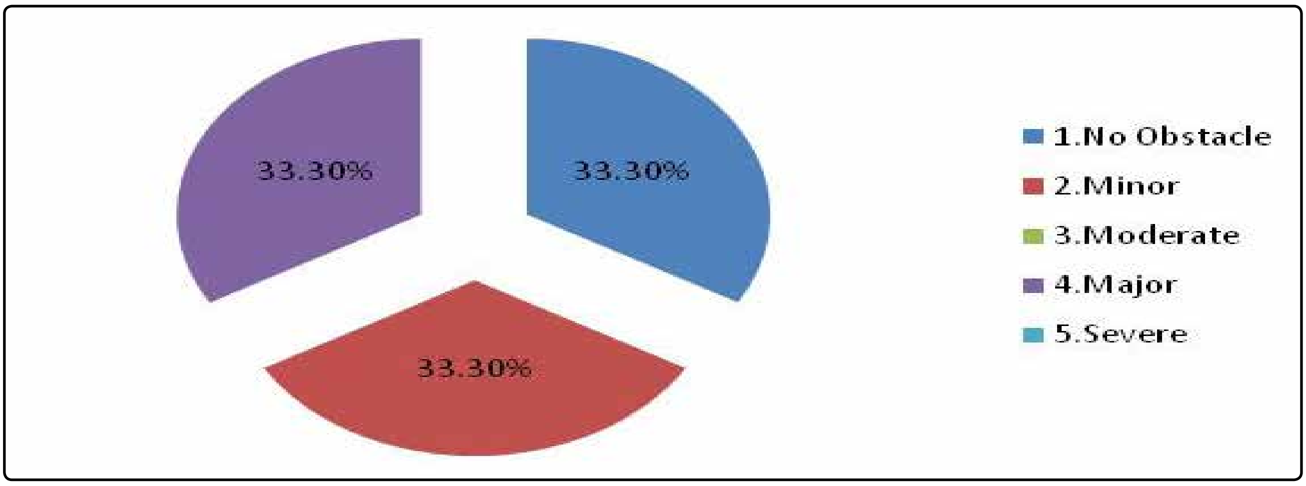
According to the analysis presented in *Table 34* above, the main obstacles to growth of the export cited by the respondents were insufficient production capacity to expand exports (66.7% response rate) and lack of foreign demand for its products (66.7% response rate). About 33.3% apiece of the respondents cited high costs of transport and lack of financing mechanisms to sell abroad *(Table 34)*. 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 56: 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 cited very low competition *(Figure 56 above)*. 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 57* below.

FIGURE 57: EFFECT OF PRACTICES OF INFORMAL SECTOR TO CURRENT OPERATIONS



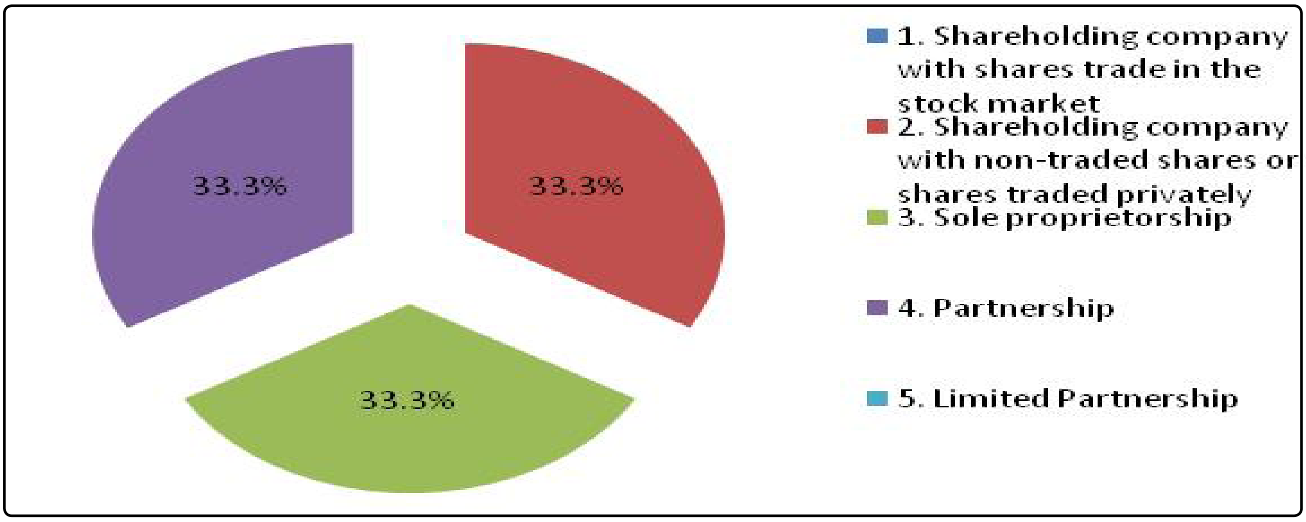
The average marketing budget per organisation was about USD260thousand per annum. About 67% of the respondents had a dedicated marketing team in place. The majority of the actors (66.7% response rate) did not comply with local and international standards. This factor disadvantages the actors on the global 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.

4.3.4 DIMENSION 4: VALUE CHAIN GOVERNANCE

4.3.4.1 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 58* below.

FIGURE 58: 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 35: 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 35 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.

4.3.4.2 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 disclosed their environmental policies, programs, and performance either online 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.

4.3.5 DIMENSION 5: SUSTAINABLE PRODUCTION AND ENERGY USE

4.3.5.1 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 59 below)*.

FIGURE 59: AVAILABILITY OF POWER FOR OPERATIONS

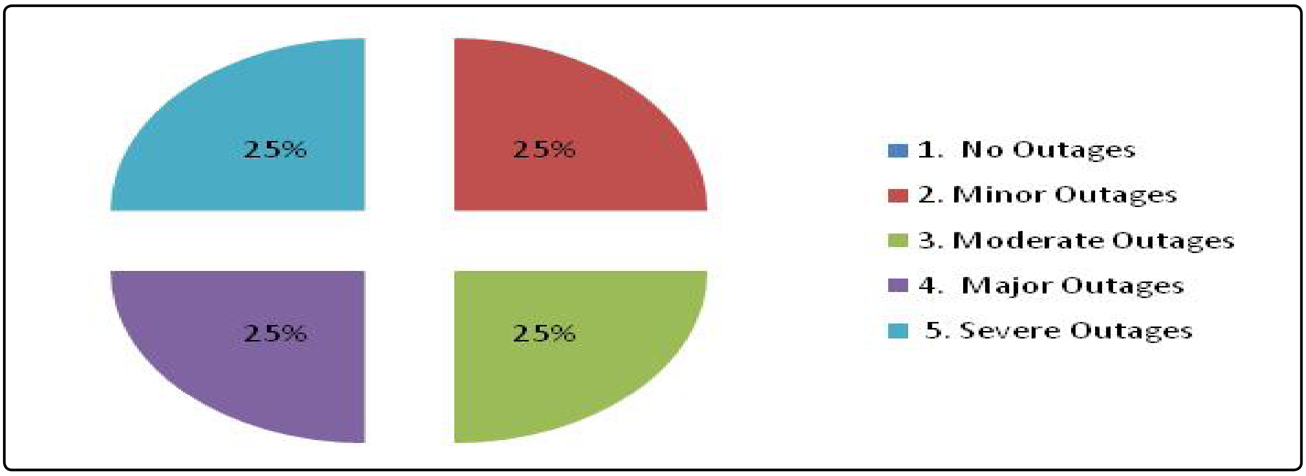
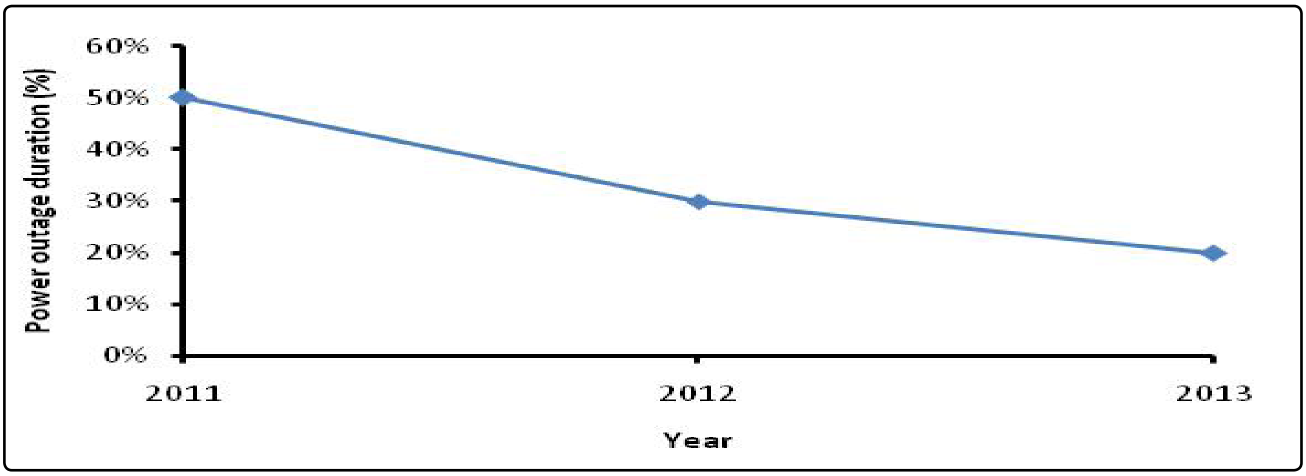


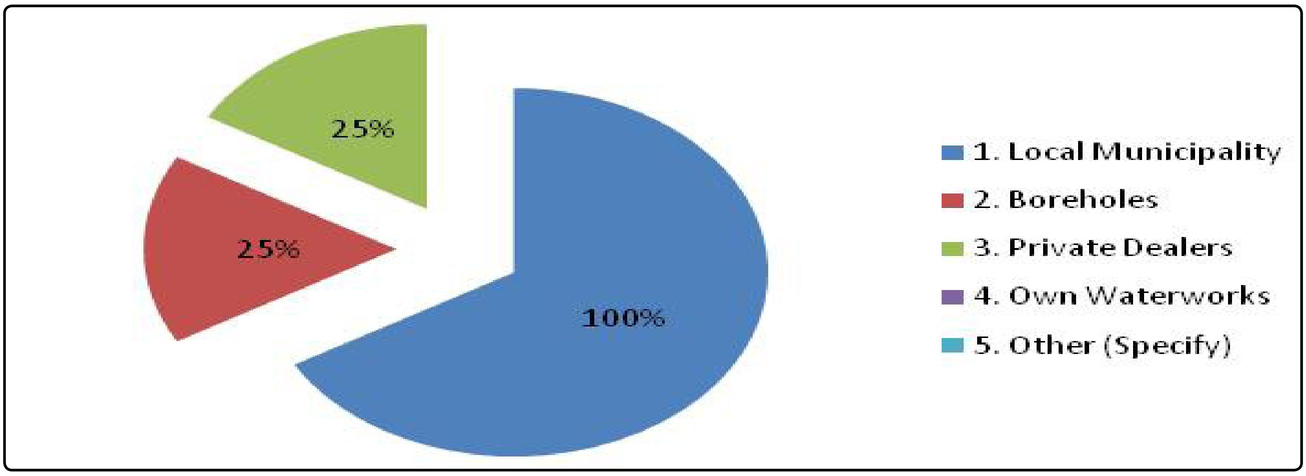
FIGURE 60: RESPONSES ON DURATION OF POWER OUTAGES IN A TYPICAL MONTH



As shown in *Figure 60* 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.

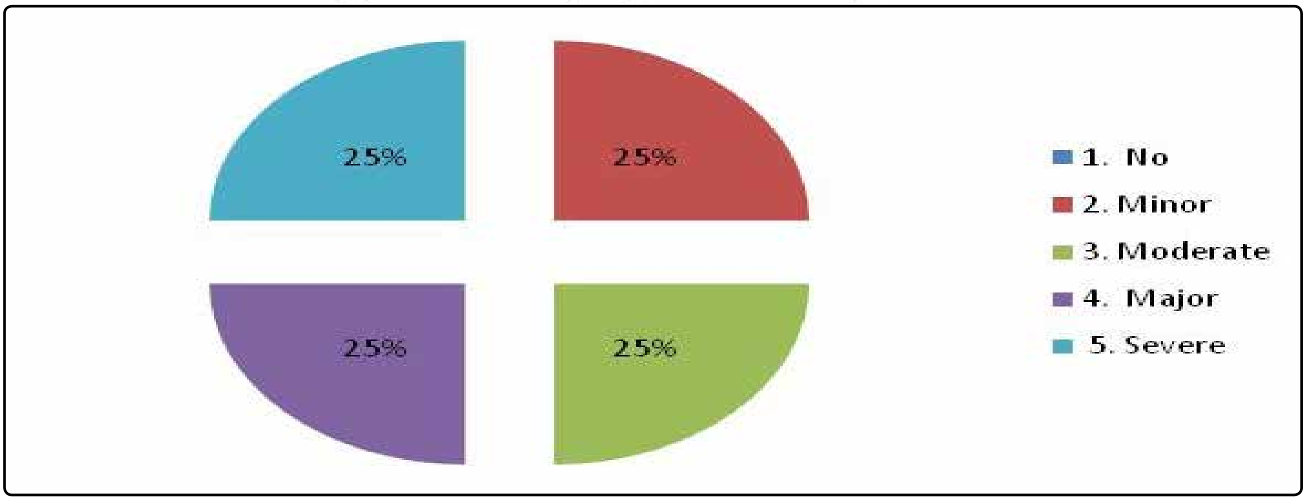
Water is a key resource in Level 3, where it is mainly used in the processes and for cooling purposes. All respondents used local municipal water as one of their major sources of water whilst 25% apiece also used boreholes and private dealers *(Figure 61 below)*.

FIGURE 61: 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 62* below.

FIGURE 62: 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.

4.3.5.2 Emissions

Table 36 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 and health issues. None had any other license or permit for other waste related issues.

TABLE 36: 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 37* 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 37: 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.

4.3.5.3 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 38 below)*.

TABLE 38: PROGRAMS AND/OR PROCEDURES TO 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.

4.3.6 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.

4.3.6.1 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.

4.3.7 DIMENSION 7: BUSINESS AND SOCIO-ECONOMIC CONTEXT

4.3.7.1 Business environment

The main obstacles cited by respondents in the business environment were political instability; corruption, finance and practices of competitors in the value chain *(see Table 39 below)*. The moderate obstacles included courts, crime, theft and disorder, tax administration and tax rates.

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	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. Others	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.

4.3.7.2 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. Two major subsectors in Level 3 namely the iron and steel making and foundries were further discussed as special case studies in the following sections. The breakdown of the local engineering and metals industry is attributed to the collapse of the iron and steel industry in Zimbabwe.

4.3.8 THE FOUNDRY INDUSTRY IN ZIMBABWE

Foundries are 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 was 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.

4.3.8.1 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 and steel merchants depend significantly on agricultural entities as end markets.

4.3.8.2 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 More wear 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 tons.Global competitors have even significantly larger capacities,e.g. China had 12 000 foundries and India had 4 500 in 2003. 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.

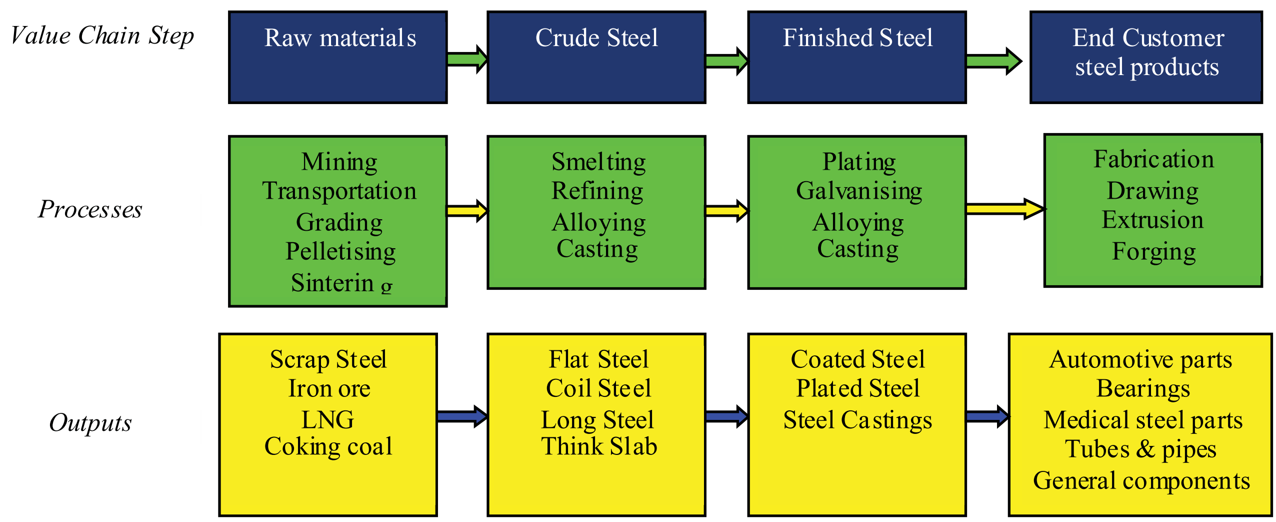
4.3.8.3 Potential Contribution to the Economy

Based on the average production volumes and capacity utilisation obtained from the study, 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. 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 USD1100/tonne, the existing capacity can bring in USD11million 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 USD158.4million and a value added of US$81million (assuming a value added potential of 51%). 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.

4.3.9 IRON AND STEEL SECTOR

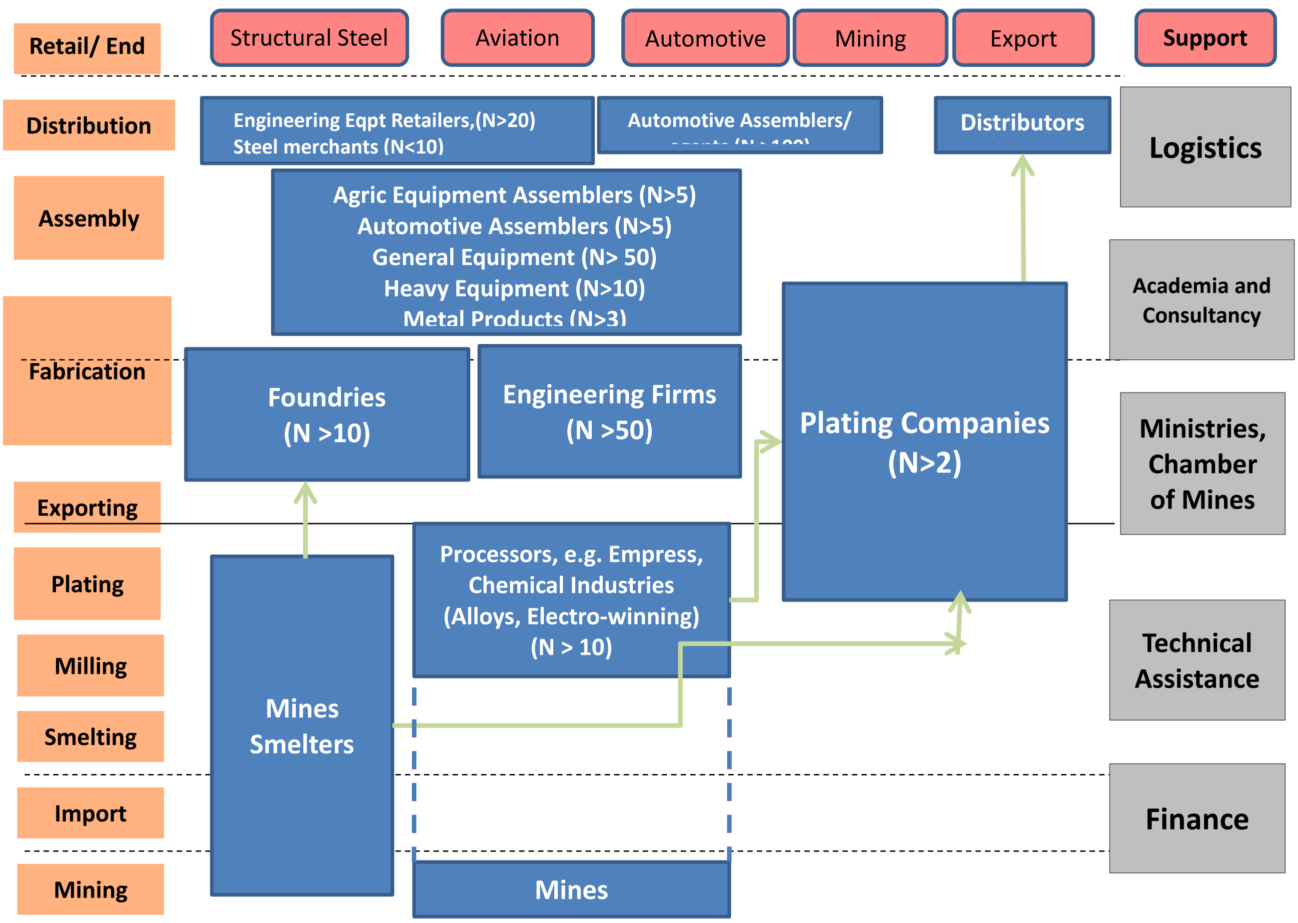
Information for the iron and steel sector was mostly obtained from the main key informants at ZISCO, who included the Works Director and the Group Metallurgist. A field visit to the ZISCO plant in Redcliff was also part of the field data collection. Comparative information was obtained from country documents 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 *Figure 63*.

FIGURE 63: 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 64* below.

FIGURE 64: IRON AND STEEL VALUE CHAIN MAP



4.3.9.1 Dimension 1: Sources of Inputs and Supplies

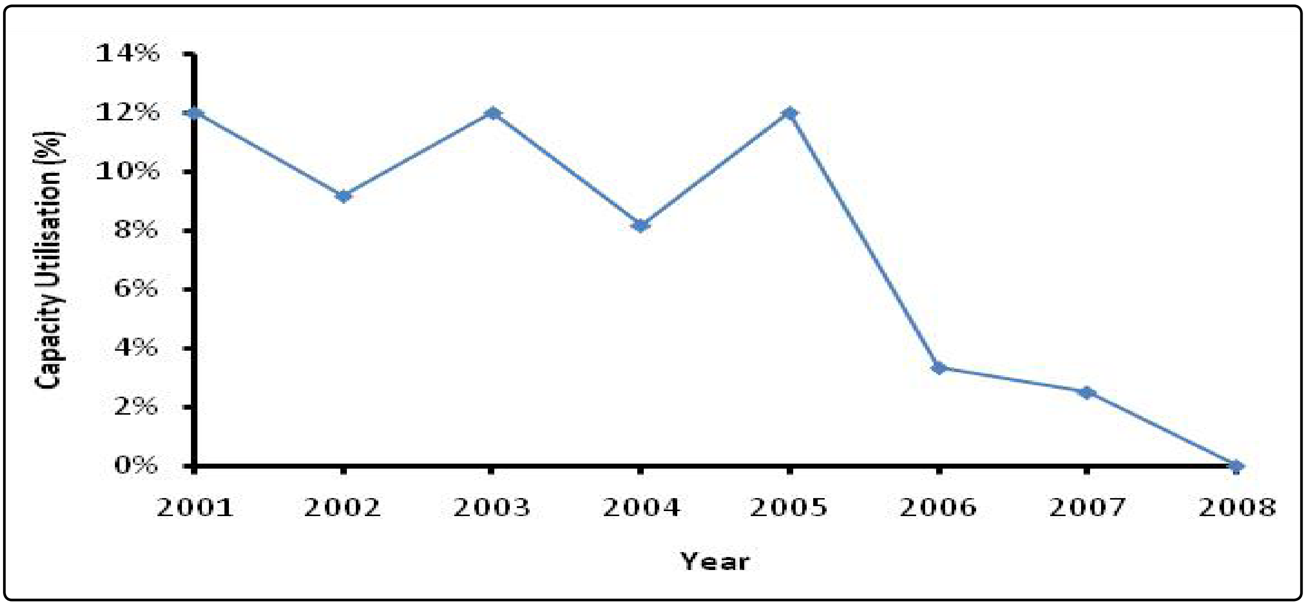
The major sources of inputs for this sub-sector were found to be iron ore, scrap metal, coal/coke, limestone, and fluxing materials like fluorspar, dolomite, manganese and corundum as well as alloying elements like ferrochrome, vanadium and nickel. Transport, logistics and storages facilities were also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

4.3.9.1.1 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 economic crisis in Zimbabwe, production of iron ore from BIMCO declined 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 65 below)*.

FIGURE 65: 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.

4.3.9.1.2 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)*.

4.3.9.1.3 Limestone

Zimbabwe has about 200 million tonnes of limestone. The biggest deposits are just a few 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 the management are confident they will not be exhausted in the near future.

4.3.9.1.4 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'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 the 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, the resource was not exploited locally.

4.3.9.1.5 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 SADC region (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 the region.

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 Zimbabwe are 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 market is 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 40 below)*. 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 40: REGIONAL PRODUCTION (000 TONNES) OF COAL (2006 TO 2010)

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

Source: Mhlanga et al., 2013

4.3.9.1.6 Other Raw Materials

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

4.3.9.1.7 Electricity and Water Supplies

The main supplier of electricity is ZESA through ZETDC, whilst ZINWA administers and regulates the supply of water. Power outages and erratic water supplies were key factors in the demise of ZISCO according to key informants *(see Annex 10)*. The summary of actors involved in the sources of supplies and inputs are presented in *Table 41* below.

TABLE 41: 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

4.3.9.2 Dimension 2: Production Capacity and Technology Use

Key informant interviews *(Annex 10)* 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 was mainly 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 railway track 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.

4.3.9.2.1 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**)** and MM Integrated Steel Mills (MMI) were major players in the milling industry *(Lundall et al., 2008)*.

Major Capacity constraints

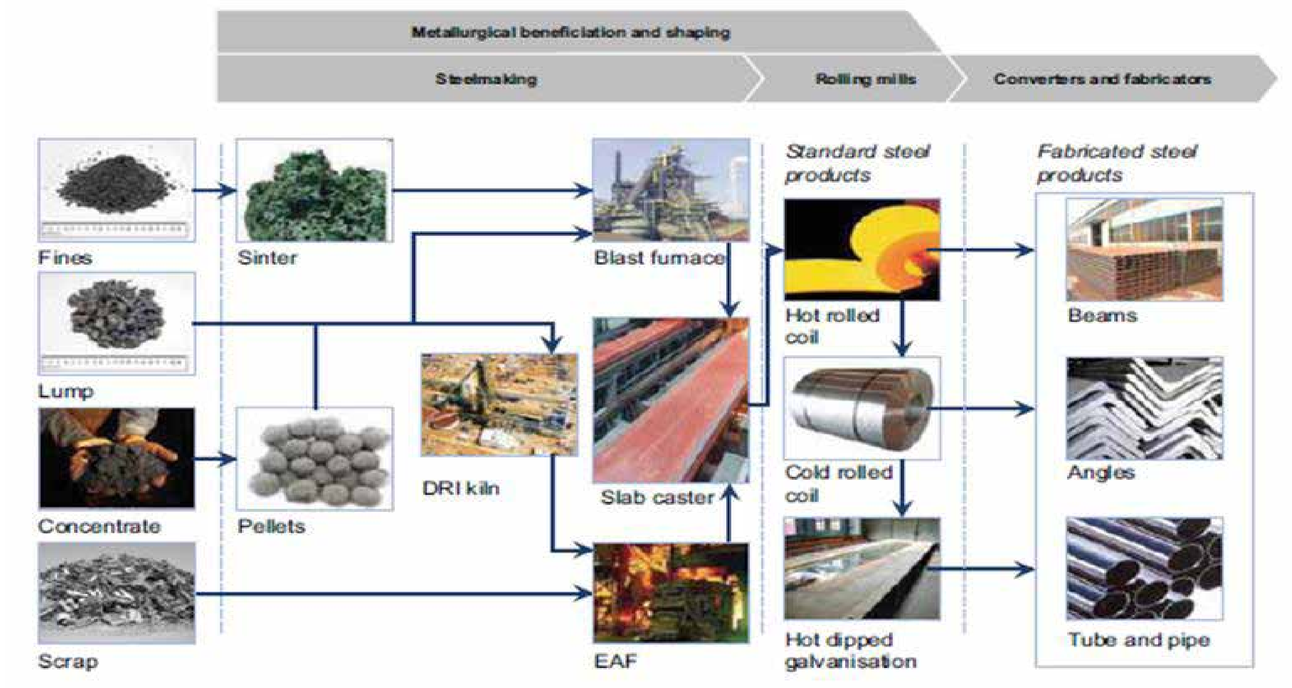
The operational challenges that faced ZISCO are in two parts – i) the constraints that limited capacity utilisation below 60% and ii) the events that led to the eventual closure of the integrated iron and steel plant. The major constraints limiting capacity utilisation were the inconsistent supply of 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 10)*, 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 on-going 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.

4.3.9.2.2 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 66* below shows the common technological routes in iron and steel making.

FIGURE 66: METALLURGICAL BENEFICIATION AND SHAPING IN THE IRON AND STEEL INDUSTRY



Source: 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, 2008). 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 steel from its 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.

4.3.9.2.3 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.

4.3.9.2.4 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 42 and 43 below*. The BOF route is currently the cheaper route (USD382.00/ton) than the EAF route (USD 498.00/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 42 below)*, taking advantage of the availability of iron ore and coking coal resources locally.

TABLE 42: BASIC OXYGEN FURNACE ROUTE STEELMAKING COSTS 2014

Integrated steelmaking - crude steel cost model (US$)						
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

Source: www.steelonthenet.com

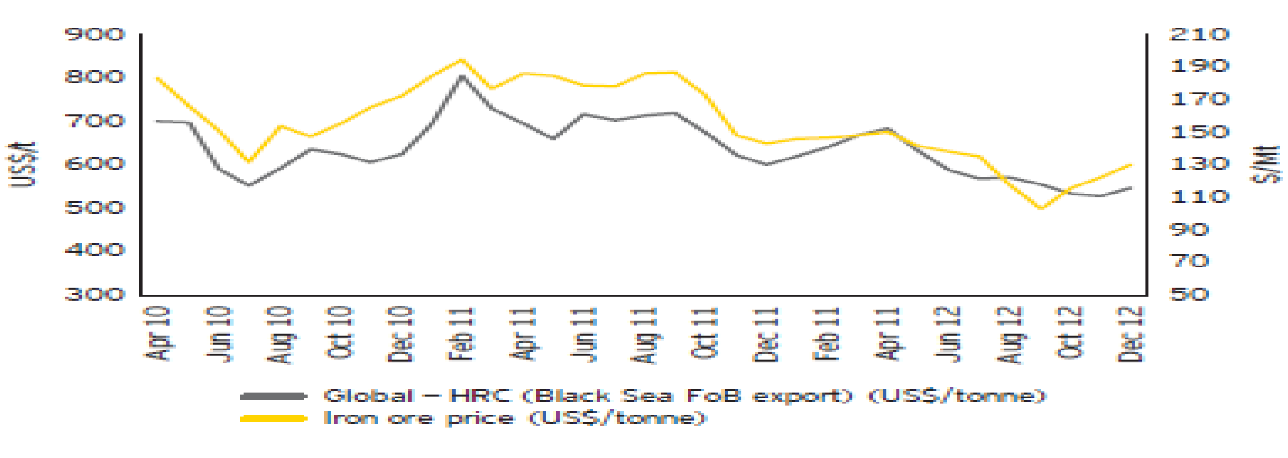
TABLE 43: CONVERSION COSTS FOR STEEL MAKING THROUGH THE EAF ROUTE

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

Source: *www.steelonthenet.com*

Figure 67 below 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 faster due 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 67: 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 USD104.00 per ton in 2001, to a high of USD350.00 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 44* 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 44: 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	0.8	0.73m
Hot rolled coil	3	585.00		
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 68 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) consider 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).

FIGURE 68: POSSIBLE IRON AND STEEL BENEFICIATION ROUTES DEPENDING ON COST COMPETITIVENESS

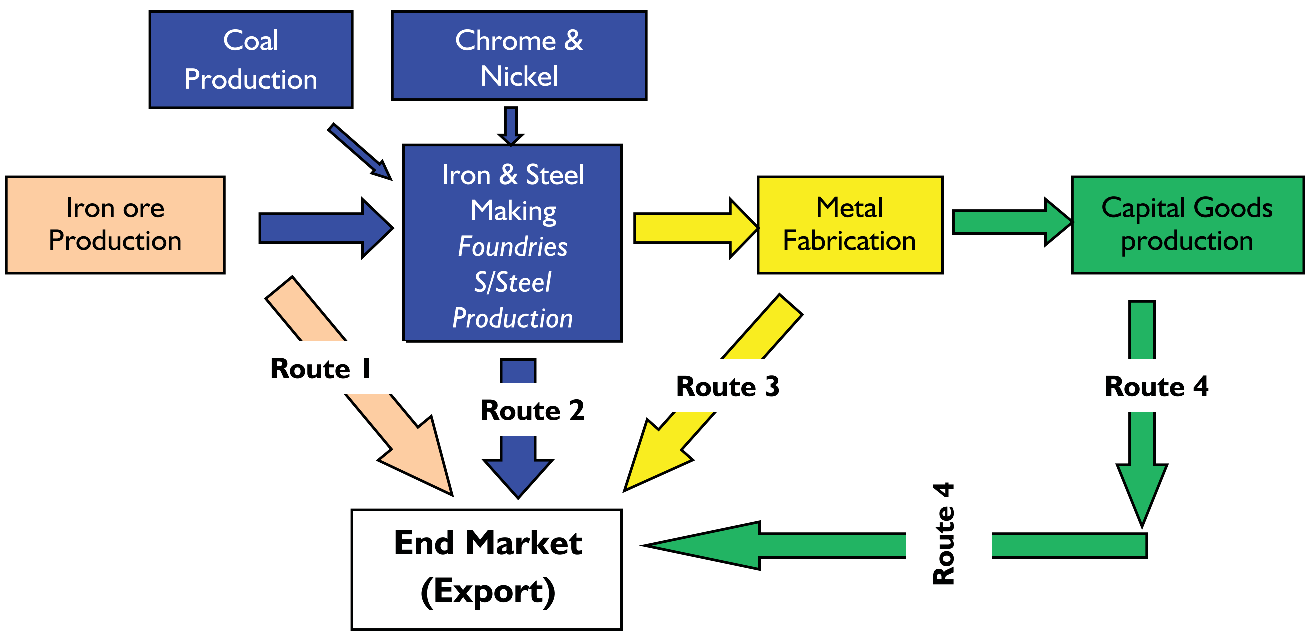


TABLE 45: COST ESTIMATES IN THE IRON AND STEEL VALUE CHAIN

		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
Flat products	2	1000.00	1300.00	1.1	1.1Bn	1.43Bn
Long products	2	1200.00	1500.00	1.1	1.32Bn	1.65Bn
Pipe and tube	3	960.00	1400.00	1	0.96Bn	1.4Bn
Stainless Steel	3	2500.00	3000.00	1	2.5Bn	3Bn
Structural Steel	4	700	1700.00	1	0.7Bn	1.7Bn
Finished goods	4	3000.00	11000.00	1	3Bn	11Bn

Source: SIRDC Analysis, 2014, Prices from www.worldsteelprices.com and local suppliers

The possible scenarios for value generation are presented in *Table 45* above. Thus it can be shown that the country is losing up to USD 2 billion potential revenue due to the closure of ZISCO operations. Another interesting possibility was the establishment of the stainless steel production in Zimbabwe considering the great jump in revenue from iron ore to stainless steel products as shown in *Table 45* 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.

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)*.

4.3.9.2.5 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 °C, 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 46 below)*. The adoption of modern steelmaking technologies like Corex, Finex and ITMk3 can utilise the 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 46: PERFORMANCE OF TYPICAL OLD PLANTS AS COMPARED TO GLOBAL BENCHMARKS

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

Source: IISA Working Group Report, 2011

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 46 above 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.

4.3.9.3 DIMENSION 3: END MARKETS AND TRADE

4.3.9.3.1 End products and 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 included ZISCO 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 steel refers 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 goods sub-sector has been driven by the cookware and cutlery sector. The tank container subsector is 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 47* below.

TABLE 47: 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

4.3.9.3.2 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 there is a strong correlation between iron and steel consumption and industrial production. The iron and steel industry is directly connected to 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 which included 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 to Britain, 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 market fed 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., and tools 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 Africa are 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 (estimated at 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 also showed 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 struggling and 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.

4.3.9.3.3 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 has resulted 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.

4.3.9.3.4 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 48* below.

TABLE 48: 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 48* 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".

4.3.9.4 DIMENSION 4: VALUE CHAIN GOVERNANCE

4.3.9.4.1 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 beaureacratic 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 sector growth 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.

4.3.9.4.2 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.

4.3.9.4.3 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 *(Claessens and Henderson 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*(Claessens and Henderson, 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)*.

4.3.9.4.4 Type of governance

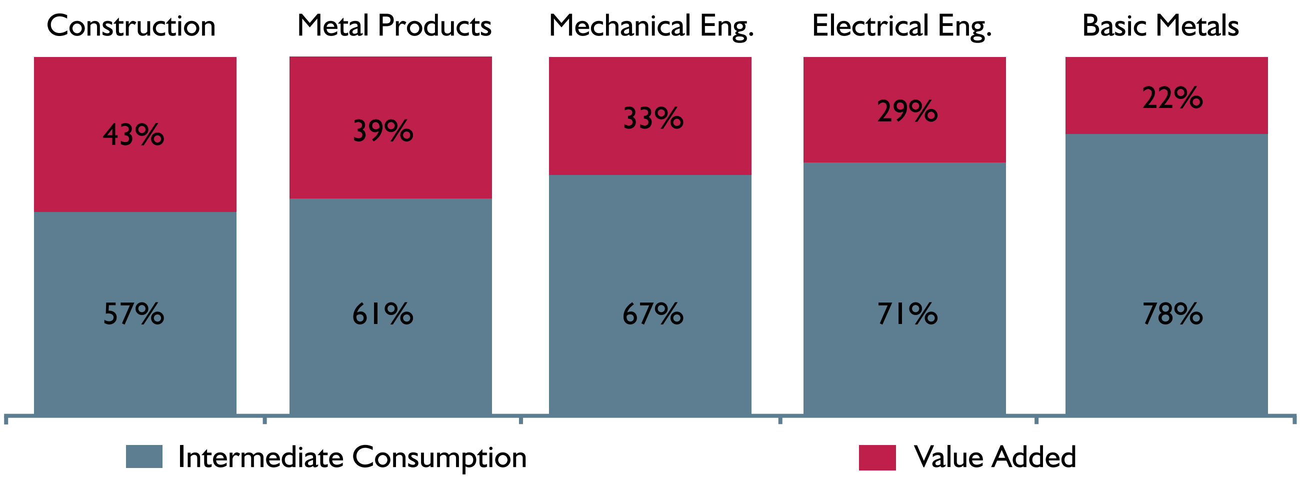
The type of governance in the Zimbabwean iron and steel industry will most likely be dependent on dependent based on the positions of the major shareholder, in this case Essar Group of India and the GoZ. In turn, the Essar Group strategic decisions will be greatly influenced by the Indian policies with 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)*.

4.3.9.5 DIMENSION 5: SUSTAINABLE PRODUCTION AND ENERGY USE

4.3.9.5.1 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 69,* illustrating 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 Levels 2 and 3, which include the steel making process due to the cost of raw materials. Leveraging on the abundance of the raw materials at lower costs, the Zimbabwean iron and steel industry has the potential to become globally competitive with higher value added percentages than the global average.

FIGURE 69: COMPOSITION OF GROSS OUTPUT IN THE GLOBAL IRON AND STEEL VALUE CHAIN



Source: 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. 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.

The key informants *(Annex 11 and 12)* 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 respectively can 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.

4.3.9.5.2 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.

4.3.9.6 DIMENSION 6: VALUE CHAIN FINANCE

4.3.9.6.1 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 sectors 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.

4.3.9.6.2 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.

4.3.9.7 DIMENSION 7: BUSINESS ENVIRONMENT AND SOCIOECONOMIC CONTEXT

The same business 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.

4.3.9.8 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

4.4 LEVEL 4 VALUE CHAIN ANALYSIS (METAL FABRICATION)

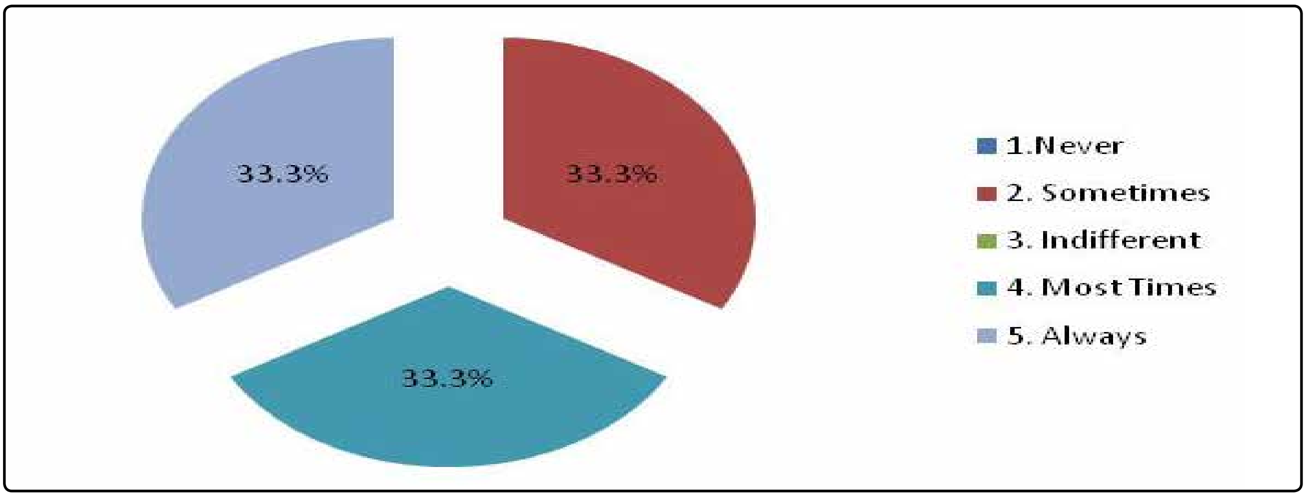
The metal fabrication stage (Level 4) involves several actors involved in the machining and fabrication of components usually used for equipment and machine building. Some of the actors in this sub-sector are both fabricators and machine builders whilst others, though few, can be integrated from metal 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.

4.4.1 DIMENSION 1: SOURCES OF INPUTS AND SUPPLIES

4.4.1.1 Characteristics of inputs, supplies and nature of suppliers

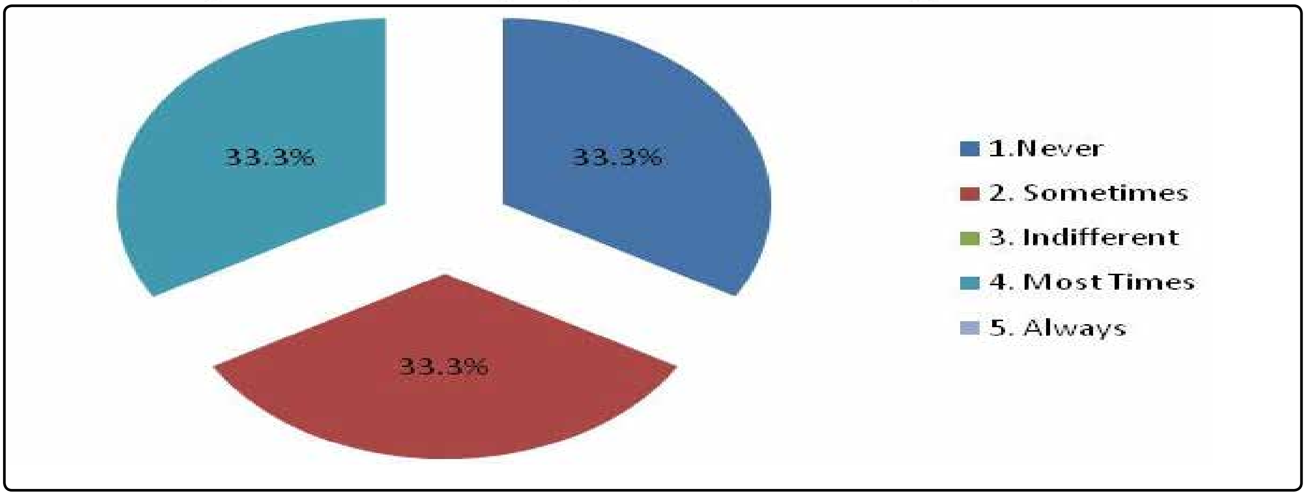
The inputs noted in the study were copper, aluminium, PVC, steel, lead and zinc, electricity, water, storage facilities and transport facilities. About 53% of the respondents required storage facilities for their raw materials. The storage facilities mentioned were store rooms, billet bins and tanks. 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 70: 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 70 above)*.The responses therefore show that the quality of locally sourced inputs was generally high.

FIGURE 71: 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 *(Figure 71 above)*. This implies that the reliability of local suppliers in delivering the expected quantities needed to be improved.

FIGURE 72: CONSISTENCY OF QUALITY OF INPUTS FROM FOREIGN SUPPLIERS

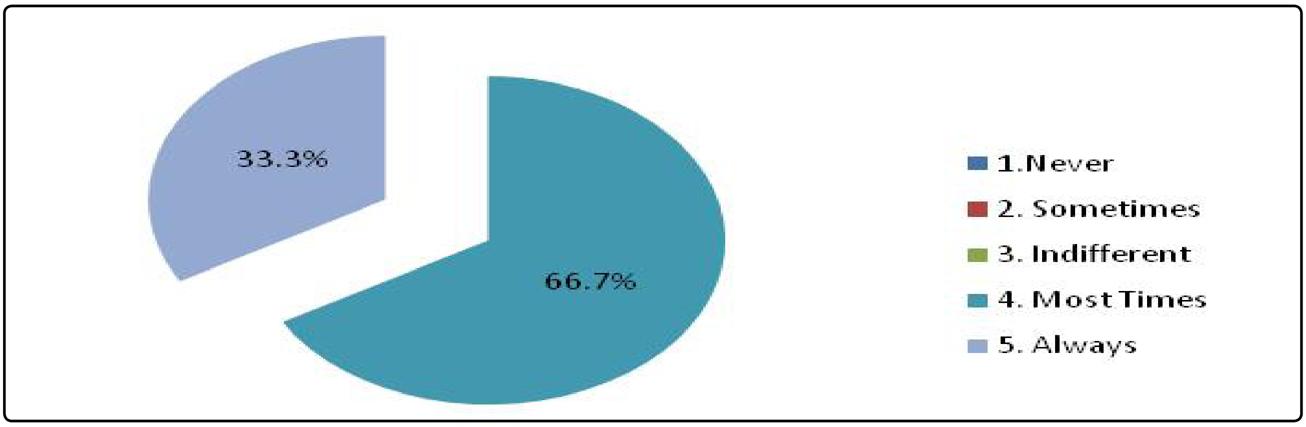


Figure 72 above shows that, of the responses on the quality of inputs from foreign suppliers, 67% said the quality was good most of the times, whilst 33% said it was always good. It generally implies that the quality of foreign sources inputs was generally high although there is need for improvement in some cases.

FIGURE 73: CONSISTENCY OF QUANTITIES OF INPUTS SUPPLIED FROM FOREIGN SOURCES

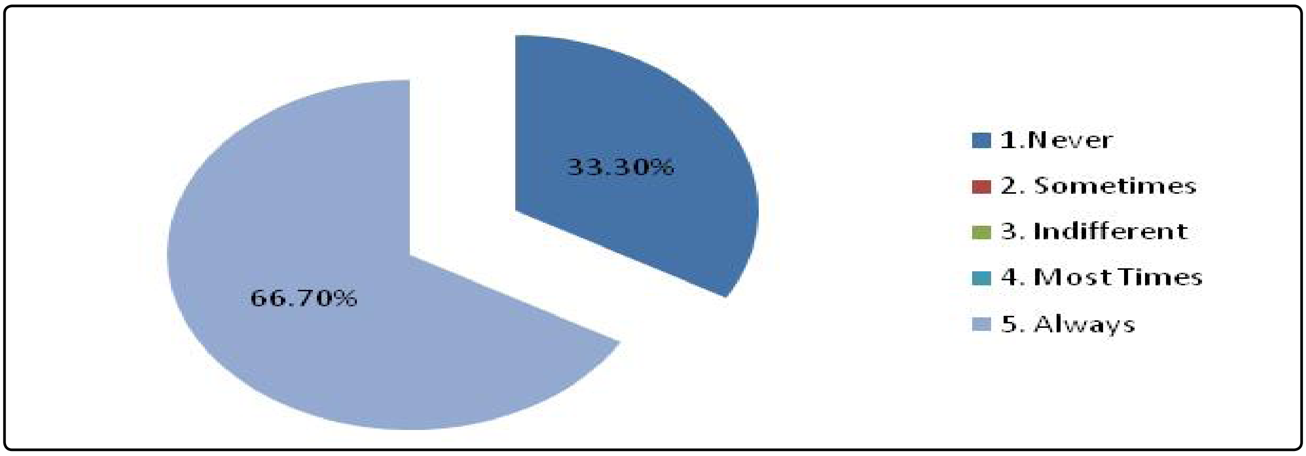


Figure 73 above shows that 67% of the respondents said that the quantities of inputs from foreign supplies were adequate most times, whilst 33% said the quantities were never adequate. The analysis therefore shows that although the consistency of quantities supplied was generally satisfactory, there was need to improve the supply quantities.

4.4.1.2 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.

4.4.2 DIMENSION 2: PRODUCTION CAPACITY AND TECHNOLOGY USE

4.4.2.1 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 49* below summarises the reasons for low capacity utilisation.

TABLE 49: 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	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 50: 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 50* 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.

4.4.2.2 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 74 below)*.

FIGURE 74: SUITABILITY OF TERTIARY EDUCATION CURRICULAR TO INDUSTRY REQUIREMENTS

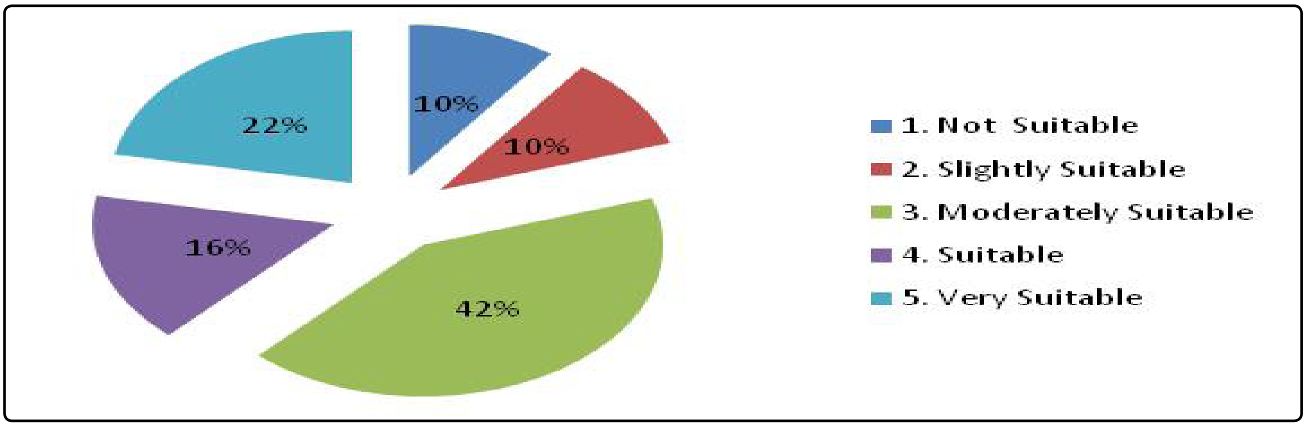
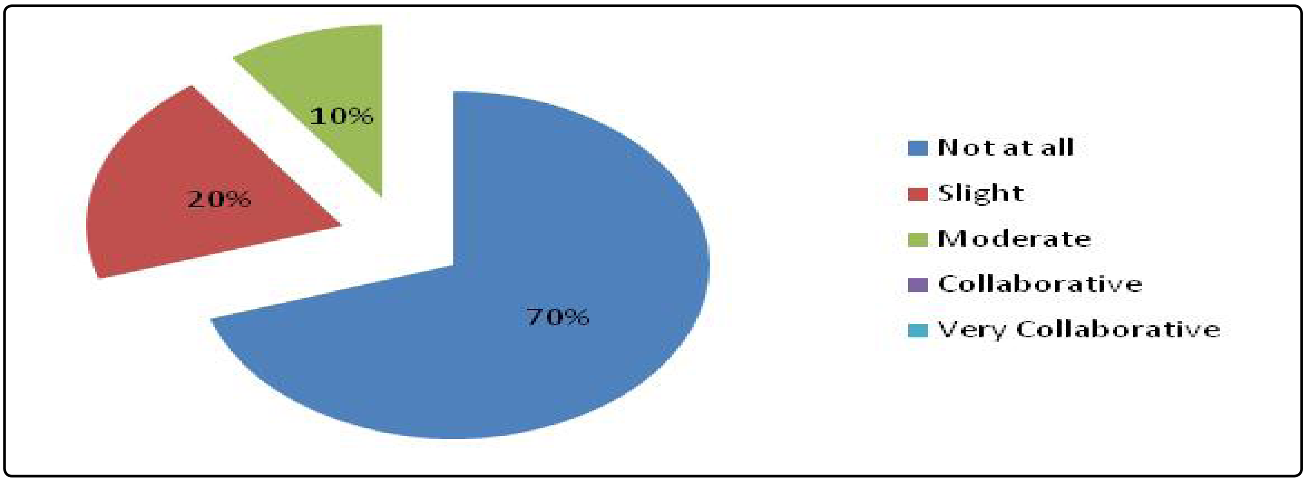
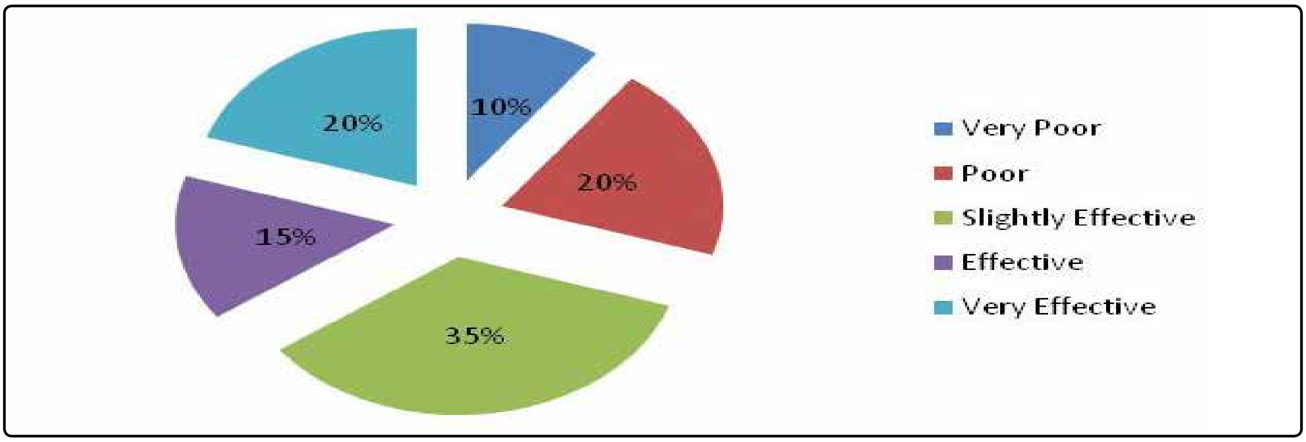


FIGURE 75: LEVEL OF COLLABORATION WITH NATIONAL RESEARCH AND DEVELOPMENT INSTITUTIONS



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 75 above)*. *Figure 76*below 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 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 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* 77 below.

FIGURE 77: DISTRIBUTION OF END PRODUCTS IN LEVEL 4

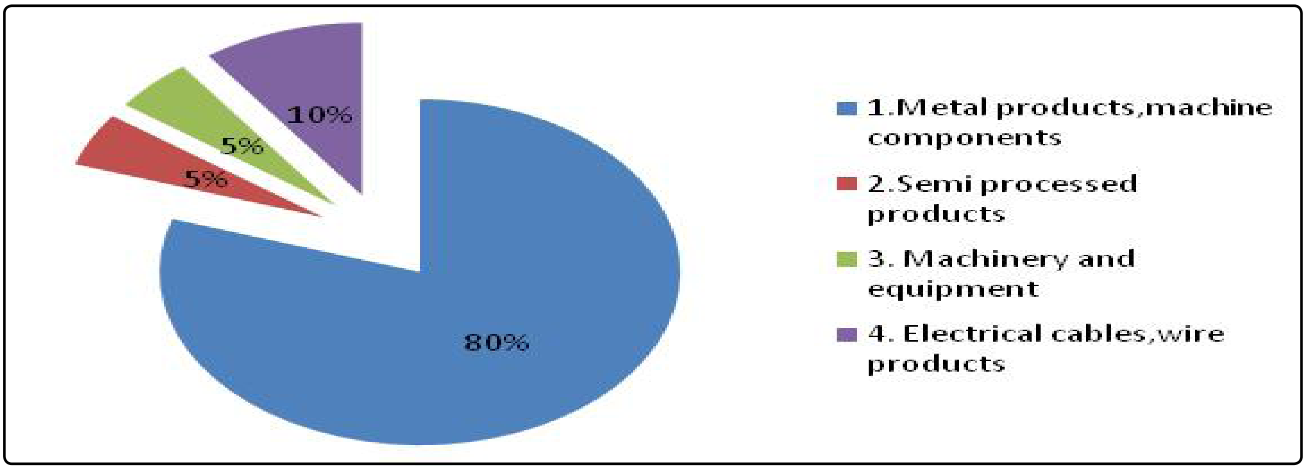
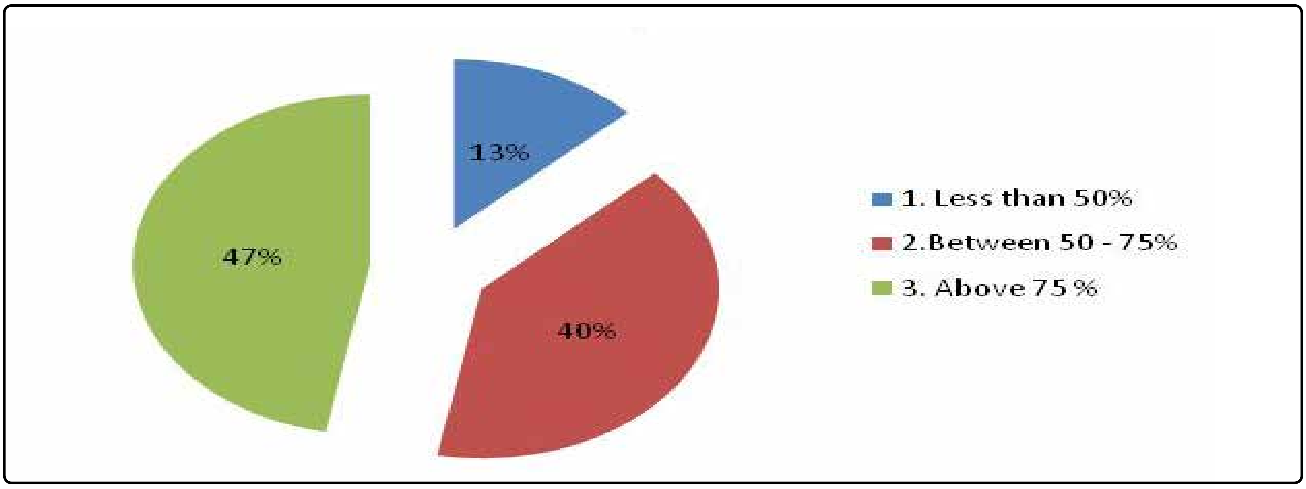


Figure 78 below shows that 40% of the firms had their main product constituting between 50 to 75% of the main product, 47% of firms constituting above 75% of sales and 13% of the firms with the main product contributing less than 50% of the total sales. There is therefore high dependence on the main 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 78: CONTRIBUTION OF THE MAIN PRODUCT TO TOTAL SALES



4.4.3.2 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.

4.4.3.3 Marketing, trade capacities and standards

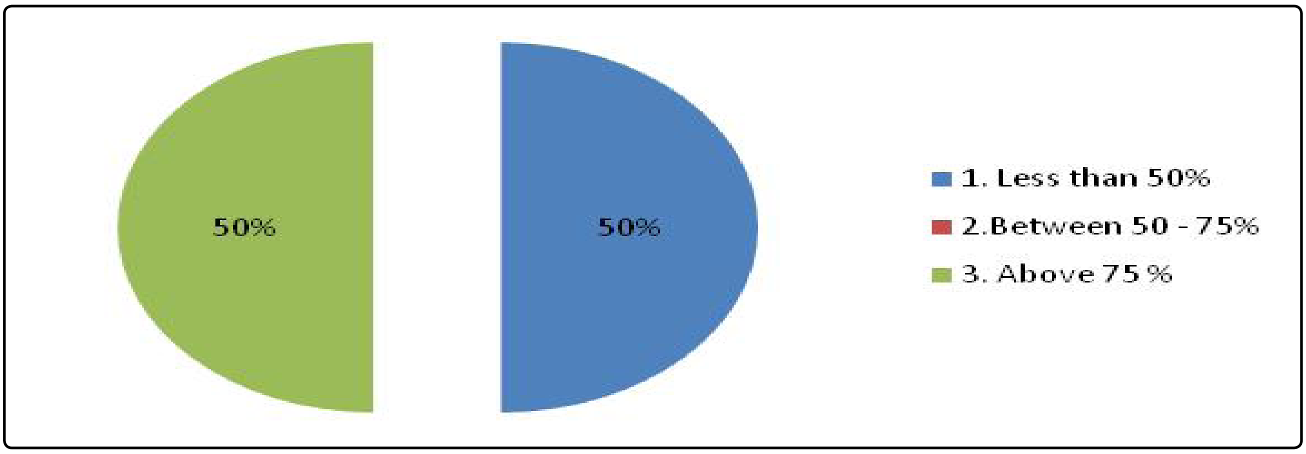
According to respondents annual volumes generated ranged between 183000 and 336000tonnes (268000tonnes average), generating annual revenues of between US$3million and US$64million for the period between 2011 and 2013. The direct export of products started in 1999. According to all respondents, clearance 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 51: 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 51 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 79: 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 79 above)*. The SADC market is therefore a critical market to the sector.

FIGURE 80: DESTINATION OF MAIN PRODUCT SOLD IN 2012

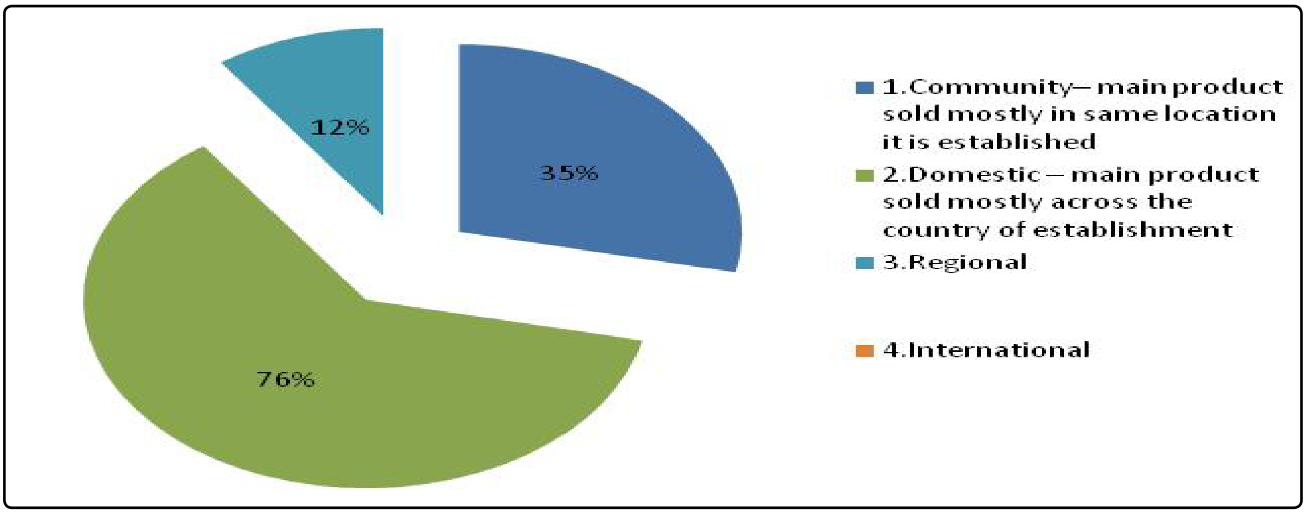
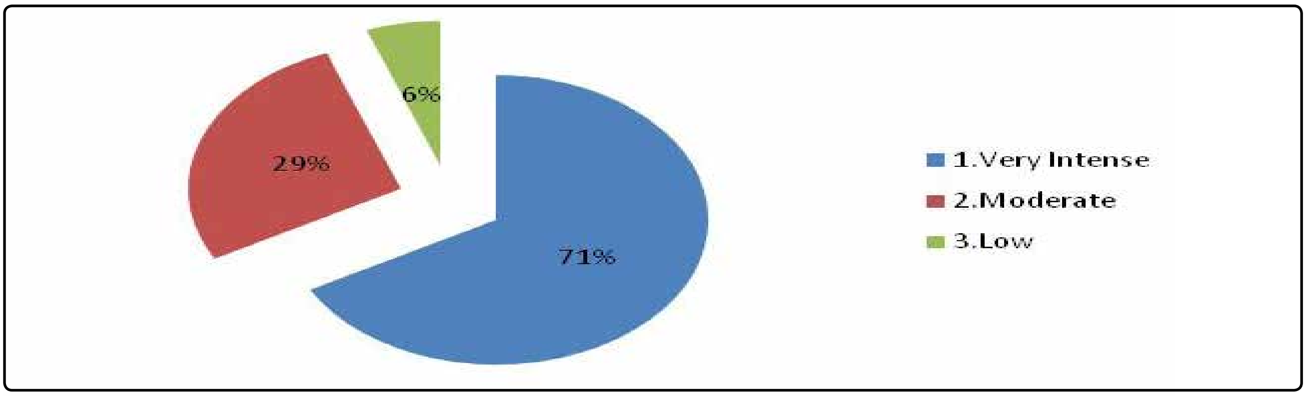


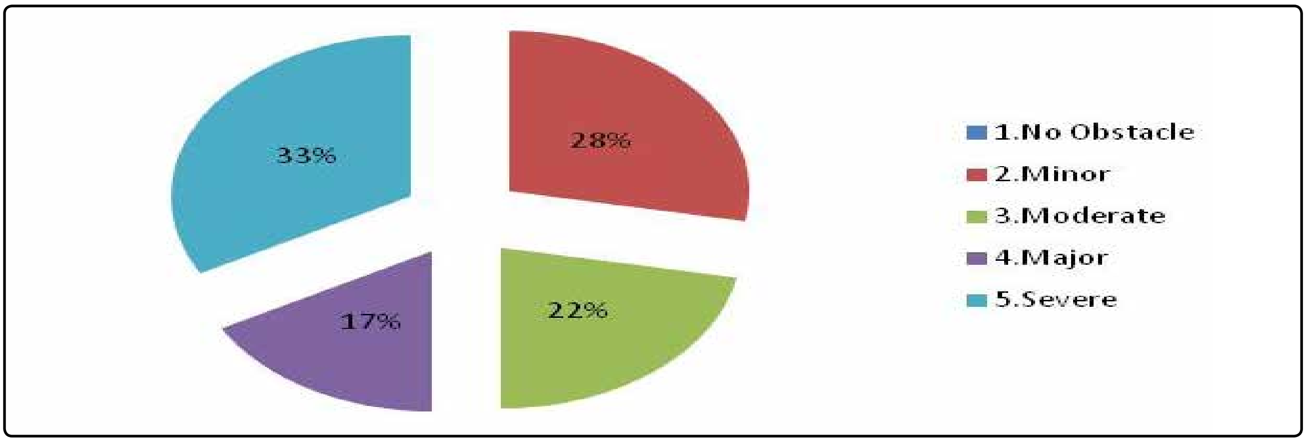
Figure 80 above shows that 76% of the respondents indicated that the main product was sold in the domestic market mostly across the country of establishment in 2012. About 35% of the respondents indicated selling the main product in the community where the firm is established. Only 12% of the respondents 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 81: 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 81 above)*. This implies that competition on the market is quite stiff. The majority of the respondents (89%) competed against unregistered or informal companies.

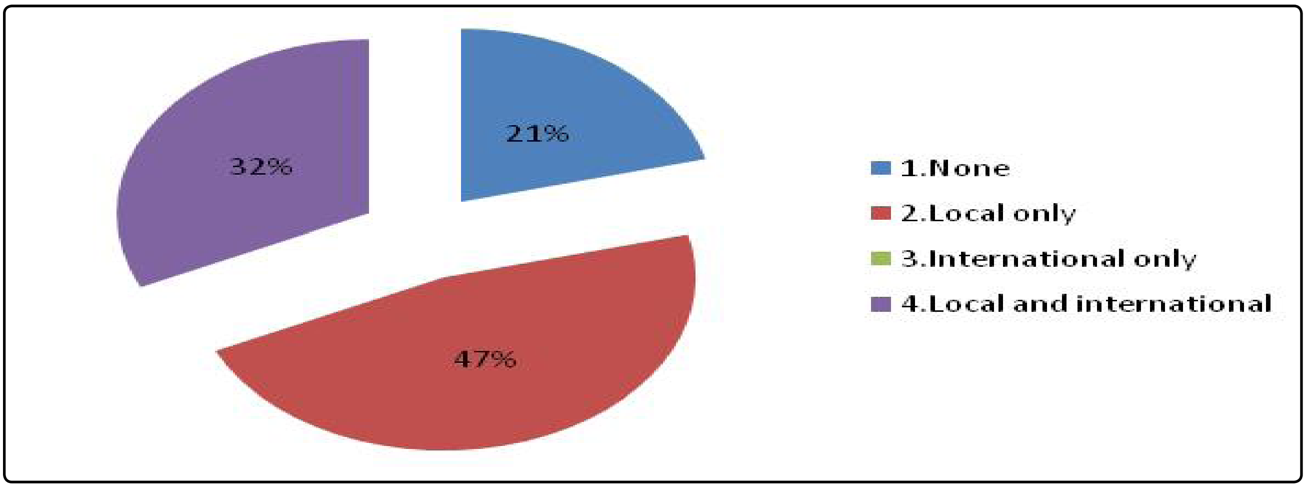
FIGURE 82: IMPACT OF PRACTICES OF INFORMAL SECTOR PLAYER TO SECTOR OPERATIONS IN 2012



A significant number of respondents (72%) were significantly affected by the practice of informal players *(see Figure 82 above)*.

The estimated annual marketing budget average for the sector was about USD9million. 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 83: RESPONSE ON COMPLIANCE WITH LOCAL AND INTERNATIONAL STANDARDS



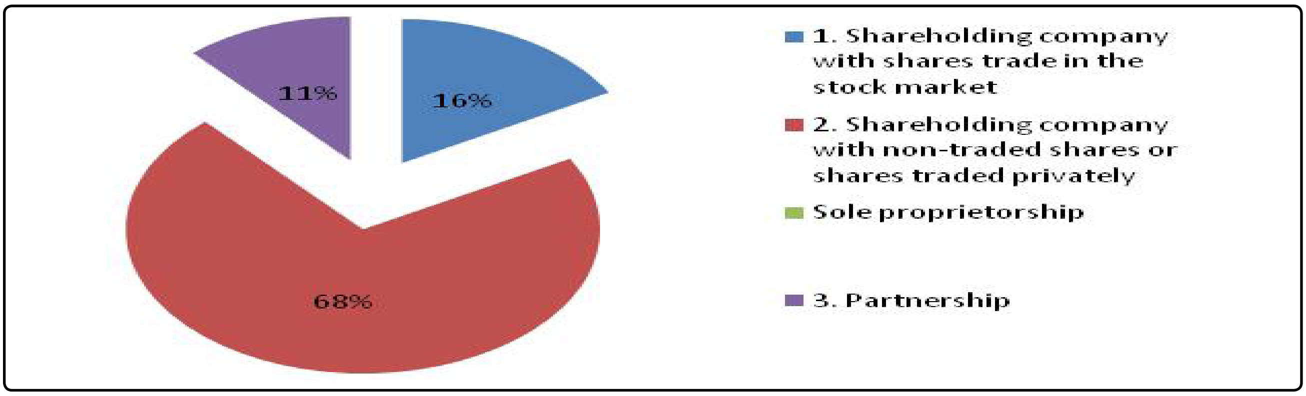
About 32% of the respondents comply with both local and international standards whilst 79% were compliant with either local or international standards *(Figure 83 above)*. About 21% of the respondents were not compliant with any standards. About 57% of the respondents stated that compliance to standards 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.

4.4.4 DIMENSION 4: VALUE CHAIN GOVERNANCE

4.4.4.1 Actor domination

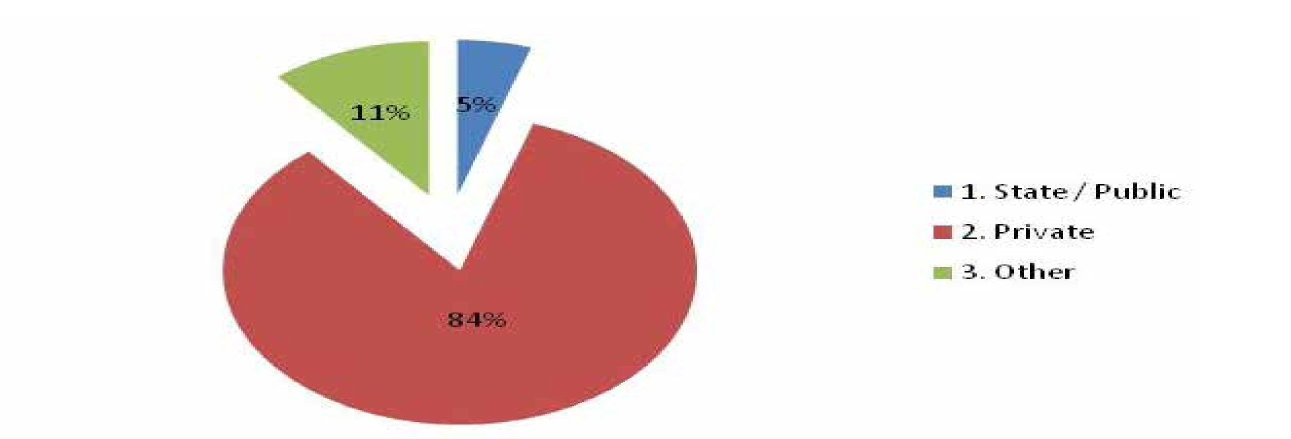
About 68% of the firms were shareholding companies with non-traded shares or shares traded privately, 16% shareholding companies with shares traded on the stock market and the remaining 11% were a partnership *(Figure 84 below)*. The firms according to the respondents were formed between 1931 and 2001.

FIGURE 84: LEGAL STATUS OF FIRMS IN LEVEL 4



About 84% of the firms that responded were private firms, whilst 5% were state/ public entities *(Figure 85below)* 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 85: STRUCTURE 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 52below)*.

TABLE 52: 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%

4.4.4.2 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 either online 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.

4.4.5 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. 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 53* below highlights the type of water used by the respondents and it indicates that 95% used municipal water whilst 30% used borehole water.

TABLE 53: 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.

4.4.5.2 Emissions

Table 54 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.

TABLE 54: 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 5. Other…. Certificate of reg of a company	60% 30%

The analysis of respondents presented in *Table 55* 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 55: 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.

4.4.5.3 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 56: 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 56 above shows that 56% apiece of respondents had programs in place for airborne emissions, hazardous waste and wastewater disposal. About 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.

4.4.6 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.

4.4.6.1 Availability of finance

From the analysis of the survey, the annual operational requirements in the automobile industry had an average of US$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 capacity according to the information given. About 81% of their customers required credit facilities whilst the rest did not.

4.4.6.2 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.

4.4.7 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 political instability, corruption, labour regulations and health issues, practices of competitors in the informal sector and tax rates and administration *(see Table 57 below)*. The moderate obstacles included licensing and permits, crime, theft and disorder and inadequately educated workforce.

TABLE 57: 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.

4.4.7.2 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.

4.4.8: DISCUSSION: THE SIGNIFICANCE OF THE LEVEL TO THE ZIMBABWEAN CONTEXT

Key actors in Level 4include 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.

4.4.8.1 Background of the Metal Fabrication Industry in Zimbabwe

Themetal fabrication 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 58* below.

TABLE 58: CLASSIFICATION OF CAPITAL GOODS IN LEVEL 4 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 (USD6.7billion) in this sector compared to imports (USD1.9billion) for the period 2008 to 2012 *(Tables 59 and 60 below)*. 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 59: EXPORTED METALS AND METALS PRODUCTS (MILLION US$) BY RANK

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**

Source: UNCOMTRADE Statistics

The figures presented in *Tables59 above and 60 below* 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 60: IMPORTED METALS AND METAL PRODUCTS (MILLION US$) BY RANK

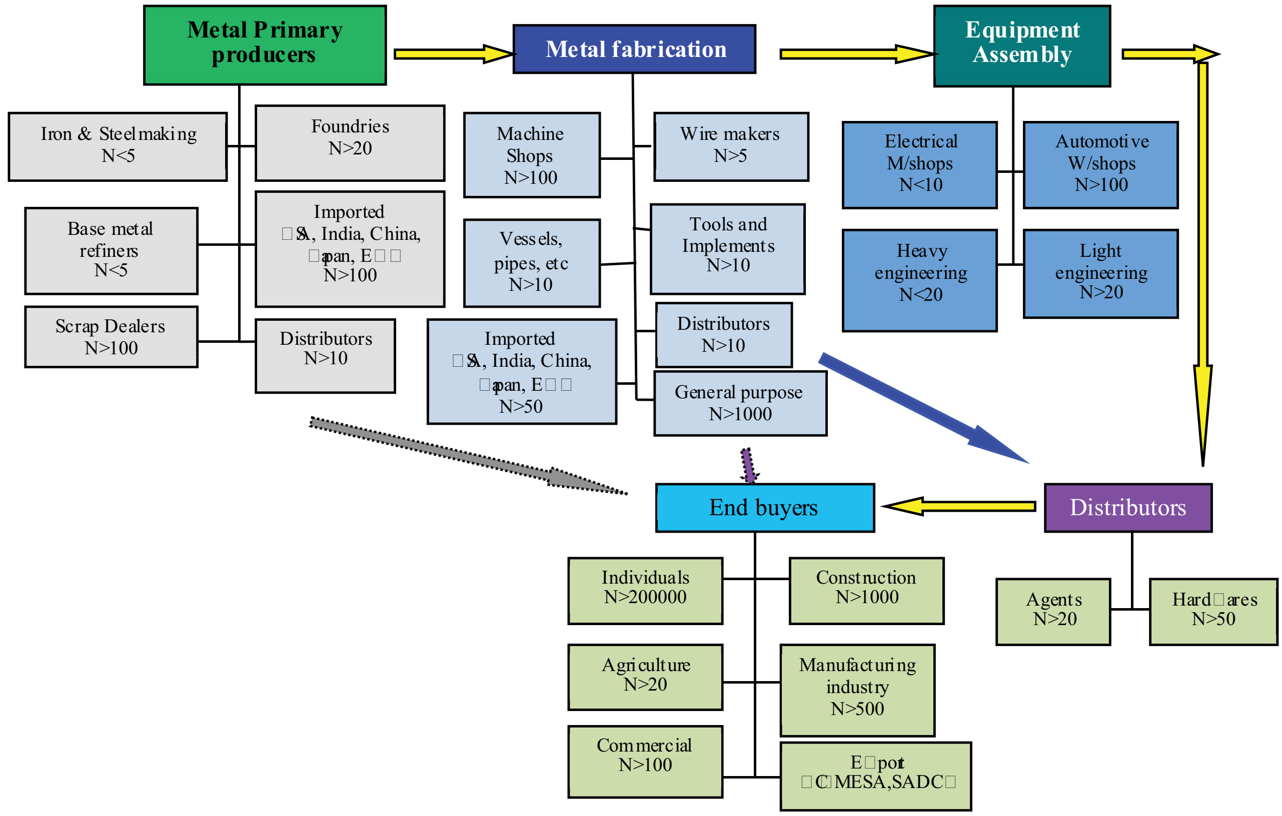
Product label	2008	2009	2010	2011	2012	Totals
Articles of iron or steel	91.6	110	112.1	134.1	147.6	**595.4**
Nickel and articles thereof	108	138.7	150.7	125.6	33	**556**
Iron and steel	38	62.9	86.4	127.8	129.2	**444.3**
Tools, implements, cutlery, etc. of base metal	17.4	14	19.6	24.1	23.7	**98.8**
Aluminium 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**

Source: UNCOMTRADE Statistics

4.4.8.2 Metal Fabrication Value Chain Map

The structure of the value chain map for Level 4 is summarised in *Figure 86* 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 86: STRUCTURE OF LEVEL 4 VALUE CHAIN IN ZIMBABWE



Source: SIRDC, 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 creates 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 was critical to improve operations of this subsector.

4.4.8.3 Conclusion

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.

4.5 LEVEL 5 VALUE CHAIN ANALYSIS (MACHINE/EQUIPMENT BUILDING & ASSEMBLY)

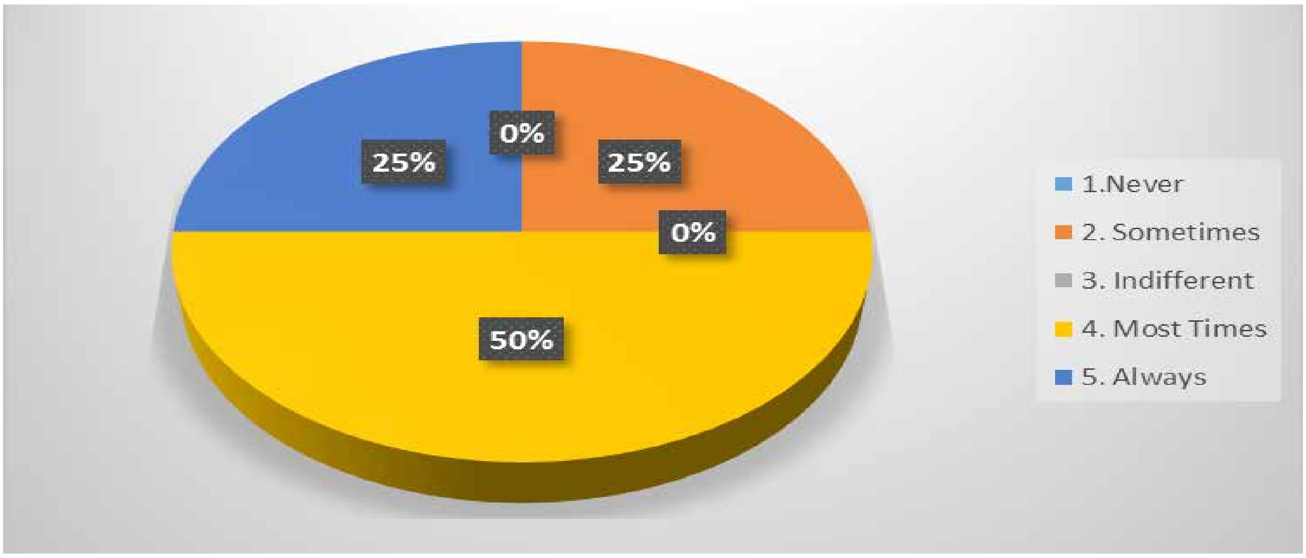
The machine/equipment building and assembling stage involves several actors in the light and heavy engineering goods subsectors. The light engineering goods sector includes agricultural, medical and food processing equipment/machine manufacturers and assemblers. The heavy engineering goods sub-sector 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.

4.5.1 DIMENSION 1: SOURCES OF INPUTS AND SUPPLIES

4.5.1.1 Characteristics of inputs, supplies and nature of suppliers

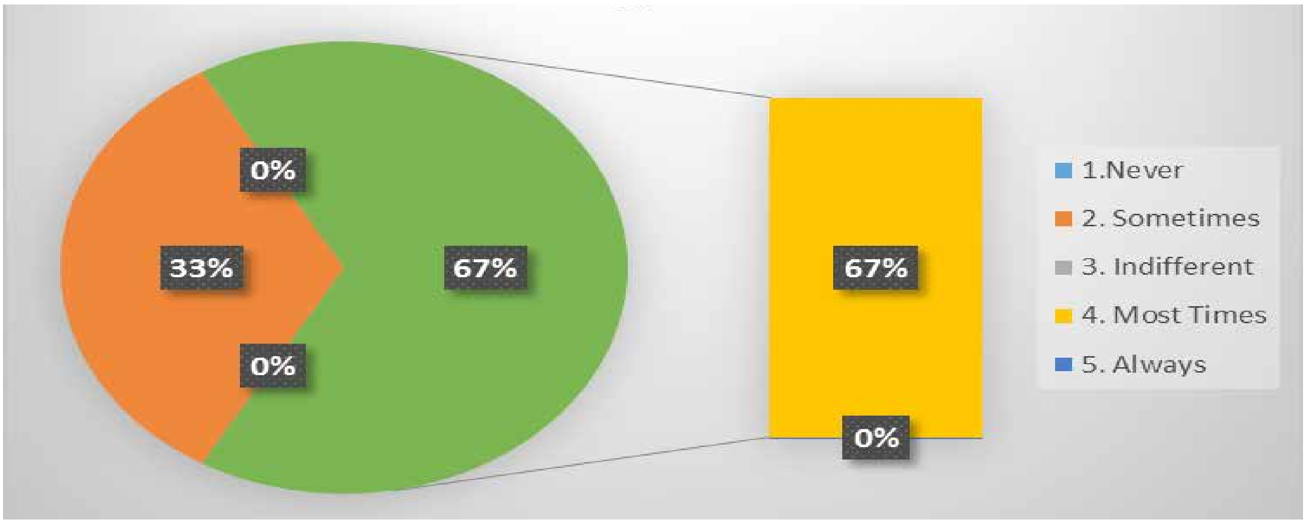
The inputs noted in the study were mild steel plates, angle irons, channel irons, castings, electricity, water, storage facilities and transport facilities. The analysis showed that all the investigated actors received 20 – 87% of their inputs locally (37% average), whilst 13 – 80% are being imported (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 87: 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 87 above)*.The responses also show that the quality of locally sourced inputs was generally high.

FIGURE 88: 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 88 above)*. This implies that the reliability of local suppliers in delivering the expected quantities was generally good.

FIGURE 89: CONSISTENCY OF QUALITY OF INPUTS FROM FOREIGN SUPPLIERS

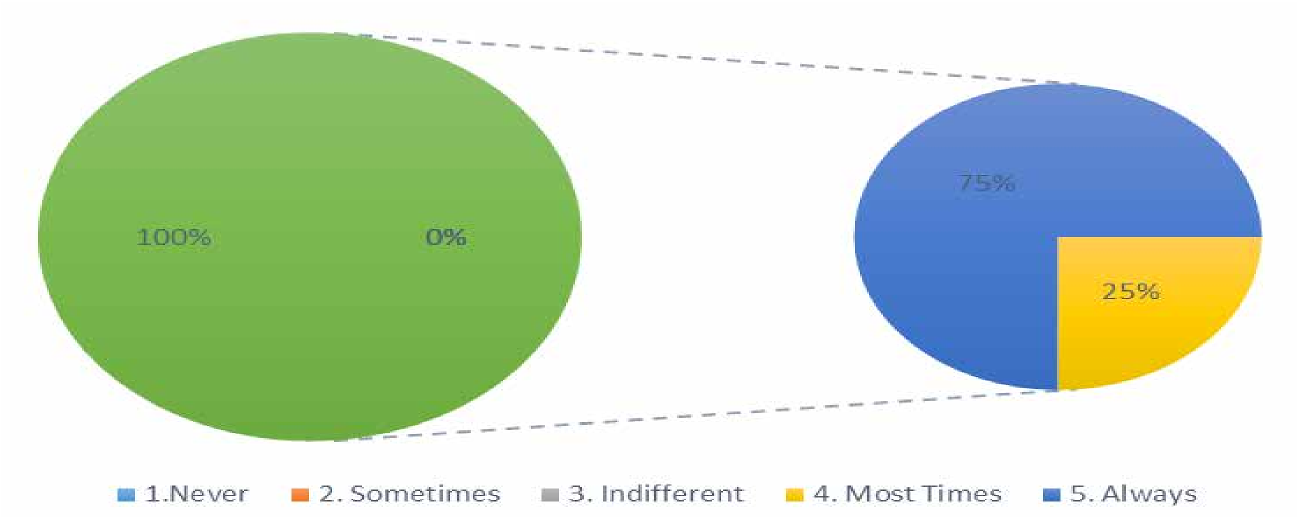


Figure 89 above shows that, of the responses on the quality of inputs from foreign suppliers, 75% said the quality was good most of the times whilst 25% said it was always. It generally implies that the quality of foreign sources inputs was generally high.

FIGURE 90: CONSISTENCY OF QUANTITIES OF INPUTS SUPPLIED FROM FOREIGN SOURCES

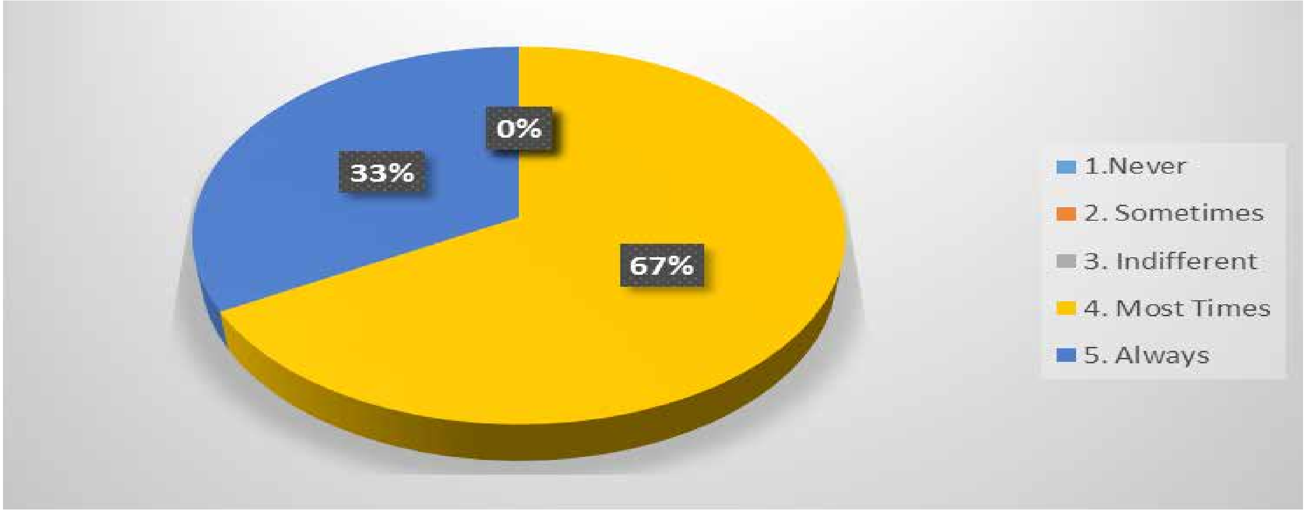


Figure 90 above shows that 67% of the respondents said that the quantities of inputs from foreign supplies were adequate most times, whilst 33% said the quantities were always sufficient.

4.5.1.2 Transport and Logistics

Transport was a non-obstacle to current operations as 50% of the respondents said so whilst 50% said it was a minor obstacle. The stockholding period for raw materials ranged between 4 and 30 days (17 days average) according to respondents. It implies that storage costs could be a significant factor in the value chain.

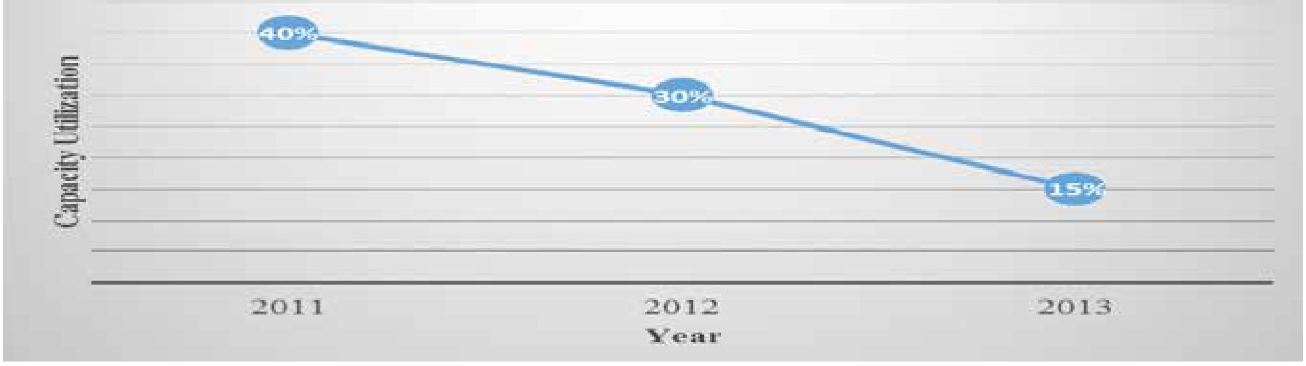
About 25% of the respondents said that they were offered bribes when dealing with customs, whilst 75% offered no bribes. The responses on customs and trade regulations indicate that this factor is not a major obstacle to current operations since 50% said it was none whilst 50% said it was a moderate 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. 25% of the respondents cited ISO standards as prerequisite certification requirements for their inputs whilst 75% used others. Accordingly, transport and logistical issues were not major in Level 5.

4.5.2 DIMENSION 2: PRODUCTION CAPACITY AND TECHNOLOGY USE

4.5.2.1 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 hour day. The production capacity ranged from 7 to 35 tonnes per month with an average of 20.67 tonnes per month.

FIGURE 91: CAPACITY UTILISATION IN LEVEL 5



Capacity utilisation dropped from 40% in 2011 to 15% in 2013 *(Figure 91 above)*. All respondents said that they performed short, medium and long term capacity reviews. About 25% of the respondents said that they subcontracted some process or operations especially manufacturing and painting. The significant decline in capacity is attributable to the decline in low local demand, working capital constraints and lack of raw materials. The other reasons cited are presented in *Table 61* below.

TABLE 61: 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. About 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 62: 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 62 above*, 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.

4.5.2.2 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 92 below)*.

FIGURE 92: SUITABILITY OF TERTIARY EDUCATION CURRICULAR TO INDUSTRY REQUIREMENTS

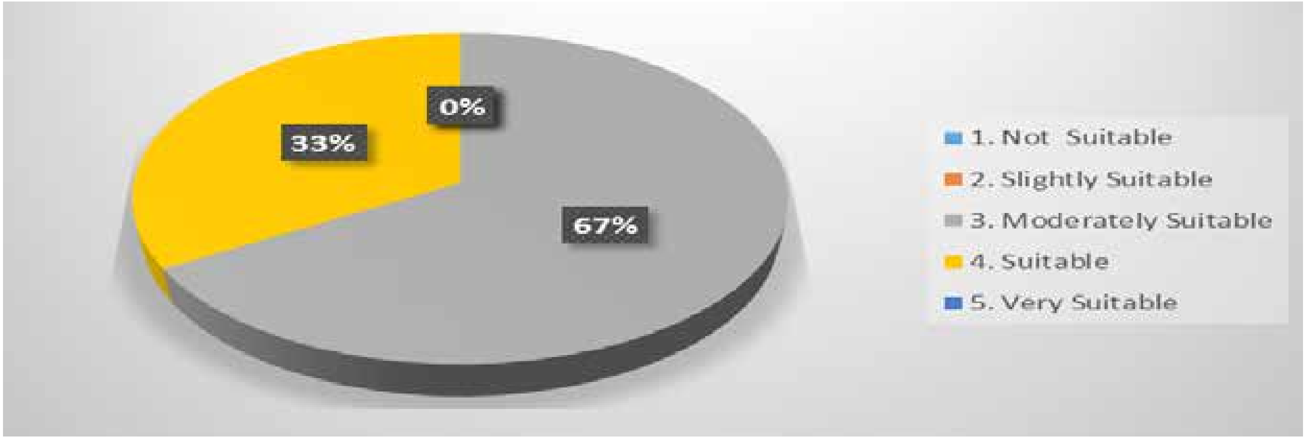
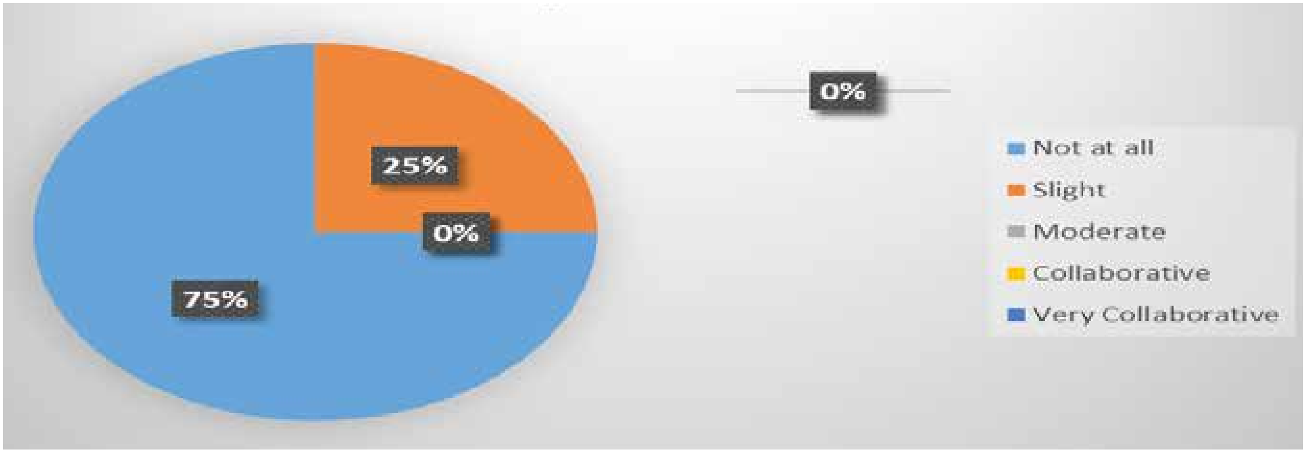


FIGURE 93: LEVEL OF COLLABORATION WITH NATIONAL RESEARCH AND DEVELOPMENT INSTITUTIONS



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 93 above)*. *Figure 94* 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 50% said it was effective.

FIGURE 94: RELEVANCE AND EFFECTIVENESS OF LOCAL RESEARCH & DEVELOPMENT FOR OPERATIONS IMPROVEMENT

4.5.3 DIMENSION 3: END MARKETS AND TRADE

4.5.3.1 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.

4.5.3.2 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.

4.5.3.3 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 63: 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 63 above)*. 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.

4.5.4 DIMENSION 4: VALUE CHAIN GOVERNANCE

4.5.4.1 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 64: 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 64 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.

4.5.4.2 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 either online 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.

4.5.5 DIMENSION 5: SUSTAINABLE PRODUCTION AND ENERGY USE

4.5.5.1 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.

4.5.5.2 Emissions

Table 65 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.

TABLE65: 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 66* 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 66: 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%

4.5.5.3 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 67: PROGRAMS AND/OR PROCEDURES TO 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 67 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 68: 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 68 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.

4.5.6 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.

4.5.6.1 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.

4.5.6.2 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.

4.5.7 DIMENSION 7: BUSINESS AND SOCIO-ECONOMIC CONTEXT

4.5.7.1 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 69 below)*. The moderate obstacles included practices of competitors in the informal sector and labour regulations & health issues.

TABLE 69: 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.

4.5.7.2 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.

4.5.8 SPECIAL CASE STUDIES IN LEVEL 5 (ASSEMBLED GOODS)

Key actors on the domestic market included 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 different subsectors operating in the country are listed in *Table 70* below.

TABLE 70: 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.

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 thelow competitiveness of the end products on the market.

Export competitiveness
It was noted from key informant interviews and field data analysis that there were little exports (USD421million) in this sector as compared to imports (USD8.6billion) for the period 2008 to 2012 *(Tables 71 and 72 below)*.

TABLE 71: EXPORTED ENGINEERING GOODS (USDMILLION) BY RANK

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**

Source: UNCOMTRADE Statistics

The figures presented in *Tables71 above and 72 below* 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 72: IMPORTED ENGINEERING GOODS (MILLION US$) BY RANK

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	**935.63**	**1135.05**	**2124.21**	**2136.44**	**2231.7**	**8563.03**

Source: UNCOMTRADE Statistics

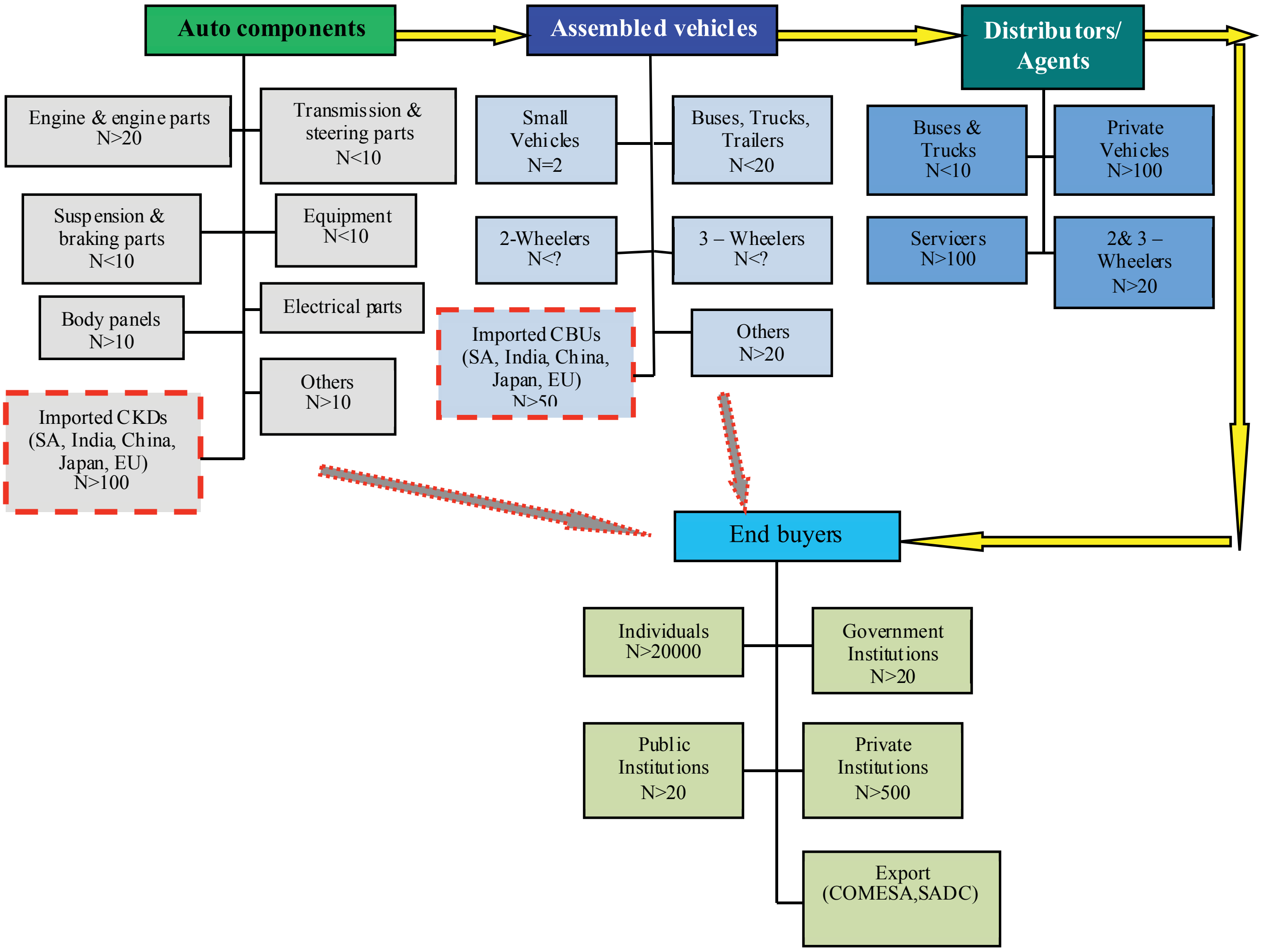
The automotive, mining and infrastructural development machinery and equipment as well as the agricultural equipment were covered in that section.

4.5.9 AUTOMOTIVE VALUE CHAIN IN ZIMBABWE

The automotive industry has the potential to become the most important and successful value chain in the engineering and metals sector of Zimbabwe. This is due to the fact that its supply chain involves all facets of the engineering and metals supply chain from the iron and steel, chrome, nickel and PGMs, foundries to machining and assembling firms as well as the chemical and the leather and textiles industries. The government of Zimbabwe in the mid 80's 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 *(Saungweme, 2011)*. This policy led to the joint venture between Willowvale Motor Industries, Mazda Motor Corporation and Itochu Corporation. 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 and South Africa which have consequently killed the domestic industry. High production costs during the economic meltdown worsened the situation, resulting in the precarious state of the domestic automotive industry.

FIGURE 95: STRUCTURE OF THE SUPPLY CHAIN IN ZIMBABWE



Source: SIRDC Analysis, 2014

Figure 95 above 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 13*.

4.5.9.1 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. Regionally South Africa has a far greater production capacity, estimated at close to 1 million vehicles per annum *(Alfaro et al., 2012)*. The major vehicle assemblers in South Africa include Ford, Nissan, Toyota, MAN, General Motors, Volkswagen and Mercedes Benz. In China and India, the production of automobiles had grown over 700 thousand and 500 thousand respectively by 2001 *(Sutton, 2004)*. Zimbabwe's capacity is therefore about 2% of South Africa's capacity, which implies that the latter is regionally and internationally insignificant.

4.5.9.2 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 been 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.

FIGURE 96: COMPARISON OF VEHICLE EXPORTS TO IMPORTS IN ZIMBABWE

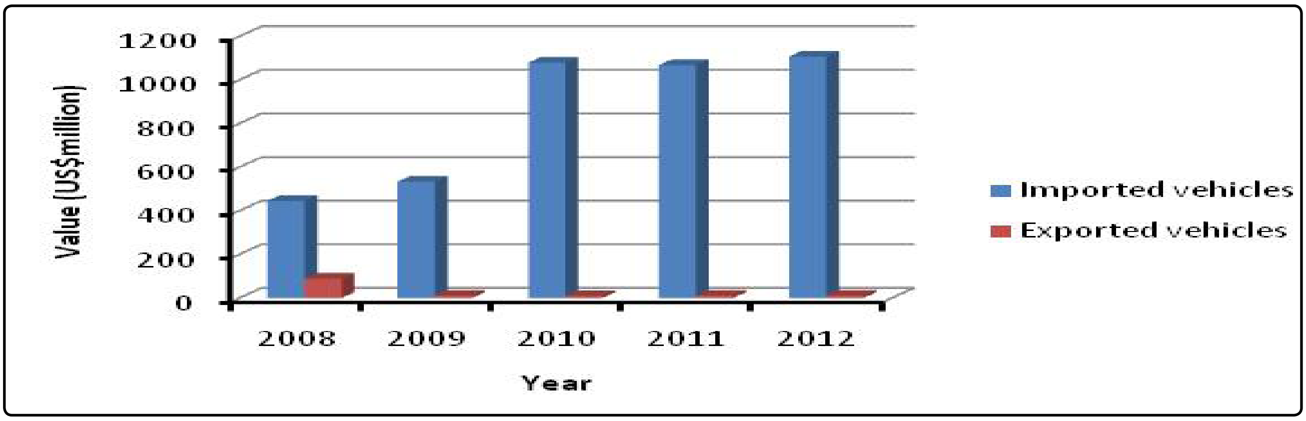
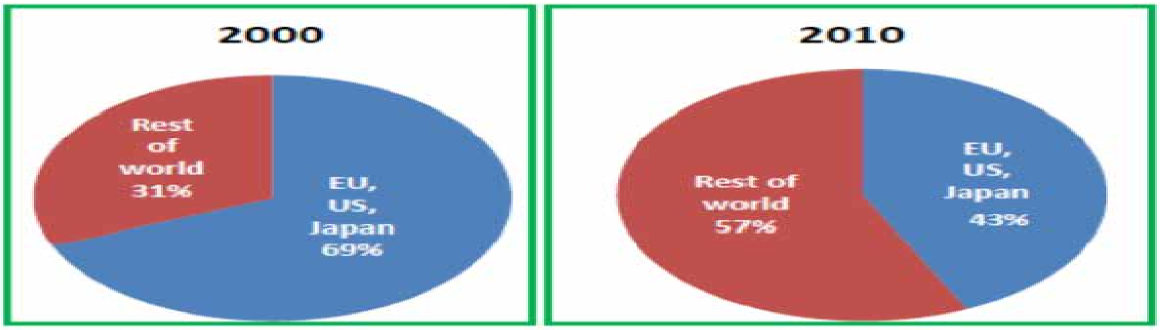


Figure 96 above shows that the trade deficit of the automotive sector was very huge (about 2 billion in 2012 and about 8 billion for the period 2008 to 2012). On one hand the trends shows a high demand for automobiles sector in the country whilst on the other hand the weakness of low domestic manufacturing capacity was exposed. The traditional export destination for both completed vehicles and components are Angola, Botswana, Malawi, Mozambique, Namibia, South Africa, Uganda and Zambia *(Saungweme, 2011)*. Critical questions for the Zimbabwean automotive market pertain to the significance of the domestic market and the capacity of the sector to produce for the export market. As already shown, the current production capacity of the Zimbabwean automotive sector was too small to compete on the regional and international market. Similarly the domestic market was also too small to justify economies of scale. Even *Alfaro et al., 2012* noted that the South African domestic market despite being significant could not be economical without significant exports.

4.5.9.2.1 Regional and international markets

The traditional markets for the automotive sector are Europe, Japan and the United States of America. Competing producers in the developing world include Egypt, Mexico and Thailand. Analysis by Alfaro et al., 2012 showed that there was a shift in automobile production to emerging markets mainly due to rapid growth of demand in the developing world as well as lower production costs. It was also reported that the emerging markets accounted for over half of light vehicle sales *(see Figure 97 below)* and a third of automobile demand was projected to be in Brazil India China (BRIC) markets by 2014 *(Alfaro et al., 2012)*.

FIGURE 97: GLOBAL EMERGING MARKETS SHARE IN AUTO-PRODUCTION



Source: Alfaro et al., 2012

The global competitiveness of the Zimbabwean automotive sector was evaluated and presented in the *Table 73* below. Transportation costs of final product to the consumer are significant, making closeness of production facility to the end market a competitive edge. In this regard, South Korea, China and India were strategically located. Whilst there were skills shortages in South Africa and massive brain drain from Zimbabwe, China, India and South Korea invested a lot in skills development as well as research and development.

TABLE 73: EVALUATION OF THE GLOBAL COMPETITIVENESS OF THE AUTOMOTIVE INDUSTRY IN ZIMBABWE

	Requirements	**Zimbabwe**	**South Africa**	**China**	**India**	**South Korea**
Enablers of successful Automotive economies	Sufficient global demand	√	√	√	√	√
	Available and affordable infrastructure for assembly and distribution	x	√	√	√	√
	Availability of skills and expertise	x	x	√	√	√
	Automobile production of global scale, exposed to local demand	x	√	√	√	√
	Coastal location of production, exposed to export markets	x	√	√	√	x
	Low input factor costs, vs competition, e.g. labour costs	x	x	√	√	x
	Capability to make high quality niche components	x	x	√	√	√
	Favourable policies	x	√	√	√	√
	Availability of credit	x	√	√	√	√

Policy wise, South Africa, China and India put in place policies that promoted the growth of their automotive sectors. For example South Africa's automotive sector grew drastically between 1924 and 2013 *(Alfaro et al., 2012)*. Whilst all the automotive components were imported in 1924, over 300 component manufacturers supplied the automotive assemblers in South Africa in 2013 *(Alfaro et al., 2012)*. Key South African interventions at policy level included the Domestic Content Program (DCP) (1961 – 1980), the Protected Export Promotion (PEP) (1981 – 1994), the Motor Industry Development Policy (MIDP) (1995 – 2012) and the recent Automobile Production and Development Program (APDP) (2013 -). The DCP transformed SA's automotive sector from an assembly operation to full scale manufacturing with the complete inward operation increasing the domestic content from 15% in 1961 to 66% in 1980.

The MIDP whilst reducing the domestic content, removed duty on imported components in exchange for equivalent exportation of finished CBUs. The export promotion resulted in drastic increase in exports. The current APDP program aimed at building competitive local manufacturing capacity was aimed at global competitiveness whilst simultaneously meeting WTO requirements on subsidies. Similarly, China and India's policies were protective of their domestic automotive industries through policies that ensured development and consumption of domestic content in production *(Sutton, 2004)*. As a result their automotive industries similarly grew drastically between 1991 and 2001. Since the nullification of the VIC Policy in Zimbabwe, no other policy intervention was made by Zimbabwe and hence the collapse of the sector.

Although the Zimbabwean automotive sector was not competitive according to the evaluation presented in *Table 73*, there were opportunities to enhance competitiveness. For example provision of efficient and affordable infrastructure, development of skills and expertise, low input factor costs, favourable policies and capacity to produce niche products are areas which can be improved. The big question would pertain to the reasons behind attraction of investors to invest in Zimbabwe's automotive sector as opposed to other countries. Mexico exports to USA, Thailand to Japan and Egypt to Europe, these links clearly being associated with the closeness to the end markets as well as trade relations between the countries. At microeconomic level the Zimbabwean local demand could be attractive to certain investors considering that 5 out of 8 automotive assemblers in India had production capacities ranging between 1000 and 19500 units per annum *(Sutton, 2004)*. This implies that a Zimbabwean demand of about 25000 units per annum can attract some individual investors.

4.5.9.3 INTEGRATION OF THE ZIMBABWEAN AUTOMOTIVE SECTOR TO THE ENGINEERING AND METALS INDUSTRY

It is has generally been shown that the sustainability of the automotive sector in the absence of a significant export market is difficult. However, the development of automotive sectors in South Africa, South Korea, India and China required phases of inward capacity development aided by domestic market protection *(Alfaro at al., 2012 and Sutton, 2004)*. Joint ventures with multinational companies were facilitated and policies requiring high local content in end products and high import tariffs on imported components were implemented until such a time when the industries had become globally competitive. In the same manner, it is important to assess the potential of the Zimbabwean domestic market and the supply chain to support the resuscitation of the automotive sector. 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 74 below)*.

TABLE 74: NUMBER OF REGISTERED VEHICLES PER YEAR (2003 TO 2010):

Type of Vehicle	Class (kgs net mass)	2003	2004	2005	2006	2007	2008	2009	2010	Total	Distbn
	Year of registration										
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%**

Source: Compendium of Statistics, 2012: ZimStat

The analysis presented in *Table 75* 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 was required per annum.

Table 75: Tonnage of Vehicles Registered in Zimbabwe (2003 – 2010)

Type of vehicle	Avg Wt (tpv)	# of veh. (2003 - 2010)	Total weight (t (2003 - 2010)	Wt Distb (%)	Avg Wt/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**

Source: SIRDC Analysis

The main export destination for both completed vehicles and components were 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 700000tons. Further assuming that Zimbabwe has a 50% market share in the region, then about 350000tons (29% of ZISCO capacity) of iron and steel products would be consumed in the Zimbabwean automotive industry when operating at full capacity. This creates a positive interlinkage with primary iron and steel and secondary production which can realise revenues close to USD240million per annum.

If automotive assembly plants were resuscitated through joint ventures with strategic partners especially from China and India, to produce approximately 25000 vehicle units per annum at say USD14000.00 per unit, then potential revenues of USD350million could be realised in the domestic market. The revenues could be further boosted up by tapping into the SADC and COMESA market which could raise the volumes by up to 6 fold (USD2.1billion). Niche Completely Knocked Down Kits (CKDs) could also be toll manufactured for automobile plants in China, South Africa and India. This is possible considering that the major ingredients for niche components were 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.

4.5.9.4 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 USD22billion 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 license for 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 strategic 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.

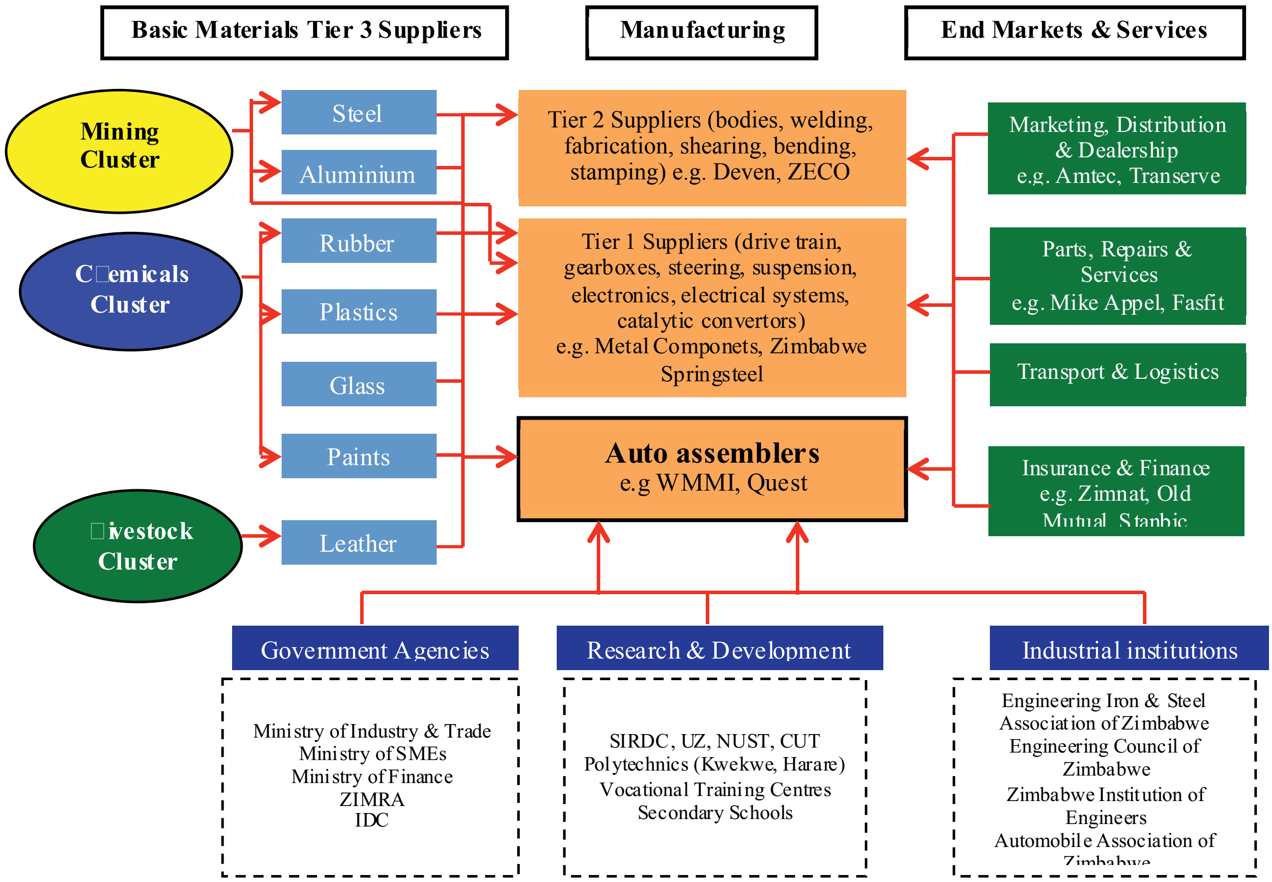
4.5.9.5 Value Chain Governance

According to key informant interviews, there was little flexibility in the joint venture agreement between local and foreign based partners resulting in the loss of the domestic market share in Zimbabwe. For example, low cost models, affordable to the ordinary Zimbabwean could not be made for the domestic market since its size was insignificant to the foreign based OEM. Establishing a local trading centre for sales and marketing of different low cost brands and used vehicles was also reported to be outside the interests of the foreign based OEMs resulting in the loss of market share to small scale dealers and individuals. Similarly, it is worth noting that about 75% of the Automotive Assemblers in China and India multinational joint ventures *(Sutton, 2004)*. In the South African case, about 57% of the automobile assemblers were owned by MNCs; 14% apiece were a joint venture with foreign based major shareholding; 50 – 50 shareholding between local and foreign ownership and SA major shareholding *(Alfaro et al., 2012)*. The dominant MNCs include General Motors Corporation, Honda, Toyota, VW and Ford amongst others. Similar to the Zimbabwean scenario before the economic crisis, most of the input and component suppliers to the automotive assemblers were local, providing significant employment opportunities to the country as well as contributing significantly to the Gross National Income.

4.5.9.6 Automotive Cluster Resuscitation

An updated industrial cluster approach is proposed to resuscitate the automotive value chain as presented in *Figure 98* below. The mining and chemical clusters are critical to this value chain. The iron and steel, and chrome and nickel value chains are necessary for the production of strong steel components for the sector. Stainless steel production was proposed in the steel industry. Catalytic convertor production was also proposed as part of PGMs beneficiation in the mining cluster.

FIGURE 98: ZIMBABWEAN AUTOMOTIVE CLUSTER STRUCTURE

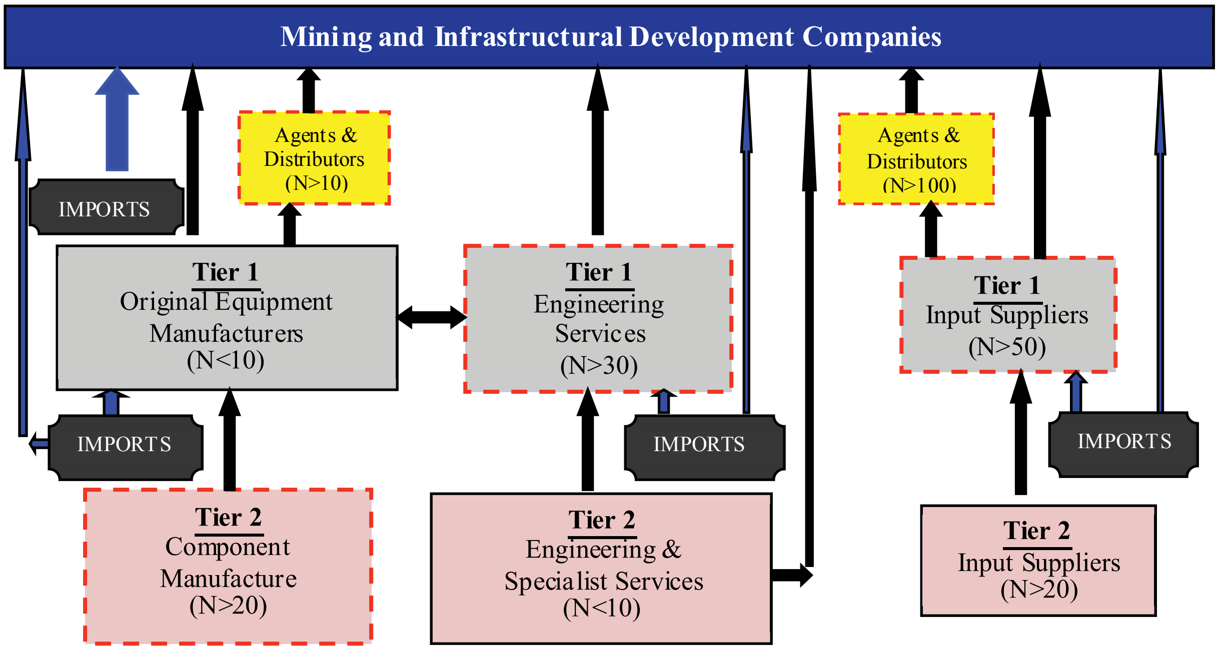


Further work is required for an in depth feasibility study for the establishment of the Automotive Cluster in Zimbabwe.

4.5.10 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 value chain map structure for the capital goods for the mining and infrastructural development is shown in *Figure 99* below.The red dotted boxes show areas where the local actors have potential to grow. Tier 1 consists of Original Equipment Manufacturers (OEMs), Engineering Services (Engineering Consultancy Firms) and Input Suppliers. Tier 2 includes component manufacturers, engineering and specialist services providers and input suppliers. Agents and distributors were mainly involved in linking the equipment and input suppliers to the end customers.

FIGURE 99: ENGINEERING GOODS FOR MINING AND INFRASTRUCTURAL DEVELOPMENT VALUE CHAIN STRUCTURE



4.5.10.1 Engineering Services

The engineering consultancy firms provide engineering, procurement, construction and management (EPCM) services for mining and infrastructural development. There were over 30 engineering consultancy firms (ECF) in Zimbabwe according to the Engineering Council of Zimbabwe (ECZ) documents *(see Annex 13)*. The major ones include ARUP, JVS Projects, Stewart Scott, Prostruct, Inter Africa, Galaxy, CGM Consulting, Vanguard Engineering Services, JVS Projects, Liquid and 23RD Century amongst others. Most of the registered companies were into civil, structural, mechanical and electrical consultancy, whilst few were into information technology (IT) and other consultancy. The work of ECFs was regulated by the Engineering Council of Zimbabwe (ECZ). The Engineering Council of Zimbabwe came into operation in 2009 through the Engineering Councils Act (Chapter 27:22). The purpose of the ECZ was to register engineers, engineering firms and technicians as well as issuance, cancellations or suspension of practising certificates, upholding of ethics and discipline in the profession, foster cooperation between constituent bodies in matters of common interest, promotion of the engineering profession on national, regional and international issues and human capital development amongst others. The Zimbabwe Association of Consulting Engineers (ZACE) was also established under Statutory Instrument 153 of 2012, which derives from the Engineering Councils Act to regulate the operations of engineering firms in Zimbabwe.

The ECFs provide expert advice on product requirements, specifications and availability as well a slump-sum turnkey (LSTK) functions. They often carry the full cost of the project up to commissioning and hand over takeover once operational. The Build – Operate – Transfer (BOT) Model was chosen by Zimbabwe at policy level in new capital projects in the subsector according to ZimAsset and the Industrial Development Policy (2012 – 2016). The firms were involved in the design and construction of facilities such as mines, buildings and road structures with the use of unique high tech components.

Due to the requirement of significant expertise in the design and integration of components, such technical integrators were often foreign project management companies. According to key informants brain drain was the major reason behind limited local expertise. Ironically, the foreign expertise, included Zimbabwean experience engineers and scientists mainly based in South Africa, having been lured by better working conditions during the economic crisis. Regionally and internationally, the local firms were not competitive, losing most of the tenders to South African engineering consultancy firms which traditionally have a long and close engagement with infrastructural and mining companies *(Walker, 2005)*. It was interesting to note that several small scale engineering consultancy firms also did exist due to the relatively high number of technical graduates in Zimbabwe. However, most of them were not formally registered and lacked the experience to handle big projects. Considering the high rate of unemployment for technical graduates, a policy that facilitates capacity building of the newly graduated and inexperienced engineers in this sector must be considered. Consortiums of local and foreign based engineering firms can enhance human capital development as well as technology transfer. Great opportunities were available for local players, especially in the low capital cost consulting activities like maintenance management systems design and implementation, software system application, system design and technical designs and drawings as well as project management.

According to SI 153 of 2012, the cost of engineering consultancy approximately ranged from 10 to 18% of the cost of works. Typical consulting costs included technical reports, designs to working drawings, contract administration and detailed drawings as well as engineering management services. The major cost contributors in project works included civil construction, steelwork, piping, and cabling, which was outsourced from both local and foreign firms.The key determinants of international competitiveness of the engineering consultancy subsector were noted as the financial muscle and the ability to facilitate project finance according to a study by *Walker, 2005*.

4.5.10.2 Original Equipment Manufacturers (OEM)

Large pieces of capital equipment were used during the development stages of infrastructure and mining in Zimbabwe. Such capital equipment include mills, crushers, fans, drilling rigs, furnaces, earth moving equipment and large material handling equipment amongst others. Most of the OEMs involved in this subsector were merely branch offices of foreign multinational firms with a long history of involvement in the mining and infrastructural development industry. The local market for large capital equipment was also very small for economic justification, resulting in the importation of much of the equipment required in the subsector. Traditional local players in OEMs supply chain include Komatsu, Arthur Garden Engineering, NRZ, Powerspeed, CAMs, Oliken Engineering and Metal Components amongst others. A significant number of small scale agents (both formal and informal) were also noted in the study. These SMEs facilitated the distribution of equipment mainly from South Africa, Asia (China, South Korea, Japan, etc), European Union and the United States of America.

The economic crisis and political instability in the country resulted in most of the OEMs closing down, relocating to other countries (typically South Africa and Zambia) or shifting their strategic inclination from “make” to “buy”. Thus most of the OEM actors have now become “agents” in reality. Nevertheless, opportunities for both large OEMs and SMEs were noted in the survey with the stabilising of the economy and the political environment. The MNCs can continue to play their role of supplying highly specialised equipment whilst home grown solutions can be provided for low technology area such as material handling infrastructure for the mining industry and manufacture of structural equipment under foreign licence. The local actors can also play a critical role in the integration of products from the OEMs into complete integrated systems.

The anticipated green and brown field developmental projects in the mining industry (iron and steel, PGMs, coal, natural gas, diamond), road construction and energy infrastructure (hydropower, solar and thermal power stations) offer opportunities for the participation of local players. It was however noted that participation of local expertise was currently limited and there was no policy facilitating such critical involvement towards technology transfer and local capacity development. The technology and capacity in most of the green and brown field projects seemed to remain with the foreign OEMs hence threatening sustainability of such projects. The core technology underpinning the high-techprojects were usually held by the foreign based parent company and hence the true value added to Zimbabwe in terms of expanding the local technological base was low. Therefore at policy level, the GoZ has to seriously consider the participation of local actors and technology transfer issues. The fact that many graduates in the technical disciplines are unemployed during the same time when many high value developmental projects are taking place exposes the weaknesses at policy making level. It was also noted that many undergraduate students from technical colleges like NUST, UZ, HIT, CUT, Harare Poly and Kwekwe

Polytechnic were failing to find places for attachment. Ironically, many greenfield and brownfield projects were taking place without the involvement of students, showing a key weakness in human capital developmental for sustainable development in the engineering and metals sector of Zimbabwe. As noted from the analysis of field data survey, the levels of collaboration between the national research and development institutions and industry were very low in the Assembly and Manufacture of Capital goods level. The relevance of local research and development was also noted to be poor by a significant number of despondence.

4.5.10.3 Input Suppliers, Agents and Distributors

The input suppliers sell consumables such as explosives, reagents, chemicals, fuel and fluxes directly to mining companies. The inputs are generally specialised and expensive and hence sold on long-term contracts with the mines. According to field data analysis detailed in the previous section, the majority of inputs were imported (63%), mainly from South Africa and Asia. There are great opportunities to increase the local market content in the inputs. The agents and distributors played a critical role in the marketing and distribution of both inputs and original equipment to mining and infrastructural development companies. Agents according to the field data analysis facilitated the distribution of inputs to the mining and infrastructural companies in 50% of the responses. These intermediary firms facilitate the supply of products such as pumps, bearings, mobile equipment and parts, castings, etc.

4.5.10.4 Engineering & Specialist Service Suppliers

The specialised engineering companies are sub-contracted by an EPCM or LSTK firm to carry out selected aspects of the design, management or installation of a project. Typical areas of expertise are electrical engineering, heat, ventilation and air-conditioning (HVAC), maintenance management systems, enterprise resource management and environmental management and services for statutory inspections as well as Plant Maintenance Contractors. Such actors actively involved in Zimbabwe include SIS, SKF, Pragma, JVS Projects, Quick Freeze and 23rd Century amongst others. It was worth noting that big specialist service providers in the soft issues of engineering were foreign companies who have established themselves for a long time, backed by expert skills and high technology.

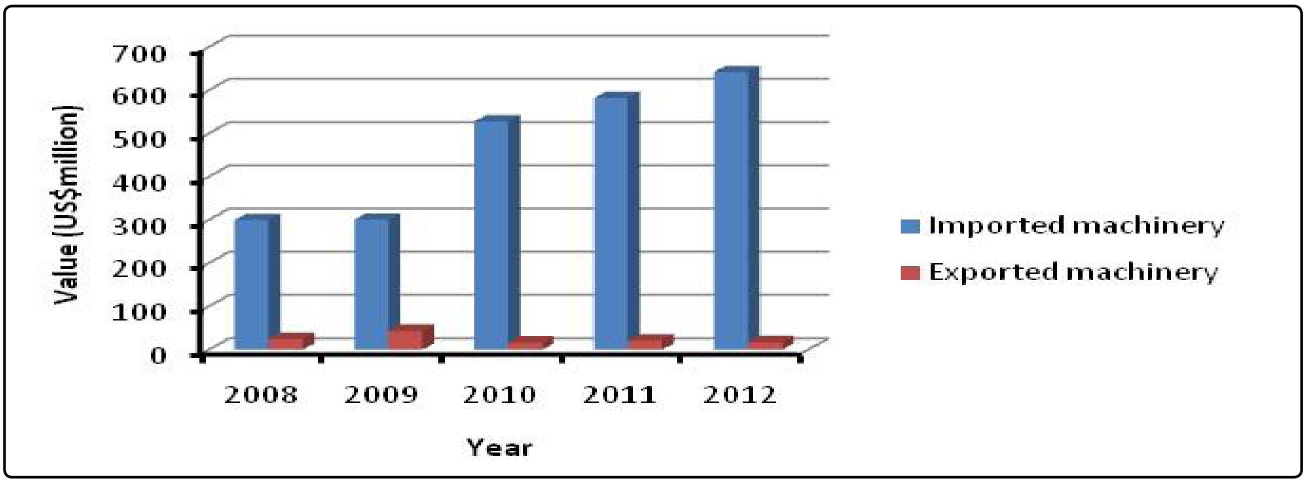
4.5.10.5 Component Manufacturers

The component manufacturers were covered in more detailed in the previous section on metal fabrication. Under the capital goods for mining and infrastructural development, component suppliers are classified into three categories namely standard components manufacturers (e.g. conveyor belt idlers, electric motors and electric cabling), niche components manufacturers (e.g. hoisting hooks, special ropes, etc.) and foundries and steel fabricators. Due to the high cost of component production in Zimbabwe, most of the component manufacturers in the first two categories have merely become agents or distributors for foreign companies. For example, one large actor in the production of electric motors has since stopped manufacturing, and relies on importing foreign brands for distribution in the country. The same has happened with the steel rope manufacturers as well as the foundries which used to manufacture pumps and other components for the mining industry. Foundries and steel fabricators play a crucial role in providing structural materials, unfinished components and wear parts to the subsector and hence the revival ZISCO (New ZimSteel) was expected to boost the domestic sector. The SMEs were also expected to participate significantly at this level.

4.5.10.6 Export Competitiveness of the subsector

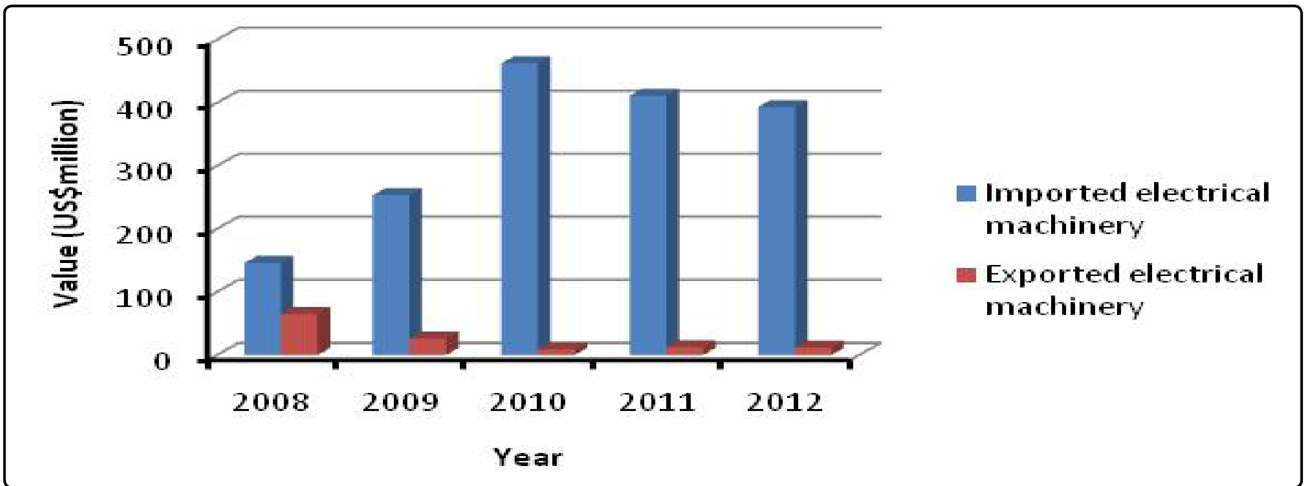
The comparison of exports to imports for mechanical and electrical machinery is presented in *Figures 100 and 101 below*. As presented, the imports were far greater than the exports by value indicating great trade deficits.

FIGURE 100: COMPARISON OF MACHINERY EXPORTS TO IMPORTS



Source: UNCOMTRADE Statistics

FIGURE 101: COMPARISON OF ELECTRICAL MACHINERY EXPORTS TO IMPORTS



Source: UNCOMTRADE Statistics

The state of the subsector portrayed that of a declining domestic production and increasing imports, leaving the subsector as a mere consumer of imported products. The challenges responsible for this scenario have been listed in the previous sections. The proposals to resuscitate the local manufacturing capacity were discussed in the following sections.

4.5.11 CAPITAL GOODS AND AGRICULTURE

The capital goods and agriculture 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 76 and 77 below* 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 76: NUMBER OF WORKING TRACTORS CLASSIFIED BY SIZE OF TRACTOR AND SECTOR, 2010

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**

Source: Compendium of statistics, 2012, ZimStat

Table 77: Number of Animal Drawn Equipment by Type of Equipment and Sector, 2010

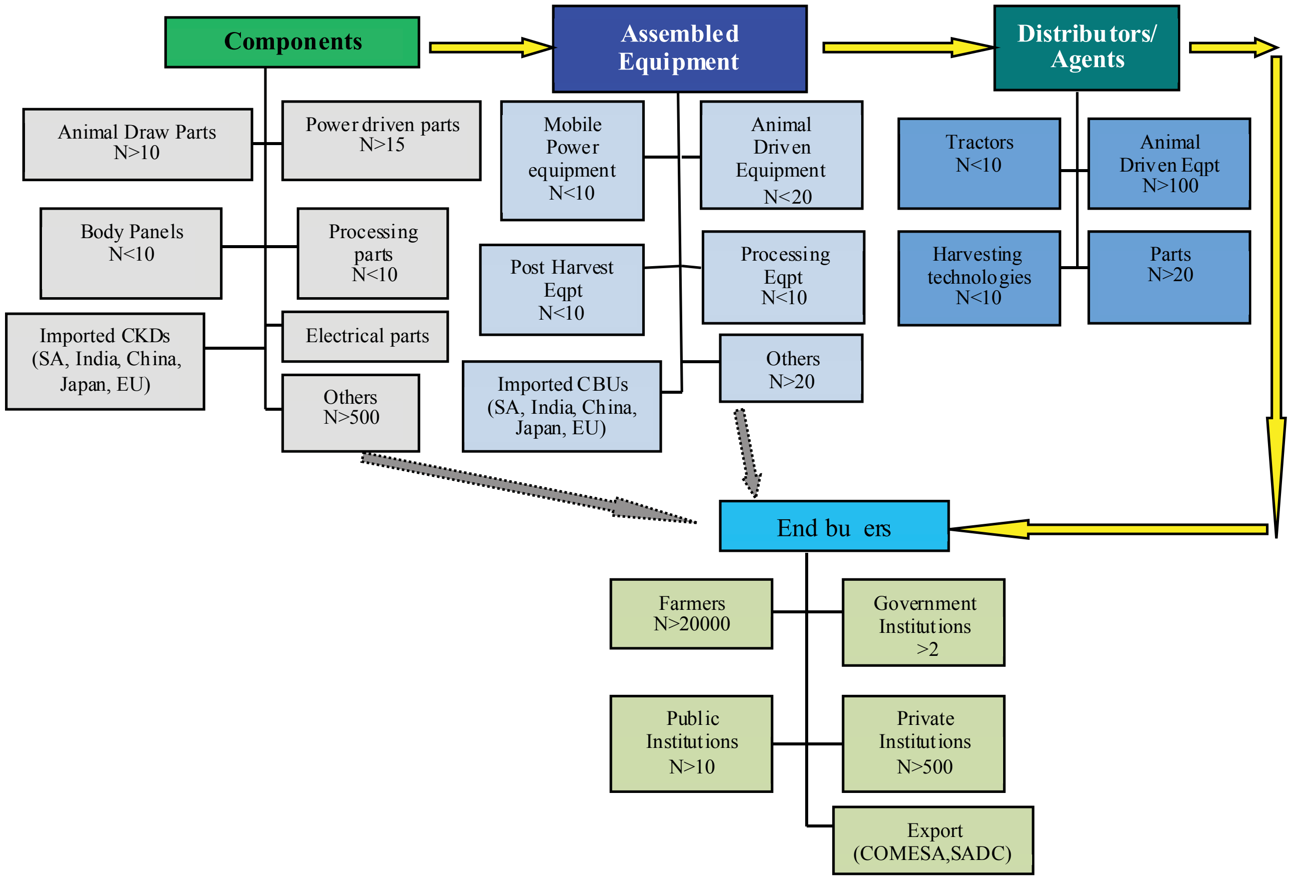
Type of Equipment	Communal	Old resettlements	A1	A2	SSCF	Total
Ploughs	815713	82952	12133	14140	12657	**937595**
Cultivators	168481	26633	30932	6951	7446	**240443**
Planters	6857	1709	2248	850	1509	**13173**
Harrows	131038	19288	25809	5566	6520	**188221**
Scotch carts	350654	44595	64129	7154	6733	**473265**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

Source: Compendium of statistics, 2012, ZimStat

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 USD10million. Assuming full capacity utilisation, the value could increase to about USD20million. The regional market according to Zimtrade *(Mafu, 2011)* has the potential to generate USD6million 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 76 – 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 102* illustrates the agricultural equipment value chain map in Zimbabwe. The list of actors in the agricultural equipment value chain is presented in *Annex 15*.

FIGURE 102: AGRICULTURAL EQUIPMENT VALUE CHAIN MAP



4.5.12 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 USD246million worthy of exports and USD4.1billion worthy of imports. The analysis showed that imports in this sector are more than 16 times the exports. There are a few machine assembling actors at this level, sourcing parts and components from engineering or machine shops and control systems from electrical and electronics firms.

FIGURE 103: LIGHT ENGINEERING GOODS VALUE CHAIN MAP

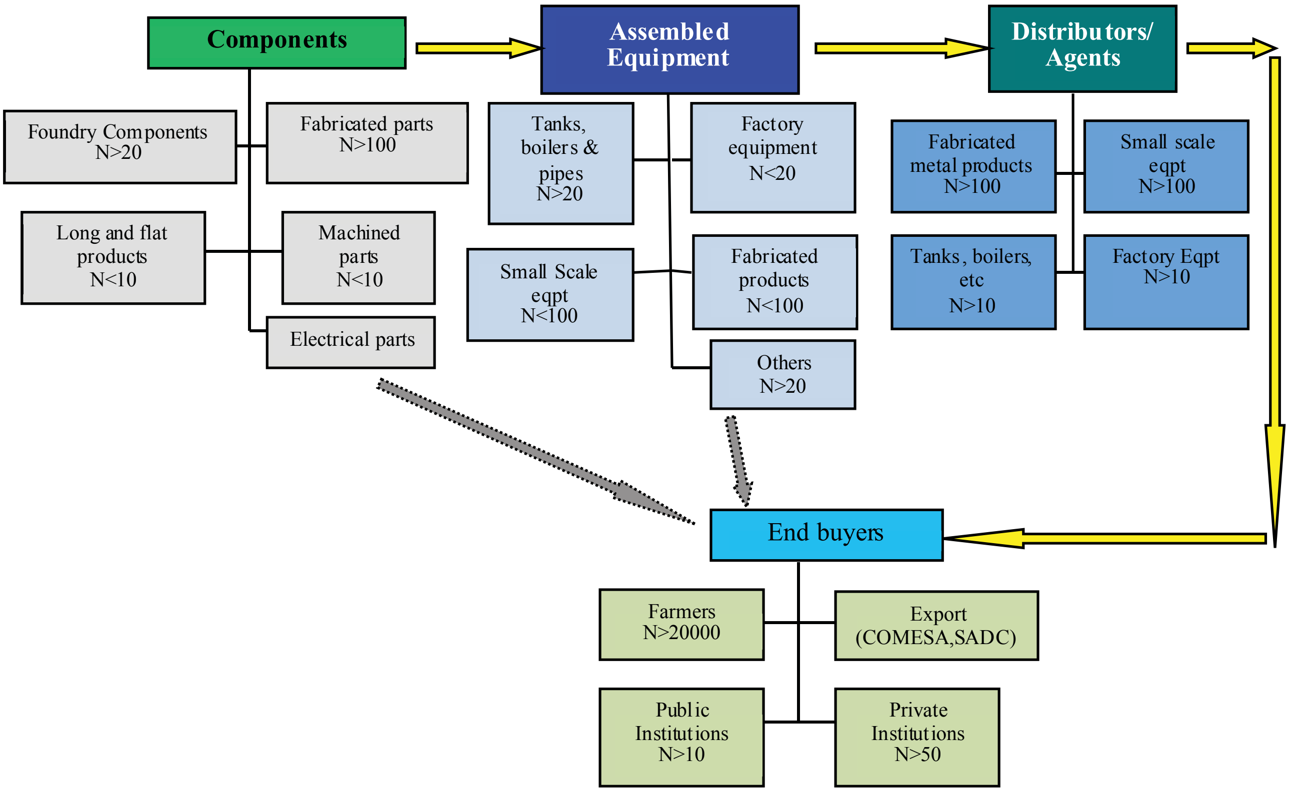


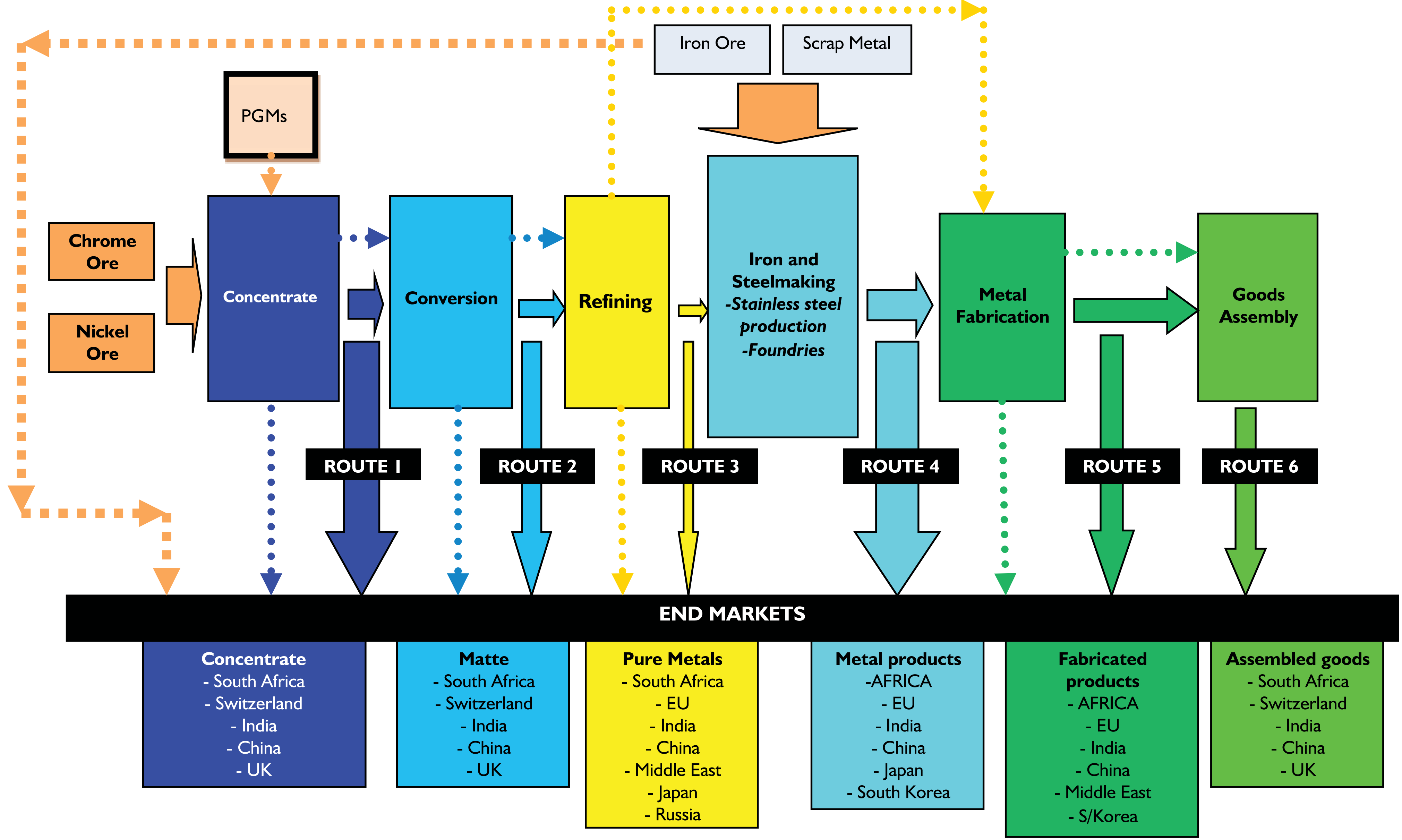
Figure 103 above illustrates the light engineering value chain map. The range of employment opportunities is significantly larger at this stage and firms in this stage of production include small, medium and large manufacturers. As a result, this subsector is very important as far as the Small to Medium 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)*. Thus Level5, 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.

4.6 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 for discussion is, "Can Zimbabwe's engineering and metals sector transform into a sustainable and competitive export driven sector which sufficiently produces for its domestic needs?" Different models are presented in *Figure104* on the next page in an attempt to answer this question against the results of the study.

FIGURE 104: 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 sector 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 104* 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 delivering 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 and diamonds. 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 revenues from 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 USD 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*can result in the increase of revenue from USD9.8billion to USD11.5billion (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 USD13.8billion. 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 cannot sustain the level of production presented, this model must be export driven. This Model also requires massive investment in both Brownfield and Greenfield projects. Investments in basic transport and energy infrastructure are prerequisites. *Table 82* below summarises the capital investment estimates to achieve the USD14billion target for the engineering and metals sector. About USD14.5billion was required to implement this model. Such models typically require the engagement of large financial institutions and big international players.

TABLE 82: PREREQUISITE INVESTMENT TO REACH THE 14BILLION TARGET FOR THE ENGINEERING AND METALS SECTOR

Investment type	Capital Cost Estimates (US$million)
PGMs Expansion and Refinery	3000
Iron and Steel	1000
Chrome	1000
Rail Road Infrastructure	4000
Power Generation Infrastructure	5500
Total Investment	**14500**

Source: Zimbuild, 2013; Muzilikazi, 2013and Key Informant Interviews

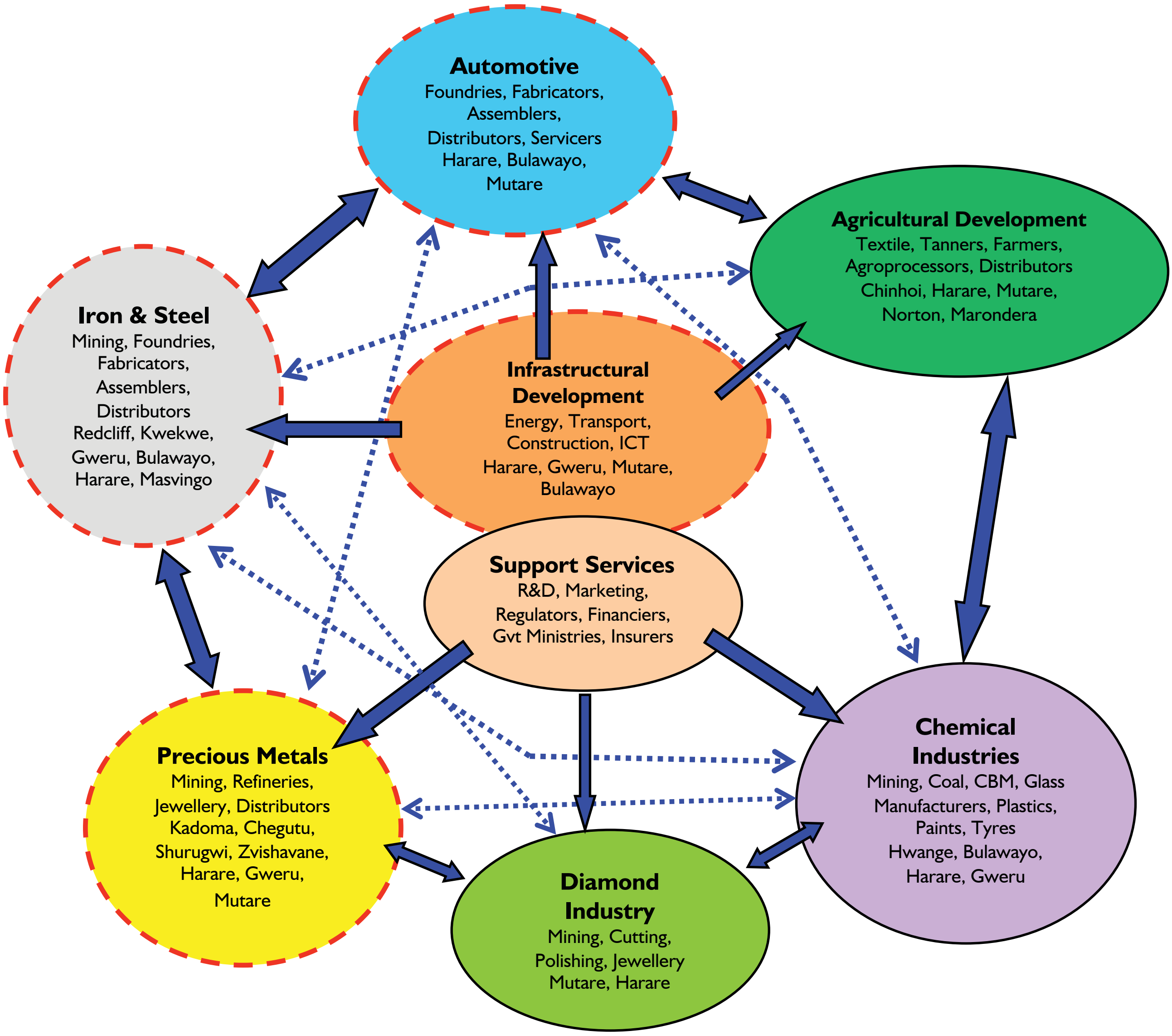
Considering the huge capital outlays involved, a phased approach to implementation is recommended, beginning with the low hanging fruits.

This model must also be supported by a strong marketing initiative, high levels of collaboration with end markets mainly based in the region, Asia and the European Union. Low cost and efficient production are prerequisites for global competitiveness. Investment in competitive technologies was also critical for global competitiveness. The engineering and metals sector can therefore leverage on the availability of the basic inputs in large quantities once the prerequisites were in place. Policy instruments that promote reverse engineering, technology transfer and innovation in the sector will contribute to the global competitiveness and sustainability of the engineering and metals sector in Zimbabwe.

4.6.4 THE INDUSTRIAL CLUSTER APPROACH TO ENGINEERING AND METALS SECTOR INTEGRATION

Based on value chain attractiveness, strategic clusters are proposed in the restructuring of the engineering and metals industries. These clusters further integrate into other sectors like the agricultural and chemical industries clusters. The proposed clusters are presented in *Figure 105* below and include the PGMs, Iron and Steel and Automotive Clusters, interlinked to the Diamond, Agricultural Development and Chemical Industries Cluster and supported by the Infrastructural Development Cluster.

FIGURE 105: INDUSTRIAL CLUSTER APPROACH TO THE REVIVAL OF THE ENGINEERING AND METALS SECTOR



There has been a global shift from the Vertically Integrated "Fordist" or "Chandlerian" firm to decentralised, clustered, networked, lean, flexibly specialized, and/or recombinatory producers since the 1980s *(Herrigel and Zeitlin, 2009)*. The shift was due to the emergence of seemingly permanent challenge of increased environmental volatility and uncertainty. Such environmental conditions were attributable to macroeconomic destabilisation, shortening product cycles, accelerating technological change, the differentiation of consumer taste, the intensification of competition and the globalisation of product markets amongst others. Flexible and specialized (disintegrated) producers, operating in the dynamic collaborative and market exchanges have proved to perform better than VICs in such environments *(Herrigel and Zeitlin, 2009)*. As a result the flexible cluster approach presented in *Figure 105* above was proposed to ensure viability.

4.6.5 FISCAL CONTRIBUTIONS

The potential that a sector has towards fiscal contribution determines its attractiveness to Government, developmental agents and policy makers. Due to limited financial information from industrial actors during field surveys, evaluation of this section was based on data from document surveys, key informants and global benchmarks. *Table 83*below shows the sources of income for the fiscus (Deloitte, 2013; KPMG, 2013 and Sackin, 2013).

TABLE 83: SOURCES OF INCOME FOR THE FISCUS

Corporate Tax (% N.P)	Withholding Tax (%Fees)	PAYE*(%)	Royalties (% M.V)	VAT (%G.R)
25.75%	15% on consultancy fees	Unskilled – 6%	Gold – 7%	15%
15% on Mining		Semiskilled – 12%	Pt – 10%	20% on Chrome
0% on BOOT & BOT For 1st 5 years		Tradespersons – 18%	Precious Metals – 4% Base Metals – 2% Indust. Metals – 2%	
20% for 50%exports		Middle Management – 26%		
		Executive management – 33.2%		
		Composition: EM -2%, MM – 8%, TP-15%, SS – 20%, US – 55%		
		Weighted Average – 11%		

Source: Deloitte International, 2013; Zimbabwe Commentary, 2013

*PAYE Computed through Weighted Averages based on known salary ranges and tax brackets
The global benchmarks on profit margins in the engineering and metals sector are presented in *Table 84* below.

TABLE 84: NET PROFIT MARGINS FOR THE ENGINEERING AND METALS INDUSTRY

Subsector %	Top 20 N.P.M Range %	Top 20 Average N.PM %	Overall sector average NPM (%)
Non ferrous metal products	2 – 72%	6%	1%
Iron and Steel	4 – 72%	7%	0.11%
Metal products	7 – 57%	10%	2.41%
Machinery & equipment	10 – 66%	11%	2.9%
Vehicles & parts	7 – 31%	9%	2.53%

Source: www.ediunet.jp

From the data provided in *Tables 82, 83 and 84*, the projected fiscal contributions were estimated and presented in *Table 85* below.

TABLE 85: MODEL 3: BENEFICIATION TO FINISHED CAPITAL GOODS

Metal products	Revenue	VAT	Net VAT	Tax Income	PAYE	Royalties	Total Fiscal Income
Iron and Steel	2286	342.90		0.38	50.29	45.72	96.39
PGMs	2227	334.05	(1101.95)	3.34	48.99	22.27	74.60
Chrome	1250	187.50		4.50	27.50	25.00	57.00
Nickel	450	67.50		1.62	9.90	9.00	20.52
Foundry products	1000	150.00		4.82	22.00	-	26.82
Pipes &tubes	960	144		4.62	21.12	-	25.74
Vehicles	4000	600		20.24	88.00	-	108.24
Machinery/equipment/etc	3000	450	(1237.50)	17.40	66.00	-	83.4
Metal components	800	120		3.48	17.60	-	21.08
Catalytic converter	200	30		1.02	4.40	-	5.42
Jewellery	290	43.5		1.40	6.38	-	7.78
PGMs	955	143.25		1.91	21.01	9.55	32.47
Chrome	2500	375		5.00	55.00	50.00	110
Copper	131	19.65		0.26	2.88	2.62	5.76
Engineering consultancy	435	-		9.79	1.08	-	10.87
Net VAT			135.55				135.55
Totals (Model 3)	**20484**	**3007.35**	**135.55**	**79.78**	**441.07**	**164.16**	**821.64**

N.B: VAT = 0.15*Revenue; PAYE = 0.11*0.2*Revenue (Labour estimated at 20% of Revenue); Tax Income = NPM*CT*R

As presented in *Table 85* above, the Engineering and Metals Sector of Zimbabwe has the potential to bring net fiscal income of at leastUSD800million per annum. Such fiscal income is significant in sustaining the civil service, community development projects and other aspects of sustainable development. Employment creation is also another fiscal benefit from the model, when implemented successfully.

4.6.6 SCIENCE, ENGINEERING AND TECHNOLOGY HUMAN CAPITAL DEVELOPMENT

Data extracted from the Compendium of Statistics, 2012 (ZimStat, 2012) on Science, Engineering and Technology skills capacity development is presented in *Table 86 below*. The analysis shows that the technical colleges and vocational training colleges have a production capacity of over 3800 technicians per year, whilst the Universities capacity is over 3000 scientist, technologists and engineers.

TABLE 86: HUMAN CAPITAL DEVELOPMENT FOR THE ENGINEERING AND METALS SECTOR

Enrolment and Output in Science and Engineering Skills Development								
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Average**
Technical colleges and VCTs								
Technical colleges	14361	13040	12855	11234	12220	16859	17432	**14000**
Vocational Training Colleges	988	915	728	765	1016	2295	1807	**1216**
Total Enrolment Skilled Personnel	**15349**	**13955**	**13583**	**11999**	**13236**	**19154**	**19239**	**15216**
Estimate output/yr	**3837**	**3489**	**3396**	**3000**	**3309**	**4789**	**4810**	**3804**
Universities								
Universityof Zimbabwe*	1446	1378	1407	1473	916	997	1437	**1293**
NUST	3594	3594	5651	5099	4057	7098	3087	**4597**
Bindura State University	1056	1654	2116	1923	2116	4394	4732	**2570**
Chinhoyi State University	2286	3287	2586	2381	4533	4533	5124	**3533**
Harare Institute of Technology	0	141	343	273	622	1245	1446	**581**
Total Enrolment - Scientist and Engineers	**8382**	**10054**	**12103**	**11149**	**12244**	**18267**	**15826**	**12575**
Estimate Output/yr	**2395**	**2873**	**3458**	**3185**	**3498**	**5219**	**4522**	**3593**
* Science & Engineering enrolment estimated at 12% of total university enrolment. 12% obtained from 2007 actual data								

Source: Compendium of Statistics, 2012 – ZimStat

Due to the prevailing economic conditions, the unemployment is high in the sector with many of the graduate technicians, scientists, technologists and engineers unemployed. Others have been absorbed by the growing sectors in the developed countries and regional countries with severe shortage of these skills. The government can facilitate policies to ensure that no unemployed graduate in the science, technology and engineering field can remain idle without adding value to the economy. Considering the different number of greenfield and brownfield projects (e.g. New ZimSteel, Solar, Biofuel, Hydropower projects, Coal Gasification, PGM Refinery, etc), the relevant graduates can be attached to understudy these projects for technology transfer as well as skills development. They can benefit from a 1% research and development allocation from the fiscus or levies and royalties from the energy regulators and mining sector respectively to cover their project expenses. Policies that facilitate these graduates' participants in consortiums and new companies that require low financial capital but high intellectual capital like engineering consultancy must be considered to ensure that the graduates have beneficial employment. The technical colleges, vocational training centres, universities and research and development institutes must also be optimally synchronised and aligned to the strategic needs and goals of the engineering and metals sector. Instead of direct competition, the institutions must complement each other towards meeting the goals of the sector. For example UZ, IMR and School of Mines can handle the Precious Metals and Automotive Cluster; whilst NUST, Kwekwe Poly handle the Iron and Steel Cluster; HIT, CUT and Mutare Poly handle the Infrastructure development cluster and so forth.

PART5: ECONOMIC POLICY IMPLICATIONS, RECOMMENDATIONS AND CONCLUSIONS

5.1 CONSTRAINTS, STRENGTHS AND OPPORTUNITIES

The diagnostic study culminated into the identification of sector specific and cross cutting issues which formed the basis for policy recommendations.

5.1.1 SECTOR SPECIFIC ISSUES

The issues pertinent to the four levels covered in this value chain study are summarised in *Table 87* below.

TABLE 87: SECTOR SPECIFIC ISSUES IN THE ENGINEERING AND METALS INDUSTRY OF ZIMBABWE

Sector	Strengths	Constraints	Opportunities
METAL PROCESSING (Level 2)	• Availability of raw materials locally • Good quality of inputs from local suppliers • High levels of compliance with relevant international and local certification authorities • High capacity utilisation (PGMs) • Export competitiveness	• High cost of power (chrome sector) • High domestic costs • Limited technology (chrome sector) • High tax rates • Labour regulations & health issues • Corruption and Political Instability • Dominance of few actors	• Increased production capacity • Increased export volumes • Improved capacity utilisation • Metals local beneficiation to value added refined and finished products • Increased participation of MSMEs • Improved and energy efficient smelting technologies
METAL FORMING (Level 3)	• Availability of high quality raw materials locally • Local Skills availability	• High transport cost • Power and wateroutages • Lack of raw materials • Antiquated machinery and breakdowns • Low local demand • Working capital constraints • Lack of access to cheap finance for recapitalisation • Products not competitive on the regional and international market • Corruption • Political instability • Tax administration and rates • Practices of competitors • Low rate of compliance to standards	• Resuscitation of iron and steel industry through technology upgrade • Improved and energy efficient technologies • Increased production capacity • Improved capacity utilisation • Improved product competitiveness on the regional and international market • Improved local and regional product demand • Greater participation of MSMEs • Compliance to local and international standards • Employment creation • Formalisation of the Scrap Metal industry

METAL FABRICATION (Level 4)	• Participation of MSMEs	• Working capital constraints • High costs of doing business • Limited local supplies of inputs • Power and water outages • Inferior technologies • Low demand of products on the export market • Insufficient production capacity to expand exports • High cost of transport • Low levels of compliance to international standards • Labour regulations and health issues • Tax rates and administration • Corruption • Political Instability	• Greater participation of MSMEs • Import substitution • Increased Production Capacity • Improved capacity utilisation. • Export market growth • Certification and compliance to international standards • Employment creation • Application of competitive technologies • Regional and international market linkages
CAPITAL GOODS (Level 5)		• High dependence on imported raw materials • High production costs • Inferior technologies • Lack of raw materials • Antiquated Machinery and Breakdowns • Power and Water Outages • Low product demand • Tax administration and rates • Competition from low costimports • Working capital constraints • Lack of financing mechanisms • Corruption • Practices of informal sector • Labour regulations and health issues	• Potential for Import Substitution • Improved Capacity utilisation • Increased production capacity • Employment creation • Export market expansionand growth • Product range expansion • Accreditation and compliance to international standards • Competitive technologies • Employment creation • Greater participation of MSMEs • Regional and international market linkages
OTHER	• Strong tertiary education system • Local Availability of Skills	• Low relevance of local research and development to industry needs • Low levels of collaboration between national, regional and international research and development and industry needs	• Cluster development and interlinkages with the agro, diamond and the chemicals industry • Infrastructure development • Human capital development • Technology transfer • Innovation

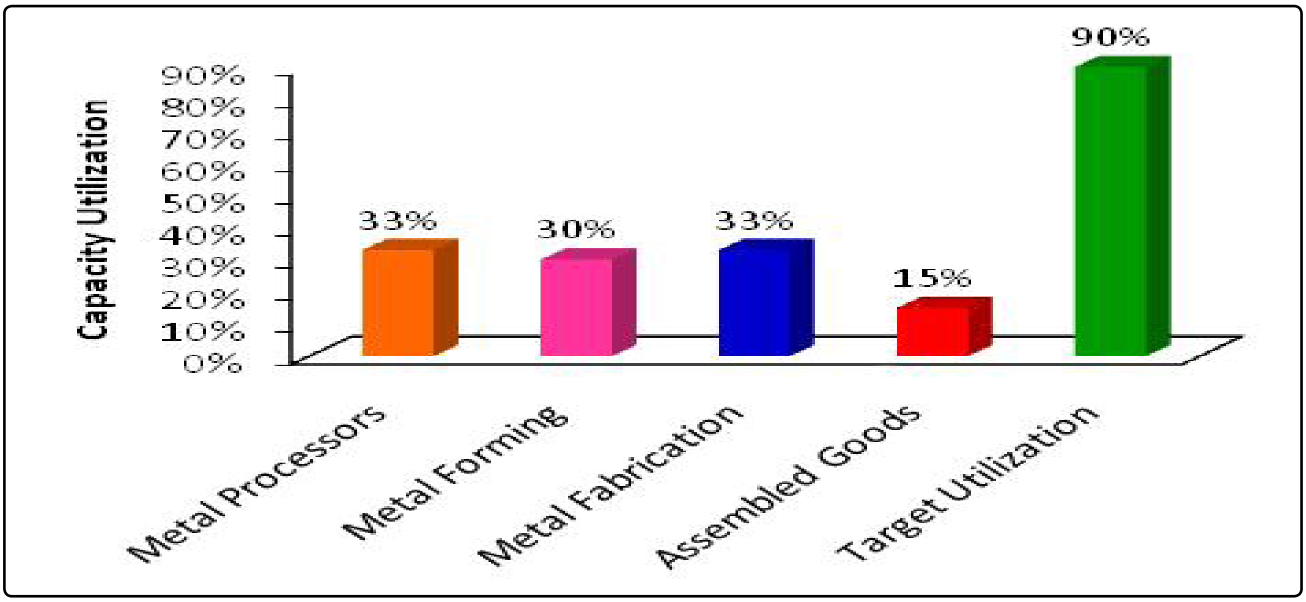
5.1.2 CROSS-CUTTING ISSUES

The study results showed that there were several issues that were common across the different subsectors in the engineering and metals industry. These issues included low and declining capacity utilisation; uncompetitive technologies on the regional and international market; insignificant export market share for products; lack of foreign demand for products; insufficient production capacities; high cost of transport; low levels of collaboration between industry and national research and development institutions; little relevance of local research and development to sector needs; lack of access to cheap finance; poor compliance to international standards; tax rates and administration obstacles; corruption and labour and health issues.

5.1.2.1 Low and declining capacity utilisation

Capacity utilisation was very low and generally showed a declining trend for the investigated period. *Figure 106* below shows the low sub-sectoral capacity utilisations which were way below the targeted values.

FIGURE 106: CAPACITY UTILISATION OF THE ZIMBABWEAN ENGINEERING AND METALS SECTOR FOR 2013



Source: SIRDC Analysis, 2013

The low capacity utilisation values across sectors are severe symptoms of distressed sector. However there were both good and bad outliers with the PGMs sector and ZIMASCO (Level 2) with over 70% utilisation, Automobile Assemblers (Level 4) with less than 5% whilst ZISCO (Levels 2 and 3) and Maranatha (Level 2) were non-operational. There were significant declines in capacity utilisation in two subsectors for the period 2011 to 2013 - metal processors (89 to 33%) and capital goods section (40 to 15%). Metal fabricators capacity utilisation remained steady at 33% whilst Metal formers utilisation increased from 15 to 30% for the period 2011 to 2013 according to the study results. The major reasons for the generally low and declining 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.

5.1.2.2 Human capital development

Whilst the study results showed that the tertiary education system was generally relevant and aligned to the sectoral needs, the relevance of local research and development was low. There also existed low levels of collaboration among national research and development institutions, academia and the sector.

5.1.2.3 End markets and trade

The major markets for the engineering and metals industry was local except for the metal processors whose end markets were regional and international (South Africa, Asia and Europe) as shown in *Table 88* below. The huge trade deficits from the study results showed low global competitiveness of Levels 3 to 5 subsectors.

TABLE 88: SUMMARY OF RESPONSE RATES (%) FOR END MARKETS FOR PRODUCTS FROM LEVELS 2 TO 5 FOR 2012.

End Markets	Metal Processors	Metal Forming	Metal Fabrication	Assembled Goods
Community	0	33	27	0
Domestic	0	67	65	100
Regional	33	0	8	0
International	67	0	0	0

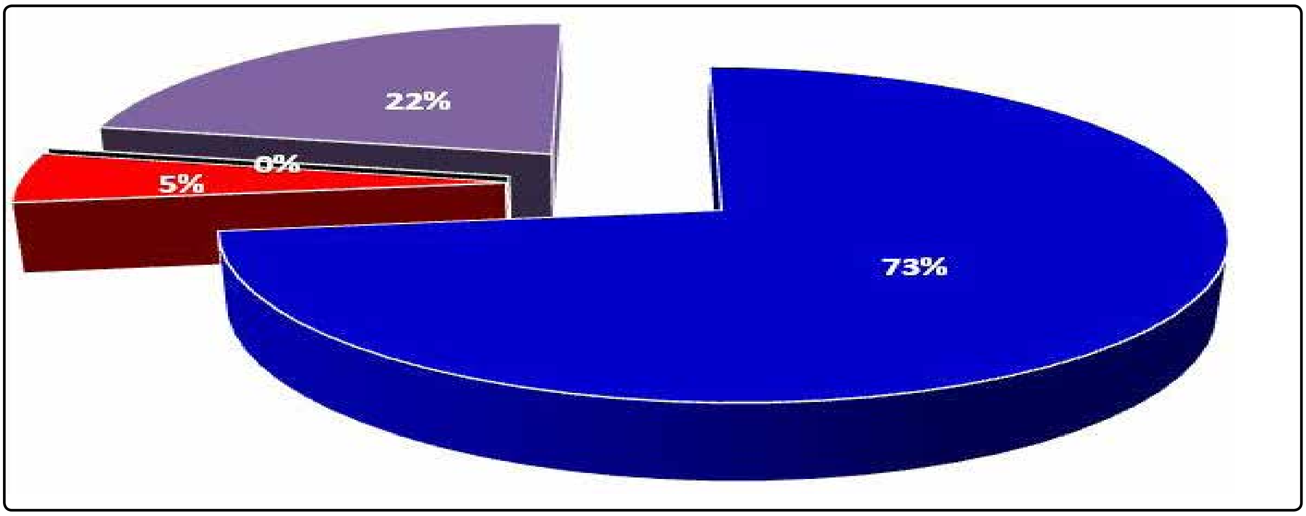
Source: SIRDC Analysis, 2013

The poor export competitiveness were attributed to uncompetitive technologies, non-compliance to international standards, high production costs, insufficient production capacities, lack of knowledge of foreign markets and an unfavourable business operating environment.

5.1.2.4 Value Chain Finance

The study results showed that the lack of access to viable financial facilities constrained the engineering and metals sector. As presented in *Figure 107* below, most entities used retained earnings (73%) and shareholder capital injections (22%) to finance operations with only 5% citing banks as the sources of finance.

FIGURE 107: SOURCES OF FINANCE FOR CAPITALISATION



The low uptake of credit facilities by the sectors could be attributable to the high lending interest rates by banks(averages of 12% for commercial banks and 18.8% for merchant banks for the period 2011 to 2012) (*ZEPARU, 2012)* as well as the lack of long term credit facilities. The results also show that little capital injection came from government. The lack of favourable financing mechanisms resulted in working capital constraints, capital scarcity for export stimulation and viability challenges due to high cost of finance.

5.1.2.5 Sustainable Production and Energy Use

As presented in *Figure 108* below, all subsectors heavily depended on electricity as the source energy for operations. The back up generators were commonly used across all sectors. Those not using generators were limited by either the capital requirements to purchase one or the susainability of using such in times of power outages.

FIGURE 108: SOURCES OF ENERGY FOR ENGINEERING AND METALS SECTOR

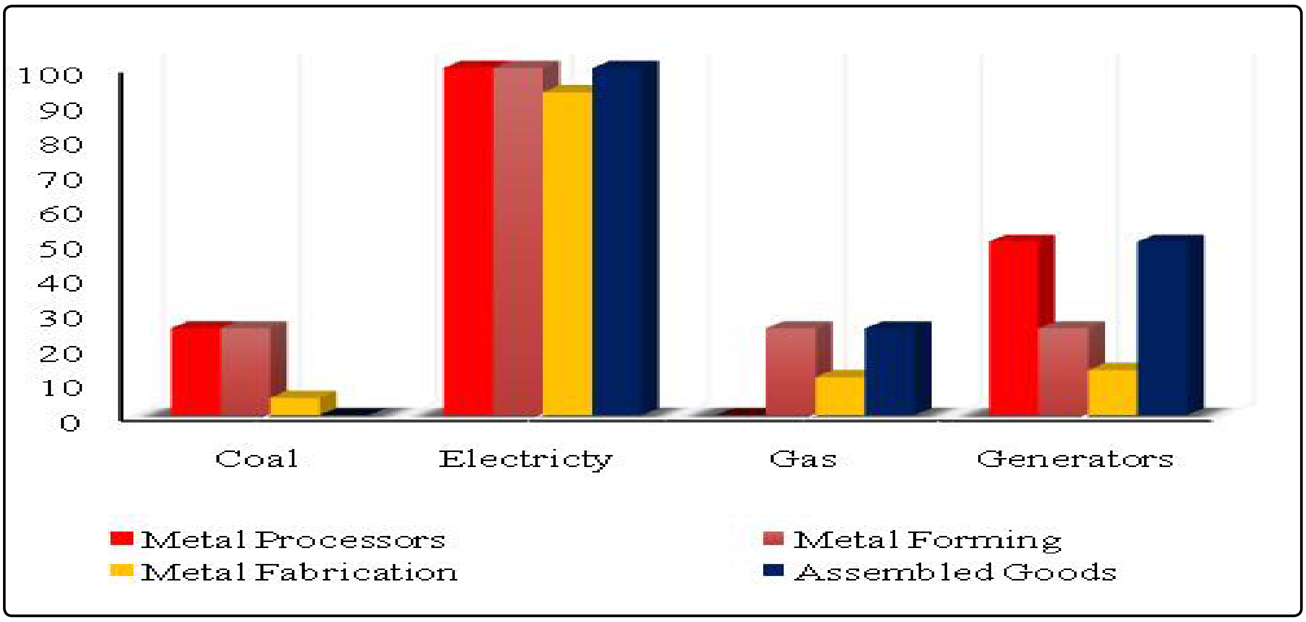
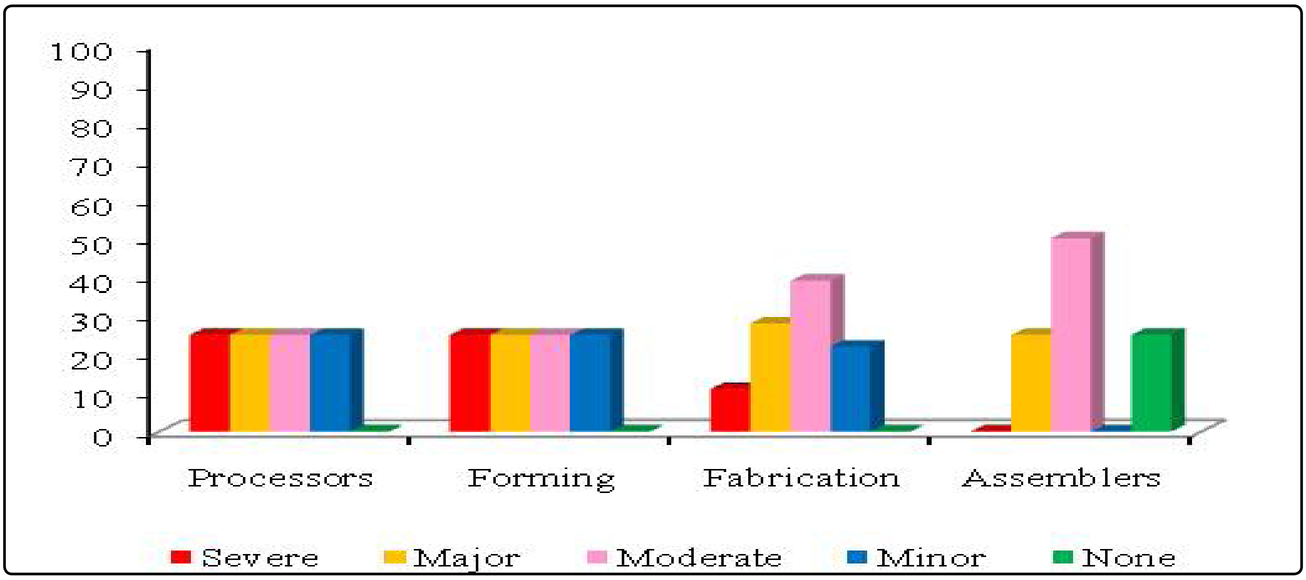


FIGURE 109: SEVERITY OF POWER CUTS (%RESPONSE RATE)



Source: SIRDC Analysis, 2013

Figure 109 above is a summary of the severity of power cuts showing that power outages significantly affected the performance of the engineering and metals subsectors. The cost of power was significantly higher than regional benchmarks (Zambia: USD0.03 – 0.04/kWh vs Zimbabwe: USD0.04 – 0.13/kWh). Water outages were also common and hence hindering competitiveness.

5.1.2.6 Business Operating Environment and the Socioeconomic Context

The common factors affecting actors in Levels 3 to 5 were policy uncertainty, tax rates, labour regulations and health issues, informal sector competitor practices and corruption. Such obstacles were found to limit competitiveness on both the local and export market and hence the current state of the sector, which is heavily dependent on imports.

5.2 POLICY IMPLICATIONS

The success of the engineering and metals sector of Zimbabwe is heavily dependent on government policies and their implementation strategy in collaboration with local, regional and international private, public and governmental players. The GoZ has come up with policies that support the engineering and metals sector. These policies are the Industrial Development Policy, National Trade Policy, Science, Technology and Innovation Policy, Minerals Development Policy, National Procurement Policy, Indigenisation and Economic Empowerment Policy and Local Authority Licensing and Regulation Policy. These policies are backed by the Zimbabwe Agenda for Sustainable Socio-Economic Transformation *(ZimAsset)* blueprint effective for the period 2013 to 2018. The economic blue print was crafted to achieve sustainable development and social equity anchored on indigenization, empowerment and employment creation which will be largely propelled by the judicious exploitation of the country's abundant human and natural resources built around four strategic clusters *(ZimAsset Document, 2013)*. The four identified clusters are Food Security and Nutrition; Social Services and Poverty Eradication; Infrastructure and Utilities; and Value Addition and Beneficiation.

5.2.1 ZIMASSET AND THE ENGINEERING AND METALS VALUE CHAIN

The engineering and metals sector crosscuts through the four clusters although the highest impact of the sector is in the Value Addition and Beneficiation and Infrastructure and Utilities clusters. Nevertheless, the engineering and metals sector contributes to the Food Security and Nutrition Clusters through supporting agricultural mechanisation and agro-processing equipment, whilst the Social Services and Amenities Cluster is supported through activities like construction, service and maintenance of public amenities including water and sanitation infrastructure; energy and power supply and Information and Communication Technology (ICT).

One of the key strategies in ZimAsset is to provide the necessary support in terms of the alignment, consistency and cohesion of policies that include the Industrial Development Policy, National Trade Policy, Science, Technology and Innovation Policy, Minerals Development Policy, National Procurement Policy, Indigenisation and Economic Empowerment Policy and Local Authority Licensing and Regulation Policy. The implementation of such strategies will eliminate policy inconsistencies which were retarding the performance of the engineering and metals sector.

The commitment by GoZ expressed in the blueprint to resuscitate distressed and closed companies in the manufacturing sector is well aligned to the revival of the engineering and metal sector current needs. The resuscitation of these companies is aimed at increasing capacity utilization to optimum levels, generating employment and substituting imports as well as building a sustainable basis for export led growth. The Industrial Development Corporation (IDC) was cited as one of the key investment vehicles to assist the ailing industries. The key engineering and metal industry selected for resuscitation is New ZimSteel (formally ZISCO) as well as the local industry under which most of Levels 3 to 5 actors fall. The selected players are therefore expected to bridge the broken link in the engineering and metals sector and hence turnaround the trade deficits into gains. Key infrastructure like power and water supply are targeted and hence expected to eliminate the power and water outages which contributed significantly to low capacity utilisation in the sector. The lack of favourable financing mechanisms was one of the key findings of the study. ZimAsset recognises this challenge and proposes tax and non-tax revenue, leveraging resources, Sovereign Wealth Fund, issuance of bonds, accelerated implementation of Public Private Partnerships, securitization of remittances, re-engagement with the international and multilateral finance institutions and other financing options, focusing on Brazil, Russia, India, China and South Africa (BRICS) as financing options. Strategic Trade and Financial Agreements with the BRICS could be preferable considering that these regions will most likely guarantee a market for the products.

5.2.1.1 Value Addition and Beneficiation Cluster

The Value Addition and Beneficiation Cluster specifies the increased supply of value added steel (700 000 tonnes of liquid steel per annum) as one of the key outcomes. The strategy involves the operationalisation of New ZimSteel, capacity building (entrepreneurial, technical and business management training) and financial support to SMEs in metal fabrication. This strategy positively supports the sector and is expected to improve capacity utilisation, result in net trade gain, create employment and increase fiscal revenues. The increase in revenue from gold was also mentioned. The threats noted are: high risk in the iron and steel sector due to over-reliance on one local supplier of inputs (New ZimSteel) and the overlooking of other precious and base metals besides gold. The blueprint takes note of the current inadequacies in relevance and collaboration amongst national research and development institutions and the sector through the human capacity building and development key result area which aligns research and development and training needs to the metals beneficiation by linking the sector to the academic and research and development institutions.

5.2.2 NATIONAL POLICIES AND THE ENGINEERING AND METALS VALUE CHAIN

The notable policies affecting the engineering and metals sector are: Industrial Development Policy (IDP); National Trade Policy (NTP); Science, Technology and Innovation Policy; Minerals Development Policy; National Procurement Policy and the Indigenisation and Economic Empowerment Policy (IEEP).Since the study results showed an increasing trade deficit profile for the engineering sector, the National Trade Policy was scrutinised. The NTP and IDP are also interlinked.

5.2.2.1 The National Trade Policy

According to the Zimbabwe National Trade Policy Document 2012 to 2016, the objectives of the policy were i) achieve annual export growth rates of 10% to reach a target of USD 7billion by 2016; ii) promotion of value addition of primary commodities to improve manufacturing sector contribution from export earnings from 16 to 50% and iii) consolidation and expansion of existing markets and to explore new markets in the region amongst others. The key drivers of this policy are Export led Industrialisation; Export Development and Promotion; Regional and Multilateral Trading Arrangements; Strategic Trade Policy Instruments and Institutional Capacity Development

The Export-led Industrialisation drive facilitates accessing the regional and international markets to benefit from the economies of scale which cannot be obtained because of low demand and the small size of the domestic market. Metal formers, fabricators and assemblers will benefit from such initiatives. The GoZ strategy of developing value addition linkages and clusters, backed by SMEs support programmes is expected to grow the exports, create employment and minimise the trade deficit and increase fiscal incomes.

The Export Development and Promotion Program seeks to consolidate and expand traditional export markets, explore and develop new markets; diversify and promote the country's exports through the Duty Drawback System which offers rebates on raw materials imported for local value addition as well as the retention of export earnings for exporters. Implementation of such programs will improve the competitiveness of Levels 3 to 5 actors. The policy also facilitates funding for companies in the export processing zone to improve production capacity. The national document mentions the Export Credit Reinsurance Fund and the willingness to join the African Trade Insurance Agency (ATI), a COMESA institution which provides export credit, political risk and investment insurances. Successful implementation of this policy will attract both foreign and local investors as well as financial institutions in capitalising the distressed engineering and metals sector.

The Regional and Multilateral Trading Arrangements comprise bilateral, regional, and multilateral trading arrangements that the country is signatory to, which include SADC, COMESA, the ACP-EU Partnership Agreements, and the World Trade Organisation. The sector can take advantage of the existing bilateral, regional and international trading arrangements which offer duty-free and quota-free market access in order to improve export performance. However, stiff competition from South Africa and low cost producers in the BRIC, Asia, Japan and Europe works against Zimbabwe. The country can therefore negotiate for a Special Safeguard Mechanism (SSM) and designation of Special Products (SPs) for developing countries since the RMTA can actually lead to the total collapse of the engineering sector. Already, there is a global excess of steel products as shown from the study results.

The Strategic Trade Policy Instruments include Tariff-Based Instruments, Non-Tariff Measures, Trade Defence Mechanisms and Trade Development Instruments and will be necessary to stimulate domestic production, promote value added exports and safeguard domestic industry and consumers against unfair trade practices. The National Trade Promotion vehicles aimed at trade facilitation include the Zimbabwe International Trade Fair (ZITF) and ZimTrade. The policy also aims at streamlining and simplifying exporting and importing procedures, eliminating customs delays and improving customs administration which resulted in the successful establishment of the Chirundu One-Stop-Border-Post. The engineering and metals sector is therefore expected to benefit from such policies. The Buy Zimbabwe Initiative contained in the policy document is aimed at promoting the use and consumption of locally manufactured goods and services. Subsectors such as the engineering consultancy firms and Levels 3 to 5 not requiring complex technologies and large capital investments are expected to benefit from the policy instrument.

Considering the influx of cheap low quality imports of engineering and metal products, the implementation of the Trade Defence Mechanisms (TDMs) like Anti-Dumping and Countervailing duties is necessary to correct the competitive imbalances created by unfair trade practices threatening the collapse of strategic sectors like the iron and steel, automobile and the capital goods sector. The proposed Zimbabwe Quality Standards Regulatory Authority is a necessary vehicle to protect the domestic industry as well as to improve the competitiveness of the local production sector. The Competition and Tariff Commission is hence expected to be effective and efficient in implementing these TDMs.

5.2.2.2 The Indigenisation and Economic Empowerment Policy (IEEP)

The study showed that there were misconceptions about IEEP. The law was also perceived as impediment in attracting foreign direct investment for the capital intensive mining and minerals processing and refining stages of the engineering and metals value chain. The GoZ through policy instruments can allow flexibility through special win-win BIPPAs and regional and international integration initiatives in-order to facilitate rapid export driven growth through capacity development.

5.3 POLICY RECOMMENDATIONS

Review of the Policy documents and the ZimAsset economic blue print has revealed that Zimbabwe has good policy documents supporting the engineering and metals sector. However these policy documents are not backed by clear implementation strategies and the required skills, tools and resources for execution. Therefore, most of the recommendations provided are rather endorsers of already existing policy instruments and vehicles. What is critically required in capacity development in effective and efficient implementation of the policy based strategies in collaboration with all stakeholders (local, regional and international).

5.3.1 SOURCES OF INPUT & INPUT SUPPLIES

a. Enhancing Local Content in procurement and other value added services

As shown by the results, local actors have the potential to provide competitive products. A policy to enhance the participation of local expertise in engineering consultancy in both brownfield and greenfield projects is proposed. The Scrap Metal Industry must be formalised and organised to ensure efficient and effective supply of the resource through the engineering and metals value chain. Similar local content vehicles can be negotiated in flexible IEEP negotiations. Targeted human capacity development to improve the competitiveness of the suppliers in meeting regional and international standards is also proposed.

5.3.2 TECHNOLOGY & INDUSTRY CAPACITY

a. Capacity Development based on International Best Practice

To achieve ZimAsset goals of export oriented manufacturing sector growth, capacity development must be targeted and aligned to the regional and international needs. A policy instrument is therefore proposed to ensure that any capitalisation initiative is focused towards low cost, energy efficient and sustainable technologies. Such policies are a must for the iron and steel, chrome and automobile value chains. The research and development, consultancy firms and the private sector must collaborate to ensure that proper technological due diligence is done before acquiring any technologies of a strategic nature. In a similar manner, the tertiary education system and local research and development institution programmes must be dynamically aligned to the strategic goals of the sector with clear and achievable roll out programmes. There must also be a policy that ensures technology transfer for any greenfield and brownfield projects to guarantee sustainability.

b. Promoting technological advancement and innovation

Through policy, innovation in the engineering and metals sector must be incentivised from primary education level, through to tertiary education as well as the research and development institutions and industry. The research and development as well as universities and colleges must complement each other through clusters rather than compete in an unproductive manner resulting in redundancies. Vast opportunities for innovation lie in the value addition and beneficiation cluster as well as energy and power development. In the iron and steel sector, innovation into competitive small scale primary steel production has the potential to guarantee self-sufficiency without the need for economies of scale.

5.3.3 END MARKETS AND TRADE

a. Champions to spearhead export growth

Champions must be selected to spearhead export growth through strategic linkages. These champions shall be backed by SMEs and favourable financing mechanisms to ensure viability. Targeted value chains include the iron and steel, automobile, mining capital goods and agricultural equipment capital goods and infrastructural capital goods.

b. Import and Export Tariffs
Non-tariff barriers to promote the resuscitation of the metal forming and automobile industries are recommended.

c. Regional and Multilateral Trade Agreements
The regional and international integration of specific value chains in win-win arrangements is proposed. For example BIPPA agreements with India and China can ensure availability of finance, huge markets for end or semi-finished products as well as economies of scale for the iron and steel, chrome as well as the automobile value chains. Joint Ventures involving COMESA, BRICS and SADC can result in strong and competitive global value chains.

d. Exploring Niche Products for the international market
Precious metals and the engineering sector provide potential for niche value added products like catalytic converters, stainless steel products and jewellery. Joint ventures with MNCs are proposed to ensure mutual benefit.

e. Marketing Organ for engineering products
In similar manner to the MMCZ, a marketing organ to spearhead the sales and marketing of metal products (particularly iron and steel products), metal components and capital goods is proposed. This proposed organ is expected to ensure dynamic export earnings growth.

5.3.4 VALUE CHAIN GOVERNANCE

a. Creating engineering and metals value chain linkages through clusters

Since the current value chains are dominated by MNCs, participation of local players must be enhanced through strategic clusters. The automobile, iron and steel and precious metal clusters proposed fit well into the ZimAsset Cluster initiatives. The Engineering Council of Zimbabwe and the Zimbabwe Institution of Engineers (ZIE) are also expected to play the active role in the implementation of reforms in the engineering and metals sector. Therefore the GoZ through policy must facilitate the effectiveness of such regulatory bodies in implementing ZimAsset.

5.3.5 VALUE CHAIN FINANCE

The first priority for financing must be given to the strategic national champions involved in the resuscitating the engineering and metals sector. Technical due diligences must be adequately done to minimise defaulting on loans and ensure sustainability of the value chains. In line with the Value Addition and Beneficiation Cluster of ZimAsset, financial preferential access can be awarded to precious metals beneficiation (PGM Refinery and Jewellery sector) as well as the iron and steel industry. Effective monitoring and evaluation systems must be in place to ensure that funds are efficiently managed and used productively.

5.3.6 SUSTAINABLE PRODUCTION AND ENERGY USE

A policy must be put in place to ensure that energy efficient, environmentally friendly and low energy consumption technologies are used in any new investments in the engineering and metals sector as one of the key competitive edges for competitiveness. Policies must also facilitate the implementation of international quality and environmental standards in MSMEs and local industry to enhance export competitiveness and viability. Incentives must also be availed to Maximum Demand Users who reduce their Maximum Demand through relevant management principles and new investments. Public Private Partnerships as outlined in the National Trade Policy document must be implemented in the development of infrastructure (energy, water and transport) aligned to the engineering and metals sector in exchange for preferable tax incentives and other non-tax incentives for participants.

5.3.7 BUSINESS AND SOCIAL POLITICAL CONTEXT

The major policy recommendations in this section are aimed at addressing the labour and health issues, tax rates and administration corruption and political instability amongst other issues highlighted in the study. The current salary gate scandals call for policies that ensure good corporate governance as well as a policy that ensures that there is a sectoral standard for the remuneration gap between the highest and lowest paid employee in a sector. The labour cost must also be aligned to productivity and sector performance to ensure sustainability, following the example of the South Korean Industrial Development. The streamlining and synchronisation of government and institutional regulatory activities affecting industry was proposed to eliminate corruption.

5.4 CONCLUSIONS

The study results showed that the Zimbabwean engineering and metals sector was generally not competitive globally. The sector had an overall trade deficit of about USD3.3billion for the period 2008 to 2012, translating into an average deficit of about USD660million per year. It was also revealed that the exports constituted 41% (USD 7billion) of trade against 59% (USD10billion imports) over the same period. The overall trade deficit was attributed to the engineering goods subsector which had a trade a huge trade deficit of about USD 8.1bn (1.6bn/yr) despite a trade gain of USD4.8billion (USD 960million/yr) for the metals and metal products sector. Whilst the metals and metal products contributed about 94% (USD 6.7billion) of the exported engineering and metals commodities, engineering goods constituted 82% (USD 8.6billion) of imports. The main exports were precious metals; base metals; ores and iron and steel; whilst the main imports were vehicles and components; machinery, boilers, equipment, parts, etc. and electrical and electronic machinery and parts. The trade figures therefore showed that the engineering sector has almost collapsed whilst the primary production is flourishing. The resuscitation of the engineering sector as well as an export led industrial growth to maximise value addition and beneficiation as well as turn around the trade deficit in-line with the national trade policy must be done urgently.

The analysis of Gross Output, Intermediate Consumption and Value Added for the period 2009 to 2011 revealed that the engineering and metals sector produced about USD 1.9billion to Gross Output (~USD 600million/yr) and a Value Added of about USD 1.1billion (~USD 367million/yr). The overall Value Added was about 58%, implying that the actors involved in value addition performed well. The metals and metal products contributed about 79% (~ USD 1.5billion or USD 500million/yr) and 82% (USD 900million or USD 300million/yr) of the engineering and metals sector Gross Output and Value Added respectively. The mining of non-ferrous metal ores and manufacture of structural steel products, tanks, etc., contributed over 95% of the metals and metal products Gross Output. General purpose machinery, vehicle body manufacturing and electrical machinery were the main contributors to engineering goods Gross Output. These results again showed the dominance of the primary metals and metal products over value added engineering goods in the Zimbabwean manufacturing sector. The high percentages of Value Added showed that the domestic manufacturing sector has great potential to spearhead the national economic recovery and growth. The study also revealed that the iron and steel, PGMs, chrome, automobile and the foundry sectors were strategic subsectors for sustainable economic growth of the Zimbabwean economy.

The diagnostic study showed that the engineering and metals sector was severely distressed with a very low average capacity utilisation of about 28%. For 2013, the capacity utilisations for Levels 2, 3, 4 and 5 were 33, 30, 33 and 15% respectively. However outliers did exist, with the PGMs performing well with capacity utilisation of over 80%. On the other hand, the automotive sector capacity utilisation was below 5%. The study also revealed that about 31% of the sampled actors at different levels of the value chain had ceased operations. The sector is therefore threatened with total collapse unless urgent interventions were implemented.

The non-operation of ZISCO was the major missing link in the chain, depriving the metals and metal products sector of over USD3billion in revenue per annum. The study also showed that the resuscitation of the iron and steel production alone had the potential to turn the trade deficit into gain. The operating environment was very tough for the players with the main problems 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 was also required on downstream actors to ensure compliance to environmental laws. Power and water shortages and a dysfunctional rail network also worsened the operating environment leaving the sector on the brink of collapse.

It was also concluded that growth of the sector was not possible without exports. The major challenge on the global export market was the excess capacity especially of engineering goods and iron and steel products. Penetration of such markets was impossible without strategic collaboration with the huge markets in Asia and Europe. Zimbabwe could bargain on the strength of abundant primary products and an educated workforce whilst the targeted end markets in the region, Asia, India, China and the EU leverage on their closeness to huge markets, advanced technologies and access to value chain finance. Policies that facilitate regional and global integration whilst promoting local participation in value added manufacturing were necessary to promote economic growth. The study revealed that Zimbabwe had good policy documents like ZimAsset, the Industrial Development and National Trade Policy to spearhead economic growth. Nevertheless, the implementing frameworks were not coherent and the implementing vehicles were not synchronised.

Great resuscitation opportunities existed for the engineering and metals sector backed by investments in metals refineries, increasing chrome smelting capacity, resuscitation of the iron and steel, the foundry and the automotive value chains. 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. The proposed new investments include stainless steel production, PGM refinery and catalytic converters and other niche production lines of fabricated metal products. The industrial cluster approach which blends well with the ZimAsset economic blue print was proposed as the backbone of the engineering and metals sector recovery. The identified clusters include the iron and steel, precious metals and the automobile cluster. These clusters would be interlinked to the chemical industry, diamond and agricultural clusters whilst supported by strong infrastructural and technology and innovation clusters.

The sector according to estimates from this diagnostic study has the potential to contribute over USD14billion dollars per annum in revenue to the economy; at least USD800million fiscal revenue; employment creation, trade gain benefits as well as significant contribution to the GDP of the country. An investment of USD 14.5billion was found to be adequate to achieve the USD14billion target.

Further work is recommended for in-depth feasibility studies for the Revival of the Automotive Cluster in Zimbabwe and the capital goods value chain upgrading. Further study on the electrical and electronic equipment value chain was also recommended considering its significant trade volumes over the past five years. Value Chain finance options for viable engineering and metals value chains are also recommended.

The engineering and metals sector could therefore become the backbone of the Zimbabwean economy if supported by export oriented policies and adequate financial mechanisms. 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 sectors, else the country could become an end market for all engineering and metal products from all over the world.

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