

# A comparative analysis of two costing systems in a steel manufacturing plant

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Mini-dissertation submitted in partial fulfilment of the requirements for the degree *Masters in Business Administration* at the Potchefstroom Business School of the North-West University

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Potchefstroom

2015

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## **ACKNOWLEDGEMENTS**

First and foremost I hereby wish to express my sincere gratitude and appreciation to my supervisor, Professor Anet Smit, for her guidance, support and patience throughout the completion of this mini-dissertation. Thank you to Antoinette Bisschoff for her language and grammar editing of this document. I want to extend my special thanks to my colleagues at ArcelorMittal South Africa for your support and assistance throughout my MBA studies.

To Veronique, thank you for your patience, love and encouragement. Last but not least, I want to express my heartfelt gratitude to my parents for all your support, inspiration and love that you have given to me, not only during this study, but always.

## ABSTRACT

Today's challenging economy has businesses focusing more than ever on increasing their competitive advantage. Companies are under increasing pressure to optimise and advance their operations in order to improve their overall profitability.

As steel organisations worldwide strive to increase their market share in a highly competitive and saturated market, pressure is placed on steel manufactures to produce their steel products at highly competitive prices without compromising on quality and to deliver the products on time to their customer. With increased steel imports and a suppressed market the need for companies to have better cost control and better understanding of which activities drive the cost of manufacturing their products is required.

The aim of this study was to determine if a platform for a more refined management tool in the form of an activity-based costing system could be used to provide a better understanding of the costs incurred by ArcelorMittal's Plate Mill plant in Vanderbijlpark.

The primary objective of this study was to compare two costing systems in a steel manufacturing plant based on a case-study approach. Initially the need for a more refined system within the context of the current economic and manufacturing environment is put into perspective. To address the above objective the study followed a retrospective analysis of the current traditional costing methodology as compared to an activity-driven costing method.

The empirical study was executed through the implementation of an activity-based costing model and by comparing the results to that of the current costing system. The results indicate that there is a difference between the product costs as determined by the two different costing methodologies. It was found that three of the four selected steel products were understated. However the financial impact of costing done on the activity-based costing method was limited due to the relatively low overheads incurred by this plant. Thus the more accurate allocation of the overhead costs to the various products resulted in limited product cost correction.

**Key terms:** Comparison of costing systems, product costing, steel industry, activity-based costing, traditional costing, management accounting, cost structure.

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## ABBREVIATIONS

ABC	Activity-based costing
ABM	Activity-based Management
AMSA	Arcelor Mittal South Africa
GAAP	Generally Accepted Accounting Principles
DL	Direct labour
DM	Direct materials
F&P	Flange and Profile
IDL	Indirect labour
IDM	Indirect materials
Q&T	Quench and Temper
PM	Plate Mill
PMP	Profitability Management Process
PTP	Plate Treatment Plant

# CHAPTER 1

## NATURE AND SCOPE OF THE STUDY

### 1.1 Introduction

South Africa's primary steel industry is a significant contributor to the economy. It provides direct employment for approximately 190 000 people and contributes 1.5% to the country's GDP. It is a strategic industry that underpins several other key South African industries.

Since the recession in 2008 South African economic growth has been slow and below the African average (Taborda, 2015; Index Mundi, 2014). Over the past two years the international and local steel industry has also changed dramatically. Numerous local steel companies have folded and tariffs for imposing quotas on imported steel have been requested from the South African Department of Trade and Industry in recent months (Aboobaker, 2015; Evans, 2015; Van Rensburg, 2015).

The World Steel Association (2013) state that uncertainties emanating from unresolved economic issues in the Euro zone countries, the unsatisfactory and partial solution to the reduction of the fiscal deficit in the US and the lower international prices of some key export commodities have had an extreme effect on the South African economy and on the demand for steel.

Furthermore, according to the World Steel Association (2013) South African steel production remained stagnant in 2014, as opposed to a fall by 7.6% year on year in May 2013. The year prior, South African production fell by 5.7% to only 7.12-million tons. This was the lowest level since 1980. This contrasted with a 1.2% rise in global steel production for the same year of 2013 after an 8.1% jump in 2011. The poor economic performance and bleak economic outlook for the South African steel industry has spurred the steel producing industries to take major steps to become more efficient and competitive (Media Club South Africa, 2015). Many local

steelworks, including ArcelorMittal South Africa, have engaged in restructuring and productivity improvements.

As steel organisations worldwide strive to increase their market share in a highly competitive and saturated market, pressure is placed on steel manufacturers to produce their steel products at highly competitive prices without compromising on quality and to deliver the products on time to their customers. Thus to sustain a competitive advantage over their rivals, steel manufacturers must focus on these three key areas.

A highly competitive environment calls for accurate product costing in order to provide value to customers and to make correct strategic decisions with regard to product pricing and product production. ArcelorMittal South Africa is the oldest steel producer in the country and has become inundated to remain profitable in recent years.

ArcelorMittal South Africa (AMSA) was founded in 1928 as a statutory parastatal organisation. The objectives of establishing the company were to produce iron and a range of steel products and to create employment opportunities. Since then the company has established itself as the largest steel producer in Africa (ArcelorMittal South Africa, 2015).

AMSA's steel operations comprise of four major facilities. These facilities produce both flat and long steel products. The flat steel operations are at Vanderbijlpark and Saldanha, while the operations in Newcastle and Vereeniging supply the market with long steel products. Market coke for the ferro-alloy industry is produced at AMSA's Coke and Chemical business based in Pretoria (ArcelorMittal South Africa, 2015).

The steel works facility in Vanderbijlpark is one of the largest inland steel mills and the leading supplier of flat steel products in South Africa. The Vanderbijlpark Works has two blast furnaces and three basic oxygen furnaces. The central focus of this steel works is to maintain and grow its established share of the local market through development of additional value added products and to focus on industry partnerships. Its international position is being refined by focusing on identified high

profit export markets and meeting international levels of operational excellence, product quality and customer satisfaction (ArcelorMittal South Africa, 2015).

The plant's steel products are manufactured in an integrated process. Raw materials such as iron ore, coke and dolomite are charged to blast furnaces where they are converted to liquid iron. The liquid iron is refined in basic oxygen furnaces to produce liquid steel. The liquid steel is cast into slabs, which are hot rolled into heavy plate in a plate mill, or into coils in a strip mill. The coils are either sold as hot rolled sheets in coil or processed further into cold rolled and coated products, such as hot dip galvanised, electro-galvanised and pre-painted sheet and tinsplate (ArcelorMittal South Africa, 2015).

The plate mill at the Vanderbijlpark Works was commissioned in 1943 mainly for the production of heavy plate (ArcelorMittal South Africa, 2015). This is a hot rolling mill where semi-finished casting products supplied from steelmaking are converted into finished products through the rolling metal process. The product line at the plate mill plant consists of four plate groups namely:

- Flange and Profile;
- As-Rolled;
- Normalised; and
- Quench and Temper.

The mission of this plant is to maintain and capture local market share and become the preferred supplier to Sub-Saharan Africa (ArcelorMittal South Africa, 2015). The competitive advantage of this plant is built up of the following points:

- Price;
- Quality; and
- On-time delivery.

Ginzburg (2009:59) states that profitable plate-making is one of the unique challenges of the steel industry as the markets served by plate mills are remarkably diverse and demanding. However, plate mills have the most reliable long-term

customer demand profile in all of steel processing thus making existing plate mills fertile ground for investment.

Today's challenging economy has businesses focusing more than ever on increasing their competitive advantage (Ginzburg, 2009:59). Companies are under increasing pressure to optimise and advance their operations in order to improve their overall profitability. Companies must react quickly and manufacture high quality, low cost products to be successful in this new environment. Therefore management should focus on improving business processes and producing products that are cost-effective (Blocher et al., 2010:133).

For companies to have better cost control and better understanding of which activities drive the cost of manufacturing of their products, systems are needed that precisely determine a product's cost (Blocher et al., 2010:133). Costing systems help companies to determine the cost of a product related to the revenue it generates (Johnson, 2015). A product's cost of sale must not be overstated in order to accurately determine its profitability (Wang et al., 2010). Mowen et al. (2014:4) state that the main objective of internal managerial accounting systems is to provide information to managers so they can make sound decisions. Internal managerial accounting systems are utilised by manufacturing plants to help in costing and managing the manufacturing process. To make proper decisions, senior managers must have accurate up-to-date costing information.

Traditional costing and activity-based costing are the two common costing systems used in business (Johnson, 2015). ArcelorMittal Vanderbijlpark makes use of the traditional costing system. According to Mowen et al. (2014:252) functional based costing approaches may produce distorted or inaccurate costs. Product cost distortions form a key challenge for many firms whose business environment is characterised by intense competitive pressures and small profit margins. Firms operating in such environments need accurate cost information in order to make effective decisions. Managers need accurate product cost information in order to achieve manufacturing excellence (Turney, 1989:1).

Traditional costing systems have lost their relevance in the contemporary manufacturing industry. These costing systems are based on volume based

allocation of overhead costs. The current manufacturing environment has changed. Overhead costs have increased and direct costs have reduced. Thus costing based on this system has become inaccurate (Johnson, 2015).

An activity-based costing system recognises the relationship between costs, activities and products, and through this relationship assigns indirect costs to products less arbitrarily than traditional methods leading to accurate cost information for the purpose of designing products that will increase customer value, improve operations and develop a more effective manufacturing strategy (Turney, 1989:1). Activity-based costing systems provide information for achieving excellence in manufacturing. A wealth of information on operating activities that can be used by managers to eliminate waste can be determined via the process of designing and rolling-out an activity-based costing system. Hence, the activity-based costing method has found its niche in the manufacturing sector (Gamal et al., 2012).

AMSA currently follows a basic costing methodology in the form of a traditional costing framework. This study is going to address the need for a more accurate and refined management tool to better understand the cost drivers of the steel plate products. A known shortcoming of the traditional costing system is that it fails to accurately assign costs and negates some of the cost drivers that may contribute to the cost of an item.

As AMSA is still utilizing the traditional costing system for the Plate Mill Plant there is a poor understanding of the true costs associated with the manufacturing of the products. An analysis of the cost structure of this plant will encapsulate the design and implementation of a costing system based on activity-based principles. The theory pertaining to the various costing methodologies as well as the application of the activity-based costing model was researched and applied in this study.

This study strived to provide a platform for a more refined management tool in the form of an activity-based costing system that can be used to provide a better understanding of the cost structure of a selected steel mill by calculating the costs of its produced products more accurately utilizing an activity-driven framework.

## 1.2 Problem statement

With a poor economic performance and a bleak economic outlook for the South African steel industry, many local steelworks, including ArcelorMittal South Africa, have engaged in restructuring and productivity improvements. During a recent interview with the General Manager of ArcelorMittal South Africa a major need was identified to formulate and implement a strategy that will improve the profitability of the plate mill by reducing its operating costs. It was suggested that a thorough analysis of the Plate Mill's cost structure and product costing should be conducted in order to identify areas where costs can be better understood and reduced.

A costing system helps companies determine the cost of a product related to the revenue it generates. The present costing system utilised for ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark is based on traditional costing principles. A shortcoming of the traditional costing system is that it fails to accurately assign costs and excludes certain non-manufacturing costs. The negation of some cost drivers that contribute to the cost of an item can lead to bad management decisions.

In the past the activity-based costing system has been found to be a more accurate and reliable costing system than the traditional costing system. This costing system provides greater costing accuracy and eliminates the allocation of irrelevant costs to a product. Thus in order to address the primary objective of this study the cost structure was analysed by implementing activity-based costing principles.

This costing system provides greater costing accuracy and eliminates the allocation of irrelevant costs to a product. Through the implementation and subsequent result analysis of an activity-based costing system for the Plate Mill Plant internal management at AMSA will be provided with a more accurate view of its product cost.

Therefore the focus of this case-based study was to analyse the cost structure of ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark by applying activity-based costing principles. The steel plates produced at this facility are divided into four product groups namely flange and profile, as-rolled, normalised and quench and

temper. To set the boundaries for this study one product from each product group was selected.

It is conjectured that by accurately identifying the cost drivers of these products and by understanding the overhead costs more informed decisions could be made by management with regard to the manufacturing of certain products. Steps could be taken to reduce costs by eliminating waste and measures could be taken to increase customer value through more competitive product pricing.

The results of the activity-based costing system will be compared to that of the present costing system as utilized by AMSA. Based on the results of the activity-based costing analysis recommendations about product costing and the potential overhead cost reduction points within the plant were made.

### **1.3 Objectives of the study**

The research objectives of the study are split into primary and secondary objectives.

#### **1.3.1 Primary objective**

The primary objective of this study was to compare two costing systems for ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark in the context of the cost structure.

#### **1.3.2 Secondary objectives**

In order to achieve this primary objective, the following secondary objectives were formulated:

- Perform a literature review on costing systems in order to determine the suitability of a traditional costing system versus an activity-based costing system for an industrial plant.
- Analyse the current costing system of ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark by employing activity-based costing principles.
- Implement an activity-based costing system for ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark.

- Compare the results of the activity-based costing system to that of the present costing system as utilized by AMSA.
- Based on the results of the activity-based costing analysis made recommendations about the potential overhead cost reduction points within the plant.

#### **1.4 Scope of the study**

This study was conducted at the Vanderbijlpark Works of ArcelorMittal South Africa. The focus of this case-based study was to analyse the cost structure of ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark by comparing two different costing methodologies. The steel plates produced at this facility are divided into four product groups namely flange and profile, as-rolled, normalised and quench and temper. To set the boundaries for this study one product from each product group was selected for the purpose of this research and an analysis was conducted by applying activity-based costing principles.

The design and the implementation of an activity-based costing system formed part of the analysis. The results of the activity-based costing model were compared to that of the present costing model as utilised by AMSA. Based on the results of the activity-based costing analysis recommendations were made.

#### **1.5 Research methodology**

To achieve the stated objectives of this research, the research was in the form of a case study. This study incorporates both a literature review and an empirical study.

##### **1.5.1 Research method**

Silverman and Marvasti (2008:161) state that the general objective of a case study is to develop a full understanding of the situation. Such a study must have clearly defined boundaries, the unit of analysis must be clear and a research problem must be established in order to maintain focus.

The above analytical features have been identified for this study and narrowed down to the analysis of the cost structure of four plate products as produced by ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark. The research problem focuses

on the lack of sufficient management accounting information required to make strategic decisions with regard to product costing and profitability analyses. The implementation of an activity-based costing system to provide a framework for the cost analysis of the selected products forms the foundation of this case study.

Welman et al. (2011:135) state that all measuring and data-collecting procedures must be based on systematic collection procedures to make a study replicable. This study is based on systematic observation and quantitative measurement of financial data.

### **1.5.2 Literature review**

In order to conduct the empirical study a literature review was performed to gather theoretical information pertaining to costing systems in order to determine the suitability of a traditional costing system versus an activity-based costing system for an industrial plant. Theory relating to the nature, design, benefits and implementation of activity-based costing systems was also researched and formed the foundation of the case study. The elements that were required to be built into the model and the steps required for the analysis as well as the steps to implement an activity-based costing system were also identified through the literature review.

The literature was acquired by consulting different sources such as academic journals, textbooks and the internet. Library resources were used as well as databases such as JSTOR, Emerald and EbscoHost. Key words included cost structure, costing methods, activity based costing, process costing, cost analysis and activity-based management amongst others.

### **1.5.3 Empirical research**

The empirical research was based on a case-study approach. A study was carried out to analyse and compare the costing of ArcelorMittal's Steel Plate Mill Plant products in Vanderbijlpark. The analysis was carried out by setting up two costing models. In order to capture and determine the costs of each product group on the present costing method as utilised by ArcelorMittal South Africa and compare the results to a scenario where costs get allocated based on an activity based costing method the two methodologies were brought into perspective by means of a case

study. The empirical study was executed through the implementation of an activity-based costing model. This study followed a retrospective analysis of the two costing principles. Historical financial data from the plant's profitability management process was analysed to determine the plant's cost behaviour by identifying all costs incurred by the plant. A pre-post analysis determined the value of utilizing an activity-based costing system as opposed to the traditional costing method. Results from the study were analysed and recommendations were made.

## **1.6 Limitations and ethical considerations**

In order to protect the competitive advantage of AMSA's Plate Mill Plant the financial data and information pertaining to this study has to be classified.

## **1.7 Layout of the study**

To indicate the flow of research and to provide a structure for the study, the following chapter layout was chosen:

### **CHAPTER 1: NATURE AND SCOPE OF THE STUDY**

This chapter sets the background for this study. The introduction, problem statement, field of research, research objectives and the method of research are set.

### **CHAPTER 2: THEORY ON COSTING SYSTEMS**

A theoretical framework of costing systems was provided in this chapter. A comparison between traditional costing and activity-based costing was made. Theory relating to the nature, design, benefits and implementation of activity-based costing systems versus a traditional costing system was also researched and formed the foundation of the empirical study in the penultimate chapter.

### **CHAPTER 3: OVERVIEW OF THE STEEL INDUSTRY**

Literature pertaining to the selected industry, its operations and its context within the world and local economy was presented in this chapter.

### **CHAPTER 4: EMPIRICAL STUDY**

The primary purpose of this study was to compare two costing systems for a steel plant in order to achieve a better understanding of the real product costs and to identify potential overhead reduction points. A scenario was analysed where two costing methodologies were brought into perspective by means of a case study. The empirical research documented in this chapter focused on the implementation of an activity-based costing model to facilitate the analysis. The results from the activity-based costing model were compared to the present traditional-based costing model.

## CHAPTER 5: FINDINGS AND RECOMMENDATIONS

Results from the study were analysed and recommendations were made regarding product costing and pricing as well as potential overhead reduction points. Conclusions were made with regard to the cost structure of the steel plate mill.

### **1.8 Chapter summary**

Chapter one was an outline of the study and included an introduction, field of study, background to the study, the problem statement, research objects, scope of study and the research methods used.

Chapter two explores the literature on costing systems for manufacturing enterprises. A theoretical framework of costing systems was provided in this chapter. An investigation into traditional costing systems as well as into activity-based costing was also conducted. Theory relating to the nature, design, benefits and implementation of activity-based costing systems versus a traditional costing system was also researched.

## CHAPTER 2

# THEORETICAL FUNDAMENTALS OF ACTIVITY-BASED COSTING AND TRADITIONAL COSTING

### 2.1 Introduction

The objective of this chapter was to provide a background to the theoretical research pertaining to activity-based costing (ABC) and traditional costing. A theoretical framework of the two costing systems is provided in this chapter. First the need for cost systems is reviewed. This is followed by a comparison between the traditional costing and the activity-based costing methods. Theory relating to the nature, design, key components, benefits and implementation of activity-based costing systems versus a traditional costing system was also researched and formed the foundation of the case study. In addition basic cost terms and fundamental concepts relating to management accounting literature were defined in this section.

### 2.2 Costing systems

Managers need cost information for decisionmaking, planning and for preparing budgets (Seal et al., 2009:22). Organisations incur costs during its operation. In order for management to make informed decisions, costs of products, services, and customers must be determined and understood (Mowen et al., 2014:26).

Costs are classified as either direct costs or indirect costs. Costing systems provide for the allocation of incurred costs to a manufactured product or to an executed service (Mowen et al., 2014:26).

The type of organisation determines how these costs are classified (Seal et al., 2009:22). There are different kinds of systems that capture the information of costs taking into account how this information is to be analysed to produce useful costing information for the end user.

Typical costing systems as discussed by Drury (2011:294) include:

- Job Costing;
- Process Costing;
- Marginal Costing;
- Absorption Costing; and
- Activity-based Costing.

## **2.3 Activity-based costing**

### **2.3.1 Introduction**

Rates based on volume-based measures such as direct labour hours, machine hours or other measures have been used historically to assign overhead costs to products. This approach to costing is still widely used by many organisations today. However these rates are based on an averaging approach and may distort costs. Thereby a product could be overstated by being priced too high or understated by being priced too low. Product cost distortions may lead to detrimental effects on a business (Mowen et al., 2014:250).

Furthermore, Mowen et al. (2014:250) indicate that businesses with intense competitive pressures, small profit margins, continuous improvement, total quality management, total customer satisfaction and sophisticated technology environments are the most susceptible to poor decisions as accurate cost information is needed to make informed business decisions.

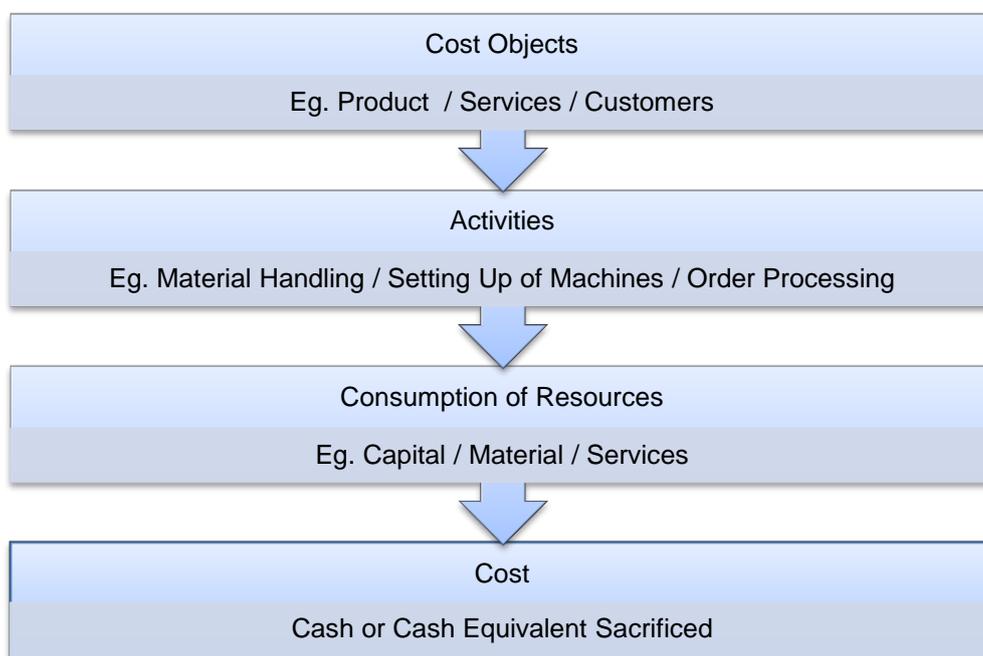
### **2.3.2 Activity-based costing concept and components**

Activity-based costing is an accounting costing method that was developed to provide more accurate product cost information than the traditional cost system (Blocher et al., 2010:127).

Hall and McPeak (2011:11) concur that the major difference between activity-based costing and traditional costing lies in the philosophy of how cost objects are assigned the consumption of costs. In an activity-based costing system the cost objects consume activities whereas in traditional cost accounting, cost objects consume resources.

Activity-based costing is a costing approach that assigns costs to cost objects (Garrison et al., 2012:285). Cost objects such as products or customers require activities to be completed. These activities that include tasks such as receiving of raw materials, setting up machines, machine production time and processing of orders amongst others consume resources. When these resources are consumed a company incurs a cost which is either cash or cash equivalent. Figure 2.1: General Structure of an ABC Model below depicts the technique of measuring costs of activities and cost objects in an ABC system.

Figure 2.1: General Structure of an ABC Model



Source: Garrison et al., 2012:279

Blocher et al. (2010:129) state that an activity-based costing model encapsulates several important components and terms specifically:

- Cost Object: An item associated with a cost figure;
- Activity: A task that consumes resources;
- Activity Measure / Cost Driver: An allocation base in ABC;
- Activity Pool: Total costs for a single activity measure;
- Resource: An economic element required to perform an activity; and
- Cost: Cash or cash equivalent sacrificed for an asset.

The condition of the activity-based costing system is in the approach that a company's products or services are derived from activities which use resources. Costs are assigned to the activities that are based on the amount of used or consumed resources. These costs as assigned to the activities are then used to determine the cost of the cost object (Garrison et al., 2012:279).

Therefore to develop a costing system using ABC principles Blocher et al. (2010:129) state that the relationship between resources, activities and products must be understood. It should be clear which resources are spent on activities that bring about a specific product or service.

Direct materials and direct labour may be traced to individual products and services thereby many of the resources used in the operation may be easily traced. Blocher et al. (2010:129) point out that many overhead costs relate only indirectly to the final product or service bringing about the need for a costing system that can identify costs with activities that consume resources.

Garrison et al. (2012:275) mention that a major difference between the traditional cost systems and activity-based systems lies in the allocation of overhead costs. The allocation base of traditional cost systems is driven by the volume of production, whereas an activity-based cost system is defined by five levels of activity, namely: unit-level, batch-level, product-level, customer-level and organisation-sustaining. These activity levels are not related to the volume of produced units as in an ABC system factory overhead costs are assigned to cost objects. (Garrison et al., 2012:275).

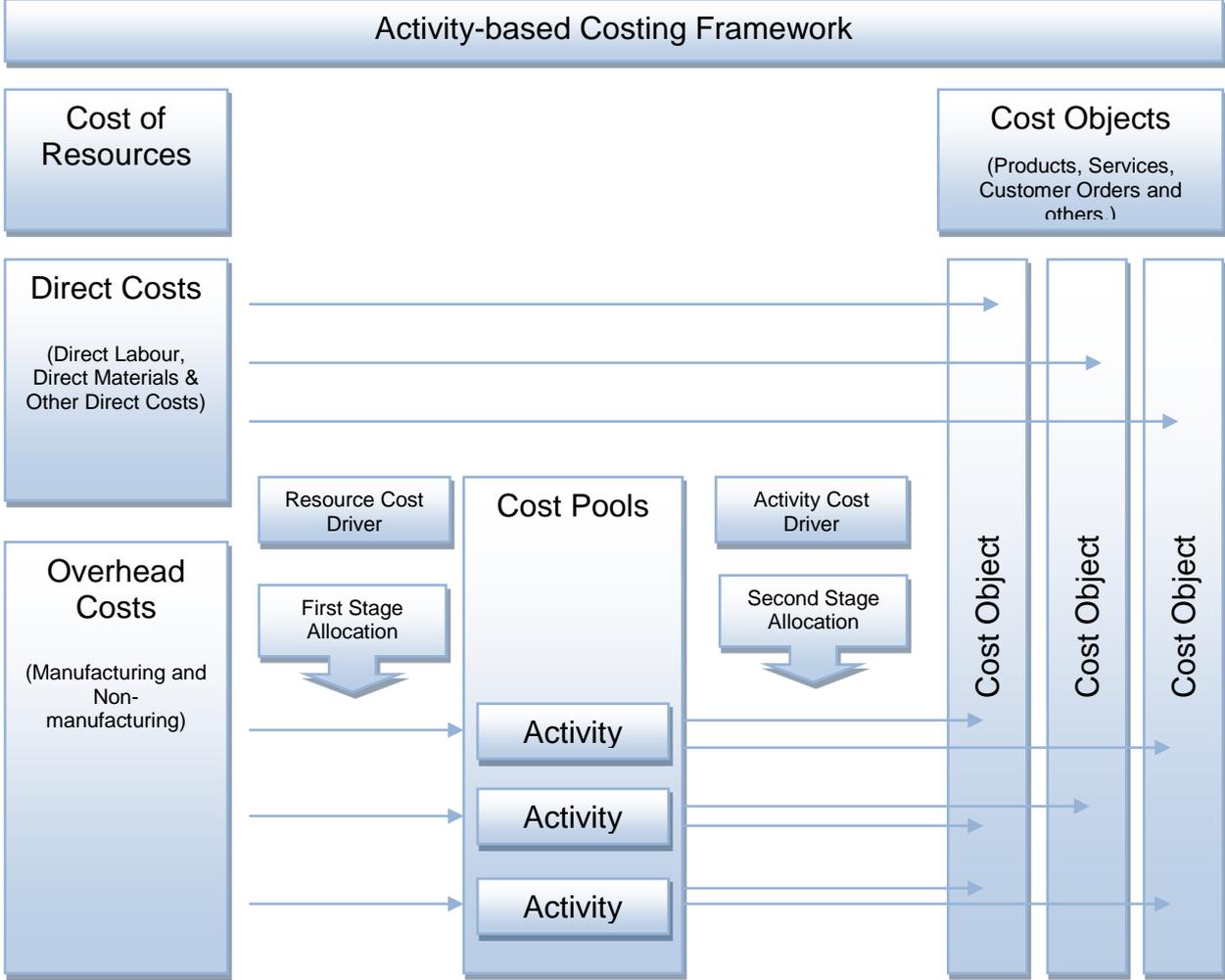
The ABC approach has great appeal in today's contemporary business environment as a result of the fact that the system provides a better understanding of costs associated with managing product diversity (IAM, 2006:1).

### **2.3.3 Framework of an activity-based cost system**

The relationship between resources cost, cost drivers, activities and cost objects in assigning costs to activities and then to cost objects is presented within an ABC framework (Garrison et al., 2012:279).

A conceptual framework that forms a generic blueprint for an activity-costing system is depicted in Figure 2.2: Activity-based costing framework.

Figure 2.2: Activity-based costing framework



Source: Adapted from Garrison et al., 2012:285

The model adopted from Garrison et al. (2012:285) depicts the direct relationship between the cost of resources, activities and cost objects. Products referred to as cost objects are the result of activities. These activities consume resources. Costs are incurred when resources are used. A clear understanding of product costs may lead to better decisionmaking, improved profitability measures and process improvement (Blocher et al., 2010:133).

### **2.3.4 Benefits of activity-based costing**

Since its initial conception by Kaplan and Burns, in the late 1980s, activity-based costing was viewed as a strategic weapon in the quest for competitive position as first described by Turney (1989:13). Turney promoted activity-based costing as a tool for manufacturing excellence. He argued that in order for enterprises to achieve and sustain a competitive advantage through manufacturing excellence attention had to be given to all aspects of manufacturing performance. Thus a roll out of continuous improvement programmes was required. Managers needed to eliminate waste, reduce lead times, increase quality and reduce costs. Thus a system was required that could assist managers with accurate product costing and information on operating activities for improved decisionmaking.

In the contemporary business environment, ABC is claimed to have major benefits for enterprises (Blocher et al., 2010:133). Blocher et al. (2010:123) identified the following advantages for implementing an ABC system:

- ABC provides for better profitability measures as product costing is more accurate and informative. Information resulting from accurate product costing and customer profitability measures leads to better-informed strategic decisions with regard to pricing, market segments and product range (Huynh et al., 2013:36).
- Improved decisionmaking can be realised with activity-based costing information due to more accurate activity-driving costs measures. Product and process value may be improved through better decisions with regard to customer support, products and promotion of value adding projects (Huynh et al., 2013:36).
- Process improvement areas may be identified with information drawn from an ABC system.
- Improved pricing decisions, budgeting and planning is a direct result of an ABC system that gives a more accurate calculation of the true cost of a product.
- Job costs for pricing and planning decisions are more accurately estimated with information extracted from the improved product costs.

- Production capacity levels can be managed more effectively to decrease the cost of its underutilisation and thereby improving product costs and their pricing.

ABC if implemented correctly may significantly contribute to better decisionmaking within the company thus increasing its competitiveness through a better understanding of its true product costs, maximisation of its resources, better cost and control management, detection of non-value adding resources and identification of reasons for poor financial performance. These benefits of ABC have been reviewed in recent works by Kumar and Mahto (2013:11) as well as Bogdanoiu (2009:6) in their respective journal articles.

Turney (1989:13), Blocher et al. (2010:133) and Bogdanoiu (2009:6) are all in agreement that the primary benefit of ABC is greater costing accuracy. ABC accuracy is derived from the activities that are required for production subsequently assigned to the products eliminating the allocation of irrelevant costs to a product.

In strategic management, ABC is an important tool used for assessing a company's cost competitiveness (Hough et al., 2011:131). It forms part of analysing a company's internal resources and competitive capabilities whereby costs of performing specific activities are determined and competitiveness evaluated.

Kumar and Mahto (2013:21) with Blocher et al. (2010:133) conclude that additional advantages of activity-based costing include a better understanding of overhead costs, a clearer perspective of costs for internal management and the ability to evaluate and compare a company's costs for activities to that of its rivals through benchmarking.

### **2.3.5 Limitations of activity-based costing**

Implementing an activity-based costing system within a company is costly and requires substantial resources (Roos, 2011:166). Costs arise from surveys and interviews that employees partake in during the process of identifying activities for the design of an accurate ABC system (Mowen et al., 2014:259). The information derived from the above interview process may be time-consuming and costly (Roos, 2011:166). A complex system resulting from encompassing too many activities is

costly to design, use and maintain (Garrison et al., 2012:279). Companies with limited funds may opt not to pursue the implementation of activity-based costing due to the initial high roll-out cost. Secondly, once implemented the upkeep of an activity-based system is greater than that of a traditional costing system (Garrison et al., 2012:297).

In an example presented by Kaplan and Anderson (2007:5), the authors make a case that ABC systems are expensive to put into service and subsequently may require time and expertise to adjust.

Garrison et al. (2012:297) state that the benefit realised from utilising an activity-based costing system may not be greater than its implementation cost. Costing distortions that arise from simpler costing systems may be insignificant in cases where products consume resources homogeneously or rivalry between competitors is weak thus reducing the need for accurate costing (Roos, 2011:169).

For the successful implementation of an activity-based costing in a company, buy-in from the employees is required (Garrison et al., 2012:279). In order to foster ownership and familiarity with ABC, Blocher et al. (2010:151) recommend that management and employees get involved in the creation of the new system as it leads to a higher success rate. Top management must support the initiative in order to reduce employee resistance to change and foster the successful implementation of the new system (Garrison et al., 2012:297). It must be ensured that reliable cost information is used to design and feed the system (Roos, 2011:166). The accuracy of the results relies on the input data that is entered into the model. Poorly determined cost drivers will generate an inaccurate output from the system (Roos, 2011:166; Kumar & Mahto, 2013:21). Another concern that an activity-based system may pose is the misinterpretation of the data. Users may easily misinterpret the information supplied by the system. Garrison et al. (2012:297) caution the decisionmakers to identify costs that are fully relevant to pending decisions as costs assigned cost objects such as products and customers are only potentially relevant. Confusing and misaligned information may lead to bad decisions.

Garrison et al. (2012:297) state that additional costs and information misalignment may be incurred after the implementation of ABC due to the need of maintaining a

dual costing system. ABC is used for internal reporting and should thus supplement a costing system that conforms to external reporting requirements such as a system based on traditional costing principles. Organisations may also experience difficulty in integrating ABC with the current accounting system and lack of software packages may also pose a hindrance to its success as found by Tatikonda (2003:5).

## **2.4 Activity-based costing implementation**

### **2.4.1 Critical implementation factors**

There are several factors that can shape the success of implementing an ABC system. In a paper published by Tatikonda entitled “Critical Issues to Address Before You Embark on an ABC Journey”, the author identified several key factors that form a prerequisite for implementing an ABC system. Tatikonda (2003:5) states that an ABC system is intertwined with critical issues concerning informational, technical, behavioural, ownership, financial and managerial aspects that need to be addressed prior to implementation.

Informational issues stem from the rationale for embarking on an ABC system. ABC systems provide accurate product cost information (Blocher et al., 2010:127; Garrison et al., 2012:279). Thus it is imperative to determine if high-level accuracy is required by the specific organisation. Roos (2011:169) states that the need for accurate costing is reduced in facilities where products consume resources homogeneously or rivalry between competitors is weak. Tatikonda (2003:5) cautions that ABC will bring limited benefits for operations with homogeneous products and high direct labour costs. ABC should thus be implemented for companies that require accurate cost information for long-term decisionmaking with regard to new products, the product mix and the outsourcing of work (Blocher et al., 2010:133; Roos 2011:167). The integrity of an ABC system is crucial to provide accurate data that can be used for strategic decisionmaking. Roos (2011:166) concludes that the accuracy of the results relies on the input data that is entered into the model.

Tatikonda (2003:5) states that lack of ownership may lead to confusion and poor support of the system by the employees. Thus a good rapport must be established between the financial and technical system users. Developing guidelines and assigning authority reduces employee confusion (Tatikonda, 2003:5). Top

management need to support the initiative to reduce employee resistance to change and to foster the implementation process (Garrison et al., 2012:297).

Behavioural and employee aspects of concern should be mitigated through effective communication and training (Tatikonda, 2003:6). Issues may arise due to reduced employee morale, as ABC data will question the current work practices and performance criteria. Of importance is that employees understand the need for ABC and its impact on product costs. Management must ensure that enough resources are allocated to the design, rollout and subsequent maintenance of an ABC system (Roos, 2011:168). Employees ought to be trained and willing to use the system. This can be achieved through developing incentives for the use of ABC information to improve product design and processes (Tatikonda, 2003:6).

Implementing an ABC system within a company is costly and requires substantial resources (Roos, 2011:166). Garrison et al. (2012:297) state that the benefit realised from utilising an ABC system may not be greater than its implementation cost. Thus a feasibility study is necessary to determine the real benefit of implementing ABC. Tatikonda (2003:6) mentions that organisation must fully understand the magnitude of the tangible as well as the intangible costs such as employee morale and resistance to change associated with the design, implementation and maintenance of the system. Jinga et al. (2010:38) in their study on Romanian companies found that adoption rates of ABC were very low at between 6% and 12% citing resistance to change, lack of support from management, high implementation costs and complicated work processes as the main factors hindering the rollout of ABC in these companies.

Several technical aspects have to be determined and weighed prior to the implementation of an ABC system. According to Tatikonda (2003:6) technical factors that require consideration include the following:

- the desired level of accuracy that must be established;
- the selection guidelines for the cost drivers must be known;
- the number of selected cost drivers must be manageable;
- the data for the chosen cost drivers must be available;
- the complexity of the ABC must be evaluated, and the

- integration level to the existing costing system must be determined.

The eventual success of the system relies heavily on the level of precision that the above factors were considered and settled on during the design stage (Tatikonda, 2003:6).

As stated by Seal et al. (2009:278) implementing an activity-based system firstly requires the full support of top management. Secondly, a cross-functional team including staff from both the financial as well as from the operational departments have to be responsible for the implementation. Management's role during this process is to promote employee buy-in and to reduce employee resistance to change thus ensuring the implementation process is successfully executed (Garrison et al., 2012:297).

#### **2.4.2 Steps for implementation**

Implementing ABC is complex and requires a system-wide integrated approach. The design of an ABC model requires a thorough analysis of a company's current costing system in order to determine the feasibility of implementing ABC. According to Garrison et al. (2012:279) most companies that utilise a traditional costing system effectively trace and thus measure the direct labour and direct materials cost of products. Garrison et al. (2012:279) state that the focus of an ABC study should therefore be on expenses relating to the company's overhead, and selling and administrative costs.

There are six steps in the implementation of ABC as proposed by Garrison et al. (2006:317), namely:

- Step 1: Identify the activities and the activity cost pools.
- Step 2: Trace overhead costs to activities and cost objects.
- Step 3: Assign costs to activity pools.
- Step 4: Calculate activity rates.
- Step 5: Assign costs to cost objects using activity rates and measures.
- Step 6: Prepare management reports.

As identified in the literature the set of basic steps that needs to be followed for the implementation of an ABC model is reviewed and discussed in the next section.

**Step1: Identify the activities and the activity cost pools.**

Garrison et al. (2012:277) state that the first step in implementing ABC lies in identifying and defining activities. An activity has been defined by Mowen et al. (2014:259) as an event that is executed by people or equipment for other people. It involves the consumption of overhead resources.

Mowen et al. (2014:259) further state that the information that is fundamental in identifying activities for the design of an accurate ABC system can be mostly extracted via interviews. According to Garrison et al. (2012:277) personnel who are knowledgeable of each functional work area must be interviewed in order to identify their major activities. The information derived from the above interview process may then be listed in an organisational activity list. Attributes including both financial and non-financial data such as time spent on an activity, type of resources consumed and measure of activity output amongst others are then assigned to each activity (Mowen et al., 2014:261).

Garrison et al. (2006:321) state that the accuracy of the ABC system is dependent on the number of activities that are tracked. The greater the number of tracked activities the more accurate the system will be. However consideration must be made to the practicality and costs associated with the design, implementation and maintenance of an elaborate system. When building an ABC system companies are advised to select a small number of activities that summarise much of the work performed in overhead departments (Garrison et al., 2006:339). Activities that are highly interrelated with each other may be grouped together on different levels, namely: unit-level activities, batch level activities, product level activities, customer-level activities and organisation-sustaining activities (Garrison et al., 2012:275).

After the major activities have been identified, these activities are grouped according to specific activity cost pools. Garrison et al. (2006:322) define an activity cost pool as an aggregate of all the costs incurred by a specific group of activities when certain operations are performed within the organisation. Garrison further explains that costs

can be attributed to certain activities and these activities are in turn assigned to products to determine the true cost of a product. This allows for ABC to be used as an effective measure to applying overhead costs (Mowen et al., 2014:259; Garrison et al., 2012:282).

After the activities and the cost pools have been identified, an allocation based referred to as an activity measure in an ABC system is used to allocate costs in a cost pool to cost objects (Garrison et al., 2006:321). Each activity cost pool relates to a single cost driver that measures the consumption of the business's resources.

### **Step 2: Trace overhead costs to activities and cost objects.**

Following the identification of the activities and the cost pools in the prior step, this step in the implementation process of an ABC model requires for overhead costs to be traced to activities and cost objects whenever possible (Garrison et al., 2006:323).

Garrison et al. (2006:324) state that overhead costs that cannot be directly traced to products are then assigned to cost objects using the ABC system.

### **Step 3: Assign costs to activity pools.**

Costs must now be allocated to the activity cost pools (Garrison et al., 2006:324). Information pertaining to the overhead costs incurred by each department is to be found in a company's general ledger. Costs such as salaries, rent, supplies and so forth can be easily identified in the general ledger. Thus a number of overhead costs may be traced directly to one of the activity pools in the ABC system. For costs that cannot be traced directly to specific activity pools, Garrison et al. (2006:325) recommend dividing the costs via an allocation process called first-stage allocation.

First-stage allocation involves the assigning of costs to activity cost pools via an allocation process (Garrison et al., 2006:325). In order to determine the allocation percentage of the costs to be assigned to the activity cost pools, interviews are conducted with personnel who are knowledgeable of the activities. The importance of conducting quality interviews with the appropriate staff members who are involved in the activities is emphasized. For the distribution of non-personnel costs, departmental managers are questioned how these costs should be allocated to the

activity cost pools. Once the percentages of the allocation costs have been determined, costs are assigned to the activity cost pools.

#### **Step 4: Calculate Activity Rates**

After the manufacturing overhead costs have been assigned to the activity cost pools the next step in the implementation process of an ABC system requires for the activity rates to be computed (Garrison et al., 2012:284; Davis & Davis, 2012:286; Seal et al., 2009:366). The calculated activity rates will be utilised for each cost pool (Garrison et al., 2012:284).

First, the total activity for each cost pool must be determined (Garrison et al., 2012:284). Seal et al. (2009:286) compute the activity rates by dividing the total cost of each activity pool by the required total level of activity for each cost pool. The overhead total costs in each activity pool are based on historical data (Garrison et al., 2012:284).

Garrison et al. (2012:284) recommend a good understanding of the overall process of assigning costs to cost objects in an ABC system. For the empirical study in Chapter 4 of this mini-dissertation, a visual perspective of an ABC model was utilised to give a better idea of the overall process and cost allocation to products at the selected ArcelorMittal plant.

#### **Step 5: Assign overhead costs to cost objects**

The fifth step in the implementation of ABC is concerned with the allocation of overhead costs to cost objects (Seal et al., 2009:287). This process is referred to as second-stage allocation by Garrison et al. (2012:285). In this step, activity rates are used to assign costs to cost objects.

Davis and Davis (2012:368) state that the calculation for allocating costs to cost objects are similar to that of applying costs to product and services utilising traditional job order costing. The allocated costs are computed by multiplying the activity rate by the activity driver consumption. Garrison et al. (2012:298) conclude that costs computed under activity-based costing are usually very different from the costs

generated by a traditional costing system. Once the second-stage allocation is complete the final step in this process will be to prepare management reports.

### **Step 6: Prepare Management Reports**

According to Garrison et al. (2012:288) the purpose of the management reports as prepared with ABC data is to highlight the most profitable growth opportunities and to alert management of products and services that operate at a loss and thus drain profits.

The above authors state that product and service margins calculated utilising the ABC system will give management a more accurate perspective on the company's product and customer profitability. Once the profitability margins have been established, managers will be able to make more informed decisions with regard to redirect their resources to the most profitable growth margins.

## **2.5 Activity-based management**

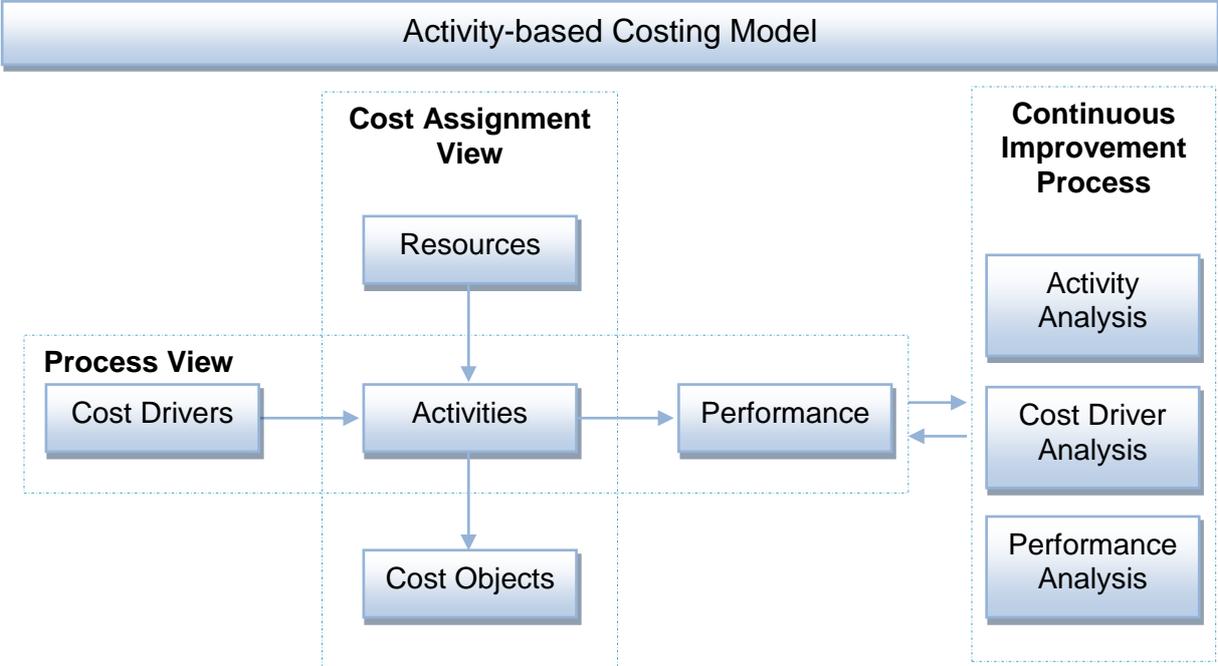
Davis and Davis (2012:378) define activity-based management (ABM) as the process of managing a business's activities with information derived from an ABC system. Blocher et al. (2010:138) state that information from an activity-based management system may lead to improved management decisions that cumulate to increased value offering to customers, higher profits and a stronger competitive stance as costs are better managed.

ABM is focused on the management of resources and activates to improve costs (Blocher et al., 2012:138). The ABC management framework depicted in Figure 2.3 shows two views relating to the cost and the need of resources and activities. Operational information with regard to business processes and its activities is derived from the process view of the framework. Financial information pertaining to the assignment of costs to the final cost objects is depicted on the vertical view (IMA, 2006:9).

The framework as described by IMA (2006:9), determines the final cost object; the cost assignment starts at the resources where specific resource drivers are identified

and thereafter assigned to the work activities. These expenses are then assigned to the final cost object as per the consumption of activity drivers.

Figure 2.3: Activity-based Management Model



Source: Adapted from Institute of Management Accounting, 2006:9

As described in section 2.3.2 ABC if implemented correctly can be used to determine costs of products more accurately. The system by itself is not capable of bringing about improved performances and profits. Blocher et al. (2012:138) state that work processes and activities may be improved by applying management improvement initiatives such as total quality management, just-in-time and benchmarking with the aid of an ABM system. Strategic decisions derived from ABM information focus on activity optimisation, correct selection of activities, reduction of non-essential activities and customer profitability. Management tools such as process-value analysis, customer profitability analysis and activity analysis supplement strategic ABM (Blocher et al., 2012:139).

Mowen et al. (2014:270) describe the process-value analysis as an integral tool which forms part of ABM, utilized for the evaluation and improvement of customer value and the subsequent profit as achieved by providing this value. The main objective of a process-value analysis is to identify cost reduction areas and to maximise system wide performance.

IMA (2006:8) states that ABM provides crucial business information with regard to activity costs, cost of non-value adding activities, accurate product cost, cost drivers, cost information for business processes and activity-based performance. This information may be strategically used to improve the business value offering to customers, reduce costs and improve the company's competitiveness by focusing on the company's key success factors (Blocher et al., 2012:138). ABC can be used for product costing, profitability analysis as well as for managing and controlling costs.

## **2.6 Traditional costing**

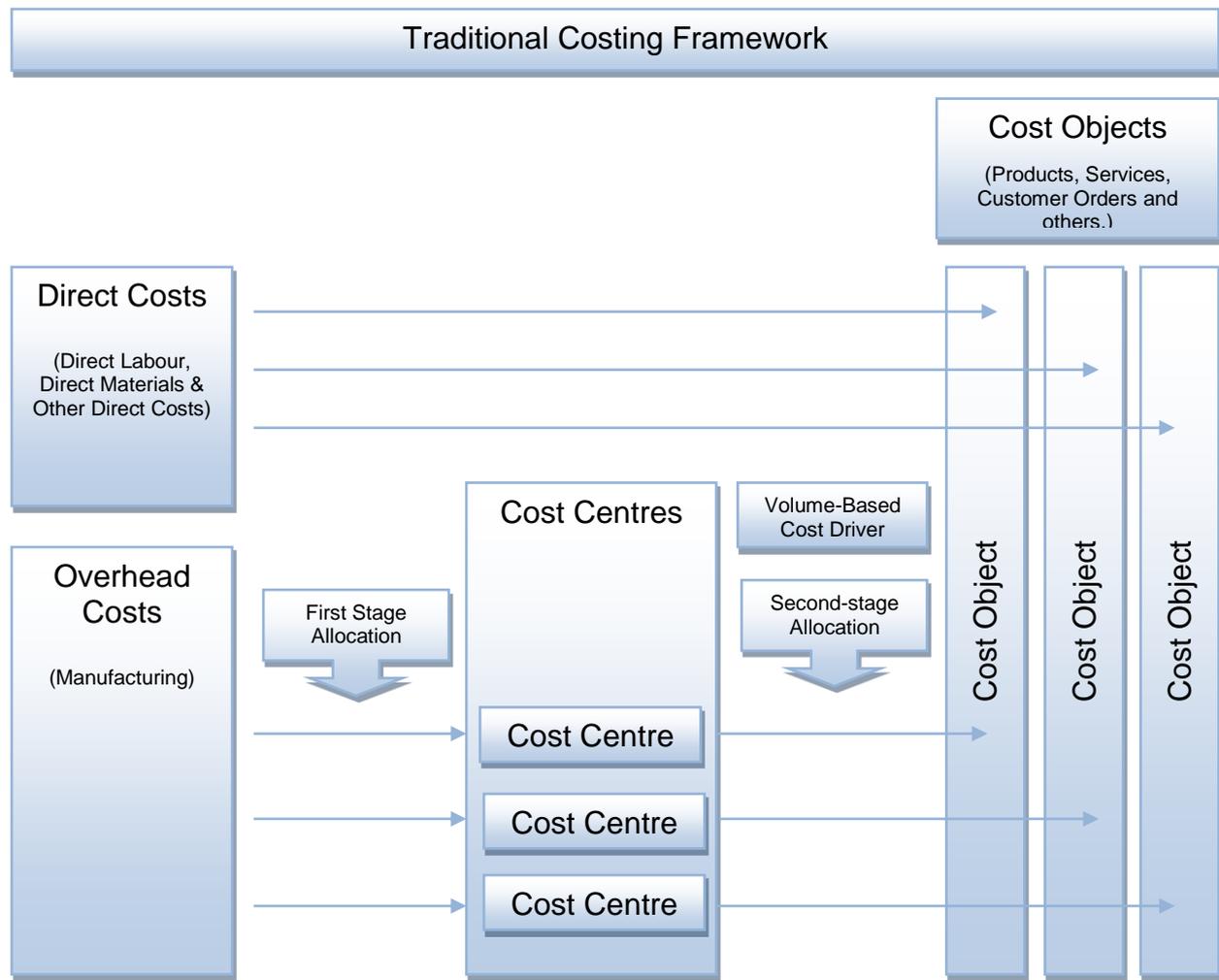
### **2.6.1 Fundamentals of traditional costing**

As opposed to activity-based costing, traditional costing is more simplistic and less accurate (Seal et al., 2009:276). According to Drury, (2011:298) both systems make use of a two-stage allocation approach. In a traditional costing system the first stage allocation process encapsulates the allocation of overhead costs to departments. Volume-based allocation is used in the second-stage allocation process. The cost drivers in the traditional costing system are subjective and are usually based on direct labour or machine hours. The predetermined overhead rate is calculated by dividing the estimated overhead costs by the amount for the cost drivers. Once determined the rate is then applied to the cost object. A distinct difference between an ABC system and a traditional costing system is in the combination of support and production cost centres. In traditional cost accounting overhead expenses are allocated to products on a predetermined volume based rate.

The steps in the implementation of traditional costing are summarised as follows:

- Step 1: Determine the overhead costs.
- Step 2: Select a time frame and estimate the overhead costs.
- Step 3: Determine cause and effect cost drivers.
- Step 4: Select a time frame and estimate a value for the cost drivers.
- Step 5: Calculate an overhead rate (Overhead Costs/Cost Driver Value).
- Step 6: Apply the overhead rate.

Figure 2.4: Traditional Costing Framework



Source: Adapted from Drury, 2011:296

### 2.6.2 Benefits of traditional costing systems

Traditional costing systems are still widely used in today's business environment (Blocher et al., 2010:128).

The major advantages of traditional costing are that it aligns with Generally Accepted Accounting Principles (GAAP), it is easy to apply for single product companies and it is less expensive to implement as compared to an activity-based costing system (Garrison et al., 2012:247, Blocher et al., 2010:128; Seal et al., 2009:276; Roos, 2011:166).

Traditional costing still has its place in today's business environment. Blocher et al. (2010:128) concur that companies whose direct labour costs are the major expense

for its product or service with relatively small and homogenous non-value adding service costs will find traditional volume-based costing adequate for their operations. Conversely, firms with high overhead costs and a diverse product range offerings must consider an ABC system in order to prevent product costing inaccuracies. Volume-based allocation in such firms will lead to certain products being overstated and others being understated (Blocher et al., 2010:128; Roos, 2011:166).

Costing distortions that arise from traditional costing systems may be insignificant in cases where products consume resources homogeneously or rivalry between competitors is weak thus reducing the need for accurate costing. Traditional costing should be considered for companies that produce few products with low associated manufacturing overhead cost as compared to its direct costs (Roos, 2011:169).

Traditional costing aligns with GAAP standards and is used for external reporting. It is used to determine the value of the cost of goods sales.

### **2.6.3 Disadvantages of traditional costing systems**

Traditional costing is viewed as an out-of-date costing system that has lost its relevance in the contemporary manufacturing environment (Drury, 2011:294). Today's manufacturing environment is becoming more automated and computerised, leading to the reduction in direct labour costs and a shift to greater overhead expenses. The traditional costing system became outdated when companies began to automate its production lines and relied less on direct labour. Thus the direct labour costs decreased and the manufacturing overheads substantially increased. Drury (2011:294) states that traditional costing systems use volume-based allocation of costs to products. Cost distortions will occur when indirect manufacturing costs are not volume related as there is not a direct cost relationship between the two (Drury, 2011:294). On the other hand, ABC can report product costing more accurately as it allocates costs according to the activities that are required to produce the product or render a service.

Traditional costing assumes that cost objects consume all resources with relation to the produced volume. Overhead costs are assigned on a volume allocation bases. This may distort product costs with overheads are relatively large compared to the cost expenses incurred from direct labour. Product cost distortions are most

prevalent in organisations that produce a wide variety of products that differ in volume and complexity (Drury, 2011:294).

Drury (2011:294) continues to state that traditional costing systems were relevant decades ago when companies manufactured a narrow range of products with major costs stemming from direct labour and direct material. Since overhead costs were small, in these labour intensive practices, the allocation of overhead cost to products through absorption resulted in limited product cost distortions.

Gunasekaran et al. (1999:392) found that a major drawback of the traditional costing systems was that only financial information was reported and information relating to non-financial activities such as quality and throughput were not available.

Distortions can arise when traditional volume related bases are used to allocate overhead costs. Allocation bases such as direct labour, material costs and machine hours are prone to distort product cost in organisations that incur large overhead costs. Traditional costing excludes certain non-manufacturing costs, such as: administrative costs, marketing costs and interest on business loans, and negates certain cost drivers that are relevant to the cost of the product or service (Mowen et al., 2014:250). Inaccurate cost information may lead to poor decisionmaking (Garrison et al., 2012:273; Blocher et al., 2010:127; Seal et al., 2009:276; Roos, 2011:167).

In a highly competitive industry companies rely on accurate product cost information to make strategic decisions. An ABC system may provide accurate product cost information in industries that offer a large number of products, carry large overhead costs and the volume between the products varies significantly (Blocher et al., 2010:127). The ABC method is capable of overcoming the product costing deficiencies of traditional costing systems.

## **2.7 Traditional costing versus activity-based costing**

Initially designed in the late 1980s, the concept of the ABC system was to lessen cost distortions as caused by traditional cost accounting systems (Tatikonda, 2003:5). Since then ABC has been seen as a more accurate costing system as it overcomes limitations of cost distortions associated with traditional costing and is thus more

suitable to provide cost information for management decisionmaking. The relevance of traditional cost accounting has been the focal point since the introduction of ABC.

Blocher (2010:128) opines that traditional costing systems should be considered for organisations that manufacture few products and carry direct labour costs as the highest contributor to their expense as compared to its manufacturing overhead cost. Roos (2011:169) adds that competition between rivals must also be weak. ABC is more suitable for organisations with high overhead costs and a diverse range of product offerings.

Drury (2011:294) states that traditional costing systems use volume-based allocation of costs to products. Cost distortions will occur when indirect manufacturing costs are not volume related as there is not a direct cost relationship between the two (Drury, 2011:294). On the other hand, ABC can report product costing more accurately as it allocates costs according to the activities that are required to produce the product or render a service. Drury (2011:294) indicates distinct differences between traditional costing and ABC systems. These differences stem from the distinct approaches in the allocation of costs of each system.

In traditional costing, cost allocation is estimated. This cost system does not focus on the cause and effect relationship between the consumed resources and the cost object. Traditional cost accounting identifies costs according to broad categories of expenses whereas in ABC costs are assigned to the activities that are responsible for the cost (Hough *et al.*, 2011:131).

Roos (2011:166) adds that in traditional costing, overhead costs are allocated to a department in accordance with the organisational structure. On the other hand ABC systems utilise activities to allocate their costs based on the amount of resources consumed by each cost object. Thus multiple overhead rates can be calculated and assigned to each activity as opposed to a cost centre as in the traditional costing approach.

Drury (2011:294) states that the amount of cost drivers varies significantly between the two systems as volume based cost drivers such as direct labour and direct machine hours are used in traditional costing and second-stage allocation cost

drivers that are linked to each activity are preferred in ABC. Roos (2011:166) confirms that a direct relationship exists between consumed resources and the assigned cost to the cost object in ABC.

Roos (2011:166) continues that due to the fact that traditional costing has fewer allocation bases as compared to an activity-based costing system, which are activity driven, the system is less expensive to implement and easier to maintain. Overhead rates that are accumulated in service departments are more accurately assigned to the cost objects, using specific cost drivers, in ABC.

Drury (2011:294) mentions that traditional costing systems were relevant when the direct cost of an organisation was the most prominent expense, overhead costs were relatively small, few products were produced and competition amongst rivals was small. Traditional costing is limited in accurately allocating overhead costs to cost objects thus posing a threat to poor decisionmaking due to inaccurate cost information. It cannot provide data that could give a sustainable competitive advantage.

Sharma and Gupta (2010:63) in their research on the strategic implications of ABC in Indian companies conclude that ABC systems provide companies with superior costing information over traditional costing methods which lead to better strategic decisionmaking. ABC can also help to reduce waste, improve efficiency and should be used as a tool for continuous improvement.

Roos (2011:166) in her comparison of the two costing systems concludes that the allocation method of ABC provides for more accurate product costing and supports strategic and long-term decisionmaking as opposed to the traditional costing method. Blocher et al. (2010:123) reiterate that changing over to an ABC system leads to new information for eliminating waste and reducing costs. ABC systems have become the accepted solution for the shortcomings posed by tradition costing systems.

## **2.8 Chapter summary**

In order to conduct the empirical study a literature review was performed to gather theoretical information pertaining to different costing systems. Literature focusing on

the comparison of a traditional costing system versus an activity-based costing system for an industrial plant was reviewed. Theory relating to the nature, design, benefits and implementation of activity-based costing systems over traditional costing methods was also researched. The elements that were required to be built into the model and the steps required for the analysis and the implementation of an activity-based costing system were also identified by the literature review. In the next chapter literature pertaining to the selected industry, its operations and its context within the world and local economy is presented. A brief summary of the highly competitive macroeconomic environment that the South African steel industries operate in is brought into perspective.

## CHAPTER 3

### OVERVIEW OF THE STEEL MACRO ENVIRONMENT AND AMSA'S STEEL MANUFACTURING PLANT

#### 3.1 Introduction

This chapter provides a brief summary of the macroeconomic environment that the South African steel industry operates in and to expose the highly competitive environment of this industry. Literature pertaining to the selected industry, its operations and its context within the world and local economy are included in this chapter.

#### 3.2 Macro environment of the steel manufacturing industry

The South African GDP growth contracted to 1.3% for the second quarter of 2015 due to the fall in output from mining, manufacturing and agriculture sectors. The lower commodity prices as well as a second consecutive drop of 6.3% in the manufacturing sector contributed to the contraction of the GDP. The manufacturing sector was significantly affected by the lower production volumes of metal products constituting of iron, steel and non-ferrous metals (Taborda, 2015).

The South African economy has stagnated. Additionally the local steel market has been going through a very challenging period spurred on by lower steel demand, increased competition from China, labour unrest and electricity shortages (Aboobaker, 2015; Evans, 2015; Van Rensburg, 2015).

Contrary to the balanced level between the supply and demand of steel between 2004 and 2007, since 2008 the demand for steel declined at an average of 5% a year while there has been a steady increase in the global steel production capacity. In 2005 steel exports had been evenly distributed across the globe. The export environment has drastically changed with China steadily increasing its exports. From 2014 the world exports are predominately from China and developed Asia. China currently produces half of the world steel and holds a major portion of global oversupply capacity (International Steel Statistics Bureau, 2015).

The current global overview indicates an overall decline in steel demand with steel output decreasing slowly creating an oversupply of steel. The world steel output has declined by 2.1% from 2014 to 93.2mtpm in the first two quarters of 2015. Consumption also slowed down by 1.7% over the same period (International Steel Statistics Bureau, 2015). China has been aggressively increasing its world exports creating an oversupply of steel and as a result a drop in steel prices. From 2013 to 2014 Chinese steel exports increased by 50% from 5.2mtpm to 7.8mtpm while the first two quarters of 2015 have already seen China steel exports reaching 8.7mtpm (International Steel Statistics Bureau, 2015).

In 2015 Chinese steel exports into Africa substantially rose by 23% of which the bulk was destined for sub-Saharan Africa. Sub-Sahara Africa is a major export destination for ArcelorMittal South Africa. More importantly for ArcelorMittal South Africa, the Chinese steel exports into the local market increased by 42% from the previous year of 2014. Steel imports into South Africa stand at 65% for the first half of 2015, a substantial increase from 39% in 2013. However, the World Steel Association expects global demand to increase by 0.5% as result of developed and emerging market growth outpacing the contraction in China (AMSA Internal Analysis; Morgan Stanley Analysis, 2015).

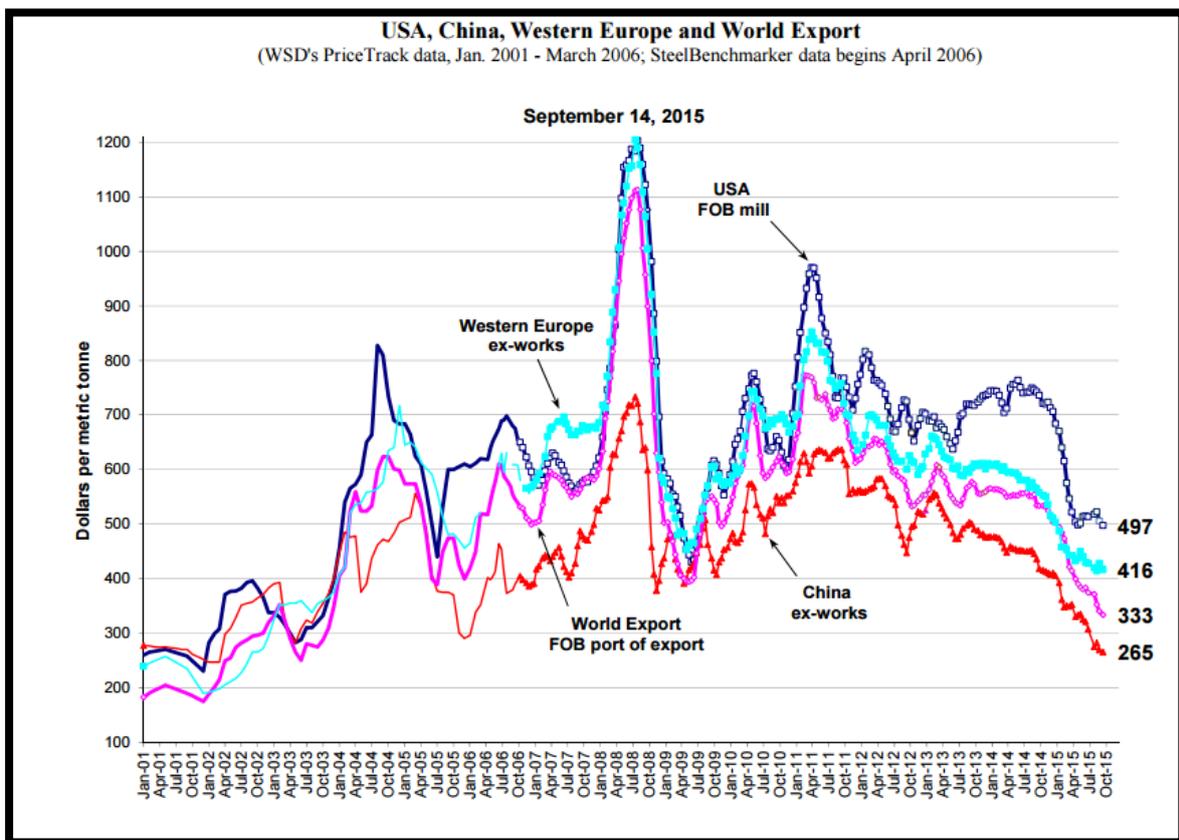
Figure 3.1: Chinese Steel Exports into Sub-Saharan Africa



Source: AMSA Morgan Stanley Analysis, 2015

China's slowing economy has resulted in the oversupply of steel to its local market. Global overcapacity of steel has been driven by China's low-cost exports. Steel prices have been tumbling. The world export price for hot roll band products has declined by 70.1% from its recent high in 2011 down to \$333 per metric tonne in September 2015 (Steel Benchmarker, 2015). China has been exporting its government subsidised steel at below cost at \$ 265 raising concerns of flooding the South African market.

Figure 3.2: Global Steel Prices Overview



Source: Steel Benchmarker, 2015

### 3.2 South African steel manufacturing industry

The steel industry is one of the most fundamental sectors of the South African economy. The South African steel manufacturing industry provides direct employment for almost 190 000 people and contributes 1.5% to the country's GDP. It is a strategic industry that underpins several other key South African industries. Businesses involved in building and construction, structural steel, cable and wire

products, automotive and mining are the top five steel consuming industries in the country that contribute 15% to the South African GDP and collectively employ around 8 million people.

In South Africa there are two major steel making corporations namely ArcelorMittal South Africa and Evraz Highveld Steel and Vanadium. ArcelorMittal South Africa steel operations comprise of four major facilities, which produce both flat and long steel products. The company has steel works facilities in Vanderbijlpark, Saldanha, Pretoria and Newcastle, while Evraz has its works based at eMalahleni, Mpumalanga. ArcelorMittal South Africa has a production capacity of 7.8 million tonnes of liquid steel per annum.

The steel industry plays a critical role in the mineral beneficiation of South Africa's iron ore. Steel increase the economic value of iron ore fourfold. Thus the industry is crucial in adding value to South Africa's mineral wealth.

The South African steel industry supports key initiatives in the country such as renewable energy, increasing rail, electricity and transport infrastructure and supporting government's goal of increasing the GDP growth and reducing unemployment.

It also plays an important role in supporting the local economy and its associated steel consuming industries. Government's goals and key drivers as laid out in the National Development Plan, Industry Policy Action Plan and the New Growth Plan are all steel dependent.

Strategically, South Africa has Sub-Sahara's only primary steel manufacturing capability, thus creating an opportunity to supply steel to its neighbouring economies.

At present the South African steelmakers are seeking protection from government against a surge of subsidised Chinese imports supplied at prices as much as 25% below local production costs (Aboobaker, 2015, Evans, 2015; Van Rensburg, 2015). The Department of Trade and Industry has also been approached to provide protection from cheap Chinese steel entering the country. According to media reports, ArcelorMittal South Africa has applied for import tariff protection for a number

of steel products, and plans to ask for anti-dumping and anti-subsidy duties shortly (Janse van Vuuren, 2015).

The South African steel industry is on the brink of collapse (Aboobaker, 2015, Evans, 2015; Van Rensburg, 2015). In recent months major steel producers in South Africa have appealed to government to intervene and provide assistance to the crisis in the local steel industry. Evraz Highveld Steel and Vanadium has filed for business distress and indicated that it will have to layoff half its workforce, while ArcelorMittal asked government to impose tariffs on certain steel products from China.

Due to the local and world weakening demand for steel and a high influx of imported steel from China, Evraz has recently filed for business rescue from the government. The company which is South Africa's second-largest steel producer has been contemplating large jobs cuts.

Increased competition from China has led to local imports increasing and losing market share. In strategic management, ABC is an important tool used for assessing a company's cost competitiveness (Hough et al., 2011:131). It forms part of analysing a company's internal resources and competitive capabilities whereby costs of performing specific activities are determined and its competitiveness evaluated.

Kumar and Mahto (2013:21) and Blocher et al. (2010:133) state that additional advantages of ABC include a better understanding of overhead costs, a clearer perspective of costs for internal management and the ability to evaluate and compare a company's costs for activities to that of its rivals through benchmarking.

It is imperative for a company that is operating in a highly competitive environment to have an accurate costing system that can provide management with correct product costing information for crucial decisionmaking (Roos, 2011:169).

As steel organisations worldwide strive to maintain and increase its market share in a highly competitive and saturated market, pressure is placed on steel manufactures to produce steel products at highly competitive prices without compromising on quality and to deliver the products on time to customers. Thus to sustain a competitive advantage over rivals, steel manufactures must focus on the following three key areas.

### **3.3 ArcelorMittal South Africa**

ArcelorMittal South Africa (AMSA) was founded in 1928 as a statutory parastatal organisation. The objectives of establishing the company were to produce iron and a range of steel products and to create employment opportunities. Since then the company has established itself as the largest steel producer in Africa with a production capacity of 7.8 million tonnes of liquid steel per annum (ArcelorMittal South Africa, 2015).

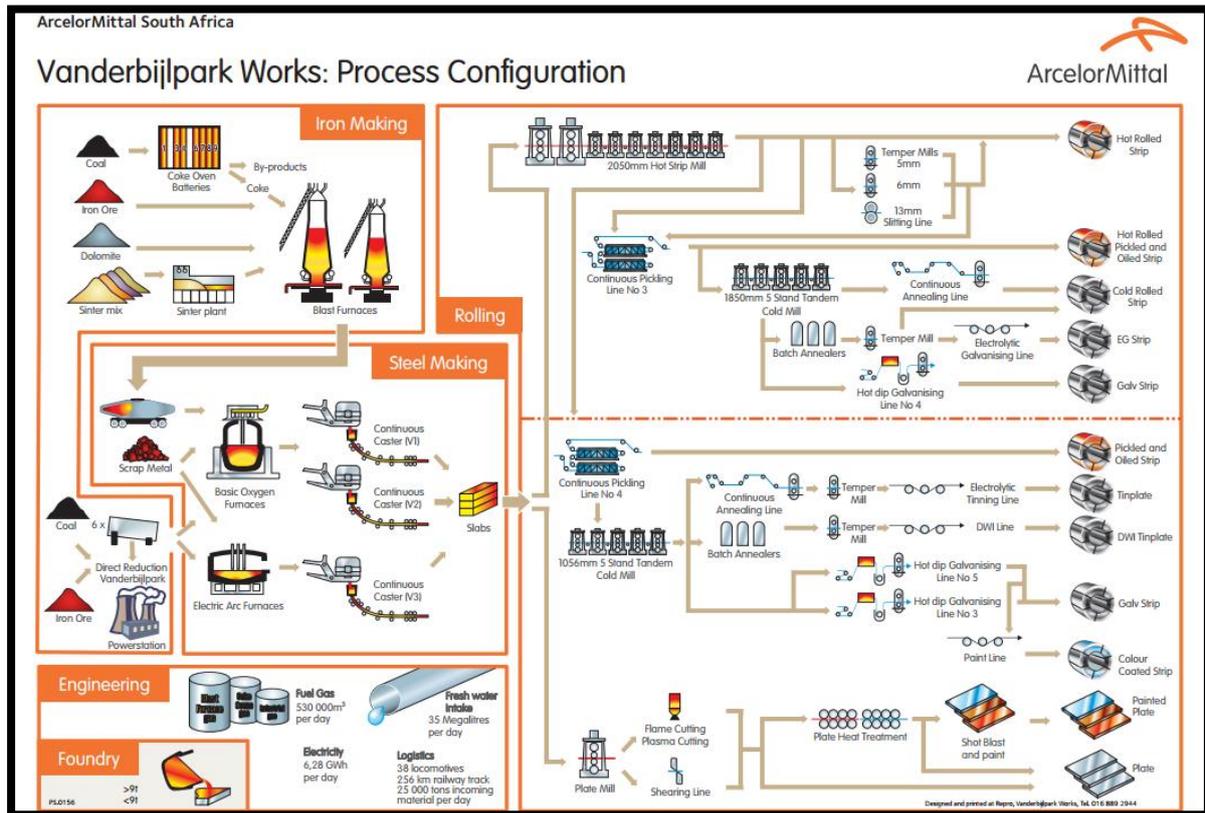
AMSA's steel operations comprise four major facilities. These facilities produce both flat and long steel products. The flat steel operations are at Vanderbijlpark and Saldanha, while the operations in Newcastle and Vereeniging supply the market with long steel products. Market coke for the ferro-alloy industry is produced at AMSA's Coke and Chemical business based in Pretoria (ArcelorMittal South Africa, 2015).

The steel works facility in Vanderbijlpark is one of the largest inland steel mills and the leading supplier of flat steel products in South Africa. The Vanderbijlpark Works has two blast furnaces and three basic oxygen furnaces. The central focus of this steel works is to maintain and grow its established share of the local market through development of additional value added products and to focus on industry partnerships. Its international position is being refined by focusing on identified high profit export markets and meeting international levels of operational excellence, product quality and customer satisfaction (ArcelorMittal South Africa, 2015).

The steel products are manufactured in an integrated process. The Vanderbijlpark Steel Works is divided into three distinct production operations which include the iron making operation, the steel making operation and the rolling operation. Each division is concerned with the effective transformation of inputs into outputs. Raw materials such as iron ore, coke and dolomite are charged to blast furnaces where they are converted to liquid iron. The liquid iron is refined in basic oxygen furnaces to produce liquid steel. The liquid steel is cast into slabs, which are hot rolled into heavy plate in a plate mill, or into coils in a strip mill. The coils are either sold as hot rolled sheets in coil or processed further into cold rolled and coated products, such as hot dip galvanised, electro-galvanised and pre-painted sheet and tinsplate (ArcelorMittal South Africa, 2015).

The process configuration of the ArcelorMittal's Vanderbijlpark Works is depicted graphically in Figure 3.3 showing the series of transformation steps where resources such as raw materials and labour are converted into a wide range of steel products.

Figure 3.3: AMSA Vanderbijlpark Process Configuration



Source: ArcelorMittal South Africa, 2015

The Vanderbijlpark Works produces a wide range of high-grade products that include Plate, Hot Rolled Coil, Hot Rolled Pickle and Oil, Cold Rolled Coil, Electrogalvanized Coil, Hot Dipped Galvanized Coil, Galvanized Colour Coil and Tin Coil.

These products are sold locally and exported to global destinations in Europe, the Middle and Far East, North and South America, Canada, Australia and Africa (ArcelorMittal South Africa, 2015).

### 3.4 Overview of AMSA's steel plate manufacturing plant

The plate mill at the Vanderbijlpark Works was commissioned in 1943 mainly for the production of heavy plate and forms part of the hot rolling operations of the steel works (ArcelorMittal South Africa, 2015).

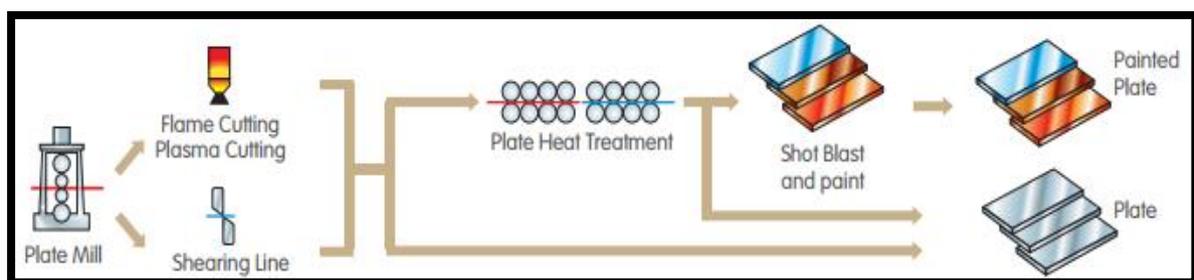
At the plate mill plant semi-finished casting products supplied from steelmaking are converted into finished products through the hot metal rolling process. Hot rolling is employed in the reduction of large steel slabs to steel plates that either form part of the end product or are further transferred to a plate treatment plant for the value adding process of heat treating.

Hot rolled plate is used in several industries and includes the manufacture of heavy engineering products such as mining, construction, pressure vessels, dump trucks, cranes, storage tanks and wind towers. ArcelorMittal South Africa's hot rolled range is available in numerous steel grades ranging from commercial quality carbon grades to structural and pressure vessels grades. The product line at the plate mill plant consists of four plate groups namely:

- Flange and Profile
- As-Rolled
- Normalised
- Quench and Temper

The steel plate production at Vanderbijlpark's Plate Mill Plant is depicted in Figure 3.4 and holds a maximum monthly output capacity of 40 000 tons (ArcelorMittal South Africa, 2015).

Figure 3.4: AMSA Plate Mill Plant Process Configuration



Source: ArcelorMittal South Africa, 2015

The four products that have been selected for this study are described in the next chapter under section 4.3.1.

### **3.5 Competiveness of the steel industry**

The mission of ArcelorMittal's plate mill at the Vanderbijlpark Works is to maintain and capture local market share and become the preferred supplier to Sub-Saharan Africa (ArcelorMittal South Africa, 2015).

The current depressed global steel market has steel companies at present wrestling to improve its market standing. The competitive rivalry has increased over the past few years with large exports from China and developed Asia threatening the existing market share of established steel products. The competitive rival in the steel industry is further fuelled by the weak differentiation of products, the low switching costs for customers and the presence of major international players.

At present the global overview indicates an overall decline in steel demand with steel output decreasing slowly creating an oversupply of steel. China's slowing economy has resulted in the oversupply of steel to its local market. Global overcapacity of steel has been driven by China's low-cost exports. Steel prices have been tumbling.

As with the global steel prices, steelmaking commodity prices have fallen sharply since 2014 and China has led a commodity rout that has sent raw materials prices skidding in the third quarter of 2015. Iron ore and coal, the two key components used in steelmaking have seen its prices slide by 48% and 23% respectively from a year ago. The five year average also indicates a progressively decline in the price of these two raw materials. The fall of the commodity prices was largely due to the slowing demand from China and excessive supply.

The progressive price decline of raw materials used in the steelmaking process is the result of the decline in the demand and the current oversupply steel worldwide.

Steel businesses are under increasing pressure to optimise and advance its operations in order to improve overall profitability. To survive companies must be able to manufacture high quality, low cost products to be successful in this new environment.

### **3.6 Current costing method**

AMSA currently follows a basic costing methodology in the form of a traditional costing framework grounded on volume based allocation of overhead costs. The total overhead costs for the plant are divided evenly according to the volume of tons produced. No distinction is made between the four product groups.

As reviewed in the literature presented in chapter 2, traditional costing systems have lost relevance in the contemporary manufacturing industry. This study addresses the need for a more accurate and refined management tool to better understand the costs incurred for the manufacturing of steel plate products. A known shortcoming of the traditional costing system is that it fails to accurately assign costs and negates some of the cost drivers that may contribute to the cost of an item.

As AMSA is still utilizing the traditional costing system for the Plate Mill Plant there is a poor understanding of the true costs associated with the manufacturing of the products. An analysis of the cost structure of this plant in chapter 4 encapsulates the design and implementation of a costing system based on activity-based principles.

### **3.7 Conclusion**

The stagnant South African economy will bring about increased competition amongst competitors and competitive rivalry for market share. The National Development Plan is not yet implemented due to government regulations. Infrastructure investment has been identified in both the New Growth Path and National Development Plan as playing a critical role in the economy, both as a direct provider of services and as a catalyst for higher employment-creation, inclusive economic growth and trade competitiveness. Roos (2011:169) states that manufacturers in a highly competitive environment must have accurate costing information that is achieved through the successful rollout of an activity-based costing system.

In the next chapter a costing system based on ABC principles will be implemented for the selected plant. The objective of this chapter is to compare two costing systems for ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark in the context of the cost structure in order to achieve a better understanding of the real product costs and to identify potential overhead reduction points.

### **3.8 Chapter Summary**

This chapter provided an overview of the AMSA steel plate manufacturing plant and a brief summary of the macroeconomic environment that the South African steel industries operate in. Literature pertaining to the selected industry, its operations and its context within the world and local economy has been included in this chapter.

The comparison of two costing systems for ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark in the context of the cost structure will be completed is presented in the following chapter.

## CHAPTER 4

### EMPIRICAL CASE STUDY

#### 4.1 Introduction

The empirical study was executed through the implementation of an activity-based costing (ABC) model. This study followed a retrospective analysis of the two costing systems. Historical financial data from the plant's financial records was analysed to determine the plant's cost behaviour. A pre-post analysis determined the value of utilizing an ABC system as opposed to the traditional costing method.

The results from the study were analysed and a comparative analysis of each product costing was done. The costing variation between the two systems was also discussed to address the secondary objectives of this study.

The chapter starts by explaining the approach that the researcher undertook for this study. The research methodology is initially discussed. Thereafter the design and subsequent application of an ABC system is covered. The chapter ends with a comparative analysis of product costing under the two different costing methodologies and subsequent analysis of the cost structure in line with the primary objective of this study.

#### 4.2 Research methodology

Research methodology is described by Welman et al. (2011:2) as the logic behind the research methods and techniques that the researchers choose to conduct their work of systematically describing, explaining and predicting phenomena. The chosen theoretical analysis of the body of methods and principles prescribe the tools that the researcher selects. The research methodology that the researcher undertakes therefore refers to the tools used to meet the formulated research objectives. This empirical research study was based on a case-study approach.

Silverman and Marvasti (2008:161) state that the general objective of a case study is to develop a full understanding of the situation. Such a study must have clearly

defined boundaries, the unit of analysis must be clear and a research problem must be established in order to maintain focus.

The above analytical features have been identified for this study and narrowed down to the analysis of the cost structure of four plate products as produced by ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark. The research problem focuses on the lack of sufficient management accounting information required to make strategic decisions with regard to product costing and profitability analysis.

The implementation of an ABC system to provide a framework for the cost analysis of the selected products forms the foundation of this empirical study. This study is based on systematic observation and quantitative measurement of financial data.

#### **4.2.1 Method of data collection**

Primary information as required for this study was collected by means of interviews, examination and analysis of financial information and analysis of the production processes.

The reviewed literature in chapter two indicates that there are three sources for the information needed to develop an ABC system namely; people, the general ledger and the organisation's information systems.

##### **4.2.1.1 Interviews**

Interviews are one of the most essential sources of information in a case study. Two types of interviews were used for this study namely structured and semi-structured interviews.

An initial structured interview was conducted with the General Manager of ArcelorMittal South Africa to discuss the approach needed for improving the plate mill's profitability. It was suggested that an analysis of the plate mill's cost structure be conducted in order to identify areas where costs can be reduced.

Mowen et al. (2014:259) state that information that is fundamental in identifying activities for the design of an accurate ABC system can mostly be identified through

interviews. Interviews were conducted with personnel from both the financial department and the production department to identify the primary and secondary activities at the Plate Mill Plant.

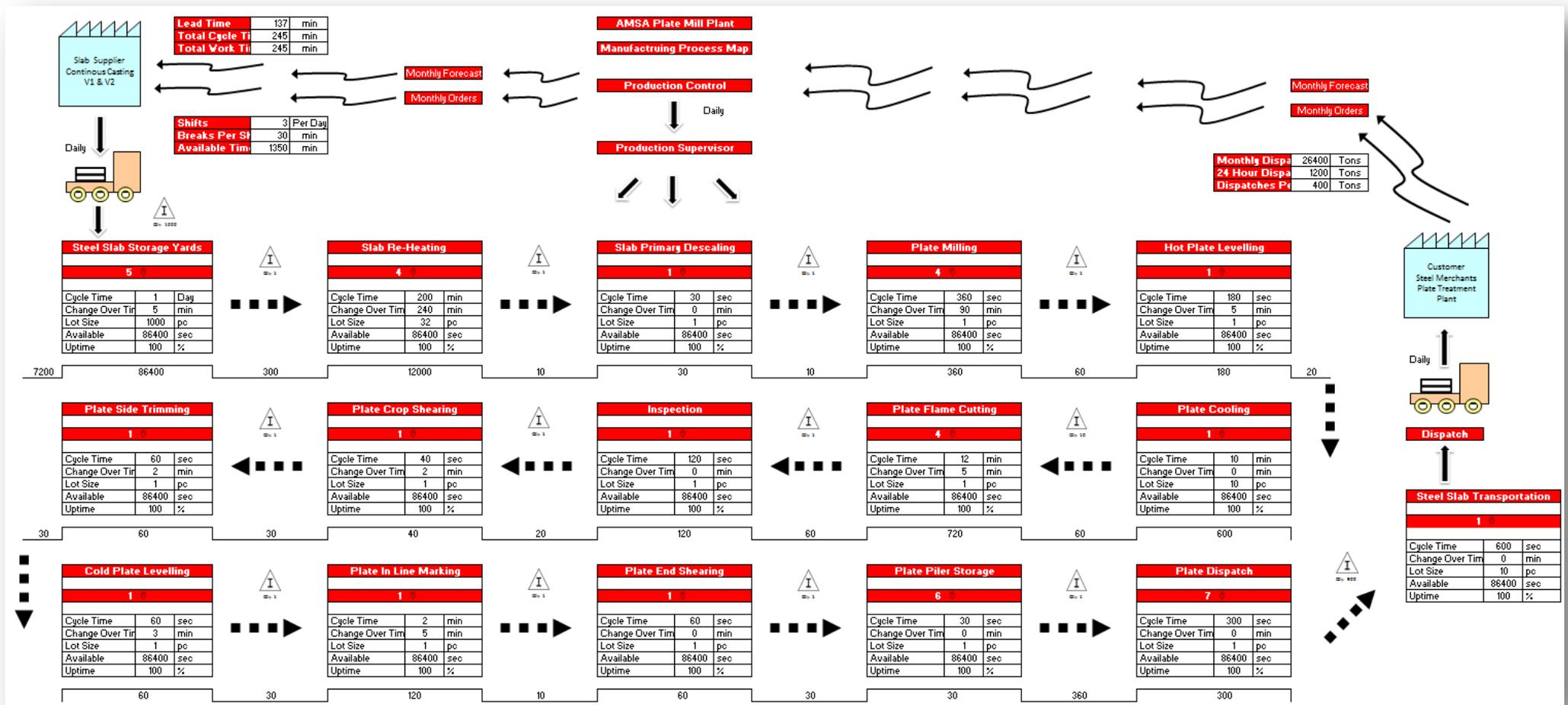
Subsequent semi-structured interviews were conducted with representatives from both the accounting and marketing departments, which included departmental managers, accountants and marketers to develop an understanding of the current costing structure which is based on traditional costing principles. Total product costs, allocation methods and product pricing were discussed.

Follow-up interviews were conducted to analyse the cost structure of the Plate Mill Products. Information gathered from interviews conducted with production and engineering personnel was used in conjunction with accounting data to identify the activities and the percentage of time spent on each activity. The information gathered during the interviews was documented by the researcher.

#### **4.2.1.2 Analysis of the production process**

As ABC is process orientated, a detailed study of business processes and costs forms the first step of implementing an ABC system. For this study the current state of the plate mill process was analysed through the value stream mapping method in order to generate a material and information flow map. Process mapping and value stream analysis assist to document and organise the results of the data collected to ensure that it is complete and understandable. The data was gathered through an interview process. The plant management, production specialists and production personnel were interviewed and relevant production documentation was studied for the purpose of gathering and understanding the production processes at the plate mill plant. Figure 4.1 illustrates the plate mill value chain.

Figure 4.1: Plate Mill Plant Value Stream Map



Source: Own Research

#### **4.2.1.3 Productivity measures**

In order to develop a comprehensive list of the activities, productivity measure instruments were used to capture each task that is required in the steel plate production process. Once the business processes were understood the activities that are central to the cost allocations were selected for this study. The information was then utilised to identify the cost pools and cost drivers.

#### **4.2.1.4 Analysis of financial information**

The financial records of the plate mill were examined to determine the cost of resources consumed for the production of plates. For the purpose of this study it was decided that financial information for the year 2014 will be used.

The information gathered from the financial records was then used to assign the costs to the activities as per literature reviewed in chapter two. The financial records that were reviewed included:

- The plate mill global cost books for the financial year 2014.
- The income statements for the plate mill plant for the financial year 2014
- The general ledger for the plate mill plant for the financial year 2014.
- The Profitability Management Process (PMP) pricing model for the plate mill product range for the financial year 2014.

### **4.3 Implementation of the ABC system**

In order to address the primary objective of this study and analyse the cost structure of this industrial plant, a costing system that can more accurately and reliably determine the costs of the products was selected to do the comparisons between the two costing systems.

According to the literature as reviewed in chapter 2 of this mini-dissertation, the ABC system has been found to be a more accurate and reliable costing system than the traditional costing system. This costing system provides greater costing accuracy and eliminates the allocation of irrelevant costs to a product.

It is hypothesised that through the implementation and subsequent result analysis of an ABC model for the Plate Mill plant internal management at AMSA will be provided with a more accurate view of its product cost and have an improved understanding of costs for benchmarking. By accurately identifying the cost drivers of the products and understanding the overhead costs more informed decisions could be made by management with regard to the manufacturing of certain products.

Consequently the focus of this case-based study is on the comparative analysis of the plate product costing system as done for ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark by applying ABC principles.

The literature review in chapter two indicates the implementation process for an ABC system to a five-step procedure. The process includes the following steps that will be used in this empirical study to complete the comparison of the two different costing methodologies:

1. Identify activities.
2. Define activity cost pools.
3. Assign cost to activity cost pools.
4. Calculate activity rates.
5. Assign cost to cost objects using the activity rates and activity measures.
6. Prepare management reports.

Steps 1 to 5 have been used in this study. After implementing the discussed steps the chapter is concluded with a section that compares the product costing results of the ABC system to that of the traditional costing method.

#### **4.3.1 Plate Mill activities**

The purpose of ABC is to measure how much effort is consumed in executing a specific task. According to Garrison et al. (2012:277) personnel who are knowledgeable of each functional work area must be interviewed in order to identify their major activities. The information derived from the above interview process may then be listed in an organisational activity list. Attributes including both financial and non-financial data such as time spent on an activity, type of resources consumed

and measure of activity output amongst others are then assigned to each activity. (Mowen et al., 2014:261)

An activity may directly support both final objects and intermediate cost objects. Costs accumulated in these cost objects are distributed to either final cost objects or other activities based on the demand for these activities, resources or services. This step in the activity-based product cost identifies the activities performed in the production of plates at ArcelorMittal South Africa. It was completed through semi-structured interviews with the staff members from the production, maintenance, sales and marketing, accounting and logistic departments. Once the activities were defined the time spent and the resources consumed were tracked. Initially a high level of detail was identified and subsequently related activities were consolidated into larger activities in order to improve the accuracy of the information. Error-free distinction between activities was recognised and used for each cost object as documented in the ensuing sections.

From the processes documented in chapter three the subsequent activities as presented in the following four sections have been determined for the four products manufactured at the plate mill.

#### **4.3.1.1 Product 1: As Rolled plates**

As described in chapter three the Plate Mill plant forms part of the hot rolling operations of the steel works where hot rolling is employed in the reduction of large steel slabs to steel plates.

The As Rolled production process starts at the slab yards where slabs are received from steel making. Once the slabs are offloaded from the transport cars the slabs are identified, marked, inspected and cut to order. Thereafter the slabs are charged into the reheating furnaces.

During this value adding step the slabs are re-heated to about 1250°C. Production planning schedules the slabs for production according to a specific sequence. The slabs have a cast and a serial number as well as a program and a sequence number. According to the program and sequence number the slabs are charged into the furnace. This specific sequence is then maintained throughout the process. The

duration of this process is dependent on the rolling schedule of various sized slabs and the efficiency of the furnace.

Once the slab re-heating process has been concluded the slab is dropped out of the furnace onto a roller table and transferred to the primary descaling unit. Here the slab is descaled, that is primed for the rolling process, by applying water at a pressure of about 6 MPa through a special set of nozzles. The descaled slab is then transferred along the roller table to the plate mill.

The 3650mm 4-high reversing plate mill is powered by two 3700 KW electric motors. In this value adding step the slab is rolled into a plate. After the rolling process a plate will require levelling. The hot leveller is used to remove the waviness from the material by means of a bending process.

The cooling beds serve as a buffer in this process. Here the material is given time to cool down before it is processed further as depending on the plate's thickness it can be as hot as 1000°C after levelling. The plate's temperature drops down to between 150°C and 600°C during this process.

The cutting process to be followed depends on the thickness of the slab. Processed material thicker than 18 mm is now identified and piled at the flame-cut piler. Here the material will cool down further, be cut to size and thereafter dispatched for defect inspection.

Plates that are thinner than 18mm are transferred to the Schloemann shear line by means of a transfer bed. Once at the crop shear the front-end of the plate is cropped while the side trimmer cuts the plate to width. Cold levelling is then used on the plate to press out any shape deformations that might have occurred during the cooling process.

Once level the plate is transferred to the in line marking equipment where each plate is marked with its cast and serial numbers, grade and dimensions by means of ink jet sprays.

The plate at the end shear is cut to its final length and is then transferred to the piler bed where an inspector checks the plate’s final dimensions and identification markings for correctness. The plates are then piled into useable stacks as required by the customer. From the dispatch area the plates are dispatched to the customer.

With the aid of the value stream mapping process, interviews with production personnel and the evaluation of the results as captured from the productivity measurement instrument the following activities have been identified for the As Rolled cost object and presented below in

Table 4.1: As Rolled Product: Activity Identification. The resource types have been classified according to direct labour (DL), direct materials (DM), indirect labour (IDL) and indirect materials (IDM).

Table 4.1: As Rolled Product: Activity Identification

Cost Object	Main Activities	Resource	Resource Type	Activity Measure
As Rolled Plate	Process customer order	Customer Service	IDL, IDM	No. of orders
	Order raw materials	Procurement	IDL, IDM	No. of orders
	Receive raw materials	Scheduling	DL, IDL	No. of slabs
	Handling of materials	Warehousing	DL, IDM	No. of slabs
	Heating of slabs	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Descaling of slab	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Milling of slab	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Levelling of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Cooling of plate	Manufacturing	DL, DM, IDM, IDL	Production hours
	Inspection of plate	Manufacturing	DL, DM, IDM, IDL	Labour hours
	Flame Cutting	Manufacturing	DL, DM, IDM, IDL	No. of cuts
	Plasma Cutting	Manufacturing	DL, DM, IDM, IDL	No. of cuts
	Cropping of plate	Manufacturing	DL, DM, IDM, IDL	No. of cuts
	Trimming of plate	Manufacturing	DL, DM, IDM, IDL	No. of cuts
	Marking of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Stacking of plates	Manufacturing	DL, DM, IDM, IDL	No. of plates
	Dispatch of final product	Logistics	IDL, IDM	No. of plates

Source: Own Research

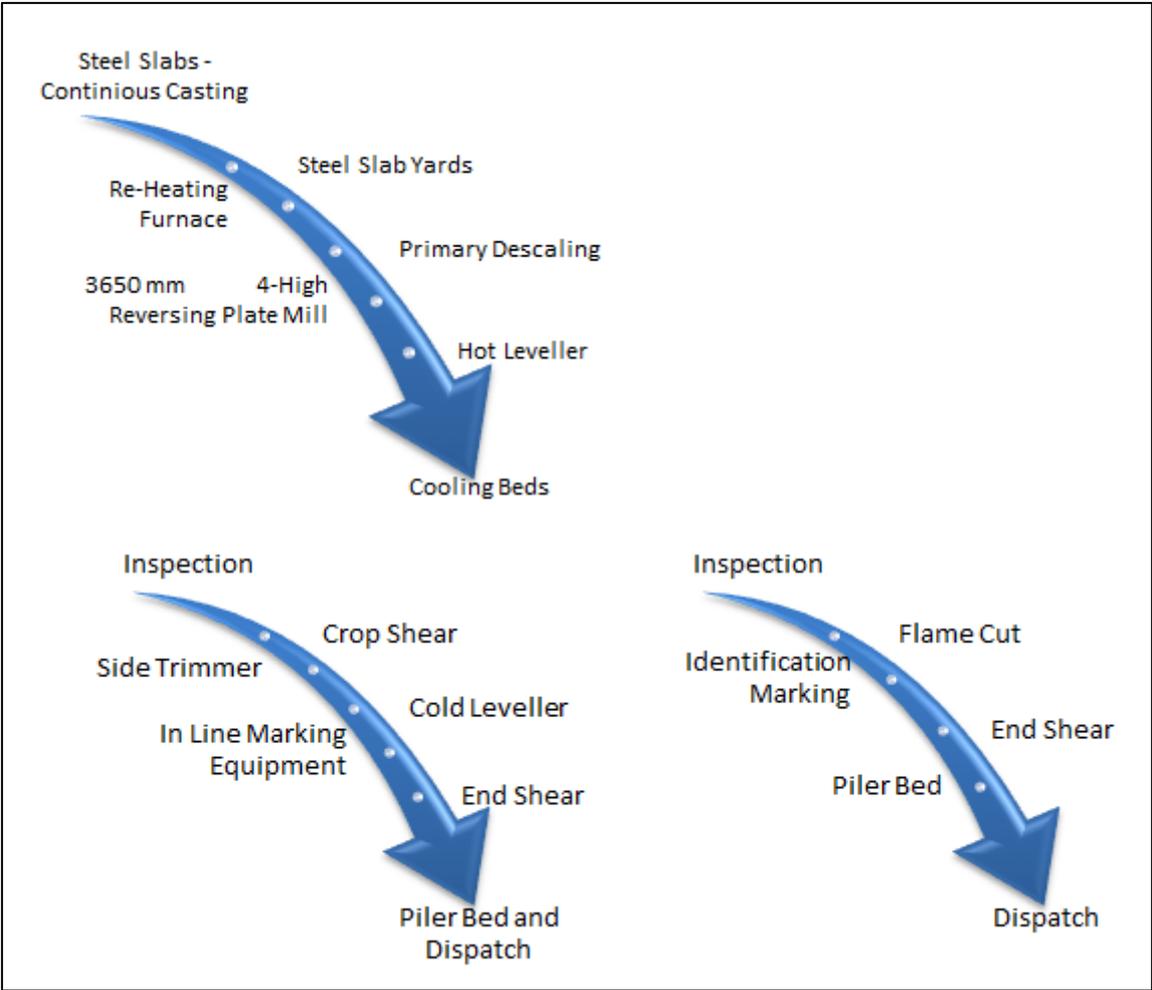
Once the activities were defined the time spent and the resources consumed were tracked. Initially a high level of detail was identified and subsequently related

activities were consolidated into larger activities in order to improve the accuracy of the information.

**4.3.1.2 Product 2: Flange and Profile plates**

The Flange and Profile plates follow a similar process to that of the As Rolled product. The type and level of activity consumption differs to that of the AS Rolled product. The process flows for this product are depicted in the figure below.

Figure 4.2: Flange and Profile Process Flow



Source: Own Research

Table 4.2 presents the 14 main activities involved in the production of the Flange and Profile plates. These main activities include creating of the customer order, ordering of raw materials, receiving of raw materials, handling of materials, reheating of the

slabs, descaling of the slab, milling of the slab, levelling of the plate, cooling of the plate, inspecting the plate, cutting of the plate, marking of the plate, stacking of the plates and the final dispatch of the product.

The resources consumed as well as the resource type per main activity have been captured. The cost drivers for each activity were identified through interviews and observation. The activity measure has also been included in the table below. The same process was followed for the other three products.

Table 4.2: Flange and Profile Product: Activity Identification

Cost Object	Main Activities	Resource	Resource Type	Activity Measure
Flange & Profile Plate	Process customer order	Customer Service	IDL, IDM	No. of orders
	Order raw materials	Procurement	IDL, IDM	No. of orders
	Receive raw materials	Scheduling	DL, IDL	No. of slabs
	Handling of materials	Warehousing	DL, IDM	No. of slabs
	Heating of slabs	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Descaling of slab	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Milling of slab	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Levelling of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Cooling of plate	Manufacturing	DL, DM, IDM, IDL	Production hours
	Inspection of plate	Manufacturing	DL, DM, IDM, IDL	Labour hours
	Cutting of plate	Manufacturing	DL, DM, IDM, IDL	No. of cuts
	Marking of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Stacking of plates	Manufacturing	DL, DM, IDM, IDL	No. of plates
	Dispatch of final product	Logistics	IDL, IDM	No. of plates

Source: Own Research

#### 4.3.1.3 Product 3: Normalised plates

The production of the normalised plates starts at the plate mill plant and follows a similar process as described for the As Rolled product. Once the plate has been converted to a slab it is transferred to a plate heat treatment plant. At the Plate Treatment Plant, plates are processed through a combination of heat treating processes in order to enhance their qualities in hardness and toughness. The process is described in the proceeding paragraphs.

Firstly, plates from the plate mill are transferred to the ultrasonic testing bed at the Plate Treatment Plant. Here the plates are checked for internal impurities by performing ultrasonic tests with a mobile unit. An inspector moves the tester in a grid pattern according to the specification and marks the area if a defect is discovered.

Following the ultrasonic testing of the plates, the plates may be shotblasted to remove scale before being sent to the normalising furnace for heat treating. The plates are charged into the furnace and reheated to 910°C for a period of 1.6 min/mm to 2.4 min/mm of plate thickness.

Once the plates have been normalised, plates that do not conform and are not within the flatness tolerances are passed through the hot leveller. Straighting of the plate is achieved through the bending process. After heat treating and levelling of the plate, the plates are transferred to the hardness and flatness tables where inspection for hardness and flatness occurs. Plates not conforming to the specifications are either retreated or scrapped.

Prime plates are then inspected and cut to size on a plasma cutting machine. After cutting the final inspection is done to ensure that the product complies with AMSA's quality plan. Thereafter, the plate is marked with its cast and serial numbers, grade and dimensions by means of a portable marking machine. The plates are then piled into useable stacks as required by the customer and dispatched. Table 4.3 presents the 17 main activities as required for the production of Normalised plates.

Table 4.3: Normalised Product: Activity Identification

Cost Object	Main Activities	Resource	Resource Type	Activity Measure
Normalised Plate	Process order	Customer Service	IDL, IDM	No. of orders
	Order raw materials	Procurement	IDL, IDM	No. of orders
	Receive raw materials	Scheduling	DL, IDL	No. of slabs
	Handling of materials	Warehousing	DL, IDM	No. of slabs
	Heating of slabs	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Descaling of slab	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Milling of slab	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Levelling of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Cooling of plate	Manufacturing	DL, DM, IDM, IDL	Production hours
	Inspection of plate	Manufacturing	DL, DM, IDM, IDL	Labour hours
	Transfer of plates	Logistics	IDL, IDM	Labour hours
	Ultrasonic Testing	Manufacturing	DL, DM, IDM, IDL	Labour hours
	Shotblasting	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Hardening of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Levelling of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Plasma cutting of plate	Manufacturing	DL, DM, IDM, IDL	No. of cuts
	Marking of plate	Manufacturing	DL, DM, IDM, IDL	Labour hours
	Dispatch of final product	Logistics	IDL, IDM	No. of plates

**4.3.1.4 Product 3: Quench and Temper plates**

Table 4.4 shows the 20 main activities involved in the production of the Quench and Temper plates.

As can be seen from the activities list below, the Quench and Temper plates follow a similar process to that of the Normalised product. However, the type and level of activity consumption differs between the two products. The production process starts to vary once the plate is discharged from the hardening furnace.

As the plate leaves the hardening furnace it moves directly into the quenching unit that consists of a high pressure as well as a low pressure system. The plate is quenched to harden its characteristics. A rapid cooling rate of approximately 400°C per second cools the plate down to ambient temperature. After quenching the plate is levelled and transferred to the tempering furnace for further heat treatment.

Tempering of the plate requires the reheating of the product in the tempering furnace to temperatures between 200°C and 690°C. This is done to obtain the desired strength and toughness levels for the product. The tempered plate is then transferred to the cutting units and cut to size.

Priming of the plates through a shotblasting machine and subsequent concludes the production process. The plate is then moved to the dispatch bay.

Table 4.4: Quench and Temper Product: Activity Identification

Cost Object	Main Activities	Resource	Resource Type	Activity Measure
Q&T Plate	Process customer order	Customer Service	IDL, IDM	No. of orders
	Order raw materials	Procurement	IDL, IDM	No. of orders
	Receive raw materials	Scheduling	DL, IDL	No. of slabs
	Handling of materials	Warehousing	DL, IDM	No. of slabs
	Heating of slabs	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Descaling of slab	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Milling of slab	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Levelling of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Cooling of plate	Manufacturing	DL, DM, IDM, IDL	Production hours
	Inspection of plate	Manufacturing	DL, DM, IDM, IDL	Labour hours
	Transfer of plates	Logistics	IDL, IDM	Labour hours
	Ultrasonic Testing	Manufacturing	DL, DM, IDM, IDL	Labour hours
	Hardening of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Shotblasting	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Levelling of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Tempering of plate	Manufacturing	DL, DM, IDM, IDL	Machine hours
	Plasma cutting of plate	Manufacturing	DL, DM, IDM, IDL	No. of cuts
	Priming of plate	Manufacturing	DL, DM, IDM, IDL	No. of plates
	Marking of plate	Manufacturing	DL, DM, IDM, IDL	Labour hours
	Dispatch of final product	Logistics	IDL, IDM	No. of plates

Source: Own Research

#### 4.4 Identification of activity cost pools

Once the activities were defined the time spent and the resources consumed were tracked for each. Initially a high level of detail was identified and subsequently related

activities were consolidated into larger activities in order to improve the accuracy of the information.

As per the literature reviewed in chapter two of this study, once the activities were identified the next step in the implementation process of an ABC is to group the activities into an activity cost pool.

The cost pools into which the activities are accumulated and the cost driver for each cost pool have been determined by the researcher through interviews with AMSA personnel as well as the analysis of financial information.

A proposed activity cost pool is presented below in Table 4.5 for the Plate Mill section.

Table 4.5: Plate Mill Activity Cost Pool

Main Activities	Resource	Level
Process customer order	Customer Service	Unit Level
Handling of materials	Logistics	Batch Level
Heating of product	Manufacturing	Batch Level
Milling of product	Manufacturing	Unit Level
Cutting of plate	Manufacturing	Unit Level
Plate Shearing	Manufacturing	Unit Level
Hardening of plate	Manufacturing	Unit Level
Tempering of plate	Manufacturing	Unit Level
Priming of plate	Manufacturing	Unit Level
Transport of product	Logistics	Batch Level

Source: Own Research

#### 4.5 Assigning costs to activity cost pools

Cost assignment in ABC is based on the amount of usage and consumption. A cause and effect relationship must exist between the resource and the cost object. Thus when a resource is not used by an activity, the resource’s costs are not allocated to it.

First-stage allocation involves the assigning of costs to activity cost pools via an allocation process (Garrison et al., 2006:325). In order to determine the allocation

percentage of the costs to be assigned to the activity cost pools, interviews were conducted with personnel who are knowledgeable of the activities. Garrison et al. (2006:325) highlight the importance of conducting quality interviews with the appropriate staff members who are involved in the activities. For the distribution of non-personnel costs, departmental managers were questioned on how these costs should be allocated to the activity cost pools. Once the percentages of the allocation costs had been determined, costs were assigned to the determined activities as per Table 4.6.

Table 4.6: Allocation of Overheads to Activities

Main Activities	Cost Driver	Total
Process customer order	Number of Orders	R 49 944
Handling of materials	Number of Slabs	R 2 686 813
Heating of product	Number of Production Machine Hours	R 13 796 005
Milling of product	Number of Production Machine Hours	R 34 831 107
Cutting of plate	Number of Cuts	R 7 882 563
Plate shearing	Number of Cuts	R 3 777 488
Hardening of plate	Number of Production Machine Hours	R 5 102 185
Tempering of plate	Number of Production Machine Hours	R 1 359 896
Priming of plate	Number of Plates	R 48 883
Transport of product	Weight of Order	R 7 380 426
<b>Total Overhead Cost</b>		<b>R 76 915 311</b>

Source: Own Research

#### 4.6 Activity cost matrix

In order to develop an activity cost matrix, the allocated overheads as per Table 4.6: Allocation of Overheads to Activities were assigned to the four different products based on each product’s consumption of resources and activities. This differs to the current costing method. On the current costing system the total overheads are divided by the total product volume in tonnage as per the throughput at each machine. No distinction is made between the product groups. The difference in time that each product group consumes per activity is also not considered.

The table below presents a matrix of the total utilization of activities for each product. The consumption of each activity is dependent on the utilization of the different cost drivers. The cost drivers have been identified for each activity in tables 4.1 to 4.4 as

activity measures and consolidated into an activity cost pool as per Table 4.5: Plate Mill Activity Cost Pool. The following paragraph discusses the cost drivers for each activity as determined through the process mapping technique, semi-structured interviews and a productivity questionnaire.

The activity driver for processing of the customer orders is the number of orders that were processed by the marketing and sales department. The handling of material was dependent on the number of slabs received from steel making and the time it took for the material to be offloaded, inspected and stacked. The process related activities are all based on the consumption of each machine’s time to process the different products. The total time as consumed per each product group is captured in the table below.

Table 4.7: Activity Utilization Matrix per Product

Main Activities	As Rolled	Profile & Flanges	Normalised	Quenched & Tempered	Total
<b>Demand (Tons)</b>	<b>79 909</b>	<b>31 551</b>	<b>20 974</b>	<b>3 137</b>	<b>135 571</b>
Process customer order	1 439	588	463	66	2 556
Handling of materials	26 636	10 517	6 991	1 046	45 190
Heating of product	209 771	86 090	55 061	4 968	355 890
Milling of product	19 955	17 668	11 746	1 255	50 623
Cutting of plate	39 955	15 775	10 487	1 568	67 786
Plate Shearing	93 227	-	24 470	3 659	121 357
Hardening of plate	-	-	187 456	61 840	249 296
Tempering of plate	-	-	-	61 840	61 840
Priming of plate	-	-	-	215	215
Transport of product	79 909	31 551	20 974	3 137	135 571

Source: Own Research

**4.7 Calculation of activity rates**

The total number of consumption was captured in the activity utilisation matrix. To determine the activity rate at which the overheads were consumed, the total overhead amount per each activity was divided by the relevant total number of consumed activities as per the following formula:

$$\text{Activity rate per unit} = \text{Overhead activity cost} / \text{Amount of consumed activity}$$

Table 4.8 below summarises the rates per activity.

Table 4.8: Activity Rates

Activity	Total Activity	Total Overheads	Activity Rate
Process customer order	2 556	R 49 944	R 19.54
Handling of materials	45 190	R 2 686 813	R 59.46
Heating of product	355 890	R 13 796 005	R 38.76
Milling of product	50 623	R 34 831 107	R 688.04
Cutting of plate	67 786	R 7 882 563	R 116.29
Plate Shearing	121 357	R 3 777 488	R 31.13
Hardening of plate	249 296	R 5 102 185	R 20.47
Tempering of plate	61 840	R 1 359 896	R 21.99
Priming of plate	215	R 48 883	R 227.36
Transport of product	135 571	R 7 380 426	R 54.44
<b>Total</b>		<b>R 76 915 311</b>	

Source: Own Research

The cost per activity for each steel plate product was calculated by multiplying the calculated activity rate by the total activity consumed by each product. The activity costs for the As Rolled, Flange and Profile, Normalised and Quenched and Tempered product ranges are presented in the following four tables (Table 4.9, Table 4.10, Table 4.11 and Table 4.12).

Table 4.9: Total Activity Costs for As Rolled Product

As Rolled Plate	Demand	Activity Rate	Value
Process customer order	1 439	R 19.54	R 28 117.92
Handling of materials	26 636	R 59.46	R 1 583 680.14
Heating of product	209 771	R 38.76	R 8 131 736.59
Milling of product	19 955	R 688.04	R 13 729 647.99
Cutting of plate	39 955	R 116.29	R 4 646 195.15
Plate Shearing	93 227	R 31.13	R 2 901 898.08
Hardening of plate	-	R 20.47	R 0.00
Tempering of plate	-	R 21.99	R 0.00
Priming of plate	-	R 227.36	R 0.00
Transport of product	79 909	R 54.44	R 4 350 221.93
<b>Total</b>	-	-	<b>R 35 371 497.81</b>

Source: Own Research

Table 4.10: Total Activity Costs for Profile & Flange Product

Profile & Flange Plate	Demand	Activity Rate	Value
Process customer order	588	R 19.54	R 11 489.46
Handling of materials	10 517	R 59.46	R 625 289.31
Heating of product	86 090	R 38.76	R 3 337 265.00
Milling of product	17 668	R 688.04	R 12 156 667.34
Cutting of plate	15 775	R 116.29	R 1 834 471.54
Plate Shearing	-	R 31.13	R 0.00
Hardening of plate	-	R 20.47	R 0.00
Tempering of plate	-	R 21.99	R 0.00
Priming of plate	-	R 227.36	R 0.00
Transport of product	31 551	R 54.44	R 1 717 611.53
<b>Total</b>	-	-	<b>R 19 682 794.18</b>

Source: Own Research

Table 4.11: Total Activity Costs for Normalised Product

Normalised Plate	Demand	Activity Rate	Value
Process customer order	463	R 19.54	R 9 046.98
Handling of materials	6 991	R 59.46	R 415 682.68
Heating of product	55 061	R 38.76	R 2 134 409.60
Milling of product	11 746	R 688.04	R 8 081 564.87
Cutting of plate	10 487	R 116.29	R 1 219 528.37
Plate Shearing	24 470	R 31.13	R 761 687.13
Hardening of plate	187 456	R 20.47	R 3 836 544.44
Tempering of plate	-	R 21.99	R 0.00
Priming of plate	-	R 227.36	R 0.00
Transport of product	20 974	R 54.44	R 1 141 841.64
<b>Total</b>	-	-	<b>R 17 600 305.72</b>

Source: Own Research

Table 4.12: Total Activity Costs for Quenched & Tempered Product

Q&T Plate	Demand	Activity Rate	Value
Process customer order	66	R 19.54	R 1 289.63
Handling of materials	1 046	R 59.46	R 62 161.24
Heating of product	4 968	R 38.76	R 192 593.48
Milling of product	1 255	R 688.04	R 863 227.30
Cutting of plate	1 568	R 116.29	R 182 368.43
Plate Shearing	3 659	R 31.13	R 113 902.79
Hardening of plate	61 840	R 20.47	R 1 265 640.52
Tempering of plate	61 840	R 21.99	R 1 359 895.68
Priming of plate	215	R 227.36	R 48 882.96
Transport of product	3 137	R 54.44	R 170 751.14
<b>Total</b>	<b>-</b>	<b>-</b>	<b>R 4 260 713.16</b>

Source: Own Research

Table 4.13 presents a summary of the activity costs as determined for each product per ton of production. The activity cost rate was determined by dividing the total activity cost of each product (see Table 4.9, Table 4.10, Table 4.11 and Table 4.12) by its relevant production volume.

Table 4.13: Activity Cost per Ton of Product

Product	Volume (Tons)	Total Activity Cost	Cost / Ton
As Rolled	79 909	R 35 371 497.81	R 442.65
Profile & Flanges	31 551	R 19 682 794.18	R 623.84
Normalised	20 974	R 17 600 305.72	R 839.13
Quenched & Tempered	3 137	R 4 260 713.16	R 1 358.42
<b>Total Overheads</b>	<b>135 571</b>	<b>R 76 915 310.87</b>	

Source: Own Research

#### 4.8 Comparison of the two costing systems

The present costing system utilised for ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark is based on traditional costing principles. A deficiency of the traditional costing system is that it fails to accurately assign costs and excludes certain non-manufacturing costs.

ArcelorMittal South Africa has adopted a traditional costing methodology for its entire steel works in Vanderbijlpark. The aim of this study was to compare two costing

systems in order to determine if the product costs as calculated according to their current methodology is accurate as opposed to a costing system that makes use of activity-based principles.

The previous section of this chapter focused on the implementation steps for an ABC system. The steps were implemented in order to determine the activity costs of each product group as produced by ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark.

In this section the two costing methodologies will be compared and the costing for each product discussed.

#### **4.8.1 Product cost**

The total manufacturing cost includes the costs of consumed resources that are required in producing a product. To determine the manufacturing cost of a product three cost categories are summated. The costs are classified as either direct material, direct labour or manufacturing overhead.

Comparing the costing methodologies of the two systems, it is evident that the cost of direct material as required for the production of a product will not change. Raw material costs will remain the same. The major difference lies in the allocation of overhead costs to each product. On the current costing system the total overheads are divided by the total product volume in tonnage as per the throughput at each machine. For a production volume of 135 571 tons the total overheads of R76 915 310.87 amount to R567.34 per ton of product for the financial period demarcated for this study.

The focus of ABC lies in determining activity drivers that consume various activities that require resources. According to literature reviewed in chapter two of this study, traditional costing systems were appropriate when manufacturing costs were largely driven by direct labour. In the contemporary environment, direct labour costs now contribute a significantly smaller percentage to the total cost of manufacturing as overhead costs have significantly risen.

The ABC approach seeks to assign manufacturing overhead costs to the activities consumed by each cost object. The activity cost rates as calculated for the plate

products in Table 4.13: Activity Cost per Ton of Product will now be used to calculate the total cost of sales of each product. The product costing will then be compared to the traditional costing method and the profitability of each product will be discussed.

**4.8.2 Activity-Based Costing versus Traditional Costing**

Currently the overhead costs are determined during the budgeting process which is done annually. The budgeted expenses are based on annual forecasted production volumes. In order to determine if product cost distortion occur under the current system, the cost of sales as utilised for each product was compared between the activity-based and traditional costing methodologies. The results of the empirical study are evaluated in the next four sections with regard to each products costing.

**4.8.2.1 As Rolled product costs**

The empirical study shows a slight costing difference for the As Rolled product as compared between the two costing methodologies. The results are presented in the table below.

Table 4.14: As Rolled Product - Costing Comparison between Traditional Costing and ABC

Traditional Costing vs. Activity-Based Costing	Plate Product: As Rolled (Per Ton Cost)		
	Traditional	ABC	Difference
<b>Raw Materials</b>	R 6 642.58	R 6 642.58	R 0.00
<b>Labour</b>	R 624.08	R 624.08	R 0.00
<b>Overheads</b>	R 567.34	R 442.65	R 124.70
<b>Total</b>	<b>R 7 834.00</b>	<b>R 7 709.30</b>	<b>R 124.70</b>

Source: Own Research

The information derived from the empirical research indicates that the cost of goods sold based on the ABC methodology was R124.70 less than the costing done according to the traditional method. The cost of this product per ton is overstated by a relatively small but significant amount of 1.59%. Overstated products have a higher cost of sales value that lead to higher pricing. Higher prices due to product cost distortions might not be desirable in a highly competitive climate as higher pricing may lead to loss of clientéle and market share.

As described in chapter three, the current macro environment for the steel is extremely competitive. A slow demand for steel coupled with a stagnant economy has made customers highly sensitive to steel prices.

Therefore the currently overstated As Rolled product may not be beneficial to ArcelorMittal South Africa. By following the current traditional costing methodology, the costing will lead to a variance of R124.70 per ton. For the demand of 79 909 tons the difference amounts to R 9 964 652.30 as calculated below.

$$\begin{aligned}
 \text{As Rolled Margin Variance} &= \text{Difference in cost of sales} \times \text{demand} \\
 &= R124.70 \times 79\,909\text{t} \\
 &= R\,9\,964\,652.30 \text{ (Overstated)}
 \end{aligned}$$

This variance is due to the shortcoming in the allocation of the conversion cost to the entire product range. It is evident that this product carries the loss of other products manufactured at this plant and its true margins have been distorted.

**4.8.2.2 Profile and Flanges product costs**

The comparison of the costing between the two methodologies reveals a costing difference of R 56.50 for the Flange and Profile product. The product costing calculation results have been summarised in the table below.

Table 4.15: Profile and Flanges Product - Costing Comparison between Traditional Costing and ABC

Traditional Costing vs. Activity-Based Costing	Plate Product: Profile & Flanges (Per Ton Cost)		
	Traditional	ABC	Difference
Raw Materials	R 4 359.58	R 4 359.58	R 0.00
Labour	R 624.08	R 624.08	R 0.00
Overheads	R 567.34	R 623.84	-R 56.50
<b>Total</b>	<b>R 5 551.00</b>	<b>R 5 607.50</b>	<b>-R 56.50</b>

Source: Own Research

As presented in Table 4.15, the cost of this product is understated by 1.02% per ton. By calculating the cost of sales under the ABC methodology and comparing it to the current system, a variance of -R 1 782 631.50 is evident as per the calculation below.

$$\begin{aligned}
\text{Profile and Flanges Variance} &= \text{Difference in cost of sales} \times \text{demand} \\
&= -R 56.50 \times 31\,551\text{t} \\
&= -R 1\,782\,631.50 \text{ (Understated)}
\end{aligned}$$

Thus the conversion costs are under recovered for the Flange and Profile product. With a lower cost of sales the margin could be slightly greater under the traditional costing. The understated costs are carried by the As Rolled product as exposed in the previous section, making this product not as profitable as initially determined.

**4.8.2.3 Normalised product costs**

As with the Flange and Profile product, the Normalised product range done under the traditional costing method is also understated. The product is understated by 3.35% which is equivalent to R 271.18 per ton. The variance amounts to -R 5 686 644.60 for the production volume of 20 970 tons.

Table 4.16: Normalised Product - Costing Comparison between Traditional Costing and ABC

Traditional Costing versus Activity-Based Costing	Plate Product: Normalised (Per Ton Cost)		
	Traditional	ABC	Difference
Raw Materials	R 6 929.17	R 6 929.17	R 0.00
Labour	R 624.08	R 624.08	R 0.00
Overheads	R 567.34	R 839.15	-R 271.81
<b>Total</b>	<b>R 8 120.59</b>	<b>R 8 392.39</b>	<b>-R 271.81</b>

Source: Own Research

**4.8.2.4 Quenched and Tempered Product Costs**

The final product that was reviewed under the ABC methodology was the Quenched and Tempered plate. As with the prior two products, this product is significantly understated on the traditional costing system. The difference of the cost of sales between the two costing methodologies is the greatest and amounts to 8.30% (See Table 4.17). As this is a low volume product the final monetary figure is considerably

lower than the variance calculated for the first three products. The difference is calculated below:

$$\begin{aligned}
 \text{Quench and Temper Variance} &= \text{Difference in cost of sales} \times \text{demand} \\
 &= -R\ 790.87 \times 3\ 137t \\
 &= -R\ 2\ 480\ 959.19 \text{ (Understated)}
 \end{aligned}$$

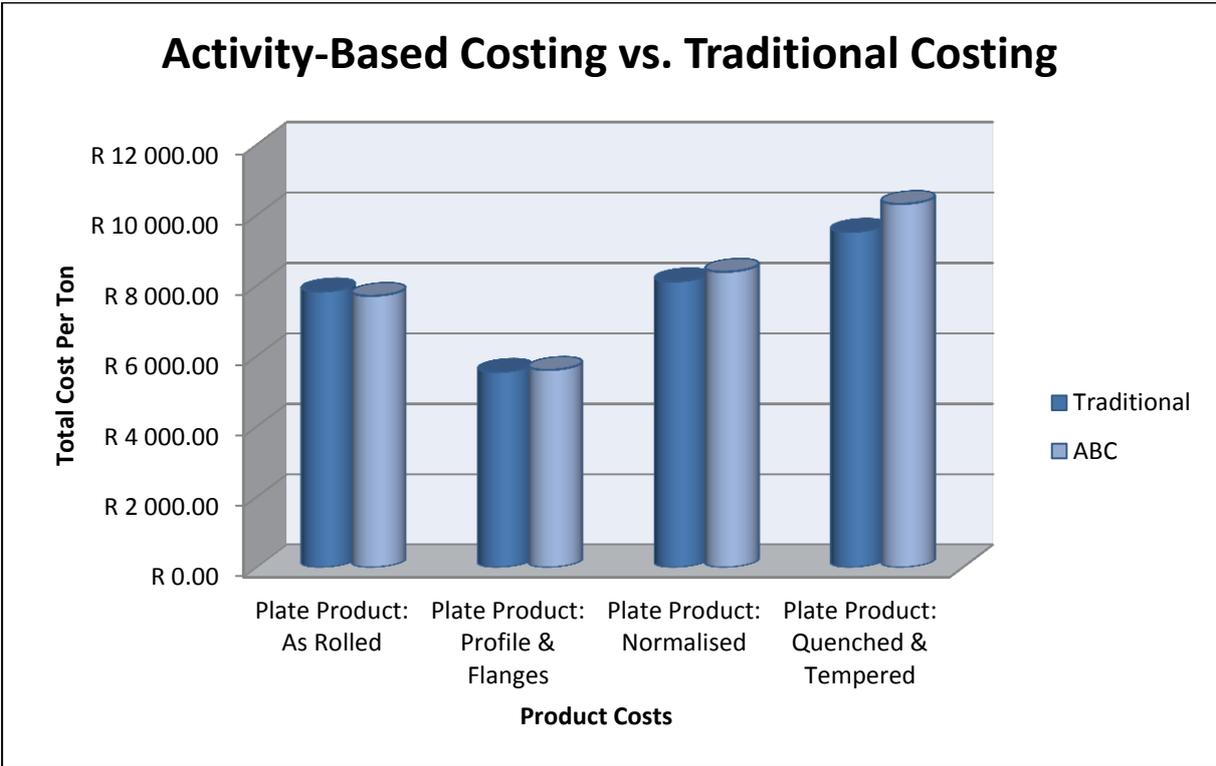
Table 4.17: Q&T Product - Costing Comparison between Traditional Costing and ABC

Traditional Costing versus Activity-Based Costing	Plate Product: Quenched & Tempered (Per Ton Cost)		
	Traditional	ABC	Difference
Raw Materials	R 8 336.35	R 8 336.35	R 0.00
Labour	R 624.08	R 624.08	R 0.00
Overheads	R 567.34	R 1 358.21	-R 790.87
<b>Total</b>	<b>R 9 527.77</b>	<b>R 10 318.64</b>	<b>-R 790.87</b>

Source: Own Research

The comparison of the two costing methodologies reflects a small variance in the costing of the products. It has been noted that the As Rolled product is slightly overstated by 1.59%. As this is a high volume product the cost variance is significant. This product bears the overhead cost loss of the other three understated products. The high performing Flange and Profile range is thus not as profitable as determined on the traditional costing method with the high volume As Rolled product carrying a higher margin as shown in Table 4.14. Care should be taken when making important strategic decisions with regard to the production range and product promotion. A summary of the product costing done under the traditional and ABC methods is presented in the table below. It is evident that there is a slight variance between the two systems. The feasibility of adopting the ABC methodology will be discussed in the final chapter.

Table 4.18: Product Costs Compared using Two Different Costing Methodologies



Source: Own Research

**4.9 Cost Structure Analysis of the Plate Mill Plant**

In order to highlight areas where costs can be potentially reduced or subjected to better control measures, a tool such as a cost structure analysis is used. Cost structures refer to the costs that a business incurs at a particular level. The type and relative proportion of fixed and variable costs are considered.

During the investigation into the application of the ABC system for the steel mill a thorough analysis of both the fixed and variable costs was made in order to identify the incurred overhead costs. This financial information was then used to implement an ABC application as documented earlier in this chapter. Once the comparison of the two different costing methodologies was made, a cost structure analysis presenting the breakdown of the incurred costs for this production plant was revealed using the financial information as identified for this study. Literature also states that the allocation of the breakdown of a cost structure might require an implementation of an ABC project to assign the costs more accurately. The implementation of ABC

system revealed the plant’s cost structure as illustrated in Table 4.19: Plate Mill Cost Structure.

A summary of both the fixed and variable costs as incurred by this plant are presented in the table below. The variable costs sustained contain the cost of direct materials, refractories, petroleum products, transport, field operations, technological fuel, electricity, water, energy and utilities. Fixed costs include both the manufacturing and administrative overhead costs as well as the cost for direct labour.

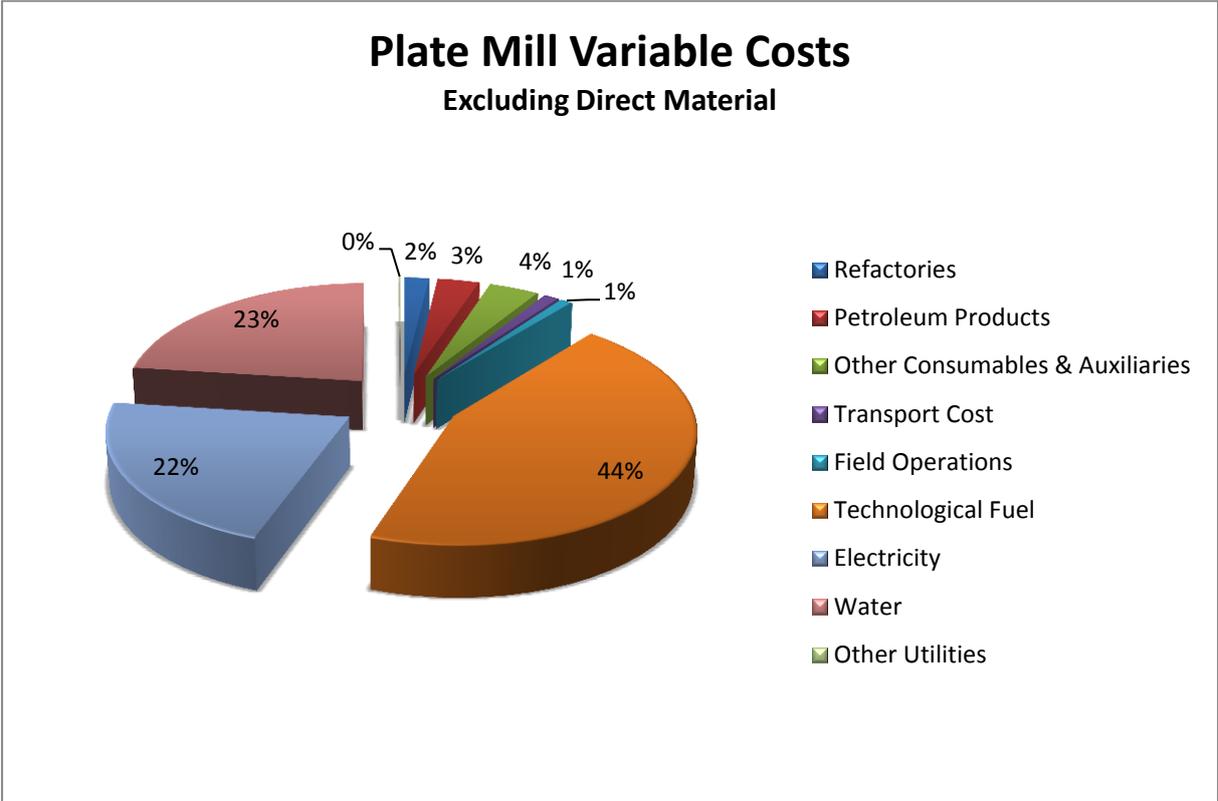
Table 4.19: Plate Mill Cost Structure

Plate Mill Cost Structure			
Variable Costs	Raw Materials	76.02%	Accumulated Total 83.79%
	Refractories	0.15%	
	Petroleum Products	0.25%	
	Other Consumables & Auxiliaries	0.30%	
	Transport Cost	0.09%	
	Field Operations	0.07%	
	Technological Fuel	3.46%	
	Electricity	1.68%	
	Water	1.78%	
	Other Utilities	0.01%	
Fixed Costs	Direct Labour	8.69%	Accumulated Total 16.21%
	Maintenance Repair Services	2.47%	
	Maintenance Spare Parts	1.38%	
	Information Technology Services	0.08%	
	Other	1.09%	
	Rental and Leasing	0.03%	
	Depreciation	2.47%	
<b>Total</b>	<b>100.00%</b>		

Source: Own Research

The analysis indicates that the variable costs amount to 83.79% of the total cost structure of the plant. The major variable cost for this plant is incurred from raw materials. Raw materials constitute 76.02% of the total cost structure. In order to provide a more refined picture of the variable expenses Figure 4.3 illustrates the breakdown of the of the plant’s variable costs with the exclusion of the raw materials cost.

Figure 4.3: Plate Mill Variable Costs

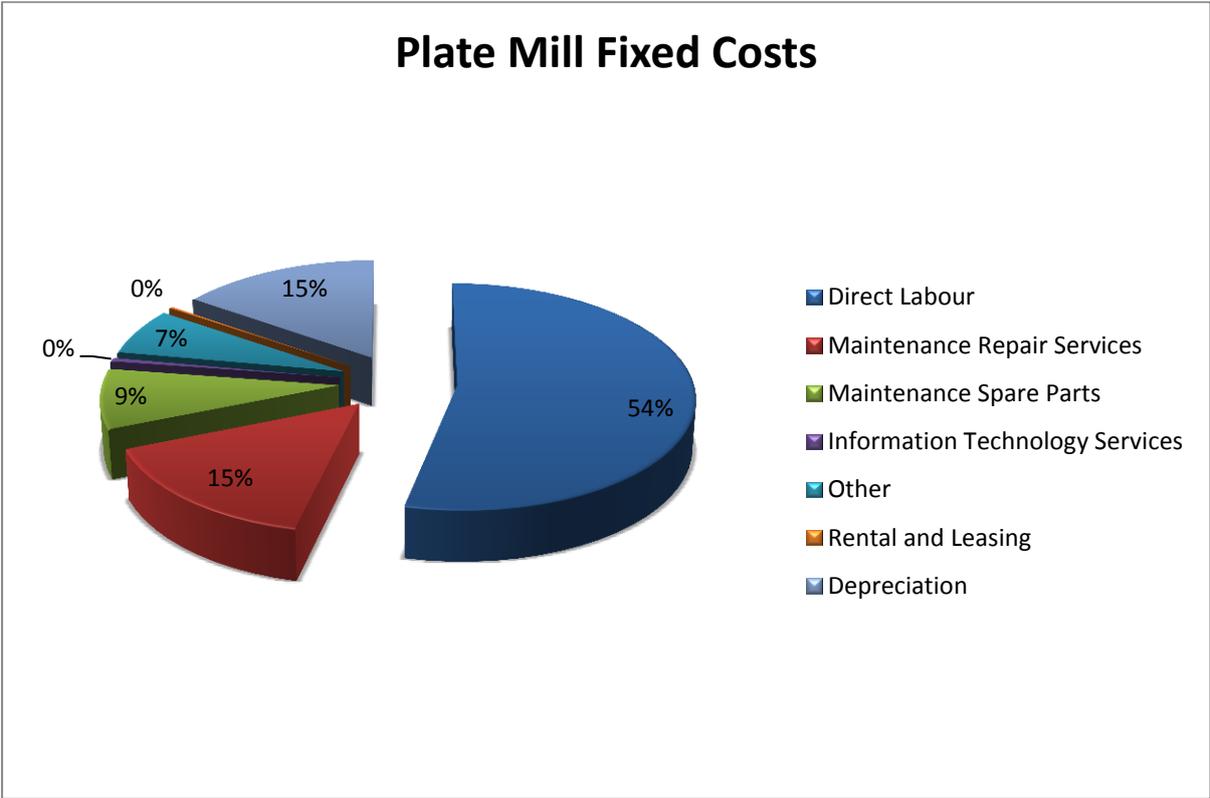


Source: Own Research

Once the costs of the raw materials have been excluded, the remaining variable costs were plotted on a chart as illustrated in Figure 4.3. The chart presents a distinct breakdown of the remaining variable costs with three prominent variable expenses. These expenses include technological fuel, water and electricity. Together with the cost of raw materials these four variable expenses contribute 82.93% of the total costs as incurred by this plant.

The breakdown of the fixed costs that include both the manufacturing and administrative overhead expenses as well as the cost of direct labour is presented in Figure 4.4 below.

Figure 4.4: Plate Mill Fixed Costs



Source: Own Research

Figure 4.4 reveals the fixed cost breakdown of the expenses as incurred by the manufacturing plant. Of the total fixed cost, direct labour accumulated 54% followed by maintenance repair services costs and the depreciation expense each contributing 15% to the total cost. The cost of the maintenance spare parts was the fourth highest category at 9%. The combined maintenance overheads add up to 24% of the total fixed costs.

In line with the secondary objectives of this study, the recommendations and conclusion regarding the reduction points for the plant’s fixed costs of direct labour and manufacturing overhead is discussed in the next chapter.

**4.10 Discussion of Results**

The empirical research presented in this chapter was based on a case-study approach. A study was carried out to compare two different costing methods for

ArcelorMittal’s Steel Plate Mill Plant in Vanderbijlpark. The current costing method was identified, analysed and compared against an activity-based framework.

In order to capture and determine the costs of each product group on the present costing method as utilised by ArcelorMittal South Africa and compare the results to a scenario where costs get allocated based on an ABC method the two methodologies were brought into perspective by means of a case study. The empirical study was executed through the implementation of an ABC model. This study followed a retrospective analysis of the two costing principles. Historical financial data from the plant’s profitability management process system was analysed to determine the plant’s cost behaviour. A scenario was then established whereby the selected products had their costing evaluated against the two different methods. A pre-post analysis determined the value of utilizing an activity-based costing system for this steel plant as opposed to the traditional costing method. The difference in the costs as per each selected product range was tabulated and analysed.

Table 4.20 presents the summary of the cost of sales difference for the products based on the comparison of the traditional costing methodology to that of ABC. ABC is said to provide a more accurate reflection of the real product costs. Under this method a cause and effect relationship must exist between the cost object and the consumption of the activities which in turn require resources. Thus the real cost of the product may be calculated utilizing this method.

Table 4.20: Differences in Cost of Sales

Product	Volume	Traditional	ABC	Variance	Total Difference
As Rolled	79 909	R 7 834.00	R 7 709.30	R 124.70	R 9 964 353.68
Profile & Flanges	31 551	R 5 551.00	R 5 607.50	-R 56.50	-R 1 782 540.24
Normalised	20 974	R 8 120.59	R 8 392.39	-R 271.81	-R 5 700 984.33
Quenched & Tempered	3 137	R 9 527.77	R 10 318.64	-R 790.87	-R 2 480 584.47

Source: Own Research

By comparing the costing methodologies of the two systems, it was evident that the major difference lies in the allocation of overhead costs to each product. The results from the empirical study indicate that there is a difference between the product costs as determined by the two different costing methodologies. Cost differences were

found for each product. The highest cost variance was for the low volume Q&T plate. The high volume As Rolled product was overstated while the Flange and Profile and Normalised products were marginally understated.

Overstated products have a higher cost of sales value that lead to higher pricing. Higher prices due to product cost distortions might not be desirable in a highly competitive climate.

However taking the above results into account, the financial impact of costing done on an ABC approach was limited due to the relatively low overheads incurred by this plant. The cost structure analysis revealed that raw materials costs attributed for 76.02% of the total cost of the final product. The manufacturing overheads collectively amounted to only 7.52% of the total product cost. Thus the more accurate allocation of the overheads to the various products resulted in limited product cost correction.

Based on the results of the ABC analysis the costing structure revealed potential areas where overheads could be identified to be reduced. Results from the study were analysed and recommendations are made in chapter 5 with regard to the objectives of this study.

#### **4.10 Summary**

In this chapter the results from the empirical study were analysed. The chapter first covers the researcher approach in gathering the data for the design and application of an activity-based costing model. The steps in the implementation of the activity-based costing methodology are covered and the results are compared to the traditional costing methodology. The chapter ends with a comparative analysis of the product costing under the two different costing methodologies and the analysis of the plant's cost structure in line with the primary objective of this study.

## CHAPTER 5

### FINDINGS AND RECOMMENDATIONS

#### 5.1 Introduction

The empirical study in the previous chapter presented the results between the comparisons of two costing methodologies that may be used for a steel manufacturing plant. The purpose of the investigation stemmed from a highly competitive steel market and increased threat from Chinese steel imports as presented in the overview of the global and local steel industry in chapter 3. The aim of the study was to analyse and compare the costing of steel plates based on two different costing principles in the context of the cost structure. The findings from the study are discussed in this chapter. Recommendations that ArcelorMittal may consider with regard to its product costing and reduction of overhead costs at the Plate Mill plant are also presented.

#### 5.2 Research Objectives

The realisation of the primary and the secondary objectives based on the results obtained from the empirical study and literature review are discussed in the following two sections.

##### 5.2.1 Primary Objective

The primary objective of this study was to do a comparative analysis between two costing systems for a steel plant. To address the above objective this study followed a retrospective analysis of the current traditional costing methodology as compared to an activity-driven costing method. Historical financial data from the plant's financial records was analysed to determine the plant's cost behaviour.

The current costing method was identified, analysed and compared against an activity-based framework. An ABC analysis was successfully applied to the cost data related to AMSA's Plate Mill Plant in Vanderbijlpark. The comparative analysis of the costing methodologies involved the identification of activities and the resources

consumed by these activities. The costs of these resources were assigned to the nominated activity costs pools. A cause and effect relationship was established and the costs of the selected cost objects were calculated using ABC principles. These costs were then compared to the traditional costing method as currently employed by the steel plant and presented in section 4.8 of this study. The major difference between the two costing methodologies was in the allocation of overhead costs to the products. This may lead to certain product being overstated with other products carrying the misallocated costs. The research results revealed that product cost distortions are present and could lead to poor management decisions based on misleading costing information. The difference in product costing between the two costing methodologies was summarised in Table 4.20: Differences in Cost of Sales

The results from the empirical study indicate that there is a difference between the product costs as determine by the two costing methodologies. As opposed to the traditional costing method ABC allocates costs on the consumption of activities that in turn consume resources. ABC brings costs in line with its real utilization and consumption of resources. Thus a more accurate product cost was determined as presented in section 4.8 of chapter 4.

The high volume As Rolled product was overstated on the current method by R124.70 per ton. For the demand of 79 909 tons the margin difference amounted to R 9 964 652.30. It is evident that this product carries the losses of other products manufactured at this plant and its true margins have been distorted. This margin loss is due to the shortcoming in the allocation of the overheads to the reaming product range. Two of the reaming three products were slightly understated, while the low volume Q&T product was significantly understated by 8.30%. The cost of sales difference as summarised in Table 4.20 indicated that the Flange & Profile, Normalised and Quenched & Temper products were understated by R1.8 million, R5.7 million and R2.5 million respectively.

Overstated products have a higher cost of sales value that lead to higher pricing. Higher prices due to product cost distortions might not be desirable in a highly competitive climate. Loss of clientéle and market share may occur. As described in chapter 3, the current macro environment for the steel is extremely competitive. A slow demand for steel coupled with a stagnant economy has made customers highly

sensitive to steel prices. Therefore the currently overstated and understated steel plate products may be damaging to ArcelorMittal South Africa.

However taking the above results into account, the financial impact of costing done on the ABC approach was limited due to the relatively low overheads incurred by this plant. The manufacturing overheads collectively amounted to only 7.52 % of the total product cost. Therefore the more accurate allocation of the overheads to the various products resulted in limited product cost correction.

As described in the literature review in chapter 2, ABC will bring limited benefits for operations with homogeneous products and high direct labour costs as is evident from the results of this study. However, ABC should be implemented for companies that require accurate cost information for long-term decisionmaking with regard to new products, the product mix and the outsourcing of work as the current macro environment of the steel industry call for. Thus the implementation of an ABC system for this steel plant will lead to more accurate product costing and present management with true information for strategic decisions.

### **5.3 Secondary Objectives**

In order to supplement the primary objective five secondary objectives were formulated in section 1.3.2 of chapter 1. The secondary objectives were realised by performing a literature review on costing systems in order to determine the suitability of a traditional costing system versus an ABC system for an industrial plant as in chapter 2 of this mini-dissertation, analysing the current costing system of ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark by employing ABC principles, implementing an ABC system for ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark (Section 4.3) and comparing the results of the ABC system to that of the present costing system (Section 4.8).

The results of the empirical study of this study confirm that costing done on the ABC methodology is more accurate than on the currently employed traditional costing system. Literature suggests that the implementation of an activity based system for a manufacturing plant that does not produce a variety of complex products that consume various levels of different activities may not outweigh the disadvantages of the systems. High implementation costs, buy-in from employees and intense upkeep

of the system may not outweigh the benefit of more accurate costing for this plant as overhead costs are relatively low.

#### **5.4 Research Summary**

The primary objective of this study was to compare two costing systems for ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark in the context of the cost structure by:

- Performing a literature review on costing systems in order to determine the suitability of a traditional costing system versus an activity-based costing system for an industrial plant.
- Analysing the current costing system of ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark by employing activity-based costing principles.
- Implementing an activity-based costing system for ArcelorMittal's Steel Plate Mill Plant in Vanderbijlpark.
- Comparing the results of the activity-based costing system to that of the present costing system as utilised by AMSA in the context of the cost structure.

#### **5.5 Conclusions and recommendations**

The results from the empirical study support the theory with regard to a more accurate costing methodology based on activity-based costing principles as opposed to costing done on traditional methods. It is evident that a more refined costing system will reduce product cost distortions and present management with true information for strategic decisions. With the current highly competitive steel market, accurate product costing and pricing may be crucial in maintaining market share. However the implementation of an activity-based system for a manufacturing plant that does not produce a variety of complex products that consume various levels of different activities may not outweigh the disadvantages of such a system. Hence the high implementation costs, required buy-in from employees and intense upkeep of the system may not outweigh the benefit of more accurate costing for this plant as overhead costs are relatively low that will lead to limited cost distortions.

Based on the results of the activity-based costing analysis recommendations about the potential overhead cost reduction points within the plant could be made. It was

found that the substantial amount of the overhead cost was spent on maintenance. As this is one of the first steel plants in South Africa, commissioned in 1943, its intended lifespan has expired years ago. With an aging infrastructure, maintenance costs have risen. Unplanned downtime due to equipment failure is high. The aging infrastructure and old equipment incur high maintenance costs as presented in the previous chapter. It is proposed that the plant be progressively returned to basic operating conditions in order to improve its reliability and reduce its breakdown maintenance costs and losses due to unproductive downtime leading to a potential clientéle loss due to late delivery.

A second point that could be proposed is in the reduction of fixed costs by increasing the automation level of this plant. As opposed to the modern manufacturing industry, this plant still carries high direct labour costs as compared to its overhead costs. Increasing the automation level of this plant will also improve the quality of the manufactured products. Lean manufacturing principles may also be applied to improve the fixed cost of this plant.

### **5.6 Limitations of this study**

The product range that was selected for this study was limited to four products. A study of the full product range would have proved to be too extensive. The selection of one of the steel manufacturing plants may not reflect the true need for a more refined costing system for this steel works, as other plants within the company are highly automated carrying lower direct labour costs as compared to their manufacturing overhead expenses.

### **5.7 Recommendation for Future Research**

This study leaves the following opportunities for future research:

- It is proposed that a future study incorporating the entire steel works should be made in order to determine the need for a more refined costing system for the company.
- Alternative costing methodologies such as Fuzzy Logic and Monte Carlo Simulation can be explored to determine their suitability in the steel manufacturing industry.

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Appendix A: Letter from Language Editor



10 November 2015

**TO WHOM IT MAY CONCERN**

**Re: Letter of confirmation of language editing**

The dissertation **A comparative analysis of two costing systems in a steel manufacturing plant** by **KK Grebowiec (12661597)** was language, technically and typographically edited. The citations, sources and referencing technique applied was also checked to comply with university guidelines. Final corrections as suggested remain the responsibility of the student.

**Antoinette Bisschoff**

Officially approved language editor of the NWU since 1998  
Member of SA Translators Institute (no. 100181)