Using Material Flow Cost Accounting to determine the impacts of packaging waste costs in alcoholic beverage production in an alcoholic beverage company in Durban

Submitted in fulfillment of the requirements of the Master of Accounting degree in the Department of Management Accounting, Faculty of Accounting and Informatics, Durban University of Technology, Durban, South Africa

By

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February, 2016

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DECLARATION

I, Omolola Ayobamidele Tajelawi, declare that this dissertation is my own work. This work has not been previously submitted for another degree. All sources used have been acknowledged and referenced.

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ACKNOWLEDGEMENTS

“It is of the LORD’s mercies that we are not consumed, because his compassions fail not. They are new every morning: great is thy faithfulness”. *Lamentations 3:22-23*

Words fail me as I begin this process of appreciation, because I feel so overwhelmed by the auspicious graciousness of God towards me. I, therefore, take this opportunity to say an awesomely resounding “Thank You” to you, my LORD and Maker, for seeing me through it all every step of the way.

I express my sincere gratitude to my supervisor, Dr H.L. Garbharran, for the unending support and assistance throughout the period of this study.

My profound appreciation goes to the company that gave me access to the information I needed to complete my research; to all my friends who have gone beyond the call of friendship to being a family. I count it an honour to have known wonderful people like Seun, Debola, Stanley, Samson and family, Kunle, Emmanuel, Toyese, Dr Segun Adebayo, Yemi, Femi Fadahunsi, Omolola, Arise, and Yemi, Temiloluwa, Yomi, and Tola, Timilehin, Folake Ijabadeniyi, Awolusis’. These brethren have contributed tremendously to the success of this work. I salute you all.

I also appreciate all my friends at the Department of Financial Accounting and Cost and Management Accounting; Mr Govender, Thabisile, Mbali, Sharon, Khanyo, Melanie, Rushian, Phumzile, Wiseman.

My acknowledgements also go to Pst and Mrs Adejimi, Pst Ben and family, Pst and Mrs Nkwoji, the Botha’s, Ogunmoroti’s, my lovely choir members who have borne my absence sometimes from choir rehearsals, Akwensi, and all who have contributed to this success.

I also appreciate my parents, Mr and Mrs Jegede and my siblings, Deji, Morenike, Yemi and Dapo, and my uncles and aunts for their consistent support, encouragement and prayers. Indeed, “blood is thicker than water”.

ABSTRACT

A large number of manufacturing companies adopt the use of the traditional accounting method in their operations. This technique fails to reflect a detailed report of all material losses incurred in their production processes. Worthy of note, is that losses/waste are considered as inefficiencies in manufacturing operations and viewed as a costly venture to the sustainability of the company.

This research, therefore, through a case study analysis, examined the efficient/inefficient flow of resources in the production process of an alcoholic beverage company in the Durban metropolis. The study was carried out in order to determine the impact of packaging waste cost in an alcoholic beverage company using the material flow cost accounting technique. Measurements included the input of packaging materials against its output, while giving consideration to waste incurred as losses.

The Material Flow Cost Accounting (MFCA) technique, an environmental management accounting tool developed for measuring the flows and stocks of materials of a company and production process in both physical and monetary units, was used to measure the costs of waste on two production lines. MFCA was used to trace all material inputs and categorize them as product or non-product output. MFCA is used to classify the relevant material flows as cost collectors, thereby allocating the costs of the company's production operations and flows.

Different packaging materials that constitute waste on the lines were analyzed using the mixed method approach, which includes observation, questionnaire administration, and analysis of six months production report. Two production lines were considered for sampling, and recommendations were given based on the data analyzed using the SPSS package.

The MFCA technique revealed that losses on both production lines were understated, and that, the bottling plant was losing a sizeable amount of monetary value of packaging materials to waste. The MFCA technique also revealed that the traditional costing technique is unable to provide adequate information managers require for strategic cost decision making.

MFCA is therefore recommended to assist managers improve production line efficiency and cost savings via accurate waste costing and reduction for corporate sustainability.

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CHAPTER ONE

1.0 GENERAL INTRODUCTION AND OVERVIEW OF STUDY

1.1 Introduction

This introductory chapter begins with an insight into the research study, providing a leverage on which the study takes off. Also, considering that this study centers on alcoholic beverage packaging waste, and that production line losses can be viewed as waste, it is necessary to give a brief description of waste. Furthermore, the contribution of alcoholic beverage to the South African economy is briefly highlighted to support the study and the environmental impact. Management accounting intervention to waste costing via cost management systems, environmental management accounting (EMA) and material flow cost accounting (MFCA) are also introduced in this chapter. Furthermore, the problem statement and research questions are stated. The aims and objectives of the study are described, followed by an overview of the research methodology. The chapter closes with a brief explanation of the arrangement of the thesis and conclusion.

1.2 Insight into the Study

The dynamic nature of the business environment in the 21st century and responsibility reporting to shareholders' investments have made cost information at internal and external level imperative for corporate sustainability. Blocher, Stout, Juras and Cokins (2013: 16) noted that, without strategic cost information, the firm is likely to stray away from its competitive course, and make strategically wrong manufacturing and marketing decisions. Likewise, Fakoya and van der Poll (2013: 137) confirmed that barriers to achieving and implementing a successful waste-reduction strategy in organizations is linked to reliable cost information. Many manufacturing companies incur losses on materials utilized during production as a result of inefficiency and other factors leading to wastage, and high production costs as reported by Gale (2006: 1229); Schliephake, Stevens and Clay (2009: 1262) and (Fakoya 2013: 250). Sustainable manufacturing seems to have become a challenge for manufacturers as costs of significant amounts of material waste from manufacturing activities contribute to competitive advantage (Smith and Ball 2012: 227). The Department of Environmental Management identified the numerous challenges faced by waste management in South Africa, and provided a plan via The National Waste Management Strategy (NWMS). The legislative requirement of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) was enacted to address these challenges (Environmental Affairs 2008).

The increasing pressure to achieve higher productivity with reduced environmental impact requires businesses to have access to tools that will enable them to account for all inputs and outputs to their operations with a view to supporting eco-efficient decisions that simultaneously improve economic and environmental performance (Christ and Burritt 2014: 1). The Waste Information System, instituted by the Department of Environmental Affairs and Tourism (Environmental Affairs And Tourism 2005: 1), only supports data in relation to quantity without cognizance to the cost aspect.

Managerial and cost accounting has helped to provide tools and perspectives that assist managers to identify, measure, analyse, interpret, and communicate cost information (Hilton and Platt 2015: 5). Nonetheless, the inability of the traditional and cost accounting methods in providing management with information needed to make sustainable business decisions has not been impressive (Fakoya 2013: 252). Cost information on materials lost on production lines get hidden in overhead accounts, thereby preventing managers from tracking activities causing revenue leakage (Jasch 2009: 41). Accountants, therefore, have a significant role to play in providing the relevant management cost information since they have access to the monetary data and information systems needed for both internal and external reporting (Jasch 2009: 1).

Accurate cost information is needed at all levels of the manufacturing domain for strategic decision making.

1.3 The South African Alcoholic Beverage Industry

The South African food and beverage industry poses a very vital component to the economy. The beverage sector alone accounts for more than 4% of all manufacturing sales and 24% of total sales (Young 2013: 1). The alcoholic beverage is a subset of the food and beverage industry in South Africa. It is particularly considered to have a high barrier entry due to its domination by a few large corporations (Jernigan 2012: 81). The South African alcoholic beverage industry is one of the most lucrative industries in the Republic, as South Africans are well-known for high levels of alcohol consumption. As a result, alcoholic beverage companies are compelled to increase production in order to match the increasing levels of alcohol consumption.

The liquor industry's manufacturing operations and capital expenditure, according to Industry Association for Responsible Alcohols (A.R.A 2015: 2), is responsible for an estimated R94.2 billion of South Africa's gross domestic product; while the industry's GDP multiplier is estimated at 2.08. The categories of alcoholic beverage consists of beer, spirit and wine (Jernigan 2009: 6). Production in this sector may be assumed to generate a considerable amount of packaging waste in its processes, especially in the bottling process. Generally, waste is known to be generated in different forms. Although this study only focuses on packaging waste, it is beneficial to establish the definition of waste from past literature studies, as it determines the categories and management approach.

1.4 Perceptions of Waste

The term "waste" is viewed from different academic perspectives. One major review of waste definition is the Baseline report in accordance with the South

African National Environmental Management Waste Act (Environmental Affairs 2012: 3) , which states that waste is "any substance, whether or not that substance can be reduced, re-used, recycled and recovered with the following features:

a. That is surplus, unwanted, rejected, discarded abandoned or disposed of;
b. Which the generator has no further use of, for the purposes of production;
c. That must be treated or disposed of; or
d. That is identified as a waste by the Minister by notice in the Gazette, and includes waste generated by mining, medical or other sector; but-

i. A by-product is not considered waste; and
ii. Any portion of waste, once re-used, recycled and recovered, ceases to be waste".

The Act indicates that waste is either general or hazardous.

On the other hand, Muzenda (2014: 105) described waste as "an unavoidable by-product of most human activity"; while Jasch (2009: 11) argued that waste is "a material which has been purchased and paid for, but which has not turned into a marketable product". The two views depict, waste as a by-product and non-marketable or unwanted product. Both views signify that the end result in a production process, being a product, was not achieved.

The emphasis on environmental issues has compelled many manufacturers to reconsider their manufacturing processes, considering the amounts of waste generated from production processes; not to mention the losses that accompany these wastes to the dump site. The quest to prevent production line losses has also prompted managers to seek cost efficient ways to prevent revenue losses. Cost is one of the key motivators for profitability.

1.5 Cost Management Systems

According to Blocher *et al.* (2013: 16), in order for an organization to develop a sustainable competitive position, a purposeful competitive strategy, such as cost leadership, is required; indicating that an effective cost management is imperative. The explosion in technology encountered by manufacturers, coupled with global competition, constrained managers to streamline their operations at the lowest cost possible; managers are moving away from a historical cost accounting perspective to a proactive cost management perspective (Hilton and Platt 2015: 23). In addition, the cost management system is seen as a management planning and control system having the following objectives:

- Measuring the cost of resources consumed in performing the organization's significant activities and, measuring the unused capacity of those resources;
- Identifying and eliminating non-value added costs;
- Determining the efficiency and effectiveness of all major activities performed in the enterprise; and
- Identifying and evaluating new activities that can improve the future performance of the organization.

The information gathered from the above objectives can assist management identify waste-generating activities, thereby, preventing cost leakage and inefficiencies in the production process. The objective of this aspect of accounting is to assist managers in managing and controlling costs by tracing costs to the activity centre where the cost was incurred (Hilton and Platt 2015: 50).

1.5.1 Management Accounting (MA) Intervention Tools for Waste Costing

Management Accounting (MA) is that branch of accounting that ultimately provides the information needs of internal management and provides data for decision making (Jasch 2009: 5; Fakoya 2012: 2). MA makes use of the conventional costing technique where indirect costs of products are assigned to overhead accounts, and costs cannot be directly traced to the product (Drury 2011:29). The slow response of the accounting system to environmental costs also does not provide managers the opportunity to make informed waste decisions due to the lack of the appropriate waste information.

Evidence has revealed that the majority of managers within organizations have very little knowledge about the costs associated with their operations (Gale 2006: 1228; Fakoya and van der Poll 2013: 138). Despite the shortfalls, MA has evolved over the years to gradually improve on deficiencies of traditional accounting through the innovation of management tools. Such tools includes stream mapping, activity based costing, product life-cycle based costing, target costing (Sygulla, Bierer and Götze 2011: 2; Apak, Erol, Elagöz and Atmaca 2012: 529-531; Hilton and Platt 2015: 167). These various tools have proved to be effective in their respective strength but also, have their limitations of which some will be discussed in chapter 2.

1.5.2 Environmental Management Accounting (EMA)

External pressures to improve business behaviors towards the natural environment led to the development of several methodologies for corporate environmental accounting such as environmental management accounting, sustainability accounting, triple-bottom line accounting, carbon management accounting (Papaspyropoulos, Blioumis, Christodoulou, Birtsas and Skordas 2012: 132). According to Christ and Burritt (2014), the development of EMA in the 1990s was a resultant need for a more integrated approach to corporate economic and the environment. The slow response of the accounting system to environmental costs did not provide managers the opportunity to make informed waste decisions due to the lack of the appropriate waste information.

Research revealed that majority of managers within organizations, have very little knowledge about the costs associated with their operations (Gale 2006: 1228; Fakoya and van der Poll 2013: 138). The analysis of material flow from an environmental and dematerialization eco-efficiency perspective was neglected (Schaltegger and Zvezdov 2014: 1). EMA, however, laid the foundation to address the often cited drawbacks associated with traditional management accounting's criticism of its failure to explicitly consider environmental information; which often led to flawed decisions.

The last two decades have seen the EMA literature developed to incorporate tools such as, Environmental Engineering Group Environmental Costing model (EEGECOST), which was used to promote environmental accounting in South Africa (De Beer and Friend 2006: 559) and Material Flow Cost Accounting (Christ and Burritt 2014: 10). These tools were used mainly in the manufacturing sector for the calculation of corporations' environmental cost since manufacturers constantly seek sustainable costing techniques that will reduce costs and improve efficiency. Most managers would be amazed if they knew the true cost of wastes being generated in their production processes and benefits lost.

1.5.3 Material Flow Cost Accounting

1.5.3.1 Historical Background of MFCA

Material flow cost accounting (MFCA), one of the most fundamental and well-developed EMA tools, is adopted in this study to cost the packaging materials lost on two production lines of an alcoholic beverage bottling plant. The origin of Flow Cost Accounting (FCA) can be traced to Augsburg in Germany where it was developed by Bernd Wagner and colleagues at the Institute für Management und Umwelt (IMU); the modified version of FCA, now MFCA has been promoted and adopted in Japan since the year 2000 after the Japanese Ministry of Economy, Trade and Industry (METI) discovered the potential of its optimal use in manufacturing (Kokubu, Campos, Furukawa and Tachikawa 2009: 15-16; Christ and Burritt 2014: 3; Schaltegger and Zvezdov 2014: 2). While the German version tends towards a facility-wide management, the Japanese version focuses primarily on product lines or processes (Christ and Burritt 2014: 3).

Due to the ability of MFCA to quantify and provide a visual representation of material losses in a process, it became possible for management's decision to focus more on material losses over other losses such as energy and water, which were attributed to their frequent uses in the Japanese manufacturing and process industry as opposed to the number of use recorded in Germany (Christ and Burritt 2014: 3).

Material flow cost accounting is an environmental management accounting tool used for measuring the flow and stocks of materials for a company, a production process product in both physical and monetary units (Jasch 2009: 116; Hyršlová, Palásek and Vágner 2011: 15; Schaltegger and Zvezdov 2014: 2). MFCA focuses on how materials and their associated costs flows from input to output, making transparent the activities in the production process (Hyršlová, Palásek and Vágner 2011: 6), thereby illuminating any inefficiencies in the process.

This technique also has a potential financial benefit of increasing material efficiency as a form of eco-efficiency (Schaltegger and Zvezdov 2014: 7). One of the unique features of this technique lies in its loss concept, which not only targets the disposal costs of the negative products, but any and all economic resources expended in connection with the material losses (Hyršlová, Palásek and Vágner 2011: 15). Material flow cost accounting gives a better understanding of cost drivers of material and energy usage and provides new and precise information on inefficient related costs and product specific costs difference (Viere, Stock and Genest 2013: 452).

Another feature of MFCA is that it delivers both increased profits and material utilization, that is, it enables organizations to manufacture the same amount of finished products with less input (Trappey, Yeh, Wu and Kuo 2013: 640). Although MFCA has been subjected to research and has been applied in various pilot companies, no rapid adoption has been documented to date (Schaltegger and Zvezdov 2014: 2). The concept of MFCA may be fairly regarded as new in the South African manufacturing process (Fakoya 2014: 13). This study, therefore, aims to harness the benefits of the MFCA technique in costing packaging waste and its relationship with respect to production line efficiency.

1.5.3.2 Theoretical Framework

The general framework supporting MFCA is guided by the International Standard Organization known as ISO 14051 (Trappey *et al.* 2013: 639). The standard provides information regarding common terminologies, objectives, working principles, fundamental elements, and the process of implementation (Kokubu *et al.* 2009: 18). MFCA has undergone various developments over the years depending on different organizational situations. MFCA is of the opinion that whatever goes into a quantity centre must leave in the form of either a product or waste (Christ and Burritt 2014: 2).

One of the features that stands MFCA out is the loss concept because it is different from the one generally followed in conventional business management (Kokubu and Kitada 2010: 7). Waste not accounted for is categorized as a loss. MFCA's loss concept approach presents an opportunity for managers of manufacturing companies to simultaneously address revenue leakage on the lines as well as the environmental impacts. MFCA's loss concept provides accurate cost information in production activities. In the diagram below, as shown in figure 1.1, MFCA identifies output as positive and negative products separately; recognizing the materials and other processing costs consumed in the manufacturing process.

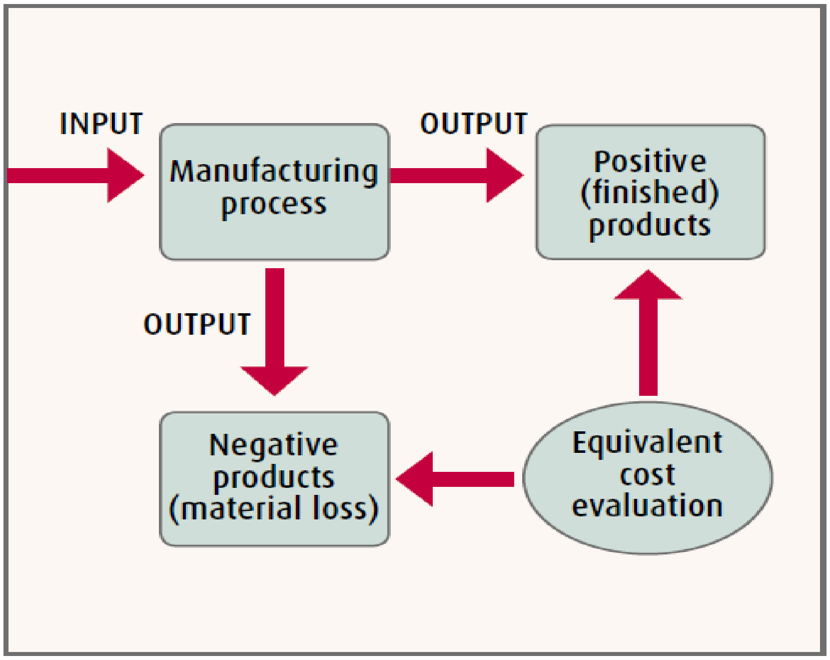


Figure 1.1: Concept of Material Flow Cost Accounting
Source: Kokubu *et al.* (2009: 16)

1.6 Case Study Company

The company used as a case study in this research is an alcoholic beverage bottling plant situated at the southern outskirts of the Durban metropolis in the KwaZulu-Natal province. The company has a well renowned and long standing reputation for its quality alcoholic beverage products. The company has a number of lines that produces a wide range of alcoholic beverage products. Few of the lines run daily while a couple run on alternate days. A number of environmentally-aligned activities have been inculcated into its production and waste management processes, as observed during the study, such as composting and recycling which are outsourced to an external contractor. The identity of the company is not disclosed as requested by the company for the purpose of this research.

1.7 Problem Statement

Conventional cost accounting system is widely used in manufacturing industries such as the alcoholic beverage industry and, the shortcomings often resulted in revenue losses (Fakoya and van der Poll 2013: 138). These revenue losses, usually referred to as "normal loss" in standard cost, often include wastes on the production lines not accounted for. Such losses are also experienced in the alcoholic beverage company in Durban, used as a case study area in this research.

The cost variance in the conventional accounting system does not reflect a true picture of all material losses. This is because the standard cost, which includes material lost as waste, is usually misconstrued and referred to as normal loss (Fakoya and van der Poll 2013: 138). This implies that only waste above the standard is considered as waste. Typically, losses included in the standard, is referred to as normal loss and forfeited, and since cost savings is linked to the efficient use of resources, the likelihood of revenue losses is unavoidable.

Material wastes, which usually constitute a major portion in production, are usually accorded much attention while packaging material waste is sometimes lumped with auxiliary materials and given little attention. However, Koss (1998: 102) argued that raw material and packaging material, mostly referred to as raw material, should be differentiated. Moreover, for a bottling plant, packaging material consumed constitutes one of the major materials consumed in production. Packaging material wastes are noticed at an increasing pace on two production lines, and wastes savings are lost.

Jasch (2009: 41), in addition, highlighted the need for more investigation of packaging waste in isolation. Information on packaging waste costs would be beneficial to bottling plant managers in evaluating the cost effectiveness of the production process. Application of the appropriate accounting tool for costing will not only be beneficial for accurate costing, but also to improve the efficient use of packaging materials. The current study seeks to identify waste generating factors and the true cost of packaging materials utilized and lost during production on the two lines. The knowledge of losses will ensure the adoption of more efficient use of packaging material for cost savings.

1.8 Research Questions

Sequel to the overview of alcoholic beverage contributions to landfill waste and the cost implication of production wastes, this study seeks to answer the following research questions:

RQ1. What amounts of packaging wastes were generated on the lines and the packaging materials that constituted the largest amount of waste?

RQ2. What factors influenced the efficient flow of resources on packaging costs?

RQ3. Evaluate the system adopted by the company against the MFCA method?

RQ4. Identify the viable alternative solutions to curtail the loss of resources on production lines?

1.9 Aim and Objectives

The general aim of this study is to determine the impact of packaging waste cost in an alcoholic beverage company using material flow cost accounting technique.

The aforementioned aim will be achieved by addressing the following specific objectives:

1.9.1 Objectives

This study is guided by the following objectives:

1. To determine the amount of packaging wastes generated on the lines and identify the packaging materials that constitute the largest amount of waste;
2. To determine the factors that influence waste generated on the lines;
3. To evaluate the system adopted by the company against the MFCA method; and
4. To provide viable alternative solutions that would curtail the loss of resources on the production lines.

1.10 Research Hypotheses

The null and alternate hypotheses were developed to achieve the research aim. The following hypotheses were statistically tested during the data analysis phase of the research study:

1.10.1 Null hypothesis.

Ho = Packaging waste cost has no impact on the alcoholic beverage production outcome;

1.10.2 Alternate hypothesis

H1 = Packaging waste cost has a significant impact on the alcoholic beverage production outcome.

1.11 Scope of the Study

The study focuses on an alcoholic beverage company domiciled in Durban in South Africa. The scope of this study is limited to packaging material wastes generated on two production lines (1 and 3), excluding the raw material, water and energy losses generated.

1.12 Significance of Study

Going by the information of revenue losses experienced by the company used as a case study, the awareness and introduction of MFCA into the production system; and a closer look at the factors influencing waste generation on these lines will inform management about the inefficiencies that resulted in increased packaging materials losses, and provide a true picture of the amount lost. This study will create opportunities for innovative line losses reduction initiatives; and also serve as an additional input into studies conducted in South Africa relating to the implementation of MFCA.

1.13 Research Methodology

The following section provides an overview of the relevant aspects of the research methodology for the current study.

1.13.1 Research Design

The research is a case study research, which was conducted using a mixed method approach. This research makes use of primary and secondary data methods. The current study is explorative in nature.

1.13.2 Targeted Population Selection

The population in this study constituted a total of 45 staff members of line 1 and 3 operators, and some production staff members whose activities were relevant to the study. Selection of staff was based on their relevance to the study.

1.13.3 Data Collection

Permission to conduct this study was granted by the company on condition that its identity is kept anonymous. Staff members involved in filling the questionnaire were educated on the content and reasons for data collection.

1.13.4 Characteristics of the Questionnaire

This study adapts a Likert-scale questionnaire made up of 20 questions and personally administered to participants. The questions were outlined to cover the production process, waste cost information, and other factors influencing waste generation on the lines. The questionnaire was structured as closed-ended questions that required the respondents to make choices from 1 (strongly agree) to 5 (neutral).

1.13.5 Sampling Method

A purposive sampling method was used to select two production lines in the case study company.

1.13.6 Data Analysis

The MFCA technique was used to quantify the production loss report. Observed activities on the production lines were reported. Data from questionnaires obtained were analyzed using the latest version of the Statistical Package for Social Sciences (SPSS).

The research hypotheses were statistically tested via a multiple regression analysis. A two-tailed significance test at the 0.01 significance level was calculated. The significance of the regression statistic was used to determine the rejection/acceptance of the null hypothesis. In addition, other statistical tools, such as bar charts, factor analysis, and the Pearson’s product-moment correlation, were used.

1.13.7 Ethical Consideration

The study was conducted according to the research ethics policy and guidelines of the Durban University of Technology. The ethics policy takes into consideration the anonymity, confidentiality, rights and voluntary participation of human subjects. Data gathered from the research have been held safely and securely.

1.14 Thesis Overview

This thesis is structured into five chapters which are detailed below:

CHAPTER 1: Introduction

The first chapter explained the background, research objectives, significance and scope of the study.

CHAPTER 2: Literature Review

The literature review guides the research questions stated in Chapter 1 and objectives to be achieved. The research questions are adapted to form the research themes. The review of relevant literature relates to information needed for strategic decision making; packaging waste in beverage production; and management techniques used for waste reduction. The latter part of the review focuses on the strengths, weaknesses and applications of the different techniques.

CHAPTER 3: Methodology

This chapter discusses the research methodology, research design, data collection and analyses, and delimitations of this study.

CHAPTER 4: Results and Analysis

Analysis of results and a discussion of the findings are presented in this chapter.

CHAPTER 5: Conclusions and Recommendations

This chapter provides a summary and conclusions of the study. Contributions and recommendations for the reduction of packaging waste costs are also discussed.

1.15 Conclusion

This chapter has provided an outline and overview for this study. An introduction to the role of accounting in providing relevant cost information and the contribution of South African beverage industry to the economic growth were discussed. Different perspectives to the waste concept were briefly highlighted. The chapter also introduced the importance of effective cost management system, management accounting techniques for waste reduction, environmental management accounting and material flow cost accounting. The historical background and framework underpinning MFCA was discussed in this chapter. The problem statement and objectives to be achieved were highlighted. Finally, the methodology to be employed, the significance of the study and the structure of this dissertation were also presented. The next chapter reviews the relevant literatures.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

In the previous chapter, a general overview of the study was discussed as well as the outline for the proposed study. This chapter presents a review of relevant literature pertaining to this study. The chapter begins with an overview of packaging waste and the types generated in the beverage industry. The environmental and economic effects on the company's profitability were also highlighted. Production planning and the bottling process were discussed. The possible root causes of waste generation on production lines and the resultant cost of packaging were reviewed.

This chapter looked into the significance of cost information in decision making, which served as the foundation for investigating waste costs in processes. The cost information need from the South African perspective was also considered. In going further in the research, the management accounting function, in providing waste cost information, is discussed, while emphasizing the traditional accounting shortfalls in providing accurate waste information. Various waste reduction techniques in use were reviewed, while giving consideration to their various applications, strengths and weaknesses, and issues of concern. The latter part of this review chapter focused on the material flow cost accounting technique as it is the technique presented to meet one the objectives for this study.

2.2 Overview of Packaging Waste

Packaging materials resulting in waste is generated both at industrial and household levels, leading to an increase in solid waste to landfill. Although there have been significant improvements in waste management approach in South Africa, these wastes have both environmental and economic cost implications to the companies. Costs are better saved when waste is controlled at the production stage. In addition, the lack of an effective costing tool or techniques for accurate waste reporting still leave most beverage manufacturers in the dark as to the real cost of waste generated from the production lines, thereby losing opportunity to save material cost.

Management accounting takes cognizance of cost flow through the production lines in order to prevent revenue leakage and improve cost savings. In order to examine and determine how packaging waste costs incurred on alcoholic beverage production lines impact on efficient output, it is necessary to first approach this study by briefly introducing the role that packaging plays in beverage production and the types of packaging materials associated with the beverage industry. Packaging plays a significant role in the protection and preservation of beverage products, although the role of packaging is viewed from different perspectives from various studies carried out. Packaging is defined as a necessary part of protecting products from their source to their destination (Dixon-Hardy and Curran 2009: 1199). Packaging is very essential to the production process in the beverage industries. It is the means whereby products are securely conveyed to the end-users. The beverage industry is one of the major consumers of packaging materials, as packaging shows up from the input to the output side of the material flow balance, and usually leaves the organization together with the product (Jasch 2009: 41).

Olajire (2012: 19) highlighted the different types of packaging materials inherent to alcoholic beverage production which includes crates, pallets and boxes, glass bottles, cans and polyethylene terephthalate (PET). Koss (1998: 102), however, previously noted that beverage people refer to raw and packaging materials as "raw" material. He argued that packaging materials should be differentiated. He categorized packaging materials into primary, secondary and tertiary packaging.

Davis and Song (2006: 148), in a review of the packaging waste generated in the United Kingdom (UK), described the following three broad categories of packaging:

- Primary packaging, which is normally in contact with the goods and taken home by consumers;
- Secondary packaging, which covers the larger packaging, such as boxes, used to carry quantities of primary packaged goods; and
- Tertiary packaging, which refers to the packaging, which is used to assist transport of large quantities of goods, such as wooden pallets and plastic wrapping.

Pasqualino, Meneses and Castells (2011: 359) conducted a study on the packaging material options on selected beverages that are contributors to packaging waste fraction in the Spanish market, which includes juice, beer and water. The packaging options considered were:

- Aseptic carton – this is a material mainly used for liquid foods and beverages and allows food to be conserved for up to six months. It is made of layers of 75% cardboard, aluminium and low-density polyethylene (LDPE). The cardboard layers give the packaging its shape, while the aluminium layer prevents air, light and micro-organisms from reaching the food, and the LDPE layer prevents the food from coming into contact with the aluminium. Recycling aseptic cartons involves separating and processing the different layers. Cardboard is the main waste component generated by aseptic cartons. Therefore, the recycling impact of packaging was attributed only to cardboard, whereas the LDPE and aluminium layers were assumed to be disposed of by landfill (Pasqualino, Meneses and Castells 2011: 359).

- Aluminium cans - These are mainly used for packaging carbonated drinks such as soft drinks and beer. Aluminium is 100% recyclable and provides aluminium scrap that can replace primary aluminium. Recycling losses include coatings, inks and other compounds present in the can (Pasqualino, Meneses and Castells 2011: 359).

- Glass bottles: These are used in three different colours according to the beverage they contain. For example, white glass is mainly used for water, milk and juice; brown glass is usually used for beer; and green glass is usually used for wine (Pasqualino, Meneses and Castells 2011: 359).

- High density polyethylene (HDPE): This material is used to make bottles for packaging juice and a wide variety of healthcare and cleaning products such as soaps, softeners, etc. (Pasqualino, Meneses and Castells 2011: 359).

- Polyethylene teraftalate (PET): This is used to make bottles mainly for mineral water and soft drink packaging. PET is a recyclable material that is cheap, light and easy to mould, and that prevents loss of carbonation and flavour. PET bottles are available in all sizes (Pasqualino, Meneses and Castells 2011: 359).

The above studies revealed that packaging has a significant impact on a company's outlook; the different packaging materials utilized have economic and environmental consequences to the business. The improvement made in relation to the composition of packaging material was stressed. However, due to the relatively short life-cycle of many consumer products, the volume of packaging on the market is estimated to equal the volume of packaging waste generated (Xie, Qiao, Sun and Zhang 2013: 627).

2.3 Packaging Waste Generation

Pasqualino, Meneses and Castells (2011: 357) observed packaging as the second largest fraction of municipal waste after the organic fraction due to the increase in varied product consumption, of which beverage is a major contributor. Figure 2.1 shows the composition of the general waste generated in 2011 (percentage by mass) in South Africa according to the baseline report. Beverage packaging waste forms part of the waste categorized under the general waste category. Plastic and glass waste of 6% and 4% ranks amongst the lowest categories of waste in this structure after tyres. The improvement of waste management approach in South Africa is a clear indication of the reduction in beverage packaging waste generated (Muzenda 2014: 106). However, with the zero waste targets of most beverage manufacturers, there is room for significant improvement not only in terms of the amount of waste generated, but also associated cost savings that could be derived from the business perspective.

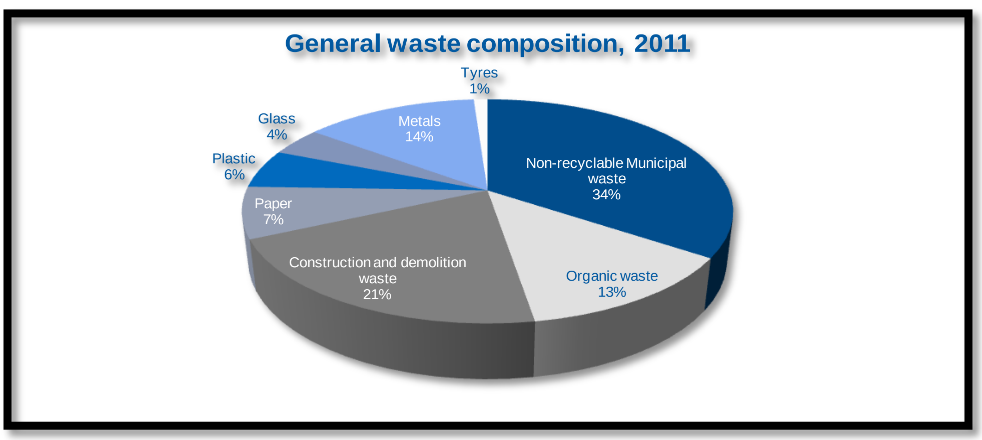


Figure 2.1 General waste compositions for year 2011
Source: Environmental Affairs (2012: 10)

Packaging waste generally generated from alcoholic production includes caps, glass bottles, PET bottles, labels, supplementary elements. The supplementary elements includes staples, glues, closure stickers, and sticky labels (van Sluisveld and Worrell 2013: 134); wooden pallets, board and plastic wrapping and containers (Dixon-Hardy and Curran 2009: 1199). The volume of packaging waste generated globally reveals the rate of inefficiencies in the utilization of resources in manufacturing processes. Figure 2.2 depicts a typical picture of how packaging waste occurs in a beverage process. Packaging waste materials can be generated both during and after the process.

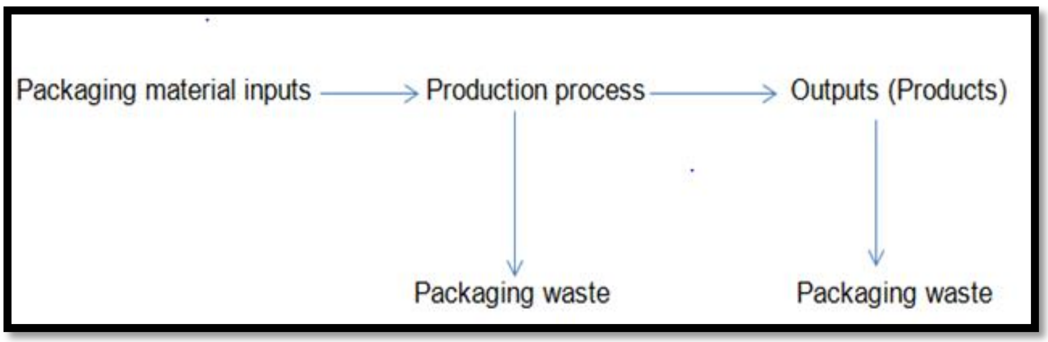


Figure 2.2 Packaging waste generation:
Source: Self-generated

Nahman (2010: 155-156) stated that the South African Department of Environment and Tourism, via the Extender Producer Responsibility enacted the Producer Pays Principle (PPP), where all waste generators become liable for paying costs associated with waste generated via their activities. All physical and financial responsibility of the the environment is shifted to the waste generators, which include external costs associated with products throughout their life cycle up to the final disposal.

2.4 Effect of Waste on Company's Profitability

According to Kumar, Teichman and Timpernagel (2012: 1293), companies need to rethink the way they produce products from the design and process stage as this provides potential benefits to a company's financial bottom-line. Similarly, Dooley (2014: 247) agree that integrating sustainable practice into business operations can boost a company's profits and achieve significant reductions in short-term operational expenditure; and also aid increments in financial shareholder value to be earned by reduction to long environmental risk.

Zeng, Meng, Yin, Tam and Sun (2010: 976) argued in a review that was based on an empirical analysis of the European paper manufacturing industry, that there is a predominantly negative relationship between environmental and economic performance, using the emissions-based index as an environmental performance measure, and no significant link was found when the inputs-based index was used. The review further presented a survey on Israeli firms which also found no support for the hypothesis that achieving improvement in environmental performance as a result of ISO 14001 implementation leads to better business performance. However, Zeng *et al.* (2010: 982), on the contrary, discovered that there is an overall positive impact of cleaner production on firms' business performance from the analysis of Chinese firms via the Structure Equation Model (SEM).

Bautista-Lazo and Short (2013: 142-144), in the review of theory of manufacturing, echoed Henry Ford's claim that "material should be used to their utmost so that the labor of men embedded in the material should not be lost", thus laying emphasis on the true cost of waste. The authors attest that, 20% of a company's products generate about 300% of the actual profits of the company; and the remaining 80% of the products either breakeven or make a loss, therefore losing 200%. Thus, any output that is not a product is a non-product output. Although an output is considered a waste if it fails to provide a useful service to the society, environment, or the economy, waste caused by inefficiency has a higher impact on a company's profitability; losses resulting from inefficiencies cannot, therefore, be considered as minor losses (Bautista-Lazo and Short 2013: 146-149).

According to van Sluisveld and Worrell (2013: 135-137), source reduction is promoted as a means of reducing the impact of packaging on the environment, meaning that unnecessary packaging is an unnecessary cost factor, especially in high-volume distribution channels. Therefore, waste is one of the cost components that needs to be managed to reduce over-all cost and increase profits, thereby increasing the company's competitive advantage (Raj and Seetharaman 2013: 119).

2.5 Environmental and Economic Impact of Beverage Packaging Waste

Packaging waste ranks the least threat on the waste hierarchy, as earlier highlighted in chapter one. However, the environmental and economic implications can both be potentially detrimental if inappropriately disposed.

Ling, Poon and Wong (2013: 25-26) identified discarded beverage glass bottles as one of the significant municipal wastes in Hong Kong which was a major concern, especially as only a few recycling channels could be identified. Government data, according to this study, showed that 373 tonnes of glass waste were generated daily but the recovery rate was less than 3.3%. The study further stated that the lack of glass manufacturing industry in Hong Kong limits the opportunities for reuse and remanufacturing waste glass produced. The study concluded that, though a number of initiatives have been made both by the government and the private sector to promote waste glass recycling in Hong Kong, there is still over 300 tonnes of waste glass which required landfill disposal every day **(**Ling**,** Poon and Wong 2013**:** 31**).**

Lincoln (2015: 16), in a study for the recovery of PET bottles in Nigeria, identified some environmental impact that PET bottle waste has in Nigeria. He highlighted that this waste has become a plague to the human environment as the bottles end up in open drains which trap mosquitoes and other harmful insects that cause diseases such as malaria and cholera. In addition, the waste constitutes serious danger to the coastal marine environment by affecting aesthetic and recreational values. He further highlights that huge economic losses have also been recorded when the waterways are filled; creating waste management problems as this waste does not degrade easily. Landfill also accumulates, thereby threatening the natural habitat.

The economic implication of beverage waste to a company may be attributed to the cost incurred in generating and disposing of the beverage waste. Mostly, the amount from recycling is usually insufficient to make up for the amount of waste losses, considering the purchase price of the glass bottles that cannot be recovered.

Schliephake, Stevens and Clay (2009: 1262), in the conclusion of a study conducted on different approaches to assess value loss in timber furniture and food manufacturing supply chains, emphasized the importance of understanding where the largest losses occur in a supply chain or where the most waste is produced in order to make any improvements. Other emphasis was laid on physical inspection of the supply chain which may assist in identifying the root causes of damaged product and duplication processes leading to avoidable material losses.

Understanding processes is thus imperative in the identification and quantification of line losses. This also provides access to factors resulting in those losses.

2.6 Production Planning and Bottling In Beverage Production

Koss (2005: 40) highlighted that the beverage production lines represent an aggregation of materials, machinery, methods and human effort used to produce packaged products for the consumer. A material balance is, therefore, essential for accurate accountability of material and services consumed in, and the losses generated from the beverage production process (Mugwindiri, Madanhire and Masiiwa 2013: 6).

Guimarães, Klabjan and Almada-Lobo (2012: 230) noted the complex nature of planning production in the alcoholic beverage industry, specifically the beer industry. This is as a result of not just the several processes involved in the production, but also the competitiveness of the market forces companies to enlarge their portfolio which poses new challenges and raises the need for decision support tools for managers.

Guimarães, Klabjan and Almada-Lobo (2012: 229) conducted a study that describes the production of beer and soft drink production process. The study aimed to provide a long-term production plan to a series of production lines located in different plants using linear programming algorithm. Guimarães, Klabjan and Almada-Lobo (2012: 230) noted the similarities in the production of beer and soft drink and both involve two production stages; liquid and bottling. The first stage of the beer production process, also known as brewing, is the stage where sugars present in starch are converted into alcohol through a reaction of yeast. Although different beers are known to have different recipes that determine their production process; they generally go through three main processes in production: wort preparation, fermentation and maturation, and filtering.

Mugwindiri, Madanhire and Masiiwa (2013: 8-10), described the bottling phase in beverage production in figure 2.3. This stage is regarded as the second stage; the stage is described as consisting of different sized cans, glass bottles (disposable and reusable), kegs and plastic (PET) bottles which are filled with beer and soft drinks. Here, each filling line consists of a series of conveyor belts and machines that wash, fill, seal, label and pack the bottles, cans or kegs. The first step involves washing and disinfection of containers, which afterwards pass through an inspection to guarantee the absence of potential hazards. The next machine performs the filling and capping of containers. To ensure product shelf life over a determined period, a pasteurization step follows container filling. For soft drinks, the pasteurization step may take place in a mixing tank instead. Its duration depends on the product features. Labelling is carried out next. Filled containers are inspected to ensure that the specified volume has been introduced and no defects occurred during the process. Containers are packed into paper boxes, packs or other selling units which precede palletization and storage.

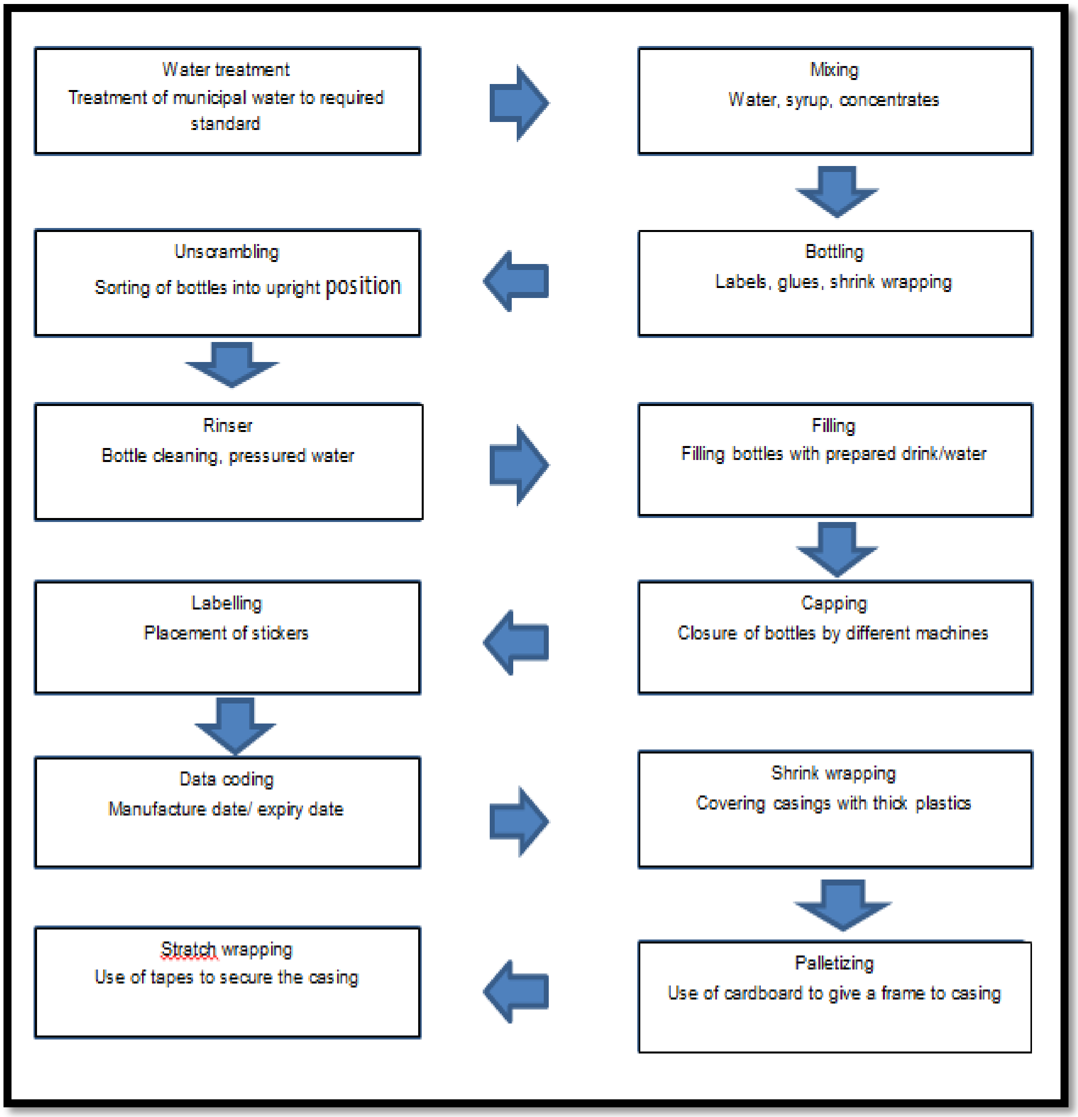


Figure 2.3 The beverage production process

Source: Mbohwa and Madanhire (2014)

More so, manufacturing companies incur losses on materials utilized during production as a result of inefficiency and other factors that lead to wastage and high production costs. The improved and innovative technology, demand for new and varied products from consumers, and high consumption level of natural resources also increase the amount of waste generated.

2.6.1 Packaging Material Consumption

Koss (1998: 102) described beverage raw materials as materials and ingredients mixed to formulate the liquid product, and packaging materials as containers, closures, etc. Similarly, Jasch (2009: 39) stated that raw and packaging materials are the material inputs that become part of an organization's final physical product or by-product, that is, the major product component. Jasch (2009: 41) also revealed that some case studies have shown that consistency of recording for packaging materials can be improved, as packaging materials are sometimes recorded with material numbers but not recorded in the warehouse inventory. Moreover, some packaging material purchased is not assigned to the corresponding account and material stock but is subsumed under other operating costs or under overhead costs. Many companies control and monitor material purchase and input into production via warehouse management and production planning (Jasch 2009: 41).

A review by Schliephake, Stevens and Clay (2009: 1258) accentuated that the lack of good information on material efficiency incapacitates many companies to assess the cost of material loss from processes due to inefficient use. Material efficiency, as described by Allwood, Ashby, Gutowski and Worrell (2011: 362), was a normal practice until the industrial revolution. A relationship between efficient use of material resources and the cost factor could be established from this review. Schmidt and Nakajima (2013: 360) also emphasized, in a review, that the issue of reducing operational material and energy inputs is considered a common goal of both economic and environmental interests in relation to environmental management systems of the 1990's.

One of the ways of reducing material waste on the line is the reduction in the material the purchase price, which is incorporated into production planning. Guimarães, Klabjan and Almada-Lobo (2012: 230), in a review, state that planning production in the alcoholic beverage industry, specifically in the beer industry, is a complex process, attributable to the several processes involved.

Also posing a challenge is the collection of information, and the need for detailed research on raw and packaging material (Jasch 2006: 1206). The study concluded that inputs to a commercial product either leave as an environmentally responsible product or as waste; inefficient waste has become a critical conceptual aid that challenges the acceptable conventional notions of products for sale and the level of inefficiencies that is permitted.

Material flow balance assesses all material inputs and resulting product and non-product outputs of the organization. From the input side, the physical and monetary values are simultaneously collected to ensure consistency of data. Since the traditional life cycle of a product begins with concept and design and ends with the disposal of the product to landfill, it is imperative that all good material inputs be maximized to eliminate the amount of waste and optimize production of the product (Kumar, Teichman and Timpernagel 2012: 1282). Reducing material production and consumption will also reduce the energy required for production and waste processing (Rouw and Worrell 2011: 483).

van Sluisveld and Worrell (2013: 134) listed the general components of beverage packaging material as consisting of cap, bottle, and supplementary elements which fulfil certain functions to contain, protect, handle, deliver and present without obstructing the other packaging functions.

2.7 Factors Influencing Waste

Beverage manufacturers are responsible for the waste generated on-site as well as the packaging on outgoing products that will end up as waste. Nagapan, Rahman and Asmi (2012: 1) stated that waste activities consume time and effort without adding value, thereby, resulting in material losses and delay in meeting stipulated times. The study further stressed the need to identify the root causes of waste generation.

The discussion on some root causes of waste, according to Mena, Adenso-Diaz and Yurt (2011: 654 - 655), revealed the interdependencies that are part of a complex web of independent causes and effects. The authors identified some management causes as the lack of information sharing, forecasting difficulties and poor ordering, performance measurement and management, training and quality management.

The study conducted by Konings and Vanormelingen (2010: 29), using firm-level data, discovered that training boosts the marginal productivity of employees. Fleisher, Hu, Li and Kim (2011: 93), using panel of firm-level data, argued that education contributes a higher marginal product than less educated workers. Jones (2001: 75) supported that there is strong evidence that education and productivity are correlated.

The aforementioned studies indicated that wastes are anti-profitable to any organization. As mentioned in 2.4, it is imperative that factors influencing waste generation be investigated, and root causes of waste on the lines confronted via preventative means rather than providing a solution afterwards, thereby preventing revenue loss.

2.8 Cost of Beverage Packaging Waste

Koss (1998: 102) stated that one of the most staggering observations in beverage plants is the usage and loss of raw and packaging materials. He further explained that, while material usage is tracked by various yield calculations, packaging material usage, on the other hand, is monitored by a variety of methods to establish cost bases. The observation was prompted by the concern of how packaging materials were used and lost on the production line. Furthermore, the author noted that the elusiveness of calculating material usage in the production cycle was becoming questionable. He further observed that most plants make use of purchase versus inventory for usage factors within the confines of the standard costing technique. Koss (1998: 102) nevertheless proposed the direct-usage method, a more positive method which tracks materials out of storage to the production line, and also identifies line losses separately from spillage or damage from storage or movement. The method is identified to lessen error potential and provides a better basis in the development of physical standards. Although this method is able to quantify the amount in volume, it still does not provide the cost information required to measure accurately the waste costs incurred on the line.

The National Waste Information Baseline's drafted report (Environmental Affairs 2012: 19) concluded that South Africa generated approximately 108 million tonnes of waste in 2011, of which 98 million was disposed of at landfill sites. The report further proved that determining a national waste information baseline for South Africa was extremely challenging due to a general lack of accurate waste data reporting. Often, companies adopt techniques that fail to reflect a detailed report of material losses incurred in their production processes. Worthy of note, is that losses/wastes are considered as inefficiencies in manufacturing operations and viewed as a costly venture to the sustainability of companies.

2.9 Significance of Cost Information in Strategic Decision Making

Management decisions are taken daily in the business environment, most of which range across financial, production, marketing, legal and environmental issues, according to Hilton and Platt (2015: 4). In addition to the information needs, accounting techniques are also essential in harnessing the potentials inherent in information so as to create value through the management of resources and activities for optimal output (Hilton and Platt 2015: 5). A number of research studies have been carried out, especially in relation to production and environmental issues, which have initiated the development of several economic and environmental-related approaches of resource utilization, as discussed above. In spite of the wide range of techniques designed to address efficiency and waste reduction, the question remains, why are managers still grappling with the right technique to adopt in effectively quantifying the true cost of waste in tackling revenue leakages on production lines? The idea behind process improvement in manufacturing via technology should be about improving efficient utilization of resources and saving cost, but that is yet to be fully achieved. All relevant information of resources at a company's disposal is important for proper allocation and utilization.

2.9.1 The Need for a Waste Cost Information System in South Africa

Gabriel, Tschandl and Posch (2014: 34) observed that the important indicators for controlling sustainability in business are costs and revenues. Therefore, the role of accurate waste cost information for strategic managerial decisions in an organization cannot be over-emphasized as necessity is laid on all manufacturers to account for all environmental-related information. This was as a resultant increase in consumption of natural resources, coupled with its impact on the environment. Included in the information is the volume of resource extraction and consumption in production, and those relating to waste and emission due to unsustainable production practice (Fakoya 2013: 251). In the absence of a fully operating South African Waste Information System (SAWIS), a general lack of accurate waste data remains a huge challenge in South Africa. Waste management in South Africa is thus still heavily reliant on landfilling as a waste management option, and waste data are inaccurate (Environmental Affairs 2012: 14).

Management of waste at the production stage assists manufacturers to prevent waste that goes to landfill and its associated costs to companies. At this stage and with the right tool, accurate information of any waste generated (in quantity and cost) can be collated.

2.10 The Management Accounting (MA) Function

Drury (2011: 19) stated that accurate cost information is required in decision-making for distinguishing between profitable and unprofitable activities. He further emphasized that, if the cost system does not capture accurately enough the consumption of resources by products, the reported product (or service) will be distorted, whereby managers drop profitable products or continue the production of unprofitable products. Gabriel, Tschandl and Posch (2014: 34) support that the indicators for controlling sustainability in business are costs and revenue. Drury (2011: 35) stated that an appreciation of the cost structure of a business is critical to its strategic, and operational success.

The management process involves the formulation of strategy, planning, control, decision-making, and directing operational activities. Therefore, managerial accounting information can aid managers perform each of these functions more effectively (Hilton and Platt 2015: 36). Management Accounting (MA), according to Jasch (2009: 5), is that branch of accounting that ultimately provides the cost information needs of internal management and data for decision making. Drury also described management accounting as designed to satisfy the information needs of internal management and provides data for product pricing, investment appraisal and other decision making.

According to Fakoya (2013: 251), it is the responsibility of the MA function to provide adequate and reliable waste information to improve resource efficiency in an organization, although accountants feel more comfortable dealing with readily quantifiable information and are rather reluctant towards environmental issues. It is, therefore, imperative for organizations to account for cost and benefits relating to environmental issues which include resource extraction and production consumption.

MA focuses on both monetary and non-monetary information, cost drivers, such as labour hours, and quantity of raw materials purchased that inform management decision making and activities, such as planning and budgeting. Such a focus ensures the efficient use of resources, performance measurement, and formulation of business policy and strategy (Jasch 2009: 5-6).

Accumulated reports of waste information from individual companies provide an aggregate of the total waste generated. However, these reports only attempt to estimate the amount of waste generated and not the cost implications and the impact on the company's economic performance and environmental costs (Fakoya 2013: 252). According to Ngwakwe (2011: 572, 952), a combination of qualitative and quantitative techniques plays an important role in developing the cost evaluation system, capable of providing useful waste cost information on various stages of design and development. Emphasis was laid on the fact that managers are still unaware of the true cost of waste generation from production of some products. This could be attributed to the use of the conventional method of accounting, which hides some cost information, such as environment-related costs in the overhead accounts (Jasch 2009: 7), resulting in non-recognition and non-inclusion of certain waste costs (Fakoya and van der Poll 2013: 137 - 138). A study by Lim (2011: 24) emphasized the importance of complete cost information for cost-effective waste management strategies.

The majority of managers within organizations have very little knowledge about the environmental costs associated with conducting their operations (although some accountants and other managers might not believe this to be the case). This lack of information is, in large part, due to deficiencies in the accounting systems. It is clear that many cost-saving opportunities are being lost because of the lack of information about environmental costs.

2.10.1 The Traditional Accounting Lapses

Although accounting provides information in monetary and physical units, the two are not consistently linked together; accountants are often plagued with the inability to reconcile information on production and environmental costs (Jasch 2009: 1-3). This has been linked to the limitations inherent in traditional, and cost accounting methods to reflect an organization's efforts towards sustainability, and to provide management with information needed to make sustainable business decisions (Fakoya 2013: 252).

The aggregation of environmental cost to overhead accounts instead of production cost centres results in their being hidden from management leading to distorted calculations for improvement options (Jasch 2009: 9). The hidden information also goes further to prevent transparency with viewing flow of resources and the activities generating losses in the process. Traditional accounting systems and practices have several limitations, which make efficient and consistent data collection regarding environmental and material flow costs a real challenge for production and environmental managers (Jasch 2009: 6). As a result, other techniques have been developed over time to curb the lapses in this method.

2.11 Techniques for Waste Estimation in Manufacturing

Cost information, according to Muzenda, Belaid, Mollagee, Motampane and Ntuli (2011) and supported by Wilson, Parker, Cox, Strange, Willis, Blakey and Raw (2012: 26), is viewed as one of the most important factors linked to the continuity of a manufacturing business. Given that cost information is linked to the sustenance of a business; it becomes important to have the right accounting tools or techniques for accurate cost analysis and representation of the cost information for management’s use.

The origination of environmental management accounting introduced in chapter one was the result of seeking a more integrated approach to corporate economic and environmental management. EMA is that accounting approach that gave rise to several accounting techniques, bridging the gap between environmental costs and costs associated with production, thereby providing the foundation that addresses the drawbacks associated with traditional accounting (Christ and Burritt 2014). EMA enables managers to identify inefficiencies on the production lines in order to make waste-reduction decisions to enhance processes and save costs that are lost as waste (Fakoya 2014: 38).

Fakoya (2014: 40) further maintained that EMA involves the generation, analysis and use of financial and non-financial information used for optimizing corporate environmental and economic performance, and also to achieve sustainable business. Several costing techniques that are environmentally aligned have been developed and attempted to bridge the gap between inefficient material consumption and cost information. Although the focus of this study is more on the cost of waste generated on the production lines leading to revenue leakages, the environmental aspect cannot be ignored as it forms part of the costs incurred by the organization via waste management.

Drury (2011: 223) classified costing systems into direct costing, traditional absorption costing and activity-based costing systems, depending on the costs assigned to cost objects. Newer costing techniques have, however, emerged over the years, although links can still be traced to the traditional costing method.

2.11.1 Activity-Based Costing

Activity-based costing (ABC) was developed and has been advocated as a means of overcoming the systematic distortions of traditional cost accounting and for bringing relevance back to managerial accounting (Mahal and Hossain 2015: 66). The study further pointed out that the purpose of ABC is to prevent cost distortion which occurs because traditional costing combines all indirect costs into a single cost pool. Cost distortion is prevented in ABC by adopting multiple cost pools (activities) and cost drivers. ABC is also used to minimize waste or non-value-adding activities by providing a process view (Mahal and Hossain 2015: 66).

Barfield, Raiborn and Kinney (2003: 141) defined ABC as a cost accounting system that focuses on the various activities performed in an organization and collects costs on the basis of the underlying nature of those activities. In addition, the costing method also focuses on attaching costs to products and services based on the activities conducted to produce, perform, distribute, or support those products and services.

Jasch (2009: 113) also explained that ABC is the correct allocation of costs to processes and products, thereby reducing the amount of costs hidden in overhead cost categories. It is necessary to allocate costs to their respective cost centres and objects. Hilsenrath, Eakin and Fischer (2015: 2) pointed out that ABC seeks to identify the best drivers of overhead costs for each product or process, and uses those drivers to allocate overhead costs to products.

Mahal and Hossain (2015: 66) carried out a review on the relationship between ABC and different recent issues. According to the review, ABC has the ability to generate accounting information needed for Total Quality Management (TQM) to evaluate costs. ABC can also help managers in supply chain management to improve the allocations of logistics costs to specific cost objects; including managerial implications and implementation techniques and a tool for pricing. The application of ABC using he Activity-Based Management (ABM) approach in Strategic Cost Management can improve profits and operating performance. In addition, ABC has been applied to hospitals to improve efficiency, waste reduction, and better quality data for organizational analysis and pricing decisions. The study highlighted the potential of applying ABC in the academic institution for categorizing costs to different activities in the university and allocating these costs based on time spent on each activity.

Most organizations that have adopted ABC have benefited from its adoption. Jasch (2009: 114) points out that ABC enhances the understanding of the business processes associated with each product, revealing where value is added and where value is destroyed. Jasch added that the ABC approach has the ability to improve economic performance as a result of improved environmental protection. Jasch is, however, of the opinion that production lines and products, which used to be profitable, may suddenly perform poorly.

Therefore, the responsible line managers will tend to refuse the change, if they don't have the means to improve the situation.

2.11.2 Life Cycle Assessment (LCA) and Life Cycle Costing (LCC)

Comandaru, Bârjoveanu, Peiu, Ene and Teodosiu (2012: 534) described LCA as an analytical tool that evaluates the environmental impact caused by products or processes/services throughout their entire life cycle by calculating the impacts of using resources and releasing pollutant species into the environment, mainly based on cause-effect relationships. However, Sygulla, Bierer and Götze (2011: 2) argued that, LCA aims at revealing the life cycle-related impacts of products and services on the natural environment, which is ecologically intended to support the reducing of environmental damages. However, they do not make clear contributions to cost savings or corporate profits. In essence, the tool majorly measures the environmental implications of the life cycle of a product.

A number of studies have adopted the use of LCA to address environmental issues. Comandaru *et al.* (2012: 541) used LCA to account for the impacts of water consumption and discharge of wastewater flows to subsequent or downstream water uses. Cleary (2013: 148-149) adopted LCA to evaluate the potential net environmental impacts that could result from these means of reducing the residential waste associated with wine and spirit packaging. Ferreira, Cabral, De Jaeger, Da Cruz, Simões and Marques (2015: 7) used LCA to analyze the packaging waste management system in Belgium in order to evaluate the sustainability of the recycling scheme.

Cleary (2013: 150) concluded that, although LCAs can be used to estimate the potential net environmental gains from package substitutions, they can be misleading if one's interpretation and extrapolation of the results lack an appropriate context.

2.11.3 Life-Cycle Costing (LCC)

On the other hand, Woodward (1997: 336) asserted that the life cycle costing of an item is the sum of all funds expended in support of the item from the conception and fabrication through its operation to the end of its useful life. Life-cycle costing estimates and calculates costs over a product's entire life cycle in order to determine whether the profits earned during the manufacturing phase will cover the costs incurred during the pre-and post-manufacturing stages (Drury 2011: 538). In addition, Drury advocated that the knowledge of costs of a product's life cycle enhances management's understanding of the total cost incurred throughout its life-cycle; and invariably assists in understanding the cost implications of product development. Drury (2011: 538) also elaborated that LCC, in contrast to the usually adopted accounting systems which report on a period basis, coupled with unmonitored profit, traces all costs and revenues on a product-by-product basis over several calendar periods throughout the life-cycle of the product.

LCC may be applied from either a planning or analysis perspective, according to the study conducted by Martinez-Sanchez, Kromann and Astrup (2015: 345). The study was conducted using LCC to develop a cost model for economic assessment within modern solid waste management systems.

Gluch and Baumann (2004: 578) established that adopting LCC for environmental decision making in the building investments gives an indication on which aspects to consider, limits the information flow by simplifying multi-attributed alternatives, and may entail learning by participating in the calculation process. However, LCC fails to handle decisions under uncertainty, fails to handle irreversible decisions, over-simplifies environmental problems into monetary dimensions, underrates future environmental costs and also suffers from poor availability and reliability of data.

According to Drury (2011: 538), a failure to trace all costs to products over their life-cycles hinders management's understanding of product profitability, because a product's life-cycle is unknown. In addition, inadequate feedback information is available on the success or failure in developing new products.

2.12 Material Flow Cost Accounting (MFCA)

2.12.1 Definition and Characteristics of MFCA

Material flow cost accounting is one of the most fundamental and well-shaped tools of environmental management for quantifying the flows and stocks of materials in processes or production lines in both physical and monetary units (Christ and Burritt 2014: 2). MFCA was developed primarily to evaluate material flows within individual organizations, the purpose being to support eco-efficient decisions that enhance resource efficiency and simultaneously improve the economic and environmental performance of the entity (Christ and Burritt 2014: 3). MFCA is regarded as a cost collector by the German Federal Environmental Ministry and Federal environmental Agency (Jasch 2009: 116). According to Hyršlová, Palásek and Vágner (2011: 6), the principal concept of MFCA are any and all inputs (materials, energy, water and other inputs) and outputs (primary/ by-products, wastes, waste water, emissions) determined within a quantity centre, and calculation is carried out in respect of material, energy, and system costs incurred for products and material losses. Christ and Burritt (2014: 2) stated that MFCA is underpinned by the premise that all materials purchased by an organization must eventually leave as either product or waste (non-product).

Since its inception in the nineties, MFCA has gradually gained popularity and acceptance by industries and researchers, especially in Germany where it originated. Moreover, the basic concept of MFCA was first introduced to Japan around the turn of the century, and both German and Japanese industries have laid the foundation for its development and diffusion (Schaltegger and Zvezdov 2014: 2).

Fakoya (2014: 59) highlighted that, the essential focal point of the MFCA technique is the recognition of waste as a non-marketable product. He further outlined that managers may need to analyze process output into marketable and non-marketable product to enhance waste reduction decisions in terms of value and physical quantities, which, in turn, positively increases the organization’s environmental performance. Fakoya further enlightened that the availability of precise waste data is a motivating factor for managers towards waste reduction rather than relying on conventional and cost accounting information.

One of the salient features of MFCA is its ability to accurately capture waste cost information beyond that provided by conventional accounting systems (Fakoya and van der Poll 2013: 136). Although MFCA has been subjected to research and has been applied in various pilot companies, no rapid adoption has been documented to date (Schaltegger and Zvezdov 2014: 2). This study, therefore, aims to harness the benefits of the MFCA technique for costing packaging waste and its relationship with respect to efficiency.

2.12.2 Focus of MFCA

The MFCA loss concept focus on the relationship[p between inputs and outputs in the production processes, where loss is defined as the difference between input and output based on waste (Kokubu and Kitada 2010: 8; 2014: 2). The authors reported that losses identified by MFCA in material outputs are regarded as standard, which can be deemed an inevitable loss. As this approach only permits loss within certain required standard, which, on the other hand, defeats MFCA’s argument on the purpose of saving costs that could have been recovered for profits? Further concluding that losses brought into focus by MFCA are losses that, while they comprise part of the manufacturing costs, they were not recognized as losses to be controlled in production management (Kokubu and Kitada 2014).

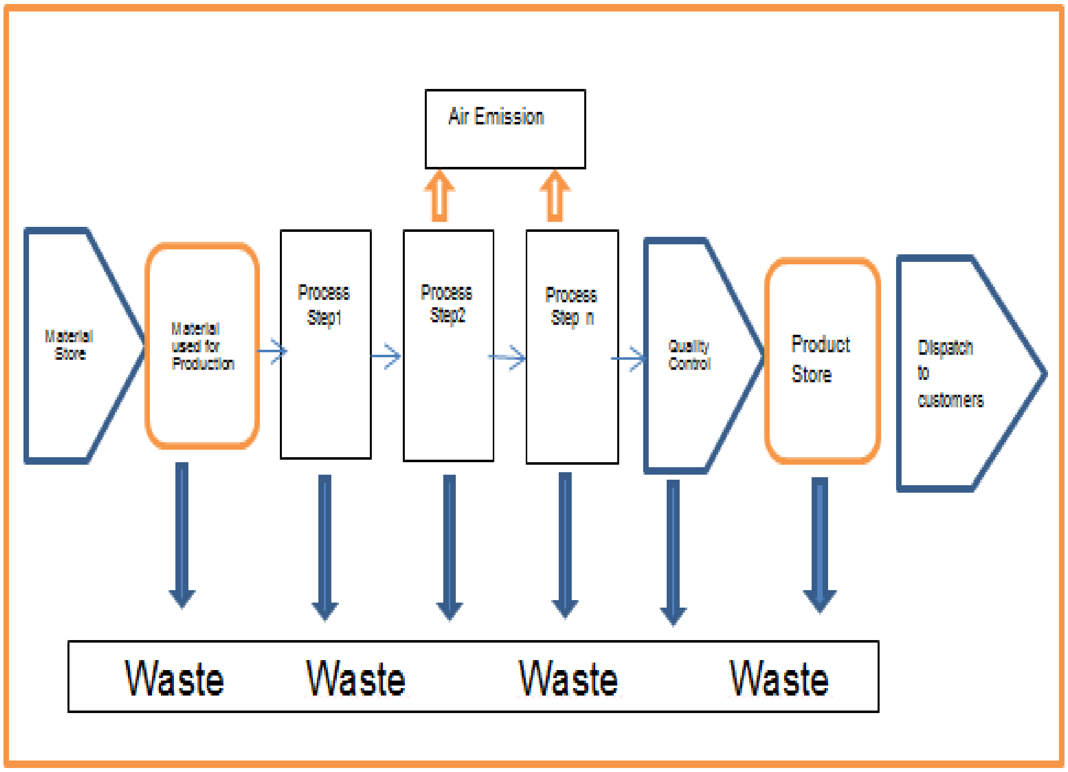
2.12.3 Working Principles of MFCA

The principle of MFCA focuses on the principal idea of eco-efficiency; however, it combines physical and monetary information in one accounting model. The concept of MFCA is based on inputs consisting of material costs (physical quantities of materials involved in the various production process such as the purchase price); system costs (all in-house handling costs such as personnel, depreciation, transportation, and maintenance costs); and disposal costs (costs incurred in ensuring that positive and negative goods leave the company in the form of waste water, energy, by-products and emission) (Jasch 2009: 119; Christ and Burritt 2014: 4). MFCA relies on the physical input information within different quantity centres within the production process to produce a resultant cost effect (Schmidt and Nakajima 2013).

Although MFCA was developed to integrate economic and environmental activities, its characteristics give it the ability to isolate a process in order to identify financial leakages and generate cost information thereof. MFCA has been applied both in isolation and in conjunction with other techniques such as Enterprise Resource Planning (ERP) (Fakoya and van der Poll 2013: 137).

A model of MFCA, shown in figure 2.4 below, reveals the flow of material from the input to the end product, and dispatch to customers. Also highlighted is the waste generated at the different stages of the production process, known as quantity centres. The application of MFCA, as revealed by this model, signifies transparency in the line activity, whereby output, as product and waste from the process in terms of material quantity and cost, is evidenced.

Figure 2.4 A model of MFCA diagram



Source: Self-generated

2.12.4 Applications of MFCA

MFCA has been applied in different manufacturing industries for achieving energy and resource efficiency. Viere, Stock and Genest (2013) discovered, in a study conducted from the textile industries, that MFCA gives a better understanding of cost drivers of material and energy usage, and provides new and precise information on inefficiency- related costs and product-specific costs' differences.

SWU is a textile industry that adopted MFCA in two production sites to calculate the material and energy flow-based costs of short fibers (Viere, Stock and Genest 2013: 462). MFCA was used to calculate material and energy flow-based costs of short fibers and then used to confront the sales revenue of its remnants. Cotton was passed from the warehouse through to the combing stage, passing through several steps; from the quantity-based and cost-based evaluation. Each production step was reported to consume energy and auxiliaries and generate waste that gave rise to disposal costs. MFCA also revealed that an inclusion of depreciation cost and labour cost will further increase the production costs (Viere, Stock and Genest 2013: 462).

Fakoya and van der Poll (2013: 138) conducted a study in the alcoholic beverage industry in which MFCA was integrated with the Enterprise Resource Planning (ERP) system to generate waste-cost information for decision making. The study concluded that integrating the ERP and MFCA systems help to speed up the availability of waste information both in quantity and costs for quicker waste management decision making. Fakoya (2014: 59) stressed that manufacturing and other industries, such as the brewery industry, are usually based on established standard costs to which actual costs are compared thereafter the resulting cost variance is analyzed and addressed.

Trappey *et al.* (2013: 640) reviewed two successful MFCA cases in electric power plants, i.e., Kansai Electric Power (KEP) and Tokyo Electric Power (TEP). The application of MFCA to KEP’s new technology of power generation allowed KEP’s outputs of negative products and waste to the made transparent to the public. Also, TEP’s application of MFCA to its nuclear power generation aided in the disclosure of both internal and external wastes, thereby making it transparent to the public. In addition, the output data provide information of the plant’s power consumption, power transmissions and water pumps, and quantities of other wastes.

The study conducted by Trappey *et al.* (2013: 644) at Innolux Corporation, an optoelectronic industry, via the adoption of MFCA in four factories located in China, revealed that the adoption of MFCA minimized negative environmental impacts and reduced its material costs.

The study conducted by Hyršlová, Palásek and Vágner (2011: 8), in a ceramic tiling plant in the Czech Republic using MFCA, described the stages from input (pulverization and homogenization of inputs) to output in the manufacturing process of interior ceramic tiles design. The stages where material losses mostly occur during manufacturing and where management should focus were highlighted. The different stages in the manufacturing process include grinding, drying, pressing, glazing, burning, sorting and packaging; the production process was monitored in m^2 and tons (Hyršlová, Palásek and Vágner 2011: 9). The entire manufacturing process was segmented into three cost centres within the existing management accounting system which includes preparation of materials, preparation of glazes and manufacturing. Based on the MFCA calculation, the preparation of a material quantity centre is proposed as the process to focus on as the process produces the majority of the material losses (Hyršlová, Palásek and Vágner 2011: 14).

2.12.5 Benefits and Issues of Concern of MFCA

The success stories that have been recorded via the application of material flow cost accounting reveal its transparent and analytical abilities to positively influence management's decisions. The transparency exposes the material and monetary losses encountered on the lines, while the analysis is an eye-opener on inefficiencies in the process that leads to losses. Ultimately, MFCA provides optimization on the lines rather than at the output stage. Some other benefits of MFCA from different studies report that MFCA delivers both increased profits and material utilization, that is, it enables organizations to manufacture the same amount of finished products with less input (Trappey *et al.* 2013: 640). Other advantages of applying the MFCA technique is to convert production losses to monetary terms to encourage managers to be aware of these losses and also reduce negative products, as related by Kasemset, Sasiopars and Suwiphat (2013: 9)

According to Jasch (2009: 120), the benefits of MFCA are:

- Cost-reduction and environmental impact reduction as a result of improved material and energy efficiency (i.e., reduced residual waste and reduced use of materials per product);
- Incentives to develop new products, technologies and procedures;
- Enhanced quality and consistency of corporate information systems, linking physical and monetary data;
- Improvement of organizational structures and procedures as a result of consistent referencing to the material flow system;
- Inter-departmental, material-flow-related communication and coordination instead of separation into divisions, departments, and cost centres with separate responsibilities;
- Increased motivation in staff and management regarding the comprehensive structuring of material flows; and
- Focus on raising material and energy productivity instead of reducing the workforce.

Although MFCA has been applied successfully in different industries, including the beverage industry, studies on calculating packaging cost in isolation, and the cost implication has not yet been carried out to the researcher's best of knowledge, considering the benefits, especially to both beverage and packaging industries. Although Koss (1998: 102) stressed the importance of differentiating between raw material and packaging material, very few studies have addressed these differences, thereby forfeiting cost savings in isolating packaging wastes. Beverage bottling plants would benefit from costing the waste generated given their high rate of consumption of packaging materials. Seeing that packaging waste contributes to environmental degradation (Xie *et al.* 2013: 634) and eat into organization's profits (although minimally), this study hopes to adopt the MFCA technique to address the cost of packaging waste's contribution to production costs. Therefore, this study employs the MFCA technique to address revenue losses encountered by the alcoholic beverage bottling company as a result of the packaging wastes being generated.

2.13 Conclusion

This chapter presented different literature studies that proved that packaging waste ranks amongst the major contributors of landfill wastes, and that landfill encroaches on land space and also contributes to greenhouse gases. The chapter also highlighted that the effects of wastes from manufacturing activities are not limited to the environment alone. In addition, the generation of packaging wastes on production lines consumes profit through revenue leakage often lost as waste. Costs are also incurred in waste management, such as recycling and disposal.

In an attempt to identify a viable costing system appropriate for effectively costing waste in manufacturing processes, different costing approaches were addressed; and their applications, benefits and impeding issues of concerns considered. Sequel to the different reviews carried out in this study on waste costing techniques, the traditional costing technique seems to fall short of providing comprehensive information needed for effective management decision making. ABC, on the other hand, provides the information lacking in the traditional technique; such as identifying the best cost drivers of overhead costs and the ability to improve economic performance. However, it lacks continuity in the event of any changes made in the process.

Life-cycle assessment and life-cycle costing have also proved to be effective analytical management tools and contributed to improved decision making. Nevertheless, LCA does not provide clear contributions to cost savings, while LCC limits information flow and fails to handle irreversible decisions, thereby hampering availability of data and providing inaccurate cost data.

MFCA has been proven not only to provide accurate and reliable data, it also provides detailed information from the input to output stages where wastes are generated in both quantity and cost value. MFCA provides both management and environmental information for effective management decision making. Therefore, manufacturers can make use of this tool to combat the inadequacies of the traditional method.

The next chapter will provide detailed information on how the MFCA technique will be applied to the case study company for waste costing. The theoretical framework anchoring MFCA will be described and the different steps applied to achieve accurate data will also be analyzed.

2.14 Research output

1. Omolola A. Tajelawi, Hari L. Garbharran (2015). MFCA: An Environmental Management Accounting Technique for Optimal Resource Efficiency in Production Processes. Paper accepted for presentation at the ICBEFA 2015: 17th International Conference on Business, Economics and Financial applications, and publication. Vol.11: No .37.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Introduction

Having reviewed different literature studies pertaining to the study in the previous chapter, the methodological approach and data used for this study will be used to address the research aims and objectives. This chapter also describes the research design and mixed methods approach adopted; unit of analysis, target population, sampling, and data collection employed. Issues relating to validity and reliability are also discussed.

3.2 Research Aim

The aim of this study is to determine the impact that packaging waste costs has on the production output of an alcoholic beverage bottling plant. This is achieved by using MFCA to estimate the true cost of packaging wastes generated on the lines, and the contributing factors. By conducting this study, the revenue leakage experienced by the bottling plant on Line 1 and Line 3 is exposed. MFCA is an environmental accounting tool that is new and almost non-existent in South Africa. Consequently, minimal information on its application is available in the South African context. Furthermore, the isolation of packaging waste in order to quantify its costings separately rather than being sub-summed under auxiliary materials is another area where little research has been carried out to the researcher’s knowledge.

Since the traditional accounting technique commonly used in manufacturing industries lacks the ability to provide accurate costs, the technique is anticipated to expose the true cost of packaging waste and provide a different perspective by which the manager can improve the plant’s efficiency and potential cost savings.

3.3 Research Design and Methodology

In order to conduct a well-planned research, a structure for the procedures the researcher followed in collecting and analyzing data is required (Leedy and Ormrod 2013: 74). The logical sequence needed to connect the empirical data to a study's initial research questions and, ultimately, to its conclusion is known as a research design (Yin 2014: 28). It essentially facilitates a smooth sailing of the various research operations, thereby making research as efficient as possible in yielding maximal information with minimal expenditure of effort, time and money, as noted by Kothari and Garg (2014: 6).

Considering various probable research techniques that can be adopted, it is important to differentiate between research methods and research methodology (Kothari and Garg 2014). The authors further describe research methods as all the techniques and methods that are used for conducting research; and methodology as a way of systematically solving a research problem, e.g., the various steps adopted by the researcher in solving the research problem and the logic behind it (Kothari and Garg 2014: 6).

3.3.1 Qualitative Research

According to Myers (2013: 5), qualitative research methods are designed to help researchers understand people and what they say and do; the method is designed to help researchers understand the social and cultural contexts within which people live. The author highlighted that qualitative methods are action research, case study research and grounded theory; this form of research includes observation and participant observation, interviews and questionnaires, documents and texts, and the researchers' impression and reaction. However, Struwig and Stead (2013: 10) argued that qualitative research is an interdisciplinary, multi paradigmatic, and multi-method indicating that qualitative research can take different approaches. Therefore, the researcher must be specific in describing how qualitative research is being used in a research project.

3.3.2 Quantitative Research

Kothari and Garg (2014: 3), explained that quantitative research is based on quantitative measurements of some characteristics; applicable to phenomena that can be expressed in terms of quantity. According to Struwig and Stead (2013: 3), quantitative research is a form of conclusive research involving large representative samples and fairly structured data collection procedures. They further stated that the primary role of quantitative research is to test an idea or theory (hypothesis) about the relationship between two or more variables (an occurrence that can be observed).

3.3.3 Mixed Methods Research

This study has selected a mixed methods research. The mixed methods approach, as explained by Creswell and Clark (2011: 4), is the type of research in which the investigator collects and analyzes data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a programme of enquiry. An important decision in mixed methods is the level of interaction between the qualitative and quantitative strands in the study; that is, the level at which the two strands are kept independent or interact with each other (Creswell and Clark 2011: 64). The qualitative aspect of this study makes use of observation of the production line activities of the company and questionnaire administration, while the quantitative aspect relies on six months' production reports of the current year. The combination of both methods provides a broader view of the information on packaging waste generated on both lines; while the application of the Material Flow Cost Accounting technique provides the cost incurred on waste generated.

3.4 The Research Approach

This study adopts a case study approach. Therefore, it is imperative to highlight the characteristics that make this approach suitable for this study. Yin (2014: 16) describes a case study as an empirical enquiry that investigates a contemporary phenomenon in depth and within its real-world context, especially when the boundaries between the phenomenon and context may not be clearly seen. However, Sekaran and Bougie (2013: 103) explained that the focus of a case study is on the collection of information about a specific object, event and activity such as a particular business unit or organization. The authors further explained a case study as a research strategy that investigates the phenomenon within its real-life context using multiple methods of data collection (mixed methods). The case study adopted in this study relates to an alcoholic beverage company which falls under the category of a business unit. The approach is suitable because it obtains a clear view of the problem on the production lines under study by examining it from a real-life situation from different angles and perspectives using multiple methods of data collection. A case study also aids in the researcher's knowledge of an individual, group, as well as organizational, social, political and related phenomena (Yin 2009: 4).

Remenyi (2012: 4) also concurred that case studies not only employ multiple sources of evidence but also multiple research methods. Although using case studies to solve problems have proved to be challenging, due to companies withholding information which is regarded as sensitive; a qualitative application, however, yields useful results to current problems based on past problem-solving experiences (Sekaran and Bougie 2013: 109).

This case study approach takes the form of an exploratory case study. Sekaran and Bougie (2013: 96) stated that an exploratory study is usually undertaken when little or no information is available on how similar problems or research issues have been solved in the past. Therefore, extensive preliminary work needs to be done to understand what is occurring, assess the magnitude of the problem, and gain familiarity with the phenomenon in the situation.

This method is relevant to this study, because the knowledge and application of MFCA in the South African manufacturing is very minimal. MFCA has the potential to reduce environmental waste by improving production line efficiency (Fakoya 2014: 84). MFCA provides information on production line wastes as a separate negative output, and on proper amounts of costs allocated to them, for management's incentive to reduce cost (Jasch 2009: 117). In addition, cost of packaging materials is given little attention and subsumed under other operating costs or under overheads, thereby losing track of the accounting records (Jasch 2009: 41). This could make it difficult to account for the cost of wastes generated form packaging materials in the production process. Wouters, Selto, Hilton and Maher (2012: 247) emphasized the importance of managers knowing how well to manage the organization's processes and activities for costs improvements. This exploratory case study approach is believed to assist the managers in having a comprehensive view on how to improve production line efficiency through waste reduction by isolating the company, using mixed methods.

3.5 Unit of Analysis

The unit of analysis refers to the level of aggregation of the data collected during the subsequent data analysis stage (Sekaran and Bougie 2013: 104). Unit of analysis, as argued by Remenyi (2012: 37), assists the researcher to determine what data to consider as important. The study centers around an alcoholic beverage company's production process. However, the units of analysis considered for scrutiny in this study are production lines 1 and 3. The two production lines are examined to identify the true picture of revenue leakages recorded on the lines via unrecovered costs lost from packaging waste.

3.6 Target Population

Yahaya, Yahaya, Amat, Bon and Zakariya (2010: 4) defined population as, the entire group of people, events, or, things of interest, that the researcher wishes to investigate. The target population for this study focus is the entire group of staff members linked to the production department (staff members from the store/warehouse, bottling lines, quality department, packaging department and the accountant). The total staff members are 70 in number, while the company presently operates 6 bottling lines.

3.7 Sampling Frame and Design

The sampling frame represents all the physical elements in the population from which the sample is drawn (Sekaran and Bougie 2013: 244). Given that the population for a study may be large, in the event of limited time and cost factor, it is important, as further highlighted by Kothari and Garg (2014: 147), to represent the entire population with an adequate selection that will be appropriate and reliable. Coldwell and Herbst (2004: 74) define sampling as the act, process or technique of selecting a representative part of a population for the purpose of determining parameters or characteristics of the whole population.

Likewise, Sekaran and Bougie (2013: 244) described sampling as the process of selecting a sufficient number of the right elements from the population, so that a study of the sample and an understanding of its properties or characteristics make it possible to generalize such properties or characteristics to the population elements (Sekaran and Bougie 2013: 244). This implies that a sizeable number of elements is drawn as a sample to represent the total population. The sampling process usually starts after the identification of the target population.

The sampling frame for this study is the production lines, and the target population is the production line staff members. The researcher has adopted a judgement sampling of two lines consisting of line 1 and line 3. This has been selected to represent the entire production lines. The justification for this selection can be attributed to the plant manager's view that the two lines run daily, and generate more revenue losses as a result of the packaging wastes compared to the other lines. In addition, the constraint of large data volume is another factor for selecting the two lines.

Judgement sampling, as explained by Sekaran and Bougie (2013: 252), involves the choice of subjects who are most advantageously placed or in the best position to provide the information required. This method of sampling is used when a limited number of a category of people have the information that is sought. In the same light, Kothari and Garg (2014: 55) noted that judgment sampling is also known as purposive or deliberate sampling where particular units are purposively chosen on the basis that they will be a typical representative of the whole.

Though this sampling method is believed to yield biasness due to experts' beliefs, and the inappropriateness to generalize data, it is, however, a sampling method that is guaranteed to meet specific objectives (Struwig and Stead 2013: 121).

3.8 Data Collection Process

Yin (2014: 103-105) stated that case study evidence can come from many sources. He emphasized that no single source has a complete advantage over the others, and that, in actual sense; the different sources complement each other. Therefore, a good case study relies on as many sources of evidence as possible. Remenyi (2012: 84), in support, noted that, due to the importance of triangulation in research into business and management studies, it is essential for the researcher to obtain different types of data from different levels in the organization.

Information collected for this study was obtained via different sources: production line activities of both lines under study have been observed; questionnaires have been administered to the line operators of both lines, and some production staff members whose job description relates to the two lines under study; and recent production reports for six months have been obtained and analyzed via the MFCA technique to support the reliability of evidence obtained. These sources were utilized in order to triangulate the results for reliability and validity.

3.8.1 Direct Observation

Data can be collected via the observational method by recognizing and noting people's behaviour, objects, and occurrences (Struwig and Stead 2013: 100). However, Yin (2014: 113) argues that a case study should take place in a real-world setting of the case, as this creates opportunity for direct observation. In the course of this study, the researcher directly observed the bottling process on the production lines. This provided the researcher with the information on how physical losses take place on the lines, the stages at which losses are mostly generated, and if the line operators' handling of the equipment reveals competence. Information extracted from directly observing the process was used to validate the result.

Kothari and Garg (2014: 91) stressed three advantages of using the observation method. Firstly, subjective bias is eliminated, if observation is done accurately, secondly, the information obtained relates to recent events, as in the case study; and, thirdly, it is relatively less demanding of active cooperation on the part of the respondents. The limitations identified with this method include that it is time consuming and expensive; the information provided is limited; and there is interference of unforeseen factors with observational task. However, the approval and support received from the plant manager and staff members in the observation of the line activities averted implications of the limitations identified with this method.

3.8.2 Questionnaire

Another method of data sourcing used in this study is the administering of questionnaires. This form of data collection is known as an efficient data collection mechanism, as it is less expensive and time consuming than interviews and observation, and can be used to collect large data (Sekaran and Bougie 2013: 147). There are three modes of administering data: personally administered, mail questionnaires and electronically administered questionnaires. For the purpose of this study, the personally administered mode was utilized. Advantages of this mode include: opportunity to establish rapport and motivate respondents, clarification of doubts, less expensive when administered to groups of respondents, a high response rate is ensured and the anonymity of respondents is high (Kothari and Garg 2014: 96 - 97).

This mode of data collection is relevant for this study because it affords the researcher a one-on-one communication with the respondents in administering the questionnaire, which also gives opportunity to reassure each respondent of anonymity. The request of anonymity of the company in order to release information likewise makes this this collection mode relevant. The researcher used questionnaires to identify the likely factors contributing to losses on both lines

.

3.8.3.1 Questionnaire Design

A total of 56 questionnaires was personally administered to the production unit staff members linked to the two lines under study. The questionnaires were completed by the participants and returned to the researcher. The questions were constructed in such a manner as to conceal the identity of participants. In addition, participants were assured of confidentiality and non-traceability. Participants were enlightened beforehand on the aim of administering the questionnaires.

3.8.3.2 Layout of Questionnaire

The layout of a questionnaire is very important as it could determine the response of participants to the whole exercise. Sekaran and Bougie (2013: 149) noted the following three principles that should guide the questionnaire design in order to minimize biases:

- Wordings of the questionnaire;
- How the variables are categorized, scaled, and coded after receipts of the response; and
- The general appearance of the questionnaire.

The language of the questionnaire is suited to the level of understanding of the respondents. The questionnaire designed for this study has been constructed with cognizance of the respondents. This study made use of the Likert-type scale questions as given in the Table 3.1 below.

Table 3.1 Likert-type scale

Strongly Agree	Agree	Strongly disagree	Disagree	Neutral
1	2	3	4	5

Source: Sekaran and Bougie (2013: 155)

The questionnaire consisted of 20 questions. The questionnaire (Appendix F) was divided into two sections. The first section was segmented into three sections, while the second section was categorized under sub-sections.

Section A

- **Biographical information of the participants**

Respondents were asked to indicate their age, relevant years of experience and qualification.

Section B

- **The production process**

Respondents were asked to provide information on the production process for lines 1 and 3.

- **Waste cost information system**

Respondents were asked if the managers have information of the quantities and cost of material waste generated on the lines.

- **Factors influencing waste generation**

Respondents were asked if the root causes of waste are investigated, if information is freely shared in the production unit, if production line staff undergoes training, if quality is maintained and machines are regularly serviced.

The questionnaire was designed with closed-ended questions based on the above sub-topics.

3.8.3.3 Open-Ended and Closed Questions

Sekaran and Bougie (2013: 150) noted that questionnaires could consist of open-ended and closed questions. The open-ended questions allow respondents to answer the questions in any way they chose while the closed questions ask the respondents to make choices among a set of alternatives. The closed question format of questionnaire was used in this study.

3.8.3 Production Reports

Yin (2014: 109) highlighted the relevance of archival records to the case study, stating that it can be used in conjunction with other sources of information in producing a case study. He cited that, although the usefulness of archival records varies from one case study to the other, in some studies, they may become the object of extensive retrieval and quantitative analysis. This study made use of the company's production report to calculate the cost of packaging waste forfeited. This will further corroborate the evidence of the inadequacies of the traditional accounting technique, as related in the literature review, to provide a true picture of waste costing in manufacturing.

Despite the support received from management with regards to data collection in the company, some information was still regarded as sensitive, and company secret. Therefore, the real values were not released. Rather, the percentage values, which were used to calculate an estimate of the total cost of packaging waste lost on the lines, were released.

In relation to this study, the production loss report plays a pivotal role in revealing the required findings for costings of suspected revenue leakages. The production loss report provides daily information of line activities and losses generated for six months (February – July, 2015). The MFCA technique was used to calculate the total waste cost generated on both lines under study.

3.9 Pilot Study

For the purpose of this study, one of the managers in the production unit went through the questions with two other members of the unit. This was done to ensure that the questions were not ambiguous and understandable to the line operators. It was also done to ensure the relevance of the questions to the intended study, as highlighted by the researcher, that is, the questions were not out of context of production line operations.

3.10 Formulation of Hypothesis

In social science, where direct knowledge of population parameter is rare, hypothesis testing is the often used strategy for deciding whether a sample data offer such support for a hypothesis so that generalizations can be made (Kothari and Garg 2014: 179). It is imperative that the hypothesis that aligns with the research problem be crafted. Some researchers are of the view that packaging material waste cost does not have a significant impact on output. Therefore, this study investigated if, indeed, packaging material waste does not affect output.

3.10.1 Null Hypothesis

A null hypothesis H_0 is a hypothesis set up to be rejected in order to support an alternate hypothesis H_A. The null hypothesis is presumed true until statistical evidence, in the form of hypothesis tests, indicates otherwise (Sekaran and Bougie 2013: 84).

The null hypothesis for this study is:
Null hypothesis.
*Ho = Packaging waste cost has no impact on the alcoholic beverage production outcome.

3.10.2 Alternate Hypothesis

This is the opposite of the null hypothesis; it is a statement expressing a relationship between two variables or indicating differences between groups (Sekaran and Bougie 2013: 84).

Alternate hypotheses
*H1 = Packaging waste cost has a significant impact on the alcoholic beverage production outcome.

*A non-directional hypothesis was selected considering the direction of the independent and dependent variables through the six months period was yet to be determined. As a result, the researcher determined the relationship between the variables.

3.11 Ethical Considerations

The research was conducted to comply with the Institutional Research Ethics Committee (IREC) of the Durban University of Technology. This policy takes cognizance of anonymity, confidentiality, rights and voluntary participation of participants. According to Myers (2013: 49), four relevant ethical principles of research includes truthfulness, thoroughness, objectivity and relevance. The participants in this research were requested to sign a consent letter (Appendix E). The letter signifies the approval to proceed with the study, specifying the roles and responsibilities of both the participants and the researcher. Participants were assured of confidentiality and anonymity regarding all information, including personal data provided by them.

3.12 Achieving Validity and Reliability

Ascertaining the credibility of research findings is very important in a good research study (Saunders, Lewis and Thornhill 2009: 156). It helps to alleviate doubts on the authenticity of the researcher's results. The next paragraphs explain how reliability and validity were achieved.

3.12.1 Validity

Validity establishes how well a technique, instrument, or process measures a particular concept (Sekaran and Bougie 2013: 154). In addition, validation acts as a confirmation of the relationship between variables (Saunders, Lewis and Thornhill 2009: 157). Content validity was utilized in this study to measure the extent to which the instrument provided accurate coverage of the topic under study (Kothari and Garg 2014: 70). The validity of this study was ensured via the different methods of data collection.

Observing the production line activities assisted the researcher to view some of the activities resulting in waste generation, and the rate at which waste is generated. The adoption of the MFCA technique was used to estimate the production loss report, while the questionnaire administered was to evaluate how the line activities support efficiency in decreasing production cost incurred. Considering that an increase in waste generated results in higher production costs, it reveals that efficiency may be compromised. These three approaches support each other in order to provide valid waste information in terms of quantity and costs incurred.

3.12.2 Reliability

Reliability refers to the extent to which the data collection techniques utilized and the extent the analysis procedures will yield consistent findings (Saunders, Lewis and Thornhill 2009: 156). It indicates the extent of the instrument's stability and consistency with the variable (Sekaran and Bougie 2013: 154). The stability aspect of reliability is concerned with securing consistent results with repeated measurements, which are determined by comparing the results of the measurement used to secure the reliability test (Kothari and Garg 2014: 71).

Reliability was achieved by taking several measurements of the same subjects via the Cronbach's alpha score for all the items in the questionnaire. The recommended Cronbach's alpha value of 0.7 was exceeded, indicating the degree of acceptability.

3.13 Statistical Methods and Data Analysis

According to Myers (2013: 165), the data analysis stage is the stage that logically follows the data gathering stage. At this point, logical sense is attributed to the different data collected. Furthermore, it is the computation of certain indices or measures along with the search for patterns of relationship that exist among the data groups (Kothari and Garg 2014: 126). The authors also noted the two major areas that exist in statistics are known as descriptive and inferential statistics.

Descriptive statistics are concerned with the development of certain indices from the raw data, while inferential statistics are concerned with the process of generalization (Kothari and Garg 2014: 127). Descriptive statistics are measures that give the idea of the overall distribution of the observations in the data-set (Kothari and Garg 2014: 129). The descriptive statistics use the measures of central tendency, and measures of dispersion. The mean, median, and mode fall under the measures of central tendency, while the range, mean deviation, and standard deviation fall under the measures of dispersion (Kothari and Garg 2014: 129-134).

Inferential statistics are known as sampling statistics and are mainly concerned with two major problems, which include the estimation of population parameters, and the testing of statistical hypothesis (Kothari and Garg 2014: 127). The inferential statistics used in this study are stated below:

3.13.1 Factor Analysis

The factor analysis is a technique that allows the researcher to group variables into factors, based on correlation between variables, while allowing the factor derived to be treated as new variables; the values derived are then summed (Kothari and Garg 2014). This is done to reduce the volume of data. According to (Sekaran and Bougie 2013: 227), factor analysis is a multivariate technique that confirms the dimension of the concept defined, and the items most appropriate for each dimension.

Factor analysis, used in this study, presented a matrix table which was preceded by a summarized table that reflected the results of Keiser-Meyer-Olkin (KMO) and Bartlett's Test.

3.13.2 Chi-Square Test

The chi-square is used to determine the relationship between two nominal variables or whether they are independent of each other (Sekaran and Bougie 2013: 288). It is associated with the degrees of freedom (df) which denote whether a significant relationship exists between two nominal variables. The chi-test is carried out to determine whether the scoring patterns per statement in the questionnaire were significantly different per option.

3.13.4 Hypothesis Testing

Hypothesis testing is used to determine if the null hypothesis can be rejected in favour of the alternate hypothesis (Sekaran and Bougie 2013: 303). A p-value is generated from a test statistic, with a significant result indicated as "$p<0.05$".

3.15.5 Correlations

Correlation analysis studies the joint variation of two or more variables in order to determine the amount of correlation between two or more variables (Kothari and Garg 2014: 126). A Pearson correlation matrix indicates the direction, strength, and significance of the bivariate relationships among all the variables that were measured at an interval or ratio level (Sekaran and Bougie 2013: 289). The data instruments utilized were questionnaires and production loss report for six months.

3.16 Application of MFCA

In order to analyze the production loss report, inputs and outputs into the two production lines (1 and 3) were first identified with their quantity centres. However, data in relation to quantity centres is limited as the company does not record waste along the lines. Therefore, the cost of output waste recorded on both lines was take along with their respective system costs. A mathematical expression has been generated to address this:

Material cost (MC) = M_i x P_m

Where:

M_i = physical quantities of materials involved in the various production process; and

P_m = material purchase unit price (kg).

Material balance (MB): Input must equal Output

Input = T_{mf} – (T_{pf} + T_{nf})

Where:

T_{mf} = input of material flow

T_{pf} = Total input of positive material flow

$T_{nf =}$ Total input of negative material flow and;

System cost (SC) = P_c + D

Where:

P_c = all in-house handling costs incurred in the material flows

D = all depreciation costs

Where:

D_c = general energy used in the factory

E_i = energy consumed in the production process

The system and energy costs are calculated according to the rate allocated to products by the company. The total cost is calculated for both the products and waste materials using the expression below:

Total Cost =

$$= \sum_{i=1}^{n} MC + \sum_{i-1}^{n} SC + \sum_{i=1}^{n} EC$$

Where n = number of quantity centres (QC); and i = counter from 1 to the number of quantity centres (QC).

3.17 Conclusion

This study sets out to determine the impact that packaging waste costs has on the production process. This chapter provided an account of the research methodology adopted. The discussion in the chapter revolved around the research design, target population, unit of analysis, sampling method, data collection and data analysis. How validity and reliability were achieved was discussed. The statistical tools utilized were discussed as well as the ethical considerations. Lastly, the MFCA model was used to estimate the cost generated from the waste on line 1 and line 3.

The next chapter will focus on the empirical findings that relate to the data collected for the purposes of this research study

CHAPTER FOUR

4.0 DATA PRESENTATION AND ANALYSIS

4.1 Introduction

The previous chapter described the research methodology on which the study is predicated. This chapter presents the interpretation and discussion of the findings obtained from the data collected in this study. Suffice to add that data was collected through observation, secondary data and questionnaire administration. The data collected from the responses were analyzed with SPSS version 23.0. Results were presented in the form of descriptive statistics in graphs, cross tabulations and other figures for the quantitative data that were collected. Inferential techniques include the use of correlations and chi-square test values; which are interpreted using the p-values. In total, 60 questionnaires were administered and 45 were returned, which gave a 75% response rate. The study examined the impact of packaging waste cost of an alcoholic beverage production via MFCA. The chapter narrows down the study in achieving certain objectives, as specified in 1.8.1. The study approach utilized was both qualitative and quantitative in nature, and the sample size focused on specific production line staff as it relates to the lines under study.

4.2 Nonparticipant Observation

One of the data collection tools used in this study was observation. This mode of data collection contributes to answering the first objective of this research, which is to determine the factors that influence waste generations on the lines. The researcher was permitted to observe the activities on both production lines. Observation of the production lines enabled the researcher to evaluate all the various activities taking place during production, and that of the line operators, as well as those which may have contributed to waste generation.

The researcher was educated on the requirements of going into the production floor, especially regarding the safety measures to be observed. It is, however, amazing to note that, a beverage plant, which has made a mark in the alcoholic beverage industry history, and having waste reduction measures in place, still battles with waste challenges that could pose a threat to its sustainability. The researcher observed that the plant is well laid out, and well organized. Waste management strategies were also in-place for disposal such as various labeled industrial bins, situated in a bin area. The company outsourced its waste management activities to external operators. The different categories of packaging materials that end up as wastes were labeled in the bin area as cardboard, glass (clear and coloured), bottle caps, empty drums, scrap plastics, used oil, scrap metal and general waste. The bin area was secured to prevent pilfering for reuse. The materials are similar to the ones identified in the study carried out by Olajire (2012: 19).

The researcher was informed that all the production line operators have been grouped into teams who meet on daily basis. The team leaders', in turn, report to the production manager. The agenda of the daily meetings includes:

- Attendance and morale of team;
- Ensuring safety checks were observed;
- Feedback on action points;
- Review of performance and improvements such as quality, costs, delivery, safety, and morale;
- Planning, which includes training, production plan, and labour layout;
- Company issues; and
- General issues.

Production plans are made on a daily, weekly and monthly basis for the lines. Planning production in the beverage industry is a complex process due to increasing competitiveness of the market which forces companies to enlarge their product portfolio, thereby posing new challenges and raising the need for decision support tools to help managers. Therefore, Mugwindiri, Madanhire and Masiiwa (2013: 6), established that a material balance is essential for accurate accountability of the materials consumed.

4.3 The Production Process

The bottling processes are conducted from six lines on the production floor. However, the study is limited to just lines 1 and 3. The bottling process begins with unscrambling, or offloading of bottles (330 ml and 750ml) on various pallets onto the conveyor that loads and arranges them on the lines. This process is known as depalletizing. The researcher observed that a number of bottles break during this process. The bottles are then conveyed to the rinser where the bottles' mouths were attached to nozzles that are connected to a tank. The rinser rinses each bottle after which they are turned upside down to drain the water. Once again, the researcher discovered that few bottles break because the nozzles were either too tight on the bottles or too loose resulting in bottles falling off the conveyor.

The drained bottles are then conveyed to the filler where they are filled with the already processed content. At this stage, bottles do not usually break except the roller picking the bottles misses its target. Afterwards, the filled bottles are set for capping or corking. At this stage of the process, the bottles are not broken. Rather, the caps that miss the bottles are thrown on the floor or get damaged. Machine jam could also result in damaged caps. The next stage is where the bottled drinks are labelled, both at the front and back. The labels get wasted when they get stuck together or when labelled wrongly and have to be manually taken off the bottles for relabeling. After the labelling stage, the filled bottles are ordered in either packs of 6s and 12s and boxed. Sometimes, bottles with contents are broken and spill content on the floor or the container at the bottom of the machine to be re-processed. However, the content sometimes gets mixed with oil and dust from the machine and become unusable. Bottles that do not make it to the end of the lines are re-positioned back to complete the bottling process. The bottles are finally packaged in carton boxes, sealed, and conveyed to the dispatch section. Cartons also get damaged at this section in the event of machine malfunction. The different stages of the manufacturing process observed by the researcher concurs with stages of a study conducted by Mugwindiri, Madanhire and Masiiwa (2013: 7 - 9).

4.4 Discussion of findings from non-participant observation

The researcher observed that wastes from the production lines are generated right from the beginning to the end of the process. The factors contributing to packaging waste generation on the lines seem to be across board in the production process. It is noted that the different stages in the production lines are not segmented in order to identify the amount of waste generated at the different stages. If wastes are, therefore, generated from the input through all the stages, all the line operators should undergo training, or the processes should be re-designed to reduce or prevent bottles breaking.

4.5 Questionnaire Findings and Interpretation

This section presents the results and discusses the findings obtained from the questionnaires in this study. The questionnaire was the primary tool that was used to collect data and was distributed to senior and middle level managers of the company.

The data collected from the responses were analyzed with the SPSS version 22.0. The descriptive statistics were presented in the form of graphs, cross tabulations and other figures for the qualitative data that were collected. Inferential techniques included the use of correlations and chi-square test values which were interpreted using the p-values.

4.5.1 The Research Instrument

The research instrument consisted of 23 items, with a level of measurement at a nominal or an ordinal level. The questionnaire was divided into 4 sections which measured various themes, as illustrated below:

Section A – Personal and Company Information;
Section B1 - The Production Process;
Section B2 - Waste Cost Information System; and
Section B3 - Factors Influencing Waste Generation.

4.6 Reliability Statistics

The two most important aspects of precision are reliability and validity. Reliability is computed by taking several measurements on the same subjects. A reliability coefficient of 0.70 or higher is considered as "acceptable" (Ataya, Adams, Mullings, Cooper, Attwood and Munafò 2012: 149).

Table 4.1 below reflects the Cronbach's alpha score for all the items that constituted the questionnaire. Sections B_2 and B_3 had reliability values greater than the acceptable coefficient of 0.70, except for section B_1.

Table 4.1 Cronbach's alpha Score

Section	**Number of Items**	**Cronbach's Alpha**
Section B1 - The Production Process	8 of 8	.666
Section B2 - Waste Cost Information System	4 of 4	.758
Section B3 - Factors Influencing Waste Generation	6 of 8	.732
Overall	20 of 20	.773

The overall reliability score, however, exceeds the recommended Cronbach's alpha value of 0.700. This indicates a degree of acceptable, consistent scoring for the various sections of the research.

The first section has a value slightly below 0.700. Amongst the reasons for this low value are the following:

- The construct is newly developed; and
- Some statements were a collective of individual statements within the same sections.

4.7 Factor Analysis

Why is factor analysis important?

Factor analysis is a statistical technique whose main goal is data reduction. A typical use of factor analysis is in survey research, where a researcher wishes to represent a number of questions with a small number of hypothetical factors (Kothari and Garg 2014: 349). For example, as part of a national survey on political opinions, participants may answer three separate questions regarding environmental policy, reflecting issues at the local, state and national levels. Each question, by itself, would be an inadequate measure of attitude towards environmental policy, but, together, they may provide a better measure of the attitude.

Factor analysis can be used to establish whether the three measures do, in fact, measure the same thing. If so, they can then be combined to create a new variable, a factor score variable that contains a score for each respondent on the factor. Factor techniques are applicable to a variety of situations. A researcher may want to know if the skills required to be a decathlete are as varied as the ten events, or if a small number of core skills are needed to be successful in a decathlon (Belohlavek and Krmelova 2014: 37). One need not believe that factors actually exist in order to perform a factor analysis, but, in practice, the factors are usually interpreted, given names, and spoken of as real things.

The matrix tables are preceded by a summarized table that reflects the results of KMO and Bartlett's Test, as shown in table 4.2 below. The requirement is that Kaiser-Meyer-Olkin Measure of Sampling Adequacy should be greater than 0.50 and Bartlett's Test of Sphericity less than 0.05. In all instances, the conditions are satisfied which allow for the factor analysis procedure.

Factor analysis is done only for the Likert-scale items. Certain components are divided into finer components. This is explained below in the rotated component matrix.

Table 4.2 represent the statistical tests carried out on the three different sections of accounting for waste from the production processes.

Table 4.2 KMO and Bartlett's Test

	Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
		Approx. Chi-Square	df	Sig.
Section B1 - The Production Process	.575	65.318	28	.000
Section B2 - Waste Cost Information System	.649	51.456	6	.000
Section B3 - Factors Influencing Waste Generation	.655	68.025	28	.000

It is required that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy value should be greater than 0.500 and the Bartlett's Test of Sphericity sig. value should be less than 0.05. The measures of sampling adequacy are well above 0.5 and the tests of Sphericity are well below 0.05. Therefore, all conditions required for factor analysis were satisfied.

Factor analysis is a statistical technique whose main goal is data reduction (Kothari and Garg 2014: 350). A typical use of factor analysis is in survey research, where a researcher wishes to represent a number of questions with a small number of hypothetical factors.

The principle component analysis was used as the extraction method, and the rotation method was Varimax with Kaiser Normalization. This is an orthogonal rotation method that minimizes the number of variables that have high loadings on each factor. It simplifies the interpretation of the factors (Kothari and Garg 2014: 350). The factor loading of the rotated component matrix explained in the tables 4.3, 4.4, and 4.5 below shows the inter-correlation between variables. Items of questions that loaded similarly imply measurement along a similar factor. An examination of the content of items loading at or above 0.5 (and using the higher or highest loading in instances where items cross-loaded at greater than this value) effectively measured along the various components.

Table 4.3 Rotated Component Matrix

Section B1 - The Production Process	Component		
	1	2	3
There is a production planning warehouse inventory management.	-.093	.794	.424
There is an increase in packaging material consumed on production line 1.	.402	.557	.214
There is an increase in packaging material consumed on production line 3.	.119	.788	-.258
Production line performance is regularly evaluated.	.700	.238	-.145
There is consistency in the recording of packaging materials on the lines.	.774	-.109	-.050
Packaging waste contributes to the major waste on the lines.	-.034	.050	.809
Raw material and packaging waste information are differentiated to track line losses.	.601	.175	.218
Managers have information on waste volumes generated.	.585	.050	.570

a. Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 4 iterations.

As noted in table 4.3, the variables that constituted section B1 loaded around 3 components (sub-themes). An evaluation of the factors of dimension measuring the packaging waste costs constructs shows that the dimensions split into different single and multiple trends. The dimension relating to production process split into multiple trends for three components. The splits are colour-coded. This implies that respondents identify three trends within this construct. Observing the alignment reveals that the first three dimensions are related to production planning and packaging materials consumed, the second dimension indicated that managers were consistent in the recording of raw materials consumed (green), production line performance (yellow), and packaging material waste information on both lines (yellow). Thirdly, packaging waste contributed majorly to the waste generated on the lines (blue).

Table 4.4 Component Matrix

Section B2 - Waste Cost Information System	Component
	1
Managers have complete cost information on waste management strategies.	.688
Managers have information on the cost implication of the volumes generated.	.766
There is an accurate account for the material consumed.	.863
There is an accurate account for line losses.	.729

a. Extraction Method: Principal Component Analysis. A. 1 component extracted

Table 4.4 indicates that the variables that constituted Section B2 loaded perfectly along a single component. This implies that the statements in the section measured what they set out to measure. However, waste cost information only split into one component. This implies that respondents identified that managers are aware of cost information and implication of waste management. Managers have knowledge of the waste management strategies, and cost implications of the volume generated by keeping accurate account of materials consumed on both lines.

Table 4.5 Rotated Component Matrix

Section B3 - Factors Influencing Waste Generation	Component		
	1	2	3
Root causes of waste generated are investigated.	.756	-.028	.421
Information is freely shared in the production unit.	.788	.176	.028
Staff training sessions are conducted regularly.	.781	.211	-.313
Quality of process is evaluated.	.566	.404	-.125
Machines are regularly serviced.	.208	.754	-.047
Process performance is regularly evaluated.	.084	.754	.121
Staff members with more years of experience are more accurate on the lines.	.166	-.072	.748
Staff members with higher qualifications are relatively more efficient on the lines.	-.314	.194	.666

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
a. Rotation converged in 5 iterations

Table 4.5 illustrate the loading on waste generation, the dimension measuring influencing factors were split into three components. The first trend relates to the root causes of waste, staff training, and quality of the process; the second trend relates to regular machine servicing and evaluation of process performance, while the third trend relates to staff members accuracy and efficiency on both lines based on higher qualification and years of experience. This implies that respondents agreed that factors affecting waste generation on the lines were investigated via regular staff training, evaluation of the quality of the process, regular machine servicing, performance evaluation, and the rate of efficiency on the lines.

4.8 Section A: Biographical Data

This section summarizes the biographical characteristics of the respondents. The biographical data explored in this study were: age, years of experience of service and qualification obtained.

4.8.1 Age of Respondents

Figure 4.1 below presents the graphical representation of the age distribution.

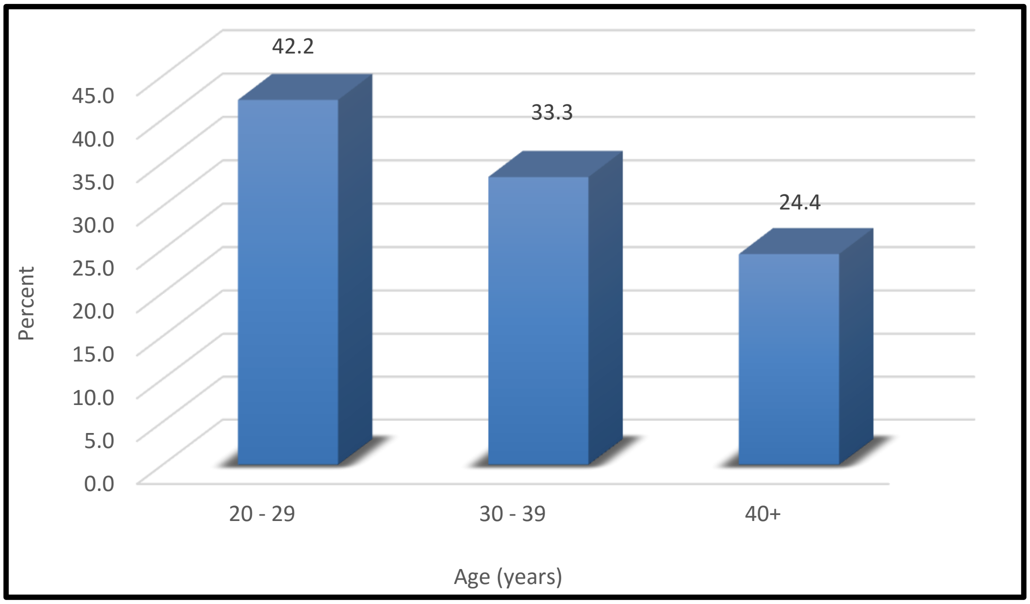


Figure 4.1 Age Distribution

Figure 4.1 shows that the majority of the respondents (42.2%) were between the ages of 20 to 29 years. A third of the respondents (33.3%) were between 30 to 39 years whilst the remaining quarter (24.4%) was at least 40 years old.

This spread of ages is useful as it indicates a fair proportion of the respondents were mature individuals. This implies that responses would have been well thought out. Such responses enhance the reliability of the research.

4.8.2 Years of Employee Service

It was considered relevant to establish the working experience of respondents, as the knowledge gained over the years of service may serve as an advantage to a person's productivity. Figure 4.2 below indicates the years of service by the employees.

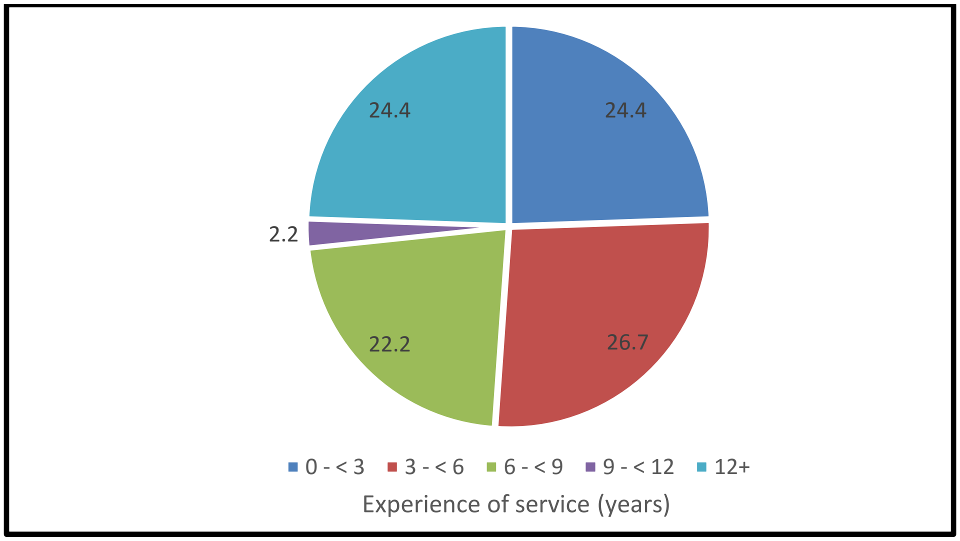


Figure 4.2: Years of Employee Service

Apart from a small grouping (2%) that has 9 to 12 years' experience, all of the other options are fairly similar ranging between 22%, to 27%. Overall, 73% have experiences ranging between 0 and less than 9 years, while 27% have between 9 and 12 years of working experience. This implies that the chunk of production line work force has lesser work experience, which may have an impact on the productivity level that resulted in packaging waste on the lines. This also implies that the longer the years of the line workers in service the more consistent will be the response rate of the respondent which will contribute to the reliability of the results.

Khojamli, Habibi, Hossein and Kazemiyan (2014: 33) confirm that a correlational relationship exists between work experience and labour productivity level. Therefore, it is inferred that the longer the years of service, the more knowledge of the system and process is expected to have been acquired over the years for optimal productive output that is capable of reducing line losses.

4.8.3 Education Distribution of Respondents

Figure 4.3 below indicates the education levels of the respondents. The educational levels attained by the line operators were included in the questionnaire to capture the extent of their general educational background. Educational background has served as a major criterion for employment.

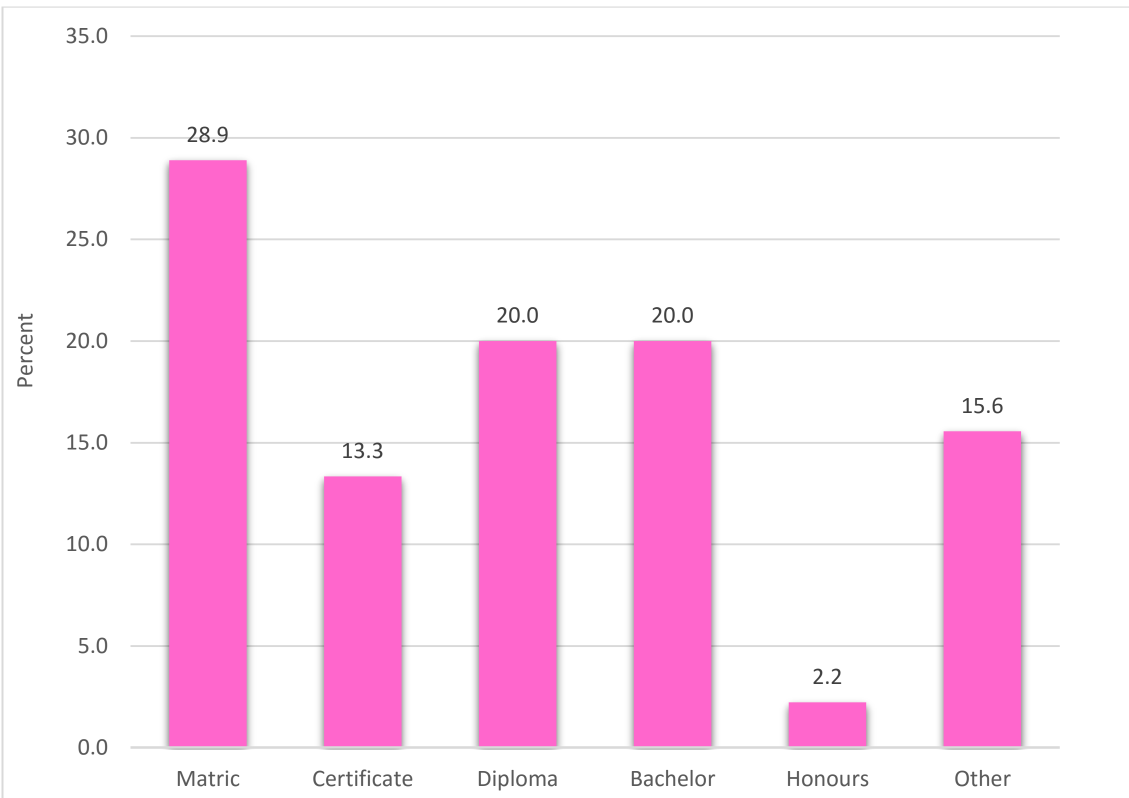


Figure 4.3: Education levels of respondents

Figure 4.3 shows that majority of respondents (71%) had a post-school qualification. This is a useful statistic as it indicates that a fair proportion of the respondents have a higher qualification. The responses gathered would imply that respondents would have been from an informed (learned) source. Higher qualification, as claimed by Fleisher *et al.* (2011: 93), contributes a higher marginal product than less educated workers. It can be inferred that the higher the qualification, the higher the marginal output. Therefore, respondents with a bachelor and honours degree would produce a higher output than others. The higher the level of education of respondents, the lesser the company would spend on human resources management such as staff training and development, health, security, and waste generated.

4.9 Section Analysis

The section that follows analyzes the scoring patterns of the respondents per variable per section. Where applicable, levels of disagreement (negative statements) were collapsed to show a single category of “Disagree”. A similar procedure was followed for the levels of agreement (positive statements). The results are first presented using summarized percentages for the variables that constitute each section. Results are then further analyzed according to the importance of the statements.

4.9.1 Section B1 - The Production Process

The following section summarizes the scoring patterns of respondents per variable section. The section intends to provide an understanding of the production planning and packaging material consumption on both lines.

The scoring pattern of the variables in section B1 (the production process) is presented below in table 4.6.

Table 4.6 Respondents' view of the production process

	Agree		Neutral		Disagree	
	Count	Row N %	Count	Row N %	Count	Row N %
There is a production planning warehouse inventory management.	34	75.6%	6	13.3%	5	11.1%
There is an increase in packaging material consumed on production line 1.	31	68.9%	9	20.0%	5	11.1%
There is an increase in packaging material consumed on production line 6.	14	31.1%	18	40.0%	13	28.9%
Production line performance is regularly evaluated.	36	80.0%	6	13.3%	3	6.7%
There is consistency in the recording of packaging materials on the lines.	30	66.7%	6	13.3%	9	20.0%
Packaging waste contributes to the major waste on the lines.	34	75.6%	4	8.9%	7	15.6%
Raw material and packaging waste information are differentiated to track line losses.	27	60.0%	5	11.1%	13	28.9%
Managers have information on waste volumes generated.	30	66.7%	8	17.8%	7	15.6%

The following patterns were observed:

- There were high and constant levels of agreement with each of the statements, except for the 3rd statement; and
- Within the scoring patterns, certain values were similar, and very high patterns were perceived, whilst others were a bit lower and constant.

4.9.1.1 Production Planning System

The researcher sought to determine the respondents' views on the availability of production planning warehouse inventory management. As can be observed from table 4.6, 11% of the respondents agreed that the organisation had a production planning warehouse, 13% were neutral in their position, while 76% disagreed with the position. From the respondents' different positions, it can be deduced that the production planning system in place is not effective. Proper production planning can reduce the consumption of raw materials consumed by the company, thereby reducing both purchasing costs, the amount and cost of financial and environmental impacts as noted by Olajire (2012: 17). Therefore, without a proper production planning system in place, line performance may not be properly evaluated.

In addition, Jasch (2009: 35) supported that production planning can assist a manager to monitor a particular product line or set of production equipment, although it doesn't justify a deeper understanding of the accounting system. However, Guimarães, Klabjan and Almada-Lobo (2012: 239) argued that the objective of production planning in minimizing losses is to manage total set-up, inventory, transfers and overtime costs.

4.9.1.2 Packaging material consumed on line 1

In terms of the outcome of respondents regarding the question, if there was an increase in packaging materials on production line 1, 69% agreed, 20% were neutral and 11% disagreed with this position. The number of respondents in agreement with packaging material consumption increase indicates the likelihood of more waste generation on this line as more materials are consumed. According to Olajire (2012: 17), the first priority of a brewing industry is to eliminate material losses, improve brewing and packaging efficiencies and determine cost effectiveness, and environmentally-preferable ways of managing waste. Wastes that end-up as environmental hazards invariably constitute disposal costs to beverage companies. This means that, the higher the packaging materials consumed on line 1, the more probable will be the waste increase on the line. This will invariably result in higher consumption and waste costs output.

4.9.1.3 Packaging material consumed on line 3

Respondents' observation from this line record that 29% disagreed that there is an increase in packaging material consumed on line 3, while 31% agreed and 40% were neutral. This indicates that lower waste is generated on this line compared to line 1. The differences in waste generation recorded on both lines may be as a result of production capacity differences of both lines. Material consumption is expected to have a significant effect on sustainability performance of the beverage sector. Some environmental impacts such as Green House Gas (GHG) emissions, as well as health-related issues, have been associated with waste from beverage packaging materials (Amienyo 2012: 57).

4.9.1.4 Evaluation of production line performance

Respondents responses on whether production line performance is regularly evaluated resulted in 80% agreement, 13% were neutral while 7% disagreed. This shows that the two lines are regularly evaluated. Consistent evaluation of production line performance assists managers to keep tabs on output. Evaluating line performance is one of the avenues to enhance production line processes, and reduce potential environmental costs. A study, carried out by da Silva and Amaral (2009: 1343), concurs that, by performing a complete evaluation of a production line, the production stages that poses the greatest impact to the environment and profitability of the company can be determined. Losses are not limited to internal costs, rather, losses also poses an external effect.

4.9.1.5 Recording of packaging materials on the lines

Respondents were required to give their views on the consistent recording of packaging materials utilized on the production lines. 67% agreed that there is consistency in packaging materials recording, 13% were neutral, while 20% disagreed. This shows that there is a regular recording of packaging materials used on the lines. Proper record keeping helps with budget plan and inventories' management. When managers are furnished with information of lines that the outputs are inconsistent with its inputs, it provides the opportunity for re-assessing what constitutes the discrepancies. This finding concurs with Schliephake, Stevens and Clay (2009: 1258) that lack of information on material inefficiency incapacitates many companies to assess the cost of material losses. However, the increased packaging waste output depicts otherwise. Given that

67% agreed to a consistent record keeping, there should be a corresponding increase in the tracking of line losses.

4.9.1.6 Packaging waste contribution to line losses

A total of 76% of respondents agreed that packaging materials contribute to the major waste generated in the production process, 9% were neutral and 16% disagreed. This shows that the majority of the line operators agreed that packaging materials contribute to the major wastes generated on both lines. The volume of packaging waste generated globally reveals the rate of inefficiencies in the utilization of resources in the manufacturing process (Dixon-Hardy and Curran 2009: 1199). The finding concurs with the study carried out by Pasqualino, Meneses and Castells (2011: 357) that beverage packaging waste is ranked as the second major contributor of municipal waste. Schliephake, Stevens and Clay (2009: 1259) further noted that significant value of line losses recorded was due to an incomplete understanding of the processes and potential packaging inadequacies. This, therefore, implies that the increase in packaging waste may be as a result of an inadequate understanding of the process or sub-standard packaging materials.

4.9.1.7 Differentiation of raw material and packaging material waste information

A total of 60% of the respondents agreed that raw material and packaging material wastes are differentiated on the lines in order to track line losses, 11% were neutral, while 29% disagreed. This further affirms that respondents working on both lines keep records of losses (raw materials and packaging materials). Having the precise waste information assist managers evaluate their production planning for material allocation. It also enables them to identify where to focus attention for waste prevention. This finding affirms Koss (1998: 102) emphasis on differentiating raw materials from packaging materials, as this assists in tracking line losses.

4.9.1.8 Waste information on volumes generated

In terms of waste information of volumes generated, a total of 67% respondents agreed that managers have information on waste volumes generated, 18% were neutral, while 16% disagreed. This finding concurs with Herrmann, Schmidt, Kurle, Blume and Thiede (2014: 285), the review stated that, without a general understanding of a manufacturing system as a combination of production factors including typical inputs factors such as, raw and auxiliary materials, semi-finished products, information, energy as well as typical output such as products, parts and waste, it will be difficult to effetively manage the manufacturing system. This infers that, when managers have the exact information of waste volumes generated, it speeds up the decision-making process in minimizing increased production line waste. Managers can liase with the accounting department on the cost implication of the waste in relation to the total production cost, and profitability, which can promote cost-saving decision making.

In addition, to determine whether the scoring patterns per statement were significantly different per option, a chi square test was done. The null hypothesis claims that similar numbers of respondents scored across each option for each statement (one statement at a time). The alternate hypothesis states that there is a significant difference between the levels of agreement and disagreement. Table 4.7 below illustrates the results of the chi-square test.

Table 4.7 Test Statistics

	Chi-square	Df	Asymp. Sig.
There is a production planning warehouse inventory management	36.133[a]	2	.000
There is an increase in packaging material consumed on production line 1	26.133[a]	2	.000
There is an increase in packaging material consumed on line 3	.933[a]	2	.627
Production line performance is regularly evaluated	44.400[a]	2	.000
There is consistency in the recording of packaging materials on the lines	22.800[a]	2	.000
Packaging wastes contributes to the major wastes on the lines	36.400[a]	2	.000
Raw material and packaging waste information are differentiated to track line losses	16.533[a]	2	.000
Managers have information on waste volumes generated	22.533[a]	2	.000

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 15.0.

The highlighted significant. Values (p-values) are less than 0.05 (the level of significance). These values imply that the distributions were not similar. That is, the differences between the way respondents scored (agree, neutral, disagree) were significant. Table 4.7 also shows that responses in the production process were positive (significant $p<0.05$), except line three where responses (agree 31%, neutral 40%, disagree 29%) were almost equal.

Differences in the level of agreement indicate that the respondents have a minimal knowledge of the packaging materials consumed, especially regarding line 3.

4.10 Section B2 - Waste Cost Information System

This section deals with respondents' view of how information on cost of waste is circulated on the production lines and the information system in place. This is also a process by which the staff members have overall information of waste generated on the production lines.

Below, in table 4.8, are the responses of the respondents regarding their perceptions of effectiveness of the waste costing system in place in the company and the implications.

Table 4.8 Waste cost information

	Agree	Neutral	Disagree
Managers have complete cost information on waste management strategies.	42.2	37.8	20.0
Managers have information on the cost implication of the volumes generated.	64.4	20.0	15.6
There is an accurate account for the material consumed.	40.0	28.9	31.1
There is an accurate account for line losses.	42.2	15.6	42.2

4.10.1 Managers have complete cost information on waste management strategies

An average number of respondents (42%) agreed that managers have complete cost information of strategies employed for managing waste, 38% were neutral, while 20% disagreed. Based on the responses, managers do not have cost information relating to waste management strategies. This finding contradicts the observation made by Gabriel, Tschandl and Posch (2014: 34) that important indicators for controlling sustainability in business are costs and revenues. Perhaps, if managers are aware of costs relating to disposal and recycling, they would be able to relay the cost implications to line operators for waste reduction purposes. Process waste reduction is beneficial to organizations in decision-making to minimize overall environmental costs, and it can be achieved through proper identification, documentation and analysis of both physical and monetary waste information (Fakoya 2013: 251). Since the knowledge of waste management strategies is still lacking among managers, it is evident this will pose a challenge to their decision-making process.

4.10.2 Managers have information of cost implication of waste volumes generated

Apart from management being aware of the waste management strategies, it is also expedient for them to be aware of the cost implication of waste volumes generated. Respondents (64%) agreed that managers have information of the cost implication of waste volumes generated, 20% were neutral, and 16% disagreed. This shows that respondents perceive that managers are adequately furnished with the cost of waste generated and its implication on production output. Lim (2011: 24) emphasized the importance of complete cost information for cost-effective waste management strategies. This finding concurs with the respondents' responses.

4.10.3 There is an accurate account for the packaging material consumed

In this section, respondents were asked to confirm if packaging materials consumed can be accounted for. Responses revealed that 40% of the respondents agreed that there was an accurate account for the materials consumed, 29% were neutral, while 31 disagreed. The response pattern does not indicate that there is an accurate account for the packaging materials consumed on the lines. Since the beverage is a major consumer of packaging materials, and it shows up from the input to the output side of the material flow balance, as stated by Jasch (2009: 41), the importance of its accountability in a beverage plant cannot be over-emphasized. However, this finding contradicts the findings of Mugwindiri, Madanhire and Masiiwa (2013: 6) that accountability for materials consumed, and losses generated from a beverage production process are important in order to achieve accurate accountability.

4.10.4 There is an accurate account for line losses

An average number of the respondents both agreed and disagreed (42%), that there is an accurate account for lines' losses, while 16 percent were neutral. This implies two things. One, there is no proper dissemination of production information among workers. Two, there are no good interpersonal relationship skills for effective communication. The company adopts the traditional method of accounting system, which does not often record data on material inputs to and from cost centres in production, but rely on general information from the production planning system, which may reflect inaccurate information on losses (Kokubu, Kitada and Mouritsen 2012: 9). It, therefore, implies that the findings may be inferred as similar to the literature finding. Apart from workshops and team building that will facilitate effective communication; the accounting system in use should be re-assessed to incorporate tools that will provide more accurate information.

A single variable chi-square test was performed to determine if there was a statistically significant difference in the waste cost system variables. The chi-square test results that test the reliability of the results are shown below in table 4.9.

Table 4.9 Test Statistics

	Managers have complete cost information on waste management strategies.	Managers have information on the cost implication of the volumes generated.	There is an accurate account for the material consumed.	There is an accurate account for line losses.
Chi-Square	3.733[a]	19.733[a]	.933[a]	6.400[a]
Df	2	2	2	2
Asymp. Sig.	.155	.000	.627	.041

a 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 15.0

From table 4.9, it is noted that two of the variables had significantly different patterns across their options of less than 0.05 (level of significance). This implies an uneven distribution. The difference in the level of agreement indicates that managers have limited knowledge of the waste costing system, particularly information on costings of waste management strategies and knowledge of accurate packaging materials consumed on the lines.

4.11 Section B3 - Factors Influencing Waste Generation

This section investigates the factors that influence the generation of waste on the production lines. The results of factors influencing waste generation on the lines are presented in table 4.10 below.

Table 4.10 Factors influencing waste generation

	Agree	Neutral	Disagree
Root causes of waste generated are investigated.	42.2	8.9	48.9
Information is freely shared in the production unit.	46.7	22.2	31.1
Staff training sessions are conducted regularly.	48.9	11.1	40.0
Quality of process is evaluated.	64.4	17.8	17.8
Machines are regularly serviced.	40.0	20.0	40.0
Process performance is regularly evaluated.	66.7	24.4	8.9
Staff members with more years of experience are more accurate on the lines.	62.2	15.6	22.2
Staff members with higher qualifications are relatively more efficient on the lines.	31.1	35.6	33.3

4.11.1 Root causes of waste are investigated

Regarding the perceptions of respondents on investigation of the root cause of waste, 49% disagreed that the root causes of waste were investigated, 9% were neutral, while 42% agreed. This showed that, at most times, the root causes of waste were not investigated, or perhaps, they were investigated by other departments but the feedback was not given to the production workers. Also, staff members working on the lines may not provide a detailed report of factors that led to waste generation. This finding contradicts Nagapan, Rahman and Asmi (2012: 1) who emphasized that, due to the time and effort consumed in generating non-value added output, results in material losses thereby requiring the root causes of waste should be investigated.

4.11.2 Information is freely shared in the production unit

A similar trend was observed about sharing of information in the production department. About 47 percent agreed that information is freely shared in the production unit, 22% were neutral while 31% disagreed. Respondents' responses seem contradictory but they still point to the fact that respondents lack inter-personal relationship skills, though this is not significant. It also shows that there is no effective communication amongst staff members. The finding partially supports the literature finding by Mena, Adenso-Diaz and Yurt (2011: 654), identifying lack of information sharing as one of the root causes of waste.

4.11.3 Staff training sessions are conducted regularly

Furthermore, in focusing on the consistency of staff training conducted for the line operators, 49% agreed that staff training is conducted regularly, 11% were neutral, and 40% disagreed. This finding indicates that a fair number of staff members agreed to the regularity of training conducted. Hence, reduction of waste on the lines was expected. However, the revenue losses experienced as a result of waste from the lines reveal that some staff members may not be aware of staff training time tables. Therefore, some attend while others do not attend. Others may probably be discouraged with the content of the training manual if they perceive it to be below or above their level of comprehension. This may be attributable to the different educational levels of workers which range from matric, certificate holders, to the uneducated. This also opposes the intended purpose of training, that is, a productive output.

Khojamli *et al.* (2014: 32) described training as the specific goals of improving one's capability, capacity, productivity and performance. This means the organizers of the training should re-evaluate the training manual if it there is need to modify it to suit the users according to their education level, or capacity in order to enhance line performance and productivity. This will also reflect on the reduction of waste output.

4.11.4 Quality of process is evaluated

In terms of the quality of process, as a factor influencing waste generation, 64% agreed that the quality of the production process was evaluated, 18% were both neutral and disagreed. This finding shows that quality of process is regularly evaluated on the production lines. However, this finding contradicts some perceptions during the observation with regards to the quality of the bottles, occasionally when they break on the lines. Efficient and random sampling of process materials will reduce waste generation through quality processes. For instance, if poor quality of process materials are detected early enough at the point of purchasing and rejected, it will have a direct reduction on the quantity of waste generated by process quality. The essence of the quality approach is its focus on integrating the sets of largely internal processes and systems, that the organization uses to ensure that alignment and consistency occur across the organization, and with respect to the organization's strategy and aims (Hubbard 2009: 182).

4.11.5 Machines are regularly serviced

Another factor considered to influence waste generation is machine maintenance. The survey revealed that 40% agreed that machines were regularly serviced, 20% were neutral, and 40% disagreed. These findings reveal contravening statements by the respondents. These are based on different respondents' perceptions. An average number of the respondents believed that the machines were regularly serviced. On the other hand, some disagreed. This difference may be attributed to their perceptions that machines should be serviced more often than the normal schedule of maintenance if they think the machines were old. Irregular machine servicing may lead to malfunctioning such as breaking bottles on the lines, improper labelling of bottles, inconsistent movement of bottles on the lines, inadequate measurement of liquid contents in the bottles and regular breakdowns.

This finding concurs with Ni and Jin (2012: 413), who identified the crucial task of machine maintenance in a production process. The authors agreed that an irregularity in production machines could potentially not only waste labour and resources, but can also extend production downtime which causes production losses and decreased profits.

4.11.6 Process performance is regularly evaluated

Process performance is another factor considered as one of the factors influencing waste generation. Amongst the total respondents surveyed, 67 percent agreed that the process performance was regularly evaluated, 24 percent were neutral, and 22 percent disagreed. This is a significant factor that influences waste generation. It indicates that process performance at different stages is consistently evaluated towards optimal output. This is important because poor process performance at any stage of production will definitely affect the next stages. Therefore, regular checks at different production process stages are encouraged. This will put a control on the waste generated on the production lines. This finding is supported by Schliephake, Stevens and Clay (2009: 1262) who attest that it is important to constantly understand where the largest losses occur in a process, or where waste is produced in order to make improvements.

4.11.7 Staff members with more years of experience are more accurate on the lines

Respondents' years of experience were also taken into consideration as a factor that influences waste generation. The data revealed that 62% of the respondents agreed that staff members with more years of experience were more accurate on the lines, 16% were neutral, while 22% disagreed. This finding concurs with the findings revealed through respondents' years of service as revealed in figure 4.2. This finding is also consistent with the findings of Godfrey, Scott, Difford and Trois (2012: 2161) that 67.7% of respondents reported that experience was the principle means of building waste knowledge that will culminate into respondent expertise which, in turn, will enhance their process performance. Therefore, it can be assumed that the more the years of experience of the respondents, the more accurate respondents become on the production lines, which will eventually lead to reduction in waste generation.

4.11.8 Staff members with higher qualifications are more efficient on the lines

Qualification is another factor considered to influence waste generation on the lines. Data show that 31% of the respondents agreed that staff members with higher qualification are relatively more efficient on the lines, 36% were neutral, while 33% disagreed. This is a mixed perception of respondents. This finding is, however, inconsistent with the findings of Godfrey *et al.* (2012: 2160) who point out that education and skills, both at the individual and company level, are very valuable in today's global economy and knowledge society, in recognizing the importance of knowledge in providing a competitive advantage over competitors in waste reduction strategies. Also, the line operators with higher educational background are more easily teachable, during workers' training and workshop, than their uneducated counterparts.

The responses indicate that, some line operators have proved more efficient as a result of years of experience, rather than their educational levels. Others may have performed better on the lines, due to the ability to learn faster on the job rather than the qualification achieved. Table 4.11 below shows the chi-square test results of the factors influencing waste generation variables.

Table 4.11 Test of Statistics

	Chi-square	Df	Asymp. Sig.
Root causes of waste generated are investigated		2	.002
Information is freely shared in the production unit		2	.127
Staff training sessions are conducted regularly		2	.005
Quality of process is evaluated		2	.000
Machines are regularly serviced		2	.165
Process performance is regularly evaluated		2	.000
Staff members with more years of experience are more accurate on the lines		2	.000
Staff members with higher qualifications are relatively more efficient on the lines		2	.936

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 15.0.

Apart from three of the statements that have similar scoring patterns, all the p-values are less than 0.05. Therefore, the scoring patterns are different.

4.12 Hypothesis Testing

The traditional approach to reporting a result requires a statement of statistical significance. A p-value is generated from a test statistic**.** A significant result is indicated with "$p < 0.05$". These values are highlighted with a *.

A second chi-square test was performed to determine whether there was a statistically significant relationship between the variables. The null hypothesis states that there is no association between the two variables. The alternate hypothesis indicates that there is an association. Table 4.12 presents a summary of the results of the chi-square tests.

Table 4.12 Pearson Chi-Square Tests

		Age (years)	Experience of service (years)	Qualification
There is a production planning warehouse inventory management.	Chi-square	2.933	6.756	10.996
	df	4	8	10
	Sig.	0.569	0.563	0.358
There is an increase in packaging material consumed on production line 1.	Chi-square	3.851	5.616	6.214
	df	4	8	10
	Sig.	0.427	0.69	0.797
There is an increase in packaging material consumed on production line 3.	Chi-square	9.766	6.512	12.129
	df	4	8	10
	Sig.	.045*	0.59	0.277
Production line performance is regularly evaluated.	Chi-square	5.541	6.155	7.073
	df	4	8	10
	Sig.	0.236	0.63	0.719
There is consistency in the recording of packaging materials on the lines.	Chi-square	8.087	6.862	11.455
	df	4	8	10
	Sig.	0.088	0.552	0.323
Packaging waste contributes to the major waste on the lines.	Chi-square	.298	17.160	14.362
	df	4	8	10
	Sig.	0.99	**.028***	0.157
Raw material and packaging waste information are differentiated to track line losses.	Chi-square	3.737	11.732	12.667
	df	4	8	10
	Sig.	0.443	0.164	0.243
Managers have information on waste volumes generated.	Chi-square	.893	3.318	6.745
	df	4	8	10
	Sig.	0.926	0.913	0.749
Managers have complete cost information on waste management strategies.	Chi-square	.435	13.985	9.848
	df	4	8	10
	Sig.	0.98	0.082	0.454
Managers have information on the cost implication of the volumes generated.	Chi-square	1.296	2.953	9.870
	df	4	8	10
	Sig.	0.862	0.937	0.452
There is an accurate account for the material consumed.	Chi-square	1.125	10.661	11.065
	df	4	8	10
	Sig.	0.89	0.222	0.352
There is an accurate account for line losses.	Chi-square	5.650	11.286	11.322
	df	4	8	10
	Sig.	0.227	0.186	0.333
Root causes of waste generated are investigated.	Chi-square	6.254	13.619	6.014
	df	4	8	10
	Sig.	0.181	0.092	0.814
Information is freely shared in the production unit.	Chi-square	3.723	10.695	9.067
	df	4	8	10
	Sig.	0.445	0.22	0.526
Staff training sessions are conducted regularly.	Chi-square	2.282	11.875	21.385
	df	4	8	10
	Sig.	0.684	0.157	**.019***
Quality of process is evaluated.	Chi-square	1.077	8.168	16.411
	df	4	8	10
	Sig.	0.898	0.417	0.088
Machines are regularly serviced.	Chi-square	2.136	7.784	18.077
	df	4	8	10
	Sig.	0.711	0.455	0.054
Process performance is regularly evaluated.	Chi-square	5.882	7.909	16.238
	df	4	8	10
	Sig.	0.208	0.442	0.093
Staff members with more years of experience are more accurate on the lines.	Chi-square	3.422	7.256	16.992
	df	4	8	10
	Sig.	0.49	0.509	0.075
Staff members with higher qualifications are relatively more efficient on the lines.	Chi-square	1.410	4.633	9.252
	df	4	8	10
	Sig.	0.842	0.796	0.508

A significant result is indicated with "$p < 0.05$", and highlighted in yellow. These values in Table 4.12 are indicated with a (*). The insignificant values are denoted with “p > 0.05”. The p-value defines the smallest value of alpha for which the null hypothesis can be rejected.

For example: The p-value between “There is an increase in packaging material consumed on production line 3” and “Age” is 0.045. This means that there is a significant relationship between the variables highlighted in yellow. That is, the age of the respondents does influence the way packaging materials consumed. This was confirmed in figure 4.2 that experience counts in the handling of resources on the production lines.

There was also a significant relationship between “Packaging waste contributes to the major waste in the line” and “Experience”, which had a p-value of 0.028. This indicates there was a significant relationship between how packaging waste contributes to the major lines’ waste and the experience of the line operators (Khojamli *et al.* 2014: 33)

It can be seen also from the result of the analysis that other variables that yielded significant results were “Staff training sessions are conducted regularly” and “Qualification”, which had a p-value of 0.019. This indicates that the regularity of the training sessions was influenced by the qualification of the respondents. However, the rest of the statements yielded insignificant results. It makes sense that training becomes effective when it is conducted among the learned.

All values without an * (or p-values more than 0.05) do not have a significant relationship.

4.12.1 Correlations

Bivariate correlation was also performed on the ordinal data. The results are found in (Appendix F). The results indicate the following patterns.

Positive values indicate a directly proportional relationship between the variables and a negative value indicates an inverse relationship. All significant relationships are indicated by a * or **.

For example: the correlation value between "There is a production planning warehouse inventory management" and "Managers have information on the cost implication of the volumes generated" is 0.355. This is a directly related proportionality. Respondents indicate that the more there is a production management system, the more information managers would have and vice versa. The beverage production represents an aggregation of materials, machinery, methods and human efforts (Koss 2005: 40). This provides the manager the opportunity to get informed on the associated costs of managing the entire process.

Positive values imply a directly proportional relationship between the variables, while negative values imply an inverse relationship. That is, the variables have an opposite effect on each other. That is, as one variable increases, the other decreases.

For example: the correlation value between "Information is freely shared in the production unit" and "There is an increase in packaging material consumed on production line 3" is -0.298. That is, the better the information dissemination system in the production unit, the lesser packaging material will be used on the lines.

In addition, there was correlation between "Managers have complete cost information on waste management strategies", and the variables of "There is an increase in packaging materials consumed on production line 1" of 0.355*. This implies that the more detailed and accurate cost information the managers have of waste management strategies, the more, their knowledge of the materials to be consumed on line 1, and the greater their knowledge of the cost implication of waste management strategies.

However, “Information is shared freely in the production unit” has a high correlation with “There is an accurate account for line losses” with significant value of 0.452**. This implies that the more information is freely shared in the production unit, the more the root causes of waste are discovered. This is aligned with Nagapan, Rahman and Asmi (2012: 1), who stressed the importance of identifying the root causes of waste.

There is, however, an inverse relationship between “There is an increase in packaging material consumed on line 3” and “Packaging waste contributes to the major waste on the lines” with significant value of -0.042. This implies that the more packaging materials are consumed on line 3, the less the cost-saving opportunities. Therefore, packaging material consumption must be monitored in the production planning unit, in order to improve cost-savings opportunities. Pasqualino, Meneses and Castells (2011: 357), link the increase in beverage packaging waste to an increase in material consumption.

Another high correlation noted is between “There is an accurate account for line losses” and “There is an accurate amount for materials consumed” of 0.690**. This implies that the more accurate the production unit can account for losses generated on the lines, the higher they can account for the total material consumption for each line. Mugwindiri, Madanhire and Masiiwa (2013: 6) attest that the accuracy in material balance provides corresponding accurate information of materials consumed.

Furthermore, there is an inverse relationship established between “Quality of process is evaluated”, and “There is an increase in packaging material consumed on line 1” with a value of -0.042. This implies that any deficiencies in the quality of the production process will result in the consumption of more packaging materials on line 1. Colledani and Tolio (2011: 486), attest that quality and production logistics are mutually related. For instance, production system architecture affects the performance of the quality of the system.

4.12.2 Summary of findings

Analysis of these findings in determining the efficiency of processes on the lines, from the input stage to the output stage that results in waste generation, revealed, contradictions between some of the responses of the respondents, and the current situation of the two production lines under study.

It is evident that the planning stage comes as one of the crucial determinants of efficient utilization of resources on the production lines. Production line 1 seems to consume more materials than line 3. However, consumption of resources was attributed to the capacity of operation on both lines, a good number of the respondents still agreed that packaging wastes contributes to line losses. Furthermore, a fair number of the respondents agreed that the evaluation of the production line performance and the record-keeping of packaging materials were efficient. This may imply the detection of revenue losses on the lines from waste generated. The planning process needs to be managed effectively in order to reduce wasteful outputs.

The findings also showed that the managers are aware of information relating to waste generation and the cost implications. All the responses regarding identifying the causes of waste generation on the lines were positive apart from the machine maintenance. This then poses a question that, if most of the criteria for establishing the causes of waste generation on the lines were fairly met, why then, are managers still battling with issues regarding revenue losses on the lines? This may probably be attributed to the costing system adopted by the company. This will be addressed in the next section of the analysis of the production report.

4.13 Analysis of the Production Report

The researcher conducted this study within the confines of an alcoholic beverage plant in the Durban metropolis. The plant bottles a number of alcoholic beverage brands on six production lines. The aim of this study is to determine the true cost of packaging waste generated on two of the production lines in the company through the application of the MFCA technique. This will enable the managers evaluate the efficient flow of packaging materials on the lines, thereby identifying the packaging material resulting in the revenue leakage.

A six months' production report on losses recorded on the lines beginning from February 2015 to July 2015 was evaluated by the researcher. The MFCA technique was then applied to evaluate the cost of losses reported. Packaging materials used on the lines were the only materials considered. Content (raw material), water and energy were excluded as the study only focused on packaging material waste. The traditional costing method in use in the company was evaluated against the MFCA technique (in the literature review). Although MFCA considers losses at different stages of the production process, packaging material costs were measured at the input stage of the bottling process, and at the end of the process. Line losses were separately identified from other costs, and values were assigned at the end of a batch using the variable costing method.

4.13.1 Regression analysis

A regression analysis was conducted to evaluate the cost variance pattern in the production line losses from February to July 2015.Table 4.13 and figure 4.4 present the six months' packaging materials losses on lines 1 and 3 from February to July 2015.

Table 4.13 Packaging material losses on line 1 and 3 (six months)

Date	Line 1 (carton)	Line 3 (carton)	Line 1 (cork)	Line 3 (cork)	Line 1 (Glass bottles)	Line 3 (Glass bottles)	Line 1 (Body label)	Line 3 (Body label)	Line 1 (Back label)	Line 3 (Back label)
Feb	2.6439714	1.7819697	0.5692073	0.3796667	3.3817989	2.0198897	0.119137	0.3142518	0.1092326	0.30225
Mar	3.0417452	1.5168238	0.6399339	0.4541911	3.4092049	2.2248763	0.2574109	0.1668779	0.1661437	0.06000343
Apr	2.9802545	1.9576898	0.5823699	0.4664614	3.3929213	1.9904233	0.1262029	0.1484597	0.0715309	0.09866102
May	1.9963708	1.4614855	0.5648494	0.4300839	3.3797621	2.1139524	0.0977621	0.1605633	0.0662854	0.0812984
June	4.0056407	4.439888	0.5565303	0.464179	6.045773	2.8878363	0.15869	0.2836037	0.117161	0.06521955
July	3.4720176	1.4396962	0.5616546	0.429129	3.0545753	0.4632596	0.1351394	0.1613854	0.0649049	0.05820612

Table 4.13 indicates the statements that were entered in the regression analysis testing. It assesses the behavior of each packaging materials consumed on both lines on the line graph. The result from the t-test is illustrated on the line graph in figure 4.4.

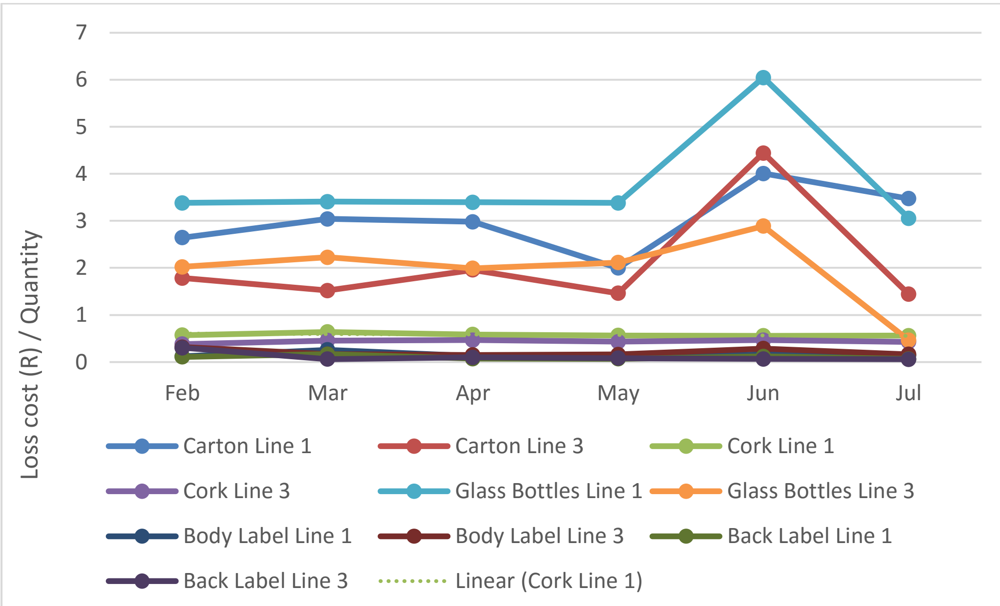


Figure 4.4 Production loss

Between February and May 2015, on figure 4.4, there is a constant line until the sharp increase in July for all the packaging materials. The sharp increase may be attributed to increase in materials consumed on the production lines, in preparation for the upcoming festive season as is the tradition of the company. Inspection of the graph reveals that line 1 value for corks, body labels, and back labels were slightly higher than those for line 3. This increase may be attributed to more activity being carried out on line 1 compared to line 3. All six values are in a narrow band of 0.1 to 0.6. Within this band, the cork value losses were higher than the body labels' and back labels' losses (cork values < body labels < back labels). There were slight peaks in June in packaging materials' losses on both lines.

There is not much change but slightly higher values in June (for the most part). The loss cost is greater in line 1 than line 3 for both glass bottles and cartons. Amongst the four variables, glass bottles in line 1 have the highest costs. The trends are similar for both the lines (1 and 3) for both types of materials, except that line 1 values are higher than line 3. Between February and May, the patterns are similar with the spike in June for both variables for both lines. The values dropped to pre-June levels in July.

Overall, glass bottles seem to generate the highest losses, followed by cartons on line 3 and then cartons on line 1. The purchase price of these packaging materials may be a contributing factor to the high costs. The higher the purchase costs of these materials, the higher the losses of materials that get wasted on the lines. Jasch (2009: 76) asserts that, in the cost category of non-product output (NPO), materials consumed and available from the profit and loss accounts should be listed and quoted with their measured or estimated loss percentage.

The regression equation is represented thus:

$y = -0.0087x + 0.6096$

$R^2 = 0.2763$

In a similar manner, the regression equations for all the lines in table 4.14 were done, and an inspection of the regression equation indicates that the slopes are close or tend to zero. This can also be observed from the graph in figure 4.4.

Table 4.14 Test statistics

Packaging materials	Y	R^2	Packaging materials
Cork line 1	-0.0087x + 0.6096	0.2763	Cork line 1
Cork line 3	0.0069x + 0.4132	0.1565	Cork line 3
Body label 3	-0.0115x + 0.2461	0.0867	Body label 3
Body label 1	-0.007x + 0.1735	0.0532	Body label 1
Back label line 1	-0.0107x + 0.1366	0.2518	Back label line 1
Back label line 3	-0.049x + 0.2331	0.4730	Back label line 3

Although the slopes shown in table 4.14 are close to zero (implying some degree of constant values), the coefficients are negative for five out of the six equations. The long-term effect (due to the small slopes) is that the dependent variable value will decrease. For example, over time, processes may get optimized, and, in turn, lead to decrease in cost values. Table 4.15 presents the regression equation for the lines that indicated that the slope also tend to zero.

Table 4.15 Test statistics

	Y	R^2
Glass bottles line 1	0.1789x + 3.1513	0.0894
Glass bottles line 3	-0.162x + 2.5171	0.1436
Carton line 1	0.1728x + 2.4185	0.2208
Carton line 3	0.1875x + 1.4434	0.0907

Three of the four slopes show increase in trends (positive) while the fourth shows a decrease. The positive slopes are similar in value. An increase in trend implies more production which leads to more cost. The line 3 glass bottles trend is a decrease in loss cost. The decrease in loss costs in line 3 may be as a result of its smaller production capacity.

However, glass bottles on line 1, and cartons on both lines will increase in cost with increase in production volume. This is also attributable to the larger production capacity.

4.14 Analysis of accounting reports

The accounting records were analyzed in order to identify total production costs of packaging materials on lines 1 and 3. This study aims to identify potential cost saving opportunities using MFCA analysis. This section set-out to achieve objective one as indicated in section 1.9.1. i.e., to determine the amount of packaging waste generated on the lines and identifies the packaging materials that constitute the largest amount of losses.

The costs that are considered important to production in the bottling company are costs of material input. Material input forms a major part of a production input, hence, the higher costs (Jasch 2009: 39). Costs associated with processing such as overheads, are also deemed important to the product output and product pricing. Table 4.16 and table 4.17 below illustrate the total production costs incurred on the two lines from February 2015 to July 2015.

Table 4.16 Total cost breakdown for line 1

	Total cost (Rands)	Total cost (%)
Variable Cost		
Labor	360295.40	0.602%
Packaging Material	58262788.17	97.38
Total Variable Cost	58623083.57	98%
Fixed Costs		
Maintenance	1125923.10	1.26%
Depreciation	202666.16	0.34%
Other Costs	255209.23	0.42%
Total Fixed Cost	1208490.84	2.00%
Grand Total	59831574.41	100%

Table 4.16 shows that a great portion of the total costs consists of variable costs (98%), while the fixed costs (2%) take on the lower value. Obviously, the activity level of the bottling plant determines the varying nature of the costs incurred. From a six months' analysis, material and labour seem to consume a chunk of the costs incurred on line 1 with 97% of packaging material and 6% of labour cost. Considering that most of the costs incurred falls under packaging materials, it is imperative that the cost management of each line activity be given adequate attention, as costs can have a ripple effect on the pricing of the products. This finding is supported by Hilton and Platt (2015: 46) that the understanding of cost concepts is absolutely critical to cost management.

Table 4.17 Total cost breakdown for line

	Total cost in Rands	Total cost (%)
Variable Cost		
Labor	271880	2.19%
Packaging Material	11412392.76	92%
Total Variable Cost	11684272.76	94%
Fixed Costs		
Maintenance	594252	4.79%
Depreciation	46608	0.38%
Other Costs	77680	0.63%
Total Fixed Cost	718540	5.79%
Grand Total	12402812.76	100%

On the other hand, line 3, from table 4.17, reveals an increase in maintenance cost of 4.79%, in addition to a high packaging material cost of 92%. An increase in maintenance costs can be attributed to constant breakdown of the machines on line three. Table 4.18 below present the total input, output and losses generated on both lines 1 and 3.

Table 4.18 Production line losses

Production lines	Input Quantity in	Input cost (Rands)	Product Quantity	Product cost (Rands)	Loss Quantity	Loss cost (Rands)
Line 1	54482668	58262788.17	52760391	55120984.81	1722277	3141803.36
Line 3	5628822	11412392.76	5416325	11269831.12	212497	142561.64

Table 4.18 shows the amount of packaging materials consumed on line 1 resulted in material of loss (R3141803.36). Loss was also recorded on line 3. However, the loss was lower than line 1 by R2999241.72. This further confirms

the reduced capacity of line 3. The outputs from a process are meant to exceed the cost expended on material purchase. In the event that it is not so, then the company's profitability is at stake.

4.15 The MFCA calculations

The purpose of this research is to use the MFCA technique to generate the true cost of packaging waste generated on lines 1 and 3 in the alcoholic beverage company used as a case study. The MFCA approach includes the Material Cost (MC) report, the System Cost (SC) and Energy Cost (EC) (Trappey *et al.* 2013: 641). Most companies are not able to generate the sequence of information required according to the MFCA calculation. However, some information from the company reports can be calculated based on the production process using the company's formula. The company under study does not have all the information required via the MFCA calculation, but has other information that can still be relevant to determine the true cost of waste that leads to revenue loss. The MFCA calculation includes the addition of the packaging material losses with the overheads for the six months period.

4.15.1 The Loss Concept

MFCA focuses on the relationship between input and output, defining loss as the difference between input and output (Kokubu, Kitada and Mouritsen 2012: 8). The salient point of MFCA is to quantify the inevitable losses overlooked by the traditional production and cost management (Kokubu, Kitada and Mouritsen 2012: 8). MFCA attributes system costs to losses generated in output. It considers the operational costs incurred in generating the losses.

The next section will show the calculation of the cost savings forfeited on the two lines as a result of the losses incurred as wastes. Below are the calculation of losses on lines 1 and 3, using the company's overhead rate.

Calculating overhead cost per unit

Overhead cost per unit = $\frac{Total\ cost\ of\ overheads}{Quantity\ in\ units}$

Line 1 $= \frac{1568786.24}{54482668}$

= R0.029

Line 3 $= \frac{990420}{5628822}$

= R0.176

Calculating material losses (cost per unit)

$$\frac{Total\ production\ loss}{loss\ quantity\ in\ units}$$

Line 1 $= \frac{3141803.36}{1722277}$

= R1.82

Line 3 $= \frac{142561.64}{212497}$

= R0.67

(Total loss = overhead per unit + cost per unit) x loss quantity

Total cost per unit on line 1

0.029 + 1.82 = R1.85 cents

Total cost per unit on line 3

0.176 + 0.67 = R0.85 cents

Therefore,

Total production loss (MFCA) = Total unit cost x loss quantity)

Line 1 = (R1.85 x 1 722 277 = R3 186 212.45); and

Line 3 = (R0.85 x 212 497 = R180 622.45).

Therefore,

Loss difference = Loss after applying MFCA – loss from production

Line 1 = (R3 186 212 – R3 141 803.36 = R44 409); and

Line 3 = (R180 622.45 – R142 561.64 = R38 060).

The calculations above reveal the true production losses incurred on lines 1 and 3 to be R44 409 and R38 060. This is the difference between the previous losses reported, and that reported after applying the MFCA technique. This finding indicates that the previous losses reported were understated on both lines by R44 409 on line 1, and R38 060 on line 3.

4.16 Conclusion

This chapter presented and interpreted the findings in this study. A combination of both qualitative and qualitative methods was applied to the methodology. Chi-square tests were performed to identify significant relationships and differences between the research variables, and the MFCA technique was used to determine the costs of losses incurred on the two production lines under study.

The findings reported, mainly concurred with literature presented in chapter two. It is obvious that the bottling plant is losing a sizeable amount of money to packaging wastes that could rather be channeled towards the overall profitability. Furthermore, the traditional method of accounting for costing has also proved not to provide the adequate information needs of managers that will curb revenue leakage (Fakoya and van der Poll 2013: 137).

The succeeding chapter will summarize the work presented, and its significance to the study will be established. In addition, possible recommendations for curbing potential revenue losses will be proposed by the researcher.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The preceding chapter presented the findings and interpretations of the data compilation. The results were presented in tables and graphical formats according to the sample size of the respondents, comprising of two production lines in an alcoholic beverage bottling plant in Durban metropolis, KwaZulu-Natal. This chapter provides an overview of the study, and how the research aims and objectives were achieved. Furthermore, a summary of the findings of the study as well as the conclusions and recommendations is presented. The study has revealed that production line managers are not aware of production line losses that result from not just inefficiencies, but also from inadequate waste cost information, and the adoption of inappropriate accounting tools for waste cost estimation. It is now evident that the competitiveness of the industry does not give room for revenue leakages. The study revealed the significance of production managers having the accurate cost information for effective decision making, and the utilization of appropriate tool for estimating the cost of waste.

5.2 Overview of the study

In this study, the MFCA technique was applied to estimate packaging waste costs on lines 1 and 3. The aim was to harness the inherent cost savings potential in the MFCA technique in order to curb revenue leakages on the lines. The qualitative and quantitative approaches were also used to address the causes of waste generation on the two lines. The following objectives were addressed in achieving this purpose:

- To determine the amount of packaging wastes generated on the lines and identify the packaging materials that constitute the largest amount of waste;
- To determine the factors that influence waste generation on the lines;
- To evaluate the system adopted by the company against the MFCA method; and
- To provide viable alternative solutions that would curtail the loss of resources on the production lines.

The dynamic business environment in recent years, coupled with the responsibility reporting for shareholders' investment has made cost information at both internal and external levels imperative for corporate sustainability (Blocher *et al.* 2013: 16). Furthermore, the quest to be environmentally responsible via the reduction of waste generating activities and increased profitability requires the adoption of an effective tool that would inform managerial decision making.

An overview of the role and importance of packaging in the beverage sector, packaging waste generation, and intervention of the Department of Environmental Affairs in the beverage industry were introduced in the literature review. The review also considered the impact of packaging waste on companies' profitability, as well as its environmental impact. Production planning in beverage production was addressed as this usually forms the structure of how resources are effectively utilized during processes. Packaging material consumption and the factors influencing waste were also discussed.

The cost of generating packaging waste and the significance of cost information in strategic decision making were discussed. The role of the management accounting function in providing an effective tool for accurate waste accountability, the traditional method of accounting, and its shortcoming in providing accurate waste information set the pace for the quest to seek an effective tool such as MFCA.

Chapter three, the research methodology chapter, provided a summary of the research approach adopted in attainment of the objectives. The chapter described the research design, which is both qualitative and quantitative in nature. The tools used for collecting data, population and sample size were discussed in this chapter.

Chapter four discussed the findings and interpretation of the data collected. The findings were derived from three methods of data collection: the observation, the Likert-scaled type questionnaire, and analysis of the production reports. The results of the observation of activities on the lines were discussed. The structure of the questionnaires made it convenient for the respondents to express their views without their identity being compromised. Since only two lines were under study, line operators of the aforementioned lines, and some other production staff members whose duties were linked with the lines were handed the questionnaires. The findings were further analyzed using the SPSS version 23.0 statistical package.

The results were presented in the form of descriptive and inferential statistics. The descriptive statistics provided the biographical data of the respondents, and established their relationship with the variables in the form of graphs, cross tabulations and other figures for the quantitative data collected. The inferential statistics tested the hypothesis of this study, in the form of correlations and regression analysis. The results were compared with existing literature studies, as highlighted in chapter two, for similarities or differences. The MFCA technique used the information from the production reports to calculate the true cost of losses incurred on the two lines.

Lastly, chapter five of the study summarized the information in the previous chapters, and included the conclusions and recommendations. The conclusions addressed the objectives of the study, and the recommendations were based on the analysis and interpretation of the results of this study.

5.3 Presentation of conclusions based on findings

The section generates a discussion to arrive at conclusions from chapter two and four in order to achieve the set out objectives. The conclusions relate to the following objectives:

5.3.1 To determine the amount of packaging wastes generated on the lines and identify the packaging materials that constitute the largest amount of waste

Objective one was addressed via the use of MFCA to calculate the losses incurred on the two lines. The problem identified by the company initially was that of revenue leakage on the lines through packaging material losses (Plant manager). Literature also concurred that the traditional management accounting tool contributes to the lack of provision of accurate cost information to managers (Drury 2011: 19; Fakoya 2013: 252). Therefore, the accounting reports of the company were first analyzed to extract the total costs that make up the production process on the lines. A total of R59 831 574.41 made up the costs on line 1 of which 98% make-up the variable costs (packaging materials and labour), while 2% make-up the fixed costs. The reports revealed that packaging materials consume a chunk of 97% of the 98% of the variable costs. On the other hand, line 3 generated a total of R12, 402, 812.76 (100%), and packaging materials, R11 412 392 (94%) of the total.

These costs established the total cost of production losses for both lines. The losses were calculated by summing up all the losses (packaging materials only) for the six months in both quantity (units) and cost. According to the report, a total loss (in Rands) of R3, 141 803.36 was reported for line 1, while a total loss of R142 561.64 was reported for line 3.

However, after the application of the MFCA technique, a total loss of R3, 186 212.45 was revealed for line 1, bringing the difference to R44 409, and a total of

R180 622.45 as loss for line 3, bring the total loss difference to R38 060.81. It is obvious that, the loss report was understated, depriving the company of cost savings totaling R82 470.26 for both lines. Hence, the first objective was achieved.

The results also confirm that glass bottles on line 1 generates the highest losses, followed by cartons on line 3, then, cartons on line 1, followed by glass bottles on line 1. Back labels on line 3 generate the lowest losses.

5.3.2 To determine the factors that influence waste generation on the lines

The second objective was addressed via the observation and analysis of the questionnaire. This objective was set to determine the incidences that are causing waste generation on the lines. From the observation, it was revealed that the bottles get broken at the point of loading of the bottles onto the lines, via the Depalletizer. Bottles can also get broken in the course of moving from one stage in the process to the other. In the course of the observation, a couple of the line operators attest that, whenever inferior quality materials were supplied, it led to frequent losses on the lines. It was also revealed that corks, labels and cartons contribute to the waste on the lines. Some of the damages have been attributed to machine malfunctions.

The questionnaires were used to complement and validate the observation in addressing the second objectives. The biographical data of the respondents' were used to assess their perception of waste generation on the lines. It was revealed that a fair proportion of the respondents were mature individuals, although only 22% have experience of over 6 years and 20% attained above the diploma level.

A fair share of the respondents (75%), confirms that the production planning process was in order, although 70% also confirm the increase in the packaging

materials consumed on line 1. The overall response was positive in the production planning section.
The outcome of determining the efficiency of the waste costing system, revealed that managers have minimal knowledge of the costing system (40%), and their accurate accountability for material consumption on the lines are relatively low.

Certain issues were raised to address factors influencing waste on the lines, and it was revealed that the system lacks the ability to investigate root causes of waste generation on the lines from the responses (40%). There was a gap identified in the communication system from the responses (47%). The responses (40%) from the irregularity of machine servicing highlight another contributing factor to the reason for waste generation on the lines. The respondents' responses (31%) regarding the relationship between higher qualification and efficiency depict a contributing factor to inefficiency on the lines that result in waste.

Overall, the hypothesis tests reveal some level of significance in the relationships between the variables, as the p-value falls within the accepted range of 0.05, indicating some association, while some reveal no association. The above discussion justifies that the second objective was attained.

5.3.3 To evaluate the system adopted by the company against MFCA method

Achieving the third objective was addressed in section 1.5.1 and the literature review. The traditional method of accounting is a technique that lumps costs under overheads, thereby making it difficult to trace cost to the activity or product (Drury 2011: 29). An example is the amount lumped under "other costs" in the overhead costs. Not being able to trace costs on the lines, can lead to inaccuracy in the costing of waste (Jasch 2009: 1 - 3).

As revealed in the literature review, MFCA separate costs into cost centres or production stages thereby, providing a transparent view of the cost centres, or stages, that generate the most waste, and the losses generated in these centres. MFCA also provides a transparent view for efficient process and cost saving decision making. However, cost centres are not allocated to the different stages in the company's process, which makes it difficult to calculate the exact waste generated in each stage.

It is also evident from the literature that, waste generated from the production lines can have a ripple effect on the environment (Ling, Poon and Wong 2013: 25 - 26). The volume of waste generated from two production lines is an indication of inefficiencies in the production processes. The majority of industrial waste in South Africa ends up on landfill sites.(Environmental Affairs 2012: 19). According to The Department of Environmental Affairs (2012: 14) , South Africa is still heavily reliant on landfilling as a waste management option. This is an indication of inefficient production processes that impact on the environment. This leads to other issues such as land encroachment and contamination of the soil. It also means the company is consistently losing revenue from waste and its disposal.

Therefore, the third objective relating to the company's evaluation system has been satisfied.

5.3.4 To provide viable alternative solutions that would curtail the loss of resources on the production lines

It is evident from the findings in chapter four that materials that are meant to end-up as products, rather, end-up as losses via waste. This is an avenue to incur revenue leakage on the lines. In order to curtail the loss of resources on the production lines, managers need to have a holistic view of the entire process, from the planning stage to the end-product. Given that the quantity of waste generated will have an impact on the cost, the relationship between the production line and the accountant must be cordial for effective information flow. The information from the cost implication can sensitize the production line with the increase or decrease in the waste generated and the cost implication. From objective 5.3.4 the following recommendations are offered.

5.4 Recommendations

5.4.1 Adopt MFCA

Based on the shortfalls identified in the traditional mode of costing, MFCA is recommended as a viable technique for costing waste to address revenue leakages on the lines to the plant manager of the case study company. The six months’ report of the different packaging materials, which include cartons, corks, glass, back labels and body labels, was summed up get the total losses per month for each packaging loss incurred. The total materials constituting the highest loss were identified, with the total costs. It is important that managers take further interest in the packaging material losses with a higher loss amount. The MFCA technique is able to provide more concise cost information. Managers can take advantage of this technique to improve cost savings. The application of MFCA will provide a solution to the question of accurate costing.

It was also noted, that enough emphasis is not laid on identifying waste at different stages of the process. It will be cost effective if the managers can look into getting a cheaper supplier of the bottles needed for these lines, or replacing the bottles with PET bottles that may be cheaper (Pasqualino, Meneses and Castells 2011: 359).

5.4.2 Need for training

It is important that management intensify the efforts to organize more training that is suited for each group according to their educational level, for maximum understanding and improvements on the lines. The training guide should also be reviewed, and be made more understandable, and, perhaps, more user-friendly. According to Mbohwa and Madanhire (2014: 12), special attention should be paid to the need for training staff as projects could fail due to inadequately trained staff. The amount of information at managers' disposal should also be re-addressed. In addition, more line operators should be encouraged to develop their education status since there was a positive correlation between education and efficiency.

5.4.3 Machine maintenance

Machine maintenance in production is very important to the output of the process. When machines breakdown, there is likelihood of meeting orders as and when due. This also tends to increase down time, that is, idle time. Waste generation may increase from malfunctioning. The managers need to assess the durability of the machines on line 3, since its maintenance cost is higher than line 1, although it has a smaller capacity than line 1. The managers should ensure that the machines are not outdated, as this could also lead to an increase in fixed costs.

5.4.4 Quality checks

The quality of materials used on production lines is very important to the output. Although 64% agreed that the quality of the production process is evaluated, however, some of the line operators attest that during the observation process, quality defects contributed to line losses. This finding concurs with Tsarouhas (2013: 522) that quality defects of materials rank among the factors leading to line losses in a beverage process. It is, therefore, recommended that the quality process itself be reassessed to verify its reliability in quality checks. It is also recommended that line operators be encouraged to participate in the quality checks in their respective duties and communicate any discrepancies.

5.4.5 Improve communication between middle and lower management

Interpersonal communication should be encouraged on the lines, especially between the lower management level and middle management level. This kind of communication will greatly enhance the flow of information on the lines regarding the quest for waste reduction on both lines. Communication will also provide the opportunity for the line operators to discover, enhance and promote their potentials in achieving overall objectives of eliminating revenue leakage.

5.5 Limitations

The limitations encountered in this study consist of the anonymity of the company, and the restrictions on access to some sensitive information utilized for the study. There would probably have been more concise information to work with without the restrictions. Also, not accounting for lines losses at every stage of the process limited the full utilization of the MFCA technique.

5.6 Suggestions for future research

Owing to the importance of cost information to companies' sustainability, as well as the impact of cost in relation to the environment, managers need to engage effective decision-making tools for sustainability in the 21st century. MFCA was used in this study to evaluate packaging waste costs on two lines. It would be interesting to see what other internal challenges the MFCA technique can practically solve, especially in South Africa, where knowledge of the technique is limited. Therefore, for future research, the MFCA technique may be experimented on evaluating losses in individual departments within an establishment.

5.7 Conclusion

This chapter provided an overview of the review and objectives of the study, highlighting how the objectives were achieved. The conclusions, recommendations, limitations and suggestions for further research were also presented.

This study aimed to determine the impact of waste on an alcoholic beverage production process and has succeeded in achieving this aim. It is the researcher's hope that the company would adopt MFCA in its process to monitor and account for line losses in order to achieve substantial cost savings.

References

A.R.A. 2015. *The South African Liquor Industry: our contribution*. Available: http://www.ara.co.za/uploads/DTI-convention-brochure%20final.pdf (Accessed 12 June 2014).

Allwood, J. M., Ashby, M. F., Gutowski, T. G. and Worrell, E. 2011. Material efficiency: a white paper. *Resources, Conservation and Recycling*, 55 (3): 362-381.

Amienyo, D. 2012. Life cycle sustainability assessment in the UK beverage sector. Doctor of Philosophy University of Manchester. Available: https://www.escholar.manchester.ac.uk/api/datastream?publicationPid=uk-ac-man-scw:183515&datastreamId=FULL-TEXT.PDF (Accessed 15 June 2014).

Apak, S., Erol, M., Elagöz, İ. and Atmaca, M. 2012. The Use of Contemporary Developments in Cost Accounting in Strategic Cost Management. *Procedia - Social and Behavioral Sciences*, 41 (0): 528-534. http://dx.doi.org/10.1016/j.sbspro.2012.04.065. Available: http://www.sciencedirect.com/science/article/pii/S1877042812009457 (Accessed 17 April 2014).

Ataya, A. F., Adams, S., Mullings, E., Cooper, R. M., Attwood, A. S. and Munafò, M. R. 2012. Internal reliability of measures of substance-related cognitive bias. *Drug and alcohol dependence*, 121 (1): 148-151.

Barfield, J. T., Raiborn, C. A. and Kinney, M. R. 2003. *Cost Accounting: Traditions and Innovations*. 5th ed. United States of America: Thomson Learning.

Bautista-Lazo, S. and Short, T. 2013. Introducing the All Seeing Eye of Business: a model for understanding the nature, impact and potential uses of waste. *Journal of Cleaner Production*, 40: 141-150.

Belohlavek, R. and Krmelova, M. 2014. Factor analysis of ordinal data via decomposition of matrices with grades. *Annals of Mathematics and Artificial Intelligence*, 72 (1-2): 23-44.

Blocher, E. J., Stout, D. E., Juras, P. E. and Cokins, G. 2013. *Cost Management: A Strategic Emphasis*. Sixth ed. New York: McGraw-Hill/Irwin.

Christ, K. L. and Burritt, R. L. 2014. Material flow cost accounting: a review and agenda for future research. *Journal of Cleaner Production*, Available: http://dx.doi.org/10.1016/j.jclepro.2014.09.005 (Accessed 04 November 2014).

Cleary, J. 2013. Life cycle assessments of wine and spirit packaging at the product and the municipal scale: a Toronto, Canada case study. *Journal of Cleaner Production*, 44 (0): 143-151. http://dx.doi.org/10.1016/j.jclepro.2013.01.009. Available: http://www.sciencedirect.com/science/article/pii/S0959652613000140 (Accessed 8 May 2014).

Coldwell, D. and Herbst, F. 2004. *Business Research*. Cape Town: Juta and Co Limited.

Colledani, M. and Tolio, T. 2011. Integrated analysis of quality and production logistics performance in manufacturing lines. *International Journal of Production Research*, 49 (2): 485-518.

Comandaru, I. M., Bârjoveanu, G., Peiu, N., Ene, S.-A. and Teodosiu, C. 2012. Life cycle assessment of wine: focus on water use impact assessment. *Environmental Engineering and Management Journal*, 11 (3): 533-543.

Creswell, J. W. and Clark, V. L. P. 2011. *Designing And Conducting Mixed Methods Research*. Second Edition ed. United States of America: SAGE Publications, Inc.

da Silva, P. R. S. and Amaral, F. G. 2009. An integrated methodology for environmental impacts and costs evaluation in industrial processes. *Journal of Cleaner Production*, 17 (15): 1339-1350. http://dx.doi.org/10.1016/j.jclepro.2009.04.010. Available: http://www.sciencedirect.com/science/article/pii/S0959652609001450 (Accessed 27 September, 2013).

Davis, G. and Song, J. 2006. Biodegradable packaging based on raw materials from crops and their impact on waste management. *Industrial crops and products*, 23 (2): 147-161.

De Beer, P. and Friend, F. 2006. Environmental accounting: a management tool for enhancing corporate environmental and economic performance. *Ecological Economics*, 58 (3): 548-560.

Dixon-Hardy, D. W. and Curran, B. A. 2009. Types of packaging waste from secondary sources (supermarkets)–The situation in the UK. *Waste Management*, 29 (3): 1198-1207.

Dooley, K. 2014. Organisational Behaviour: Business Models for a Profitable and Sustainable Future. *Journal of Social Sciences (COES&RJ-JSS)*, 3 (1): 247-257.

Drury, C. 2011. *Management and Cost Accounting*. 7th ed. Hampshire, United Kingdom: Pat Bond.

Environmental Affairs And Tourism, D. 2005. *National Waste Management Strategy Implementation South Africa: Waste Information System.* SOUTH AFRICA: Department of Environmental Affairs And Tourism. Available: http://sawic.environment.gov.za/documents/209.pdf (Accessed 02 October 2015).

Environmental Affairs, D. 2008. *National Waste Management Strategy*. Available: https://www.environment.gov.za/documents/strategicdocuments?q=content/strategic_docs/national_waste_management_strategy (Accessed 02 October 2015).

Environmental Affairs, D. 2012. *National Waste Information Baseline Report.* South Africa: Department: Environmental Affairs. 7 June, 2013).

Fakoya, M. B. 2012. Applying Material Flow Cost Accounting in Waste-Reduction Decisions: Case of a Micro-Brewery in South Africa. Paper presented at the *15th EMAN Conference.* Helsinki, Finland, 24-26 September 2012. 1-7.

Fakoya, M. B. 2013. Integrated Waste Management Decisions in South Africa: The Role of the Management Accounting Function. *J Hum Ecol*, 43 (3): 249-255.

Fakoya, M. B. 2014. An adjusted material flow cost accounting framework for process waste-reduction decisions in the South African Brewery industry. PhD Commerce, University of South Africa. Available: http://uir.unisa.ac.za/bitstream/handle/10500/13942/thesis_fakoya_mb.pdf?sequence=1 (Accessed 12 August 2015).

Fakoya, M. B. and van der Poll, H. M. 2013. Integrating ERP and MFCA systems for improved waste-reduction decisions in a brewery in South Africa. *Journal of Cleaner Production*, 40: 136-140.

Ferreira, S., Cabral, M., De Jaeger, S., Da Cruz, N. F., Simões, P. and Marques, R. 2015. Life cycle assessment and valuation of the packaging waste recycling system in Belgium. *Journal of Material Cycles and Waste Management*: 1-11.

Fleisher, B. M., Hu, Y., Li, H. and Kim, S. 2011. Economic transition, higher education and worker productivity in China. *Journal of Development Economics*, 94 (1): 86-94.

Gabriel, M., Tschandl, M. and Posch, A. 2014. Sustainability-Oriented Lifecycle Costing. *Annals of the Faculty of Engineering Hunedoara*, 12 (1): 33-40. Available: http://search.proquest.com/docview/1503677068?accountid=10612 (Accessed 4 August 2014).

Gale, R. 2006. Environmental management accounting as a reflexive modernization strategy in cleaner production. *Journal of Cleaner Production*, 14 (14): 1228-1236.

Gluch, P. and Baumann, H. 2004. The life cycle costing (LCC) approach: a conceptual discussion of its usefulness for environmental decision-making. *Building and Environment*, 39 (5): 571-580. http://dx.doi.org/10.1016/j.buildenv.2003.10.008. Available: http://www.sciencedirect.com/science/article/pii/S0360132303002610 (Accessed 17 May 2015).

Godfrey, L., Scott, D., Difford, M. and Trois, C. 2012. Part 1: The role of waste data in building knowledge: The South African waste information system. *Waste Management*, 32 (11): 2154-2162.

Guimarães, L., Klabjan, D. and Almada-Lobo, B. 2012. Annual production budget in the beverage industry. *Engineering Applications of Artificial Intelligence*, 25 (2): 229-241. http://dx.doi.org/10.1016/j.engappai.2011.05.011. Available: http://www.sciencedirect.com/science/article/pii/S0952197611000935 (Accessed 01 May 2015).

Herrmann, C., Schmidt, C., Kurle, D., Blume, S. and Thiede, S. 2014. Sustainability in Manufacturing and Factories of the Future. *International Journal of Precision Engineering and Manufacturing-Green Technology*, 1 (4): 283-292.

Hilsenrath, P., Eakin, C. and Fischer, K. 2015. Price-Transparency and Cost Accounting Challenges for Health Care Organizations in the Consumer-Driven Era. *INQUIRY: The Journal of Health Care Organization, Provision, and Financing*, 52: 0046958015574981. (Accessed 18 June 2015).

Hilton, R. W. and Platt, D. E. 2015. *Managerial Accounting: Creating Value in a Global Business Environment. 9th edition*. New York: McGraw- Hill/Irwin.

Hubbard, G. 2009. Measuring organizational performance: beyond the triple bottom line. *Business Strategy & the Environment (John Wiley & Sons, Inc)*, 18 (3): 177-191. 10.1002/bse.564. Available: http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=36165593&site=ehost-live (Accessed 28 October, 2013).

Hyršlová, J., Palásek, J. and Vágner, M. 2011. Material flow cost accounting (Mfca)–tool for the optimization of corporate production processes. *Business, Management and Education*, (1): 5-18.

Jasch, C. 2006. Environmental management accounting (EMA) as the next step in the evolution of management accounting. *Journal of Cleaner Production*, 14 (14): 1190-1193. http://dx.doi.org/10.1016/j.jclepro.2005.08.006. Available:

http://www.sciencedirect.com/science/article/pii/S0959652605001927 (Accessed 25 September 2015).

Jasch, C. 2009. *Environmental and Material Flow Cost Accounting*. Vienna: Springer Science.

Jernigan, D. H. 2009. The global alcohol industry: an overview. *Addiction*, 104: 6-12. 10.1111/j.1360-0443.2008.02430.x. Available: http://onlinelibrary.wiley.com/doi/10.1111/j.1360-0443.2008.02430.x/pdf (Accessed 03 July 2013).

Jernigan, D. H. 2012. Global alcohol producers, science, and policy: the case of the international center for alcohol policies. *American Journal of Public Health*, 102 (1): 80-89.

Jones, P. 2001. Are educated workers really more productive? *Journal of Development Economics*, 64 (1): 57-79. http://dx.doi.org/10.1016/S0304-3878(00)00124-3. Available: http://www.sciencedirect.com/science/article/pii/S0304387800001243 (Accessed 20 November 2013).

Kasemset, C., Sasiopars, S. and Suwiphat, S. 2013. The Application of MFCA Analysis in Process Improvement: A Case Study of Plastics Packaging Factory in Thailand. In: Proceedings of *Proceedings of the Institute of Industrial Engineers Asian Conference 2013.* Springer, 353-361.

Khojamli, M., Habibi, M., Hossein, M. and Kazemiyan, M. 2014. THE RELATIONSHIP BETWEEN WORK EXPERIENCE, MOTIVATION, TRAINING AND STRESS WITH LABOR PRODUCTIVITY. *Kuwait Chapter of the Arabian Journal of Business and Management Review*, 3 (11A): 31.

Kokubu, K., Campos, M. K. S., Furukawa, Y. and Tachikawa, H. 2009. Material flow cost accounting with ISO 14051. *ISO Management System*, 9 (1): 15-18.

Kokubu, K. and Kitada, H. 2010. Conflicts and solutions between material flow cost, Accounting and conventional managemnt thinking. In: Proceedings of *6th Asia-Pacific Interdisciplinary Perspectives on Accounting Research (APIRA) Conference at University of Sydney on.* 12-13.

Kokubu, K. and Kitada, H. 2014. Material flow cost accounting an existing management perspectives. *Journal of Cleaner Production*, Available: http://ac.els-cdn.com/S0959652614008609/1-s2.0-S0959652614008609-main.pdf?_tid=62f2872a-9199-11e5-b188-00000aacb35d&acdnat=1448252548_4ae994ceb508a5f4edcf20c7aa0dfeaf (Accessed 09 October 2015).

Kokubu, K., Kitada, H. and Mouritsen, J. 2012. MATERIAL FLOW COST ACCOUNTING AND CONVENTIONAL MANAGEMNT THINKING: INTRODUCING A NEW ENVIRONMENTAL MANAGEMENT ACCOUNTING TOOL INTO COMPANIES. In: Proceedings of *Interdisciplinary Perspectives on Accounting Conference, Cardiff.*

Konings, J. and Vanormelingen, S. 2010. *The Impact of Training on Productivity and Wages: Firm Level Evidence.* Bonn, Germany: Institute for the Study of Labor.

Koss, J. P. 1998. Packaging material usage and loss. *Beverage World*, 117 (1659): 102. Available: http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=768545&site=ehost-live (Accessed 12 September 2013).

Koss, J. P. 2005. "THE" PRODUCTION LINE. *Beverage World*, 124 (1): 40-40. Available: http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=15944231&site=ehost-live (Accessed 22 November 2013).

Kothari, C. R. and Garg, G. 2014. *Research Methodology: Methods And Techniques*. Third ed. Delhi: New Age International (P) Ltd.

Kumar, S., Teichman, S. and Timpernagel, T. 2012. A green supply chain is a requirement for profitability. *International Journal of Production Research*, 50 (5): 1278-1296.

Leedy, P. D. and Ormrod, J. E. 2013. *Practical Research: Planning And Design*. Tenth ed. New Jersey: Pearson Education, Inc.

Lim, M. 2011. Full Cost Accounting in Solid Waste Management: The Gap in the Literature on Newly Industrialised Countries'. *Journal of Applied Management Accounting Research*, 9 (1): 21-36.

Lincoln, J. 2015. Designing a Closed Loop System for PET Bottles Recovery in Nigeria. Bachelor's in International Business, University of Applied Sciences Haaga-Helia. Available: http://www.theseus.fi/bitstream/handle/10024/95529/Thesis%20submission%2030.pdf?sequence=1 (Accessed 29 June 2015).

Ling, T.-C., Poon, C.-S. and Wong, H.-W. 2013. Management and recycling of waste glass in concrete products: Current situations in Hong Kong. *Resources, Conservation and Recycling*, 70 (0): 25-31. http://dx.doi.org/10.1016/j.resconrec.2012.10.006. Available: http://www.sciencedirect.com/science/article/pii/S0921344912001917 (Accessed 29 June 2015).

Mahal, I. and Hossain, M. A. 2015. Activity-Based Costing (ABC)–An Effective Tool for Better Management. *Research Journal of Finance and Accounting*, 6 (4): 66-73.

Martinez-Sanchez, V., Kromann, M. A. and Astrup, T. F. 2015. Life cycle costing of waste management systems: Overview, calculation principles and case studies. *Waste Management*, 36 (0): 343-355. http://dx.doi.org/10.1016/j.wasman.2014.10.033. Available: http://www.sciencedirect.com/science/article/pii/S0956053X14005224 (Accessed 17 May 2015).

Mbohwa, C. and Madanhire, I. 2014. Cleaner production framework for an beverage manufacturing company. Available: http://ujdigispace.uj.ac.za/bitstream/handle/10210/13562/Cleaner%20Production%20Framework%20for%20an%20Beverage.pdf?sequence=1&isAllowed=y (Accessed 13 April 2015).

Mena, C., Adenso-Diaz, B. and Yurt, O. 2011. The causes of food waste in the supplier–retailer interface: Evidences from the UK and Spain. *Resources, Conservation and Recycling*, 55 (6): 648-658. http://dx.doi.org/10.1016/j.resconrec.2010.09.006. Available: http://www.sciencedirect.com/science/article/pii/S0921344910002077 (Accessed 15 November 2013).

Mugwindiri, K., Madanhire, I. and Masiiwa, T. 2013. Design of a Cleaner Production Framework for Engineering Company: DrinkCo Beverages. *International Journal of Science and Research (IJSR)*, 2(2): 1-17. Available: http://ijsr.net/archive/v2i2/IJSROFF2013031.pdf (Accessed 19 August 2013).

Muzenda, E. 2014. A discussion on waste generation and management trends in South Africa. Available: https://scholar.google.co.za/scholar?hl=en&q=A+discussion+on+waste+generation+and+management+trends+in+South+Africa&btnG=&as_sdt=1%2C5&as_sdtp= (Accessed 21 January 2015).

Muzenda, E., Belaid, M., Mollagee, M., Motampane, N. and Ntuli, F. 2011. Reflecting on waste management strategies for South Africa. In: San Francisco: Proceedings of the World Congress on Engineering and Computer Science (WCECS).

Myers, M. D. 2013. *Qualitative Research in Business Management*. Second Edition ed. London: SAGE Publications Inc.

Nagapan, S., Rahman, I. A. and Asmi, A. 2012. Factors Contributing to Physical and Non-Physical Waste Generation in Construction Industry. *International Journal of Advances in Applied Sciences*, 1 (1): 1-10.

Nahman, A. 2010. Extended producer responsibility for packaging waste in South Africa: Current approaches and lessons learned. *Resources, Conservation and Recycling*, 54 (3): 155-162. http://dx.doi.org/10.1016/j.resconrec.2009.07.006. Available: http://ac.els-cdn.com/S0921344909001578/1-s2.0-S0921344909001578-main.pdf?_tid=0a63e3f2-919d-11e5-ba47-00000aacb360&acdnat=1448254117_558a8fa6935d147287c1a48c69955785 (Accessed 15 July 2013).

Ngwakwe, C. C. 2011. Waste Costing as a Catalyst in Pollution Prevention Investment Decisions. *Journal of Industrial Ecology*, 15 (6): 951-966. 10.1111/j.1530-9290.2011.00370.x. Available: http://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=67671479&site=ehost-live (Accessed 15 July 2013).

Ni, J. and Jin, X. 2012. Decision support systems for effective maintenance operations. *CIRP Annals-Manufacturing Technology*, 61 (1): 411-414.

Olajire, A. A. 2012. The brewing industry and environmental challenges. *Journal of Cleaner Production*: 1-21. 10.1016/j.jclepro.2012.03.003.

Papaspyropoulos, K. G., Blioumis, V., Christodoulou, A. S., Birtsas, P. K. and Skordas, K. E. 2012. Challenges in implementing environmental management accounting tools: the case of a nonprofit forestry organization. *Journal of Cleaner Production*, 29–30 (0): 132-143. http://dx.doi.org/10.1016/j.jclepro.2012.02.004. Available: http://www.sciencedirect.com/science/article/pii/S0959652612000649 (Accessed 18 July 2014).

Pasqualino, J., Meneses, M. and Castells, F. 2011. The carbon footprint and energy consumption of beverage packaging selection and disposal. *Journal of Food Engineering*, 103 (4): 357-365.

Raj, J. R. and Seetharaman, A. 2013. Role of Waste and Performance Management in the Construction Industry. *Journal of Environmental Science and Technology*, 6 (3): 119.

Remenyi, D. 2012. *Case Study Research*. United Kingdom: Academic Publishing International Limited.

Rouw, M. and Worrell, E. 2011. Evaluating the impacts of packaging policy in The Netherlands. *Resources, Conservation and Recycling*, 55 (4): 483-492.

Saunders, M., Lewis, P. and Thornhill, A. 2009. *Research Methods for Business Students*. Fifth ed. Essex Pearson Education Limited.

Schaltegger, S. and Zvezdov, D. 2014. Expanding material flow cost accounting. Framework, review and potentials. *Journal of Cleaner Production*, Available: http://dxdoi.org/10.1016/j.jclepro.2014.08.040 (Accessed 04 November 2014).

Schliephake, K., Stevens, G. and Clay, S. 2009. Making resources work more efficiently – the importance of supply chain partnerships. *Journal of Cleaner Production*, 17 (14): 1257-1263.

Schmidt, M. and Nakajima, M. 2013. Material Flow Cost Accounting as an Approach to Improve Resource Efficiency in Manufacturing Companies. *Resources*, 2 (3): 358-369.

Sekaran, U. and Bougie, R. 2013. *Research Methods for Business: A Skill-Building Approach*. Sixth Edition ed. Illinois: John Wiley & Sons Ltd.

Smith, L. and Ball, P. 2012. Steps towards sustainable manufacturing through modelling material, energy and waste flows. *International Journal of Production Economics*, 140 (1): 227-238.

Struwig, F. W. and Stead, G. B. 2013. *Research: Planning, Designing. and Reporting*. Cape Town: Pearson Education South Africa (Pty) Limited.

Sygulla, R., Bierer, A. and Götze, U. 2011. Material Flow Cost Accounting–Proposals for Improving the Evaluation of Monetary Effects of Resource Saving Process Designs. In: Proceedings of *Beitrag zur 44th CIRP international conference on manufacturing systems.*

Trappey, A. J., Yeh, M. F., Wu, S. C.-Y. and Kuo, A. Y. 2013. ISO14051-based Material Flow Cost Accounting system framework for collaborative green manufacturing. In: Proceedings of *Computer Supported Cooperative Work in Design (CSCWD), 2013 IEEE 17th International Conference on.* IEEE, 639-644.

Tsarouhas, P. H. 2013. Evaluation of overall equipment effectiveness in the beverage industry: a case study. *International Journal of Production Research*, 51 (2): 515-523.

van Sluisveld, M. A. and Worrell, E. 2013. The paradox of packaging optimization–a characterization of packaging source reduction in the Netherlands. *Resources, Conservation and Recycling*, 73: 133-142.

Viere, T., Stock, M. and Genest, A. 2013. How to achieve energy and resource efficiency: Material and energy flow modeling and costing for a small and medium-sized company. In: Neugebauer, R., Götze, U. and Drossel, W.-G. eds. Proceedings of *Energy Related Balancing and Evaluation in Production Engineering-Methods and Examples, Technical University of Chemnitz.*

Auerbach, 451-467. Available: http://nbn-resolving.de/urn:nbn:de:bsz:ch1-qucosa-109067 (Accessed 20 September 2014).

Wilson, D. C., Parker, D., Cox, J., Strange, K., Willis, P., Blakey, N. and Raw, L. 2012. Business waste prevention: a review of the evidence. *Waste Management & Research*, 30 (9 suppl): 17-28.

Woodward, D. G. 1997. Life cycle costing—Theory, information acquisition and application. *International Journal of Project Management*, 15 (6): 335-344. http://dx.doi.org/10.1016/S0263-7863(96)00089-0. Available: http://www.sciencedirect.com/science/article/pii/S0263786396000890 (Accessed 17 May 2015).

Wouters, M., Selto, F., Hilton, R. and Maher, M. 2012. *Cost and Management Accounting Strategies for Business Decisions*. International ed. Berkshire: McGraw-Hill Higher Education.

Xie, M., Qiao, Q., Sun, Q. and Zhang, L. 2013. Life cycle assessment of composite packaging waste management—a Chinese case study on aseptic packaging. *The International Journal of Life Cycle Assessment*, 18 (3): 626-635.

Yahaya, A., Yahaya, N., Amat, F., Bon, A. T. and Zakariya, Z. 2010. The effect of various modes of occupational stress, job satisfaction, intention to leave and absentism companies commission of Malaysia. *Australian Journal of Basic and Applied Sciences*: 1676-1684.

Yin, K. R. 2009. *Case Study Research: Design and Methods*. Fourth ed. United States of America: SAGE Publications, Inc.

Yin, K. R. 2014. *Case Study Research: Design and Methods*. Fifth ed. United States of America: SAGE Publications, Inc.

Young, J. 2013. *Expanding the food and beverage sectors in South Africa*. Available: http://www.frontiermarketnetwork.com/article/2361-expanding-the-food-and-beverage-sectors-in-south-africa#.VAGZ8WPgUn4 (Accessed 30 August 2014).

Zeng, S. X., Meng, X. H., Yin, H. T., Tam, C. M. and Sun, L. 2010. Impact of cleaner production on business performance. *Journal of Cleaner Production*, 18 (10–11): 975-983. http://dx.doi.org/10.1016/j.jclepro.2010.02.019. Available: http://www.sciencedirect.com/science/article/pii/S0959652610000685 (Accessed 30 October 2013).

APPENDIX A LETTER OF INFORMATION

LETTER OF INFORMATION

Title of the Research Study: Exploring production wastage costs within the profits of food and beverage industry in Greater Durban.

Principal Investigator/s/researcher: Omolola Ayobamidele Tajelawi (M Tech Cost and management accounting)

Co-Investigator/s/supervisor/s: Dr Hari Lall Garhbarran

Brief Introduction and Purpose of the Study: The study is a part of an M Tech in Cost and Management Accounting at Durban University of Technology that aims to explore and analyze ways of improving existing framework in production processes of food and beverage industry for improved cost control and profitability.

Outline of the Procedures: the manufacturing process of the different production process will be surveyed.

Risks or Discomforts to the Participant: There is no foreseeable risk as a voluntary participant.

Benefits: The study will assist management to re-evaluate the strategies utilized in its production process in order to identify limitations and improve on creating new procedures that will contribute significantly to its profitability. Furthermore, it will be published in an accredited journal and presented at a national or international conference.

Reason/s why the Participant May Be Withdrawn from the Study: There will be no adverse consequences for the participant should they choose to withdraw.

Remuneration: None

Costs of the Study: Nil cost for the participant

Confidentiality: As a participant, you will remain anonymous and all information will be treated as strictly confidential. Your organization's production processes and financial information will be anonymously processed into the study report. Analysis will be given with the strictest of confidence.

Research-related Injury: You are absolved of any injurious responsibility sustained by researcher in the course of this study.

Persons to Contact in the Event of Any Problems or Queries:

Please contact the researcher: Omolola Tajelawi (0785102696), my supervisor: Dr Hall Garhbarran (031-3735740) or the Institutional Research Ethics administrator on 031 373 2900. Complaints can be reported to the DVC: TIP, Prof F. Otieno on 031 373 2382 or dvctip@dut.ac.za.

General:

Potential participants must be assured that participation is voluntary and the approximate number of participants to be included should be disclosed. A copy of the information letter should be issued to participants. The information letter and consent form must be translated and provided in the primary spoken language of the research population e.g. isiZulu.

APPENDIX B CONSENT LETTER

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, ____________ (name of researcher), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: ___________,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____________________ ___________ ______ ________________

Full Name of Participant **Date** **Time** **Signature/ Right Thumbprint**

I, ____________ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

__________________ ___________ ____________________

Full Name of Researcher **Date** **Signature**

__________________ ___________ ____________________

Full Name of Witness (If applicable) Date Signature

__________________ ___________ ____________________

Full Name of Legal Guardian (If applicable) Date Signature

Please note the following:

Research details must be provided in a clear, simple and culturally appropriate manner and prospective participants should be helped to arrive at an informed decision by use of appropriate language (grade 10 level - use Flesch Reading Ease Scores on Microsoft Word), selecting of a non-threatening environment for interaction and the availability of peer counseling (Department of Health, 2004)

If the potential participant is unable to read/illiterate, then a right thumb print is required and an impartial witness, who is literate and knows the participant e.g. parent, sibling, friend, pastor, etc. should verify in writing, duly signed that informed verbal consent was obtained (Department of Health, 2004).

If anyone makes a mistake completing this document e.g. wrong date or spelling mistake a new document has to be completed. The incomplete original document has to be kept in the participant file and not thrown away and copies thereof must be issued to the participant.

References:

Department of Health: 2004. *Ethics in Health Research: Principles, Structures and Processes* http://www.doh.gov.za/docs/factsheets/guidelines/ethnics/

Department of Health. 2006. *South African Good Clinical Practice Guidelines*. 2nd Ed. Available at: http://www.nhrec.org.za/?page_id=14

Full Name of Legal Guardian (If applicable) Date Signature135

APPENDIX C REQUEST TO CONDUCT RESEARCH ON DETERMINING PACKAGING WASTE COST

Good day Gwen,

I would like to request the permission of your organization to conduct a study on "Using Material Flow Cost Accounting to determine the impacts of packaging waste costs in alcoholic beverage production in an alcoholic beverage company in Durban".

The study will include:

- Observation of the activities on the production lines.
- Questionnaires will be handed out to staff members for response and,
- Reports from the production lines will be requested.

The above, will aid my study in estimation of the true costs incurred on packaging waste on the production lines and its impact on efficiency on the production lines.

I await your favorable response.

Thank you.

Omolola Tajelawi

APPENDIX D GATEKEEPER'S PERMISSION

Individual Confidentiality Deed

I, acknowledge confirm and undertake as follows:

- I am an Student , **at Durban University of Technology, Student number 21242700 Address: 8 Corlo Court Residence , 18 Heswall Road .**
- I understand that this Confidentiality Deed binds me for the benefit of **Diageo S.A** and any of its shareholders **(Diageo/ Brandhouse)**
- I acknowledge, that in the context of **conducting research on Production waste**, information may be disclosed to me in the course of the performance of my duties which is confidential to Diageo, including (but not limited to):
    - Cost of Waste materials
    - Volumes of Material
    - Cost of utilities and Fuel
    - Cost and Volumes of packaging associated with disposal and recycling
    - Waste and Environmental KPI's

  or any intellectual property of Diageo, secrets, information, formulas, processes, methods, records or data of Diageo not already in the public domain (**Confidential Information**).
- In relation to any Confidential Information which is disclosed to me and/or to which I become privy by any other means, I agree to be bound by obligations of confidentiality to Diageo.
- I will not without Diageo's prior written consent use or attempt to use any Confidential Information for any purpose other than as expressly invited or permitted by Diageo in connection with_ **Cost of Waste Project.**
- I will not for whatever reason either for myself or any third party appropriate, copy, memorise or in any manner reproduce any Confidential Information.
- At Diageo's request I will immediately hand over to Diageo any documents, records or other materials in whatever form which may be in my possession custody or control, which contain or relate in any way to any Confidential Information.
- My obligations to Diageo in relation to the Confidential Information will remain in full force and effect until all Confidential Information has been returned to Diageo pursuant to clause 7 of this Undertaking.
- I confirm that I have entered into this undertaking freely and willingly, and having had an opportunity to seek independent legal advice as to its meaning and effect before signing below.
- This Undertaking is governed by the laws of the Republic of South Africa and I submit any dispute relating to the same to the non-exclusive jurisdiction of the Courts of South Africa.

Dated this 20 day of August 2015

Executed as a deed.

Signed, sealed and delivered by me: [redacted]

Signature

[redacted]

Signatory print name

In the presence of a witness: [redacted]

Witness signature

[redacted]

Witness print name

APPENDIX E ETHICAL CLEARANCE

Institutional Research Ethics Committee
Faculty of Health Sciences
Room MS 49, Mansfield School Site
Gate 8, Ritson Campus
Durban University of Technology

P O Box 1334, Durban, South Africa, 4001

Tel: 031 373 2900
Fax: 031 373 2407
Email: lavishad@dut.ac.za
http://www.dut.ac.za/research/institutional_research_ethics

www.dut.ac.za

25 June 2014

IREC Reference Number: **REC 26/14**

Ms A O Tajelawi
Flat 201, Corlo Court Residence
18 Heswall Road
Durban
4001

Dear Ms Tajelawi

Determining the impact of packaging waste costs on material flow efficiency in an alcoholic beverage company in Durban

I am pleased to inform you that Provisional Approval subject to piloting of the data collection tool (questionnaire) has been granted to your proposal REC 26/14.

The Proposal has been allocated the following Ethical Clearance number **IREC 042/14**. Please use this number in all communication with this office.

Approval has been granted for a period of one year, before the expiry of which you are required to apply for safety monitoring and annual recertification. Please use the Safety Monitoring and Annual Recertification Report form which can be found in the Standard Operating Procedures [SOP's] of the IREC. This form must be submitted to the IREC at least 3 months before the ethics approval for the study expires.

Any adverse events [serious or minor] which occur in connection with this study and/or which may alter its ethical consideration must be reported to the IREC according to the IREC SOP's. In addition, you will be responsible to ensure gatekeeper permission.

Please note that any deviations from the approved proposal require the approval of the IREC as outlined in the IREC SOP's.

Please note that you may continue with validity testing and piloting of the data collection tool. Research on the proposed project may not proceed until IREC reviews and approves the final document. If there are no changes to the data collection tool, kindly notify IREC in writing.

Yours Sincerely

[redacted]

Prof J K Adam
Chairperson: IREC

APPENDIX F QUESTIONNAIRE

QUESTIONNAIRE

INFORMATION ON IMPACT OF PACKAGING WASTE ON MANUFACTURING FIRM'S SUSTAINABILITY

Information gathered is for research purposes only and the company's identity and information will not be compromised in anyway.

SECTION A:

PERSONAL AND COMPANY INFORMATION

Mark the appropriate box with a cross (X).

1. **Please indicate your age.**

10-20	20-30	30-40	40-50 or over

2. **Please indicate relevant experience of service.**

0-3yrs	3-6yrs	6-9yrs	9-12yrs	12yrs and over

3. **State your qualification.**

Matric		Cert.		Diploma		Bachelor		Honours		Other	

SECTION B

Please tick one box for each statement.

SA (STRONGLY AGREE)

A (AGREE)

SD (STRONGLY DISAGREE)

D (DISAGREE)

N (NEUTRAL)

	Statement	SA	A	SD	D	N
	The Production Process					
1.	There is a production planning warehouse inventory management.					
2.	There is an increase in packaging material consumed on production line 1.					
3.	There is an increase in packaging material consumed on production line 3					
4.	Production line performance is regularly evaluated.					
5.	There is consistency in the recording of packaging materials on the lines.					
6.	Packaging waste contributes to the major waste on the lines.					
7.	Raw material and packaging waste information are differentiated to track line losses.					
8.	Managers have information on waste volumes generated.					
	Waste Cost Information System					
9.	Managers have complete cost information on waste management strategies.					
10.	Managers have information on the cost implication of the volumes generated.					
11.	There is an accurate account for the material consumed.					
12.	There is an accurate account for line losses.					

	Factors Influencing Waste Generation					
13.	Root causes of waste generated are investigated.					
14.	Information is freely shared in the production unit.					
15.	Staff training sessions are conducted regularly.					
16.	Quality of process is evaluated.					
17.	Machines are regularly serviced.					
18.	Process performance is regularly evaluated.					
19.	Staff members with more years of experience are more accurate on the lines.					
20.	Staff members with higher qualifications are relatively more efficient on the lines.					

Thank you for your co-operation

Omolola Tajelawi

APPENDIX G CORRELATION

			There is a production planning warehouse inventory management	There is an increase in packaging material consumed on production line 1.	There is an increase in packaging material consumed on production line 3.	Production line performance is regularly evaluated.	There is consistency in the recording of packaging materials on the lines.	Packaging waste contributes to the major waste on the lines.	Raw material and packaging waste information are differentiated to track line losses.	Managers have information on waste volumes generated.	Managers have complete cost information on waste management strategies.	Managers have information on the cost implication of the volumes generated.	There is an accurate account for the material consumed.	There is an accurate account for line losses.	Root causes of waste generated are investigated.	Information is freely shared in the production unit.	Staff training sessions are conducted regularly.
Spearman's	There is a production planning warehouse inventory management.	Correlation Coefficient	1.000														
		Sig. (2-tailed)															
		N	45														
	There is an increase in packaging material consumed on production line 1.	Correlation Coefficient	.439**	1.000													
		Sig. (2-tailed)	.003														
		N	45	45													
	There is an increase in packaging material consumed on production line 3.	Correlation Coefficient	.242	.242	1.000												
		Sig. (2-tailed)	.109	.110													
		N	45	45	45												
	Production line performance is regularly evaluated.	Correlation Coefficient	.095	.088	.122	1.000											
		Sig. (2-tailed)	.536	.565	.426												
		N	45	45	45	45											
	There is consistency in the recording of packaging materials on the lines.	Correlation Coefficient	-.178	-.022	.152	.365*	1.000										
		Sig. (2-tailed)	.242	.884	.319	.014											
		N	45	45	45	45	45										
	Packaging waste contributes to the major waste on the lines.	Correlation Coefficient	.120	-.006	-.042	.107	.220	1.000									
		Sig. (2-tailed)	.434	.967	.783	.485	.147										
		N	45	45	45	45	45	45									
	Raw material and packaging waste information are differentiated to track line losses.	Correlation Coefficient	.010	.268	.149	.084	.249	.051	1.000								
		Sig. (2-tailed)	.950	.076	.329	.585	.099	.741									
		N	45	45	45	45	45	45	45								
	Managers have information on waste volumes generated.	Correlation Coefficient	.187	.455**	.040	.053	.191	.232	.286	1.000							
		Sig. (2-tailed)	.218	.002	.793	.732	.209	.125	.057								
		N	45	45	45	45	45	45	45	45							
	Managers have complete cost information on waste management strategies.	Correlation Coefficient	.099	-.017	-.001	.026	.167	.160	.109	.184	1.000						
		Sig. (2-tailed)	.520	.910	.995	.864	.273	.294	.476	.226							
		N	45	45	45	45	45	45	45	45	45						
	Managers have information on the cost implication of the volumes generated	Correlation Coefficient	.355*	.296*	.098	.223	-.029	.138	.223	.421**	.398**	1.000					
		Sig. (2-tailed)	.017	.048	.521	.140	.851	.368	.142	.004	.007						
		N	45	45	45	45	45	45	45	45	45	45					
	There is an accurate account for the material consumed.	Correlation Coefficient	-.072	.141	-.036	-.060	.389**	.106	.339*	.150	.547**	.327*	1.000				
		Sig. (2-tailed)	.638	.355	.814	.696	.008	.489	.023	.326	.000	.028					
		N	45	45	45	45	45	45	45	45	45	45	45				
	There is an accurate account for line losses.	Correlation Coefficient	.050	.201	.092	.180	.496**	.169	.374*	.229	.279	.261	.690**	1.000			
		Sig. (2-tailed)	.747	.185	.547	.236	.001	.268	.011	.130	.064	.083	.000				
		N	45	45	45	45	45	45	45	45	45	45	45	45			
	Root causes of waste generated are investigated.	Correlation Coefficient	-.071	.123	-.116	.216	.303*	.134	.273	.247	.193	.249	.371*	.535**	1.000		
		Sig. (2-tailed)	.644	.422	.448	.154	.043	.380	.070	.102	.204	.099	.012	.000			
		N	45	45	45	45	45	45	45	45	45	45	45	45	45		
	Information is freely shared in the production unit.	Correlation Coefficient	-.075	.027	-.298*	-.127	.084	-.025	.304*	.260	.004	.027	.113	.245	.452**	1.000	
		Sig. (2-tailed)	.623	.861	.047	.404	.583	.871	.043	.085	.980	.863	.462	.104	.002		
		N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	
	Staff training sessions are conducted regularly.	Correlation Coefficient	-.130	-.138	-.064	.035	.202	-.066	.076	.084	.091	.051	.231	.337*	.262	.487**	1.000
		Sig. (2-tailed)	.396	.366	.675	.820	.182	.667	.619	.583	.550	.739	.128	.024	.082	.001	
		N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
	Quality of process is evaluated.	Correlation Coefficient	.090	-.042	-.055	.237	.327*	-.047	.152	.140	.146	.267	.216	.232	.256	.270	.452**
		Sig. (2-tailed)	.555	.785	.720	.117	.028	.759	.318	.359	.339	.077	.153	.125	.090	.072	.002
		N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
	Machines are regularly serviced.	Correlation Coefficient	.167	.031	.002	.045	-.007	-.270	-.250	.061	-.027	.018	-.114	0.000	.080	.252	.293
		Sig. (2-tailed)	.274	.842	.989	.768	.964	.073	.097	.691	.861	.906	.456	1.000	.602	.095	.051
		N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
	Process performance is regularly evaluated.	Correlation Coefficient	.358*	.062	.042	.132	-.113	-.098	.007	.051	.064	.323*	.158	.075	.130	.174	.129
		Sig. (2-tailed)	.016	.684	.782	.388	.459	.523	.962	.740	.678	.031	.301	.624	.395	.253	.398
		N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
	Staff members with more years of experience are more accurate on the lines.	Correlation Coefficient	-.016	-.021	.089	-.087	-.115	.258	.165	-.061	.258	.037	.156	.094	.093	.061	.034
		Sig. (2-tailed)	.918	.890	.562	.572	.451	.087	.279	.692	.087	.810	.306	.540	.545	.690	.827
		N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
	Staff members with higher qualifications are relatively more efficient on the lines.	Correlation Coefficient	.299*	.017	.180	.255	.070	.107	.037	-.186	.236	.325*	.041	.027	.197	-.129	-.201
		Sig. (2-tailed)	.046	.911	.236	.091	.650	.484	.809	.221	.118	.030	.791	.862	.195	.400	.185
		N	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45