AN INTEGRATED FRAMEWORK OF ENVIRONMENTAL MANAGEMENT ACCOUNTING PRACTICES TO PROMOTE GREENER GOLD MINING IN ZIMBABWE

By

MOSES NYAKUWANIKA

Submitted in accordance with the requirements for the degree of

DOCTOR OF PHILOSOPHY IN ACCOUNTING SCIENCES

in the subject

MANAGEMENT ACCOUNTING

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: PROF HM VAN DER POLL

CO-SUPERVISOR: PROF JA VAN DER POLL

2022

DECLARATION

Student no.: 43136605

I, Moses Nyakuwanika, declare that **AN INTEGRATED FRAMEWORK OF ENVIRONMENTAL MANAGEMENT ACCOUNTING PRACTICES TO PROMOTE GREENER GOLD MINING IN ZIMBABWE** *is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.*

I further declare that I submitted the thesis to originality-checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

SIGNATURE  **DATE** 10 March 2022

DEDICATION

Completing this study is dedicated to God, the creator of heaven and earth, who gave me the life and power to do this study. The success of this study is also dedicated to my late parents (Mr Nyakuwanikwa John Revai and Mrs Nyakuwanika Monica) for raising me to be a God-fearing person.

I also dedicate this study to my kids and wife: Immaculate, Moses Jnr, Abraham-Nyasha, Nathaniel-Kuitakwashe, and Memory.

This study is also dedicated to future researchers and may thus provide the bridge for future research and engagements.

ACKNOWLEDGEMENTS

I want to take this chance to express my sincere gratitude and appreciation to all those who assisted me in this work.

I am deeply indebted to my supervisors: Professor Huibrecht Margaretha van der Poll and Professor John Andrew van der Poll.

I also thank Professor JA van der Poll, who funded this partly from his Research Professor fund. I also want to thank Great Zimbabwe University for the support granting me special leave to travel and meet with my supervisors.

I would also like to thank the mining companies that participated in the study: Freda Rebecca Gold Mine, Brompton Gold Mine, Magnesite Mine, Mrasta Gold Mine and Birdgreen Gold Mine.

ABSTRACT

Although the Zimbabwean gold mining industry has been praised for its positive contributions to economic growth, it has also come under fire for harming local communities through forced evictions and forced relocation of communities without providing adequate compensation, pollution of water and air, loss of grazing and agricultural land, the creation of unprotected pits, and exploitation and depletion of natural resources. The literature has identified material flow cost accounting (MFCA), life cycle costing (LCC) and activity-based costing (ABC) as essential environmental management accounting practices (EMAPs) to manage the environment. The EMAPs tend to be discussed in isolation hence the need to integrate them. Current frameworks fail to direct sustainability in organisations, opening calls for new approaches that integrate sustainability into business processes. The study was motivated by a lack of studies on the importance of EMAPs, noted in developing countries. Due to the existing frameworks' failure to address environmental challenges, practical means and techniques for businesses to integrate, measure and communicate environmental issues remain challenging. Existing frameworks have been observed as lacking industry scale, besides failing to describe how to achieve the integration of sustainability. Research questions and research objectives were developed from the problem statement. Institutional, stakeholder and sustainability theories were identified as providing the lens for the study. Institutional theory (major theory underpinning study) provides that forces around them shape organisations to adopt greener initiatives. A multi-method qualitative research choice was made for the study.

After a comprehensive literature review, a preliminary framework of environmental management accounting practices to promote green gold mining in Zimbabwe was developed. The preliminary framework was enhanced by conducting personal interviews and later validated through a focus group. Findings revealed that coercive pressure was mostly applied by the environmental regulator and that gold mining activities negatively impacted the environment. In addition, gold mining companies failed to import green technology equipment due to excessive tax rates charged by the Zimbabwean Revenue Authority (ZIMRA). Key recommendations are that small gold mines should continually be monitored, and ZIMRA should reduce its tax rates to reduce the cost for gold mining organisations to import green technology. The study contributed to the body of knowledge and practice by developing an integrated

framework for the Zimbabwean gold mining sector as a guide to greener gold mining and to theory (the integrated framework will work as a formal rule to be followed by entities). Similar work focusing on mining sectors like coal, platinum and chrome could be undertaken in Zimbabwe.

Keywords: Activity-based costing, cost optimisation, cost savings, environmental management accounting practices, gold mining, life cycle costing, material flow cost accounting, stakeholder pressure

OKUCASHUNIWE

Nanxa imboni yezokumbiwa kwegolide eZimbabwe inconywe ngeqhaza layo elihle ekukhuliseni umnotho, iphinde yagxekwa ngokulimaza imiphakathi yasendaweni ngokuxoshwa ngendluzula kanye nokufuduswa kwemiphakathi ngaphandle kokunikeza isinxephezelo esanele, ukungcoliswa kwamanzi nomoya, ukulahlekelwa amadlelo kanye nomhlaba wezolimo, ukwakhiwa kwemigodi engavikelekile, nokuxhashazwa kanye nokuqedwa kwemithombo yemvelo. Izincwadi zihlonze ukubalwa kwezindleko zokugeleza kwezinto (MFCA), izindleko zomjikelezo wokuphila (LCC) kanye nezindleko ezisekelwe kumsebenzi (ABC) njengezinqubo zokubala zokuphathwa kwemvelo ezibalulekile (EMAPs) zokuphatha imvelo. Ama-EMAP avame ukuxoxwa ngawo wodwa yingakho kunesidingo sokuwahlanganisa. Izinhlaka zamanje ziyehluleka ukuqondisa ukusimama ezinhlanganweni, ukuvula izingcingo zezindlela ezintsha ezihlanganisa ukusimama ezinqubeni zebhizinisi. Ucwaningo lugqugquzelwe ukuntuleka kwezifundo ngokubaluleka kwama-EMAP, okuphawulwe emazweni asathuthuka. Ngenxa yokwehluleka kwezinhlaka ezikhona ukubhekana nezinselele zezemvelo, izindlela ezingokoqobo namasu okudidiyela amabhizinisi, ukulinganisa kanye nokuxhumana ngezindaba zemvelo kusalokhu kuyinselele. Izinhlaka ezikhona zibonwe njengezintula izinga lemboni, ngaphandle kokwehluleka ukuchaza indlela yokufeza ukuhlanganiswa kokusimama.

Imibuzo yocwaningo nezinjongo zocwaningo zakhiwe kusukela esitatimendeni senkinga. Izindlela zokuqonda izinhlangano kanye nezinqubo zokuphatha, ababambiqhaza kanye nokusimama zihlonzwe njengezinikeza ithuluzi lomcwaningi lokubuka ucwaningo. Indlela yokuqonda izinhlangano kanye nezinqubo zokuphatha (Umbono omkhulu osekela ucwaningo) ihlinzeka ngokuthi amandla okubazungezile alolonge izinhlangano ukuthi zithole inqubo ephelele yokuphatha imvelo. Kwakhethwa ucwaningo lokuchaza lwezindlela eziningi kulolu cwaningo. Ngemva kokuhlolwa okupheleleyo kwezincwadi, kwasungulwa uhlaka lokuqala lwendlela yokuphathwa kwemvelo ukuze kuthuthukiswe ukumbiwa kwegolide eliluhlaza eZimbabwe. Uhlaka lokuqala lwathuthukiswa ngokwenza inhlolokhono yomuntu siqu futhi kamuva lwaqinisekiswa ngeqembu okugxilwe kulo. Okutholakele kuveze ukuthi ingcindezi ephoqayo yayisetshenziswa kakhulu umlawuli wezemvelo nokuthi imisebenzi yokumba igolide ibe nomthelela omubi kumvelo. Phezu kwalokho, izinkampani ezemba igolide zehlulekile ukuthenga kwamanye amazwe ubuchwepheshe

bezemvelo ngenxa yokukhokhwa kwemithelo eyeqisayo ebizwe Yisiphathimandla Semali Engenayo yaseZimbabwe (ZIMRA). Iziphakamiso ezisemqoka ngezokuthi imigodi emincane yegolide kumele ihlale igadiwe, futhi iZIMRA kumele yehlise imithelo ukuze yehlise izindleko zezinhlangano ezemba igolide ukuthi zithenge kwamanye amazwe ubuchwepheshe bezemvelo.

Ucwaningo lufake isandla kumgwamanda wolwazi nokuzejwayeza ngokwenza uhlaka oludidiyelwe lwemboni yezezimayini zegolide zaseZimbabwe njengomhlahlandlela wokumbiwa kwegolide eliluhlaza kanye nombono (uhlaka oludidiyelwe luzosebenza njengomthetho osemthethweni okufanele ulandelwe yizinhlangano). Umsebenzi ofanayo ogxile emikhakheni yezimayini efana namalahle, i*platinum* kanye ne*chrome* ungenziwa eZimbabwe.

Amagama asemqoka: Izindleko ezisekelwe emsebenzini **(Activity-based costing)**, ukwenza ngcono izindleko **(cost optimisation)**, ukonga izindleko **(cost savings)**, izinqubo zokubala zokuphathwa kwemvelo **(environmental management accounting practices),** ukumba igolide **(gold mining)**, izindleko zomjikelezo wempilo **(life cycle costing)**, ukubalwa kwezindleko zokugeleza kwezinto **(material flow cost accounting)**, ingcindezi yabambiqhaza **(stakeholder pressure)**

OPSOMMING

Alhoewel die Zimbabwiese goudmynbedryf opgehemel is vir sy positiewe bydrae tot ekonomiese groei, het die bedryf ook onder skoot gekom vir sy skade aan plaaslike gemeenskappe deur die gedwonge uitsettings en hervestiging van gemeenskappe sonder voldoende vergoeding, water- en lugbesoedeling, verlies aan beweiding en landbougrond, die skep van onbeskermde skagte, en die uitbuiting en uitputting van natuurlike hulpbronne. Die literatuurstudie het wesenlike vloeikosteberekening (*MFCA*), lewensikluskosteberekening (*LCC*) en aktiwiteitsgebaseerde kosteberekening (*ABC*) as essensiële omgewingsbestuur rekeningkundige praktyke (*EMAPs*) geïdentifiseer om die omgewing te bestuur. Aangesien die neiging is om *EMAPs* in isolasie te gebruik, is daar ’n behoefte om hulle te integreer. Huidige raamwerke slaag nie daarin om volhoubaarheid in organisasies te bestuur nie, wat die geleentheid skep vir ’n oproep tot nuwe benaderings wat volhoubaarheid met besigheidsprosesse integreer. Die beweegrede vir die studie is die gebrek aan navorsing (wat in ontwikkelende lande bespeur is) oor die belangrikheid van *EMAPs*. As gevolg van die bestaande raamwerke se onvermoë om omgewingsuitdagings te hanteer, bly praktiese metodes en tegnieke om omgewingskwessies te integreer, meet, en kommunikeer steeds ’n uitdaging vir besighede. Afgesien dat hulle misluk het om ’n beskrywing te gee van hoe om die integrasie van volhoubaarheid te verwerf, is dit duidelik dat bestaande raamwerke nie op industriële skaal is nie. Die probleemstelling is gebruik om navorsingsvrae en navorsingsdoelwitte te ontwikkel. Institusionele, belanghebber- en volhoubaarheidsteorieë is geïdentifiseer as synde ’n lens vir die studie te verskaf. Volgens die institusionele teorie (hoofteorie wat die studie steun), is dit magte buite organisasies wat bepalend is in organisasies se aanneem van groener inisiatiewe. Die studie het multi-metode, kwalitatiewe navorsing gebruik.

Na ’n omvattende literatuuroorsig, is ’n voorlopige raamwerk vir omgewingsbestuur rekeningkundige praktyke vir die bevordering van groen goudmynwese in Zimbabwe ontwikkel. Hierdie voorlopige raamwerk is versterk deur persoonlike onderhoude wat gevoer is en is later deur ’n fokusgroep bekragtig. Die bevindinge het aan die lig gebring dat die omgewingsbeheerraad grotendeels dwang toegepas het en dat goudmynbedryfaktiwiteite die omgewing negatief affekteer. Daar is bykomend ook gevind dat maatskappye wat in die goudmynbedryf betrokke is, in gebreke gebly het om groentegnologie-toerusting in te voer as gevolg van die buitensporige belasting

wat deur die Zimbabwean Revenue Authority (ZIMRA) gehef word. Die vernaamste aanbevelings is dat klein goudmyne deurlopend gemonitor moet word en dat ZIMRA sy belastingkoerse moet verlaag om goudmynorganisies se koste vir die invoer van groentegnologie te verminder. Die studie het tot die breë kennisbasis en praktyk bygedra deur ’n geïntegreerde raamwerk vir die Zimbabwiese goudmynsektor as riglyn tot groener goudmynwese, sowel as teorie te ontwikkel (die geïntegreerde raamwerk sal as formele reël dien wat deur entiteite gevolg moet word). Soortgelyke ondersoeke wat op ander mynsektore soos steenkool, platinum en chroom fokus, kan in Zimbabwe onderneem word.

Sleutelwoorde: Aktiwiteitgebaseerde kosteberekening, koste-optimalisasie, kostebesparings, omgewingsbestuur rekeningkundige praktyke, goudmynwese, lewensikluskosteberekening, wesenlike vloeikosteberekening, belanghebberdruk

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

DEFINITIONS OF TERMS AND CONCEPTS

EMA is defined as "the identification, gathering, analysis, and use of two types of information for internal decision making: I physical information on the use, flows, and destinations of energy, water, and materials (including wastes) and ii) financial information on environment-related costs, earnings, and savings" (Jasch, 2009:13).

MFCA is “an instrument for measuring material flows and stockpiles in process or production lines in both physical and monetary units “(ISO Central Secretariat, 2011:3).

ABC is defined as a costing system that strongly emphasises accurately allocating overhead costs to products by connecting each activity cost pool to the cost objects through an activity driver that tracks activity consumption (Tsai *et al.*, 2015).

LCC evaluates the costs experienced by one or more actors across a product's life cycle, including externalities anticipated to be internalised in the decision-relevant future (Rebitzer and Nakamura, 2008).

Institutionalisation refers to "the procedure by which social commitments, obligations, or realities come to have a status resembling that of rules in social cognition and conduct" (Meyer and Rowan, 1977:41).

ACRONYMS

MFCA	Material Flow Cost Accounting
ABC	Activity-Based Costing
LCC	Life Cycle Costing
ZIMRA	Zimbabwe Revenue Authority
EMAPs	Environmental Management Accounting Practices
EMA	Environmental Management Accounting
UNEP	United Nations Environmental Programme
EMAg	Environmental Management Agency
LCA	Life Cycle Assessment
ELCC	Environmental Life Cycle Costing
GRI	Global Reporting Initiative
ICMM	International Council on Mining and Metals
ZELA	Zimbabwe Environmental Law Association
ZEMA	Zimbabwe Environmental Management Act
ISO	International Organisation for Standardization
IFAC	International Federation of Accountants
PEMA	Physical Environmental Management Accounting
MEMA	Monetary Environmental Management Accounting
TQM	Total Quality Management
AIS	Accounting Information System
CSR	Corporate Social Responsibility
SLO	Social Licence to Operate
CMA	Carbon Management Accounting
ABM	Activity-Based Management
TBL	Triple Bottom Line

CHAPTER 1: BACKGROUND TO THE STUDY

1.1 INTRODUCTION

Naturally, mining, if undertaken responsibly, can positively contribute to the economies of the host nations and the lives of such citizens (Stamp, 2015:14) since it calls for a balance of resource use and allocation. In Zimbabwe, the environment is managed through the Environmental Management Act (ZEMA) of 2002 (Rajah, Rajah & Jerie, 2012:408), designed to promote the sustainable management of Zimbabwe's natural and physical resources. However, weaknesses within the policy have made it challenging to achieve its objective, which has motivated the development of an integrated framework for the gold mining sector to promote and become greener through Environmental Management Accounting Practices (EMAPs).

The mining industry is capital intensive, which calls for conducting a cost-benefit analysis of the mining methods and aiding decision-makers to make the best decisions (Bazillier & Girard, 2020; Humphreys, 2020). Bazillier and Girard (2020) argue that it is essential to reconsider costing employed by mining organisations since a flawed costing approach may adversely impact decision-making. Traditional costing systems allocate overheads to products based on their relative usage to direct labour (Hilton & Platt, 2019), which has become outdated (Zamrud & Abu, 2020), resulting in inaccurate costing for product lines. According to Hilton and Platt (2019), apart from treating the technology cost as a period cost, the traditional costing system does not identify variable/avoidable costs. Hence, it is plausible to choose techniques that will assist in detecting financial viability whilst assigning correct costs to cost objects based on their usage.

The traditional cost calculation system the mining industry uses distributes indirect expenses randomly, which does not agree with the causality principle and can lead to erroneous decision-making (Boca & Sorina, 2015). Furthermore, traditional costing assumes that products rather than activities cause costs. As a result, the total cost of producing products ought to be divided among the products, which results in the cross-subsidisation of costs (Bazillier & Girard, 2020). Because costs are aggregated and divided without consideration for activities, traditional accounting systems have a key problem: they do not provide a suitable framework for finding necessary data (Vasile & Man, 2012; Messaaud & Mourad, 2021). The inappropriateness of traditional

management systems in providing adequate and relevant information to solve environmental issues has motivated the growth and importance of EMAPs (Vasile & Man, 2012). An integrated framework of EMAPs that identifies the relevant data needed to manage the environmental costs was developed to overcome this challenge.

There is a need for business tools that minimise the use of resources while supporting high productivity levels (Christ & Burritt, 2015:1378). The development of EMAPs during the 1990s as an integrated approach to an organisation's economic and environmental management offers a way to overcome the deficiencies of traditional management accounting, which failed to identify environmental information in particular (Godschalk, 2010; Fuzi *et al*., 2020). Organisations can access an information system through EMAPs highlighting quantitative and qualitative information about how their operations influence the environment (Appelbaum *et al*., 2017; Appiar, 2020). It can be argued that EMAPs that support high levels of production whilst reducing environmental impacts need to be integrated into the framework for a greener gold mining sector.

The study developed an integrated framework of EMAPs to promote green gold mining in Zimbabwe, thereby contributing to existing Environmental Management Accounting (EMA) literature. In addition, the developed framework could be used as a guideline for the gold mining sector in developing countries. An essential contribution of this study is that it can be used for reference in future research in other sectors of the economy and by policymakers when formulating policies to protect the environment.

1.1.1 The goal of the chapter

This chapter's main objective is to provide background information about the research subject under examination. In addition, a summary of the research technique is also provided in this chapter.

1.1.2 The layout of the chapter

Following the introduction to the study in section 1.1, the background of the research problem is presented in section 1.2, followed by the thesis statement in section 1.3. The problem statement is defined in section 1.4. Section 1.5 presents the research questions, followed by the research objectives in section 1.6. The significance of the

study is discussed in section 1.7. A brief explanation of the research methodology in section 1.8 follows this. Section 1.9 with the structure of the thesis. The chapter concludes with a summary of the study in section 1.10.

1.2 BACKGROUND TO THE RESEARCH PROBLEM

Concerns about businesses' environmental impacts are fast becoming important issues globally (Mokhtar, Jusoh and Zulkifli, 2015:111). Consequently, numerous organisations are incorporating aspects of the environment into their business strategies (Ernst & Young, 2013). Incorporating such environmental information into an organisation's business strategy may require EMAPs. To this end, conventional management accounting systems (MASs) have been claimed not to provide enough environmental information since it is treated as overheads or even hidden costs (Sari *et al*., 2021). For example, environmental costs in Zimbabwe are not adequately disclosed, and the only visible environmental costs in most financial statements that mining organisations produce are fines, while other costs are hidden (Muza & Magadi, 2014:2). Hence, a framework that addresses these challenges to the best knowledge of the researcher is lacking.

Manufacturing organisations are facing costs and complexity pressures created by the tightened environmental norms, and organisations are investing more in Research and Development (R&D) to develop products that can be of less or no harm to the natural environment (Mohr *et al.*, 2013). Because of pressure, organisations are moving forward, thinking beyond conventional functions and adopting green innovation, eco-production, and Green Supply Chain Management (GSCM), among other techniques, to develop and implement an environmental management strategy (Ar, 2012). This suggests a need for an integrated framework for the gold mining sector to become greener through EMAPs.

Calls by some scholars to change the manufacturing philosophy came as a result of environmental degradation caused by the economic activities of organisations (Pooe & Mhelembe, 2014:1). With environmental degradation expected to continue on the national and international stage, failure to collect data on the environmental impacts of business activities will result in insufficient information to serve the needs of decision-makers in a dynamic marketplace (Latan *et al*., 2018). Hence, developing a planned integrated framework may assist in collecting information that may help to

prevent environmental degradation.

During the past few decades, environmental issues have risen due to global incidents like the Bhopal chemical leak and the Exxon Valdez oil spill of 1989, which received global media attention (Kamruzzaman, 2012:2; Tran *et al.*, 2020). These authors have further stated that these incidents have caused the public, NGOs, and governments to pressure organisations to be environmentally responsible. Pressure to reconsider behaviour towards the environment stems from governmental regulations, international agreements, various stakeholders and society (Papaspyropoulos *et al.*, 2012:132). Furthermore, such pressure started in the early 1970s (Gray, 2001), which increased after the Rio de Janeiro Earth Summit in 1992 (Etzion, 2007). This resulted in the introduction of corporate environmental accounting methodologies like EMAPs and sustainability reporting (Jasch, 2009; Burritt *et al.*, 2011), the setting up of guidelines for environmental reporting (Global Reporting Initiative [GRI], 2016; Department of Environment Food & Rural Affairs [DEFRA], 2019), and the relevant applications (Burritt, Herzig & Tadeo, 2009). Subsequently, the need arose for an integrated framework for the gold mining sector to become greener through EMAPs.

1.2.1 Impacts of mining on the environment

Mineral commodities are in high demand worldwide, leading to significant economic activities globally. Some of these are mining (Oliveira, Camanho & Zanella, 2017:2364), which, unlike agriculture, has to take place where the minerals are available (Sengupta, 2021). The stages of industrial mining are set out in Table 1.1.

Table 1.1: Stages of industrial mining

Stage	Period
Ore prospection	2–3 years
Exploration	2–5 years
Development	2–5 years
Exploitation or production	10–30 years
Reclamation	1–10 years

Each of the stages in Table 1.1 has a substantial impact on the environment (Wang *et al*., 2020). Metal mining in Latin America has resulted in social and environmental

conflicts (Jaskoski, 2012). Bad governance practices (Murombo, 2013; Liao, 2019), impacts and benefits as well as inequitable distribution of risk (Kemp *et al.*, 2011), and cultural contexts (Rizvi & Gary, 2020) are some of the factors that have contributed towards conflicts. This suggests that managing the environmental impacts and costs through integrating EMAPs may be one way of solving conflicts.

Gold mining (also practised in Zimbabwe) contributed over US$171.6 billion to the global economy in 2013. Yet the socio-economic impacts of (in particular) gold mining on the host nations are poorly understood (Stamp, 2015:14). Despite the economic advantages of mining for communities, risks of the depletion of the land's natural resources throughout the Southern African Development Community (SADC) have affected the health and safety of the surrounding communities (Cronje, Reyneke & van Wyk, 2013:1; Kumar & Nikhil, 2014). It is argued that mining organisations contribute to social development through job provision, tax payments, industry building, and technology transfer (Cronje *et al.*, 2013). However, Jenkins and Cronje *et al.* add that they are also linked to interference with sovereign affairs, poor conditions for labour, corruption, transfer pricing, pollution, shortcomings regarding health and safety and disregard for human rights. Therefore, the integration of EMAPs into a framework may provide a balance to the benefits received from mining activities and sustainability for future generations.

The socioeconomic impact of mining is significant for local communities in many mining countries (Stamp, 2015:14). Environmental exposure to air, soil, water and noise pollution has adverse effects on the community (Kumar & Nikhil, 2014), while non-environmental exposure and events like mining disasters, pit closures, migration and poverty do also affect mining communities (Cronje *et al.*, 2013:3). Environmental degradation is of significant concern to governments, societies and business organisations in the world (Peprah, Opoku-Fofie & Nduro, 2016:32).

Environmental degradation heightens risks and reduces opportunities for advancing human well-being, especially among the poor and vulnerable (United Nations Environment Programme [UNEP], 2012). Destructive environmental transformations occur in a progressively more globalised, industrialised and interconnected world, with a growing global population and unsustainable production and consumption patterns (Peprah *et al.*, 2016). Organisations are the source of most environmental problems (Rozar *et al.*, 2015). Therefore, it is plausible that the socio-economic damage done

by mining activities could be minimised with an integrated framework.

The mining and processing industry in Zimbabwe is complex since it involves different operations and situations. There are artisanal miners and alluvial panners, besides large-scale mechanised miners, all affecting the environment negatively (Dzidzornu, 2011; Manzungu, 2012; Arthur, 2014). The authors also point out that Zimbabwe's mining industry contributes to environmental degradation by ignoring environmental protection laws and exploiting their gaps and flaws. Even though businesses are aware of environmental standards, some believe that doing so drives up production costs, rendering some projects unprofitable. The Zimbabwe Environmental Management Act (ZEMA) requires organisations to conduct environmental impact assessments (EIAs). However, law enforcement is lax, and the Environmental Management Agency (EMAg), the watchdog supposed to enforce the law, has been affected by a lack of resources, making monitoring and ensuring compliance almost impossible. In contrast, those organisations that carried out EIAs have done it merely to satisfy the legal requirements (Poverty Reduction Forum Trust [PRFT] & Zimbabwe Environmental Law Association [ZELA], 2012:19). Therefore, having an integrated framework for the gold mining sector may assist in reducing incidents of manipulation since it ought to compel the mining sector to comply with a set of standards.

Due to outdated regulations and inconsistent policies, the mining industry is plagued with corruption. It supports domestic and international organisations' theft of mineral resources (Centre for Research and Development [CRD], 2014). Even though there is a new draft Mines and Mineral Act, the current Mines and Mineral Act of 1961, enacted during the colonial era, is the weakest link and hinders economic development since it is oriented towards mineral resource exploitation with little or no regard to sustainability development. Moreover, the act does not promote access to information, transparency, accountability, value addition and beneficiation and does not acknowledge the role that can be played by some other key stakeholders like civil society organisations and the community (Dhliwayo, 2014:6). A framework to promote transparency, access to information and above all environmental accountabilities might alleviate some of these challenges.

1.2.2 Environmental management accounting practices (EMAPs)

Environmental disasters led to calls for organisations within the global village to pay

attention to environmental issues (Lee, 2011). Adopting environmentally friendly practices has become essential to the operations of organisations (Tran *et al.*, 2020:941). Environmental responsibility is not only a way to improve an organisation's image, however: it is also a way to attract Foreign Direct Investment (FDI) and a criterion taken into consideration by stakeholders (Lee, 2020). Environmental responsibility, part of Corporate Social Responsibility (CSR), has been observed to communicate between an organisation and its stakeholders. It has been noted that environmentally responsible organisations tend to obtain unsecured loans (Yoon& Lee, 2019; Chen *et al.*, 2020).

EMAPs help organisations measure their business's environmental impact and allocate related costs and earnings/savings gained from environmental activities (Javed *et al*., 2022). EMA is a relatively new branch of accounting (Mokhtar *et al.*, 2015:112), and there have not been many implementations in emerging and developing economies (Herzig *et al.*, 2012). Therefore, an integrated framework for the gold mining sector through EMAPs may assist mining organisations in measuring the environmental impacts of their activities and be able to allocate relevant costs to mining activities for decision-making.

EMAPs have been observed to be essential in addressing negative ecological burdens from the production processes (Christine *et al.*, 2019:458). EMAPs have gradationally been examined and used as a management tool to deal with environmental burdens and orthodox practices (Qian, Burritt & Monroe, 2018). EMAPs have been recognised to be key in encouraging environmental redress and enhancing organisational responsiveness (Schaltegger, 2018). In addition, EMAPs have been argued to have the potential to assist management by providing information that should address the environmental impacts of organisational activities (Tran *et al.*, 2020). EMAPs, such as Material Flow Cost Accounting (MFCA), Life Cycle Costing (LCC), Activity Based Accounting (ABC), the Sustainability Balanced Scorecard (SBSC), and carbon accounting, have been found by a number of academics to be crucial for determining how an organization affects ecological conditions (Jasch, 2009; Henri & Journeault, 2018; Lu *et al.*, 2018; Nouri, Nikabadi & Olfat, 2019). Even though all the identified EMAPs are good and have proven results, this research only used MFCA, LCC and ABC in the integrated framework. These are discussed and justified in the following paragraphs.

1.2.3 Material flow cost accounting (MFCA)

MFCA is defined as a “tool for quantifying the flows and stocks of materials in processes or production lines in both physical and monetary units” (ISO Central Secretariat, 2011:15). By visualising material flows with their associated costs and internalised environmental repercussions, MFCA is particularly ideal for enhancing resource efficiency since it contributes to increased transparency (Rieckhof, Bergmann & Guenther, 2015:1263), which motivated its adoption. Jasch (2009) states that organisations can identify inefficiencies and hidden costs, thereby minimising wastage and improving environmental and financial performance. The author adds that material flows are essential in that they reflect the direct environmental impacts of organisations and decrease production costs, thereby increasing corporate financial performance. The emphasis on enhancing resource efficiency and value generation is an additional advantage over conventional cost accounting techniques (Rieckhof *et al.*, 2015:1263). The knowledge generated by MFCA can catalyse organisations and managers looking for ways to simultaneously generate advantages by increasing material efficiency while concurrently lowering material prices and negative environmental impacts (Kokubu, Kitada & Mouritsen, 2012:3). A decrease in access to numerous resources and rising costs of handling, storing, and disposing of waste led to a demand for improved material efficiency (Rohn, Lettenmeier & Pastewski, 2011). It has been concluded that material usage accounts for 40–80% of the overall expenditure in the manufacturing sector (Jiang & Ma, 2020). Hence, a tool dealing with material management like MFCA may need to be considered within the gold mining sector to improve material efficiency.

With the rising demand to increase productivity and decrease environmental impact, organisations need tools that will assist in accounting for all inputs and outputs that encourage environmentally friendly choices while enhancing economic and environmental performance (Kokubu & Tachikawa, 2013:351). Furthermore, MFCA may assist organisations from developing countries to move into the competitive global village, emphasising rigorous environmental management to control the use of resources and prove their commitment to economic and environmental competence (Christ & Burritt, 2015:1384). Therefore, MFCA may apply to a developing country like Zimbabwe and might assist in improving the efficiency and positioning of the gold mining sector to be competitive in the global village.

1.2.4 Activity-based costing (ABC)

The ABC method, developed by Cooper and Kaplan, looks at actions pertinent to manufacturing a product to identify profitable goods, worthwhile clients, processes with or without value additions, and areas needing improvement (Weygandt *et al*., 2020). By eliminating biases in the conventional cost accounting method, ABC offers more accurate costing measurements for decision-making (Cooper & Kaplan, 1998a). ABC shifts management's attention away from the customary short-term planning, control, decision-making, and product costing to a more strategic, integrated, and competitive method of looking at internal structures (Hansen *et al*., 2021), which motivated its adoption. Information obtained from ABC has been used for environmental management (Emblemsvag & Bras, 2012; Jimenez *et al*., 2020), hence the need to have it within the integrated framework. Unlike traditional costing, ABC assigns costs to many cost pools representing the most significant activities in the production process, resulting in identifying cost drivers suitable for each cost. Costs are assigned from activity pools to each production job in proportion to the amount of activity used up by that activity (Alsayegh, 2020). ABC, therefore, assigns costs to cost objects based on activity drivers that accurately measure activity consumption. Mining is naturally capital intensive, and ABC was selected since it offers more accurate costing measurement, which is essential for decision-making.

1.2.5 Life cycle cost (LCC)

Lifecycle assessment (LCA) is one of the EMAPs used to identify and quantify the environmental impacts of goods and services during their entire life cycle – the “cradle to grave” approach. Since it does not consider financial aspects, LCC should be implemented to encompass both environmental and economic aspects; since LCC can create a cost-effective model for predicted environmental impact (Kulczycka & Smol, 2016). LCA is a standardised methodology to identify, quantify and evaluate Ecological LCA is used to identify the influence of the product thoroughly and meticulously on the natural environment during its life cycle. However, it should be supplemented with cost analysis (LCC) to determine the relationship between the potential product’s influence on the environment and related costs (Biernacki, 2015:305). Biernacki considers LCC outdated and introduces environmental life cycle costing (ELCC) as an improvement, which introduces environmental cost into the

analysis. ELCC also analyses costs from the consumer side (waste disposal).

Compared with LCC, it does consider economic costs enlarged by external costs, which may potentially arise in the future (Miah *et al*., 2017). Biernacki (2015:308) argues that ELCC should not be treated as an independent practice but as an LCA supplementation. Biernacki defines ELCC as the sum of costs incurred when designing, building, producing, transporting, and using articles until the end of stockpiling, market usage and reprocessing. LCC was selected because of its ability to trace environmental costs of a mine during its entire life which could help in decision-making.

The knowledge of integrating MFCA, ABC, and LCC in practice is still lacking despite the arguments made in the previous sections. This study's goal is to summarise how various EMAPs might be combined to reduce expenses and the environmental impact.

1.2.6 Integration of techniques and methods

Owing to the GRI, which provides standards of reporting on environmental, social and economic performance in the context of sustainability (Northey, Haque & Mudd, 2013:119), and following various standards and protocols, some organisations within the mining sector are becoming more and more transparent in releasing information related to their interaction with the environment (Perez & Sanchez, 2009). In addition, environmental disasters such as the toxic gas leak at a chemical plant in Bhopal which killed 3,500 people in 1984; the Exxon Valdez oil spill in the Gulf of Alaska in 1989; and the 1986 accident at the Chornobyl nuclear plant in Ukraine, and the vast amounts of new information about global warming and ozone depletion, have shifted the global investment community’s attention to environmental concerns (Viviers, Venter & Krüger, 2012). Therefore, responding to global pressure and working towards environmental sustainability may enhance a country’s image in the global village.

Since the early 1990s, when the mining industry started to show an increasing interest in social and environmental issues, organisations have been including sustainable development in their agendas (Agbedahin, 2019) and identifying methods for integrating sustainability challenges into their primary business practices (CiCi & D'Isanto, 2017; Stanitsas *et al*., 2021). Various initiatives nationally and internationally have resulted in the development of frameworks, for example, the European Union framework, which promotes four (4) pillars as priorities: environmental protection;

economic issues; social performance and employment; and research and technological development (European Union [EU], 2007). The Mining Association of Canada's commitment to responsible mining, Towards Sustainable Mining (TSM) (Mining Association on Canada [MAC], 2021), aims to enhance the sector's reputation by improving its environmental, social and economic performance while the International Council on Mining and Metals' (ICMM) framework promotes basic principles of good practice, ethical management and sustainable development (International Council on Mining and Metals [ICMM], 2022).

Calls to integrate environmental issues into the production process of an organisation (Biesbroek, 2021; Montesano *et al*., 2021) have been made by several researchers (Seuring & Müller, 2008; Molina-Azorín *et al.*, 2009; Sarkis, Zhu & Lai, 2011; Gimenez & Tachizawa, 2012). However, it has been noted that key stakeholders like the government, NGOs and partners have not been included in an integrated framework (Wong, Yip & Mok, 2014). It has been argued that the best results are achieved by combining results from different forecasting methods (Qian *et al*., 2022). The researcher, therefore, advocates the integration of MFCA, ABC and LCC. The premise that both physical and monetary data should be discovered about a company's capacity to decrease waste while simultaneously enhancing resource efficiency, environmental performance, and economic performance has inspired research into implementing MFCA (Jasch, 2009). ABC is particularly relevant to the environment since it produces more relevant cost information traced to products through activities based on the drivers of such costs (Tsai *et al.*, 2011). LCC considers operational costs and investment expenses over the product's expected lifetime since it adopts a broad view of the lifecycle (Kambanou, 2020). Hence, it is plausible that through integration, one tool might work on managing material costs, and another would assign relevant costs. At the same time, another considers investment costs, thereby promoting greening within the gold mining sector.

Institutional, stakeholder and sustainability theories are selected as the theoretical lens to help view and foster green gold mining in Zimbabwe. The theories are analysed through the literature review, resulting in the development of some propositions used in developing the conceptual framework. In addition, the theories are examined qualitatively through in-depth interviews and focus group discussions, making the study unique in terms of an organised methodology which combines theory and

context.

1.3 THESIS STATEMENT

Poor EMA governance practices in the gold mining sector in developing economies have resulted in hazardous mining practices with much ecological damage. Gold mining activities have exposed communities to environmental degradation, water pollution, forced dislocation, and loss of livelihoods.

1.4 PROBLEM STATEMENT

Researchers have identified MFCA, LCC and ABC as essential EMAPs to manage the environment. However, it has been observed that there is a lack of studies on the significance of EMAPs in developing countries (Jamil *et al*., 2015; Asiri *et al*., 2020; Tran *et al*., 2020). Furthermore, it has been reported that the practical means and techniques for businesses to integrate, measure, communicate and improve sustainability remain challenging (Lozano, 2015; Tseng *et al*., 2021). Current methods and frameworks are falling short in driving and directing organisational sustainability (Hahn, 2013; Bibri, 2019). In addition, existing approaches lack industry scale (Reefke and Sundaram, 2017), and there is ambiguity associated with definition and sustainability within organisations (Morioka & Calvalho, 2016; Pedersen *et al.*, 2018). Therefore, this calls for a new holistic management approach to integrate sustainability into the manufacturing industry (Lozano, 2015; Reefke & Sundaram, 2017).

If environmental issues are not appropriately addressed, the reputation of a business in a market can be damaged; qualitative research is essential for analysing environmental management accounting issues (Kamruzzaman, 2012; Wu *et al.*, 2018). Without placing them within the larger context of the many conditions and requirements of phases in the evolution of environmental management, EMAPs have been established. They are being debated in isolation (Gunarathne, 2015:310). The author contends that an integrated framework is required since the current literature fails to acknowledge the impact of environmental management accounting in the context of information management on the progression of environmental management stages. The current body of research regarding EMAPs, and environmental phases is insufficient.

Additionally, there are claims that corporate environmental management plans and EMAPs have not been fully and methodically implemented (Lee, 2011; Gunarathne & Lee, 2015). A structured approach to environmental management could give businesses a competitive edge because current methods are mostly fragmented and have been established periodically in response to numerous internal and external influences (Gunarathne, 2015:311). To support an organisation's environmental mission, it is necessary to implement EMAPs holistically (Battistoni *et al*., 2019).

None of the previous researchers has presented the info-logical and data-logical structures necessary to integrate EMAPs, especially in general organisational information systems (Stout & Propri, 2011; Calabrese *et al.*, 2019). The compartmentalised approach followed by empirical research has proved to be an obstacle to essential progress in accounting for sustainability (Nielsen *et al*., 2016; Argento *et al*., 2020). Maas, Schaltegger and Crutzen (2016:237) argue that the tendency to deal with the broad role of accounting and reporting for sustainability in general and focus on only specific practices like MFCA has proved to be an obstacle to achieving sustainability. A research gap has therefore opened up on how to develop and implement an integrated framework (Calabrese *et al.*, 2019). Therefore, sustainability information production requires an interplay between different methods and actors in an organisation to collect, analyse and communicate relevant data (Maas *et al.*, 2016).

Many organisations have of late shown an interest in using integrated management systems to increase their sustainability value (Rodríguez-Olalla & Avilés-Palacios, 2017:1). The authors argue that most available frameworks, though they address sustainability in organisations, fail to describe how to achieve the integration of sustainability. Principles in a framework serve as guidelines for decisions towards a more sustainable way of managing organisations (Nawaz & Koc, 2018; Mendoza *et al.*, 2019). Therefore, principles signify the need for a more group-based driving force behind decision-making (Cardoso, 2020). In addition, the framework ought to show how essential it is that stakeholders are engaged (Gadenne *et al*., 2012; Mendoza *et al*., 2019), which motivates the development of an integrated framework and tries to see how that can be addressed.

Due to the complexity of integrating the inherent trade-offs between socio-political,

environmental, ecological, and economic issues, Pimentel, Gonzalez, and Barbosa (2016) highlight how challenging it is to resolve divergent stakeholder demands. Additionally, they contend that one of the key opportunities for establishing decision-support frameworks and techniques for mining Organisations is to optimize project and portfolio selection by balancing economic, environmental, and social aims. For example, recycling concerns should be considered during the design stages of sustainable mining operations to turn waste into wealth and promote social development (Tayebi-Khorami et al., 2019), an area lacking broader application in mining (Pimentel *et al.*, 2016:2153).

Plans for mine output based on operations research still do not consider sustainability objectives (Yu *et al*., 2017). It is suggested that the sustainability of new technologies be evaluated through their impact on societal well-being, prosperity, the environment, and finite resources to establish future frameworks (Jawahir & Bradley, 2016; Tsalis *et al.*, 2020). Sustainability process design methods call for integrating such technologies within a consistent design. This will stand for multi-objective optimisation problems in which manufacturing costs should be minimised while improving all other sustainability indicators (Govindan *et al*., 2015; Madoumier *et al*., 2019).

Based on these considerations, the research challenges examined in this thesis are as follows: Along with failing to identify, classify, measure, and report environmental information, the conventional management accounting system does not give management the pertinent environmental information they need to make decisions that will ensure the gold mining industry's ability to sustain itself environmentally and to go green. Considering this, the study aimed to create an integrated architecture of EMAPs to support green gold mining in Zimbabwe. By concentrating on the more environmentally friendly gold mining in Zimbabwe, the study also aimed to advance theory and practice. This study's theoretical underpinnings and the qualitative research methodology addressed the identified research gap.

1.5 RESEARCH QUESTIONS

The literature review conducted for this study gave rise to the following research questions.

1.5.1 Main research question

How can EMAPs be integrated on an operational level to assist gold mining organisations in becoming greener?

1.5.2 Research sub-questions

The following are the research sub-questions:

1. What role can institutional forces like the government and other key stakeholders play in facilitating greener gold mining activities?
2. What are the effects of gold mining operations on the environment?
3. What strategies are being employed, and what information do gold mining organisations need to reduce waste generated through gold mining activities?
4. What are the characteristics, benefits, and gaps of selected EMAPs, and how can their integration address the gaps identified?

Answers to these questions provided information about the current situation of EMAPs among the selected gold mining organisations in Zimbabwe. They were used to develop an integrated framework for the gold mining sector to become greener.

1.6 RESEARCH OBJECTIVES

Emanating from the problem statement, the research aimed to enhance knowledge on how EMAPs can be integrated on an operational level and assist gold mining organisations in becoming greener.

1.6.1 Main research objective

To establish how EMAPs can be integrated on an operational level and assist gold mining organisations in becoming greener.

1.6.2 Research sub-objectives

To be able to achieve the main research objective, the study sought to:

1. determine the role that can be played by institutional forces like the government and other key stakeholders in facilitating greener gold mining activities.
2. establish the effects of gold mining operations on the environment.

3. illicit strategies employed and information needed by gold mining organisations to reduce waste generated through their activities.
4. identify characteristics, benefits, and gaps of selected EMAPs and how their integration can address the gaps identified.
5. develop an integrated framework to assist gold mining organisations in becoming greener.

By achieving the above objectives, the research contributed to how EMAPs can be integrated and used to address challenges in the gold mining industry related to the environment, thereby promoting sustainable gold mining.

1.7 SIGNIFICANCE OF THE STUDY

The research integrates MFCA, ABC and LCC to introduce resource efficiency into the gold mining industry. Consequently, this study develops an integrated framework synthesising these EMAPs into a coherent framework.

This research aims to contribute to integrating MFCA, ABC and LCC to enhance the gold mining industry's ability to address sustainable development challenges more effectively in developing countries, specifically Zimbabwe.

It contributes to knowledge and adds to the existing literature by focusing on the Zimbabwean gold mining sector's integrated framework that promotes environmental sustainability and remediation. Besides, it highlights how the EMAPs can be integrated and generate environmental information to assist key stakeholders in decision-making. Furthermore, the research seeks to contribute to practice and knowledge by developing an integrated framework of EMAPs for the gold mining sector in developing countries. Finally, the research provides valuable insights into preparing environmental reports within the gold mining sector to enhance user decision-usefulness (policymakers and management). To this end, they will be made aware of their needs and the role they ought to play in promoting sustainability.

Theoretically, the interaction between the gold mining sector and other institutions within the environment will likely moderate the gold mining sector to adopt greener initiatives. This follows the argument that the sector is motivated by acceptability concerns to incorporate sound environmental practices (Comyns, 2018). The identified theories (institutional, stakeholder and sustainability) offered a theoretical

framework for researchers to identify and investigate factors that sustain behaviour towards environmental management. In addition, the theories assisted the researcher in designing research methodology and methods that would result in adopting EMAPs to promote green gold mining in Zimbabwe.

This research, therefore, seeks to develop an integrated framework for the gold mining sector through a multi-method qualitative approach, starting with a comprehensive literature review (which resulted in the development of the preliminary framework) and followed by in-depth personal interviews to enhance the preliminary framework of EMAPs and focus group validating the framework. Furthermore, a holistic approach to transparency is required, given the corporate environmental scandals. This could be achieved if an integrated guiding framework of EMAPs, which promotes sustainability, is developed.

1.8 SCOPE OF THE STUDY

This research focussed on integrating MFCA, ABC and LCC to promote green gold mining in Zimbabwe. Although reviews of green gold mining in other countries were considered during the literature review, this research focused on the Zimbabwean gold mining sector.

Through the interpretivist philosophy, the study adopted the qualitative research design, which allowed the researcher to view the events within the gold mining sector through the perceptions and experiences of the participants. The study was conducted and limited to the gold mining extractive industry. Though many minerals are mined in Zimbabwe, the gold mining sector was selected because of its demarcated target community and easy access. Literature survey, in-depth interviews and focus group discussions were used as research instruments for this study. The study targeted those in decision-making and environmental policy formulation for the in-depth interviews and focus group. Purposive sampling was used in selecting participants since it involved strategically selecting rich cases that would tell a story of their experiences.

A few assumptions and delineations underpinned this study, which would give a guide on proper interpretations of results, were made, and are therefore discussed below:

- Access associated with collecting qualitative data limited the number and choices of gold mines used during in-depth interviews and focus group. Eleven gold mines were approached to participate, and only five (5) gold mines granted access.
- The qualitative methodology used in the study may be subjective, affecting the interpretation of results though efforts were made to improve reliability.
- The study was exploratory and descriptive. A sample size of twelve people was used for the in-depth interviews, and six were used for the focus group. The sample was drawn from five gold mines that had granted access to participate, and this was deemed a fair representation of the gold mining sector in Zimbabwe.

1.9 RESEARCH METHODOLOGY

The main objective of the research was to develop an integrated framework for the gold mining sector in developing countries, with the limitation of using only organisations in Zimbabwe that would promote environmental sustainability through EMAPs. Emanating from the problem statement, a further objective of the study was to determine the role that institutional forces like the government and other key stakeholders could play in facilitating greener gold mining activities. To be able to achieve this objective, the research sought to establish the effects of gold mining operations on the environment, illicit strategies employed, and information needed by gold mining organisations to reduce waste generated through their activities, and lastly to identify characteristics, benefits, and gaps of selected EMAPs and how their integration can address the gaps identified.

The review of relevant literature to explore research relevant to this study was the first thing to be done by the researcher to understand approaches, arguments and conclusions that were used and given by other researchers to establish the knowledge gap that this research intends to fill. The review of the literature resulted in the development of the preliminary framework. This research followed the interpretivism research philosophy. According to interpretivism, social scientists must understand the subjective meaning of social action because an approach that recognises the disparities between humans and the natural sciences' objects is necessary (Bryman, 2012:30). An inductive technique was chosen following the philosophy, which entails

researchers moving back and forth between the themes and the database until they build a complete set of themes (Creswell & Poth, 2018).

A comprehensive literature survey was the research strategy chosen for this study, using a qualitative research design; it takes its departure point as the insider perspective on social action (Babbie, 2020). Accordingly, the researcher considers words, diagrams, and videos, for example, rather than numeric data. Emphasis was placed on the generation of theories and how individuals interpret their social world. The method resembles a diary or series of snapshots, representing events at a given time and examining EMAPs in a cross-sectional way. The preliminary framework from the comprehensive literature review was enhanced by in-depth interviews and later validated using a focus group. The target population for the in-depth interviews included those in decision-making and environmental policy formulation. Purposive sampling was used to select participants. During the fieldwork phase, interviews were recorded and transcribed so that their perceptions and experiences could be analysed qualitatively and used to enhance the framework. A touch typist was employed to transcribe the audio interview recordings to save time. The key points that emerged from each interview were summarised and analysed to identify themes or patterns (Wagner, Kawulich & Garner, 2012:231). In this way, phenomena can be better understood by looking at how various participants experience such phenomena; the insights gained can be used in building the framework.

1.9.1 Ethical Considerations

Ethical concerns are paramount where research involves human participants, whether or not the research is conducted person-to-person (Saunders, Lewis & Thornhill, 2019). The researcher obtained permission from the selected goldmines before selected managers or participants were approached and asked for their willingness to participate. A participant information sheet was given to each participant and an informed consent form, which they were requested to sign before participating in the research. The participants were introduced to the researcher during the interviews, and they were informed that the interview procedure was optional and that they might leave at any time. Before beginning the study, the Department of Management Accounting's ethics committee approved it.

1.10 STRUCTURE OF THE THESIS

This research aims to develop an integrated framework of EMAPs to promote greener gold mining in Zimbabwe. The thesis is presented in seven (7) chapters.

Chapter 2 This chapter discusses EMAPs used to develop an integrated framework. The discussion commences with a brief discussion of EMA as the larger discipline from which MFCA, ABC and LCC have emerged. A detailed discussion of EMAPs follows. Next, the chapter describes and justifies the research questions based on the literature review. This leads to the development of the initial framework.

Chapter 3 This chapter reviews the institutional theory underpinning the research and related stakeholder and sustainability theories. In addition, the chapter describes the impact of mining on the environment.

Chapter 4 describes the research methodology followed in this research: the rationale and justification of the interpretivism philosophy adopted and detailed information on the research design, research instruments and their application.

Chapter 5 focuses on the findings from the participant-initiated, in-depth interviews. It is demonstrated how this addresses the research objectives by the detailed relevant responses from the participants. The data are analysed on a thematic level.

Chapter 6 validates the framework developed in chapter 3 and enhanced in chapter 5 by conducting a focus group.

Chapter 7 summarises the study's findings and concludes. Then, it is discussed how the research contributes and offers suggestions. Finally, the chapter makes suggestions for other research areas.

1.11 SUMMARY

The inadequacy of the traditional cost accounting system cannot be over-emphasised. The mining sector is capital intensive, and there is a need to use EMAPs that would assist in assigning correct costs to cost objects and detecting the sector's financial viability. This study is being done with this foundation in mind. To encourage greener gold mining in Zimbabwe, the study creates an integrated framework of EMAPs. The background of the research problem, problem statement, research questions, and objectives are all provided in this chapter as an introduction to the research. This

chapter has also covered the research methods, a quick assessment of the literature, and the importance of the study.

The following two chapters deal with the existing scholarship. The first chapter discusses the impact of mining on the environment and EMAPs selected and used in the development of the framework, while the next chapter expounds on the major theory underpinning the study.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The research background, problem statement, study justification, and methodology were all provided in the preceding chapter, which served as a broad introduction to the study. Within the background, it was revealed that environmental costs are not adequately disclosed in Zimbabwe. Calls for environmental awareness have arisen from increasing environmental degradation, which necessitates an integrated system to mitigate and help address the environmental challenges being experienced.

2.1.1 The goal of the chapter

The discussion of EMA and the identified EMAPs, MFCA, LCC, and ABC, which will be a component of the integrated framework to support greener gold mining, as follows. Finally, the literature review creates propositions which guide the creation of a preliminary framework after chapter 3.

2.1.2 Chapter overview and layout

In section 2.2, the development of propositions for this research is presented. The impact of mining on the environment is set out in section 2.3. This section discusses the geographic, economic, and social impacts of mining on health and well-being and the impact of environmental conflicts on business costs and planning in mining regions. This is followed in section 2.4 by some background information related to developmental issues raised by the impact of mining. Section 2.5 gives a brief overview of EMA. This is followed by section 2.6, which discusses MFCA, and section 2.7, which outlines the history and application of LCC. Section 2.8 reviews ABC, another critical EMAP for developing the framework. Finally, section 2.9 provides a summary of the chapter.

PREVIOUS WORK: A large portion of the literature review in chapters 2 and 3 has been released as a journal article (Nyakuwanika, van der Poll and van der Poll, 2021).

2.2 DEVELOPMENT OF PROPOSITIONS

A thorough literature review led to the formulation of three sets of premises, which were used to build the basic framework shown in figure 3.2 after chapter 3. The

following categories apply to the propositions:

- Content propositions indicating concepts identified, labelled *Cp*1, *Cp*2 … *Cp*n.
- General propositions, labelled *Gp*1, *Gp*2 … *Gp*q.
- Association propositions representing the relationships between concepts identified, labelled *Ap*1, *Ap*2, …. *Apr*

2.3 THE IMPACT OF MINING ON THE ENVIRONMENT

After World War II, economic growth accelerated (Steffen *et al.*, 2015), resulting in a rapid growth in demand for mineral resources (Moser, 2016). The increase in production meant that the number and size of mines increased, leading to social and environmental damage, creating more conflicts and putting pressure on the mining industry to enhance its performance on both social and environmental fronts (Tost *et al.*, 2018:969). As a result, the human pressures on the earth accelerate: several thresholds are close or have been exceeded so that abrupt and possibly irreversible changes to the planet are likely to occur, with adverse implications for human well-being (UNEP, 2012:6). Mining and sustainable development are intrinsically connected (Pimentel *et al.*, 2016:2146). The social and environmental impact of mineral development could compromise public acceptance of the social sector, as reflected in the resource curse debate (Mancini & Sala, 2018). The resource curse is based on the observation that nations with abundant natural resources grow more slowly than nations with limited natural resources (Cai & Newth, 2013; Ivanova, 2014). The resource curse theorem (Mateus & Martins, 2021; Zhan, 2022) has been empirically analysed in developing and developed economies with varying conclusions (Mancini & Sala, 2018). The commodity curse, through which resource-rich nations have been unable to convert those into lasting success (Kasprzyk, 2011), leads to more corruption, greater exposure to economic volatility, slower growth, oppression and government opacity, calling for the strategic management of natural resources to adopt a mature and organised approach (Pimentel *et al.*, 2016).

Because mining operations have limited lifespans, humanity's reliance on non-renewable resources may not last forever (Sterman, 2012). Therefore, in addition to utilising the mineral resources as effectively as possible, a sustainable mining operation should be secure, financially stable, and dedicated to leading practices in

environmental management and community involvement (Laurence, 2011). Meeting the above criteria will optimise the life span of the mining project, maximise community benefits, and ensure wider community acceptance for the industry (Pimentel *et al.*, 2016:2146). The mining business can be seen as a long-term, networked value chain, starting with the exploration of mineral resources, continuing with site design, construction, and operation, and ending with ultimate closure and rehabilitation, lasting anywhere between 10 and 100 years or more (Syahrir *et al*., 2020). According to Pimentel *et al.* (2016), Even though the operation phase lasts the longest and is frequently the focus of environmental efficiency, every stage of development should be balanced by investing in long-term advantages.

2.3.1 Geographic impacts of mining on health and wellbeing

Mineral production is not in harmony with environmental conservation since many mineral deposits, including gold and coal, exist below thick forests. The environmental impact is the result of land disturbance, which includes altering land use and landforms, destroying habitat, including that of flora and fauna, natural watersheds, and drainage patterns, as well as the harmful chemical effects of improperly treated wastes, which include air pollution, waste dumps, effluents, including acid mine drainage (AMDD), and noise and vibration from blasting (Sahu, Prakash & Jayanthu, 2015).

Compared with underground mining, surface mining can destroy ecosystems and affect their service values through direct occupation and indirect impact on the neighbouring ecosystems (Qian *et al.*, 2018:138). Mining removes vegetation and soil, interrupts ecosystem service flows, and inevitably causes the loss of farmland, sometimes permanently (Schueler, Kuemmerle & Schröder, 2011:528). Mining activities have resulted in severe environmental damage and ecological degradation like air pollution, destruction of landscape, loss of biodiversity, water acidification and soil quality decline. For example, though mining has contributed significantly to the rapid growth of China’s national economy, it has also caused serious environmental and ecological problems (Lei, Pan & Lin, 2016:320).

In Ghana, surface mining has resulted in deforestation and substantial loss of farmland within the mining concessions (Schueler *et al.*, 2011:528). Before Christmas 2016, a ground collapse in Zaruma, Ecuador, engulfed an elementary school, and it was

discovered that the cause was gold mining operations under the town (Vangsnes, 2018:317). Besides directly destroying the ecosystem, mining development also indirectly impacts the surrounding ecosystem (Qian *et al.*, 2018:139). For instance, nearby plants and animals will be negatively impacted by the noise and dust pollution created during excavation (Chukwuma, 2011). In addition, ore exploitation and processing significantly impact the environment (Breitenlechner *et al.*, 2010:1458). It is hoped that gold mining's direct and indirect environmental threats may be addressed by integrating EMAPs into the framework.

2.3.2 Economic impacts of mining on health and wellbeing

After depleting the natural resources, mine sites are abandoned. In most cases, financial provisions for rehabilitation are not available, resulting in the sites being abandoned without proper rehabilitation measures being taken (Mackenzie, 2016; Matshusa & Leonard, 2022). In many countries, mining organisations are required by law to demonstrate the availability of sufficient funds for later rehabilitation (Matshusa & Makgae, 2017:71). The indirect economic effects of mineral mining on neighbouring communities have a negative impact on local people's health and quality of life (Mactaggart *et al.*, 2016). Strong economic growth in first-world countries has increased the demand for minerals and metals (International Council of Mining and Metal [ICMM], 2013), but besides being a primary source of essential metals and green technology, mining also has negative impacts (Ranängen & Lindman, 2017). For instance, because it is the world's most significant consumer of mercury, gold mining entails contamination risks (Veiga, Angeloci-Santos & Meech, 2014).

Although mining is a vital part of the economies of many countries, particularly those in the developing world (Schueler *et al.*, 2011:528), local economies rarely benefit from mining operations, despite the negative consequences on the environment and society as a whole (Mateus & Martins, 2021). Gold mining employs over 16 million people worldwide (Seccatore *et al.*, 2014). It is a significant source of revenue, but it may not be directly connected to the local economy. As a result, it may not fully support the diversification and sustainable growth of the local economy (Ivanova, 2014:101).

At most, mining development causes an increase in people from outside the area (Hresc, Riley & Harris, 2018:64), which increases the demand for housing and raises rentals in communities with insufficient housing supply (Haslam Mckenzie & Rowley,

2013), causing a rise in housing prices and cost of living (Hresc *et al.*, 2018). The most vulnerable groups in society tend to be displaced (Haslam Mckenzie & Rowley, 2013), and residents are subject to financial and societal pressures (Hossain *et al.*, 2013). Mental health deterioration is associated with poor housing affordability, especially for individuals living in low-income households (Bentley *et al.*, 2011). Population influx causes unsustainable pressure on local healthcare, for example, increased waiting times (Hossain *et al.*, 2013). Therefore, if not properly managed, gold mining development may adversely impact the local community.

2.3.3 Social impacts of mining on health and wellbeing

The need to increase the provision of a few ecosystem services, like food production, has altered more than half of the planet's land use (Voinea *et al*., 2020). Although mining provides considerable economic benefits, significant adverse environmental and other social impact is associated with the mining sector (de Villiers, Low & Samkin, 2014:57). Apart from irreversible worldwide climate change, mineral development has highly detrimental effects on the environment, society, and economy at all scales, from the neighbourhood to the world (Li *et al.*, 2017:125). Extremely adverse effects of the mining industry might include workplace accidents, human rights violations, health and safety concerns, environmental degradation, and an influence on local communities' quality of life (Mutti *et al.*, 2012:212). The mining industry is also a significant source of environmental pollution of heavy metals (Anju & Banerjee, 2012; Ding *et al.*, 2017). Mining practices have resulted in water pollution and land surface subsidence, which have caused social and health problems in mining areas and the surrounding regions (Kapusta & Stańczyk, 2011). Conflicts arise from concerns about livelihood security and environmental degradation. There is a perception that environmental performance has not improved in proportion to the profits generated by mining organisations (Church & Crawford, 2020). Therefore, if not well managed, gold mining development may erode the foundations of livelihood and affect people's health and safety.

Conflicts between mining venture objectives, host community needs, and government policy are frequently brought on by the mineral extraction industry (Li *et al.*, 2012). Many developing nations' governments lack the political will to address the many adverse effects of mining, such as socioeconomic injustice and inequality (Morrice & Colagiuri, 2013). This may be due to governments prioritising economic growth and

poverty alleviation over the negative impact on local communities in mining areas (Hilson & Maconachie, 2020). Mining is welcomed in some communities as a source of new jobs and development opportunities, but in other communities, it has sparked conflicts, especially where mines compete for land with other stakeholders (Ranängen & Lindman, 2017:43). Lack of defensive measurement of the effects of mining on host communities may be the cause of the disregard for the welfare of the host community in the mining areas (Li *et al.*, 2017). Therefore, having in place a framework that integrates several EMAPs such as MFCA, LCC, and ABC for the gold mining sector may provide a solution to some of its challenges since MFCA aims to reduce waste, LCC assesses environmental cost, and ABC is concerned with cost assessment and environmental cost measurement.

2.4 IMPACT OF ENVIRONMENTAL CONFLICTS ON BUSINESS COST

Even though natural resource extraction projects transform communities, environments, and economies, it also generates social conflicts (Frynas & Buur, 2020). Previous research has found a relationship between mining and broader civil conflicts on the one hand (Bernauer *et al*., 2012; Leonard, 2021) and individual cases of project-level conflicts on the other hand (Yao *et al.*, 2020; Wang & Wu, 2020). Conflict can be defined as the coexistence of aspirations, interests, and world views that cannot be met simultaneously (or are perceived as such). It ranges from low-level tension to escalated situations involving a complete relationship breakdown or violence (Rees, Kemp & Davis, 2012).

Costs imply the negative effect of community conflict on an organisation’s tangible and intangible assets, including value erosion. Unmitigated environmental and social risks can adversely affect the financial success of projects in the extractive industries (Franks *et al.*, 2014:7576). For example, a study of 19 publicly traded gold mining organisations found that two-thirds of the market capitalisation of these organisations was a function of the value of gold in the ground (Henisz, Dorobantu & Nartey, 2014). Because mining and sustainable development are so intricately linked, integrating environmental and social goals into strategic, tactical, and operational choices is difficult (Pimentel *et al.*, 2016:2145). It is, therefore, essential to understanding the drivers of an organisation's behaviour to build an adequate framework for promoting a greener environment.

2.4.1 Planning in mining regions

According to Lechner *et al.* (2017), mining area planning should consider extracting mineral resources alongside other recognised land uses, like agriculture and ecological preservation. To avoid conflicts, they argue that achieving a common vision of mining development requires clear objectives and transparency about potential land use. Besides resource supply and extraction efficiency, mining activities should increasingly consider how they may affect local communities, biodiversity, and hydrology (Mudd, 2010; Lechner *et al.*, 2016). The cumulative consequences of successive and incremental changes on the environment, society, and economy should be considered when planning regionally in resource-rich areas (Franks, Brereton & Moran, 2013). In resource-rich locations, multiple activities like mining and farming have an interconnected and accumulated impact, leading to a cumulative impact on the environment (Evans & Kiesecker, 2014).

Assessing the cumulative impact would require an awareness of the interrelationships between social, economic, and environmental factors (Lechner *et al.*, 2017:269), characterised by systems thinking and an integrated approach to planning and modelling (Hamilton *et al.*, 2015). A system's various and varied components are combined through an integrated assessment process that transcends social, organisational, and conceptual boundaries (Hamilton *et al.*, 2015). This could equip decision-makers to explore social-ecological interactions and develop policies for acceptable environmental and socioeconomic outcomes. Understanding the effects of mining development can therefore aid in identifying trade-offs between competing land uses, particularly when development in one sector impacts development in another.

2.4.1.1 Challenges of planning in mining in regions

Because minerals have a finite supply, mining is distinct from other types of development in this regard (Lechner *et al.*, 2017). Given suitable interventions and management, natural resource developments like agriculture can potentially continue (Rankin, 2011). Mineral resources are vulnerable to volatility (boom/bust cycles) on a global scale (Petkova *et al.*, 2009), which could lead to substantial changes in mine operations, ranging from times of expansion and increased output to times when production is decreased or interrupted. However, some environmental and social harm might happen during the exploratory stage because of drilling and acquiring access to

land. Environmental and social harm often happens after the mine is operated (Lechner *et al.*, 2017:267). Arguably, the benefits derived from mining activities can be balanced with their negative impact. The mining sector should be regulated through a framework to guide how to achieve a balance within the sector.

One of the most significant sources of damage to the environment and society is mining (Dushin *et al.*, 2020), because mining drastically alters the components of ecosystems. Because environmental destruction is irreversible, especially when more intense mining techniques like open-cut mining are used, a return to the ecosystem's historical state cannot be achieved (Perring, Standish & Hobbs, 2013). Alterations hamper land restoration to the terrain, soil, groundwater, and hydrological systems and the development of stable non-natural land cover features such as waste rock dumps (Doley & Audet, 2015). In addition, mines that their original owners have abandoned at the end of the cycle pose serious threats to the environment and society because the impacted area cannot be used (Unger *et al.*, 2015). In the US, hard rock mine sites have been abandoned at a rate of about 161,000. (Government Accounting Office [GAO US], 2011). Knowledge of these mining sector developments may help decision-makers reform their practice. Having an integrated framework that provides decision-makers with information may go a long way towards solving the challenges within the gold mining sector.

2.5 BACKGROUND AND DEVELOPMENTAL ISSUES ON THE IMPACT OF MINING

Demand for minerals grows in emerging economies (Church & Crawford, 2020). The production of many minerals has increased in quantity and value due to the sharp rise in prices and demand (Sahu *et al.*, 2015:232). The global total material extraction increased by a factor of eight over the period from 1900 to 2005, most strongly in construction minerals and ores (Jeswiet, 2017:494). Both industrialised and emerging nations experienced a gold boom due to rising gold prices (Schueler et al., 2011), resulting in a rise in small-scale and artisanal gold mining, despite the downward price trend between 2012 and 2015 (World Gold Council, 2022). Small-scale miners represent 20–30% of gold production (Veiga *et al.*, 2014).

The discussion in the above sections leads to the 1st content proposition:

***Proposition Cp1**: Gold mining activities adversely affect the natural*

environment since they leave a strong environmental footprint, arguably more than any other industrial activity.

Mineral resources are strategically essential for the competitiveness of the industrial sector. Mining supplies other industrial sectors that are key for sustaining the population's well-being and the functioning of global economies (Mancini & Sala, 2018). The normal growth of Gross Domestic Product (GDP) figures in developing countries may disguise a strong depreciation in gold inventory and environmental damage (Ouoba, 2017:194). Depletion of natural resources is an issue facing humankind today, and the earth cannot be considered an endless mineral repository (Valero *et al.*, 2014:548). Mineral extraction tends to leave a strong environmental footprint, more than any other industrial activity (Sahu *et al.*, 2015:233), producing detrimental effects on society and the environment (Mancini & Sala, 2018:98) and thereby restricting the UN's defined sustainable development goals (SDGs), like good health and clean water (UN, 2016). The impact of mining ranges from the geographic and cultural displacement of indigenous communities to the contamination of water, air, and land with toxic by-products (Moran *et al.*, 2014). Therefore, there is a need to balance the substantial positive economic benefits of mining, in the form of royalties and taxes collected by the government, with the exhaustion of natural resources (Akinseye & Cawood, 2021).

Global consumption continues to generate growth in mining, which in developing economies offers the potential to generate new resources for development and create challenges to sustainability in regions in which extraction occurs (Church & Crawford, 2020). The mining industry's effects on society and the environment should be mitigated to be entirely acceptable to the public (Moffat & Zhang, 2014). However, insufficient strategies are available to prevent environmental contamination at future legacy sites (Matshusa & Makgae, 2017). Legacy mine land has been mined and is orphaned, abandoned and in need of remedial work or is now being used for another purpose (Collyard & Patterson, 2021). The land area required by mining differs according to the extent of the orebody. In most cases, after mineral production, the land is no longer productive in terms of agriculture or safe for residential development unless proper remedial action is taken (Matshusa & Makgae, 2017:71). It was revealed in a study that wastes dumps limit the development of different economic activities (George-Laurentiu, Florentina-Cristina & Andreea-Loreta, 2016). Therefore, the

mineral strategy must include measures to deal with the increasing production of minerals and to mitigate the adverse impact.

Human activities and their corresponding impact on the environment have led to adverse social and economic situations (Fawzy *et al.,* 2020). Therefore, obtaining cleaner production requires that environmental protection and sustainability issues are recognized and acted upon accordingly (Khajehpour, Saboohi & Tsatsaronis, 2017:998). Furthermore, integrated action plans are required to deal with these issues in any part of the system contributing to environmental problems (Khajehpour *et al.*, 2017). Therefore, having in place, a system that comprises both environmental management and wealth generation ought to go a long way towards mitigating the impact of mining on the environment.

2.6 ENVIRONMENTAL MANAGEMENT ACCOUNTING (EMA)

EMA is described as the identification, collection, analysis, and application of physical information on the usage, flows, and destinations of energy, water, and materials, as well as financial information on environment-related costs, earnings, and savings for decision-makers (Javed *et al.*, 2022). EMA provides internal and external decision-makers with physical (PEMA) and monetary (MEMA) information about many environmental issues (Gunarathne, 2015:308). It should be noted that EMA is not a practice but a wide range of ideas and methods that offer guidance on implementing environmental plans successfully (Javed *et al*., 2022). EMA information is utilised for internal and external reporting (Johnstone, 2020; Gunarathne *et al.*, 2021). EMAPs, which are continuously developed, include environmental capital budgeting, life cycle accounting, environmental ABC, MFCA, accounting for energy, materials, water, and waste, and the sustainability balanced scorecard (Gunarathne, 2015); however, this research focuses only on the integration of MFCA, LCC and ABC. The following section looks at MFCA.

The above discussion leads us to the 2nd content proposition:

Proposition Cp2: *EMA may hold much promise to be employed to manage the various challenges facing the gold mining sector.*

From the above proposition, we may infer that:

Proposition Cp3**:** *The EMA divisions of PEMA and MEMA may provide essential information for the sustainable management of the challenges facing gold mining*.

Proposition Ap1: *There is an association between accounting subject matter, EMA and EMAPs, for example, LCC*.

2.7 ORIGINS OF MATERIAL FLOW COST ACCOUNTING (MFCA)

The leading proponents of MFCA development were Germany and Japan (Schaltegger & Zvezdov, 2015). MFCA is an environmental accounting method created in Germany and improved by the Japanese in the 1990s (Christ & Burritt, 2015; Guenther *et al.*, 2015). The history of MFCA is traced to a textile organisation in Germany in the late 1980s (Wagner, 2015). Efforts towards a new standardisation of MFCA for EMA of the ISO 14000 family began in 2007, culminating in the standardisation of ISO 14051 and 14052 (ISO Central Secretariat, 2011; Kokubu & Kitada, 2015). MFCA has received attention from researchers and practitioners, especially in German-speaking nations, where its genesis can be attributed (Jasch, 2009). Around the turn of the century, MFCA was first introduced to Japan (Nakajima, 2010). The creation and spread of MFCA were made possible by the robust efficiency and technology-driven industries in Germany and Japan (Endenich, 2012). MFCA, which evolved from environmental management and not accounting, can be classified as a management control practice interlinking accounting and management systems. It was born from environmental initiatives by the textile company Kunert in Southern Germany in the late 1980s and early 1990s (Wagner, 2015:1255).

A specialised accounting technique called MFCA is described as one that aims to recognise and value financial inefficiencies in the usage of resources like materials and energy (Schmidt, Götze & Sygulla, 2015:1320). MFCA was created primarily to assess material flows within specific organisations to promote eco-efficient decisions that increase resource efficiency and enhance an entity's economic and environmental performance (Zhou *et al.*, 2017:111). However, interest has recently increased in how MFCA may be expanded to help with supply chain management (Nakajima, Kimura & Wagner, 2015).

2.7.1 An overview of MFCA and implementation issues

Growing industrial demand in recent years has caused the depletion of available energy and material resources and unfavourable environmental effects (Christ & Burritt, 2015). As a result, the United States Environmental Protection Agency (USEPA) introduced several rules and restrictions in project implementation and industrial activities that call for accounting systems to identify and assess the environmental impact of business activities more precisely. This was done in response to environmental problems brought on by excessive waste production (Fakoya & van der Poll, 2013). MFCA is a novel management and accounting system that examines the relationship between mass and energy balances and identifies the source of produced waste, thereby supporting and improving waste-reduction decisions (Mahmoudi *et al*., 2017; Bux & Amicarelli, 2022). MFCA has been identified as one of the most promising available EMAPs (Kokubu & Kitada, 2015:1279) and hence can be used to balance material and energy flows within the gold mining sector.

MFCA can provide accurate waste information for internal decision-making, which accounts for its popularity (Tajelawi & Garbharran, 2015:3760). Management choices could now be made with a greater emphasis on material losses (Schaltegger & Zvezdov, 2015). Based on material balance, MFCA allows for the possibility that the input material could be commensurate with the total of products and material waste (Kokubu & Kitada, 2015:1280). Since it increases material efficiency, the cost of material losses computed by MFCA can motivate managers and organisations trying to achieve financial benefits by lowering negative environmental consequences (ISO Central Secretariat, 2011:1).

MFCA can begin with a somewhat easy workout (Christ & Burritt, 2017:602). Christ and Burritt (2015:1381), in their analysis of the literature on MFCA, outlined five (5) basic steps of MFCA:

- ***Step 1: Agree on the boundary of the system –*** which entails choosing MFCA systems in which material flows in both the physical and monetary senses are gathered in quantity centres, and material losses are to be computed. The components of a system that collects and quantifies data on inputs and outputs in both monetary and physical terms are called quantity centres. The value

chain's organisation, facility, cost centre, process, and others could all be considered system boundaries.

- ***Step 2: Construct a flow model and assign physical values –*** establish and measure the system's actual material and energy flows under consideration (ISO Central Secretariat, 2011).
- ***Step 3: Establish a "material balance" –*** calculating physical outputs and material losses requires balancing the physical inputs of material and energy flows (ISO Central Secretariat, 2011).
- ***Step 4: Assign monetary values to inputs, outputs, and inventory items in the systems –*** calculating physical outputs and material losses requires balancing the physical inputs of material and energy flows.
- ***Step 5: Identify opportunities for improved resource efficiency*** – devise creative strategies to reduce resource waste once material losses are discovered.
- ***Step 6: Act*** – depending on the available MFCA data regarding potential courses of action, select the optimum course of action.

The implementation of EMAP activities begins with the MFCA (Jasch, Ayres & Bernaudat, 2010) since it is based on the idea that all resources an organisation purchases will eventually become either products or garbage (Fakoya & van der Poll, 2013). MFCA depends on getting the relevant physical data about materials and energy flows (Bennett, Schaltegger & Zvezdov, 2013:8). The primary goal of MFCA is to optimise cost through the identification of unfavourable outputs (material or energy losses) (Mahmoudi *et al.*, 2017:530). MFCA also serves an environmental purpose by reducing resource use and harmful emissions (Schmidt *et al.*, 2015). MFCA is a powerful practice since it can quantify the potential for material and energy saving and, therefore, help to determine energy and material flows (Mahmoudi *et al.*, 2017:530).

Unlike other practices of conventional cost accounting, the cost of material losses and inefficiencies are highlighted by MFCA, which allocates charges to final goods and co-products and material losses, thereby improving transparency (Rieckhof *et al.*, 2015). Furthermore, MFCA focuses on material inventories, and flows inside a business are tracked, measured in physical units, and expenses related to such material movements are assessed following MFCA (Mahmoudi *et al.*, 2017:351). This encourages businesses and managers to look for possibilities to produce monetary

and economic gains (ISO Central Secretariat, 2011).

MFCA integrates physical and monetary data to assess how well an organisation uses resources, preserves the environment, and performs economically and environmentally (Bux & Amicarelli, 2022). This is accomplished by analysing the production's waste costs, particularly the costs of materials and wasteful use (Bautista-Lazo & Short, 2013). For businesses where most materials are used directly to create the final product, a specific focus on reducing the number of materials used in the product might provide opportunities for material savings (Schaltegger & Zvezdov, 2015). Therefore, decision-makers are helped by the MFCA study's findings to reduce material use and related costs (Herzig *et al.*, 2012).

MFCA has become one of the essential EMAPs. The information generated by this practice can motivate businesses and managers to look for ways to increase material efficiency while lowering material costs and damaging environmental effects (Schaltegger & Zvezdov, 2015). Hence, the adoption of MFCA will assist the gold mining sector by improving material efficiency while reducing the environmental impact of the gold mining sector.

The discussion above leads to the 4th content proposition:

Proposition Cp4*: MFCA, as an EMAP, supports eco-efficiency decisions that enhance resource efficiency to improve a mining organisation's economic and environmental performance.*

Hence, we can infer that:

Proposition Cp5: *Gold mining systems should have a management accounting system that determines wasteful activities and optimises costs*.

(Note: This is a complementary proposition as it supports many other propositions in this study)

2.7.2 Development of MFCA as a management tool

MFCA as an EMAP involves the improvement of the economy and, at the same time, reducing environmental impacts. MFCA in a production line details expenditures related to product and material losses that the organisation is unaware of (Tajelawi & Garbharran, 2015). Physical and monetary losses are defined by MFCA for each

process in numerical terms so that organisations can identify problems and recognise the need for improvement (Dunuwila, Rodrigo & Goto, 2018). Therefore, an appropriate EMAP within the organisation alerts management to the material losses incurred.

The universal applicability of MFCA to business is stressed by ISO 14051 (Kokubu & Tachikawa, 2013). MFCA applies to any organisation as long as they use materials and energy (ISO Central Secretariat, 2011:1). Following the standardisation for MFCA by releasing ISO 14051 and 14052 (ISO Central Secretariat, 2011, 2017). The method or framework for controlling the flow of materials has been established for organisations in recent years, directly affecting resource efficiency and cost reduction (Yagi & Kokubu, 2018:763). Therefore, decision-making for the gold mining sector may require a proven, standardised and internationally recognised practice.

The above discussion leads to the 6th content proposition:

Proposition Cp6: *ISO standards play an essential role in the governance of environmental regulations and developing EMAPs such as MFCA.*

To improve decision-making and accountability, MFCA investigates the connections between accounting, the environment, and information management (Zhou *et al.*, 2017), unlike traditional management accounting, which does not provide sufficient information to manage the environment systematically (Schmidt, 2015). Furthermore, MFCA bases its cost accounting method on material flow balances (Margallo *et al.*, 2014). It is a logical continuation of Kaizen and lean production, with the additional dual purpose of cost reduction and environmental management (Guenther *et al.*, 2015). Therefore, traditional management accounting's purview is expanded by MFCA to consider the real world, business sustainability, and eco-efficiency (Wan *et al.*, 2015), making goal-setting more methodical and scientific (Zhou *et al.*, 2017).

2.7.3 Benefits of MFCA

The assignment of costs to both goods and non-products is a crucial component of MFCA. As a result, the actual cost related to material misuse will be revealed by allocating charges to a non-product (Christ & Burritt, 2017:603). Output managers will be more inclined to deal with waste concerns if they are informed about the actual cost of a non-product since they will be viewed as more important from an economic

standpoint (Christ & Burritt, 2017), in comparison with the understatement of the waste cost before MFCA analysis (Bux & Amicarelli, 2022). When the cost of a non-product is known with a high degree of certainty, corrective action can be taken to decrease the amount of the non-product, enhancing the organisation's financial and environmental performance (Christ & Burritt, 2017:604). Hence, having MFCA in the integrated framework might help the gold mining sector derive the benefits of using the practice.

The discussion above leads to the 7th content proposition:

Proposition Cp7a*: MFCA can assist gold mining organisations in reducing waste to enhance the gold mining sector's economic and environmental performance.*

Hence, we can infer that:

Proposition Cp7b*: MFCA can assist the gold mining organisations in economic and environmental performance through:*

- the reduction of waste
- improved energy usage
- improved decision-making and accountability.

The potential for MFCA has been shown in numerous case studies, with the average cost of wasted materials before the implementation of MFCA calculated as 40–70 percent of the total environmental cost (Jasch, 2009; Christ & Burritt, 2015). The application of MFCA reveals its logical and analytical potential to positively impact managerial decisions since it has uncovered the inefficiencies in the process leading to losses (Tajelawi & Garbharran, 2015:3762). MFCA turns manufacturing losses into monetary terms, urging managers to be aware of these losses and reducing unfavourable goods (Kasemset, Chernsupornchai & Pala-ud, 2013). The advantages of MFCA, which it is hoped will be realised in the gold mining sector as given by some authors (Jasch, 2009; Schmidt & Nakajima, 2013; Abed & Hussein Hani, 2022) are:

- improved consistency and quality of business information systems, connecting financial and physical data.
- prioritise increasing energy and material productivity over workforce reduction.

- a decrease in costs and a lessening of the environmental effect due to increased material and energy efficiency.
- greater drive on the part of management and personnel to structure material flows thoroughly.
- financial rewards for creating novel products, technology, and practices.
- coordination and communication over interdepartmental material flow as opposed to creating departments, divisions, and cost centres with distinct roles;
- Enhanced organisational procedures and structures because of regular use of the material flow system.

According to a Malaysian study, MFCA has many potential applications for SMEs, especially in organisations where the necessity to achieve economic goals is critical (Sulong, Sulaiman & Norhayati, 2015). The ability of MFCA to identify opportunities for improving efficiency and lowering waste was discovered in several empirical studies conducted in several countries (Doorasamy, 2015; Doorasamy, 2016; Christ & Burritt, 2017; Phan *et al*., 2018). It is plausible that being capital intensive and having strong economic objectives (profit motive), the gold-mining sector can achieve the profit motive and reduce its environmental impact by using MFCA.

2.7.4 Application of MFCA

Although there is rising interest in how the technique might be used in underdeveloped countries, MFCA is a practice that originated from projects carried out mainly in rich countries (Christ & Burritt, 2015:1384). Nevertheless, research has shown that MFCA offers a lot of potential for identifying inefficient areas and directing reform efforts to places where they would have the most significant impact (Herzig *et al.*, 2012). Jasch and Danse (2005) demonstrate how a comparison of EMAP activity in Austria and Costa Rica demonstrates how MFCA may be useful in spotting chances for good housekeeping that are more prevalent in emerging economies. MFCA has, in recent years, been gradually recognised in Asia through the standardisation of ISO 14051 and 14052, which have put in place mechanisms for organisations to manage their material flows. MFCA is a practice that increases efficiency and optimises material use (Sulong *et al.*, 2015). Numerous European and Japanese organisations have employed it in manufacturing and non-manufacturing areas (Jasch, 2009; Christ &

Burritt, 2015; Sulong *et al*., 2015); hence this might assist the gold mining industry.

According to Tajelawi and Garbharran (2015), different manufacturing industries have used MFCA to increase resource and energy efficiency. For example, a study on the textile industry found that MFCA delivers new and accurate information on inefficiency and a better knowledge of the cost drivers of material and energy utilisation. -related costs and price variations for individual products (Viere *et al*., 2013). In a study of the alcoholic beverage industry in South Africa, Fakoya and van der Poll (2013) concluded that the integration of MFCA with Enterprise Resource Planning (ERP) systems aids in accelerating the availability of waste information, both in terms of quantity and costs, allowing quicker waste management decision-making. MFCA has been successfully used in industrial applications like lens manufacturing (Schmidt & Nakajima, 2013), the brewery industry (Fakoya & van der Poll, 2013), the automotive industry and pharmaceutical production and health care (Kokubu *et al.*, 2009), and heavy machinery production (Tang & Takakuwa, 2012). In all the cases where MFCA has been applied, MFCA has helped improve organisations' overall economic performance (Wan *et al.*, 2015). Besides being a unique allocation method for distributing the cost of production to physical products and material losses, MFCA enables organisations to identify how much value is lost due to material losses (Schmidt, 2015:1310). Arguably, integrating MFCA, LCC and ABC into one framework will benefit the gold mining sector more. As such, integrating MFCA with other EMAPs may speed up the availability of waste information for quicker waste management information.

The discussion in the above sections leads to the 8th content proposition:

Proposition Cp8*: MFCA helps to achieve resource and energy efficiency since it assists in the speedy availability of waste information.*

The NITTO Corporation, located in Japan, introduced MFCA in 2000, with a 10% increase in effectiveness (Zhang & Liu, 2015). In Malaysia, MFCA also resulted in a considerable decrease in waste and cost for Alpha, an automotive parts organisation (Sulong *et al.*, 2015). These studies have identified the flaws in the corresponding processes, which will ultimately increase revenues by focusing on waste reduction and cost efficiency improvement (Dunuwila *et al.*, 2018:588). A few studies have combined MFCA, Life cycle analysis (LCA) and material flow analysis (MFA) (LCA) (Nakano & Hirao, 2011; Schaltegger, Viere & Zvezdov, 2012; Ulhasanah & Goto, 2012). However,

the researcher has identified no study integrating MFCA, LCC and ABC.

MFCA has so far had more practical applications and less empirical attention while being primarily employed by Japanese and German organisations and low-income countries (Guenther *et al.*, 2015:1249). MFCA was introduced to five (5) organisations under the Malaysian Productivity Corporation (MPC) project, in selected SMEs in Asia and in a non-profit context in Greece where financial constraints were imperative, and it was observed that these organisations achieved dual advantages of environmental sustainability and economic growth (Herzig *et al.*, 2012; Papaspyropoulos *et al.*, 2012; Sulong *et al.*, 2015). MFCA was found to have a lot of potential for usage by SMEs, particularly in organisations with a pressing need to achieve economic goals (Sulong *et al.*, 2015:1365).

Therefore, it can be concluded that MFCA is a particular way of evaluating the cost incurred by an organisation and can lead to lean production (Doorasamy, 2015; Schmidt, 2015; Fu *et al*., 2017; Giang, 2022). A distinction is made between productive and non-productive activities in the organisation within lean production. There is also mention of Muda, the Japanese word for losses (Schmidt, 2015). The method's ability to demonstrate the direct costs of waste and the lost added value to the organisation is a critical component of MFCA's effectiveness (Schmidt, 2015). Therefore, a suitable framework may aid in making the distinction between value-adding and non-value-adding operations. As a result, an organisation may eventually try to use the built framework to find ways to stop doing things that do not provide value.

2.7.5 Barriers to MFCA implementation

Until recently, most MFCA research has been conceptual (Christ & Burritt, 2015:1378). The limited case studies already in existence are primarily action-based projects where skilled researchers were crucial in aiding uptake and implementation (Nakano & Hirao, 2011; Schaltegger *et al.*, 2012). Organisations must be adequately persuaded of MFCA's benefits and prepared to pursue implementation without academic assistance (Christ & Burritt, 2015:1382). MFCA may not be gaining traction more quickly since it is poorly advertised and its management and economic benefits are unknown (Yang & Chang, 2018). In such cases, there is a need to engage stakeholders and publicise the practice. In addition, there may be a need for training on how the concept works and how it can be implemented to be acceptable to

implementers.

Loss is described by MFCA as the weighted difference between input and output, with a focus on the interaction between them in the production processes (Schmidt, 2015). After production has started, management can ignore this loss as a target if it is challenging to eliminate and is projected to be recovered from anticipated profits (Kokubu & Kitada, 2015:1281). The framework of EMA can also be used to view generally the erroneous measurement of material losses in current management accounting (Nkundabanyanga *et al*., 2021). The following are some of the drawbacks of MFCA (Zhou & Xu, 2013):

- further research is necessary since the MFCA uses technical standards and data that may be challenging to adapt to the calculation of emissions for some other inventories;
- the accounting context is constrained and limited to material for internal resource loss and has nothing to do with the burden on the outside world; and
- the accounting process is not systematic, and the cost of material loss due to abandonment and ineffective use is calculated using a single standard like weight, which is inappropriate for some other stocks like iron and steel.

One disadvantage of MFCA is that an organisation's energy and material flow should be known. As a result, an elaborate ecological accounting system is required, and "new knowledge to promote ecological accounting" (Walz & Guenther, 2021). In their literature review, Zhou and Xu (2013) expose some drawbacks of MFCA as an oversimplified system since it only uses material flow to determine the categorisation rules for the positive and negative product costs. Furthermore, it becomes complicated in those industries where a range of materials, resources, and energy must be used since the by-product will be produced by thorough resource utilisation throughout the manufacturing process. Hence, knowledge of the drawbacks of the technique may be essential to decision-makers and how adopting other EMAPs (ABC and LCC) will counter those drawbacks.

Barriers to the implementation of MFCA range from lack of team cooperation (Sulong *et al*., 2015), lack of technical knowledge and training (Tran & Herzig, 2020), and perception challenges (Kokubu, 2010) to performance appraisal (Tran & Herzig, 2020). One of the EMAPs that is least used in Japanese organisations is MFCA

(Dechampai *et al*., 2021).

Lack of teamwork across several departments and within the MFCA team itself has been a barrier to implementing environmental projects (Sulong *et al.*, 2015:1367). Environmental costs, for instance, might be available in the environmental department, materials and other production costs in the production department, and design costs in the engineering department, and it might be challenging to measure and allocate environmental costs effectively without the cooperation of the concerned departments (Sulong *et al*., 2015). In addition, a lack of technical training and knowledge has been identified as a barrier to MFCA implementation (Hyrslová, Vágner & Palásek, 2011; Sulong *et al.*, 2015).

The next barrier to implementing MFCA is the perception challenge: How MFCA is seen and viewed (Tran & Herzig, 2020). Some people fail to see how MFCA differs from other practices already used by organisations (Walz & Guenther, 2021; Kitada *et al*., 2022). As a result, organisations tend to misinterpret and become perplexed by the concept and actual operation of MFCA, even though it differs from conventional cost accounting and other methods (Kitada *et al*., 2022). The belief that profit-seeking is the main corporate goal, which is believed to be at odds with environmental goals, is the other part of the perception difficulty (Kokubu, 2010). The traditionalist perspective holds that increasing environmental management will decrease organisational profitability (Garza-Reyes, 2015; Hallam & Contreras, 2015). MFCA aligns with the revisionist perspective, which contends that environmental management and financial performance are positively associated (Sulong *et al.*, 2015:1367). Organisations could be reluctant to start MFCA because of these perception difficulties (Sulong *et al.*, 2015). Therefore, it is possible that MFCA will not fully realise its potential for producing both economic and environmental gains simultaneously (Kokubu, 2010).

Evaluation of the performance of EMA participants on individual and departmental levels presents a further barrier to MFCA since the environmental impact is generally excluded from this process (Tran & Herzig, 2020; Arise & Shewell, 2021). Tran and Herzig (2020) argue that performance evaluations without an environmental component impact cannot improve behaviour, particularly concerning environmental issues as described by management. Furthermore, MFCA may not spread rapidly due to a lack of publicity since organisations exposed to market rivalry will implement

MFCA to outperform rivals (for instance, its economic and management virtues are unclear) (Yagi & Kokubu, 2018:763).

2.7.6 Facilitating factors for MFCA implementations

MFCA contributes to resource efficiency (Schmidt & Nakajima, 2013; Untersteller, 2014). There is a need to boost material efficiency due to decreasing availability of various resources and rising expenses associated with handling, storing, and disposing of waste (Rohn *et al.*, 2011). In addition, compatibility with existing management systems has been identified as another factor that has enabled MFCA implementation since it facilitates smooth implementation (Sulong *et al.*, 2015:1366). It has been determined that MFCA enhances the organization's current system of Total Quality Management (TQM) and Total Productivity Maintenance (TPM), making it easier to deploy MFCA (Higashida, 2012). In addition, research has established that organisations with available required data for analysing material flow in their records can implement MFCA more easily (Schmidt, 2015; Salim *et al*., 2017; Walz & Guenther, 2021).

The unique technical benefit of using MFCA as an accounting method is that it acknowledges waste as a negative product with its expenses (Christ & Burritt, 2017). The information produced by MFCA on waste expenses is more accurate than that produced by conventional cost accounting, which includes waste costs in general overhead (Jasch, 2009; Fakoya & van der Poll, 2013), allowing a more transparent reporting of production costs and wastages (Fakoya & van der Poll, 2013), thereby motivating management to take steps to reduce wastage (Sulong *et al*., 2015; Giang, 2022).

Top management is another key factor in MFCA implementation because of the value of executive management involvement and commitment to the effective participation of all departments involved in EMA projects (Giang, 2022). Hence, without top management's support and involvement, MFCA will likely face difficulties and barriers during implementation.

2.7.7 Relationship between MFCA and other EMAPs

The range of attention is typically limited due to the perception's tendency to become more focused when dealing with complexity (Simonds, 1995). This is because

engineers inside an organisation observe how technical processes and products perform, managers observe the cost and profit side, and environmental officers observe emissions, effluents, and waste, all of which affect their sense of corporate reality (Guenther *et al.*, 2015). As a result, the goals of the three (3) groups might conflict with each other, and hence the use of MFCA, which supports the integration of various views (Guenther *et al.*, 2015:1249), might be the solution to the conflict.

Since sometimes a combination of practices may be necessary to produce an equivalent improvement in economic and environmental performance, it is essential to look at the incremental performance benefit attained when different practices are combined within different contexts (Christ & Burritt, 2015:1384). MFCA, as a practice, can surely optimise integration (Guenther *et al.*, 2015:1249). And hence, MFCA is but one in a set of possible EMAPs (Javed *et al.*, 2022). There has been limited research on the similarity and comparability of MFCA with other EMAPs (Schaltegger & Zvezdov, 2015). However, research has underlined the potential value of MFCA in post hoc investment evaluation and appraisal (Schaltegger *et al*., 2012; Christ & Burritt, 2015). Moreover, MFCA is not just a corporate accounting exercise; it also falls within the category of industrial ecology's approach toolbox. Its use is expanding to include the supply chain and life cycle perspective (Guenther *et al.*, 2015:1249).

Evidence from Argentina suggests that a scorecard that focuses on the environment may have a place in material flow cost management (Christ & Burritt, 2015; Listone-Heyes & Vazquez Brust, 2016). Christ and Burritt (2015) do provide that very little about the function of MFCA is known, and hence, more research is needed to substantiate assertions that it would seem compatible with a variety of EMAPs (Jasch, 2006). MFCA is at the nexus of environmental management, management accounting practices, and material and energy efficiency evaluations. It adopts a different standpoint from other EMAPs in the savings in energy and material, resulting in cost reductions that benefit the environment (Guenther *et al.*, 2015:1250). This suggests that MFCA identifies opportunities for material efficiency and cost savings, which could be advantageous for the capital-intensive gold mining industry.

Christ and Burritt (2015:1384) argue the necessity of examining the incremental performance gain attained when various approaches are combined and applied in various settings. They continue by saying that while MFCA may be helpful in some circumstances, in others, it may be necessary to use a combination of methods to

achieve the same benefits in economic and environmental performance. Hence, the need to see how MFCA can be integrated with other EMAPs.

2.8 HISTORY AND APPLICATION OF LCC

LCC is an accounting practice that estimates an acquired item or equipment's total life cycle costs (including equipment procurement and ownership costs) (Al-Chalabi, 2018:360). LCC has evolved from a project appraisal to a more comprehensive practice incorporating sustainable development aspects in various sectors (Jayasuriya *et al.*, 2019). Life cycle thinking creates a comprehensive systems perspective, which takes the whole chain and spread of activities from pre-production, production and post-production, into consideration, besides practically incorporating diverse factors with a judicious mix of quantitative and qualitative aspects (Reddy, Kurian & Ardakanian, 2015). A systems perspective may benefit the mining industry since this may assist managers in decision-making, especially when bottleneck activities are highlighted. Therefore, LCC within the integrated framework would result in correct investment decisions since it considers not only investment costs but also operating costs of the gold mining sector during the mine's estimated lifetime.

Though the historical records about the origin of LCC are vague (Apipour *et al*., 2020), the practice is believed to have been first used in the military in the 1960s to aid with the purchase of military equipment by the US Department of Defence (Goh & Sun, 2016; Dwaikat & Ali, 2018). It was also used to evaluate and compare energy design options in commercial buildings (Harris & Fitzgerald, 2017:304). Currently, LCC is used to evaluate traffic engineering, bridge construction and highway materials and methods by the highway management and engineering industry (Di Mino, Salvo & Noto, 2014; Liu, Smartz & Descheneaux, 2015). In addition, LCC is a crucial procedure for estimating future costs in investment projects (Higham, Fortune & James, 2015:74) and analyses all associated costs throughout a proposed investment project's design life to determine the total cost of the project (Ranganath & Sarkar, 2021). Discounting future costs to present value is one of the crucial steps in carrying out an LCC analysis, which enables a fair comparison of design options (Algahtani *et al.*, 2021). Therefore, based on the extensive use of the practice in some other sectors, it may be valuable for evaluating the gold mining sector in Zimbabwe.

2.8.1 Overview of LCC

Life cycle assessment (LCA) does not consider financial aspects. However, it has grown in importance due to the setting of sustainability targets by several industries and governments, resulting in the LCC practice being implemented to include economic and environmental considerations (Kulczycka & Smol, 2016). During the past decades, people have become aware of the impact brought about by technological development and production on the environment, and all living beings, which has necessitated implementing LCC to improve the entity's sustainability (Munteanu & Mehedintu, 2016:65). Environmental life cycle costing (ELCC) (a combination of LCA and LCC) is the assessment of the economic dimension of production concerning the environmental impact and sustainable development. It is a practice of estimating the environmental impact of production (quantitative and qualitative), which can be used for measuring the progress of ecological activities of an enterprise (Biernacki, 2015:10). However, this study will only consider LCC, which is likely to be beneficial to the gold mining sector since it encompasses both the environmental and economic aspects. Since its objective is to promote sustainability, LCC implementation could help reduce the environmental impacts of the gold mining sector.

It is important to carry out investment projects in compliance with the sustainable development principles (Broman & Robert, 2017), and evaluate in terms of how it affects the environment, society, and the economy (Michelsen & Fet, 2010), which are aspects considerations that should be made and integrated (Kravanja *et al.*, 2012). In the European Union (EU) countries, there has been a dynamic increase in environmental protection spending (Tsireme *et al.*, 2012). The standards for financial support were initially fairly loose, but recently more investment projects that meet both economic and ecological standards have been adopted (Lewandowska *et al.*, 2013). It is arguable that if an investment project meets the standard regarding sustainable development, it could contribute to its economic, social, and environmental aspects.

The discussion in the above sections leads to the 9th content proposition:

Proposition Cp9: *LCC may be implemented in conjunction with MFCA by the gold mining sector following the principles of sustainable development, thereby considering the economic, social, and environmental aspects of an investment project.*

According to Adiansyah *et al.* (2017:114), mining is an activity that generates adverse environmental impacts. Therefore, more people now recognise the need for sustainable mining management to maintain their social licence to operate (SLO). The authors accentuate the importance of managing environmental impact by preparing a comprehensive environmental management plan. Mining operations could be hazardous to human health and the environment during the life cycle's exploration, production, and closure phases. Environmental monitoring, measuring activities, environmental audits, and control measures are all described in the environmental management plan, along with possible effects and dangers (Canberra: Department of the environment, 2014). The most prevalent techniques used to analyse the environmental effects of various systems include LCC, net present value, and cost best analysis (McLellan *et al.*, 2009; Erkayaoğlu & Demirel, 2016). All these practices can be used to assess if environmental management techniques for mining operations are feasible (Adiansyah *et al.,* 2017:114), although this study has chosen to adopt LCC. Recurring costs and environmental factors are the major concerns for energy projects. Hence, investment in projects needs to be optimised, with LCC emerging as the leading approach to evaluate energy projects (Soni, Singh & Banwet, 2016:26). Environmental impact should be minimised to prevent environmental disasters and prevent environmental disasters and to be able to obtain an SLO. Hence, choosing a practice that does that is essential to the wellbeing of the gold mining sector.

The expansion of the mining industry involves a significant investment in operating and capital costs (Adiansyah *et al.,* 2017). For example, a copper mine in Indonesia had an initial financial commitment of about US$1.8 billion (Newmont Corporation, 2016). A direct capital expenditure of AUS$726 million was incurred by the Pilbara iron ore mine in Western Australia (Gordon, 2014). During the planning stage, mining organisations conduct a financial analysis and use LCC and environmental valuation tools to evaluate various mining choices, such as power generation, processing technologies, and tailings disposal (Higham *et al*., 2015; Orfanidou *et al*., 2023). With the aid of these options, decision-makers may choose the best course of action for exploration, production, and post-mining (Adiansyah *et al.,* 2017:115). The importance of integrated economic and ecological decision-making has been strongly emphasised by scholars (Bierer *et al.*, 2015:1289). Therefore, based on cost, LCC becomes a critical factor to consider when assessing the viability of mining development projects.

LCC was developed to assist with the identification and documentation of all costs incurred throughout the span life of an asset as the life cycle cost (Munteanu & Mehedintu, 2016:69). Given that public procurement is essential in all countries, the business will be significantly affected by the public sector's greater emphasis on environmental performance (De Benedetto & Klemeš, 2010). It follows that businesses unable to provide information on their environmental performance and LCC of their products (Akhtar *et al.*, 2015) could encounter difficulties in the present and the future in obtaining contracts with the public sector (Kulczycka & Smol, 2016:830). Furthermore, environmental performance metrics are becoming more widespread across all economic sectors (Elms & El-Halwagi, 2010). Hence, improving techniques and procedures for evaluating environmental performance (Roos & Neto, 2017; Famiyeh & Adaku, 2018), especially for investments projects that impact the environment (Zhu, Wang & Zhang, 2014), is essential.

LCC analyses the internal and external costs of a product or production system (Mah, Fujiwara & Ho, 2018) and is used to make metrics more comparable regarding economic or financial benefits (Soam *et al.*, 2018). LCC is a comprehensive decision-making practice for calculating total costs which are generated over the entire life of services and products (Kádárová, Kobulnický & Teplicka, 2015). The implementation of LCC enables the potential cost drivers and cost savings of a product or service to be identified over its entire life cycle, and by comparing different alternatives, to choose the most cost-effective option (Auer, Bey & Schäfer, 2017). LCC was created within the engineering and construction sectors (Olubodun *et al.*, 2010:255). LCC and life cycle management go beyond the narrowly established objectives of least-cost design and optimisation, making LCC essential for planning (Asim *et al.*, 2014:41). Therefore, LCC is about expanding the traditional emphasis on production in all industrial dimensions to incorporate the environmental, social, and economic effects of a product throughout its entire life (Soni *et al.*, 2016:28).

Life cycle thinking for managing natural resources has become an essential practice to assess sustainable development due to its objectives of lowering energy resource use, in recent years due to its objectives of lowering energy resource use, as well as enhancing its socioeconomic performance during its life cycle, use, and emission to the environment (Soni *et al.*, 2016:28). Compared to other industries like forestry and construction, LCC has not been examined as much in the mining sector (Adiansyah

et al., 2017). The significance of consistently assessing LCC and environmental life cycle performance is emphasised in increasing studies (Schawab-Castella *et al*., 2009:430; Dong, 2018). However, most EMAPs are analysed concurrently and according to several scopes, which results in double effort and inconsistent analysis, thereby reducing the importance of the finding (Bierer *et al.*, 2015). Therefore, in pursuing a consistent way of evaluating projects, a more effective way of integrating the practices might benefit the gold mining sector more.

The discussion above leads to an enhancement of the previous proposition.

Proposition Cp9b*: LCC may be implemented in conjunction with MFCA by the gold mining sector to facilitate:*

- principles of sustainable development;
- economic, social, and environmental aspects of an investment project;
- the feasibility of environmental management strategies;
- cost savings; and
- enhanced decision-making.

2.8.2 LCC principles and implementation

LCC is essential since acquisition costs are smaller when compared to the total costs associated with owning and operating it (Al-Chalabi, 2018:359). An LCC analysis considers all relevant costs over a designated period (Rushing, Kneifel & Lippiatt, 2013). Relevant costs include all direct costs of acquiring, owning and disposing of an investment (Banerjee, 2022; Hald *et al*., 2021). Arguably, an integrated framework that identifies all relevant costs associated with the ownership of a gold mining organisation can be implemented in the sector.

LCC is recognised as a practice for assessing the total cost of ownership and informs decision-makers about alternative systems by evaluating the cost-effectiveness of the system investment (Harris & Fitzgerald, 2017:304). LCC is most useful early in the design process when alternative options that adhere to the same performance criteria, in terms of how much their start-up and operating costs vary, are compared to determine the most inexpensive system (Fuller, 2016). Tracking and accumulating costs and revenues attributable to the product over its entire life cycle is the significant difference between LCC and conventional management accounting (Vlachý,

2014:206). A typical LCC model has numerous distinct inputs, and as in the case of engineering products, there are warranty coverage period, costs of training, costs of installation, repairs, the material cost of failure, testing, travel time, documentation, and integration costs (Dhillon, 2010). Therefore, the viability of any LCC hinges on the availability of information spanning diverse locations and activities (Vlachý, 2014:207).

The drive to collaborate and provide the most significant value rather than the cheapest option for all important parties engaged in investment is now well established in some countries (Higham *et al.*, 2015:73). LCC also serves as a practice to control business performance, such as evaluating the effectiveness or ineffectiveness of measures taken in terms of the economy and the environment (for example emission targets) (Bierer *et al.*, 2015). It would be logical to assume that the appropriate built environment professional would value techniques like LCC in delivering early-stage project cost because newer forms of project procurement bind the design, production and operation phases of an investment together (Heijumgs *et al*., 2013; Janjua *et al*., 2019). In addition, LCC makes it possible to more accurately measure the long-term effects of operations associated with the life cycles of investment projects (Higham *et al.*, 2015:73). Hence, given that the gold mining sector is capital intensive, an integrated framework that will deliver economic and ecological benefits would work to the good of the industry.

Using LCC during the design of an investment project would make it possible to make better financial decisions on the long-term life of the planned asset (Higham *et al.*, 2015; Jayasuriya *et al.*, 2019). LCC could improve the sustainability of a planned investment project by considering difficulties with energy use and maintenance costs of various design options (Kelly & Hunter, 2009; Akinrata, 2016). Higham *et al*. (2015:74) assert that cost recommendations might be generated more accurately if LCC were used early in the project review process. The life cycle of a product forms the basis of LCC, and therefore, the financial data should be collected at the following stages of an LCA (Bierer *et al.*, 2015; Rickhof & Guenther, 2018):

- ***Step 1: Goal definition and scoping –*** systems divisions and functional components are established now. Therefore, LCC should be conducted for each identified and defined functional unit.
- ***Step 2: Life cycle inventory analysis –*** involves data collection and calculation procedures to quantify relevant inputs and outputs of a product.

- ***Step 3: Life cycle impact assessment –*** entails using the outcomes of step 2 to evaluate any potential environmental effects.
- ***Step 4: Valuation and interpretation –*** incorporates many environmental effect categories' weights and summations into a decision model.

LCC is a key strategy for making decisions about the life cycle that are economically and environmentally sound (Rossi & Sihn, 2013). It is a technique for cost management that assesses all financial trade-offs and repercussions that arise throughout the life cycle of an object, such as costs, revenues, and cash flows (Jasinski *et al*., 2015). LCC aids in cost-oriented decision-making across different life cycle phases and can therefore be used for identifying cost drivers, evaluating profitability, and comparing product and product technology designs and business strategies (Kadir *et al*., 2020). Hence, LCC enables decision-making for designing products and processes, purchasing and replacing equipment, and capital allocation and budgeting (Bierer *et al.*, 2015:1290).

2.8.3 Benefits of using LCC

LCC is based on the principles of the engineering economy to make the costs and benefits comparable by considering the time value of money (Blank & Tarquin, 2017). LCC can be used to develop life cycle budgets and conducted at any time during a project (Fan *et al*., 2016). Accordingly, future costs associated with a project are typically assessed using LCC as a cost evaluation technique (Janjua *et al*., 2019; Alasmari *et al*., 2022). LCC is a practice utilised to evaluate a project's expected economic performance throughout its life cycle (Gaus *et al*., 2022) and a method that aims to assess the overall design life costs of the materials or components used in the design of an investment project (Higham *et al.*, 2015).

LCC offers a valuable key to decisions involved in acquiring new systems through meticulous investigation of acquisition, operation, support, maintenance, and disposal costs to achieve cost-effectiveness in managing the new or existing assets (Alasmari *et al.*, 2022). For example, according to UK Treasury guidelines, value-for-money evaluations of public projects must be carried out using LCC to guarantee that end-user needs are satisfied by the investment project (Her Majesty’s Treasury [HM Treasury], 2022). Besides the merits of being valued by stakeholders involved in construction and procurement projects, LCC might be advantageous for client

organisations that want to be involved in their investment initiatives for a long time (Higham *et al.*, 2015:74). Accordingly, Opoku (2013) claims that commitment to a project for a long time and a desire to minimise ownership expenses throughout the project's life cycle, has been a key driver for commissioning LCC studies. Therefore, it is arguable that an integrated framework of EMAPs that considers requirements for end-users in the gold mining sector should be developed.

LCC can assist in evaluating sustainability and the project's economic and environmental implications (Caplehorn, 2012). The application of LCC is also becoming popular because of design decisions that contractors must make as part of private finance projects and public-private partnerships, including the type of risk involved and its long-term effects (Larsen *et al.*, 2022). LCC remains an essential practice to ensure the long-term success of investment projects, despite practical difficulties associated with implementation (Meng & Harshaw, 2013; Larsen *et al.*, 2022). The basic function of LCC is quantifying the costs associated with owning a facility throughout analysis (Dwaikat & Ali, 2018:303). LCC is a crucial method for making decisions about the life cycle that are both economic and ecological (Rossi & Sihn, 2013). It can be applied to facilitate design choice appraisal studies as well as evaluate current and foreseeable maintenance expenses (Higham *et al.*, 2015) and to predict “cash flows of an asset” for budgeting, cost planning, tendering and cost reconciliation purposes (Kelly & Hunter, 2009). However, to realise synergy effects, a framework that integrates various EMAPs may need to be developed so that the weakness of one is offset by the other.

LCC offers benefits in assessing the costs of projects, facilities, and equipment before a commitment to the project is made (Mishan & Quah, 2020). LCC, as a practise enables comparative cost assessments to be made over a predetermined time, where all pertinent factors, including initial capital and future operational costs, are considered (Janjua *et al.*, 2019; Mishan & Quah, 2020). Since LCC analysis entails assessing all cost components and translating them into a cost at a specific period, the three (3) key areas that should be considered (Olubodun *et al.*, 2010:255) are to:

- gather information on the component's capital, operating, maintenance, and disposal or replacement costs.

- establish assumptions about the asset's longevity and the lifespan of each part, as these factors will determine the asset's lifespan and how frequently parts will need to be replaced or maintained; and
- predict upcoming market circumstances, including interest rates, inflation, and risk.

These decide the discount rate that'll be applied to determine the present values of future cash flows and expenses (Oduyemi *et al*., 2014; Goh & Sun, 2016; Iraldo *et al*., 2017).

A literature review on the use of LCC includes product analysis using LCC (Zakaria *et al.,* 2020; Kneifel & Webb, 2020), LCC analysis in municipality organisations (Nubi *et al.,* 2022), and LCC and its application in the construction industry (Neugebauer *et al*., 2016; Safi *et al*., 2013; Petrovic *et al*., 2021). LCC applies to both new building projects and the investigation of preservation techniques for existing assets (Kulczycka & Smol, 2016:830). However, a product developed or purchased at the lowest initial cost need not necessarily be the one that will also provide the same utility at the lowest overall cost, as product ownership costs over the whole product lifecycle are essential, sometimes exceeding their acquisition costs by multiples (Vlachý, 2014:205).

In their investigation of a coalmine's LCC analysis in the Appalachia region of the United States, Epstein *et al.* (2011) accounted for the expenses of extraction, transportation, processing, and combustion. As a result, the economic analysis suggested fewer coal-fired power plants, cleaner smart networks, and a halt to mountaintop removal based on a waste stream that negatively affected human health and the environment. In some nations, using LCC in public procurement is advised as an economic analysis tool for engineering solutions that quantifies the disparate costs of alternative investment options for a particular project (Kulczycka & Smol, 2016; Heralova, 2017; Iraldo *et al*., 2017). In addition, the procedure is frequently employed in capital investment projects like building and construction (Kulczycka & Smol, 2016:831). Therefore, performing an LCC analysis helps to estimate a system's optimal replacement time (RT) to reduce the total ownership cost (TOC) of the system and increase its profitability (Al-Chalabi, 2018:359).

The construction industry has become a significant implementer of LCC since buildings are used and operated over a long period (Vlachý, 2014:206). However, for

buildings, operational costs are as high as the cost of construction (Opoku, 2013). Despite the long-term benefits of LCC, its adoption has been relatively slow in other industries (Vlachý, 2014), and its application and analytical approaches are also rather diverse (Dhillon, 2010). This study tries to bridge that gap by applying the concept to the mining sector.

2.8.4 Barriers to the implementation of LCC

According to Dhillon (2010), LCC has the disadvantage that it is costly and time-consuming, the acquisition of data for analysis is complex, and it has doubtful data accuracy. Moreover, the steps to be performed in LCC raise a lot of uncertainty (Olubodun *et al.*, 2010:255; Micheli *et al.*, 2020), raising the question of whether LCC is, in fact, of benefit to decision-makers. According to Olubodun *et al.* (2010:255), determining the expenses across the entire lifecycle may be complicated and challenging. As a result, many professionals in the field view LCC as a cosmetic procedure and are sceptical of its benefits (Oduyemi *et al*., 2014; Higham *et al*., 2015). Similarly, Safi et al. (2013) acknowledge that it is not entirely clear if the LCC outcome is relevant.

Furthermore, it is asserted that LCC analysis can be modified to state anything the particular endeavour desires (Bradley *et al*., 2018). Olubodun *et al.* (2010:255) concur, pointing out that the analyst chooses the discount rate used in LCC calculations based on the value for money. Therefore the analyst is bound to select that which is most appropriate for a given asset. This is mainly subjective since experience, knowledge, and intuitions are factors that come into play. Scholars have demonstrated that a discount rate that is too high will favour solutions with cheap capital costs for the immediate term, while a discount rate that is too low will favour future cost savings unduly (Olubodun *et al*., 2010; Bradley *et al*., 2018). Therefore, though not all the disadvantages can be overcome, integrating LCC with other EMAPs in an integrated framework will yield better results than when practice is used alone.

The application of LCC in projects is still limited and problematic (Gundes, 2016). Issues that have been cited relate to the cost of implementing LCC (Goh & Sun, 2016; Alasmari *et al*., 2022); a lack of reliable lifecycle cost input data (Oduyemi *et al*., 2014; Di Giuseppe *et al*., 2017); the requirement to predict aspects like lifecycles, maintenance, and future operating expenses over a lengthy period (Kovacic & Zoller,

2015); uncertainty associated with life cost assumptions, shortage of actual cost and performance information about mining along with the way project owners perceive the value of lifecycle benefits (Cox *et al*., 2020); and discount rates and inflation rates (Reddy, 2015; Mislick & Nussbaum, 2015).

The barriers to LCC were a lack of a common methodology for carrying out an LCC procedure, lack of capital and the high financial costs and prevailing interest rates which can induce investors on advanced investments to cut the operating costs, and the risk-laden assumptions on which LCC forecasts are modelled (Oduyemi *et al.*, 2014). Lack of formal guidelines, reliable past data, and difficulty in estimating future costs appear to be the main reasons for the tardy adoption of LCC (Reddy, 2015:18; Mislick & Nussbaum, 2015). Imperfect understanding of LCC and its application are also considered key barriers to the application of LCC (Mislick & Nussbaum, 2015; Dwaikat & Ali, 2018; De Giacomo *et al*., 2019).

LCC's financial orientation may compromise its use's reliability as a sustainability-based tool (Arshad *et al*., 2021). Life cycles are a barrier to implementing the practice; mere awareness of its potential does not provide a strong argument for its adoption (Kurczewski, 2014:594). Some researchers note that only a minority of practitioners use LCC to evaluate an investment project design (Opoku, 2013). Scholars advocate the formation of a forum that would enable the sharing of information and comments to address the issue of data scarcity (Berawi *et al*., 2018; Richter *et al*., 2019).

An issue preventing LCC from being used more widely has been recognised as a lack of awareness of the approach and its advantages, which is why a standardised manner of application is required (Olubodun *et al.*, 2010). Kirkham (2005) favours an LCC analysis standard technique (Jayasuriya *et al*., 2019). However, some authors contend that there is already enough information about LCC practises and guidelines; more training is required, such as holding seminars on the usage of the technique (Perera, Morton & Perfrement, 2009). Additionally, using LCC is compromised by a lack of integrated thinking (Bradley *et al*., 2018) when each investment project's component, whether planning, maintenance, or reclamation, is taken into account independently, which is against the LCC concept (Higham *et al.*, 2015). Furthermore, applying LCC analysis in projects has been significantly constrained by bureaucratic systems influencing public sector client organisations.

Figure 2.1 portrays the vicious circle of LCC implementation.

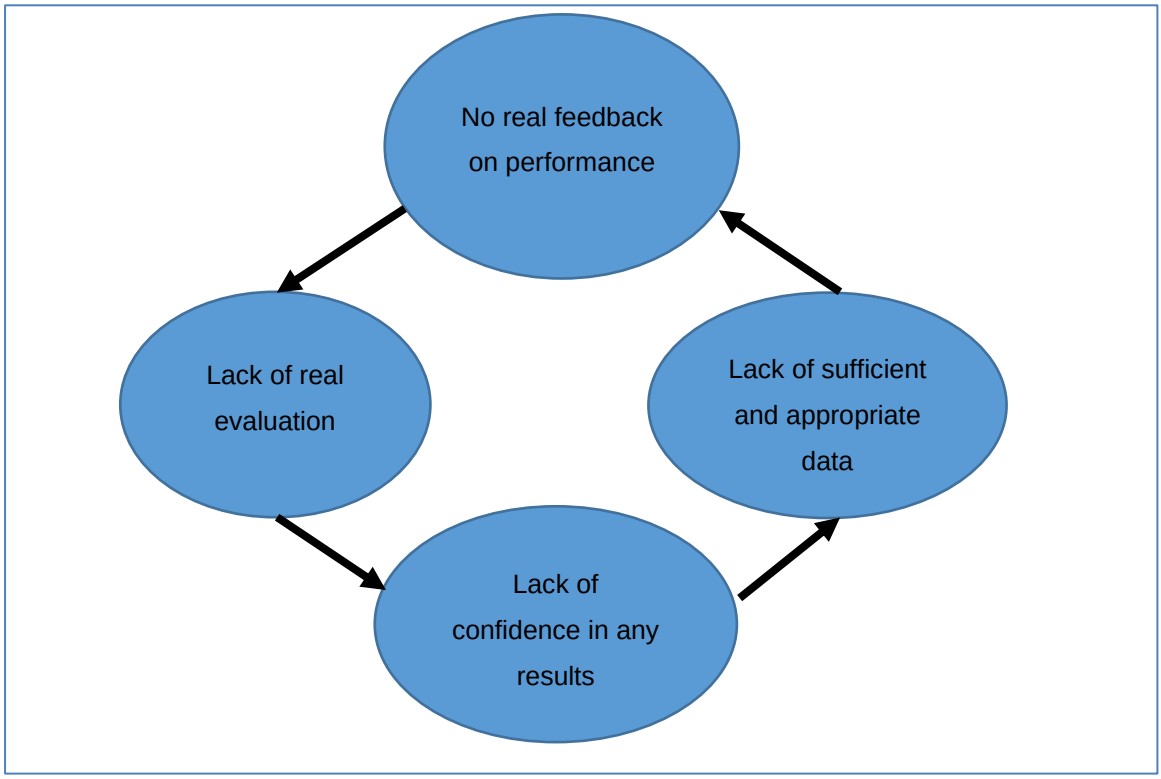

Figure 2.1: The vicious circle of LCC implementation

Source: Al-Hajj (1999)

Figure 2.1 illustrates the lack of evaluation feedback to those who would have implemented LCC, making it difficult to evaluate progress made. In addition, a lack of data would end up affecting confidence. The arrows show the relationships of the blocks. A lack of actual evaluation implies that no real feedback on performance is carried back to the design stage of similar assets. Therefore, a lack of reliable and appropriate data is inevitable, resulting in a lack of confidence (Lu *et al*., 2021; Thang, 2021). Hence, LCC as a provider of information to decision-makers, could be doubtful and inconclusive. Therefore, LCC should be consistent with successful development practices and simplified for use as a common practice, which could be achieved by combining methods and practices into a framework (Reddy *et al.*, 2015).

2.8.5 Application of LCC to the mining industry

There is pressure on the mining industry to reduce the environmental effects of its operations on a global scale (Murguia *et al*., 2016). Solid wastes salted mining waters, problems with dust and fumes, and solid waste management are Poland's significant

environmental issues. The most significant move made by the Polish government to address the issue was the introduction of a new regulation for the mineral industry with severe fines and penalties for environmental pollution (Akhatar *et al*., 2021). As a result, organisations started looking for ways to reduce these expenses (Burchard-Dziubinska, 2019).

Because reducing environmental impact, costs, and waste management are the main goals of mining firms, using LCC can result in a model for the expected environmental impact that is accurate and affordable (Eddine & Salah, 2012; Liu *et al.*, 2021). LCC helps compare project options that meet the exact performance requirements but differ in initial and operating expenses to choose the option that minimises costs (Fuller, 2016). Since environmental issues are affecting the mining industry globally, given the substantial amount of material that should be transported and processed, it should be acknowledged that mining and metallurgical processes are environmentally detrimental: Mining-related garbage makes up over 29% of the average yearly waste generation in the EU (Di Maria *et al*., 2018; Mah *et al*., 2018). Therefore, having LCC within the integrated framework of EMAPs ought to help the gold mining sector minimise environmental impacts and assist in waste management.

2.9 ACTIVITY-BASED COSTING (ABC)

ABC includes activities needed to produce an item when assigning the manufacturing overhead of a product (Al-Qudah & Al-Hroot, 2017:271). Furthermore, ABC measures the costs of related activities through all resources used to manufacture products (Tsai & Jhong, 2018:1151), as well as tracing related costs into cost centres (Kumar *et al.*, 2022), thereby improving the accuracy of product cost information (Eijk, 2020). Therefore, implementing ABC may assist the gold mining industry cope with environmental pressures and estimate production cost since the practice has a dual role.

2.9.1 Overview of ABC

Human beings have over-exploited resources to pursue more comfortable living, which has resulted in substantial waste production and environmental harm (Warwick, 2018; Berners-Lee, 2021). Efficient use of available resources, or even extending their life cycle and recycling them, would help in preventing the waste and over-exploitation of

resources, thereby enhancing environmental protection (Yang & Chang, 2018:27). ABC can model the use of all resources in all the activities performed with these resources and linked to products (Zamrud & Abu, 2018). The tool has become a very successful practice within the business sector to deal with the scarcity of resources by enhancing the efficiency of resource allocation and performance evaluation (Singh *et al.*, 2018). Where many products are being produced, there is advancement in technology, and many machines are being used, ABC has been observed to work very well (Al-Qudah & Al-Hroot, 2017). Furthermore, ABC uses various drivers to allocate costs (Tai, Wang & Chang, 2012), which is likely to improve the accuracy of the cost object when compared to traditional costing, leading to more appropriate management decisions (Tai, Wang & Katrichis, 2015:260).

Unlike traditional costing, ABC is intended to prevent cost distortion in product costs (Alsmadi, Almani & Khan, 2014). The tool recognises that all products and services lead to activities, leading to the use of resources that generates costs (Haroun, 2015:262). This tool differs from traditional costing in that it considers the causes of the costs involved (Tai *et al.*, 2015:264). ABC has the edge over traditional costing in that managers are interested in evaluating the effectiveness of resource allocation in their organisations (Drury, 2020). Activities have been considered the reason for resource consumption in recent years. Therefore more reliance has been placed on ABC, which derives cost drivers from activity considerations (Tai *et al.*, 2015:264). Previously, the distortions meant managers were poorly served when deciding product prices and strategies (Jackson, 2010:338). By contrast, ABC focuses not on the cost object but on activities that produce the product or service (Tran & Thao, 2020). The activities of labour, materials, machinery, space and other corporate overheads are seen to consume resources (Jackson, 2010:338). Costs can be traced to products and services that consume the identified activities (Abd-Allar & Abd-Alkadm, 2023) via the use of cost drivers (factors that create demand for particular activities) (Oraby, 2021). Therefore, there may be a need to implement ABC within the gold mining sector to provide enough information for managers to be able to evaluate options at their disposal to make the sector greener.

ABC is a cost accounting technique that concentrates on the tasks carried out within an organisation (Mahal & Hossain, 2015). The authors add that ABC minimises waste

by providing a process view where costs are allocated to cost pools, thereby preventing distortions that result from conventional costing, in which each indirect expense is grouped into its cost pool. Drury (2020) categorises ABC into the following four (4) steps:

a) identifying the activities,
b) assigning costs to activity cost centres,
c) deciding on the most relevant cost factors to use when tying the cost of the activities to the objects and
d) Allocating activity costs to products.

Like traditional costing, ABC uses a two-step process for allocating costs to products and services (Tsai *et al.*, 2011, 2012a). The first stage involves assigning resource costs by resource drivers to activity cost pools divided into different activity levels like unit, batch, product, and facility (Tsai *et al*., 2015). Compared to traditional costing, which ignores non-volume related overhead costs, ABC uses a significant number of cost pools to analyse non-volume related overhead costs like security (Wahidi *et al*., 2021), as shown in Figure 2.2. First, costs are allocated to cost pools (Tsai *et al.*, 2013), representing the essential activities in the production process. Then, costs are allocated from each activity cost pool to each cost object according to how much of the activity is used by the cost object after cost drivers for each cost pool have been determined (Abu *et al.*, 2017) in the second phase, via activity drivers, which are activities that incur costs (Hilton & Platt, 2019). These assess how much activity products or services consume (Tsai *et al.*, 2012). Hence, ABC ought to help the gold mining sector assign costs to charge things according to the activity drivers that accurately measure the consumption of the activity.

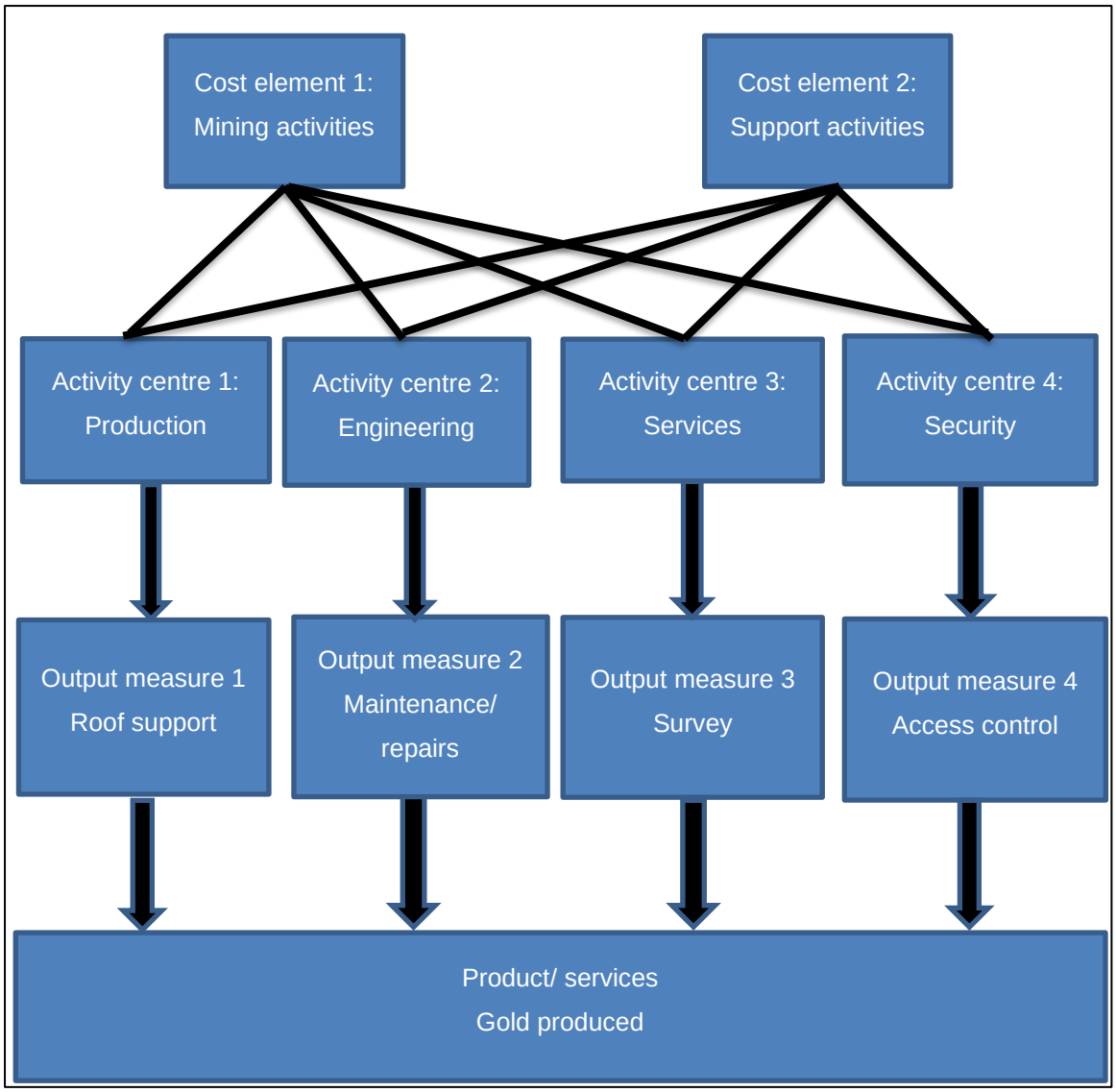

Figure 2.2: Simplified activity-based costing system

Source: *Adapted from Lind (2001:79)*

Figure 2.2 illustrates a two-stage process for allocating expenses to cost items from cost pools. In the first stage, overheads are assigned to cost pools using resource drivers. In the second phase, costs are allocated from the cost pool to the cost object, following how much of the activity was used by the cost object.

2.9.2 Application and benefits of ABC

Some organisations have abandoned ABC because of limited results and difficulties implementing and maintaining it (Krishnan, Mistry & Narayanan, 2012). Though prior research has found little connection between ABC use and organisational performance (Charaf *et al*., 2022; Vetchagool *et al*., 2020), ABC provides a richer

information base that leads to new management insights, thereby providing management with information since they are responsible for taking new actions that lead to value enhancement (Hansen *et al*., 2021). Research has shown that ABC has been utilised to analyse various managerial decisions, including environmental management (Chea, 2011; Al-Dhubaibi, 2021), pricing, quoting, product mix and joint product (Tsai *et al*., 2013), outsourcing (Drury, 2018), and quality improvement (Tsai & Lai, 2018). Studies have concluded that ABC assists with production-related decision-making and the identification of facility investment value (Tsai *et al.*, 2011). ABC is committed to accurately allocating overhead product costs (Tsai *et al.*, 2015:453). ABC provides a better estimate of production costs and the price of each particular production activity (Tsai *et al.*, 2011).

In those organisations that have implemented ABC, it has been estimated that it reduces costs by between 3% and 5% whilst increasing revenue growth by between 5% and 15% (Orji & Wei, 2016; Finta, 2017). For instance, ABC was applied in the Taiwan electrical industry, minimising environmental impacts and maximising organisational profits (Tsai *et al.*, 2015). In addition, ABC is a better method of allocating overhead costs, managing costs, and assessing product profitability as a methodology for the costing and monitoring of activities involved in tracking resource consumption and costing final outputs (Lan *et al*., 2020). Consequently, ABC accurately measures the costs a cost object would have consumed.

The discussion in the above sections leads to the 10th content proposition:

Proposition Cp10: *ABC may be used with the aforementioned accounting strategies to assist with product-related decision-making for the gold mining sector since it focuses on accurately assigning product overhead costs.*

In reviews of the relationship between ABC and various issues, it was discovered that ABC could produce the accounting data required for TQM to analyse costs, can be utilised by managers in SCM to enhance the allocation of logistic costs to cost objects, and can help improve profits and operating performance when applied with activity-based management (ABM) (Mahal & Hossain, 2015). In addition to its capacity to increase economic performance as a result of enhanced environmental performance, ABC enhances understanding of the business process connected with each product by exposing where value is gained and where it is being wasted (Almeida & Cunha,

2017). Mahal and Hossain (2015) emphasised the possibility of using ABC in educational settings by categorising and allocating costs to the different activities based on the time spent. Hence, the adoption of ABC in the gold mining industry is likely to add value to the sector by providing accurate cost assignments.

The drawback of the traditional costing practice is that it does not focus on the activities that enhance the value that consumers receive; by focusing on calculating the costs incurred on performing the activities of manufacturing a product or rendering a service, ABC is useful in distribution of overhead costs in proportion to the activities performed in a specific job and thus provides more accurate cost estimates (Haroun, 2015:262). The major advantage of ABC is that it allocates the overhead costs with a direct causal link to the actual resources consumed (Rchid, Bouksour & Beidour, 2013). The advantages of ABC are its ability to provide effective estimates of the overhead for a product, to provide a more precise understanding of cost drivers, to charge items with costs, and to identify non-value-added costs (Garrison, Noreen & Brewer, 2010). Consequently, contrary to typical costing, ABC strongly emphasises actions that benefit the clients.

Some of the advantages of implementing ABC are product profitability assessment, performance evaluation of divisions according to cost difference, high-level competitive advantage assessment decision for the allocation of cost drivers, internal service recipients and resource and cost estimation (Erdil, 2020; Calvalho *et al*., 2021; Quesado & Silva, 2021; Kwistianus *et al*., 2022). ABC adds value by assisting organisations with improving operational efficiency, creating innovative management processes, and profitability management (Drury, 2018; Quesado & Silva, 2021). In addition, ABC can calculate product costs more accurately, reduce waste and improve the effectiveness of business performance (Mahal & Hossain, 2015; Yang & Chang, 2018). Profit advantage combines the most profitable strategic model, the most effective activities flow and competitive advantage (McGrath, 2013). ABC is, therefore, endorsed as the only management practice that assists organisations in achieving the above advantages by integrating their vision processes, indicators, management information and action plans (Yang & Chang, 2018:34). Therefore, ABC provides strategic benefits through improved information for strategic decision-making in addition to operational benefits from a better understanding of customers, production activities and cost drivers (Shin, Sudhir & Yoon, 2012).

2.9.3 Limitations and reasons for non-implementation of ABC

Since its inception in the middle of the 1980s, ABC has been the focus of many studies and publications (Allain & Laurin, 2018:181). The major drawbacks of ABC are the system's complexity, costs and length of implementation (Al-Qudah & Al-Hroot, 2017:272). ABC was found to be underused by local and multinational organisations in many countries (Samapa *et al*., 2012; Rundora *et al*., 2013; Quinn *et al*., 2017). When the contextual factors influencing the idiosyncrasies of product costing were examined, ABC adoption was found to be at 15% in UK organisations (Al-Omiri & Drury, 2007). Seven (7) nations—Japan, USA, Canada, UK, France, Italy, and Germany—were used to examine the amount of ABC acceptance in organisations regarding perceived usefulness, speed, and success of ABC implementation. It was discovered that organisations' perspectives on ABC's value varied widely (Bhimani *et al.*, 2007). In sum, studies report that ABC is used by an average of 15–18% of organisations (Stratton *et al.*, 2009; Schoute, 2011). Only a small proportion of South African organisations have implemented ABC (Wessels & Shotter, 2000:216). Therefore, this study will contribute to the literature by developing an integrated framework of the EMAPs, including ABC.

Despite its global acceptance, several studies have reported many difficulties that prevent ABC from being adopted (Fadzil & Rababah, 2012; Nassar *et al*., 2013). Resistance to change is the main justification (Allain & Laurin, 2018:181). The opposition may stem from political or cultural factors or be brought on by a sense of irrelevance (Malmi, 1997), senior management's lack of support, lack of resources and cost difficulties associated with cost system modelling. In the management literature, a thorough knowledge of the causes of the challenges encountered during ABC implementation appears absent (Allain & Laurin, 2018:182).

In addition to the above, other problems identified as hindrances to the successful implementation of ABC range from problems of accumulating the necessary data to the identification and selection of activities and cost drivers (Hansen *et al.*, 2021), competition with other innovations such as JIT (Kumar & Mahto, 2013; Babu & Masum, 2019), because ABC is so sophisticated, using and implementing it takes a lot of effort and money (Chea, 2011; Ramamoorti *et al.*, 2013; Almeida & Cunha, 2017), and maybe a group policy that requires organisations within the group to implement other

practices for costing rather than ABC (Brayton & Mishchenko, 2010; Chiarini, 2012).

The other reasons for non-implementation of ABC may be that an organisation has a higher priority like penetrating the market, which might compete with ABC implementation for resources (Nassar *et al*., 2013; Alsayegh, 2020), the organisation may be satisfied with the alternative costing practice currently in use and see no need for change (Waweru, 2010; Bums *et al*., 2013), Organisations may take a while to understand ABC's benefits and costs (Sorros *et al.*, 2022), and some organisations have the perception that ABC is no more accurate than traditional costing. Hence, it is not worth investing in the technique (Ahmad, 2014). The financial managers of these organisations may have obtained their financial credentials before introducing ABC, making it difficult for them to comprehend the concept (Ramamoorti *et al.*, 2013). Hence, understanding these limiting factors would help decision-makers produce strategies to overcome them.

The other reasons cited in the literature for the low adoption of ABC are perceived technical or organisational difficulties (Quinn *et al*., 2017; Madive *et al.*, 2020). Organisational problems normally encountered during the implementation of ABC are viewed as the biggest hindrance to its success (Oseifuah, 2014). Instead of technical problems and features, the challenges with implementing ABC seem tied to managerial characteristics (Allain & Laurin, 2018). Too much data is required to implement ABC (Balakrishnan, Labro & Sivaramakrishnan, 2011), so employees should conduct time-consuming and expensive regular surveys to determine the time spent on various activities (Stout & Propri, 2011; Namazi, 2016). Employees also make subjective estimates in ABC surveying which raises doubts about accuracy (Namazi, 2016; Park *et al*., 2019).

These difficulties associated can only be explained because a cost system can be viewed as a part of the larger management control system package (Malmi & Brown, 2008; Zimmerman, 2016). Accordingly, when one analyses the dysfunctional effects of improper use, the concerns related to the fundamental applications of a systems package component are crucial (Mundy, 2010). Literature on the challenges of cost system implementation may be influenced by problems with using a cost system (Malmi, 1997). Therefore, it has been argued that using a cost function system (enabling or controlling) should be considered during the implementation stage (Allain & Laurin, 2018:182).

It might be assumed that ABC can be employed in a variety of ways because it can be said to serve many functions, which may inhibit implementation (Allain & Laurin, 2018). Researchers revealed a lack of an integrated information system which prohibited the collection of some accounting data, resulting in insufficient information for ABC (Cannavacciuolo *et al.*, 2015). Jasch (2009) notes that production lines and products that used to perform well and were profitable may suddenly perform poorly after adopting ABC. Researchers consider ABC practice-oriented in the long term, which links the cost of resources utilised in production to products (Allain & Laurin, 2018). ABC works on the assumption that all costs will change according to output. This will not be the case where there are numerous fixed costs in the near term, like labour, rent, and equipment, which are incurred whether there is production or no production (Alsmadi *et al.*, 2014:911). The other problem is the identification of cost drivers for each activity (Haroun, 2015:262). Therefore, ABC may give wrong information in the short term by not reflecting on the actual costs of cost behaviour (Altawati *et al*., 2018; Drury, 2018).

2.9.4 Critical success factors in implementing ABC

The success of the ABC implementation is measured by how much management uses the ABC data to inform decisions to enhance financial performance (Alsayegh, 2020; Al-Dhubaibi, 2021). It can be evaluated by considering both the degree of general success and the accomplishment of a specific stage of implementation (Intakhan, 2014:290). The success of ABC implementation was measured using a variety of practices, namely measurement based on the decision-making processes that use ABC information, management appraisal of ABC's overall success, decisions made using ABC information, and finally, dollar improvements as a result of ABC (Kitsantas *et al*., 2020; Tran & Tran, 2022).

Surveys have been conducted to pinpoint crucial success elements of implementing ABC (Alsayegh, 2020; Al-Dhubaibi, 2021). For example, support from senior management, ABC training, and connections to performance measurement and evaluation and compensation links have been identified as key factors crucial to the successful implementation of ABC and therefore have been hypothesised and empirically demonstrated (Oseifuah, 2014; Mohamed, 2020; Raucci & Lepore, 2020; Yang *et al*., 2020). In addition, the adequacy of resources and links to quality initiatives

have been noted to significantly influence the success of ABC in organisations (Vetchagool *et al*., 2020; Quesado & Silva, 2021; Kitsantas *et al*., 2020). For instance, a Canadian study of business units discovered that every stage of ABC implementation is impacted by organisational structure (Gosselin, 1997), while in an Australian study, organisational culture was found to play a significant role in the success of the implementation of ABC (Baird, Harrison & Reeve, 2007).

Top management support is the most significant success factor (Nassar *et al.*, 2013; Hansen *et al*., 2021). Top management support is the level of apparent support for ABC from top managers (Jimenez *et al*., 2020) and has been identified as associated with ABC's success (Burket & Lueg, 2013; Al-Sayed & Dugdale, 2016; Narsaiah, 2019; Gosselin & Journeault, 2022). Management support has been identified as a prerequisite for successfully implementing ABC (Faria *et al.*, 2018; Husin & Khairudin, 2019). The ability of the organisation to connect the performance evaluation system to ABC is another crucial success factor (Moeuf *et al*., 2020). The extent to which organisations enhance compensation, including bonuses and promotions, in proportion to the quality of ABC is referred to as links to performance evaluation (Intakhan, 2014). In addition, ABC should adhere to the strategic objectives of the organisation if it is to succeed (Lanen *et al*., 2013; Hansen *et al*., 2021). The other critical success factor is that ABC should be linked to quality, necessary cultural attributes, orientation, attention to detail, and innovation (Fei & Isa, 2010; Rohn *et al.,* 2021). The lack of competing initiatives could restrict the resources available to ABC's competitors and play an essential function in implementing ABC.

Another crucial success component is ABC training, which enables staff to comprehend how ABC differs from traditional accounting and why it is preferable (Allain & Laurin, 2018; Wahab *et al*., 2018). This refers to the training level needed to decide how to use, execute, and design ABC (von Brandt-Siemers, 2019). ABC training improves the skill level of employees (Nair & Tan, 2018), and is essential for ABC's success (Intakhan, 2014). Therefore, top management support may be required to signal to the organisation the importance of the practice. Lack of such involvement is evident when top management fails to provide funding for implementing the system and fails to help people implement ABC. Arguably, employees need to be trained to educate them on the reasons for adopting the practice and how it works to reduce its resistance level.

Limited resources are a major stumbling block in implementing ABC preventing the project from starting (Nkuna, 2018). Adequate resources relate to the personnel and materials needed to perform the ABC tasks (Intakhan, 2014:293) effectively. An ABC project requires plenty of resources in the form of people, time, software, hardware, and an ABC team (Chea, 2011; Chiarini, 2012). According to Shields (1995), there were low resistance levels in organisations with sufficient internal resources. On the other hand, researchers have cited a lack of resources as an essential hindrance to the execution of ABC (Fadzil & Rababah, 2012; Nassar *et al*., 2013). Therefore, management should make available enough resources if ABC is to succeed.

The discussion above leads to the 11th content proposition and 6th association proposition:

Proposition Cp11: *The gold mining industry in a developing economy with limited resources may benefit through adopting and integrating various EMAPs, notably MFCA, LCC and ABC.*

Proposition Ap2: *An association is needed between applying EMAPs and meeting the objectives and goals of a gold mining enterprise.*

2.9.5 Association between ABC and the performance of an entity

Researchers who sought to evaluate the impact of applying ABC concerning financial performance found a positive association between the application of ABC and financial performance when the practice was implemented in complex organisations with costs that are comparatively essential (Al-Qudah & Al-Hroot, 2017; Fei *et al.*, 2017). A significant impact on organisational value was found in organisations implementing ABC in the UK (Askarany & Yazdifar, 2012). Efficiency and effectiveness were found to have increased in organisations implementing ABC in Australia (Zaman, 2009). However, Pokorná (2016) found that organisations that had implemented ABC had the same or, in some cases, lower average financial performance compared to those that had not implemented the systems in the Czech Republic. Therefore, it is plausible that the implementation of ABC can assist the gold mining sector in improving its profits.

From the general discussion of all EMAPs, we may infer that,

Proposition Cp12*: Top management support is essential for successfully implementing all EMAPs.*

2.10 ACCOUNTING SOFTWARE

To perform day-to-day operational work, accountants use various accounting software applications (Do *et al.*, 2020). There is evidence that information communication technology (ICT) is an effective and efficient accounting system leading to increased organisational performance (Thottoli, 2021:2). Even though ICT uses both computer software and hardware in recording accounting information (Knapp, 2019), most accounting software is user-friendly to accountants, enabling them to perform accounting tasks accurately and timeously (Xu, 2020). Furthermore, the traditional system of recording, which was in use, has been replaced by computerised accounting systems in most organisations (Phyu & Vongurai, 2020). Therefore, the use of accounting software can be combined with EMAPs which may help to make timely availability of environmental accounting information.

Based on the importance of the connection between ICT and accounting function, continuous efforts must be made to equip accountants with ICT skills and knowledge that will help them perform their tasks accurately (Turner, Weickgenannt & Copeland, 2020). The use of accounting software has superseded the limitations of manual systems, such as incomplete records (Kumar, 2020). In addition, the use of accounting software has revolutionised the accounting function. It involves transactional entity, data storage and the preparation of financial statements, which have impacted the decision-making of stakeholders who use accounting information (Thottoli, 2021). It has been argued that using accounting software has improved the internal control systems employed by organisations (Turner *et al.*, 2020). Hence, the management accountant should have the knowledge and skill to use at least one accounting software. One must remember that accounting software is an essential accounting information system (AIS), which offers timely, accurate and reliable information to all key stakeholders of an organisation (Thottoli, 2021). It has been argued that accounting software allows companies to record and manage financial statements in an orderly manner, thereby reducing many mistakes that arise from manual recording and calculations (Paul & Sadath, 2019). Hence, organisations that use accounting software are likely to produce reliable accounting information that will likely help an entity's stakeholders.

2.11 SUMMARY

The demand for minerals in emerging and developing economies has led to an increase in global mineral extraction. Rising gold prices have triggered a boom in the gold-mining sector, attracting many artisanal and small gold miners. However, the sector uses toxic chemicals that threaten the economy, community, and environment if they are not controlled. Furthermore, the expansion of the mining sector has an opportunity cost since it competes for land with other potential uses of the same land, such as agriculture. On the other hand, mineral resources are essential for industry development in any economy since they are required as inputs. It must also be remembered that mineral resources cannot be considered infinite, and whatever comes from mining activities must be used wisely for all benefits. Despite positive contributions, mining can be very destructive to the environment, so the sector needs to be watched.

MFCA was initially presented as an EMAP created especially to collect waste-related information and used to enhance waste-reduction decisions in an overview of EMA. Any economic sector, including the mining industry, can use MFCA. Due to its capacity to track the flow and inventories of resources in both physical and monetary units, including materials, energy, water, waste, and processes, MFCA has become increasingly significant. This capability might be particularly beneficial to the gold mining industry. The MFCA improves goal management by systematising and scientifically measuring material flows. This is because identifying waste would result in a search for solutions to waste, eventually translating to waste reductions and eventual cost savings. The result would be an increase in the profitability of the gold-mining sector.

MFCA provides a sound waste recovery framework recognising waste as a non-marketable product. This is useful in the decision-making process and ensures that the product cost is not overstated since this waste should be removed from the cost of a product. MFCA is governed by ISO 14051 and 14052; hence it is a standardised practice recognised internationally with a proven record, which is suitable for the gold mining sector of Zimbabwe. Furthermore, MFCA has as its major objective to support organisations to improve their environmental and economic performance simultaneously. Therefore, it is good for the gold mining sector since its major objective

is profit maximisation. The benefits of MFCA are enhanced quality of corporate information, cost reduction, environmental impact reductions and increased employee motivation because of its comprehensive structure of material flows. This practice has been applied in many sectors and has proved to be very effective in waste-reduction decisions that will benefit the gold mining sector.

The next section of the chapter discussed LCC, an EMAP developed to make decisions concerned with engineering systems. LCC results in correct investment decisions since the practice considers the investment cost of investment and operating costs. LCC considers the whole chain, from pre-production and production to post-production. LCC has been used in many sectors of the economy in different countries and applies to the gold mining sector. Its major advantage is that it encompasses an investment project's environmental and economic aspects. LCC aims to promote sustainability and, considering the impact of the gold mining sector on the environment, is a practice likely to assist with sustainability issues in the gold mining sector.

LCC integrates a project's economic, social, and environmental aspects as a decision-making tool for estimating the costs anticipated to be incurred during a project. Before they are implemented, environmental measures for a gold mining operation can be evaluated for viability using LCC, which helps reduce the industry's negative environmental effects. LCC is also a vital technique used in cost management. Although the primary goal of the gold mining industry is profit maximisation, LCC goes beyond the traditional focus on production in all aspects of the mining industry by considering an investment project's environmental, social, and economic performance throughout its whole life.

Over the years, LCC has become an essential practice for managing natural resources since it is used to assess sustainable development and has as its goal the reduction of energy use and emissions into the environment. In addition, LCC helps identify and own relevant costs associated with ownership of an investment project. Of course, LCC has its drawbacks; however, since it will be integrated into a framework with other practices, the others might overcome its drawbacks.

The last section of the chapter reviewed ABC as an essential EMAP to be used in developing an integrated framework for promoting greener gold mining in Zimbabwe.

ABC was a response to the drawbacks of traditional costing, which had failed to give accurate costs of products and services. A flawed costing system encouraged decisions that led to losses in the long run. As a capital-intensive sector, the gold mining sector may benefit from an integrated framework of EMAPs that produces accurate cost assignments for decision-making. In light of globalisation, organisations should adopt new strategies and innovations like ABC to maintain a competitive advantage. An efficient EMAP that provides accurate costs of products is essential to improving the performance and competitiveness of an organisation within the global village.

Organisations have therefore been encouraged to adopt modern costing practices (ABC included) because of the drawbacks of traditional cost accounting. ABC has gained recognition because of its ability to deal with scarce resources since it can enhance resource allocation and performance evaluation, which will benefit the gold mining sector. ABC help with production-related decision-making and the identification of investment value. This will be beneficial to the gold mining sector. ABC focuses on activities that improve the value received by the customer.

The next chapter will review the institutional theory underpinning the study: the related stakeholder and sustainability theories. Finally, the preliminary framework of the study is developed at the end of chapter 3.

CHAPTER 3: THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1 INTRODUCTION

The previous chapter discussed the environmental impacts of mining, focusing on geographic, social, and economic aspects. In addition, the chapter also discussed the EMAPs used in developing an integrated framework, especially MFCA, LCC and ABC. MFCA was included because of its ability to trace the flow of materials and quantify them into products and non-products, while LCC was chosen because of its ability to guide investment decisions, which could help the gold mining sector. Finally, ABC was chosen for its ability to provide accurate cost assignment, which could also help the gold mining sector in decision-making.

3.1.1 The goal of this chapter

This chapter will review the institutional theory underpinning the study and the related stakeholder and sustainability theories. The chapter ends with the development and presentation of the preliminary framework.

3.1.2 Chapter layout

The chapter discusses the institutional theory (the major theory underpinning study), and the stakeholder and sustainability theories (related theories) used in this study. Section 3.2 provides the theoretical position. Section 3.3 discusses the research's major theory and explains coercive, mimetic, and normative pressures. The use of institutional theory is discussed in section 3.4. Stakeholder theory is discussed in section 3.5, and sustainability theory in section 3.6. Section 3.7 presents the conceptual framework. Finally, in section 3.8, the chapter is summarised.

3.2 THEORETICAL POSITION

Three (3) theories were identified as providing the lens for this study, and these are institutional theory (major theory underpinning study) and stakeholder and sustainability theories (related theories). These are discussed below.

3.3 MAJOR THEORY UNDERPINNING STUDY: INSTITUTIONAL THEORY

The institutional theory was initially introduced as an alternative to theories assuming

that organisations are independently rational actors (DiMaggio & Powell, 1983). Berger and Luckmann refined the theory by addressing the nature and origin of social order (Scott, 1987). Scott argues that social order is founded on a common social reality, which humans build via social interaction. Institutionalisation is the process by which individual actors transmit what is socially defined as real or taken for granted as part of this social reality (Zucker, 1977). The interaction between these institutional pressures will likely moderate their influence on organisational practices (Delmas & Toffel, 2004:214). Hence, through social interactions, organisations share and shape each other. When some of the gold mining organisations adopt EMAPs, this may send a signal to others, and they may be forced to respond in similar ways. Therefore, the gold mining sector may need to be infused with the values of EMAPs, going beyond technical requirements to foster a culture in all key stakeholders.

Organisations that society regards as legitimate can access vital resources like labour and finance without resistance (DiMaggio & Powell, 1983; Heugens & Lander, 2009). To avoid social processes becoming enshrined and institutionalised, organisations are motivated by legitimacy concerns to change their organisational structure and incorporate sound environmental practices (Comyns, 2018). Institutions represent formal and informal rules within a society, while the relevant organisations embody these rules (Andrews-Speed, 2016:217). Institutions are defined as regulatory, normative, and culturally cognisant components that give social life stability and meaning along with related activities and resources (Scott, 2013:56). Besides constraining behaviour and change; institutions enable change through their inherent ambiguity, which can empower actors to experiment and learn (Jackson, 2010). An integrative framework of EMAPs may be viewed as a formal rule within the gold mining sector and direct organisations to initiate activities promoting greener gold mining. Therefore, institutional forces should help stabilise the gold mining sector in green initiatives.

The institutional theory proposes that organisations operate within a social network, which is a strong motivating force underlying an organisation's behaviour (Lin & Sheu, 2012:534). The institutional theory offers a theoretical framework through which researchers can identify and investigate forces that support the continuation and legitimacy of organisational practises, including elements like culture, the social environment, rules, tradition, and history, as well as economic incentives, while also

acknowledging the importance of resources (Bruton, Ahlstrom & Li, 2010). Therefore, an integrated framework for the gold mining sector ought to assist in promoting environmental management initiatives within the gold mining sector.

Lin and Sheu (2012) argue that non-economic motivations like culture, laws and regulations can shape the form and behaviour of organisations. Institutional theory can be used to describe how decisions about environmentally friendly activities and environmental management are impacted by modifications in societal values, technical improvements, and legislation (Ball & Craig, 2010). The researcher explored how various organisational methods resulted in the adoption of EMAPs using institutional theory (Delmas & Toffel, 2004). Institutional environments may influence organisations through the logic they legitimate and the governance systems and rules of social action they support (Scott *et al.*, 2000). Various elements influence organisational decisions, including social and cultural norms, concerns about legitimacy, and rational efficiency goals (Gibbs & Kraemer, 2004). In line with stakeholders' expectations, the gold mining sector should manage the environment proactively to legitimise their practices. Therefore, there is a need to understand the gold mining sector's institutional environment and impact to motivate the sector to initiate EMAPs.

The institutional theory could be particularly useful for developing industry-level explanations since it includes collectively held ideas, values and beliefs in the analysis, unlike much business theory, which is based upon neo-classical assumptions that industrial producers are monolithic and economically rational actors (Wittneben *et al.*, 2012). Organisations within the same sector will adopt similar structures and practices through the process of isomorphism (Comyns, 2018), by which entities imitate the behaviours of other entities (Lin & Sheu, 2012:535) – either consciously or unconsciously since isomorphism is socially transmissible (Oliver, 1991). The three (3) types of pressures/drivers that lead to isomorphism in organisational tactics, structures, and processes are described by institutional theory as coercive, normative, and mimetic (DiMaggio & Powell, 1983:104; Glover *et al.*, 2014; Higgins & Larrinaga, 2014). This help to explain how best practices are diffused and institutionalised, preparing the ground for the development and establishment of institutions (Dedoulis, 2016). Institutional isomorphism leads organisations to adopt similar structures, strategies and processes (DiMaggio & Powell, 1983): entities in the same

organisational environment (gold mining sector) may display similar behaviours as they interact within the environment. Hence, the development of a framework ought to assist in the diffusion of gold mining practices and promote greener mining practices.

The discussion above leads to the 3rd association proposition (Ap3) and the 13th content proposition (Cp13):

Proposition Ap3*: Institutional forces, environment, and governance systems are associated with a country's rules and legislation.*

From the above proposition, it can be deduced that:

Proposition Cp13: *Social order within the mining sector may be based on a shared social reality.* (Note that this may be a general proposition in other spheres of life).

3.3.1 Coercive pressures

Organisations are subject to formal and informal pressures exerted on them by their socioeconomic environment and function within a society with certain cultural expectations (DiMaggio & Powell, 1983:150; de Villiers & Alexander, 2014). Coercive pressures result from the influence of persons in high positions and entities that control resources essential to an organisation (Glover *et al.*, 2014). Governmental and regulatory entities are typically linked to coercive forces (Sarkis, Gonzalez-Torre & Adenso-Diaz, 2010). The regulative pillar is based on establishing which monitors and enforces rules and regulations (Comyns, 2018:3). Organisations' strategic decisions are constrained by the loss of operating permits and the fines and penalties associated with regulatory non-compliance (Darnall, Henriques & Sadorsky, 2010). For instance, Australian environmental law holds businesses accountable for the offences committed by their organisation. It puts liability on management, pushing them to reduce their environmental impact and adhere to the law (NSW Parliamentary Counsel, 2021). It has been hypothesised that organisations that experience more substantial coercive pressures will invest more time and money into reducing their negative effects on the environment (Phan & Baird, 2015). Therefore, regulation authorities may need to play a leading role if gold mining organisations are to improve the implementation of EMAPs. Subjecting the gold mining organisations to pressure may be essential to motivate for environmental management.

The discussion above leads to a preliminary version of the 14th content proposition:

Proposition Cp14a*: The government and other regulatory bodies with rich resources could exert numerous forces on mining organisations to adopt greener practices and avoid penalties for failing to comply.*

Proposition *Cp14a* is elaborated further in this study.

3.3.2 Mimetic pressures

Mimetic drivers develop when organisations replicate the behaviours of successful industry rivals, especially when an organisation is unsure what to do, to duplicate the road to success and legitimacy (de Villiers & Alexander, 2014). Mimetic isomorphism is copying another similar organisation's behaviour (Sherer, Meyerhoefer & Peng, 2016) to be taken seriously (DiMaggio & Powell, 1983). Mimetic pressures can incentivise management to create a system that offers data for analysing sustainability issues (Schaltegger & Burritt, 2010). Arguably, the mining sector should look at what other sectors are doing in promoting sustainability to copy best practices. Hence gold mining organisations ought to mimic the behaviours of those promoting EMAPs.

3.3.3 Normative pressures

The term normative isomorphism describes the rules and procedures for the profession formed by educational and training programmes, professional networks, and the migration of people across organisations (Sherer *et al.*, 2016:572; Comyns, 2018). Organisations have been observed to be motivated to adopt environmental practices to be perceived as engaging in legitimate organisational activities due to normative constraints (Sarkis, Zhu & Lai, 2011; Zhu & Geng, 2013). Normative pressure has been found to drive organisations to be more conscious of the environment. Further institutional research may be required to comprehend how new social norms like ethical principles and ecological awareness affect society (Ball & Craig, 2010).

Organisations that want to improve their environmental management may encounter normative pressures manifested such as internally, externally or professionally (Phan & Baird, 2015:48). Internal normative pressure can come from employees since they are both the source and the recipient of organisationally proactive environmental

efforts (Sarkis *et al.*, 2010). Especially when the organisation has a large number of employees that are concerned about environmental issues in general (Phan & Baird, 2015:48). It can also derive from an organisation's corporate values, environmental policy, and beliefs when the organisation thrives on efficiency and accountability which will move their environmental actions to go beyond just following the rules (Sharfman, Shaft & Tihanyi, 2004). Phan and Baird (2015:48) state that external normative pressures can come from customers since they are the most important motivator for organisations to implement EMAPs. However, other sources, such as professional associations, media, and the community, can influence this. As an illustration, it was discovered that customers put the second-highest pressure on Canadian organisations to adopt an environmental plan (Henriques & Sadorsky, 1996). Therefore, the pressure exerted by key stakeholders may motivate the gold mining sector to adopt strategies that promote greener gold mining in Zimbabwe.

The above discussion leads to the 4th association and 15th content propositions:

Proposition Ap4*: There is an association between stakeholder pressure and environmental management (involving EMAPs) strategy adoption.*

Proposition Cp15*: Employees who are internal to a mining environment and the media who are external stakeholders may likewise exert pressure that motivates mining organisations to adopt strategies for greener gold mining.*

3.4 USE OF INSTITUTIONAL THEORY

Researchers have used institutional forces to explain patterns of innovation diffusion (Cole, 1989; Palmer, Jennings & Zhou, 1993), effects of the state on organisations (Ingram & Simons, 2000), and patterns of industry evolution (Haveman & Rao, 1997), amongst others. Some researchers have investigated the competitive aims of the organisation as the driver for adopting an environmental strategy (Hart, 1995; Delmas & Pekovic, 2013), while others have focused on the regulatory frameworks (Daddi *et al.*, 2014; Testa *et al.*, 2014). Institutional theory has been applied to corporate green management (Jennings & Zandbergen, 1995; Cordeiro, Zhu & Sarkis, 2009) and used widely in studies exploring environmental management in entities (Bansal, 2005). It is acknowledged that it justifies why particular behaviours are selected when there isn't a clear economic benefit (Berrone *et al.*, 2010). In addition, the adoption of accounting standards has been influenced by institutional theory (Judge, Li & Pinsker, 2010).

Therefore, the application of institutional forces ought to work for the gold mining sector since it has been proven to have worked in other industries. The use of institutional force may compel the gold mining sector, which has been identified to impact the environment negatively, to adopt greener initiatives.

3.4.1 Institutional pressures and environmental management

It is strongly suggested that institutional pressures within the institutional framework affect organisations' environmental management since they create and spread a common set of values for environmental sustainability (Delmas & Toffel, 2008). There are few exceptions in agreement in the literature that isomorphism pressure leads to isomorphic behaviours in organisations because they strive for legitimacy from external institutions (Daddi *et al.*, 2016:648). For example, little evidence was found of institutional pressures exerting constraints on organisations to obtain legitimacy (Kraatz & Zajac, 1996). Research on institutional environments suggests that organisational strategy, activities, and reactive and proactive strategies (DiMaggio, 1988) are the best-known classification of strategic heterogeneity (Lin & Ho, 2016:765). Therefore, an integrated framework for the gold mining sector could cause isomorphic behaviours since gold mining organisations want to achieve legitimacy from external institutions, especially those that buy gold. As a result, organisations in the gold mining sector are likely to respond differently to institutional pressures.

Lin and Ho (2016:765) argue that organisations actively shape and build their institutional environment. Institutional pressures can be understood as a crisis in the organisational field created by the social skills of a new group of change entrepreneurs (Castel & Friedberg, 2010:312).

There has been much discussion in the literature about the role of institutional pressures in adopting proactive environmental strategies, particularly external pressures that cause organisations to voluntarily implement environmental strategies that go beyond environmental law requirements (Darnall *et al.*, 2010). Due to various organisational internal characteristics, structure, and management styles, institutional forces can cause organisations to behave differently regarding environmental strategy (Delmas & Toffel, 2011). The motivators may be influenced by competitive strategy, environmental concerns, or monetary or normative incentives (Granly & Welo, 2014). Motivations from inside and outside the organisation are the two (2) main approaches

that can be used to explain drivers (Daddi *et al.*, 2016). Tourais and Videira (2016) state that external motivation includes obtaining third-party certification, which is necessary to improve the reputation in the eyes of external stakeholders. Therefore, an integrated framework may complement motivational drivers and boost EMAPs. Furthermore, there may be a need to recognise that organisations within the gold mining sector respond differently to institutional pressures.

Organisations are becoming more active in identifying ways to reduce their exposure to environmental risks and take a proactive approach to environmental management as a result of growing awareness and concern about how businesses impact the environment (Phan & Baird, 2015:45). The impact of institutional pressures put on institutions by different stakeholders, such as the government, has been examined in previous research (Zhu, Cordeiro & Sarkis, 2013), customers (Sangle, 2010), and the community (Sarkis, Gonzalez-Torre & Adenso-Diaz, 2010) on environmental management initiatives. To exert further pressure on the gold mining sector to take a proactive approach to environmental management, an integrated framework of EMAPs could perform a regulatory role.

3.4.2 Institutional theory and the government

Much research has been carried out on the influence of enforced legislation and regulation on an organisation's implementing environmental management strategies (Delmas, 2002). Governments are crucial in disseminating novel practices imported from other nations (Arias & Guillen, 1998). The ability of each country's state to impose coercion is a key factor in disseminating innovation across national boundaries since governments may provide incentives for organisational transformation (Delmas & Montes-Sancho, 2011). In China, coercive government institutional involvement has emerged as one of the most influential factors in corporate environmental management. Since the 1970s, China has enacted and implemented policies, principles, regulations, and laws in response to the critical state of its environmental problems (Rowe & Guthrie, 2010, p. 512). It was noted that Chinese organisations, even when manipulating or defying regulations, would follow unwritten government rules, thus recognising the government's dominant hand (Tian *et al*., 2009). Therefore, the government's pressure on gold mining organisations may ensure they take initiatives that promote a greener environment. The more dedicated the government

is to protect the environment, the greater the likelihood of organisations' committing themselves to environmental management.

The discussion in the above sections leads to the 16th content proposition:

Proposition Cp16: *The government and other key stakeholders may adopt legislation that may accelerate the rate at which organisations comply with environmental regulations.*

It is important to recognise that institutional processes are worth consideration when analysing public environmental management since political influence is known to have some bearing on organisational life (Rowe & Guthrie, 2010:515). In most of the literature, government pressure is perceived as oppressive and monolithic, even if the actual legal landscape is more complicated (Delmas & Montes-Sancho, 2011:104). It is arguable that if the government and society join hands to exert institutional pressure on the gold mining sector, it might lead to greater compliance. If an integrated framework of EMAPs complements these, it may foster environmental management compliance.

3.4.3 The role of environmental pressure groups and the community towards the environment

Delmas and Toffel (2004:213) assert that local groups can apply coercive pressures on organisations by participating in local and federal elections, environmental advocacy, and citizen lawsuits. In addition, community group pressure (Florida & Davison, 2001) and the desire to be a good neighbour (Raines, 2002) motivate organisations to adopt EMAPs. According to Delmas and Montes-Sancho (2011:112), non-governmental organisations (NGOs) that are part of the community may pressure businesses to implement specific procedures, helping ideas spread across their member nations. Delmas and Montes-Sancho (2011) add that NGOs are also seen as change agents in the global village and have become highly effective communicators. For example, the environmental reporting of an Australian mining organisation was influenced by an NGO, the World-Wide Fund for Nature (Deegan & Blomquist, 2006). There is, therefore, a need to empower the community to know the role they should play in environmental management practice. For example, NGOs may form a support group that will help promote sustainable gold mining practices in Zimbabwe.

3.4.4 The role of industry, customers, and competitive pressures on the environment

Organisations may also facilitate coercive, isomorphism, and governmental pressures (Delmas & Toffel, 2004:213). For example, the same standard may need to be adopted by organisations trading with nations that have a certain standard for those nations to accept those organisations' products and services. Some businesses may use coercive pressure on their suppliers, while others may copy the actions of rival businesses (Delmas & Montes-Sancho, 2011). Institutional scholars agree that businesses are more inclined to imitate the actions of other businesses they collaborate with within the value chain network (Guler, Guillén & Macpherson, 2002). Besides responding to customer requirements (Anderson, Daly & Johnson, 1999), organisations may also mimic practices adopted by leading organisations (Delmas & Toffel, 2004:213). Therefore, pressure on the gold mining sector may need to come from many stakeholders for the diffusion of environmental management.

The discussion in the above sections leads to the betterment of an earlier proposition:

Proposition Cp14b: *NGOs and other essential pressure groups assist in the diffusion of ideas among mining organisations, motivating them to adopt environmental management initiatives.*

3.5 STAKEHOLDER THEORY

A stakeholder refers to a person or entity who benefits from the existence and proper functioning of an organisation: shareholders, employees, investors, customers, the general public, the government, and the local community as reflected in their expectations of the organisation (Galant, 2017:33). Stakeholder theory comprises a large body of knowledge that focuses on taking the interests of various stakeholders simultaneously into account (Mutti *et al.*, 2012). Stakeholder theory has its roots in the time of large organisational development and an increase in the strength of public opinion in the early 1930s (Galant, 2017:32). Reconciling the interests of key stakeholders, including environmental management, through creating an integrated framework of EMAPs could help the gold mining industry gain social acceptance.

Satisfying the interests of multiple stakeholders is ethically sound (de Gooyert *et al.*, 2017). Stakeholder theory suggests that understanding the perspectives of the various

stakeholders who can be affected by or affect an organisation's operations and policies is essential for designing appropriate and effective policies (Mutti *et al.*, 2012:213). Galant (2017:33) indicates that besides the critical goal of profit maximisation, an organisation should also maintain healthy connections with the stakeholders it depends on and the environment. Stakeholder theory recognises that though shareholders are essential, so are profits and financial performance, which are part of the value creation process (Theodoulidis *et al.*, 2017:174). Hence there is a need for the gold mining sector to identify its key stakeholders, understand their perspectives, and see how the reconciliation of these can help in environmental management since taking good care of an organisation's relationship with the environment might improve its image.

3.5.1 Stakeholder theory and corporate social responsibility (CSR)

To maximise the development of shared value for a company's owners, stakeholders, and society, CSR is a process meant to incorporate social, environmental, ethical, human rights, and consumer issues into business operations (European Commission, 2011). Stakeholders like environmental activists, consumers, NGOs and employees argue that organisations should assist in promoting sustainable development (Crilly, Zollo & Hansen, 2012). Some organisations respond positively to environmental sustainability pressure by adopting innovative environmental practices and participating in several initiatives. But, for instance, other organisations do not respond or change their business practices (Sarkis, Zhu & Lai, 2011; Wu & Pagell, 2011). Therefore, knowing how organisations behave under environmental pressure is key since it may help strategically implement environmental practices.

In the literature, understanding when stakeholder pressures work to encourage organisations to become more sustainable has been a crucial problem (Dubey *et al.*, 2016). research on how organisations and societies interact (Lee, 2011; Dubey *et al.*, 2016) has demonstrated that corporate social behaviours are influenced by both formal institutions (laws, regulations, and constitution) and informal institutions (norms, values, and shared beliefs). Stakeholder groups like shareholders, employees, customers and NGOs impact corporate social behaviours (Xiao *et al.*, 2018:138). As sustainability becomes institutionalised, the legitimacy of stakeholders' requests changes (Rivoli & Waddock, 2011). Lee (2011) argues that when stakeholders make

sustainability requests, organisations that ignore these requests run the risk of losing their legitimacy and opening themselves up to coercive sanctions from stakeholders and even criticism because requests, like the reduction of polluting emissions, have enough support from formal and informal institutions (laws, regulations, norms, values, shared beliefs, and constitutions) in the socioeconomic context. When organisations have to make trade-offs between their many goals, sustainability will be given more weight as a nation institutionalises it (Xiao *et al.*, 2018). Therefore, institutionalisation of sustainability in the gold mining sector may result in sustainability issues being given greater priority and attention by gold mining organisations.

3.5.2 Stakeholder pressures and corporate sustainability management

Organisations depend on their stakeholders (such as customers, suppliers, and the local community) for essential resources, a competitive advantage, and even their survival since they are intertwined in a web of interactions with them (Clarkson, 1995). Therefore, stakeholders can pressure organisations to advance their interests or the interests of society by using their authority and power (Lee, 2011). For organisations to ensure enduring support from stakeholders, They ought to respond to and take care of the legitimate concerns of stakeholders (Xiao *et al.*, 2018:139) since they have varied degrees of influence over these stakeholders (Power *et al.*, 2015). In the specific context of business sustainability, stakeholders have a variety of demands they might make of Organisations (Khor *et al.*, 2016). For example, consumers are now increasingly demanding environmentally friendly products (Xiao *et al.*, 2018), while NGOs and environmental activists are pushing organisations to participate in environmental programmes that are not primarily tied to the production activities of the organisation (Darnall *et al.*, 2010). Since the gold mining organisations operate within the global village and depend on stakeholders for key strategic resources, identifying and responding to stakeholders' environmental requests may build lasting beneficial relationships. Arguably, the needs of stakeholders can be reconciled if gold mining organisations are to gain legitimacy or get a social licence to operate.

3.5.3 Stakeholder engagement

Research on stakeholder theory has shown that there may be a considerable gap between what the organisation sees as the interests of stakeholders and what the

stakeholders themselves believe their interests to be (Bryson, 2004). Failing to identify stakeholder interests has been shown to cause unanticipated resistance during the implementation of decisions, hence the need for stakeholder engagement (de Gooyert *et al.*, 2017). Engagement in itself is a morally neutral practice (Greenwood, 2007), which can help build lasting beneficial relationships (Maak, 2007), resulting in higher financial returns for an organisation (Henisz *et al.*, 2014). Efforts have been made to integrate stakeholder management into sustainability management systems (SMS) (Ranängen, 2017:15), there has been talking about stakeholder consultation and mapping (Singh, Murty & Gupta, 2007), and identification of key stakeholders has been advocated (Asif *et al.*, 2011). Stakeholders should be seen as the battery that powers the rest of SMS (Rocha *et al*., 2007). Therefore, identification of stakeholders' needs is key.

All organisations have stakeholders, and to succeed in the current and future environment, organisations should consider stakeholder groups (Freeman, 1984). An organisation should manage the relationship with its stakeholder groups in an action-oriented way (Ranängen, 2017:16). The integrated framework for the gold mining sector will arguably facilitate stakeholder engagement since it may help to bridge the expectation gap between stakeholders and gold mining organisations, thereby building lasting beneficial relationships. Identifying stakeholders' needs and their reconciliation is key for gold mining organisations to succeed in the long term.

The discussion in the above sections leads to the 5th association proposition, 17th content proposition, and 1st general proposition:

Proposition Ap5*: Aspects around social responsibility concerning sustainability have an association with the expected results of a gold mining company.*

Proposition Cp17*: Stakeholder engagement assists in building lasting beneficial relationships, and stakeholder mapping and identifying their needs is an essential strategy for mining organisations.*

Proposition Gp1*: Communication and engagement are essential among stakeholders to create a common vision*.

3.6 SUSTAINABILITY THEORY

The social licence to operate (SLO), which describes a way of conceptualising the

organisation's relationship with society and local communities (Parsons, Lacey & Moffat, 2014:83), emerged in response to the perceived threat to the industry's legitimacy as a result of environmental disasters in the late 1990s (Thomson & Boutilier, 2011). SLO is closely related to CSR, corporate citizenship and stakeholder theory (Parsons *et al.*, 2014:83). Sustainable development has become one of the hottest subjects in our generation (Patzelt & Shepherd, 2011). Incorporating social, environmental, and economic obligations, sustainability is frequently associated with waste and pollution reduction, energy efficiency, emission reduction, and a decrease in the consumption of hazardous materials (Gimenez & Tachizawa, 2012:149-150). Therefore, an integrated framework might promote sustainable development in the mining sector.

Pursuing profits and maintaining a competitive edge may collide with developing a sustainable social and environmental strategy. This is a challenge for sustainable strategies and how organisations track their progress toward strategic objectives (Glover *et al.*, 2014:103). Sustainable development and sustainability have become widely spread concepts in practice and research (Stål, 2015:355). Sustainability theory is seen as a business and investment strategy that seeks to use the best business procedures that balance the needs of all stakeholders, both present and future. The theory emphasises the importance of meeting stakeholders' needs and balancing the economic, environmental and social dimensions of an organisation's performance (Chang *et al.*, 2017:48). An SLO exists when a mining project is seen as having broad, ongoing approval and acceptance of society to conduct its activities (Thomson & Boutilier, 2011). SLOs have emerged in part due to society's embrace of sustainable development (Prno & Scott Slocombe, 2012:347), which has been described as development that satisfies present-day requirements without jeopardising the potential of future generations to meet their own needs (World Commission on Environment and Development [WCED], 1987). According to the researchers, the idea came about due to the realisation that the world required a new, less destructive long-term strategy for development and that social, economic, and environmental problems needed to be resolved jointly (Mitchell, 2002; Speth & Haas, 2006). Having an SLO often results in fewer stakeholder conflicts, which may be good for developing the gold mining sector.

Businesses and industries have been pressured to contribute to sustainable development since the Earth Summit of 1992 (Mutti *et al.*, 2012:212). Furthermore,

CSR is viewed by researchers as a tool for organisations to contribute to sustainable development (Hamann, 2004). Various societal forces, such as environmental pressure groups and indigenous people, who have voiced concerns about the social and environmental repercussions of mining, particularly in developing nations, are putting pressure on and scrutinising mining organisations (Banerjee, 2000; Kapelus, 2002). Being proactive in EMAPs may sometimes reduce pressure on gold mining organisations since they will be viewed as contributing to sustainable development.

Due to societal pressure, mining organisations have been proactively innovating to address their operations' various sustainability challenges (Mutti *et al.*, 2012:212). Extractive industry organisations, for example, were among the first to publish stand-alone environmental reports and to adopt voluntary codes of conduct in environmental management (Jenkins & Yakovleva, 2006)j. However, mining is not generally considered incompatible with sustainability principles if decision-makers consider the values and interests of all stakeholders involved (Cragg & Greenbaum, 2002). Therefore, gold mining organisations should address sustainability issues by reconciling stakeholders' interests. Figure 3.1 portrays institutional forces and stakeholder relationships.

The above discussion leads to the 6th association and 18th content propositions:

Proposition Cp18*:* *To be granted a social licence to operate (SLO), gold mining organisations should consider the societal needs of the communities in which they operate.*

Proposition Ap6: *There is an association between meeting the objectives/goals of a mining company (CSR) and expected results concerning cost savings and minimising environmental impacts.*

Figure 3.1: Institutional forces and stakeholder relationship

Source: *Researcher's own*

Based on figure 3.1, mining organisations are at the centre of institutional forces from various stakeholders. Institutional forces help to compel the mining organisation to adopt greener initiatives. The figure portrays institutional forces that shape a mining company to adopt green initiatives. The power possessed by institutional force will determine how the gold mining company will respond.

Figure 3.2 presents a diagrammatic summary of chapter 3, including the environmental impacts of mining, as discussed in section 2.3.

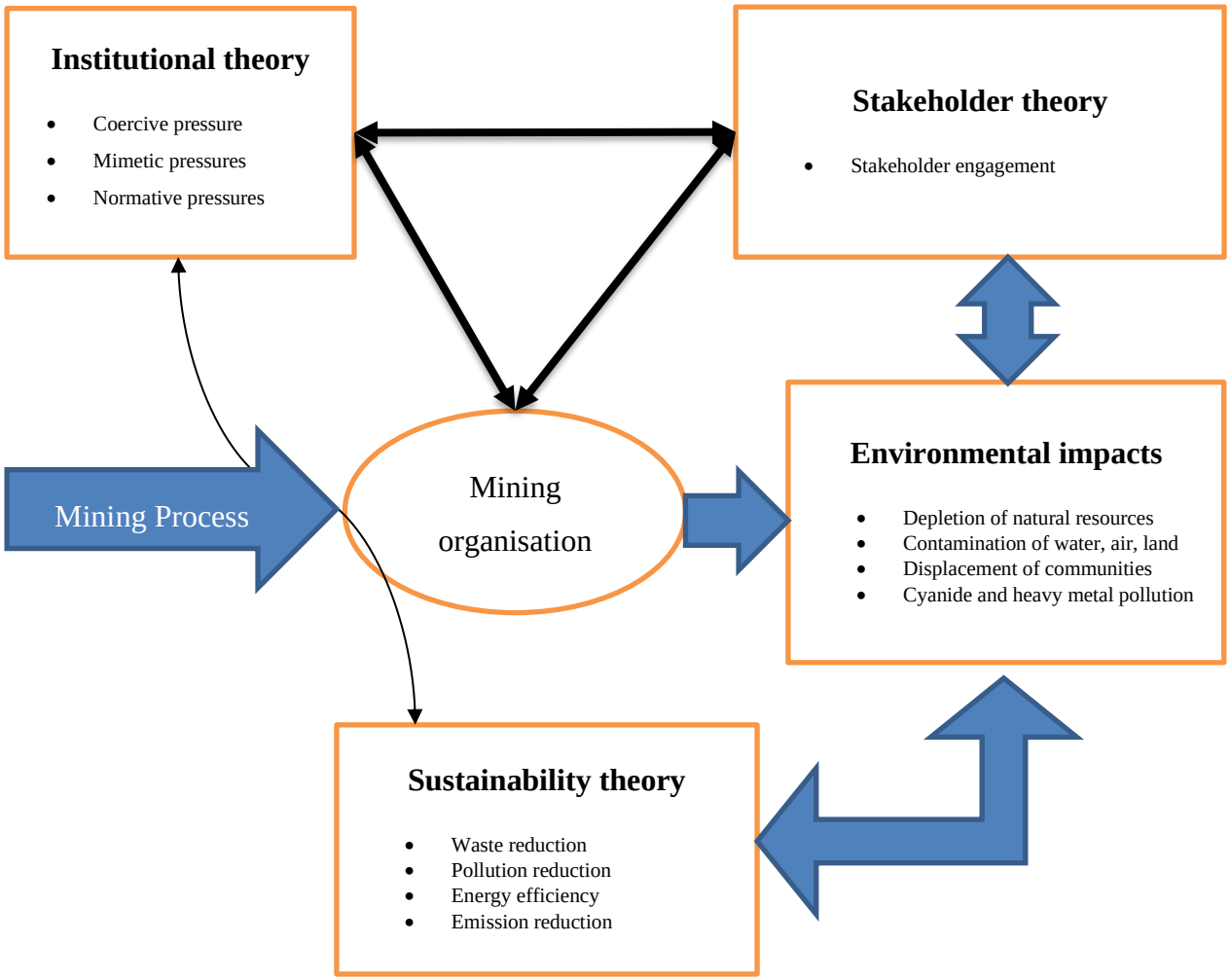

Figure 3.2: Diagrammatic summary map of chapter 3 inclusive of the environmental impacts of mining

Source: *Researcher's own*

Figure 3.2 indicates that the mining processes have an environmental impact. Institutional and stakeholder theories pressure the gold mining organisations to redress this environmental impact. Based on the requirement of sustainability theory, the goal is to work towards reducing its environmental footprint. The figure indicates if the institutional forces would shape the mining company's environmental policy and behaviour.

3.7 PRELIMINARY INTEGRATED FRAMEWORK FOR THE ADOPTION OF ENVIRONMENTAL MANAGEMENT ACCOUNTING

The association, content and general propositions generated in chapters 2 and 3 were consolidated, leading to the preliminary integrated framework (Figure 3.3) to facilitate

greener gold mining in Zimbabwe. The preliminary framework presented in figure 3.3 gives a practical exhibition of the synthesised propositions by demonstrating seven (7) essential themes: subject matter, objectives, expected results, EMAPs, interested parties, corporate governance structure and sustainability. The links between these themes/propositions are based on their relationship and association. In Appendix A, a summary of the three (3) sets of propositions is provided.

The preliminary framework provides a guideline for the gold mining sector to use the information to facilitate greener gold mining. The information provided by the preliminary framework to the gold mining sector will result in economic and sustainable mining. The arrows indicate the flow of information. Economic and sustainable mining, in this case, will be influenced by EMAPs such as MFCA, LCC and ABC. The EMAPs are a product of the subject matter, which is EMA.

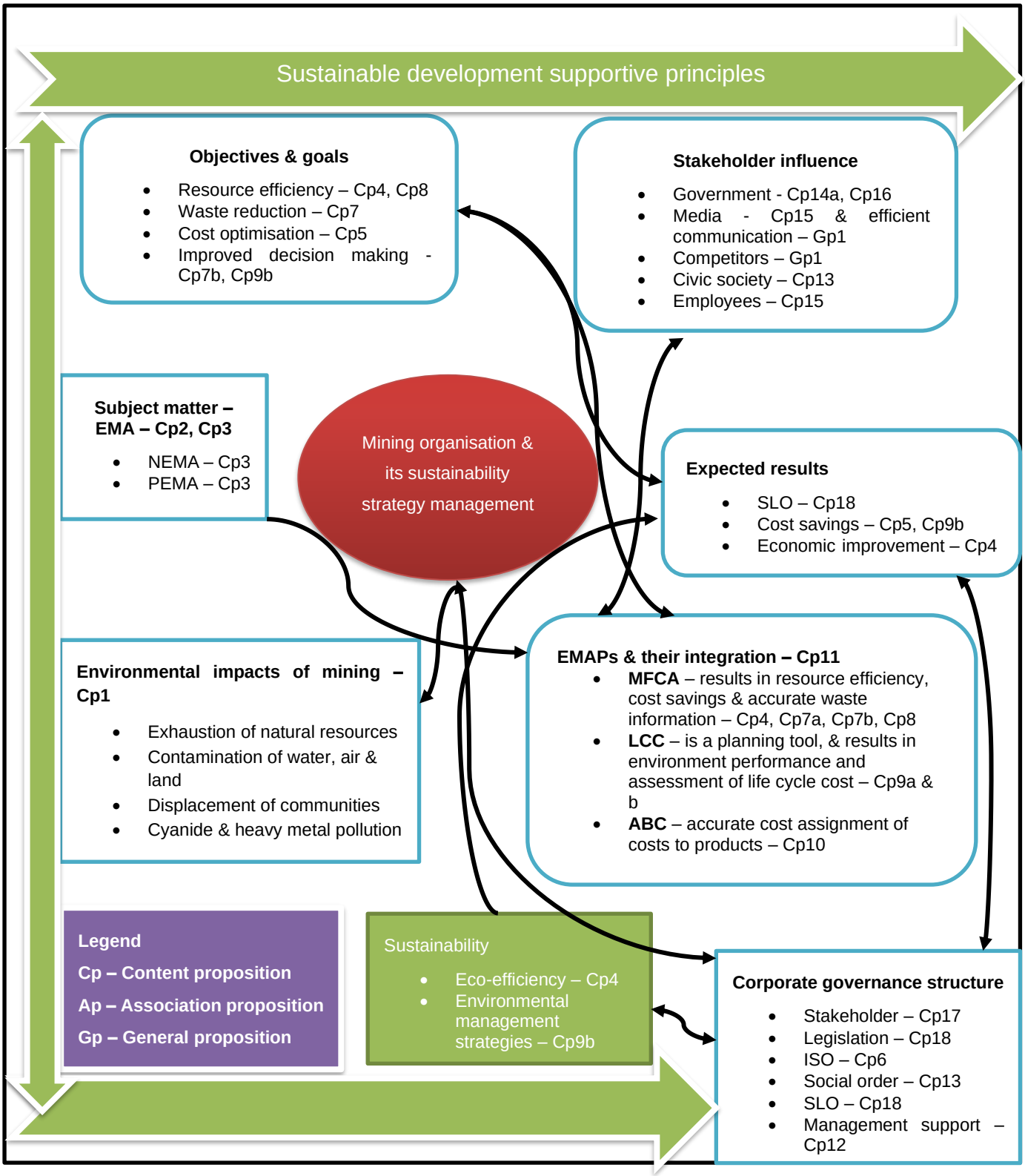

Figure 3.3: Preliminary conceptual framework

Source: *Researcher's own*

The gold mining industry is under pressure from important stakeholders to comply with laws and implement greener strategies. Therefore, corporate governance structure or environmental monitoring is achieved through stakeholder pressure and following ISO

standards and regulations. Personal interviews were conducted, and their input was used to refine the preliminary framework (Figure 5.2), validated through a focus group. The modified framework is presented at the end of chapter 5, answering the main goal of this study, which was to create an integrated framework of EMAPs to help gold mining organisations become more environmentally friendly.

3.8 SUMMARY

This chapter has discussed institutional theory, the major theory underpinning the study. The origin of the theory, how it relates to the environment and the role that institutional forces can play were discussed. The institutional theory views organisations as responding to forces from the external environment. Organisations have the power to influence those around them. There is a need to infuse them with environmental management values at the conceptual stage, which can help foster this in all stakeholders they relate to. Organisations do exist where there is a reciprocal typification of habituated social actions by actors. Related stakeholder and sustainability theories also receive attention.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 INTRODUCTION

The preceding chapter discussed the theoretical lens, including a description of the conceptual framework. The purpose of this chapter is to describe the research strategy applied in this study. It is complicated to formulate a concise statement of what constitutes research (Kawulich, Garner & Wagner, 2009). Research is a process through which new knowledge is discovered (Salkind, 2009:2). The research methodology used here was developed following (Saunders *et al.*, 2019) research onion (portrayed in Figure 4.1), which argues that the essential layers of the research onion should be peeled away.

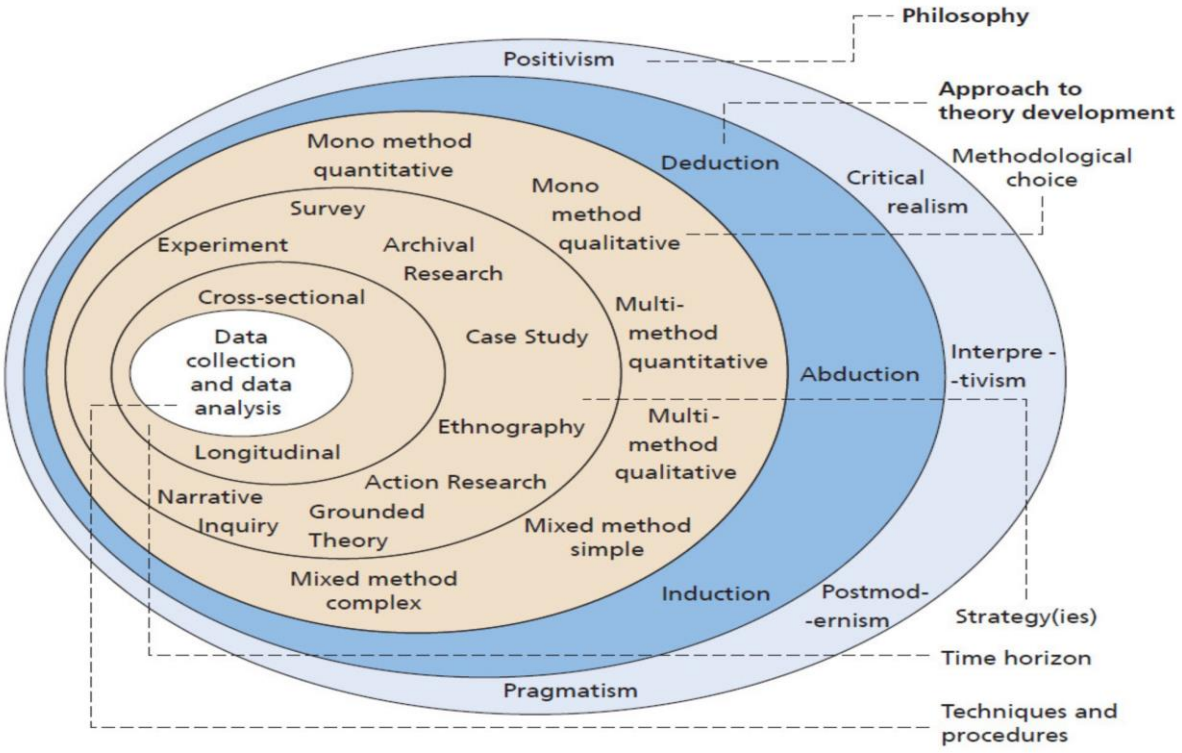

Figure 4.1: The research onion

Source: Saunders *et al.* (2019:130)

4.1.1 The goal of the chapter

This chapter examines the research approach to meet the study's objectives.

4.1.2 Chapter layout

The chapter begins with a discussion of the triangulation of research techniques in

section 4.2, followed by an explanation of research philosophy in section 4.3. Section 4.4 discusses the research approach; the purpose of the research is explained in section 4.5. The research settings are discussed in section 4.6. The chapter provides a discussion of the research design in section 4.7. The qualitative research approach is discussed in section 4.8. The chapter explains the time horizon in section 4.9. Data collection techniques and procedures are discussed in section 4.10. The chapter provides a discussion of data collection methods in section 4.11. The summarising and categorising of data are discussed in section 4.12. Data analysis is presented in section 4.13. Ethical issues are discussed in section 4.14, and validity and reliability checks are in section 4.15. The chapter concludes with a summary in section 4.16.

4.2 TRIANGULATION OF RESEARCH TECHNIQUES

The environmental challenges of gold mining need to be understood through different methods. The researcher uses triangulation, involving a comprehensive literature survey, in-depth personal interviews, and a focus group to ensure a balanced view. Triangulation mitigates bias since each of the selected practices has its drawbacks. It is a qualitative research strategy used to evaluate validity by ensuring the convergence of information from different sources (Cope, 2014). This research uses method triangulation, which entails collecting data via various approaches (Polit & Beck, 2012). The comprehensive literature survey conducted in chapters 2 and 3 develops a preliminary framework (Figure 3.3). The interview guide for in-depth interviews is based on the comprehensive literature survey and aligned with the research objectives. In-depth personal interviews assist the researcher in gaining a thorough awareness of environmental management concerns within the gold mining industry by transcribing and analysing them and using in-depth personal interview results in the enhanced framework (Figure 5.2). Finally, the enhanced framework is validated using a focus group. The focus group guide follows the (Krueger & Casey, 2014) guideline.

4.3 RESEARCH PHILOSOPHY

This research adopts the interpretivist research philosophy. Philosophy implies using abstract ideas and beliefs that inform our research (Creswell & Poth, 2018). Research philosophy entails the development of a research assumption, its knowledge and

nature (Saunders *et al.*, 2019). The assumption is a reasoning based on philosophising persons' knowledge and insights born as a product of intellectual activity (Žukauskas, Vveinhardt & Andriukaitienė, 2018). This study assumes that meaning and understanding could be gathered through interactions with people within the gold mining sector. The interpretivist and methodological decisions are described in the following sections to explain the researcher's framework of inquiry further.

4.3.1 Interpretivist framework

The interpretivist philosophy was followed in this research. This aligns with the argument that understanding the philosophical underpinnings of the research will inform the choice of research questions, methodology, methods, and intentions to be used (Grix, 2004:57). This research was done on the assumption that the researcher had to work and mix with people to understand environmental management issues within the gold mining sector. The interpretivist philosophy allows researchers to view the world through the perception and experiences of the participants (Thanh & Thanh, 2015:24), which motivated the researcher to adopt the philosophy. The interpretivist philosophy is appropriate for this research since the researcher relies on in-depth personal interviews and a focus group to gather perceptions and experiences from the respondents.

An interpretive framework employed in qualitative research is thought to have four (4) central tenets: ontology, epistemology, axiology, and methodology (Denzin & Lincoln, 2017). The ontological assumption of this research is that the researcher and reality are inseparable. As a result, social reality is constructed from multiple perspectives by people who interpret events differently, resulting in multiple perspectives of an incident (Mack, 2010:8). Epistemology refers to examining what separates reasonable assurance from opinion (Brewerton & Millward, 2001:224). It is furthermore concerned with how the researcher can learn about the phenomena of interest (Walker & Evers, 1988). In this research, in-depth personal interviews and focus groups were designed to understand participants' views of the subject matter under consideration and thus enhance and validate the preliminary framework to promote greener gold mining. Epistemologically, "objective separateness" is minimised by reaching out to participants and talking with them.

The axiological assumption examines how the researchers make their values known

in their research (Creswell & Poth, 2018). Participants were not forced to participate in the research. The methodology can be described as inductive, emergent, and formed by the researcher's experience with data collection and analysis. The data analysis started during collection, and respondents were audio recorded with their permission during interviews. Data were analysed using ATLAS.ti software, as explained in section 4.13.

The truth of an interpretation is continually negotiated through continuous conversation and dialogue. This study aimed to develop and use the EMAPs framework to encourage greener gold mining in Zimbabwe. A benefit of the interpretivist perspective is that the researcher and participant work closely together so that participants can communicate their stories (Crabtree & Miller, 1999). The social flexibility of the interpretivist is an important element in this research.

4.4 RESEARCH APPROACH

This research used an inductive approach. To develop a complete list of themes, researchers use an inductive process in which they go back and forth between the topics and the database (Creswell & Poth, 2018). Inductive reasoning moves from the specifics to general in that a framework is constructed from specific observations, thereby representing an ordering among the events observed (Babbie, 2020). In induction, one starts from observed data and develops a generalisation, which explains the relationships between the objects observed (Beveridge, 2004:113). The induction is well represented as a circle presented in Figure 4.2.

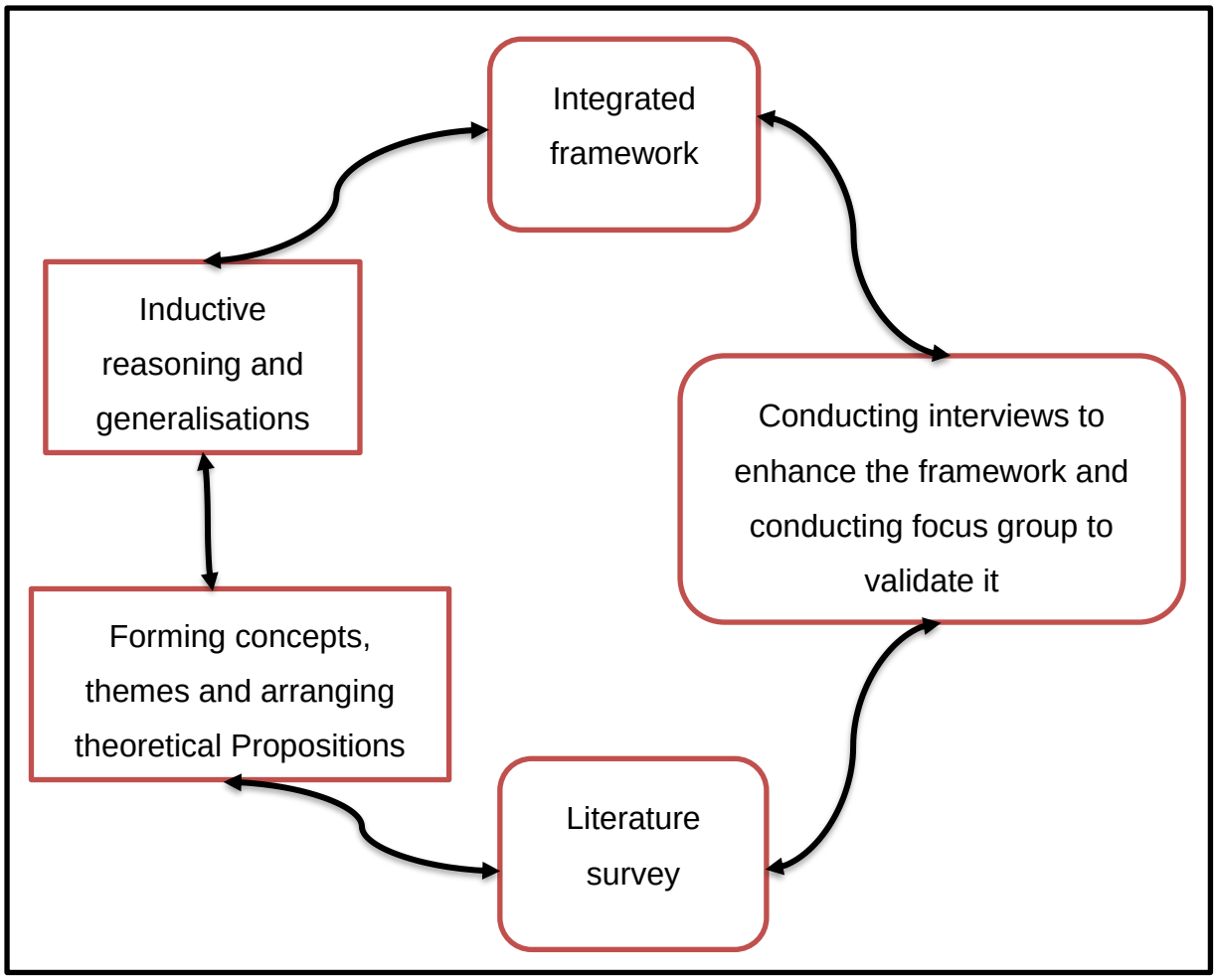

Figure 4.2: The Wheel of Science

Source: *Researcher's own*

Following inductive reasoning, figure 4.2 portrays that this research starts with a survey literature review and searching for patterns to inform the preliminary framework. This is followed by generalisations which arise from deductive reasoning. Finally, the preliminary framework calls for in-depth personal interviews and validation through a focus group: these aspects require inductive reasoning.

4.5 THE PURPOSE OF THE STUDY

This research is exploratory and descriptive since a research project can have multiple purposes (Saunders *et al.*, 2019). The exploratory approach requires that the theory be found empirically and inductively in the data. It primarily utilises the saturation sampling model since a valid, reliable and generalizable sample size cannot be pre-determined in advance due to the need to thoroughly explore a yet unknown area of behaviour (Trotter II, 2012:399). Furthermore, the exploratory approach is typically

used when a researcher examines a new interest (Babbie, 2020). The current research was exploratory in that it explored what has been happening regarding EMAPs in the gold mining industry in Zimbabwe. This developing country helped clarify the researcher's understanding of the problem. The exploration involved conducting in-depth personal interviews and a focus group. The research was also descriptive, as it aimed to portray an accurate profile of events or situations happening to environmental management in Zimbabwe.

4.6 STUDY SETTING

The study was conducted in the Zimbabwean gold mining extractive industry. Zimbabwe is a gold-rich country, and at its peak in 1999, the country used to produce an average of 27 tonnes of gold per annum (Chamber of Mines of Zimbabwe, 2014). Thereafter, production averaged 15 tonnes per annum through expansion opportunities exist (Ngwenya & Busangavanye, 2016). There are over 4,000 recorded gold deposits in Zimbabwe (Government of Zimbabwe, 2018). While many minerals are extracted in Zimbabwe, the gold mining sector was selected because of its demarcated target community and ability to provide the data necessary to address this study's research questions and objectives. In addition, gold is a strategic resource of national interest in Zimbabwe and is accorded national strategic resource status by the Mines and Mineral Act of Zimbabwe (Chapter 21:05).

4.7 RESEARCH DESIGN

A research design is related directly to answering a research question. Qualitative creditability (internal validity) is concerned with whether the data collection techniques used by the researcher and analyses address the research questions adequately (Bless, Higson-Smith & Sithole, 2013:16). The research strategy, research choice and time horizon are thought of as focusing on the process of research design (Saunders *et al.*, 2019). Therefore, the research strategy, choice, and time horizon are explained and used to justify the research design.

4.7.1 Research strategies

The researcher employed a literature survey, in-depth interviews, and a focus group as research strategies for this study. First, the comprehensive literature survey is

presented in chapters 2 and 3, developing a preliminary framework. Next, in-depth face-to-face interviews enhance the preliminary framework (Figure 5.2). Finally, the enhanced framework is validated through a focus group.

4.7.2 Qualitative research choice

Researchers worldwide believe that the interpretivist philosophy commonly uses qualitative methods (Silverman, 2000; Thomas, 2003; Willis, 2007; Nind & Todd, 2011). Qualitative methods permit in-depth inquiry into selected issues with careful attention to detail, context, and nuance, such that predetermined analytical categories should not constrain data collection. This contributes to the potential breadth of a qualitative inquiry (Patton, 2015). A qualitative researcher begins with an immersion in a natural setting, describing events as accurately as possible, as they may be occurring or would have occurred, and building a second-order construct (Babbie, 2020). In this research, data were collected in a real mining setting, the day-to-day natural environment of participants. In-depth personal interviews and a focus group provided an in-depth understanding of environmental management within the gold mining sector.

4.7.3 Time horizon

When all data is collected simultaneously, the research design is cross-sectional, and the researcher attempts to understand a topic by collecting a cross-section of relevant information (Bless *et al.*, 2013:135). This research can be likened to a diary or series of snapshots representing EMAP events at a given time: hence its cross-sectional nature. The one-point-in-time approach chosen for this research involves one interview per person to document their experiences, reactions and outcomes (Patton, 2015:255), in contrast to a longitudinal study, which involves multiple points of contact over some time (Patton, 2015). Most studies undertaken for academic research are time-constrained (Saunders *et al.*, 2019), hence the move to cross-sectional research. The inherent challenge with a cross-sectional design is that it is hard to demonstrate causality since it does not allow the researcher to measure change over time (Bless *et al.*, 2013:135).

4.8 DATA COLLECTION, TECHNIQUES AND PROCEDURES

4.8.1 Research participants

The population for research is described as that group (usually of people) about whom conclusions are to be drawn (Babbie, 2020). Most of the gold mines in Zimbabwe are found along the Great Dyke of Zimbabwe (Wilson, 1996). To complete this study, the research participants are defined as selected employees of five (5) gold mining organisations in Zimbabwe, selected from the Great Dyke of Zimbabwe. Primary data is based on in-depth personal interviews and a focus group, while secondary data derives from an extensive literature survey. The research targets those in decision-making and environmental policy formulation for in-depth interviews and a focus group. Four (4) of the selected goldmines provided 12 participants for the in-depth personal interviews (Seven (7) participants came from the environmental management function, and the other five (5) from the management accounting function, which made the interview protocol be divided into two (2) sections) while the 5th mine supplies the focus group, with six (6) participants.

4.8.2 Sampling

The sample for this research derives from the context of the inquiry, the Zimbabwean gold mining sector, consisting of small gold miners (artisanal gold miners) and large-scale gold miners. In this research, a large-scale and a small-scale goldmine were selected. Purposive sampling was used to select participants within the selected goldmines (Bless *et al.*, 2013). The researcher had to select relevant, convenient, and available individuals for the research, with stories to tell about their lived experiences. This agrees with the argument that participants must have first-hand knowledge of the phenomenon being investigated (Creswell & Poth, 2018). Although the study utilised purposive sampling, which is a method of selecting people who can help by contributing towards building a framework (Corbin & Strauss, 2015), the researcher was interested in those individuals that hold management positions and have worked in the gold mining industry for some years and would be able to tell a story of their experience. This was crucial for creating an integrated framework/architecture of EMAPs to support more environmentally friendly gold mining.

Purposeful sampling was used since it involved strategically selecting rich information

cases that, by their nature and substance, would illuminate the inquiry question being investigated (Patton, 2015:265). The researcher noted the argument (Marshall & Rossman, 2010) that sampling could change during research and that the researcher needs to be flexible, despite planning for their sampling strategy.

To facilitate more environmentally friendly gold mining operations, institutional entities like the government and other important stakeholders can play a role. This was the study's primary goal. The second goal was to determine the environmental impact of gold mining activities. A literature review was performed, followed by conducting in-depth personal interviews and working with a focus group to address these objectives adequately. The third objective was to identify the strategies employed and the information needed by gold mining organisations to reduce waste generated through mining activities. This was also addressed by conducting a literature review and in-depth personal interviews with practitioners within the gold mining sector, thereby collecting rich information on current developments within the gold mining sector.

In addressing the fourth objective of the study, which was to identify characteristics, benefits, and gaps of selected EMAPs and how their integration can address the gaps identified, the researcher developed an integrated framework of EMAPs. The study aimed to build a framework that integrated MFCA, LCC and ABC. It was envisaged that integrating the EMAPs into a single framework would address each practice's weakness and promote greener gold mining within Zimbabwe. The ultimate purpose of this study was to develop an integrated framework to assist gold mining organisations in becoming greener.

4.8.3 Sample size

A researcher can arguably never research all the population members and can, therefore, never make every observation of them, hence the need to select a sample from among the data to be collected and studied (Babbie, 2020). The sample sizes in qualitative research should not be so small; that it is difficult to achieve data saturation (data adequacy) (Morse, 1995:14). The most common focus for qualitative research resolves around pursuing in-depth studies; as a result, the sample sizes tend to be small and consensus-oriented (Trotter II, 2012). Despite focusing on a few subjects, the usual rule for sample size in qualitative research is to gather in-depth information about each subject or site under investigation (Creswell & Poth, 2018). Studying 3–10

subjects is recommended in qualitative research (Dukes, 1984), and Rieman (1983) did study 10 individuals. In this research, 12 respondents were interviewed during in-depth personal interviews, while six (6) respondents participated in the focus group.

4.9 DATA COLLECTION METHODS

In qualitative research, inquiry data is collected using in-depth interviews, focus groups, open-ended survey questions, posting on social media, direct observations in the field and analysis of documents (Patton, 2015:255). This research used in-depth personal interviews and a focus group to collect data. In addition, individuals with experience of the phenomenon being studied were selected as participants for the research.

4.9.1 Main data collection method: In-depth interviews

In-depth qualitative interviews are characterised by looking for rich and detailed information (Rubin, 2011:29). Semi-structured interviews are based on a set of prepared questions, primarily open-ended questions, which guide the interviewees and interviewer. The author argues that interviews have attracted considerable interest and are widely used (Flick, 2018). Semi-structured, in-depth personal interviews were motivated by the need to analyse professional and expert experiences and knowledge, which was used in building the framework for the gold mining organisations in Zimbabwe. However, this was applied flexibly to leave room for the interviewee's perspective and topics in addition to questions. Therefore, the interview protocol was divided into two (2) sections (Appendix B): Section A had questions addressed to participants in the environmental management accounting function, and section B had questions for those in the management accounting function.

4.9.2 Focus group

A focus group was used to validate the enhanced framework. A focus group comprises six (6) to ten (10) respondents interviewed together. The method has grown in importance of late because participants can discuss the issues at hand with each other and produce a much deeper understanding of the whole issue (Wagner *et al.*, 2012136; Bless, Higson-Smith and Sithole, 2013). Since discussion in a focus group is focused on a particular topic, participants representing the target population were

chosen. Six (6) participants participated in the focus group. This technique was chosen since it allowed the researcher to gain insights through group dynamics. The focus group discussion questions were designed following Krueger's (2002) guideline (Appendix C).

4.10 SUMMARISING AND CATEGORISING DATA

Beginner researchers are frequently intimidated by the time required to gather qualitative data and the quantity and quality of the material they come across (Creswell & Poth, 2018). Therefore, the researcher conducted a pilot interview to estimate the time needed to collect data. Each interviewee was assigned a code and recorded. After each interview, the researcher listened to each recording while making notes.

Once collected, the non-standardised data was condensed and categorised as a narrative to support meaningful analysis. This was done through the creation of a conceptual framework. Considering the argument that qualitative data analysis is a demanding process and should not be taken as an easy option (Saunders *et al.*, 2019), the researcher had to be prepared for the task at hand. Once the data had been collected through in-depth personal interviews and a focus group, it had to be prepared for analysis. Data was transcribed first, reproducing it as a written account. Transcribing all keywords, phrases and statements allowed participants' voices to speak. The researcher was interested in what participants said, how they said it, and the tone they used. Interviews were transcribed soon after conducting them to avoid the build-up of audio recordings. The researcher ensured the transcription was accurate by correcting transcription errors (data cleaning).

The researcher used the services of a touch typist to transcribe the interview audio recordings to reduce the time needed to transcribe audio recordings. Textual data (electronic documents) were prepared for the analysis by ensuring that data stored for analysis were free from errors, cleaned, and suitably anonymised. A summary of key points that emerged from the interview was produced, designed to reduce lengthy statements into shorter ones while at the same time preserving the semantics of the longer statement. This was followed by developing categories from the data, which provided the researcher with an emergent structure that was relevant to enhancing the framework for the gold mining industry in developing countries. Categorisation was followed by uniting data and assigning relevant material to the appropriate category.

ATLAS.ti was used to help process the data.

The emergence of patterns or relationships among categories enabled the enhancement of the framework for the gold mining industry, which was evaluated inductively from the data by considering alternative explanations. Validation of the framework was done by going back to one of the gold mining organisations that had agreed to participate and conducting a focus group to give input concerning the framework.

4.11 DATA ANALYSIS

Qualitative data analysis is the most difficult, dynamic, intuitive and creative aspect of this kind of research (Basit, 2003:143). Data analysis involves working with data, organising, synthesising, searching for patterns, discovering what is essential and what is to be learned and deciding what others will be told (Bogdan & Biklen, 1998). The data retrieved and gathered from in-depth personal interviews and a focus group was logically organised and analysed; themes and results were compared and matched using a systematic triangulation. The researcher organised data into computer files and converted files to appropriate text units for analysis by the computer. Once the data was organised the researcher read the transcripts several times to immerse himself in the details and make sense of them. This was followed by classifying, describing, and interpreting the data, which involved forming codes. Detailed descriptions and themes were constructed. The researcher went on to interpret the data, which involved making sense of the data. This involved the abstraction of the data beyond codes and themes to extensive meaning. Finally, the data were represented in text, tabular or figure form. Thematic analysis was applied, a general approach to analysing qualitative data by identifying themes or patterns in the data (Wagner et al., 2012:231). It allowed the researcher to deal with some phenomena by examining various participants' experiences with such phenomena and using that to enhance the preliminary framework.

4.12 RESEARCH DESIGNQUALITY CHECKS

Internal validity, the ability to answer research convincingly, was measured in terms of two (2) separate though related dimensions: internal and external validity (Bless *et al.*, 2013:157). The sample of people selected for the study were those with gold mining

experience and representative of the sector: this would achieve external validity. In addition, in-depth personal interviews and a focus group were done in natural settings, that is, in the gold mining organisations, to simulate reliability on the ground. The researcher ensured that the chosen research instruments (in-depth interviews and a focus group) adequately addressed the research questions and objectives of this research. Furthermore, using two (2) instruments, the researcher ensured that their weaknesses cancelled each other.

In this research, reliability and validity had to be balanced. The use of in-depth interviews allowed the researcher to discuss with respondents in greater detail, which in the end enabled the extraction of rich information (Bless *et al.*, 2013:235), which is considered reliable. Still, the interpretation of the questions is subjective by nature, which had to be balanced using a focus group.

4.13 ETHICAL ISSUES

Ethical issues can be grouped into covert activities, participants' requests that go beyond social norms, confidentiality towards participants, sponsors and colleagues, informed consent procedures and benefits of research to participants over risks (Lipson, 1994). Ethical concerns are paramount when research involves human participants, irrespective of whether the research is conducted person-to-person (Saunders *et al.*, 2019). Failure to follow ethical guidelines can result in the loss of funding for both researchers and the university for whom they work and or censure by professional organisations (Salkind, 2009). The researcher obtained approval from the UNISA ethics committee to conduct the research and use it to gain permission to conduct interviews and enable accessible data collection. (The ethical clearance certificate is attached as Appendix D.) It was important to give careful consideration to factors relating to the suitability of the site (Weis & Fine, 2000) because it might be challenging to access organisations, venues, and people for research (Creswell & Poth, 2018), and this was taken into consideration when selecting gold mining organisations and participants. The context of the inquiry, the Zimbabwean gold mining industry, was used in producing the sample. Access to these mines and time consideration constrained the study's choice and is related to collecting qualitative data. Before selected managers or participants were called and asked about their willingness to participate in the study, the researcher obtained permission from the

selected gold mining organisations. A participant information sheet was given to each participant with an informed consent letter, which they were requested to sign before participating in the research. A meeting with participants was arranged where the purpose and goals of the study were explained. Participants were informed that the interviews and responses to the interview questions were voluntarily given, and patients could stop at any time. The researcher protected the informants by assigning numbers to individuals. A date for the interview was arranged following the meeting. With the permission of interviewees, the interviews and a focus group were audio recorded. The researcher engaged a touch typist to transcribe interviews and focus group audio recordings. A confidentiality agreement was signed between the researcher and a touch typist (see Appendix).

Participants in the focus group discussion were told that confidentiality in the focus group could not be assured, though the researcher would ensure that responses were strictly confidential. Participants were also told that the data collected would transcend the borders of Zimbabwe and end up in South Africa.

4.14 SUMMARY

The research methodology used in this research was discussed in this chapter. The research adopted the interpretivist research philosophy. In addition, in-depth personal interviews and focus were adopted for this research as the research instruments to collect rich qualitative data.

CHAPTER 5: DATA ANALYSIS, INTERPRETATION AND DISCUSSION

5.1 INTRODUCTION

The preceding chapter discussed the research methodology used in this research. Then, guided by inductive reasoning, in-depth interviews were used to gather the primary data for this chapter's presentation, interpretation, and discussion of the results to answer the research objectives and work towards enhancing the integrated preliminary framework of EMAPs, which will be this study's contribution to the body of knowledge.

The data analysis begins with immersing in the details and specifics of inquiry and discovering themes, patterns, and interrelationships. Then, analytical principles guide the analysis from particular to general; there is a lot of interplay between the data collected and the preliminary framework (Figure 3.3), which enables its enhancement.

5.1.1 The goal of the chapter

This chapter's main objective is to discuss the findings from interviews conducted with employees of selected gold mining organisations. The discussion of findings should be in alignment with the following research objectives:

1. determine the role that can be played by institutional forces like the government and other key stakeholders in facilitating greener gold mining activities.
2. establish the effects of gold mining operations on the environment.
3. illicit strategies employed and information needed by gold mining organisations to reduce waste generated through their activities.
4. identify characteristics, benefits, and gaps of selected EMAPs and how their integration can address the gaps identified.
5. develop an integrated framework to assist gold mining organisations in becoming greener.

Questions for the personal in-depth interview addressing the research objectives are recorded in Appendix B: Interview protocol. The resultant enhanced framework, with the augmented content of the entities, is shown in Figure 5.1.

5.1.2 The layout of the chapter

The chapter sets out to discuss the findings of the interviews conducted on the Zimbabwean gold mining sector and is structured in a way that addresses the study's goals. Following an introduction in section 5.1, section 5.2 provides a discussion of objective 1; section 5.3 presents a discussion of objective 2, followed by section 5.4, which covers objective 3. Next, objective 4 is discussed in section 5.5, followed by the new aspects that emerged from face-to-face interviews, enhancing the framework in section 5.6. Finally, in section 5.7, there is a summary of the chapter.

5.2 OBJECTIVE 1: DETERMINE THE ROLE THAT CAN BE PLAYED BY INSTITUTIONAL FORCES LIKE THE GOVERNMENT AND OTHER KEY STAKEHOLDERS IN FACILITATING GREENER GOLD MINING ACTIVITIES

To achieve the first objective, questions were raised on the role being played by institutional forces and other key stakeholders in facilitating greener gold mining in Zimbabwe (Appendix B). This objective is addressed in theme one.

5.2.1 Theme 1: Stakeholder influence

The researcher established through the literature review that institutional forces influence the mining sector to adopt greener initiatives (Delmas & Toffel, 2011; Dedoulis, 2016; Comyns, 2018). Accordingly, respondents were questioned regarding the function of stakeholder influence in adopting and implementing greener initiatives in Zimbabwe. This was essential to assess whether the Zimbabwean gold mining sector was operating according to global developments. The findings of the interviews on the role that can be played by the institutional forces like government and other key stakeholders in facilitating greener gold mining activities are shown in table 5.1.

Table 5.1: Stakeholder influence in Zimbabwe gold mining sector

Aspect	Code Response	Total Codes	%
Memetic-competitors	0	7	0%
Mimetic-industry	0	7	0%
Normative-community	0	7	0%
Normative-customers	0	7	0%

Aspect	Code Response	Total Codes	%
Coercive-EMAg	4	7	57%
Normative-employees	0	7	0%
Normative-media	0	7	0%
Coercive-Min of Mines	3	7	43%
Normative-NGOs	0	7	0%

The literature review classifies institutional pressure into coercive (for example, government and regulatory bodies), mimetic (for example, competitors and industry) and normative (for example, community, customers, employees, media and NGOs) (DiMaggio & Powell, 1983; Schaltegger & Burritt, 2010; Comyns, 2018). On stakeholder influence, the percentages in table 5.1 show that only two (2) stakeholders (EMAg and Ministry of Mines) were proposed as the most influential of greener gold mining initiatives: EMAg with a frequency of 57% and Ministry of Mines with 43% frequency. Some respondents indicated that pressure from EMAg was necessary for order within the mining sector. However, most respondents believed that EMAg was forceful and sometimes the pressure they put on organisations was excessive and redundant. Due to this excessive pressure by EMAg, several respondents indicated that they do things to please the government agent, aiming at compliance and no more. In their view, this destroyed environmental entrepreneurship.

One of the participants (P1) stated:

> "*…during project proposal, we are supposed to submit an Environmental Impact Assessment, where we outline how our project is going to affect the environment and how we are going to mitigate those effects. Now, most of the times, we, as miners we, just write beautiful things, but when it comes to action, we don't do that. So EMAg now comes, it makes a follow up to see whether what we wrote in our proposal is exactly what we are doing on the ground".*

Regarding the Ministry of Mines, participant P4 stated that,

> "*We talk of the Ministry of Mines. I think the Ministry of Mines has the various units, but I think their inspectorate division is more cohesive or enforcing…"*

Participants (P1, P2, P3, P4 and P7) identified coercive pressure as the most

significant influence, exerting the highest pressure on the gold mining sector to adopt greener initiatives in Zimbabwe. They identified EMAg and the Ministry of Mines, both arms of the government, as exerting coercive pressure on the gold mining sector. This was in line with Phan and Baird (2015), who stated that mining organisations respond more to coercive pressure than others. Some respondents (P5 and P6) believed that those polluting the environment had problems with government agencies, while those that were environmentally responsible had no problems with the government agent.

In response to the query posed, one of the participants (P4) gave the following statement:

> "…*we have principles in environmental management, and we have what we call pollute affairs principles, that one can only be affected by government agencies if they are polluting…"*

Several respondents (P1, P2, P4, P6 and P7) stated that although coercive pressure was good, it should be applied with care. Respondents believed that some organisations could be proactive on their own, and if you put them under pressure, they may be forced to respond only to pressure and otherwise do nothing. In this regard, respondents felt that if gold mining organisations operate with minimum pressure, they may develop beneficial initiatives to save the environment rather than being limited to minimum compliance. Interviewees pointed to organisational culture as a crucial element in managing the environment. Respondents believed that if culture is to be blended with employee training on environmental management, that may be the best strategy for organisations to come up with to manage the environment. One participant (P5) was compelled to emphasise the importance of culture by saying the following:

> "We *have a culture where an organisation is willing to resource in terms of human resources, to avail competent personnel in charge of environmental management, which alone is an indication of an enabling environment."*

Notably, mimetic and normative pressures appear to have minimal or no effect on the Zimbabwean gold mining sector to adopt greener initiatives. This was shown by a score of zero percent on competitors (mimetic pressure), community, customers, employees, media, and NGOs (normative pressure).

Most respondents noted that some stakeholders, such as NGOs, were inactive in

environmental activities. For instance, some of the participants (P1 and P3) responded to the issue under discussion as follows:

> "*I have not come across any NGO which is very active in environmental management."*
>
> *"We don't have any NGOs except for those who come inform of ZAZIC in the health section. These are the guys that help our workers in issues like for example, blood testing, cancer testing and some other these things. With the ladies, they talk of birth control systems and so forth, but none have come with concerns on environmental management in the mining of gold mining sector."*

This was contrary to de Villiers and Alexander (2014), who stated that organisations might copy the behaviours of powerful and prosperous rivals in the market to follow their lead and potentially earn legitimacy and that mimetic pressures do motivate the management of an organisation to develop a sustainability initiative strategy (Schaltegger & Burritt, 2010).

It has been claimed that employees exert the highest normative pressure by being the initiators and beneficiaries of environmental strategy (Sarkis *et al.*, 2010). Still, in this research, they were found to exert no influence, unlike in other countries where customers were proven to be among the highest influencers of companies in adopting environmental initiatives (Phan & Baird, 2015), for example, in Canada (Henriques & Sadorsky, 1996), in the Zimbabwe gold mining sector customers were found not to be exerting any force. The researcher sees a research gap in the need to educate customers on their role in fostering environmental management.

The researcher proposes that gold mining organisations should proactively manage the environment and try to be innovative on environmental management issues. Government should provide a framework that encourages innovation and use minimum force unless an organisation is negligent of the environment.

5.3 OBJECTIVE 2: ESTABLISH THE EFFECTS OF GOLD MINING OPERATIONS ON THE ENVIRONMENT

The objective is to understand how the Zimbabwean gold mining sector operations are impacting the environment, to assist Zimbabwe in drawing lessons from the impact of the operations of the sector, and possibly devise policies to promote sustainable gold

mining. The selection of gold mines for this research was based on their reputation and performance.

5.3.1 Theme 2: Negative impacts of gold mining

Authors cited in the literature review, whose views are in agreement with the interviewees, argue that mining has both a negative and a beneficial effect on the ecosystem, though the negative outweighs the positive (Sterman, 2012; Sahu *et al.*, 2015; Pimentel *et al.*, 2016; Tost *et al.*, 2018). In this research, the participants (P1, P4, P5, P6 and P7) pointed to the following as positive contributions of the gold mining sector:

- creation of employment opportunities for local communities around the mining area;
- construction of roads, bridges, clinics, and schools to surrounding communities; and
- provision of water by drilling boreholes.

One participant (P1) mentioned that:

> "*We help them because we are in the community, and we are part of them. We need to access our mines, and our employees need health care and drinking water."*

Most interviewees (P1, P2, P3, P4, P6 and P7) stated that gold mining activities are not harmonised with environmental management and conservation since the desired mineral exists underground beneath forests. They also mentioned that surface and underground mining take place even though underground mining is the most dominant. In addition, several interviewees (P1, P3, P4, P5, P6 and P7) identified the following as the significant negative impacts of gold mining activities:

- land degradation, since vast amounts of vegetation, soils and rocks must be removed to access the mineral;
- displacement of people from mining areas, which usually results in conflicts with local communities;
- serious industrial accidents due to poachers who disregard sustainable mining principles; and

- violation of human rights and compromised safety and health of miners due to gold poaching.

Most participants (P1, P3, P5 and P6) noted that organised poaching in registered and unregistered mines was high, mainly due to the readily available market for the yellow metal and the firming of the international gold price.

Table 5.2 shows the negative impacts of gold mining in Zimbabwe.

Table 5.2: Negative impacts of gold mining activities

Aspect	Response	Total	%
Acidification	1	7	14%
Air pollution	2	7	29%
Aqua-life extinction	1	7	14%
Deforestation	3	7	43%
Land Degradation	4	7	57%
Displacement	1	7	14%
Global warming	0	7	0%
Resource depletion	0	7	0%
Water pollution	4	7	57%
Wildlife extinction	3	7	43%

Source: *Own Compilation*

Table 5.2 suggests that land degradation (57%) results from open shaft mining. Most respondents (P2, P3, P4, P6 and P7) pointed out that mineral resources are found underneath the earth's surface, and land should be cleared to access it.

One of the respondents (P6) gave an added emphasis by saying:

> "…*we need to be digging the earth depending on the type of mining that we will be doing. Sometimes it is open cast mining where you have large excavations, so a lot of disturbances are done to the environment since you need to sort of takeout trees so that you can dig holes to extract the mineral*."

The damage was found to be less extensive when conducting underground mining

when compared to open cast. This is in agreement with the assertion by Qian *et al.* (2018) that surface mining tends to destroy the environment more than underground mining and results in the loss of ecosystem service values in the area.

Water pollution (57%) was also mentioned as having a significant impact on the environment, mainly from the disposal of chemicals and waste. Most of the respondents noted that they generate effluent water containing some hazardous substances like cyanide which would have been used inside the plant to leach their gold. Most of the respondents indicated that gold mining uses a lot of chemicals that contaminate the water bodies. Deforestation (43%) and wildlife extinction (43%) were the other impacts listed, where trees have been cut to make way for mining activities, and wildlife has been eliminated. To emphasise the point, one of the respondents (P6) said:

> *"There used to be wildlife activities here, but once mining activities were set up, wildlife activities were disturbed."*

The above discussion agrees with the views of Sahu *et al.* (2015), who describe the environmental impact caused by mining resulting from land disturbance that covers changes in land use and landforms, destruction of habitat including flora, fauna, natural watersheds and drainage patterns.

The minimum impact was on air pollution (29%), acidification (14%), aqua-life extinction (14%) and displacement (14%). Few respondents indicated they had trucks moving around, generating a lot of dust and noise. Air pollution was minimal due to the type of mining that most of the mines were conducting to access the gold, which was underground mining and not open cast. On loss of aqua-life, some respondents pointed out that though they have tried to make sure not to contaminate water bodies, mitigation systems in place were not 100% effective, so the mining process is indeed affecting aqua-life. They noted that dams around mining areas used to have many fish, but now the numbers have been depleted, suggesting that their operations negatively affect aqua life. This is difficult to quantify with the naked eye, considering there are also fish poachers in addition to organised fishing.

The displacement of people also appears to be minimal. Most respondents indicated that Zimbabwe, a developing country, has vast amounts of land that are not settled and have not been explored, and now mines are being pegged in these areas.

However, a few respondents highlighted instances where rich mineral resources are found in a settled area and people have been displaced to pave the way for mining activities. For example, one respondent (P6) said:

> *"...you would find that sometimes the areas that we go to may have people already settled there, grazing their cattle and so forth, so when we get there, we start disturbing the whole set up, it is now a no-go area and the area is fenced up and so forth and we no longer want people inside."*

It was revealed that a lot of dust is raised during the crushing of rocks to extract gold, and a lot of water is used to suppress the dust and avoid pollution and contamination of employees. This aligns with the view of (Lei *et al.*, 2016), who argue that mining activities result in environmental damage and ecological degradation like air pollution, destruction of landscape, loss of biodiversity, water acidification and loss of fertile soils.

However, respondents were silent on resource depletion and global warming. This was contrary to the literature review, where it emerged that mining results in the depletion of natural resources (Mackenzie, 2016) and irreversible climate damage (Li *et al.*, 2017).

Some respondents cited the erosion of culture as another negative impact of gold mining activity in Zimbabwe. Interviewees indicated that their traditional culture had been eroded due to the influx of people in search of work from other communities.

One interviewee (P3) said:

> "*We used to have a very decent community here with people who are well behaved, but with the intrusion of these guys who come from outside, they brought their own culture. A mine attracts lots of people who come seeking for employment. We also have intruders who come to poach our gold claims."*

On the question of whether gold mining leaves the most substantial footprint on the environment, several participants (P1, P2, P4, P5 and P6) opined that when compared to other mining projects like coal, platinum, and chrome, which are open cast, gold mining damage is far lower, since most of it is activities take place underground.

One respondent (6) indicated that:

> "*Most of gold is extracted underground and it's done maintaining standards to*

achieve minimum dilution whilst the minerals outlined above involves surface mining and are more disruptive to the environment than gold mining."

Respondents (P1, P4 and P5) indicated that farming leaves a more substantial footprint than gold mining because of the hectares involved. Large pieces of land must be cleared to grow enough crops to feed a nation. Interviewees indicated that gold mining had gained a bad reputation since it had attracted a lot of poachers or illegal miners who were not concerned with environmental management.

Several respondents (P1, P2, P4, P5 and P6) indicated that mining size matters and large gold mines are more organised and work towards environmental management. They noted that larger gold mining organisations are registered, implementing management systems and have mining closure plans, unlike smaller gold mines. They also indicated that smaller mines leave the most substantial footprint due to a lack of resources to buy technology and employ competent, qualified personnel.

In sum, the finding of this research was contrary to the assertion that mineral extraction tends to leave a more substantial environmental impact than any other commercial activity (Sahu *et al.*, 2015).

On strategies which have been employed to manage ecological damage, respondents (P1, P2, P4, P5 and P6) indicated that they do teach employees about the importance of environmental management since it is a requirement of EMAg. In addition, these respondents indicated that Zimbabwe has a day set aside as a national tree planting day on 21 December each year. Gold mining organisations observe this day and plant trees around their mining communities.

Two interviewees (P2 and P6) stated:

"*We teach our staff in terms of protecting the environment and not unnecessarily cutting down trees since we operate in a protected area*."

"*We observe the national tree planting day by planting trees and ensure revegetation of the environment*."

Most respondents reported that effluent water from plants is pumped, recirculated, and used in the plant to avoid its flowing downstream and contaminating water bodies. Some respondents indicated that they have gone on to create quarry organisations that crush stones used in the construction industry as a strategy for waste rock

management. Most respondents from large gold mining organisations indicated that due to the availability of resources, they had done a lot in terms of best practice, employing the international standards for the best practice and ultimately aiming to achieve excellence and maintain it, unlike other small gold mining organisations which try to achieve legal compliance. Most respondents revealed that mining organisations are working on minimising their environmental footprint by adopting internationally accepted environmental standards. To this end, interviewees indicated their mission statement included reducing their environmental footprint. Interviewees from large gold mining organisations indicated that to minimise their environmental footprint, they had adopted internationally accepted standards certified by a German company GDS. Respondents added that they work with a strategic plan and evaluate their possible impact on the environment each year and discuss programmes to reduce it. Respondents indicated that they work with targets, for example, no chemical spills into the environment and a strategic vision of zero environmental harm.

5.4 OBJECTIVE 3: ILLICIT STRATEGIES EMPLOYED AND INFORMATION NEEDED BY MINING ORGANISATIONS TO REDUCE WASTE GENERATED THROUGH THEIR ACTIVITIES

The purpose is to establish information needed by gold mining organisations to reduce waste generated by gold mining and processing. The findings from questions about how to achieve the objective are discussed in this section.

5.4.1 Theme 3: Sustainability and waste management

Table 5.3 contains a summary of the sustainability and waste management responses.

Table 5.3: Sustainability and waste management

Aspect	Code Response	Total Codes	%
Community engagement	3	7	43%
Energy efficiency	1	7	14%
Environment awareness	3	7	43%
Pollution reduction	3	7	43%
Reforestation	2	7	29%

Aspect	Code Response	Total Codes	%
Standardisation	2	7	29%
Waste accountability	5	7	71%
Waste reduction	5	7	71%

Source: *Own compilation*

Table 5.3 gives a figure of 43% for mining organisations' environmental awareness to community engagement. Most interviewees (P1, P2, P3, P5, and P6) indicated that their operations affect the surrounding community. They try as much as possible to engage the local community to understand their expectations and learn to work together. This, they argued, would help them devise strategies to protect both the environment and the animals roaming around the mining areas. Several participants (P1, P2, P3, P5 and P6) indicated that continuous engagement between themselves and the farmers in the surrounding community is what makes them introduce safety measures like fencing around and avoiding the contamination of water bodies, which in the end protects both animals and people. Participants (P4 and P6) reported that most of the regulations governing gold mines in Zimbabwe are "imported wholesale in total unchanged from other countries, and community engagement would help in their application. It was felt that the copied regulations would not apply to the Zimbabwean situation since we are a developing country. One interviewee (P4) emphasised the point:

> "*We have a lot of stakeholders, and I think engagement is very key because we need to find each other. Critical stakeholders that we have are regulators, like I explained before, Environmental Management Agency. We need to engage because some of our challenge with the Zimbabwean regulations is an adoption of American regulations or a British regulation. It is just copied and pasted like that."*

The findings also reveal that there are efforts to reduce pollution, as evidenced by a 43% frequency. Some respondents revealed that they reduce cyanide to acceptable levels before discharging effluent water into downstream operations. They indicated that cyanide is eliminated by using chemicals and some of it naturally, by exposing it to the sun. Several interviewees indicated that a lot of dust is generated when crushing stones to extract gold, and they use water to suppress the dust to avoid contaminating

their employees. A degree of standardisation (29%) is taking place, as evidenced by some respondents who indicated that they had adopted international standards to benchmark their operations and minimise their environmental footprint. Furthermore, some are carrying out reforestation (29%) and energy efficiency (14%).

The findings propose that most mining organisations take waste accountability and reduction very seriously, as evidenced by a frequency of 71% for each. Most participants indicated that waste was being recorded separately. Several participants revealed that it was essential to record waste separately since waste is moved at a cost so that the amount of waste within a rift or ore determines the profits to be generated. Interviewees revealed that a certain percentage of waste had to be treated as acceptable within the rift if an organisation was to generate profits. One interviewee (P1) stated:

> "*To us, it's necessary because that waste we move, we move it at a cost. And at the end of the day, it also makes us know the ratio between our rift and the waste."*

Most participants revealed that though other types of waste can be converted to other uses, knowing the amount generated helps in decision-making. For example, interviewees indicated that hard rocks are crushed into quarry stones used for building when doing hard mining. They indicated that this was a strategy to manage waste by converting it into building material to generate other income for the mining organisation. Some respondents indicated that what might be considered waste in one mining organisation could be an asset in others. Respondents pointed out that there was no technology available that could be used to extract all available gold within the ore or rift, and what is regarded as waste is built up in tales which become assets to the mining organisations as they await future gold extraction. One interviewee (P2) stated:

> "…*the waste in gold is your tales, and though gold could have been extracted within the tales, gold is never exhausted. As you extract it, whatever waste that you throw away, you dump it somewhere. Then, as you improve, and as new mining methods are discovered, you still revisit that waste which now sits as an asset and retreat that dump to get more gold because when we are looking at the mining aspects, as you build up that dump you are creating value out of it."*

It was noted that knowing the amount of waste generated would assist the gold mining sector in decision-making by coming up with strategies to reduce waste. On the drivers of waste-reduction decisions, several participants commented that it would depend largely on organisational culture, mission, and the operating environment. For example, one interviewee (P5) stated:

> "*…all about culture, it is all about efficiency of technology of what the industry has begun, the legislation also comes into play, competence also comes into play, consumer pressure also comes into play, community demand, and management awareness also comes into play. We are looking at the growth perception of your interested or affected parties on how the operations in terms of influencing to go green."*

This aligns well with Tajelawi and Garbharran's (2015) views that accurate waste information is essential for internal decision-making.

Most participants (P1, P2, P4, P5 and P6) regarded a relationship between waste reduction and the economic performance of a gold mine as essential since waste reduction implies cost saving and, therefore, an increase in profitability. However, it is not always easy to reduce waste since waste generation is due to the nature of the rift being mined. Several interviewees indicated that a wider rift results in less waste, and a narrow rift results in more waste, diluting gold percentage returns. Interviewees opined that waste reduction would result in an improvement in gold production processes. One of the participants (P4) mentioned that:

> "*In our efforts to reduce waste, we may end up optimising our processes. If we optimise our processes, we are going to use less of inputs per gold output or the ore processed, which means we improve our efficiencies that improve our productivity so the bottom line would be increased. So, we increase our bottom line, we reduce our waste, thereby optimising our processes. This is very key."*

This is in line with the views of Christ and Burritt (2015), who argued that waste reduction supports eco-efficiency decisions while also enhancing an organisation's economic and environmental performance.

Most participants indicated that large gold mining organisations have a waste-reduction strategy, while smaller gold mines operate without a strategy. Respondents from large gold mines indicated that the strategy of managing waste was integrated

into the business model, and waste management could not be separated from their production processes. Consequently, an improvement in the production process would generate minimum waste. On the other hand, several respondents from small goldmines noted that although they submitted environmental management plans to the regulator, they rarely followed them.

One respondent P6 indicated that:

> *"Here, we don't have a documented management plan in place. Yes, we have activities to manage the environment to try to protect it, but we cannot say we have an environmental management plan in place."*

On challenges to gold process waste reduction, most respondents pointed out that sometimes the nature of the rift being mined may be narrow, making it challenging to reduce waste. Participants argued that in as much as they may want to reduce waste being generated, the nature of the rift was the one which determined the amount of waste generated. Even though the nature of the rift determines the amount of waste generated, several participants explained that some gold mining organisations lacked the capital to invest in modern waste-reduction technologies. Interviewees claimed that adopting greener technology was very expensive due to the punitive tax system and that the excessive duty charged by the Zimbabwean government on imports was found to be a hindrance to adopting greener technologies by the Zimbabwean gold mining sector.

On efforts which have been taken to reduce waste, most participants again mentioned the difficulty posed by the nature of rift. Some participants argued, however, that there was a need to invest in modern waste-reduction technologies since those that have adopted them have been able to extract gold from ore deemed not extractable, thereby reducing the amount of waste.

5.5 OBJECTIVE 4: IDENTIFY CHARACTERISTICS, BENEFITS AND GAPS OF SELECTED EMAPS AND HOW THEIR INTEGRATION CAN ADDRESS THE GAPS IDENTIFIED

The objective was to assist in the understanding of the characteristics and gaps in existing EMAPs. This objective was partially addressed during the literature review in chapter 2, where characteristics, benefits, and gaps of selected EMAPs were

discussed. In addition, it is also addressed by four (4) themes discussed below.

5.5.1 Theme 4: Accounting package and waste management

Table 5.4 contains a summary of the accounting package and waste management responses.

Table 5.4: Accounting package and waste management

Aspect	Response	%
Cyspro	1	20%
Manual system	1	20%
Page 300	1	20%
Pastel	2	40%
SAP	0	0%
TOTALS	**5**	**100%**

Source (Own Compilation)

The findings from table 5.4 suggest that 80% of the mining organisations use accounting packages, although chiefly for financial accounting. Only one mining company was using a manual system.

Several interviewees (P8, P9, P10 and P11) felt that the accounting system does not support eco-efficiency decisions. They attributed this to the nature of the reports required by the environmental regulator, which did not support eco-efficiency decisions; ultimately, gold mining organisations are regulation compliant. One of the interviewees (P11) stated:

> "*We only subscribe to EMAg, which is the environmental regulator. They have what they call quarterly reports, and they also raise invoices for specific environmental impacts and assessments that has to do with mining activities."*

It was revealed by several interviewees (P8, P9, P10 and P11) that the accounting systems being used by most organisations focused on financial accounting issues and not the environment. One interviewee (P9) emphasised:

> *"Accounting system in use handles accounting issues only. It does not have other modules even to use by HR or plant processing, and hence it is just for*

accounting purposes."

Two participants (P10 and P11) reported that waste information was regarded as an investment, and even though the accounting system had its limitations, it assisted with measuring environmental performance, which in turn assisted with keeping track and comparing progress to projections. In addition, they stated that waste accounting does support eco-efficiency decisions since if the dumping site of waste is built in an environmentally friendly way, spillage into water bodies and the environment will be avoided.

It was also reported by some participants (P8, P10 and P12) that some gold mining organisations do subscribe to standards that prescribe waste management while others do not subscribe to any standards. They mentioned that they subscribe to ISO 4001, ISO18001 and Orchards 45001. Interviewees stated that ISO 4001 prescribes how gold mining organisations should manage the environment. One participant (P8) stated that:

> "*ISO 18001 and Orchards 45001. These are more like recent standards, so they are good in terms of the environmental management, and they are being checked on a yearly basis. The guys come down usually to do resubscription process, and compliancy with standards is key to be given an operating licence."*

Some participants (P9 and P11) indicated that small gold mines did not subscribe to waste management standards due to a lack of resources. Ultimately, these mines only subscribe to EMAg standards, which is the regulator.

Most of the participants (P8, P10, P11 and P12) reported that several gold mining organisations were providing waste-related information to management and that the information was rated well. They argued that waste-related information, a requirement of EMAg, had to be shared with management so that everyone knew, and they could not be found wanting.

One interviewee (P11) emphasised:

> "*Yes, we provide management with waste information since same information is required by EMAg, the regulator. The information we provide to management helps us not to be caught on the wrong side of the law because the issue of use of mercury, for example, has been popular."*

Several interviewees argued that waste is an asset that should be properly accounted for in large mines. A tales report should therefore be provided, and the information made readily available to management so that it could be utilised when needed. In addition, participants argued that waste-related information was essential to management as it helps devise a more cost-effective way of extracting gold in future within the tales since gold is never exhausted.

Regarding barriers to providing gold process waste information, participants (P10, P11 and P12) cited the lack of resources to invest in current technologies as the major barrier. In addition, they identified the economic meltdown and sanctions as issues that have hindered the importation of current technologies that could be used in providing waste-related information. On strategies that have been adopted to try and address this barrier, the participant (P10) indicated that they have tried entering into partnership agreements with would-be investors from countries with advanced technologies. At least, when they come to invest, they bring advanced technologies from their countries, which has assisted in making waste-related information available.

5.5.2 Theme 5: Integrated accounting system and environmental management accounting practices

Several interviewees (P8, P9, P10 and P12) indicated that most gold mine organisations have an integrated database management system. They pointed out that gold mining was capital intensive, and its activities needed to be integrated and work together for the project's good. Respondents suggested that when activities are integrated, activities with linkages could be identified and solutions sought to consolidate the linkages. Most of the activities in gold are interrelated, making it prudent to have an integrated database management system.

Some of the interviewees (P9 and P12) responded to the question as follows:

> "*activities must be integrated and have to work together like, for example, the survey and geology, have to be integrated with the plant and processing so that you get a clear understanding of the amount of resource that you have. So once everything is processed, geologists must know output and determine the life of the mine,"*

> "*We are linked to the IT department, which is then the section that is in charge*

of storage of all information for the organisation, including our accounting information."

Most interviewees (P8, P10, P11 and P12) indicated that gold mining, besides being capital intensive, is a very complex approach that needs all its activities to be integrated and work for the common good if it's to be a profitable venture. They felt that geologists and surveyors should quantify the ore underground, using data mining software and go on to draw maps on how it should be mined and what information should be made available to those who would use it, using an integrated system.

One interviewee (P12) emphasised the importance of an integrated system:

"*What I need as a management accountant is what has been milled, I need what has been wasted so that I know what the wasted cost per tonne is, what is the milling cost per tonne. So, what you are really integrating to the system is the output from their data. As a management accountant, I may not actually understand how they do their processes, but I understand their reports. Reports pulled from their system."*

A few respondents indicated that some gold mine organisations operated without a data management system. These were found to be small gold mines which lacked resources.

One of the participants (P11) stated:

"*We are a small mine and still lacking resources to invest in database management systems."*

Table 5.5: Environmental management accounting practices

EMAP	Response	%
ABC	4	80%
LCC	0	0%
MFCA	0	0%
No practice	1	20%
TOTALS	**5**	**100%**

Source: *Own compilation*

The findings from table 5.5 indicate that most of the mining companies in Zimbabwe are applying ABC as an EMAP, as shown by the 80% frequency; only 20% use a manual system. None of the mining companies uses the other types, such as LCC and MFCA.

Some of the respondents (P10 and P12) responded as follows to the question:

> "…*ABC because we look at the cost of each activity, of each section right up to exploiting the resource to when you finally get the ore, these are the final output in terms of the gold and the actual dump which is earmarked for future use."*
>
> *"…at our mine, we are using ABC where actually costing per activity done, and you realise that, like I have mentioned before that, when we look at waste."*

It was evident that ABC assists in decision-making. For example, interviewees (P8, P10, P11 and P12) stated that ABC allows managers and other decision-makers to focus on specific areas that were giving them problems. This concurs with the idea of (Kennedy and Affleck-Graves, 2001), who indicate that ABC provides an information base leading to new management insights for taking new actions.

The research found that MFCA was not used in the Zimbabwean gold mining sector, as evidenced by a zero-percentage frequency above. The body of research demonstrates that MFCA's primary objective is to promote resource efficiency and eco-efficient decision-making to raise an entity's economic and environmental performance (Zhou *et al.*, 2017). Hence, the Zimbabwean gold mining organisations fail to take advantage of this significant benefit. The other major advantage surrendered by the mining sector by not using MFCA is that besides reducing adverse environmental impact, it can generate financial benefits when material efficiencies are improved (ISO Central Secretariat, 2011). MFCA was shown to be the starting point for the implementation of EMAPs because of its emphasis that material input into a process should leave as a product or non-product (Fakoya and van der Poll, 2013), which helps in improving accountability of resources used by an organisation.

Most of the interviewees (P8, P9, P11 and P12) commented that using EMAPs in an integrated system would make information easily available for eco-efficiency decisions, which would help identify high-cost areas needing management attention. In addition, they believed that using EMAP, like ABC, in an integrated system would have the potential to provide information on how each activity impacts the

environment.

On EMAPs being linked and concerning a gold mining organisation's economic and environmental performance, most respondents (P8, P9, P11 and P12) argued that gold mining was a business venture to generate a profit. Therefore, miners work on reducing waste to generate a profit. They noted that the use of ABC would assist in identifying gold process activities that should be performed to extract gold: departments can be broken down into activities, and the contribution of each activity within the value chain is identified. They also pointed out that gold mining involves a lot of activities, including digging trenches, excavations, drilling holes, fencing and rehabilitation of mined areas. The cost of rehabilitating, for example, should be accounted for and added as part of the exploration activities on the geology side, whilst the area being worked on needs to be fenced to protect animals from trenches and pits. They argued that identifying these activities and their management would help identify high-cost activities and devise strategies to manage the costs.

Most participants (P8, P9, P10, P11, and P12) contended that mining is a business venture and planning, and its operation should consider economic, social, and environmental aspects. Participants pointed out that investors require a return on their investment (ROI) and cannot put money where there is no economic return. They revealed that all three (3) aspects of the triple bottom line (TBL) should be considered since the regulator now requires that planners consider social and environmental aspects if they are to be granted a licence to operate.

One of the interviewees (P10) mentioned that:

> "*We are looking at the economic viability with specific reference to the revenues that we expect to derive from it. It also must have some economic aspects in the sense that wherever we do, there must be employment creation. Then the social aspect, it is now a requirement, that if you want to set up a mine anywhere, you have to involve the local authority, they have to give you the green light to go ahead, and they now levy a tax for the development of the community. They say it is meant to be ploughed back to the local community in which you operate. As per EMA requirements, the mining aspect must consider environmental issues. So, I would say the planning and operation consider those three aspects.*"

Most of the participants (P8, P10, P11 and P12) noted that management of costs is essential if a profit is to be attained. They pointed out that despite regulatory obligation, a mine operates in a community, is part of the community, and should engage in social responsibility initiatives by doing projects that assist local communities. This was essential for the granting of an SLO. Participants provided that eco-efficiency decisions should also be noted during the planning of the mining venture.

Several large gold mining organisations do have a strategic environmental plan. Most respondents (P8, P9, P10 and P11) noted that only small gold mining organisations operated without a strategic environmental plan. They provided evidence that the mining organisations should have a strategic environmental plan in response to the environmental regulator's requirement. Most small gold mines would not go further than mere compliance. This aligns with the views of Selto and Jasinski (1996), who provide that for an organisation to succeed, it should have a road map aligned with the strategic goals of the organisation and EMAP in use.

On how life cycle costing assisted in cost saving and measuring the environmental performance of a gold mining organisation, several respondents indicated that it was essential to know how much was needed at each level and if production levels at each stage could sustain the organisation.

One interviewee (P11) stated:

> "*We look at how is the mine performing and how has it been performing, and which strategies must be adopted at each stage of the mine life cycle to manage costs.*"

Most participants (P8, P9, P10, P11 and P12) indicated that to extract gold, the planning process should take a systems approach since all activities within the value chain should be performed to extract the desired output gold. Participants indicated a need to use the holistic approach and view all activities as one with the same objective. They argued that this would enable management to manage costs and achieve the desired output cost-effectively. Most interviewees commented that all activities should be planned for since gold mining is capital-intensive and destructive to the environment. Ineffective activities are identified, and strategies are devised for improving inefficient processes if a gold mining organisation is to report a profit. They argued that the systems approach had assisted the gold mining process in integrating

activities and viewing activities as one with a common goal of extracting gold in an environmentally sustainable manner. Even though gold mining organisations do not have control over gold prices, which are determined by market forces, participants showed that the need to get a return from an investment makes them look at the whole system to reduce production costs per ounce. One of the interviewees (P8) stated:

> *"Fine we need good profit margins for us to get that we focus on the only thing we can control, which is the cost. We, therefore, focus on reducing our production cost per ounce by focusing on activities."*

Several respondents argued that a systems approach gives direction so that they can plan for activities. Mining, therefore, should be systematic to produce results.

Most of the respondents (P8, P9, P10 and P11) indicated that most gold mining organisations do not have a system to gauge the total expenditure of a project. Instead, most rely on historical data or look at what is being done by other, similar organisations and use accounting systems to gauge a project's total expenditure. For example, one interviewee (P8) stated:

> "*We use historical records and benchmarking to other similar gold mines. For example, we basically get information on how the equipment operates from other similar mines and the cost related to the machine."*

Interviewees (P8, P9, P10 and P11) argued that most projects in mines are not new to the mining sector; these are historic projects. Engineers quantify what is wanted using a bill pay system, and the management accounting department does the costing. Even though it was found that planning takes a systematic approach, most participants revealed those in management accounting are not taking an active role in EMA and have delegated all issues to do with environmental management to the Safety, health, and environment (SHE) department. One respondent (P9) from the management accounting function stated:

> "*In terms of the management of the environment, we do not have a system that manages the environment from the accounting side. But of course, from the SHE side, yes."*

Most respondents (P8, P9, P10, P11 and P12) agreed that top management support was essential to implement EMAPs successfully. Furthermore, respondents argued that it was essential for top management to take a leading role in implementing EMAPs

as that was likely to signal to all employees on their importance.

One of the interviewees (P11) responded to the question as follows:

> *"I think it is critical that top management not only support but take the lead in the implementation of any environmental management plan, this will send signal to middle management and supervisors of the interest and commitment they have to organisational programs. The issue of environmental management has to be integrated at all levels of the organisation because if left in the hands of those who are hands on like, for example, the miners, directorship and management would have no leading role, and that will not succeed.*"

Respondents (P8, P9, P11 and P12) argued that a mining project requires a large capital outlay and without top management support, it was difficult to invest in new or improve existing projects. In addition, several respondents noted that even if you propose a fair project idea, it suffers a stillbirth if it lacks management support. The above discussions are consistent with Lee *et al.* (2005), who found that top management support, involvement and commitment are required for project implementation and take-off.

5.5.3 Theme 6: Benefits of environmental management accounting practices

Table 5.6 contains a summary of the benefits of EMAPs' responses.

Table 5.6: Benefits of Environment Management Accounting Practices

Benefit	Response	Total	%
Economic performance	2	5	40%
Environment performance	3	5	60%
Improve decision-making	1	5	20%
Resource efficiency	3	5	60%

Source: *Own compilation*

The findings from table 5.6 suggest that mining companies in Zimbabwe regard environmental performance (with 60% frequency) and resource efficiency (with 60% frequency) as the most significant benefits of adopting management accounting practices. Most respondents believed that if things are properly planned, inefficient

activities can be identified, and strategies can be found for managing them. They indicated that gold mining requires strategies for controlling costs since they do not have control over the gold price. Economic performance and decision-making improvement have frequencies of 40% and 20%, respectively. It should be noted that the percentages in Table 5.6 do not add up to 100% – this is owing to the overlap among the benefits in column 1.

Respondents (P8, P9, P10 and P11) indicated that ABC, which is the most used EMAP, promotes material efficiency and cost savings opportunities in the gold mining process by identifying activities and materials with an adverse impact on the environment. Several participants revealed that decisions are made on adopting less harmful materials and improving activities to improve efficiency and reduce environmental impact. Some interviewees (P10 and P8) stated:

> "…. *we are looking at our waste, and we identify where we are losing out since there a slag in our system, and obviously we are able to improve our efficiency because we monitor that on our database",*
>
> "*Since we have got separated operations based on activity, you can easily determine where efficiencies are high and where efficiencies are low and try to focus on cost minimising."*

ABC has been found to enhance efficiency, resource allocation and performance evaluation (Griesel and Cronje, 2005).

Respondents (P8, P9, P10, P11 and P12) indicated that knowing the different activities performed in gold mining and processing was essential since it is likely to assist in estimating the requirements of each activity. In addition, interviewees indicated that knowing how each activity contributes to the final output was essential. They stated that besides contributing to the final output, management should also know how the different activities impact the environment and devise strategies to reduce these if they are adverse. One interviewee (P8) emphasised the importance of knowing different activities by saying the following:

> "*You cannot measure what you don't know. So, knowing when the process starts and when the process ends is one of the things to do."*

5.5.4 Theme 7: Environmental management accounting challenges

Table 5.7 contains a summary of the environmental management accounting challenges' responses.

Table 5.7: Environment Management Accounting Challenges

Challenge	Response	Total	%
Acquisition costs	1	5	20%
Implementation costs	2	5	40%
Resources shortage	1	5	20%
Technological challenges	2	5	40%

Source: *Own compilation*

On the challenges faced in implementing EMAPs, the findings in table 5.7 suggest that the mining companies face implementation costs and technology adaptation challenges with 40% frequency each. Most participants (P8, P10, P11 and P12) indicated that it was difficult for Zimbabwean gold mines to benchmark with global organisations due to the deteriorating economic conditions in the country. In addition, they indicated that most gold mines could not import green technology due to the high tax being levied by the Zimbabwean government and poor economic prospects. For instance, this was proven by one of the respondents (P8), who stated:

> *"The economic problems facing the country have made it difficult to import latest technologies required to promote greener mining."*

Acquisition costs and resource shortage are also part of the challenges, with 20% frequency each. This was shown by a statement from one of the respondents (P11):

> "…*our major barrier is lack of resources. We are using a manual system because of lack of resources which makes it difficult in providing information. Documenting information using a manual system increases your cost."*

Most of the interviewees' responses revealed that the unavailability of resources, as shown above, was hindering gold mines from investing in the latest technologies, making extracting gold process waste information easier. Responses revealed a need for local mining organisations to enter joint ventures and partnerships with investors from countries with more advanced technologies. The interviewees argued that these

investors would likely provide technology from their countries to help the Zimbabwean gold mining sector. One of the interviewees stated:

> "*Through partnership with would be investors who normally come to do due diligence. Countries like Australia and Canada have got more sophisticated mining methods because where they mine their mining areas, the gold is actually far lower than what we have in this continent, and so we can benefit from the technology that they have."*

However, some interviewees' responses revealed a need to be careful when entering partnership with foreign investors as most of them tended to under declare gold found, knowing the local organisations do not have the technology to measure and detect the amount of gold available. This agrees with the view of Shields (1995), who noted that ABC's success required adequate resources.

On strategies that have been adopted to facilitate the implementation of EMAPs, most participants (P8, P9, P11 and P12) indicated that several mining organisations were training employees on best environmental management practices. Intakhan (2014) confirms that training is essential for the success of an EMAP. Most participants indicated that mining organisations have resorted to concentrating on one central dumping area to minimise the cost of rehabilitating many areas. Interviewees indicated that EMAg requires mining dump areas and those that come in contact with cyanidation to be covered with plastic lining and fenced to avoid contaminating water bodies and exposure to animals. One interviewee stated:

> "…*concentrate all your work into one area so that you avoid dumping everywhere since that would make it difficult to rehabilitate all the areas that have been affected by cyanidation. So, if everything is concentrated in one area, it becomes cheaper to put the plastic lining in that one area and have the dump in such a way that it is growing upwards as high as possible so that all the water just spills on the plastic lining and is contained there, and it does not spread all the way round."*

5.6 NEW ASPECTS THAT EMERGED FROM FACE-TO-FACE INTERVIEWS ENHANCED THE FRAMEWORK

The initial framework (Figure 3.3) presented in chapter 3 gave a practical exhibition of the synthesised propositions developed from literature by demonstrating seven (7) essential themes: subject matter, objectives, expected results, EMAPs, interested parties, corporate governance structure, and sustainability, with links between them based on their association. Some new aspects augmenting aspects of the entities in the preliminary framework did emerge from personal interviews conducted during fieldwork. As a result, the preliminary framework can be enhanced with the findings from face-to-face interviews conducted during fieldwork.

These aspects are indicated in Figure 5.1 and portray the different aspects that shape an organisation’s environmental strategy. This starts with the goals of the mining organisation, which should be clear and promote environmental initiatives. The goals must be linked to the expected results, which we will realise if environmental initiatives are adopted. The figure indicates that adopting environmental initiatives comes from a country's stakeholder influence and corporate governance structure, which tends to influence an entity's adoption of the EMAPs. The initial framework was built from the literature review.

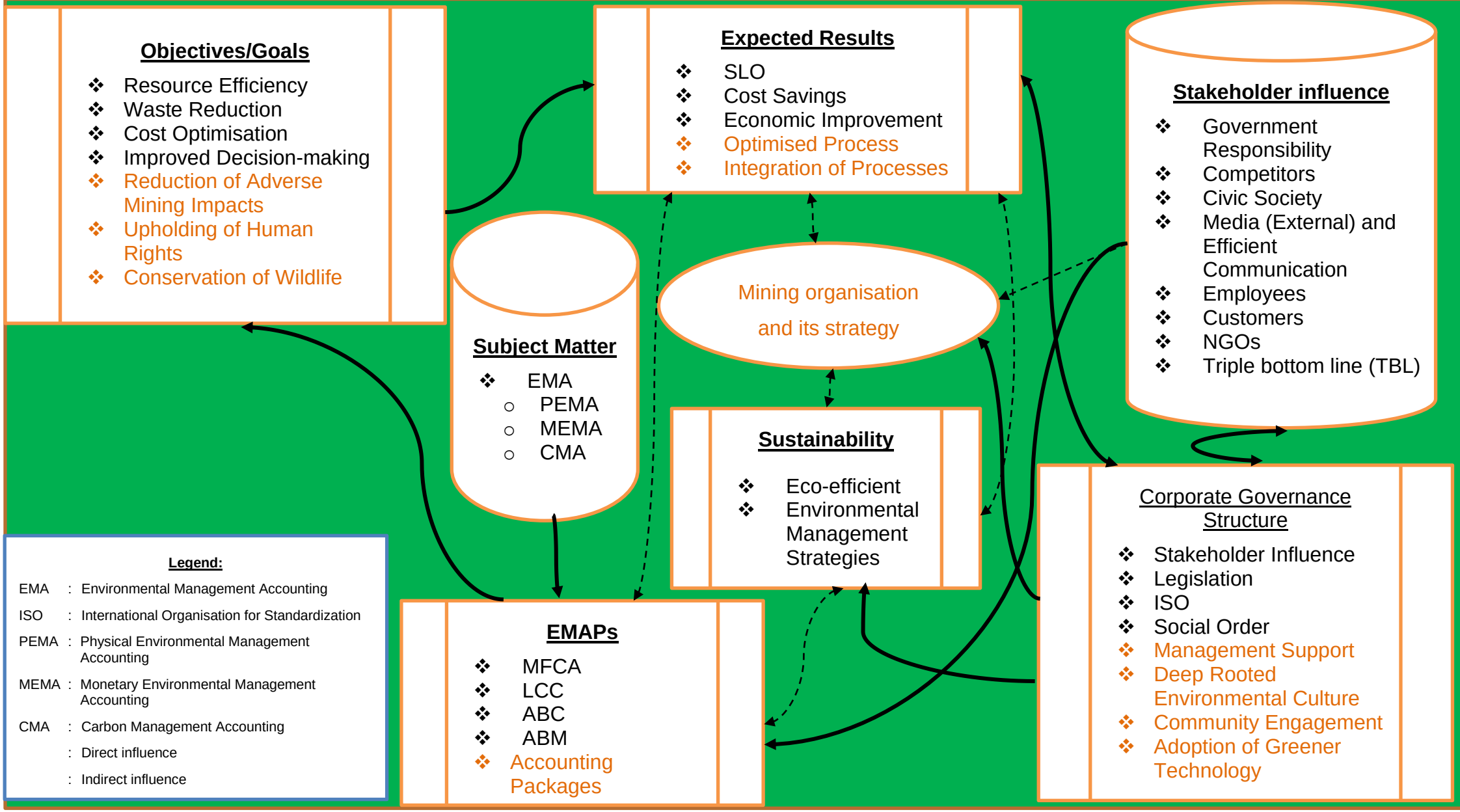

Figure 5.1: The enhanced integrated framework for Zimbabwean gold mining sector (Source: Researcher's own construction)

5.7 CHAPTER SUMMARY

The results of the conducted interviews are presented in this chapter. The results demonstrate that institutional pressures significantly impact the Zimbabwean gold mining sector in adopting greener initiatives and that the sector tends to respond to coercive pressure. Coercive pressure was found to be the most effective, and this was found to be coming from government departments like EMAg and the Ministry of Mines. Although respondents indicated that coercive pressure was good, it needed to be applied with care since it tended to reduce the gold mines to compliers of the law, thereby killing the initiation of new ideas. Gold mining activities were identified as not being in harmony with the environment. The gold mining sector has an adverse impact on the environment. Land degradation, displacement of people and violation of human rights were identified as some of the harmful effects on the ecology of the gold mining operations. The sector does not have a standardised practice of managing waste. Respondents indicated a need for stakeholder engagement in developing a waste management policy that addressed the Zimbabwean situation and therefore avoided borrowed policies from other countries. Most of the gold mining organisations were found to take waste accounting very seriously. Among the selected EMAPs, only ABC was found to be extensively used, while MFCA was not used at all. The next chapter discusses the findings from the focus group validating the developed integrated framework.

CHAPTER 6: FOCUS GROUP VALIDATION OF THE FRAMEWORK

6.1 INTRODUCTION

The results of extensive interviews were covered in the preceding chapter. Seven (7) entities' attributes, as shown in Figure 5.1, were added to the conceptual framework presented at the end of chapter 3. The current chapter focuses on validating the framework enhanced in the previous chapter. Validation was done by conducting a focus group at the Magnesite mine in Kadoma at the end of October 2021. Permission was granted by the mine for the researcher to conduct a focus group.

6.1.1 The goal of the chapter

This chapter's primary objective is to discuss the results from the focus group, which was consulted to validate the framework. In addition, the chapter will also present the final framework resulting from this process.

6.1.2 The layout of the chapter

A discussion of findings from the focus group in section 6.2 follows the introduction in section 6.1. Next, section 6.4 presents the final integrated framework of environmental management accounting practices to promote green gold mining in Zimbabwe. Finally, section 6.5 concludes the chapter with a summary.

6.2 FINDINGS FROM THE FOCUS GROUP

Beginning with the initial questions, this section includes interpreting and discussing the research's findings. While some other questions added a fresh perspective that gave rise to new subjects, some debate relates to the structure shown in Figure 5.1. The focus group participants were asked questions in the text boxes to validate the framework.

6.2.1 Job function and sustainability

Please tell us your name and what your job entails or what you do?

Two (2) participants, P2 and P4, were from the finance department. Participant P2

oversaw administration and finance, responsible for all the organisational corporate secretarial services, which embrace financial management, accounting, HR issues and other statutory requirements. P4 was responsible for managing and consolidating all the financial reporting for the group. Participant P3 was from the surveying department, responsible for taking measurements of quantities of ore underground and for planning purposes. The job entails taking accurate measurements and recordings of mine working conditions, designing, and planning both surface and underground safety mining activities, which is essential for the well-being of the mine and the environment.

Participants P1 and P6 were from the management department: P1 was the general manager of the mine, responsible for general management, planning and controlling of mining activities. P6 was the operations manager, responsible for managing the plant operations, crushing the ore and extracting gold from it. Participant P5 was from the SHE with the responsibility to plan and develop strategies to manage the business risks of the gold mine. The role involved planning and allocating resources to achieve a zero-harm impact on the environment and become Zimbabwe's leading low-cost producer of gold. The researcher felt that the group was well represented with participants who participated in environmental management.

Conclusion: The composition of the above group and what their jobs entailed shows that participants participated in environmental management issues. The focus group findings and discussion should provide rich information to validate the framework and encourage sustainable gold mining in Zimbabwe.

6.2.2 Expected results and sustainability

When you hear the words “environmental management”, what comes to mind?

All the participants indicated that environmental management implied sustainable usage of resources within the gold mining sector. Participants indicated that sustainable usage of resources involved planning, organising, leading, and controlling activities to reduce environmental impact. In response to further probing, P5 stated that environmental management is a positive way to balance mining and preserving the environment. P5 indicated that since they have a SHE department, it means they are serious about attaining their environmental management objectives by ensuring

that:

- The effluent discharged by the mine to the tailings is safe for humans and animals. The SHE department collects discharge samples daily to ensure minimal cyanide levels. When cyanide levels are high, the discharge is diluted with ferrous sulphate to ensure water is not contaminated, making it safe for animals and humans.
- Revegetation takes place on all sites mined through the planting of trees. The SHE department ensures that employees are dedicated to planting trees to preserve the environment and do not have to wait for national tree planting day.
- All fumes from the plant sulphur are controlled. In addition, the SHE department ensures that the sulphur burners are constantly changed and serviced to curb fumes that may pollute the environment when worn out.

The rest of the participants offered no objection to the above and emphasised the need for their operations to avoid negatively impacting the environment. The researcher agrees with the participants' views and advocates optimising resource usage to improve human well-being while lowering the environmental footprint.

Conclusion: These findings show that participants understand environmental management, essential for validating the framework.

6.2.3 Special skills and environmental management

Are there any special skills one must have to manage the environment?

Fifty percent of the participants (P1, P3 and P5) indicated that skill is needed to be able to discharge environmental management duties, whilst the other 50% (P2, P4 and P6) argued that environmental management does not require skill but a mindset which can be developed through organisational culture.

P5 indicated that environmental management was a science and art which could not be left to untrained people. The argument was that one must understand environmental management principles to appreciate environmental management. P1 agreed and went on to state that you cannot know the negative impacts of a mining activity if you do not have the skill; having the skill would direct one to strategies to adopt to be able to minimise negative impact. P3 indicated that environmental

management also involves convincing the mining organisation's community to adopt sustainable initiatives in their operations. Hence, convincing the community through public awareness, convincing employees to embrace environmental management initiatives and developing a culture of environmental responsiveness that all can adopt is an art or skill which can only be performed by one with the expertise.

On the contrary, P2, P4 and P6 argued that there is no need for a special skill for one to be able to oversee environmental management. They argued that one only needs to understand how mining operations affect the environment to design strategies to reduce the mining footprint. In their view, one should be a responsible citizen to manage the environment. Littering, for example, does not require skill, they argued, but good citizenship and a sense of duty. Participants believed that what is key in environmental management is consciousness and the ability to note the environmental consequences of their behaviour and find strategies to mitigate it.

The researcher concurs with those participants (P1, P3 and P5) who indicated a need for a special skill to discharge environmental management duties. Environmental management is too important an area to be left to guesswork, and hence, should be managed by skilled and responsible people who know what they do.

Conclusion: The focus group findings suggest that skill is essential for managing the environment. This will support the notion of a corporate governance structure indicated in the framework, which in the long term will benefit sustainability.

6.2.4 Views on the proposed integrated framework

What are your views on the proposed framework?

All the participants indicated that the proposed framework was good as it integrated several environmental management principles. The group presented the following argument: the framework will bring sustainable development and green management to the Zimbabwean mining sector, generally and specifically the gold mining industry. Aspects like resource efficiency, waste reduction and cost optimisation were key to generating a profit in the gold mining sector. Hence, the framework is applicable in practice. In addition, they indicated that wildlife conservation within the framework was essential in managing conflict between the gold mining sector, civic society, and National Parks, hence ensuring a balance between mining and wildlife conservation.

However, there was a degree of disagreement among participants as the focus group indicated that all gold mines discharge cyanide in their tailings. Therefore, it was essential to ensure cyanide levels were low and safe for wild animals and humans. They argued that the use of ferrous sulphate should be observed before discharging cyanide-contaminated tails. This would ensure a safe planet for all and be contrary to what came from in-depth interviewees.

When further probed, P2 stated that the framework appeared practical; however, there was a need to see how data collection could be automated. This dynamic component should be added to the framework. P2 indicated that the framework reflects a holistic approach to issues related to environmental management. Once adopted and implemented, it would assist the gold mining sector exercise good corporate citizenship and earn an SLO. The researcher agrees with participants that wildlife conservation within the framework was essential in managing conflict between the gold mining sector, civic society, and National Parks.

Conclusion: From the discussion among group members, it is clear that environmental management is a broad area encompassing wildlife conservation.

6.2.5 Key environmental management aspects in the proposed framework

What do you view as key in the proposed framework?

Participants P3 and P2 agreed that they viewed stakeholder pressure as key in the proposed framework. They indicated that gold mining organisations needed a push to adhere to environmental management. They argued that we could develop sound policies, to which everyone may agree, but gold mining organisations tend to ignore them unless pushed. Consequently, they agreed that stakeholder influence is key to achieving environmental management goals within the mining sector.

On the contrary, P4 highlighted upholding human rights and wildlife conservation as key components of the proposed framework. In most instances, gold mining organisations tended to have conflicts with communities in which gold deposits were discovered, forcing some community members to migrate to make way for mining activities. The participant emphasised the dangers of cyanide already mentioned. In addition, humans and animals have a right to a clean and healthy environment, and the framework advocates this aspect.

Participant P2 pointed to sustainability as the key aspect of the proposed framework. The participant approved of the framework's advocacy of eco-efficiency, which would ensure that the mining organisation benefits while conserving the environment for future generations. The participant believed that aspects like corporate governance structure, deep-rooted environmental culture, engagement, and adoption of greener technology are all critical in fostering sustainability within the gold mining sector. Participant P1 viewed the framework's listed objectives as key: if those objectives were met, the gold mining sector would not have challenges in environmental management. Attainment of the framework's objectives would realise the environmental management goals since they all work towards eco-efficiency. Lastly, P5 commended the framework for internalising externalities to improve efficiencies. The researcher concurs with the various views of the participants, emphasizing that all aspects of the framework are essential in fostering environmental management.

Conclusion: From the discussions, it emerged that stakeholder pressure, upholding human rights, conservation of wildlife, objectives or goals, and sustainability are all key aspects in fostering sustainable environmental management.

6.2.6 Change and environmental management

When you make a reflection, what are the new things you tried to implement to enhance environmental management and what are the things you tried to discontinue?

Regarding new things they tried to implement to enhance environmental management, it was noticeable that most participants disagreed because they gave information aligned with their departments. Participant 1 indicated that they had discontinued the unnecessary cutting down of trees. They used to rely on trees to build underground wall pillars to ensure that shaft tunnels do not collapse, but they have since discontinued the practice and are now using pillars made from cement and metals. They have subsequently discouraged employees from using firewood for cooking, encouraging them to use electricity instead. They have made free electricity available to all employees, counting it as a mine production cost. The participant indicated that they believed as a company that if another power source were made available to employees in this way, it would help preserve the environment.

P4 indicated that they have recommended that the organisation discontinue using coal-powered furnaces and boilers and replace them with electricity-powered fusion furnaces and boilers. This is because not only were the coal-powered furnaces and boilers constantly breaking down, but they were also producing high emissions into the atmosphere. Hence, the electric-powered ones were needed to enhance environmental management and increase eco-efficiency. By contrast, P2 indicated that they had replaced the manual system with a computerised system, which needed a lot of paperwork. This has allowed them to regularly produce environmental reports on time, which the regulator wants.

P3 indicated that they had discouraged the disposal of used oil and chemicals into the environment to enhance environmental management. They used to dispose of used engine oil and chemicals everywhere, which they felt was very bad for the environment. In addition, they used to leave the pits open, which were dug to take samples during surveys, a tradition they have since discouraged. Once samples are taken, the pits are closed, and the area reclaimed since they are left in a community that rears animals, and some of these animals used to get injured by falling into their pits. This created a conflict with surrounding communities. P6 indicated they have discouraged discharging used water with chemicals into the environment. To avoid spillage, they recycle the water into the plant. P5 indicated that instead of implementing new measures, they adopted environmental disclosures (voluntary and solicited), ISO 14001 and sustainability reporting and assurance.

Conclusion: From the discussions among the focus group participants, it emerged that they had discontinued the practice of unnecessary cutting down of trees, using coal-powered furnaces and boilers, which were producing high levels of emissions into the atmosphere, as well as disposing of chemicals into the environment as means of enhancing environmental management.

6.2.7 Progress of change management

What helped you continue with the change and what has been the progress?

Participant P5 pointed out that a comprehensive change is not easy; however, it can be well received by everyone when nurtured. P4 indicated that since the

implementation of the electric furnace and boiler, gold recovery has increased, which has been motivational.

The rest of the group pointed to remarkable progress, and that continuous engagement with workers and other stakeholders was key to continuing the change. They indicated they are getting support from the mine directors, motivating them to continue the change. They also argued that they usually engage with the community to manage conflicts. Finally, they indicated that implementing new ideas is a process and not an event; hence, it is ongoing.

The researcher agrees with the participants that change is a process and not an event, which calls for effective management if results are to be realised.

Conclusion: From the focus group's results, it is evident that new measures have been implemented, and managers have gained experience managing new projects, which ought to benefit environmental management if the framework is adopted.

6.2.8 Role of workmates

What role do your workmates and others have in your success?

All the participants indicated that teamwork is key in any organisation to achieve results. Participant 4 indicated that he gets support from colleagues, making it possible to achieve desired goals. Participant 2 pointed out that it was essential to cultivate the spirit of teamwork in whatever they do as an organisation. The participant stated that they make efforts to ensure that the issue of environmental management is incorporated into the organisational mission statement and becomes an organisational culture, which they must adhere to from day to day. In addition, the participant argued that when they work as a team, they can achieve environmental management goals and hence, grow to be the company they are today due to the team efforts of members.

Participant P3 indicated that the survey is a team effort, and to be able to take samples, they must dig pits, which calls for team participation. Workmates provide awareness of changes happening in the survey field, environmental management consultancy and ideas on managing the environment. Following the same argument, P1 pointed out that environmental management was not a one-person band. It was group work, hence the need to assist one another. The participant believed they had been able to succeed due to teamwork. Consequently, the researcher concludes that teamwork is

essential for achieving results. To green the environment, all stakeholders should play an active role.

Conclusion: Based on the focus group's results, teamwork has been observed to be key to the sustainability of the gold mining sector.

6.2.9 Environmental management accounting practices (EMAPs)

Do you think the application of EMAPs (such as ABC, LCC and MFCA) serves the purpose of resource efficiency, waste reduction and improved decision making?

Participants P1 and P3 had no idea of EMAPs. Participants P2, P4, P5 and P6 knew only of ABC. As a group, they presented the following argument: ABC ensures every component of the gold mining is costed, which helps identify those activities consuming the highest costs. In the end, a comprehensive review of the costing system is done, and strategies are adopted to reduce the costs of those activities consuming the highest amount based on information provided by ABC. Participants pointed out that they needed to manage costs to generate a profit in gold mining. Participants noted that ABC has highlighted that diesel which they were using in powering most of their plants, was causing leakage of profits, so they have invested in smart solar energy and electric furnaces and boilers, which has resulted in significant cost savings and has been very helpful in terms of resource efficiency and wastage reduction. Finally, they requested to be schooled on the other practices listed and how they would benefit from using them.

The gold mining sector failed to take advantage of the benefits that could have accrued had they been using MFCA. The SHE department was using LCC. The researcher agrees with participants about educating the gold mining sector on EMAPs like MFCA and the benefits likely to accrue from its implementation.

Conclusion: According to the focus group results, EMAPs might be useful for waste reduction and improved decision-making and should be complimented with the adoption of MFCA for resource efficiency.

6.2.10 Objectives of gold mining and sustainability

Do you think meeting the goals of a mining company (such as resource efficiency, waste reduction and improved decision making) results in cost savings and minimisation of environmental impact? Kindly explain?

All participants agreed that meeting a mining organisation's goals results in cost savings and minimisation of environmental impact. The participants indicated that:

- When there is resource efficiency, there is also waste reduction, thereby enhancing company viability, which minimises environmental impacts.
- Improved resource efficiency is associated with improved productivity, which implies efficiency along the production and supply chain, which reduces operational costs and improves the bottom line.
- Waste reduction is a reduction of items to be discharged into the environment, hence minimising environmental impacts.
- Waste pollutes the environment; although organisations work towards zero pollution, they sometimes have accidents that pollute the environment. Waste reduction means that the number of accidents that pollute the environment declines.
- A decline in incidents polluting the environment reduces penalties from environmental regulators, resulting in cost savings.
- Improved decision-making implies that managers are provided with relevant information that helps them control resources, resulting in cost savings.
- The cost of pollution control at the end of pipe is much higher when compared with the integration of control during a product's life. Therefore, high efficiency implies prevention through a design (PTD) model, which internalises organisational externalities to bring goodwill and an excellent corporate image.

The researcher infers that meeting the goals of a mining organisation results in cost savings and minimisation of environmental impacts since meeting the goals improves the gold mining processes.

Conclusion: There was agreement among the group members after their discussions that meeting the goals of a gold mine is associated with cost savings and minimisation of environmental impacts, which is the major goal of the proposed framework.

6.2.11 Association between social responsibility and performance

Do you think being socially responsible and adoption of greener strategies would lead to cost savings and economic improvement?

Participant P3 was not sure. The other five participants indicated that there was an association between being socially responsible and the financial performance of a goldmine company. The participants pointed to the following:

- Adopting green strategies is being socially responsible. When adopted, resource efficiency, waste reduction, cost optimisation and improved decision-making are all crystal aspects of cost savings, leading to increased profits.
- The viability of gold mines resulting from cost savings and foreign currency earnings implies the improved performance of the entire economy of a country.
- Green strategies are becoming required to access foreign markets, and pollution and monitoring fees from the regulator EMAg have been structured, so that cleaner strategies enjoy lessor monitoring and pollution fees (Blue licence for air emissions is USD100 compared to USD350 per discharge point before pollution quantification factor). Therefore, producing in the blue band positively impacts the bottom line.
- When a gold mining company becomes socially responsible by exercising good corporate citizenship, it is likely to earn it a social licence to operate and co-exist with the community. The result is building a good image and avoidance of unnecessary bad publicity and unnecessary visits by the regulator.

Participants pointed out that being socially responsible was expensive in the short-term but profitable in the long run. The researcher agrees with participants that being socially responsible results in an improvement in the financial performance of an organisation.

Conclusion: There is agreement among the group members based on their conversations that being socially responsible is associated with the economic performance of a goldmine, which would benefit sustainability within the framework.

6.2.12 Essential environmental management aspect

Of all the environmental management aspects we discussed, which one is most important to you?

Regarding the priority of essential management aspects under discussion, participants P1, P3 and P6 identified stakeholder influence as the most important aspect discussed. They argued that stakeholder push was essential for the gold mining sector to adhere to environmental management principles. Their responses indicated that all relevant stakeholders should actively participate in environmental management because gold mining's capital-intensive nature means that sustainability issues are sometimes ignored because they add costs.

Participant P2 pointed to sustainability as an essential aspect of the framework. The overall goal of the framework is to work towards reducing the environmental impacts of gold mining, and hence achieving sustainable gold mining was key. Participant P4 indicated that resource efficiency was an essential aspect discussed. The participant argued that achieving resource efficiency would mean other objectives like waste reduction and cost optimisation are being met, which translates to improved financial performance. Participant P5 pointed out that all aspects discussed are essential since they are designed to work as a unit to attain the environmental management objective. The participant indicated that care should be exercised when using the framework, given the no one-size-fits-all and the ALARP principle, which advocates that risk should be managed to as low a level as is reasonable. The researcher agrees with Participant P5 that all aspects of the framework are key in environmental management.

Conclusion: From the discussions, stakeholder pressure was essential for the gold mining sector to adhere to environmental management.

6.3 AN INTEGRATED FRAMEWORK OF ENVIRONMENTAL MANAGEMENT ACCOUNTING PRACTICES (EMAPS) TO PROMOTE GREENER GOLD MINING IN ZIMBABWE

A preliminary framework (Figure 3.3) was constructed following a comprehensive literature review of chapters 2 and 3. Qualitative interviews were conducted, and the

findings were used to enhance the preliminary framework resulting in the enhanced framework (Figure 5.2). The focus group validated the enhanced framework, resulting in the final framework.

The unbroken arrows indicate direct influence, while the dashed arrows indicate indirect influence. The final framework appears in Figure 6.1, indicating that EMAPs need to be marketed to the Zimbabwean gold mining sector, and their advantages are clearly explained, so they are adopted.

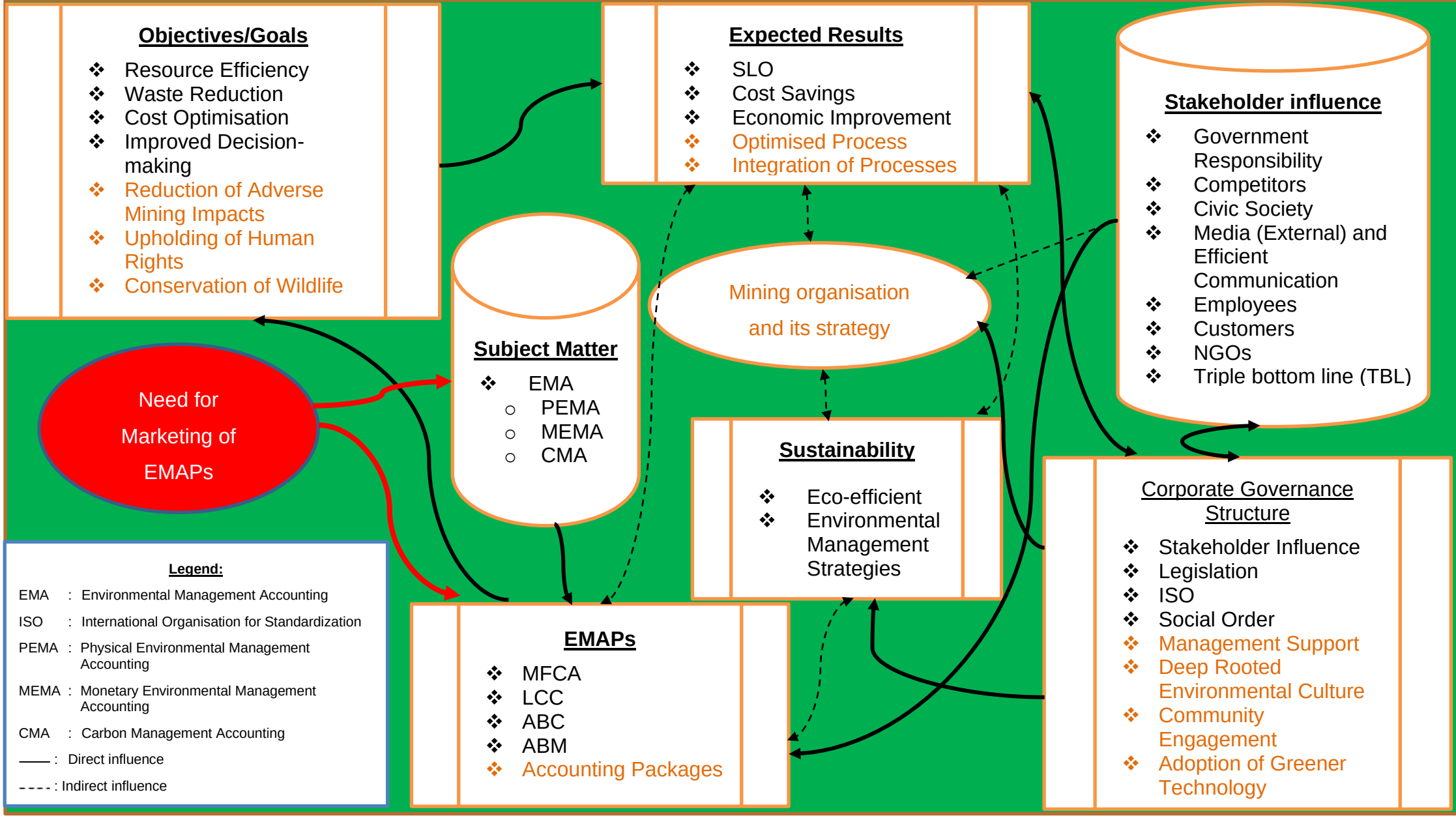

Figure 6.1: AN INTEGRATED FRAMEWORK OF ENVIRONMETAL MANAGEMENT ACCOUNTING PRACTICES TO PROMOTE GREENER GOLD MINING IN ZIMBABWE ***(Source: Researcher's own construction)***

6.4 SUMMARY

The research findings from the focus group were presented in this chapter. The major goal of the chapter was to validate the enhanced framework (Figure 5.2). The results showed that participants' job functions entailed participating in environmental management issues and that they understood what was meant by the words *environmental management*. Furthermore, participants indicated that the framework was good and would promote sustainable development and green management in the Zimbabwean mining sector, generally and specifically the gold mining industry.

Participants argued that resource efficiency, waste reduction, and cost optimisation were essential, providing a balance in the gold mining sector between generating profits and environmental management. In addition, participants viewed stakeholder pressure, upholding human rights and conservation of wildlife as key aspects of the proposed framework for fostering sustainable environmental management. The final framework is presented in Figure 6.1.

The next chapter, discussions and recommendations, presents findings from personal interviews and the focus group conducted in chapters 5 and 6, respectively. The chapter will also present areas for future research.

CHAPTER 7: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

The focus group results, which served to validate the framework, were covered in the preceding chapter. The chapter also included the final framework, which had previously been created, presented at the end of chapter 3, improved in chapter 5, and validated in chapter 6.

The current chapter provides a discussion, conclusions, and recommendations for this research. The chapter's main goal is to provide an overview of the findings, contribution to knowledge, and research recommendations. The chapter ends by providing direction for future research.

7.1.1 The goal of the chapter

This chapter's main objective is to audit the entire thesis and consider how the research objectives have been achieved. The findings of this research are discussed, providing a basis for recommendations and conclusions. The chapter also provides a discussion of future research.

7.1.2 The layout of the chapter

The purpose of this chapter is to present the study's conclusions, discuss the study's results, and offer recommendations. Following an introduction in section 7.1, a summary is given in section 7.2, and a discussion of the results is given in section 7.3. Section 7.4 summarises how objectives were achieved through in-depth interviews and the focus group. It is followed by 7.5, which discusses the thesis's contribution to theory and practice. Section 7.6 provides a conclusion of the research, followed by section 7.7 with recommendations. Section 7.8 offers a self-evaluation and assessment, while Section 7.9 offers suggestions for further research.

7.2 AN OVERVIEW OF THE STUDY

The growing promotion and awareness of environmental management issues have resulted in modern business planning, development, and adoption of eco-friendly systems. In addition, environmental awareness and promotions have been necessitated by global environmental disasters and the increase in the consumption

of natural resources to satisfy increased consumer demand. The research was conducted across the gold mining sector of Zimbabwe, and the following are key findings from the research:

- Chapter 1 demonstrated a need to develop a framework to curb the environmental impact perpetrated by the gold mining sector due to the high unemployment rate, increased metal demand and firming gold prices. Therefore, five (5) gold mining organisations were selected for the research. Four (4) of the gold mines were used in face-to-face interviews, and the fifth was used during the focus group and validation of the framework.
- As a result, the selected gold mines represented the gold mining industry. Hence, the selected participants from the selected gold mines represented the Zimbabwean gold mining sector for the in-depth interviews and the focus group.
- Qualitative research design was adopted for the research to address the research objectives. The qualitative design started with a comprehensive literature review and the development of association, content, and general propositions, which informed the development of the preliminary integrated framework Figure 3.3.
- The research was conducted according to UNISA’s ethical guidelines and requirements, and the Department of Management Accounting's Ethics Committee granted the researcher ethical clearance (Appendix D).
- Following the development of the preliminary framework after a comprehensive literature review, In-person interviews were conducted to enhance the preliminary framework, which resulted in the development of the improved framework shown in Figure 5.1.
- Following the enhanced framework, the focus group meeting was held to validate the enhanced framework, which resulted in the development of the final framework in Figure 6.1.
- Thematic data analysis used as a general approach to analysing qualitative data by identifying themes or patterns (Wagner *et al.*, 2012) was used in this research.

7.3 DISCUSSION OF THE FINDINGS

Personal interviews, a literature survey, and a focus group provided valuable insights

into the integrated framework. The thematic data analysis formed the basis of analysing data from in-depth interviews in this research. Themes were established by organising the data from in-person interviews and online interviews, as well as by comparing and contrasting the findings. In contrast to the focus group, held at one gold mine, the 12 in-depth face-to-face interviews were performed in four (4) carefully chosen gold mines. The study's objectives were addressed using the information gathered from the interviews, and hence these are discussed:

- Regarding the issue of stakeholder influence in promoting greener gold mining in Zimbabwe, most of the participants pointed out that the government (coercive pressure) through its agents like the Ministry of Mines and EMAg was the one which was most influential and exerted the highest pressure on gold mines to adopt green initiatives. On the other hand, most participants indicated that there was no mimetic (for example, competitors) or normative (for example, employees, media, and NGOs) pressure being applied to the gold mines in Zimbabwe.

  Though literature identified coercive force as the most effective form of forcing organisations to comply with environmental management initiatives, forcing businesses to lessen their environmental impact (Darnall, Henriques and Sadorsky, 2010; NSW Parliamentary Counsel, 2021). The researcher opines that coercive pressure though most effective should be applied with care and at most to small gold mining organisations since most large gold mine organisations are proactive on environmental management issues. If coercive pressure is used, it is likely to result in mere compliance, which will ultimately kill environmental entrepreneurship.
- Regarding the negative impacts of the gold mining organisations on the environment, most participants indicated that though mining has both positive and negative impacts, they indicated that the negative impacts tended to outweigh the positive. Many of the participants pointed to the gold mining industry's beneficial contribution, such as creating employment for surrounding communities, constructing roads, schools and clinics, earning foreign currency and increasing GDP. On the other hand, participants identified the displacement of people in areas found with gold deposits to make way for mining, land degradation, water pollution and deforestation, among others, as the negative

impact of mining. The researcher suggests that gold mining must be regulated, and all mining organisations monitored since some use toxic chemicals like mercury that have long been banned. In addition, some should build proper dumping sites to contain toxic waste chemicals derived from their production process, which is a risk to local communities and animals, since they may find ways to water bodies.

- On the issue of leaving the most substantial footprint on the environment, most participants indicated that gold mining impact cannot be compared to coal, platinum and chrome mining which is mostly open cast and requires vast land, unlike gold which is primarily underground. In addition, most of the participants indicated that they had strategies in place to manage the environment, like providing training to employees on environmental management strategies and planting trees. However, the literature review (Sahu et al., 2015) insisted that goldmining leaves the most substantial environmental footprint, contrary to the above discussion.

  The researcher believes that only larger gold mine organisations have the resources to manage the environment and be proactive in environmental management initiatives, leaving a minimal environmental footprint. On the other hand, small mining organisations lack the resources to manage the environment and view environmental management as a cost that reduces the profits generated. Therefore, the researcher believes there is an environmental management gap in Zimbabwe which should be closed by close monitoring and conducting intensive training in small gold mining organisations to address the gap within the sector.

- Regarding sustainability and waste management, 43% of the participants engaged the community on environmental management issues. In addition, another 43% of the participants indicated they were working on reducing pollution. Seventy-one percent of participants indicated that they take waste accountability and reduction very seriously since it was being moved at a cost and affecting profitability. Regarding waste-reduction strategy, most participants in large gold mine organisations indicated that they operated with a strategy, while those in small gold mine organisations operated without one. Most participants indicated that waste generation depended on the nature of the mined

rift. A narrow rift tended to generate more waste than a wider rift. Most participants indicated that they were failing to invest in greener technology due to the punitive taxes charged on greener technology imports by the Zimbabwe Revenue Authority (ZIMRA). The literature review aligns with the preceding discussion of taking waste reduction seriously, confirming that management should adopt a tool like MFCA to provide accurate waste information for decision-making. Additionally, it reduces the damage mining activities have on the ecosystem, as shown by Christ and Burritt (2015); and Tajelawi and Garbharran (2015).

- Regarding accounting systems in use and waste management, 80% of the participants had accounting packages, though these were used more for financial reporting than generating management accounting reports. Most participants indicated that the accounting packages in use do not support eco-efficiency decisions, which was attributed to the nature of the reports required by the regulator, which did not support eco-efficient decisions. On subscribing to standards that prescribe waste management, most large gold mine organisations participants indicated that they subscribed to ISO 4001, ISO 18001, and Orchards 45001. In addition, most participants indicated that they do provide waste-related information to management since it was essential to devise a more cost-effective way of extracting gold in future. The literature review indicated that standards provided a basis for managing the materials flows, besides allowing for the standard treatment of environmental issues (Kokubu & Tachikawa, 2013; Yagi & Kokubu, 2018), which aligns with preceding discussions of subscribing to standards.
- Regarding an integrated accounting system and EMAPs, 80% of the participants indicated they are applying ABC as an EMAP. However, LCC was not extensively used, and none of the gold mining organisations was found to use MFCA. The researcher postulates that gold mining organisations in Zimbabwe do not have enough practices to improve material efficiency. As a result, the researcher believes that gold mining organisations in Zimbabwe fail to take advantage of the benefits of MFCA (since it is not being used) and LCC (which is only partially used). The researcher attributes a lack of knowledge of MFCA as the significant

reason the EMAP is not being used and is convinced that the Zimbabwean gold mining industry has an EMA knowledge gap that must be filled.

In addition, most participants recommended having an integrated database management system, since activities must be linked and monitored, and gold mining is a capital-intensive project. Most participants indicated that using ABC within an integrated system would make information available for eco-efficiency decisions. Regarding the relationship between ABC and a gold mining company's economic and environmental performance, most participants indicated that gold mining was a business venture to generate a profit. If miners work on reducing waste, it will lead to a generation in profits. In addition, several participants' responses revealed that investors require a return on their investment; since it is a business venture, social, economic, and environmental aspects should be considered. Participants from large gold mines indicated that they had a strategic environmental plan, and participants from small gold mines indicated that though they operated with one, it was rarely followed. Researchers such as Kennedy and Affleck-Graves (2001), Fakoya and van der Poll (2013), Schmidt *et al.* (2015), and Zhou *et al.* (2017) confirmed that besides providing a richer base that leads to management insights, using EMAP within an integrated system also helps speed up the information's availability, both in terms of quantity and price.

Regarding whether the gold mining planning process should take a systems approach, most of the participants agreed on the planning process taking a system approach since all activities within the value chain should be performed to get the desired output, which was gold. Most of the participants' responses indicated that gold mining was capital-intensive, and for gold mining organisations to generate a profit, the margin of error should be eliminated. In addition, gold mining was destructive to the environment, so there was a need to plan appropriately for all activities. Having them integrated would help to minimise its destructive tendency. Several respondents indicated that the systems approach gave direction to the mining process. That said, the researcher notes there are, as could be expected, disagreements among the interview participants and members of the focus group concerning environmental impacts.

- On systems used in gauging the total expenditure of a project, most participants indicated that they use historical data and benchmark to other similar organisations in the sector by looking at what had been done by others previously. However, it was indicated that those in management accounting are not taking an active role in environmental management, and all issues to do with environmental management are divorced from those in the SHE Management department. The researcher is certain there is a knowledge gap in EMA and a need to fill it in the gold mining industry.
- Regarding the benefits of EMAPs, 40% of the participants believed that they improve the economic performance of a gold mine, whilst 60% indicated that EMAPs help reduce the environmental impacts of a gold mine. Furthermore, most of the participants indicated that the EMAP in use assists in resource efficiency, whilst only 20% of the participants pointed towards improved decision-making. This agrees with Griesel and Cronje (2005), who stated that an EMAP like ABC, besides adding value and assisting in operational efficiency, which improves economic performance, has also been shown to enhance resource allocation and performance evaluation.

  The researcher is of the view that EMAPs are essential. Still, these are not effectively used by the Zimbabwean gold mining sector, which has resulted in the sector sacrificing the benefits they could have enjoyed from their use.
- Regarding gold mining organisations' challenges in implementing EMAPs, most participants indicated implementation costs, technology adaptation challenges, acquisition costs and resource shortages. In addition, most participants indicated that the government imposes high taxes on imports of green technology, making them very expensive for mining organisations to buy.

  Although most participants indicated that they were training employees on best environmental management practices, the researcher feels that this may not be enough if employees do not have the necessary equipment for managing the environment. Researchers such as Shields (1995) and Intakhan (2014) confirmed similar challenges faced during the implementation of EMAPs.
- Regarding what their job entails, it was found that focus group participants had various responsibilities and were all involved in issues regarding environmental

management. All the focus group participants were active in or had experience in environmental management.

- On their understanding of environmental management, all the participants indicated that they knew what *environmental management* meant. Participants understood that environmental management implies sustainable usage of resources, which involves balancing mining profits and preserving the environment.
- On the need for skills to manage the environment, 50% of the participants agreed there was a need for one to have the skill to manage the environment, whilst the other 50% strongly disagreed. Those who indicated that one must have the skill to manage the environment argued that environmental management was both an art and a science, which could not be left in the hands of untrained people. Those to the contrary argued that what is key in environmental management is consciousness and the ability to recognise the effects of organisational actions on the environment and find mitigatory strategies.
- On their views on the proposed framework, all the participants praised the framework for integrating several environmental management principles. Participants' responses indicated that including aspects like resource efficiency, waste reduction, and cost optimisation were key to both environmental management and profit generation by the gold mining sector. Participants also felt that the framework appeared practical, though there was a need to see how data collection could be automated.
- On what participants viewed as key in the proposed framework, participants P2 and P3 viewed stakeholder pressure as key, whilst P4 saw upholding human rights as the key component of the proposed framework. In addition, participant P2 viewed sustainability as the key component in the proposed framework, and P1 viewed objectives to be key, whilst P5 identified internalising of externalities for an organisation to improve efficiencies as key in the proposed framework.
- Participants gave information related to their departments on the matter of new measures they had tried to implement and practices they tried to discontinue, to enhance environmental management. It was noted that various initiatives had been implemented to enhance environmental management, which range from discontinuing the practice of unnecessary cutting down of trees, making an

alternative source of power available to employees for cooking, discontinuing the use of coal-powered furnaces and boilers which were polluting the environment, and discontinuing the discharge of used oils and chemicals into the environment.

- On the issue of what helped them continue with the change and what progress has been made, participants pointed out that although the change was not easy, everyone may accept it when correctly planned and achieved. Participants pointed to continuous engagement with workers and key stakeholders as the key to their success.
- On the role of workmates and others in their success, participants agreed that teamwork was key to achieving results.
- On the application of EMAPs such as ABC and LCC and how they service the purpose of resource efficiency, waste reduction and improved decision-making, it was noted that P1 and P3 had little understanding of these practices. The remaining participants knew ABC and did not know MFCA. It was observed that there was a need to market EMAPs to the Zimbabwean gold mining sector.
- On the issue regarding meeting the goals of a mining organisation and its link to a reduction in cost savings and minimisation of environmental impacts, all participants agreed that meeting the goals of a mining organisation, like resource efficiency, waste reduction and improved decision-making was associated with cost savings and would result in the minimisation of environmental impacts.
- On the association of being socially responsible and adopting greener strategies with cost savings and economic improvement, most participants agreed that there was an association between being socially responsible and the economic performance of the gold mining organisation. However, it was considered expensive in the short term but profitable in the long run.
- On the question of the essential environmental aspect among those discussed, 50% of the participants identified the need for a push for the gold mining sector to adopt greener strategies, highlighting stakeholder influence as the most important. On the other hand, P4 pointed to resource efficiency being key, P2 indicated that sustainability was key whilst P5 was of the view that all aspects are key as they are to work together towards environmental management.

7.4 HOW THE OBJECTIVES WERE ACHIEVED THROUGH IN-DEPTH INTERVIEWS AND THE FOCUS GROUP

Table 7.1 details how the literature survey, interviews, and focus group helped to accomplish the research's objectives.

Table 7.1: How the objectives of the study were achieved

Research Objective	Interviews	Recommendations / Observations
Research Objective 1: Determine the role that can be played by institutional forces like the government and other key stakeholders in facilitating greener gold mining activities.	The interviews and focus group established that: • EMAg and the Ministry of Mines were the two (2) government agencies exerting the highest force on the gold mining sector to adopt greener strategies. • The pressure by the regulator was sometimes too excessive. The interviews also established that mimetic and normative pressures were not being exerted on the Zimbabwean gold mining sector to adopt greener strategies.	It is recommended that coercive pressure be applied with care as it was forcing some gold mine organisations to work towards compliance with the law and not go beyond. Coercive pressure has killed the spirit of innovation within some other gold mining organisations. The gold mining sector should be given enough room to manage the environment proactively. In addition, the government should provide a framework that encourages innovation unless the gold mining company is found to be negligent on environmental management issues.
Research objective 2: Establish the effects of gold mining operations on the environment.	The interviews and focus group established that gold mining activities: • are not in harmony with the environment since the desired mineral exists underground. • have the following adverse effects: ✓ Land degradation ✓ Violation of human rights and displacement of people from mining areas ✓ Extreme industrial accidents due to poachers who disregard sustainable mining principles ✓ Water pollution ✓ Deforestation	Even though most small goldmines were found to lack resources to comply with environmental management principles, it is recommended that the regulator continue monitoring and ensuring that small gold mines are not discharging toxic chemicals into the environment

Research Objective	Interviews	Recommendations / Observations
	✓ Acidification and air pollution	
Research objective 3: Establish what strategies are being employed and what information is needed by gold mining organisations to reduce waste generated through mining activities	The interviews established that: • gold mining companies are engaging surrounding communities to understand their expectations and be able to devise strategies for closing the expectation gap; the focus group also confirmed this aspect. • most of the policies used by the regulator are a "copy and paste" from other countries and were not applicable in Zimbabwe. The interviews and focus group established that: • gold mining organisations discharge waste into the environment, which might contaminate water bodies and put the lives of animals and humans at risk. The focus group established that: • there is a need to have the skill to manage the environment, and environmental management is too important an area to be left to chancers.	• On accounting systems in use and waste management, it is recommended that the gold-mining sector invests in packages that support eco-efficiencies decisions. • Regarding sustainability and waste management and challenges in implementing EMAPs, it is recommended that the government, through ZIMRA, exempt or reduce tax on the importation of green technology as a strategy for promoting green gold mining in Zimbabwe since they were acting as a hindrance towards environmental management. • It is also recommended that the regulator devise policies tailor-made for the Zimbabwean situation and avoid a "copy and paste" of policies from the developed world. Gold mines should be engaged when policies are drafted. Engagement with communities and key stakeholders should be continuous. • Management accountants were found not to be participating in environmental issues. Instead, they were leaving everything to the SHE

Research Objective	Interviews	Recommendations / Observations
		department, so it is recommended that management accountants take an active role in environmental management accounting issues.
Research objective 4: Identify characteristics, benefits, and gaps of selected EMAPs and how their integration can address the gaps identified.	The interviews established that: • the accounting systems being used by most gold mining companies do not support eco-efficient decisions. It was also revealed that most gold mining organisations used ABC, and participants had little or no knowledge of MFCA. • using EMAPs in an integrated system would make available information required to manage the environment. • planning should consider economic, social, and environmental aspects. • the current EMAP in use does promote material efficiency and cost savings opportunities in the gold mining sector. • the challenges faced in implementing EMAPs are acquisition costs, implementation costs, resource shortage and technological challenges.	Regarding the benefits of EMAPs, it is recommended that these be marketed to the mining sector since there is a knowledge gap that was found and needs to be felt as most gold mining organisations are losing out on benefits from non-implementation and non-use of MFCA
Research objective 5: Develop an integrated framework to assist gold mining organisations in becoming greener	The preliminary framework was enhanced through in-depth interviews and later validated through the focus group. Participants agreed that the framework was good	It is recommended that the framework be adopted and implemented in the gold mining sector or be used as a guide for government environmental policymaking since participants judged it to be excellent and applicable in practice.

7.5 RESEARCH LIMITATIONS

The limitations of traditional management accounting systems in providing necessary environmental information were observed during the study. There is a likelihood that the study may have suffered from inherent limitations associated with a qualitative study, like subjectivity and generalisation. The results obtained from five gold mines may not apply to other extractive mines since generalisation is a controversial issue in exploratory qualitative research, even though attempts were made to improve the reliability of the study findings and overcome these limitations. To this end, the study would benefit replication in different extractive industries, not only to triangulate the findings of this study but to come up with a universally applicable framework.

7.6 CONTRIBUTION OF THE STUDY

Several advances were made in prior literature in this research. The research has contributed to knowledge in the field of EMA. The study suggested a comprehensive set of EMAPs to encourage more environmentally friendly mining in the Zimbabwean gold sector, thereby contributing to both theorising and doing. From a theoretical perspective, an article was published in 2021 in the journal *Sustainability*, which is peer-reviewed, open access and based in Switzerland, adding value to the general body of knowledge on EMAPs. It has been noted from discussions that the framework could be used to:

- curb the environmental impacts of the gold mining sector;
- uphold human rights and conservation of wildlife;
- improve the viability of the mining sector while enhancing the environmental performance of the sector; and
- advocate for stakeholder engagement to achieve sustainable development.

The research serves as a benchmark for future research globally. In addition, the research provides insight for the Zimbabwean government on policy formulation for the mining sector. The research identified a need for EMAPs to be marketed to the Zimbabwean gold mining sector, which is a knowledge gap. The researcher conducted interviews to enhance the preliminary framework developed. The preliminary framework was later validated using a focus group. Based on the findings, the researcher submits that an essential contribution of the integrated framework is the

possibility of adopting the framework not only by the gold mining sector but also by other sectors of the economy to foster the greening of Zimbabwe. The above benefits facilitate the discussion between stakeholders involved in environmental management.

The theoretical contributions were made by developing an integrative framework of EMAPs, which may be viewed as a formal rule within the gold mining sector and ought to direct gold mining organisations to initiate activities promoting green gold mining and stabilising the sector in green initiatives. Figure 6.1 represents the integrated framework. The researcher theorised how the key participants responded to EMAPs as influenced by the institutional, stakeholder and sustainability theories and extended the insights on these theories as applied to a critical context. Andrews-Speed (2016) argues that institutions represent formal and informal rules within a society, while the relevant organisations embody these rules. The theories were used to describe how decisions about environmental activities and environmental management are impacted by modifications in societal values, technical improvements, and legislation (Ball & Craig, 2010) which aligned with the findings.

The study endorses the role played by coercive pressure as the most effective form of pressure driving gold mining organisations to comply with environmental management initiatives and thereby coercing businesses to lessen their impact on the environment (Dadd *et al.*, 2014; Lin & Ho, 2016). This study, therefore, adds to the body of knowledge regarding an essential concern of stakeholder pressure (coercive pressure). Stakeholder pressure is the most effective in promoting green initiatives, to be applied with due care since it will likely kill environmental management entrepreneurship by driving organisations to compliance.

This study also endorses culture as an essential factor in environmental management. Non-economic factors like culture, laws and regulations can shape the form and behaviour of organisations (Lin & Sheu, 2012), which aligns with the findings. The researcher theorised that some organisations could be proactive on their own, and culture needs to be blended with employee training on environmental management, an essential aspect of environmental management. An organisation should be willing to source human resources and avail competent personnel to manage environmental management. The theories were, therefore, essential in providing industry-level explanations as they included collectively held ideas, values and beliefs in the analysis

and shaped the development of the framework.

7.7 CONCLUSION

The research examined why the gold mining sector was leaving a strong environmental footprint, which led to an analysis of how EMAPs could assist the sector in reducing its footprint. Following the literature review, a preliminary framework was developed at the end of chapter 3. Face-to-face interviews resulted in the enhanced framework at the end of chapter 5. The enhanced framework was validated using a focus group resulting in the final integrated framework at the end of chapter 6. The gold mining sector has to reduce its footprint on the environment. As a field, EMA should ensure that appropriate practices are available to foster green gold mining. The findings of this research reveal that coercive stakeholder pressure is the most effective in influencing the gold mining sector to adopt greener strategies. In addition, it was also established that most of the participants do not know and are not using MFCA, thereby sacrificing the potential benefits that could have accrued had the practice been in use. The researcher argues that this may be a general problem in the mining sector. While the focus was on the gold mining sector, the findings from this research may be generalised to other sectors of the economy in Zimbabwe.

The gold mining sector was found to have negative impacts outweighing its positive contribution. It was established that although gold mining leaves a strong environmental footprint, its impact could not be compared to coal, platinum, and chrome mining, which are open cast. The researcher proposes regulating the gold mining sector and monitoring its activities. Gold mines were found to be failing to invest in greener technology due to high import tax rates imposed by the Zimbabwe Revenue Authority (ZIMRA). The final findings from the research were that the framework had merit and could be applied in practice and assist the sector.

7.8 SELF-REFLECTION AND ASSESSMENT

The research has assisted me in understanding and interpreting things in a completely new way. In addition, by continually discussing, reading and reviewing draft chapters with the assistance of my supervisors, l have come to a complete understanding of EMA and the challenges of conducting a doctoral study.

The focus l had, in the beginning, was not on a doctoral level. My supervisors assisted

me a lot, and as I progressed, my initial title and objectives changed several times till I settled for an integrated framework of EMAPs. The methodology changed several times as I gathered new information until I settled for the multi-method qualitative research. I attended several research workshops at work and online and learned a lot of new ideas about doctoral research.

The research has proven to be more challenging than was anticipated at the start, which resulted in taking longer than planned. The factors which contributed to the delays were as follows:

- Organisations that had been selected to participate in the research took time to respond, which resulted in delays in applying for and getting ethical clearance to conduct field work;
- Most of the specialists that had been selected as participants for the research took more time than expected to be available for interviews since they were too busy with work and not willing to contribute towards research;
- The COVID-19 pandemic made it impossible to conduct the interviews since most employees were working from home and not physically reporting to working stations; and
- Gathering people for the focus group was a challenge. Though they had agreed to participate in the research, it later turned out that participants had tight schedules, and it took time to get them all together for the focus group.

The distribution of the specialists that had been selected for the focus group also contributed to the delay in the study's completion. Though these specialists worked for the same organisation in the same town, it turned out that the organisation had different mining sites scattered around Kadoma town, and these sites required the services of these specialists. This made it difficult for the researcher to see participants for the focus group. The researcher received assistance from the general manager and was able to meet the specialists and hold the focus group 2 hours before a scheduled board meeting.

Some of the delays in gathering primary data could be attributed to the nature of the sector selected. The gold mining sector is believed to be too secretive and does not want to pass the information on gold mining issues to outsiders. They view all people who visit them as agents of the regulator coming to spy on their operations to expose

them. The ethical clearance assisted the researcher in being accepted and giving confidence to the respondents.

The doctoral study is an individual journey rich in knowledge. In the process, I managed to have an article published in an accredited journal, with another to follow.

7.9 RECOMMENDATION FOR FUTURE WORK

The framework has proved that it can be applied in practice and assist the gold mining sector to foster environmental management. The current research relied on a comprehensive literature review, in-depth interviews, and a focus group. This fact, therefore, limited the information that could be gathered to strengthen the framework. It is believed that more information could have been collected by observation and spending time at some selected gold mines. Other improvements of the framework could come from its application of it in other mining sectors.

The framework developed in this study is static, and future research may incorporate a dynamic component within it.

REFERENCES

Abdul Majid, J. and Sulaiman, M. (2008) 'Implementation of activity-based costing in Malaysia', *Asian Review of Accounting*, 16(1), pp. 39–55. doi: 10.1108/13217340810872463.

Adiansyah, J. S. *et al.* (2017) 'Life cycle cost estimation and environmental valuation of coal mine tailings management', *Journal of Sustainable Mining*, 16(3), pp. 114–125. doi: https://doi.org/10.1016/j.jsm.2017.10.004.

Akhtar, S. *et al.* (2015) 'Life cycle sustainability assessment (LCSA) for selection of sewer pipe materials', *Clean Technologies and Environmental Policy*, 17(4), pp. 973–992. doi: 10.1007/s10098-014-0849-x.

Al-Chalabi, H. S. (2018) 'Life cycle cost analysis of the ventilation system in Stockholm's road tunnels', *Journal of Quality in Maintenance Engineering*, 24(3), pp. 358–375. doi: 10.1108/JQME-05-2017-0032.

Al-Hajj, A. (1999) 'The development of an integrated life cycle costing model using object oriented and VR technologies'. Rotterdam. doi: 978-0-660-17743-40-660-17743-9.

Al-Omiri, M. and Drury, C. (2007) 'A survey of factors influencing the choice of product costing systems in UK organizations', *Management Accounting Research*, 18(4), pp. 399–424. doi: https://doi.org/10.1016/j.mar.2007.02.002.

Al-Qudah, L. A. M. and Al-Hroot, Y. A. K. (2017) 'The Implementing Activity-Based Costing Technique (ABC) and Its impact on Profitability: A Study of Listed Manufacturing Companies in Jordan', *International Journal of Economics and Financial Issues*, 7(2), pp. 271–276. Available at: https://www.econjournals.com/index.php/ijefi/article/view/4384.

Aliakbari Nouri, F., Shafiei Nikabadi, M. and Olfat, L. (2019) 'Developing the framework of sustainable service supply chain balanced scorecard (SSSC BSC)', *International Journal of Productivity and Performance Management*, 68(1), pp. 148–170. doi: 10.1108/IJPPM-04-2018-0149.

Allain, E. and Laurin, C. (2018) 'Explaining implementation difficulties associated with activity-based costing through system uses', *Journal of Applied Accounting Research*, 19(1), pp. 181–198. doi: 10.1108/JAAR-11-2014-0120.

Alsmadi, M., Almani, A. and Khan, Z. (2014) ‘Implementing an integrated ABC and TOC approach to enhance decision making in a Lean context ’, *International Journal of Quality & Reliability Management*, 31(8), pp. 906–920. doi: 10.1108/IJQRM-04-2013-0063.

Anderson, S. W., Daly, J. D. and Johnson, M. F. (1999) ‘Why Firms Seek ISO 9000 Certification: Regulatory Compliance or Competitive Advantage?’, *Production and Operations Management*, 8(1), pp. 28–43. doi: https://doi.org/10.1111/j.1937-5956.1999.tb00059.x.

Anderson, S. W. and Young, S. M. (1999) ‘The impact of contextual and process factors on the evaluation of activity-based costing systems’, *Accounting, Organizations and Society*, 24(7), pp. 525–559. doi: https://doi.org/10.1016/S0361-3682(99)00018-5.

Andrews-Speed, P. (2016) ‘Applying institutional theory to the low-carbon energy transition’, *Energy Research & Social Science*, 13, pp. 216–225. doi: https://doi.org/10.1016/j.erss.2015.12.011.

Anju, M. and Banerjee, D. K. (2012) ‘Multivariate statistical analysis of heavy metals in soils of a Pb–Zn mining area, India’, *Environmental Monitoring and Assessment*, 184(7), pp. 4191–4206. doi: 10.1007/s10661-011-2255-8.

Aouad, G. *et al.* (2001) ‘An integrated life cycle costing database: A conceptual framework’, in *17th ARCOM Conference*. Salford University.

Ar, I. M. (2012) ‘The Impact of Green Product Innovation on Firm Performance and Competitive Capability: The Moderating Role of Managerial Environmental Concern’, *Procedia - Social and Behavioral Sciences*, 62, pp. 854–864. doi: https://doi.org/10.1016/j.sbspro.2012.09.144.

Arias, M. E. and Guillen, M. F. (1998) ‘The transfer of organisational management techniques’, in Alvarez, J. L. (ed.) *The diffusion and consumption of business knowlwdge*. London: MacMillan.

Arnaboldi, M. and Lapsley, I. (2003) ‘Activity based costing, modernity and the transformation of local government’, *Public Management Review*, 5(3), pp. 345–375. doi: 10.1080/1471903032000146946.

Asiedu, Y. and Gu, P. (1998) ‘Product life cycle cost analysis: State of the art review’,

International Journal of Production Research, 36(4), pp. 883–908. doi: 10.1080/002075498193444.

Asif, M. *et al.* (2011) 'Including sustainability in business excellence models', *Total Quality Management & Business Excellence*, 22(7), pp. 773–786. doi: 10.1080/14783363.2011.585784.

Asim, T. *et al.* (2014) 'Optimal sizing and life-cycle cost modelling of pipelines transporting multi-sized solid–liquid mixtures', *International Journal of Pressure Vessels and Piping*, 113, pp. 40–48. doi: https://doi.org/10.1016/j.ijpvp.2013.11.003.

Auer, J., Bey, N. and Schäfer, J.-M. (2017) 'Combined Life Cycle Assessment and Life Cycle Costing in the Eco-Care-Matrix: A case study on the performance of a modernized manufacturing system for glass containers', *Journal of Cleaner Production*, 141, pp. 99–109. doi: https://doi.org/10.1016/j.jclepro.2016.08.096.

Babbie, E. R. (2020) *The Practice of Social Research*. 15th edn. Boston: Cengage Learning.

Baird, K., Harrison, G. and Reeve, R. (2007) 'Success of activity management practices: the influence of organizational and cultural factors', *Accounting & Finance*, 47(1), pp. 47–67. doi: https://doi.org/10.1111/j.1467-629X.2006.00195.x.

Baird, K. M., Harrison, G. L. and Reeve, R. C. (2004) 'Adoption of activity management practices: a note on the extent of adoption and the influence of organizational and cultural factors', *Management Accounting Research*, 15(4), pp. 383–399. doi: https://doi.org/10.1016/j.mar.2004.07.002.

Balakrishnan, R., Labro, E. and Sivaramakrishnan, K. (2011) 'Product Costs as Decision Aids: An Analysis of Alternative Approaches (Part 1)', *Accounting Horizons*, 26(1), pp. 1–20. doi: 10.2308/acch-50086.

Ball, A. and Craig, R. (2010) 'Using Neo-Institutionalism to Advance Social and Environmental Accounting', *Critical Perspectives on Accounting*, 21(4), pp. 283–293. doi: 10.1016/j.cpa.2009.11.006.

Banerjee, S. B. (2000) 'Wose Land is it Anyway? National Interest, Iindigenous Stakeholders, and Colonial Discourses: The Case of the Jabiluka Uranium Mine', *Organization & Environment*, 13(1), pp. 3–38. Available at: http://www.jstor.org/stable/26161542.

Banker, R. D., Bardhan, I. R. and Chen, T. (2008) 'The role of manufacturing practices in mediating the impact of activity-based costing on plant performance', *Accounting, Organizations and Society*, 33, pp. 1–19. doi: 10.1016/j.aos.2006.12.001.

Bansal, P. (2005) 'Evolving sustainably: a longitudinal study of corporate sustainable development', *Strategic Management Journal*, 26(3), pp. 197–218. doi: https://doi.org/10.1002/smj.441.

Basit, T. (2003) 'Manual or electronic? The role of coding in qualitative data analysis', *Educational Research*, 45(2), pp. 143–154. doi: 10.1080/0013188032000133548.

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, pp. 141–150. doi: https://doi.org/10.1016/j.jclepro.2012.09.011.

Beamon, B. M. (1999) 'Designing the green supply chain', *Logistics Information Management*, 12(4), pp. 332–342. doi: 10.1108/09576059910284159.

Bebbington, A. *et al.* (2008) 'Mining and Social Movements: Struggles Over Livelihood and Rural Territorial Development in the Andes', *World Development*, 36(12), pp. 2888–2905. doi: https://doi.org/10.1016/j.worlddev.2007.11.016.

Bebbington, A. J. and Bury, J. T. (2009) 'Institutional challenges for mining and sustainability in Peru', *Proceedings of the National Academy of Sciences*, 106(41), pp. 17296–17301. doi: 10.1073/pnas.0906057106.

Bell, F. and Donnelly, L. (2006) *Mining and its impact on the environment*. New York: Taylor & Francis.

De Benedetto, L. and Klemeš, J. (2010) 'The environmental bill of material and technology routing: an integrated LCA approach', *Clean Technologies and Environmental Policy*, 12(2), pp. 191–196. doi: 10.1007/s10098-009-0247-y.

Bennett, M., Schaltegger, S. and Zvezdov, D. (2013) *Exploring Corporate Practices in Management Accounting for Sustainability*. London: Institut of Chartered Accountants of England and Wales.

Bentley, R. *et al.* (2011) 'Association Between Housing Affordability and Mental Health: A Longitudinal Analysis of a Nationally Representative Household Survey in Australia', *American Journal of Epidemiology*, 174(7), pp. 753–760. doi:

10.1093/aje/kwr161.

Bernauer, T., Böhmelt, T. and Koubi, V. (2012) 'Environmental changes and violent conflict', *Environmental Research Letters*, 7(1), p. 15601. doi: 10.1088/1748-9326/7/1/015601.

Berrone, P. *et al.* (2010) 'Socio-emotional Wealth and Corporate Responses to Institutional Pressures: Do Family-Controlled Firms Pollute Less?', *Administrative Science Quarterly*, 55(1), pp. 82–113. Available at: http://www.jstor.org/stable/27856089.

Beveridge, W. I. B. (2004) *The art of scientific investigation*. New York: Blackburn Press.

Bhimani, A. *et al.* (2007) 'Activity-based costing: how far have we come internationally?', *Cost Management*, 21(3), pp. 12–17.

Bierer, A. *et al.* (2015) 'Integrating Life-cycle Costing and Life-cycle Assessment Using Extended Material Flow Cost Accounting', *Journal of Cleaner Production*, 108(B), pp. 1289–1301. doi: 10.1016/j.jclepro.2014.08.036.

Biernacki, M. (2015) 'Environmental life cycle costing (ELCC) in the aspect of cost management accounting in the company', *Zeszyty Naukowe*, 77, pp. 305–312. doi: 10.18276/frfu.2015.77-31.

Blank, L. and Tarquin, A. (2017) *Engineering Economy*. Eight. New York: McGraw Hill Education.

Bless, C., Higson-Smith, C. and Sithole, L. (2013) *Fundamentals of Social Research Methods*. Fifth. Johannesburg: Juta & Company.

Blok, K. *et al.* (2013) 'A Novel Methodology for the Sustainability Impact Assessment of New Technologies'. Utrecht: Prosuite, pp. 1–23.

Boca, R. and Sorina, I. (2015) 'The Role of Cost Calculation Method for the Mining Companies in order to Improve the Performance of Their Activity'. Romanian Academy - Institute for World Economy. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2636785.

Bogdan, R. C. and Biklen, S. K. (1998) *Qualitative research for education: An introduction to theory and methods*. Third. Boston: Allyn and Bacon.

Bolis, I., Morioka, S. N. and Sznelwar, L. I. (2014) 'When sustainable development risks losing its meaning. Delimiting the concept with a comprehensive literature review and a conceptual model', *Journal of Cleaner Production*, 83, pp. 7–20. doi: https://doi.org/10.1016/j.jclepro.2014.06.041.

Bouachera, T., Kishk, M. and Power, L. (2007) 'Towards a Generic Framework for Whole Life Costing in the Oil Industry', in Boyd, E. (ed.) *23rd Annual ARCOM Conference*. Belfast: Association of Researchers in Construction Management.

Boussabaine, A. and Kirkham, R. (2004) *Whole Life-Cycle Costing: Risk and Risk Responses*. New Jersey: Wiley-Blackwell.

Breitenlechner, E. *et al.* (2010) 'The impact of mining activities on the environment reflected by pollen, charcoal and geochemical analyses', *Journal of Archaeological Science*, 37(7), pp. 1458–1467. doi: https://doi.org/10.1016/j.jas.2010.01.006.

Brewerton, P. M. and Millward, L. (2001) *Organisational research methods: a guide for students and researchers*. London: Sage Publication.

Bridge, G. (2004) 'Contested Terrain: Mining and the Environment', *Annual Review of Environment and Resources*, 29(1), pp. 205–259. doi: 10.1146/annurev.energy.28.011503.163434.

Brown, R. A. and Pierce, B. (2004) 'An Empirical Study of Activity-Based Systems in Ireland', *The Irish Accountancy Review*, 11(1), pp. 35–55.

Brown, R. and Yanuck, R. (1985) *Introduction to Life Cycle Costing*. Atlanta: Prentice Hall PTR.

Bruton, G. D., Ahlstrom, D. and Li, H. (2010) 'Institutional Theory and Entrepreneurship: Where Are We Now and Where Do We Need to Move in the Future?', *Entrepreneurship Theory and Practice*, 34(3), pp. 421–440. doi: 10.1111/j.1540-6520.2010.00390.x.

Bryman, A. (2012) *Social Research Methods*. Fourth. New York: Oxford University Press.

Bryson, J. M. (2004) 'What to do when Stakeholders matter', *Public Management Review*, 6(1), pp. 21–53. doi: 10.1080/14719030410001675722.

Bull, J. W. (2003) *Life Cycle Costing for Construction*. Abingdon-on-Thames:

Routledge.

Burritt, R. L. (2004) ‘Environmental management accounting: roadblocks on the way to the green and pleasant land’, *Business Strategy and the Environment*, 13(1), pp. 13–32. Available at: https://www.proquest.com/scholarly-journals/environmental-management-accounting-roadblocks-on/docview/213771144/se-2?accountid=14648.

Burritt, R. L. (2005) ‘Challenges for Environmental Management Accounting BT - Implementing Environmental Management Accounting: Status and Challenges’, in Rikhardsson, P. M. et al. (eds) *Implementing Environmental Management Accounting: Status and Challenges. Eco-Efficiency in Industry and Science*. Dordrecht: Springer Netherlands, pp. 19–44. doi: 10.1007/1-4020-3373-7_2.

Burritt, R. L. *et al.* (2011) ‘Sustainable Supply Chain Management and Environmental Management Accounting BT - Environmental Management Accounting and Supply Chain Management’, in Burritt, R. et al. (eds) *Environmental Management Accounting and Supply Chain Management*. Dordrecht: Springer Netherlands, pp. 3–20. doi: 10.1007/978-94-007-1390-1_1.

Burritt, R. L., Hahn, T. and Schaltegger, S. (2002) ‘An Integrative Framework of Environmental Management Accounting — Consolidating the Different Approaches of EMA into a Common Framework and Terminology BT - Environmental Management Accounting: Informational and Institutional Developments’, in Wolters, T., Bennett, M., and Bouma, J. J. (eds) *Environmental Management Accounting: Informational and Institutional Developments*. Dordrecht: Springer Netherlands, pp. 21–35. doi: 10.1007/0-306-48022-0_2.

Burritt, R. L., Herzig, C. and Tadeo, B. D. (2009) ‘Environmental management accounting for cleaner production: The case of a Philippine rice mill’, *Journal of Cleaner Production*, 17(4), pp. 431–439. doi: https://doi.org/10.1016/j.jclepro.2008.07.005.

Cagwin, D. and Bouwman, M. J. (2002) ‘The association between activity-based costing and improvement in financial performance’, *Management Accounting Research*, 13(1), pp. 1–39. doi: https://doi.org/10.1006/mare.2001.0175.

Cai, Y. and Newth, D. (2013) ‘Oil, Gas and Conflict: A Mathematical Model for the Resource Curse’, *PLoS ONE*, 8(6), pp. 1–10. doi: 10.1371/journal.pone.0066706.

Calvano, L. (2008) ‘Multinational Corporations and Local Communities: A Critical Analysis of Conflict’, *Journal of Business Ethics*, 82(4), pp. 793–805. doi: 10.1007/s10551-007-9593-z.

Canberra: Department of the environment (2014) *Environmental management plan guidelines*. Available at: https://www.environment.gov.au/system/files,resources/21b0925f-ea74-4b9e-942e-a097391a77fd/files/environment-management-plan-guidelines.pdf (Accessed: 15 November 2016).

Cannavacciuolo, L. *et al.* (2015) ‘An activity-based costing approach for detecting inefficiencies of healthcare processes’, *Business Process Management Journal*, 21(1), pp. 55–79. doi: 10.1108/BPMJ-11-2013-0144.

Caplehorn, P. (2012) *Whole Life Costing A New Approach*. London: Routledge.

Castel, P. and Friedberg, E. (2010) ‘Institutional Change as an Interactive Process: The Case of the Modernization of the French Cancer Centers’, *Organization Science*, 21(2), pp. 311–330. Available at: http://www.jstor.org/stable/27765969.

Centre for Research and Development (CRD) (2014) *Raising the Community Voice in the Extractive Sector Challenges and future Prospects of the mining sector in Zimbabwe*. Mutare: Centre for Research and Development (CRD). Available at: https://www.africaportal.org/publications/challenges-and-future-prospects-of-the-mining-sector-in-zimbabwe/.

Chamber of Mines of Zimbabwe (2014) *Chamber of Mines Annual Report*. Available at: http://chamberofminesofzimbabwe.com (Accessed: 7 October 2019).

Chang, R.-D. *et al.* (2017) ‘Evolving theories of sustainability and firms: History, future directions and implications for renewable energy research’, *Renewable and Sustainable Energy Reviews*, 72, pp. 48–56. doi: https://doi.org/10.1016/j.rser.2017.01.029.

Chen, Y.-S. *et al.* (2020) ‘Improving green product development performance from green vision and organizational culture perspectives’, *Corporate Social Responsibility and Environmental Management*, 27(1), pp. 222–231. doi: https://doi.org/10.1002/csr.1794.

Christ, K. L. and Burritt, R. (2017) ‘Material Flow Cost Accounting for Food Waste in

the Restaurant Industry', *British Food Journal*, 119(3), pp. 600–612. doi: 10.1108/BFJ-07-2016-0318.

Christ, K. L. and Burritt, R. L. (2015) 'Material flow cost accounting: A review and agenda for future research', *Journal of Cleaner Production*, 108, pp. 1378–1389. doi: 10.1016/j.jclepro.2014.09.005.

Christine, D. *et al.* (2019) 'The Relationship of Environmental Management Accounting, Environmental Strategy and Managerial Commitment with Environmental Performance and Economic Performance', *International Journal of Energy Economics and Policy*, 9(5), pp. 458–464. Available at: https://www.proquest.com/scholarly-journals/relationship-environmental-management-accounting/docview/2288760666/se-2?accountid=14648.

Chukwuma, C. (2011) 'Environmental impact assessment, land degradation and remediation in Nigeria: Current problems and implications for future global change in agricultural and mining areas', *International Journal of Sustainable Development and World Ecology*, 18(1), pp. 36–41. doi: 10.1080/13504509.2011.543837.

Church, C. and Crawford, A. (2020). Minerals and the Metals for the Energy Transition: Exploring the Conflict Implications for Mineral-Rich, Fragile States. In: Hafner, M., Tagliapietra, S. (eds) *The Geopolitics of the Global Energy Transition*. Lecture Notes in Energy, vol 73. Springer, Cham. https://doi.org/10.1007/978-3-030-39066-2_12 Clarke, P. J., Hill, N. T. and Stevens, K. (1999) 'ACTIVITY-BASED COSTING IN IRELAND: BARRIERS TO, AND OPPORTUNITIES FOR, CHANGE', *Critical Perspectives on Accounting*, 10(4), pp. 443–468. doi: https://doi.org/10.1006/cpac.1997.0197.

Clarkson, M. B. E. (1995) 'A Stakeholder Framework for Analyzing and Evaluating Corporate Social Performance', *The Academy of Management Review*, 20(1), pp. 92–117. doi: 10.2307/258888.

Cobb, I., Innes, J. and Mitchell, F. (1992) *Activity-based costing, problems in practice*. London: The Chartered Institute of Management Accountants.

Cohen, S., Venieris, G. and Kaimenaki, E. (2005) 'ABC: adopters, supporters, deniers and unawares', *Managerial Auditing Journal*, 20(9), pp. 981–1000. doi: 10.1108/02686900510625325.

Cole, R. E. (1989) *Strategies for Learning: Small-Group Activities in American, Japanese, and Swedish Industry*. Berkeley: University of California Press. doi: doi:10.1525/9780520330818.

Cole, R. J. and Sterner, E. (2000) 'Reconciling theory and practice of life-cycle costing', *Building Research & Information*, 28(5–6), pp. 368–375. doi: 10.1080/096132100418519.

Comyns, B. (2018) 'Climate change reporting and multinational companies: Insights from institutional theory and international business', *Accounting Forum*, 42(1), pp. 65–77. doi: https://doi.org/10.1016/j.accfor.2017.07.003.

Cooper, R. (1990) 'ABC: a need, not an option', *Accountancy*, pp. 86–88.

Cooper, R. and Kaplan, R. S. (1988) 'Measure costs right: make the right decisions', *Harvard Business Review*, 69(5), pp. 96–103.

Cooper, R. and Kaplan, R. S. (1998) 'How cost accounting distorts product costs', *Management Accounting*, 69(10). Available at: http://coin.wne.uw.edu.pl/pmodzelewski/How cost accounting distorts product costs.pdf.

Corbin, J. and Strauss, A. (2015) *Basics of qualitative research: grounded theory procedures and techniques*. Fourth. New York: Sage Publication.

Cordeiro, J. J., Zhu, Q. and Sarkis, J. (2009) 'Internationa and Domestic Pressures and Chinese Organisational responses to Greening', *Academy of Management Proceedings*, 2009(1), pp. 1–6. doi: 10.5465/ambpp.2009.44251848.

Cowell, S. J. *et al.* (1999) 'Sustainability and the primary extraction industries: theories and practice', *Resources Policy*, 25(4), pp. 277–286. doi: https://doi.org/10.1016/S0301-4207(00)00003-9.

Crabtree, B. F. and Miller, W. L. (1999) *Doing qualitative research*. London: Sage Publications.

Cragg, W. and Greenbaum, A. (2002) 'Reasoning about Responsibilities: Mining Company Managers on What Stakeholders are Owed', *Journal of Business Ethics*, 39(3), pp. 319–335. doi: 10.1023/A:1016523113429.

Creswell, J. W. and Poth, C. N. (2018) *Qualitative inquiry and research design:*

choosing among five approaches. Sage Publications.

Crilly, D., Zollo, M. and Hansen, M. T. (2012) 'Faking It or Muddling Through? Understanding Decoupling in Response to Stakeholder Pressures', *Academy of Management Journal*, 55(6), pp. 1429–1448. doi: 10.5465/amj.2010.0697.

Cronje, F., Reyneke, S. and van Wyk, D. (2013) 'Local communities and health disaster management in the mining sector : original research', *Jamba : Journal of Disaster Risk Studies*, 5(2), pp. 1–12. doi: 10.4102/jamba.v5i2.78.

Cronje, J. F. and Chenga, C. S. (2007) 'Health issues in an mining community in South Africa', in Falola, T. and Heaton, M. (eds) *HIV/ Aids illness and African Well-being*. Austin: Rochester Press, pp. 210–242.

Daddi, T. *et al.* (2014) 'The Effects of Integrated Pollution Prevention and Control (IPPC) Regulation on Company Management and Competitiveness', *Business Strategy and the Environment*, 23(8), pp. 520–533. doi: https://doi.org/10.1002/bse.1797.

Daddi, T. *et al.* (2016) 'Exploring the link between institutional pressures and environmental management systems effectiveness: An empirical study', *Journal of Environmental Management*, 183, pp. 647–656. doi: https://doi.org/10.1016/j.jenvman.2016.09.025.

Darnall, N., Henriques, I. and Sadorsky, P. (2010) 'Adopting Proactive Environmental Strategy: The Influence of Stakeholders and Firm Size', *Journal of Management Studies*, 47(6), pp. 1072–1094. doi: https://doi.org/10.1111/j.1467-6486.2009.00873.x.

David, A. and Mounir, M. H. (1999) 'Life Cycle Cost Analysis (LCCA) in Municipal Organizations', *Journal of Infrastructure Systems*, 5(1), pp. 1–10. doi: 10.1061/(ASCE)1076-0342(1999)5:1(1).

Dedoulis, E. (2016) 'Institutional formations and the Anglo-Americanization of local auditing practices: The case of Greece', *Accounting Forum*, 40(1), pp. 29–44. doi: https://doi.org/10.1016/j.accfor.2015.11.003.

Deegan, C. (2003) *Environmental Management Accounting: An Introduction and Case Studies for Australia*. Victoria: Institute of Chartered Accountants in Australia.

Deegan, C. and Blomquist, C. (2006) 'Stakeholder Influence on Corporate Reporting:

An Exploration of the Interaction Between the World Wide Fund for Nature and the Australian Minerals', *Accounting, Organizations and Society*, 31(4–5), pp. 1–39.

Delmas, M. A. (2002) 'The diffusion of environmental management standards in Europe and in the United States: An institutional perspective', *Policy Sciences*, 35(1), p. 91. Available at: https://www.proquest.com/scholarly-journals/diffusion-environmental-management-standards/docview/221249366/se-2?accountid=14648.

Delmas, M. A. and Montes-Sancho, M. J. (2011) 'An Institutional Perspective on the Diffusion of International Management System Standards: The Case of the Environmental Management Standard ISO 14001', *Business Ethics Quarterly*. 2015/01/23, 21(1), pp. 103–132. doi: DOI: 10.5840/beq20112115.

Delmas, M. A. and Pekovic, S. (2013) 'Environmental standards and labor productivity: Understanding the mechanisms that sustain sustainability', *Journal of Organizational Behavior*, 34(2), pp. 230–252. doi: https://doi.org/10.1002/job.1827.

Delmas, M. A. and Toffel, M. W. (2004) 'Institutional pressure and environmental management practices', *Stakeholders, the Environment and Society*, (January 2004), pp. 230–245. doi: 10.4337/9781845423629.00017.

Delmas, M. A. and Toffel, M. W. (2008) 'Organizational responses to environmental demands: opening the black box', *Strategic Management Journal*, 29(10), pp. 1027–1055. doi: https://doi.org/10.1002/smj.701.

Delmas, M. A. and Toffel, M. W. (2011) 'Institutional Pressures and Organizational Characteristics: Implications for Environmental Strategy', *The Oxford Handbook of Business and the Natural Environment*. Edited by P. Bansal and A. J. Hoffman. Oxford University Press, pp. 229–247. doi: 10.1093/oxfordhb/9780199584451.003.0013.

Delmas, M. and Toffel, M. W. (2004) 'Stakeholders and environmental management practices: an institutional framework', *Business Strategy and the Environment*, 13(4), pp. 209–222. doi: https://doi.org/10.1002/bse.409.

Demeere, N., Stouthuysen, K. and Roodhooft, F. (2009) 'Time-driven activity-based costing in an outpatient clinic environment: Development, relevance and managerial impact', *Health Policy*, 92(2), pp. 296–304. doi: https://doi.org/10.1016/j.healthpol.2009.05.003.

Denzin, N. K. and Lincoln, Y. S. (2017) *The SAGE Handbook of Qualitative Research*.

5th edn. California: SAGE PUBLICATIONS, INC.

Department of Environment Food & Rural Affairs (DEFRA) (2019) ‘Environmental Reporting Guidelines: Including streamlined energy and carbon reporting guidance’, *Environmental Reporting Guidelines*. London: Information Policy Team, pp. 1–152. Available at: https://www.gov.uk/government/publications/environmental-reporting-guidelines-including-mandatory-greenhouse-gas-emissions-reporting-guidance.

Dhillon, B. S. (1989) *Life Cycle Costing: Techniques, Models and Applications*. New York: Routledge.

Dhillon, B. S. (2010) *Life cycle costing for engineers*. New York: CRC Press.

Dhliwayo, M. (2014) ‘A Review of Zimbabwe’s Draft Minerals Policy’. Harare: Zimbabwe Environmental Law Association (ZELA), pp. 1–42. Available at: https://www.academia.edu/30865992/A_Review_of_Zimbabwes_Draft_Minerals_Policy.

DiMaggio, P. (1988) ‘Interest and Agency in Institutional Theory’, in *Institutional patterns and organisations: culture and environment.* Cambridge: Ballinger Publishing Company, pp. 3–21.

DiMaggio, P. J. and Powell, W. W. . (1983) ‘The Iron Cage Revisited: Institutional Isomorphism and Collective Rationality in Organizational Fields’, *American Sociology Association*, 48(2), pp. 147–160.

Ding, G. K. C. (2008) ‘Sustainable construction—The role of environmental assessment tools’, *Journal of Environmental Management*, 86(3), pp. 451–464. doi: https://doi.org/10.1016/j.jenvman.2006.12.025.

Ding, Q. *et al.* (2017) ‘Effects of natural factors on the spatial distribution of heavy metals in soils surrounding mining regions’, *Science of The Total Environment*, 578, pp. 577–585. doi: https://doi.org/10.1016/j.scitotenv.2016.11.001.

Do, D. T. *et al.* (2020) ‘An analysis of underlying constructs affecting the choice of accounting as a major’, *Management Science Letters*, 10(2), pp. 361–368. doi: 10.5267/j.msl.2019.8.034.

Doley, D. and Audet, P. (2015) ‘Identifying natural and novel ecosystem goals for rehabilitation of postmining landscapes’, in Jarvie-Eggart, M. E. (ed.) *Responsible mining: case studies in managing social and environmental risks in the developed*

world. Englewood: Society for Mining, Metallurgy and Exploration, pp. 609–638.

Drury, C. (2020) *Cost and Management Accounting*. 11th edn. London: Cengage Learning.

Dub, S. (1997) 'ABM at Lawson: Beyond the technology', *Management Accounting*, 78(9), pp. 34–36. Available at: https://www.proquest.com/scholarly-journals/abm-at-lawson-beyond-technology/docview/229795296/se-2?accountid=14648.

Dubey, R. *et al.* (2016) 'Towards a theory of sustainable consumption and production: Constructs and measurement', *Resources, Conservation and Recycling*, 106, pp. 78–89. doi: 10.1016/j.resconrec.2015.11.008.

Dukes, S. (1984) 'Phenomenological methodology in the human sciences', *Journal of Religion and Health*, 23(3), pp. 197–203. doi: 10.1007/BF00990785.

Dunuwila, P., Rodrigo, V. H. L. and Goto, N. (2018) 'Financial and environmental sustainability in manufacturing of crepe rubber in terms of material flow analysis, material flow cost accounting and life cycle assessment', *Journal of Cleaner Production*, 182, pp. 587–599. doi: https://doi.org/10.1016/j.jclepro.2018.01.202.

Dwaikat, L. N. and Ali, K. N. (2018) 'Green buildings life cycle cost analysis and life cycle budget development: Practical applications', *Journal of Building Engineering*, 18, pp. 303–311. doi: https://doi.org/10.1016/j.jobe.2018.03.015.

Ellis, E. C. and Ramankutty, N. (2008) 'Putting people in the map: anthropogenic biomes of the world', *Frontiers in Ecology and the Environment*, 6(8), pp. 439–447. doi: https://doi.org/10.1890/070062.

Elms, R. D. and El-Halwagi, M. M. (2010) 'The effect of greenhouse gas policy on the design and scheduling of biodiesel plants with multiple feedstocks', *Clean Technologies and Environmental Policy*, 12(5), pp. 547–560. doi: 10.1007/s10098-009-0260-1.

Endenich, C. (2012) *Comparative Management Accounting*. Wiesbaden: Gabler Verlag. doi: https://doi.org/10.1007/978-3-8349-4277-7.

Epstein, P. R. *et al.* (2011) 'Full cost accounting for the life cycle of coal', *Annals of the New York Academy of Sciences*, 1219(1), pp. 73–98. doi: https://doi.org/10.1111/j.1749-6632.2010.05890.x.

Erkayaoğlu, M. and Demirel, N. (2016) ‘A comparative life cycle assessment of material handling systems for sustainable mining’, *Journal of Environmental Management*, 174, pp. 1–6. doi: https://doi.org/10.1016/j.jenvman.2016.03.011.

Ernst & Young (2013) ‘Value of Sustainability Reporting : A Study by The Center for Corporate Citizenship and Ernst & Young LLP’, *Ernst & Young*. Boston: Boston College, Centre for Corporate Citizenship, pp. 1–15. Available at: www.BCCorporateCitizenship.org.

Etzion, D. (2007) ‘Research on Organizations and the Natural Environment, 1992-Present: A Review’, *Journal of Management*, 33(4), pp. 637–664. doi: 10.1177/0149206307302553.

European Commission (2011) *A renewed EU strategy 2011-14 for corporate social responsibility*. Brussels: European Commision. Available at: https://www.eurocommerce.eu.

European Union (2007) ‘Promoting sustainable development in the non-energy extractive industry’. European Union Law. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al28113.

Evans, J. S. and Kiesecker, J. M. (2014) ‘Shale gas, wind and water: assessing the Potential cumulative impacts of energy development on ecosystem services within the Marcellus play’, *Plos One*, 9(2), p. e89210.

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, pp. 136–140.

Ferreira, A. and Otley, D. (2009) ‘The design and use of performance management systems: An extended framework for analysis’, *Management Accounting Research*, 20(4), pp. 263–282. doi: https://doi.org/10.1016/j.mar.2009.07.003.

Ferry, D. J. O. and Flanagan, R. (1991) *Life cycle costing - a radical approach*. London: Construction Research and Information Association.

Flanagan, R., Jewell, C. and Norman, G. (2005) *Whole Life Appraisal for Construction*. Oxford: Blackwell PublishingLtd.

Flick, U. (2018) ‘The SAGE Handbook of Qualitative Data Collection’. London. doi: 10.4135/9781526416070.

Foster, G. and Swenson, D. W. (1997) 'Measuring the Success of Activity-Based Cost Management and Its Determinants', *Journal of Management Accounting Research*, 9, pp. 109–141. Available at: https://www.proquest.com/scholarly-journals/measuring-success-activity-based-cost-management/docview/210172651/se-2?accountid=14648.

Frækaland Vangsnes, G. (2018) 'The meanings of mining: A perspective on the regulation of artisanal and small-scale gold mining in southern Ecuador', *Extractive Industries and Society*, 5(2), pp. 317–326. doi: 10.1016/j.exis.2018.01.003.

Franks, D. M. *et al.* (2014) 'Conflict translates environmental and social risk into business costs', *Proceedings of the National Academy of Sciences*, 111(21), pp. 7576–7581. doi: 10.1073/pnas.1405135111.

Franks, D. M., Brereton, D. and Moran, C. J. (2013) 'The cumulative dimensions of impact in resource regions', *Resources Policy*, 38(4), pp. 640–647. doi: https://doi.org/10.1016/j.resourpol.2013.07.002.

Freeman, R. E. (1984) *Strategic management: a stakeholder approach*. Boston: Pitman Publishing.

Fuller, S. (2016) *Life-Cycle Cost Analysis (LCCA)*. Available at: https://www.wbdg.org/resources/life-cycle-cost-analysis-lcca (Accessed: 15 September 2019).

Gadenne, D. *et al.* (2012) 'The influence of sustainability performance management practices on organisational sustainability performance', *Journal of Accounting & Organizational Change*, 8(2), pp. 210–235. doi: 10.1108/18325911211230380.

Galant, M. (2017) 'the Stakeholders Theory As a Starting Point for the Critique of Corporate Social Responsibility', *Research Papers of Wroclow University of Economics*. WROCŁAW UNIVERSITY OF ECONOMICS, pp. 31–42. doi: 10.15611/pn.2017.464.03.

Garrison, N., Noreen, E. W. and Brewer, P. C. (2010) *Managerial Accounting*. Thirteenth. New York: McGraw Hill.

George-Laurentiu, M., Florentina-Cristina, M. and Andreea-Loreta, C. (2016) 'The Assessment of Social and Economic Impacts Associated to an Abandoned Mining Site Case study: Ciudanovita (Romania)', *Procedia Environmental Sciences*, 32, pp. 420–

430. doi: https://doi.org/10.1016/j.proenv.2016.03.048.

Gibbs, J. L. and Kraemer, K. L. (2004) 'A Cross-Country Investigation of the Determinants of Scope of E-commerce Use: An Institutional Approach', *Electronic Markets*, 14(2), pp. 124–137. doi: 10.1080/10196780410001675077.

Gimenez, C. and Tachizawa, E. M. (2012) 'Extending sustainability to suppliers: a systematic literature review', *Supply Chain Management: An International Journal*. Edited by R. Wilding and B. Wagner, 17(5), pp. 531–543. doi: 10.1108/13598541211258591.

Glad, E. and Becker, H. (1994) *Activity-Based Costing and Management*. Cape Town: Juta Limited.

Global Reporting Initiative (GRI) (2016) 'GRI 101: Foundation 2016 101', *GRI Standards*. Amsterdam: Stichting Global Reporting Initiative (GRI), p. 29. Available at: www.globalreporting.org.

Glover, J. L. *et al.* (2014) 'An Institutional Theory perspective on sustainable practices across the dairy supply chain', *International Journal of Production Economics*, 152, pp. 102–111. doi: https://doi.org/10.1016/j.ijpe.2013.12.027.

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), pp. 571–580. doi: https://doi.org/10.1016/j.buildenv.2003.10.008.

Godschalk, S. (2008) 'Does Corporate Environmental Accounting Make Business Sense?', in Schalteger, S. et al. (eds) *Environmental Management Accounting for Cleaner Production*. Berlin: Springer, pp. 249–265.

de Gooyert, V. *et al.* (2017) 'Reviewing the role of stakeholders in Operational Research: A stakeholder theory perspective', *European Journal of Operational Research*, 262(2), pp. 402–410. doi: https://doi.org/10.1016/j.ejor.2017.03.079.

Góralczyk, M. and Kulczycka, J. (2005) 'LCC application in the Polish mining industry', *Management of Environmental Quality: An International Journal*. Edited by M. A. Curran, 16(2), pp. 119–129. doi: 10.1108/14777830510583137.

Gordon, I. (2014) *Update capital cost estimate for PIOP*. Washingtom: US Department of Energy.

Gosselin, M. (1997) ‘The effect of strategy and organizational structure on the adoption and implementation of activity-based costing’, *Accounting, Organizations and Society*, 22(2), pp. 105–122. doi: https://doi.org/10.1016/S0361-3682(96)00031-1.

Government Acounting Office (GAO US) (2011) *Abandoned mines: information on the number of hard rock mines, cost of clean-up, and value of financial assurances: testimony before the subcommittee on energy and mineral resources, committee on natural resources*. Available at: https://www.gao.gov/new.items/d11834t.pdf (Accessed: 12 January 2019).

Government of Zimbabwe (2018) *Minerals potential: procedures and requirements of acquiring licences and permits in terms of the mineral act (Chapter: 21:05)*. Harare. Available at: http:www.mines.gov.zw/?q=zgs/58.

Grabski, S. V and Marsh, R. J. (1994) ‘Integrating Accounting and Manufacturing Information Systems: An ABC and REA-Based Approach.’, *Journal of Information Systems*, 8(2), pp. 61–80. Available at: http://0-search.ebscohost.com.oasis.unisa.ac.za/login.aspx?direct=true&db=bsu&AN=9705270001&site=ehost-live&scope=site.

Granly, B. M. and Welo, T. (2014) ‘EMS and sustainability: experiences with ISO 14001 and Eco-Lighthouse in Norwegian metal processing SMEs’, *Journal of Cleaner Production*, 64, pp. 194–204. doi: https://doi.org/10.1016/j.jclepro.2013.08.007.

Greenwood, M. (2007) ‘Stakeholder Engagement: Beyond the Myth of Corporate Responsibility’, *Journal of Business Ethics*, 74(4), pp. 315–327. doi: 10.1007/s10551-007-9509-y.

Griesel, L. and Cronje, S. (2005) ‘Activity based management : its value for strategy implementation’, *Management Today*, 21(6), pp. 52–53. doi: 10.10520/EJC70032.

Grix, J. (2004) *The foundations of research (Palgrave Research Skills)*. Second. London: Palgrave Macmillan.

Guenther, E. *et al.* (2015) ‘Material Flow Cost Accounting - looking back and ahead’, *Journal of Cleaner Production*, 108(B), pp. 1249–1254. doi: 10.1016/j.jclepro.2015.10.018.

Guler, I., Guillén, M. F. and Macpherson, J. M. (2002) ‘Global competition, institutions, and the diffusion of organizational practices: The international spread of ISO 9000

quality certificates', *Administrative Science Quarterly*, 47(2), pp. 207–232. doi: 10.2307/3094804.

Gunarathne, A. D. N. (2015) 'Fostering the Adoption of Environmental Management with the Help of Accounting: An Integrated Framework', in Rahim, M. and Idowu, S. (eds) *Social Audit Regulation*. Cham: Springer Nature Switzerland. Available at: https://doi.org/10.1007/978-3-319-15838-9_15.

Gunarathne, N. and Lee, K. H. (2015) 'Environmental Management Accounting (EMA) for Environmental Management and Organizational Change: An Eco-Control Approach', *Journal of Accounting and Organizational Change*, 11(3), pp. 362–383. doi: 10.1108/JAOC-10-2013-0078.

Gupta, M. and Galloway, K. (2003) 'Activity-based costing/management and its implications for operations management', *Technovation*, 23(2), pp. 131–138. doi: https://doi.org/10.1016/S0166-4972(01)00093-1.

Hagelstein, K. (2009) 'Globally sustainable manganese metal production and use', *Journal of Environmental Management*, 90(12), pp. 3736–3740. doi: https://doi.org/10.1016/j.jenvman.2008.05.025.

Hahn, R. (2013) 'ISO 26000 and the Standardization of Strategic Management Processes for Sustainability and Corporate Social Responsibility', *Business Strategy and the Environment*, 22(7), pp. 442–455. doi: https://doi.org/10.1002/bse.1751.

Haibin, L. and Zhenling, L. (2010) 'Recycling utilization patterns of coal mining waste in China', *Resources, Conservation and Recycling*, 54(12), pp. 1331–1340. doi: https://doi.org/10.1016/j.resconrec.2010.05.005.

Hamann, R. (2004) 'Corporate social responsibility, partnerships, and institutional change: The case of mining companies in South Africa', *Natural Resources Forum*, 28(4), pp. 278–290. doi: https://doi.org/10.1111/j.1477-8947.2004.00101.x.

Hamilton, S. H. *et al.* (2015) 'Integrated assessment and modelling: Overview and synthesis of salient dimensions', *Environmental Modelling & Software*, 64, pp. 215–229. doi: https://doi.org/10.1016/j.envsoft.2014.12.005.

Haroun, A. E. (2015) 'Maintenance cost estimation: application of activity-based costing as a fair estimate method', *Journal of Quality in Maintenance Engineering*, 21(3), pp. 258–270. doi: 10.1108/JQME-04-2015-0015.

Harris, D. and Fitzgerald, L. (2017) ‘Life-cycle cost analysis (LCCA): a comparison of commercial flooring’, *Facilities*, 35(5/6), pp. 303–318. doi: 10.1108/F-10-2015-0071.

Hart, S. L. (1995) ‘A Natural-Resource-Based View of the Firm’, *The Academy of Management Review*, 20(4), pp. 986–1014. doi: 10.2307/258963.

Hartman, H. L. and Mutmansky, J. M. (2002) *Introductory mining engineering*. Second. New Jersey: John Wiley & Sons Inc.

Haslam Mckenzie, F. M. and Rowley, S. (2013) ‘Housing Market Failure in a Booming Economy’, *Housing Studies*, 28(3), pp. 373–388. doi: 10.1080/02673037.2013.759177.

Haveman, H. A. and Rao, H. (1997) ‘Structuring a Theory of Moral Sentiments: Institutional and Organizational Coevolution in the Early Thrift Industry’, *American Journal of Sociology*, 102(6), pp. 1606–1651. doi: 10.1086/231128.

Henisz, W. J., Dorobantu, S. and Nartey, L. J. (2014) ‘Spinning gold: The financial returns to stakeholder engagement’, *Strategic Management Journal*, 35(12), pp. 1727–1748. doi: https://doi.org/10.1002/smj.2180.

Henri, J.-F. and Journeault, M. (2018) ‘Antecedents and Consequences of Eco-Control Deployment: Evidence from Canadian Manufacturing Firms’, *Accounting Perspectives*, 17(2), pp. 253–273. doi: https://doi.org/10.1111/1911-3838.12168.

Henriques, I. and Sadorsky, P. (1996) ‘The determinants of an environmentally responsive firm: An empirical approach’, *Journal of Environmental Economics and Management*, 30(3), pp. 381–395. doi: 10.1006/jeem.1996.0026.

Her Majesty’s Treasury (HM Treasury) (2022) *The Green Book: appraisal and evaluation in central government*. London. doi: 978-1-5286-2229-5.

Herzig, C. *et al.* (2012) *Environmental Management Accounting: Case Studies of South-East Asian Companies*. Oxfordshire: Routledge.

Heugens, P. P. M. A. R. and Lander, M. W. (2009) ‘Structure! Agency! (and other quarrels): A meta-analysis of institutional theories of organization’, *Academy of Management Journal*, 5(1), pp. 61–85. doi: https://doi.org/10.5465/AMJ.2009.36461835.

Higgins, C. and Larrinaga, C. (2014) ‘Sustainability reporting : insights from

institutional theory', in Bebbington, J., Unerman, J., and O'Dwyer, B. (eds) *Sustainability Accounting and Accountability*. Second. London: Routledge. doi: https://doi.org/10.4324/9781315848419.

Higham, A., Fortune, C. and James, H. (2015) 'Life cycle costing: evaluating its use in UK practice', *Structural Survey*, 33(1), pp. 73–87. doi: 10.1108/SS-06-2014-0026.

Hilson, G. (2002) 'An overview of land use conflicts in mining communities', *Land Use Policy*, 19(1), pp. 65–73. doi: https://doi.org/10.1016/S0264-8377(01)00043-6.

Hilson, G. and Murck, B. (2000) 'Sustainable development in the mining industry: clarifying the corporate perspective', *Resources Policy*, 26(4), pp. 227–238. doi: https://doi.org/10.1016/S0301-4207(00)00041-6.

Hilson, G. and Yakovleva, N. (2007) 'Strained relations: A critical analysis of the mining conflict in Prestea, Ghana', *Political Geography*, 26(1), pp. 98–119. doi: https://doi.org/10.1016/j.polgeo.2006.09.001.

Hilton, R. and Platt, D. (2019) *Managerial Accounting*. Twelve. New York: McGraw-Hill Education.

Holmen, J. S. (1995) 'ABC vs. TOC: Its a matter of time', *Management Accounting*, January, pp. 37–40.

Hossain, D. *et al.* (2013) 'Impact of the mining industry on the mental health of landholders and rural communities in southwest Queensland', *Australasian Psychiatry*, 21(1), pp. 32–37. doi: 10.1177/1039856212460287.

Hresc, J., Riley, E. and Harris, P. (2018) 'Mining project's economic impact on local communities, as a social determinant of health: A documentary analysis of environmental impact statements', *Environmental Impact Assessment Review*, 72, pp. 64–70. doi: https://doi.org/10.1016/j.eiar.2018.05.009.

Hyrslová, J., Vágner, M. and Palásek, J. (2011) 'Material Flow Cost Accounting (Mfca) - Tool For The Optimization Of Corporate Production Processes', *Business, Management and Education*, 9(1), pp. 5-n/a. doi: http://dx.doi.org/10.3846/bme.2011.01.

IFAC (2005) *International Guidance Document: Environmental Management Accounting*. International Federation of Accountants. Available at: https://www.ifac.org/knowledge-gateway/preparing-future-ready-

professionals/publications/international-guidance-document-environmental-management-accounting.

Ingram, P. and Simons, T. (2000) ‘State Formation, Ideological Competition, and the Ecology of Israeli Workers’ Cooperatives, 1920-1992’, *Administrative Science Quarterly*, 45(1), pp. 25–53. doi: 10.2307/2666978.

Innes, J. and Mitchell, F. (1995) ‘A survey of activity-based costing in the U.K.’s largest companies’, *Management Accounting Research*, 6(2), pp. 137–153. doi: https://doi.org/10.1006/mare.1995.1008.

Intakhan, P. (2014) ‘ABC success: evidence from ISO 9000 certified companies in Thailand’, *Asian Review of Accounting*, 22(3), pp. 287–303. doi: 10.1108/ARA-06-2013-0044.

International Council of Mining and Metal (ICMM) (2013) *Trends in the mining and metals industry*. Available at: www.icmm.com (Accessed: 5 May 2018).

International Council on Mining and Metals ((ICMM)) (2022) *Mining Principles: Performance Expectations*, *ICMM Mining with Principles*. London. Available at: https://www.icmm.com/en-gb/about-us/member-requirements/mining-principles.

International Federation of Accountants (IFCA) (2005) ‘International guidance document on environmental management accounting’. New York: International Federation of Accountants.

ISO Central Secretariat (2008) ‘ISO15686-5: Buildings and constructed assets — Service life planning — Part 5: Life-cycle costing’. Geneva: International Organisation for Standardization. Available at: https://www.iso.org/obp/ui/#iso:std:iso:15686:-5:ed-2:v1:en.

ISO Central Secretariat (2011) ‘ISO14051: Environmental management - Material flow cost accounting - General framework’. Geneva: International Organization for Standardization. Available at: https:www.iso.org/standard/50986.htm.

ISO Central Secretariat (2017) ‘ISO14052: Environmental management - material flow cost accounting - guidance for practical implementation in a supply chain’. Geneva: International Organisation for Standardization. Available at: https://www.iso.org/standard/54811.html.

Ivanova, G. (2014) ‘The mining industry in Queensland , Australia : Some regional

development issues', *Resources Policy*, 39, pp. 101–114. doi: 10.1016/j.resourpol.2014.01.005.

Jackson, G. (2010) 'Actors and institutions', in Morgan, G. et al. (eds) *The Oxford handbook of comparative institutional analysis*. Oxford: Oxford University Press, pp. 63–86.

Jamil, C. Z. M. *et al.* (2015) 'Environmental Management Accounting Practices in Small Medium Manufacturing Firms', *Procedia - Social and Behavioral Sciences*, 1(172), pp. 619–626. doi: 10.1016/j.sbspro.2015.01.411.

Jasch, C. (2003) 'The use of Environmental Management Accounting (EMA) for identifying environmental costs', *Journal of Cleaner Production*, 11(6), pp. 667–676. doi: 10.1016/S0959-6526(02)00107-5.

Jasch, C. (2006) 'How to perform an environmental management cost assessment in one day', *Journal of Cleaner Production*, 14(14), pp. 1194–1213. doi: 10.1016/j.jclepro.2005.08.005.

Jasch, C., Ayres, D. and Bernaudat, L. (2010) 'Environmental Management Accounting (EMA) Case Studies in Honduras –an Integrated UNIDO Project', *Issues In Social And Environmental Accounting*, 4(2), p. 89. doi: 10.22164/isea.v4i2.48.

Jasch, C. and Danse, M. (2005) 'Environmental Management Accounting Pilot Projects in Costa Rica BT - Implementing Environmental Management Accounting: Status and Challenges', in Rikhardsson, P. M. et al. (eds). Dordrecht: Springer Netherlands, pp. 343–364. doi: 10.1007/1-4020-3373-7_17.

Jasch, C. M. (2009) *Environmental and Material Flow Cost Accounting*. Springer International Publishing.

Jaskoski, M. (2012) *Resource Conflicts: Emerging Struggles over Strategic Commodities in Latin America Phase II*. Monterey. Available at: https://apps.dtic.mil/sti/pdfs/ADA571721.pdf.

Jenkins, H. (2004) 'Corporate social responsibility and the mining industry: conflicts and constructs', *Corporate Social Responsibility and Environmental Management*, 11(1), pp. 23–34. doi: https://doi.org/10.1002/csr.50.

Jenkins, H. and Yakovleva, N. (2006) 'Corporate social responsibility in the mining industry: Exploring trends in social and environmental disclosure', *Journal of Cleaner*

Production, 14(3), pp. 271–284. doi: https://doi.org/10.1016/j.jclepro.2004.10.004.

Jennings, P. D. and Zandbergen, P. A. (1995) 'Ecologically Sustainable Organizations: An Institutional Approach', *The Academy of Management Review*, 20(4), pp. 1015–1052. doi: 10.2307/258964.

Jeswiet, J. (2017) 'Including Towards Sustainable Mining in Evaluating Mining Impacts', *Procedia CIRP*, 62, pp. 494–499. doi: https://doi.org/10.1016/j.procir.2016.06.123.

Jones, T. M. (1995) 'Instrumental Stakeholder Theory: A Synthesis of Ethics and Economics', *The Academy of Management Review*, 20(2), pp. 404–437. doi: https://doi.org/10.2307/258852.

Judge, W., Li, S. and Pinsker, R. (2010) 'National Adoption of International Accounting Standards: An Institutional Perspective', *Corporate Governance: An International Review*, 18(3), pp. 161–174. doi: https://doi.org/10.1111/j.1467-8683.2010.00798.x.

Kádárová, J., Kobulnický, J. and Teplicka, K. (2015) 'Product Life Cycle Costing', *Applied Mechanics and Materials*, 816, pp. 547–554. doi: 10.4028/www.scientific.net/AMM.816.547.

Kamruzzaman, M. (2012) 'Framework of Environmental Management Accounting: An Overview'. doi: https://dx.doi.org/10.2139/ssrn.2179031.

Kapelus, P. (2002) 'Mining, Corporate Social Responsibility and the "Community": The Case of Rio Tinto, Richards Bay Minerals and the Mbonambi', *Journal of Business Ethics*, 39(3), pp. 275–296. doi: 10.1023/A:1016570929359.

Kaplan, R. S. (1989) 'Introduction to activity-based costing', in *NAA Conference, Global Solutions to Global Problems II*. Boston.

Kaplan, R. S. and Anderson, S. R. (2004) 'Time-driven activity-based costing', *Harvard Business Review*, 82(11), pp. 131–138.

Kaplan, R. S. and Anderson, S. R. (2007) 'The Innovation of Time-Driven Activity-Based Costing', *Cost Management*, 21(2), pp. 5–15.

Kapusta, K. and Stańczyk, K. (2011) 'Pollution of water during underground coal gasification of hard coal and lignite', *Fuel*, 90(5), pp. 1927–1934. doi: https://doi.org/10.1016/j.fuel.2010.11.025.

Kasemset, C., Chernsupornchai, J. and Pala-ud, W. (2013) ‘Application of MFCA in waste reduction: Case study on a small textile factory in Thailand’, *Journal of Cleaner Production*, pp. 1–10. doi: 10.1016/j.jclepro.2014.09.071.

Kasprzyk, D. S. M. (2011) *Curse or blessing? Challenges of commodity-based economies*. Massachusetts Institute of Technology.

Kawulich, B., Garner, M. W. and Wagner, C. (2009) ‘Student’s conceptions and misconceptions of social research’, *Qualitative Sociology Review*, 5(3), pp. 5–25.

Kee, R. (2008) ‘The sufficiency of product and variable costs for production-related decisions when economies of scope are present’, *International Journal of Production Economics*, 114(2), pp. 682–696. doi: https://doi.org/10.1016/j.ijpe.2008.03.003.

Kelly, J. and Hunter, J. (2009) *Life cycle costing of sustainable design*. London.

Kemp, D. *et al.* (2011) ‘Just Relations and Company–Community Conflict in Mining’, *Journal of Business Ethics*, 101(1), pp. 93–109. doi: 10.1007/s10551-010-0711-y.

Kennedy, T. and Affleck-Graves, J. (2001) ‘The impact of activity-based costing techniques on firm performance’, *Journal of Management Accounting Research*, 13(1), pp. 19–45.

Khajehpour, H., Saboohi, Y. and Tsatsaronis, G. (2017) ‘Environmental responsibility accounting in complex energy systems’, *Journal of Cleaner Production*, 166, pp. 998–1009. doi: https://doi.org/10.1016/j.jclepro.2017.08.013.

Khor, K. S. *et al.* (2016) ‘Reverse logistics in Malaysia: The Contingent role of institutional pressure’, *International Journal of Production Economics*, 175, pp. 96–108. doi: https://doi.org/10.1016/j.ijpe.2016.01.020.

Kiani, R. and Sangeladji, M. A. (2002) ‘An Empirical Study Of Application & Usefulness Of Activity-Based Costing And Activity-Based Management Techniques In Practice’, *https://doi.org/10.19030/iber.v1i9.3978*, 1(9). doi: https://doi.org/10.19030/iber.v1i9.3978.

Kim, J. (2009) 'Activity-based framework for cost savings through the implementation of an ERP system', *International Journal of Production Research*, 47(7), pp. 1913-1929.

Kirk, S. J. and Dell’isola, A. J. (1995) *Life cycle costing for design professionals*.

Second. New York: McGraw-Hill.

Kirk, S. J. and Dell'isola, A. J. (2003) *Life cycle costing for facilities*. New York: Reed Construction Data.

Kirkham, R. J. *et al.* (2004) 'Rethinking whole life cycle cost based design decision-making', in Khosrowshahi, F. (ed.) *20th Annual ARCOM Conference, Association of Researchers in Construction Management*. Edinburgh.

Kirkham, R. J. (2005) 'Re-engineering the whole life cycle costing process', *Construction Management and Economics*, 23(1), pp. 9–14. doi: 10.1080/01446190410001678765.

Kishk, M. (2004) 'Combining various facets of uncertainty in whole-life cost modelling', *Construction Management and Economics*, 22(4), pp. 429–435. doi: 10.1080/0144619042000176483.

Klassen, R. D. (1993) 'The integration of environmental issues into manufacturing':, *Production and Inventory Management Journal*, 34(1), p. 82. Available at: https://www.proquest.com/scholarly-journals/integration-environmental-issues-into/docview/199911606/se-2?accountid=14648.

Knapp, K. (2019) *U. S Patent Number 10,304,095*. Washington: U.S Patent and Trademark Office.

Kokubu, K. *et al.* (2009) 'Material flow cost accounting with ISO 14051', *ISO Management System*, 9(1), pp. 15–18.

Kokubu, K. (2010) 'Conflicts and Solutions between Material Flow Cost Accounting and Conventional Management Thinking', in *6th Asia-pacific Interdisplinary Pespectives on Accounting at University of Sydney, Australia*. Sydney.

Kokubu, K. and Kitada, H. (2015) 'Material flow cost accounting and existing management perspectives', *Journal of Cleaner Production*, 108, pp. 1279–1288. doi: 10.1016/j.jclepro.2014.08.037.

Kokubu, K., Kitada, H. and Mouritsen, J. (2012) 'Material Flow Cost Accounting and Conventional Management Thinking: Introducing a New Environmental Management Accounting Tool into Companies', in *10 th Interdisciplinary Perspectives on Accounting Conference*. Cardiff.

Kokubu, K. and Nashioka, E. (2005) 'Environmental Management Accounting Practices in Japan', in Rikhardsson, P. M. et al. (eds) *Implementing Environmental Management Accounting: Status and Challenges*. Eco-Effici. Dordrecht: Springer Netherlands, pp. 321–342. doi: 10.1007/1-4020-3373-7.

Kokubu, K. and Tachikawa, H. (2013) 'Material Flow Cost Accounting: Significance and Practical Approach', in Kauffman, J. and Lee, K. (eds) *Handbook of Sustainable Engineering*. Dordrecht: Springer, pp. 351–369. doi: https://doi.org/10.1007/978-1-4020-8939-8_96.

Kraatz, M. S. and Zajac, E. J. (1996) 'Exploring the Limits of the New Institutionalism: The Causes and Consequences of Illegitimate Organizational Change', *American Sociological Review*, 61(5), pp. 812–836. doi: 10.2307/2096455.

Kravanja, P. *et al.* (2012) 'Perspectives for the production of bioethanol from wood and straw in Austria: technical, economic, and ecological aspects', *Clean Technologies and Environmental Policy*, 14(3), pp. 411–425. doi: 10.1007/s10098-011-0438-1.

Krishnan, R., Mistry, J. J. and Narayanan, V. G. (2012) 'A Field Study on the Acceptance and Use of a New Accounting System', *Narayanan Journal of Management Accounting Research*, 24(1), pp. 103–133. doi: https://doi.org/10.2308/jmar-50203.

Kronenberg, T. (2004) 'The curse of natural resources in the transition economies*', *Economics of Transition and Institutional Change*, 12(3), pp. 399–426. doi: https://doi.org/10.1111/j.0967-0750.2004.00187.x.

Krueger, R. A. and Casey, M. A. (2014) *Focus Groups A Practical Guide for Applied Research*. Fith. SAGE Publications.

Kulczycka, J. and Smol, M. (2016) 'Environmentally friendly pathways for the evaluation of investment projects using life cycle assessment (LCA) and life cycle cost analysis (LCCA)', *Clean Technologies and Environmental Policy*, 18(3), pp. 829–842. doi: 10.1007/s10098-015-1059-x.

Kumah, A. (2006) 'Sustainability and gold mining in the developing world', *Journal of Cleaner Production*, 14, pp. 315–323. doi: 10.1016/j.jclepro.2004.08.007.

Kumar, A. and Nikhil, K. (2014) 'Environmental Impact Assessment (Eia) Study of Metal Mines: A Critical Review', *International Journal of Engineering and Technical*

Research (IJETR), 2(6), pp. 6–8.

Kumar, P. N. (2020) 'Technological improvement in accounting system through cloud computing', *Our Heritage*, 68(54), pp. 649–656.

Kurczewski, P. (2014) 'Life cycle thinking in small and medium enterprises: the results of research on the implementation of life cycle tools in Polish SMEs—part 1: background and framework', *The International Journal of Life Cycle Assessment*, 19(3), pp. 593–600. doi: 10.1007/s11367-013-0675-0.

Lang-Koetz, C. *et al.* (2006) 'Environmental Accounting Instruments: Implementation & Continuous Use — Concepts for the Application of Input-Output Balance, Environmental Performance Indicators and Flow Cost Accounting BT - Material Flow Management: Improving Cost Efficiency and Enviro', in Hinz, K., Wagner, B., and Enzler, S. (eds) *Material Flow Management. Sustainability and Innovation*. Heidelberg: Physica-Verlag HD, pp. 131–157. doi: 10.1007/3-7908-1665-5_6.

Laurence, D. (2011) 'Establishing a sustainable mining operation: an overview', *Journal of Cleaner Production*, 19(2), pp. 278–284. doi: https://doi.org/10.1016/j.jclepro.2010.08.019.

Lechner, A. M. *et al.* (2016) 'The Impact of Underground Longwall Mining on Prime Agricultural Land: A Review and Research Agenda', *Land Degradation & Development*, 27(6), pp. 1650–1663. doi: https://doi.org/10.1002/ldr.2303.

Lechner, A. M. *et al.* (2017) 'Challenges of integrated modelling in mining regions to address social, environmental and economic impacts', *Environmental Modelling & Software*, 93, pp. 268–281. doi: https://doi.org/10.1016/j.envsoft.2017.03.020.

Lee, B.-W., Jung, S.-T. and Kim, J.-H. (2005) 'Environmental Accounting Guidelines and Corporate Cases in Korea BT - Implementing Environmental Management Accounting: Status and Challenges', in Rikhardsson, P. M. et al. (eds) *Implementing Environmental Management Accounting: Status and Challenges. Eco-Efficiency in Industry and Science*. Dordrecht: Springer Netherlands, pp. 239–255. doi: 10.1007/1-4020-3373-7_12.

Lee, J. W. (2020) 'CSR Impact on the Firm Market Value: Evidence from Tour and Travel Companies Listed on Chinese Stock Markets', *The Journal of Asian Finance, Economics and Business*, 7(7), pp. 159–167. doi:

10.13106/JAFEB.2020.VOL7.NO7.159.

Lee, K. H. (2011) ‘Motivations, barriers, and incentives for adopting environmental management (cost) accounting and related guidelines: A study of the republic of Korea’, *Corporate Social Responsibility and Environmental Management*, 18(1), pp. 39–49. doi: 10.1002/csr.239.

Lee, M.-D. P. (2011) ‘Configuration of External Influences: The Combined Effects of Institutions and Stakeholders on Corporate Social Responsibility Strategies’, *Journal of Business Ethics*, 102(2), pp. 281–298. doi: 10.1007/s10551-011-0814-0.

Lei, K., Pan, H. and Lin, C. (2016) ‘A landscape approach towards ecological restoration and sustainable development of mining areas’, *Ecological Engineering*, 90, pp. 320–325. doi: https://doi.org/10.1016/j.ecoleng.2016.01.080.

Lewandowska, A. *et al.* (2013) ‘LCA as an element in environmental management systems—comparison of conditions in selected organisations in Poland, Sweden and Germany’, *The International Journal of Life Cycle Assessment*, 18(2), pp. 481–489. doi: 10.1007/s11367-012-0481-0.

Li, Q. *et al.* (2017) ‘Exploring the impacts of coal mining on host communities in Shanxi , China – using subjective data’, *Resources Policy*, 53, pp. 125–134. doi: 10.1016/j.resourpol.2017.03.012.

Li, Z. *et al.* (2012) ‘Assessment tools , prevailing issues and policy implications of mining community sustainability in China’, *International Journal of Mining, Reclamation and Environment*, 26(2), pp. 148–162. doi: 10.1080/17480930.2011.593351.

Lin, L.-H. and Ho, Y.-L. (2016) ‘Institutional Pressures and Environmental Performance in the Global Automotive Industry: The Mediating Role of Organizational Ambidexterity’, *Long Range Planning*, 49(6), pp. 764–775. doi: https://doi.org/10.1016/j.lrp.2015.12.010.

Lin, R. and Sheu, C. (2012) ‘Why Do Firms Adopt/Implement Green Practices?–An Institutional Theory Perspective’, *Procedia - Social and Behavioral Sciences*, 57, pp. 533–540. doi: https://doi.org/10.1016/j.sbspro.2012.09.1221.

Lind, G. H. (2001) ‘Activity based costing: Challenging the way we cost underground coal mining systems’, *Journal of The South African Institute of Mining and Metallurgy*,

101(2), pp. 77–82.

Lipson, J. G. (1994) ‘Ethical issues in ethnography’, in Morse, J. M. (ed.) *Critical issues in qualitative research methods*. Thousand Oaks: Sage Publication.

Liu, R., Smartz, B. W. and Descheneaux, B. (2015) ‘LCCA and environmental LCA for highway pavement selection in Colorado’, *International Journal of Sustainable Engineering*, 8(2), pp. 102–110. doi: 10.1080/19397038.2014.958602.

Lozano, R. (2015) ‘A Holistic Perspective on Corporate Sustainability Drivers’, *Corporate Social Responsibility and Environmental Management*, 22(1), pp. 32–44. doi: https://doi.org/10.1002/csr.1325.

Lu, W. *et al.* (2018) ‘The effects of green building on construction waste minimization: Triangulating “big data” with “thick data”’, *Waste Management*, 79, pp. 142–152. doi: https://doi.org/10.1016/j.wasman.2018.07.030.

Maak, T. (2007) ‘Responsible Leadership, Stakeholder Engagement, and the Emergence of Social Capital’, *Journal of Business Ethics*, 74(4), pp. 329–343. doi: 10.1007/s10551-007-9510-5.

Maas, K., Schaltegger, S. and Crutzen, N. (2016) ‘Integrating corporate sustainability assessment, management accounting, control, and reporting’, *Journal of Cleaner Production*, 136, pp. 237–248. doi: https://doi.org/10.1016/j.jclepro.2016.05.008.

Mack, L. (2010) ‘The Philosophical Underpinnings of Educational Research’, *Polyglossia*, 9, pp. 5–11.

Mackenzie, S. (2016) ‘Post-closure funding initiatives to facilitate custodial transfer and relinquishment of mining tenure’, *Mine Closure 2016: 11th International Conference on Mine Closure*. Edited by A. B. Fourie et al. Perth: Australian Centre for Geomechanics PP - Perth, pp. 419–422. Available at: https://papers.acg.uwa.edu.au/p/1608_30_Mackenzie/.

Mactaggart, F. *et al.* (2016) ‘Examining health and well-being outcomes associated with mining activity in rural communities of high-income countries: A systematic review’, *Australian Journal of Rural Health*, 24(4), pp. 230–237. doi: https://doi.org/10.1111/ajr.12285.

Mah, C. M., Fujiwara, T. and Ho, C. S. (2018) ‘Life cycle assessment and life cycle costing toward eco-efficiency concrete waste management in Malaysia’, *Journal of*

Cleaner Production, 172, pp. 3415–3427. doi: https://doi.org/10.1016/j.jclepro.2017.11.200.

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

Mahmoudi, E., Jodeiri, N. and Fatehifar, E. (2017) 'Implementation of material flow cost accounting for efficiency improvement in wastewater treatment unit of Tabriz oil refining company', *Journal of Cleaner Production*, 165, pp. 530–536. doi: 10.1016/j.jclepro.2017.07.137.

Malmi, T. (1997) 'Towards explaining activity-based costing failure: accounting and control in a decentralized organization', *Management Accounting Research*, 8(4), pp. 459–480. doi: https://doi.org/10.1006/mare.1997.0057.

Malmi, T. and Brown, D. A. (2008) 'Management control systems as a package—Opportunities, challenges and research directions', *Management Accounting Research*, 19(4), pp. 287–300. doi: https://doi.org/10.1016/j.mar.2008.09.003.

Mancini, L. and Sala, S. (2018) 'Social impact assessment in the mining sector: Review and comparison of indicators frameworks', *Resources Policy*, 57, pp. 98–111. doi: https://doi.org/10.1016/j.resourpol.2018.02.002.

Maponga, O. and Mutemererwa, A. (1995) *Management of natural resources and the environment in Zimbabwe: The case of gold*, *United Nations Conference on trade and Development (UNCTAD/COM/45)*. United Nations Conference on Trade and Development.

Margallo, M. *et al.* (2014) 'Environmental sustainability assessment in the process industry: A case study of waste-to-energy plants in Spain', *Resources, Conservation and Recycling*, 93, pp. 144–155. doi: https://doi.org/10.1016/j.resconrec.2014.09.014.

Marshall, C. and Rossman, G. B. (2010) *Designing qualitative research*. Fifth. Thousand Oaks: Sage Publication.

Matshusa, K. and Leonard, L. (2022) 'Exploring strategies for management of disasters associated with illegal gold mining in abandoned mines: A case study of Ekurhuleni Metropolitan Municipality', *Journal of Disaster Risk Studies*, 14(1), pp. 1–9. doi: 10.4102/jamba.v14i1.1237.

Matshusa, K. and Makgae, M. (2017) 'Prevention of future legacy sites in uranium

mining and processing: The South African perspective', *Ore Geology Reviews*, 86, pp. 70–78. doi: https://doi.org/10.1016/j.oregeorev.2017.01.024.

McLellan, B. C. *et al.* (2009) 'Incorporating sustainable development in the design of mineral processing operations – Review and analysis of current approaches', *Journal of Cleaner Production*, 17(16), pp. 1414–1425. doi: https://doi.org/10.1016/j.jclepro.2009.06.003.

Meng, X. and Harshaw, F. (2013) 'The application of whole life cycle costing in PFI/PPP projects', in Smith, S. D. and Ahiaga-Dagbui, D. D. (eds) *Proceeings 29th Annual ARCOM Conference*. Reading: Association of Researchers in construction Management, 2-4 September, pp. 769–778.

Meyer, J. W. and Rowan, B. (1977) 'Institutionalized Organizations: Formal Structure as Myth and Ceremony', *The American Journal of Sociology*, 83(2), pp. 340–363.

Michelsen, O. and Fet, A. M. (2010) 'Using eco-efficiency in sustainable supply chain management; a case study of furniture production', *Clean Technologies and Environmental Policy*, 12(5), pp. 561–570. doi: 10.1007/s10098-009-0266-8.

Mining Association on Canada (MAC) (2021) 'Towards Sustainable Mining', *Towards Sustainable Mining*. Canadian Mining. Available at: https://mining.ca//wp-content/uploads/dlm_uploads/2021/07/TSM-fact-sheet-English-2021.pdf.

Di Mino, G., Salvo, G. and Noto, S. (2014) 'Pavement management system model using an LCCA-microsimulation integrated approach.', *Advances in Transportation Studies*, 1, pp. 101–112.

Mitchell, B. (2002) *Resource and environmental management*. Second. New York: Prentice Hall.

Moffat, K. and Zhang, A. (2014) 'The paths to social licence to operate: An integrative model explaining community acceptance of mining', *Resources Policy*, 39, pp. 61–70. doi: https://doi.org/10.1016/j.resourpol.2013.11.003.

Mohr, D. *et al.* (2013) 'The road to 2020 and beyond What's driving the global automotive industry?', *Advance Industries*. McKinsey & Company, pp. 1–24. Available at: https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/automotive and assembly/pdfs/mck_the_road_to_2020_and_beyond.ashx.

Mokhtar, N., Jusoh, R. and Zulkifli, N. (2015) 'Corporate characteristics and

environmental management accounting (EMA) implementation: Evidence from Malaysian public listed companies (PLCs)', *Journal of Cleaner Production*, 136(1), pp. 111–122. doi: 10.1016/j.jclepro.2016.01.085.

Molina-Azorín, J. F. *et al.* (2009) 'Quality management, environmental management and firm performance: A review of empirical studies and issues of integration', *International Journal of Management Reviews*, 11(2), pp. 197–222. doi: https://doi.org/10.1111/j.1468-2370.2008.00238.x.

Monteiro, J. G. M.-S., de Queiroz Fernandes Araújo, O. and de Medeiros, J. L. (2009) 'Sustainability metrics for eco-technologies assessment, Part II. Life cycle analysis', *Clean Technologies and Environmental Policy*, 11(4), pp. 459–472. doi: 10.1007/s10098-009-0205-8.

Moran, C. J. *et al.* (2014) 'Sustainability in mining, minerals and energy: new processes, pathways and human interactions for a cautiously optimistic future', *Journal of Cleaner Production*, 84, pp. 1–15. doi: https://doi.org/10.1016/j.jclepro.2014.09.016.

Morioka, S. N. and de Carvalho, M. M. (2016) 'A systematic literature review towards a conceptual framework for integrating sustainability performance into business', *Journal of Cleaner Production*, 136, pp. 134–146. doi: https://doi.org/10.1016/j.jclepro.2016.01.104.

Morrice, E. and Colagiuri, R. (2013) 'Health & Place Coal mining , social injustice and health : A universal conflict of power and priorities', *Health & Place*, 19, pp. 74–79. doi: 10.1016/j.healthplace.2012.10.006.

Morse, J. M. (1995) 'The Significance of Saturation', *Qualitative Health Research*, 5(2), pp. 147–149. doi: 10.1177/104973239500500201.

Moser, P. (2016) 'Raw materials as re-industrialisation ooportunities', in *Re-Industrialisation of the EU 2016, 26-28 October 2016, Bratislava-Slovakia*. Bratislava.

Mudd, G. M. (2010) 'The Environmental sustainability of mining in Australia: key mega-trends and looming constraints', *Resources Policy*, 35(2), pp. 98–115. doi: https://doi.org/10.1016/j.resourpol.2009.12.001.

Muller, N. Z. and Mendelsohn, R. (2007) 'Measuring the damages of air pollution in the United States', *Journal of Environmental Economics and Management*, 54(1), pp.

1–14. doi: https://doi.org/10.1016/j.jeem.2006.12.002.

Mundy, J. (2010) ‘Creating dynamic tensions through a balanced use of management control systems’, *Accounting, Organizations and Society*, 35(5), pp. 499–523. doi: https://doi.org/10.1016/j.aos.2009.10.005.

Munteanu, A. and Mehedintu, G. (2016) ‘The Importance of Facility Management in the Life Cycle Costing Calculation’, *Review of General Management*, 23(1), pp. 65–77. Available at: http://0-search.ebscohost.com.oasis.unisa.ac.za/login.aspx?direct=true&db=bsu&AN=117787486&site=ehost-live&scope=site.

Muradian, R., Martinez-Alier, J. and Correa, H. (2003) ‘International Capital Versus Local Population: The Environmental Conflict of the Tambogrande Mining Project, Peru’, *Society & Natural Resources*, 16(9), pp. 775–792. doi: 10.1080/08941920309166.

Mutti, D. *et al.* (2012) ‘Corporate social responsibility in the mining industry : Perspectives from stakeholder groups in Argentina’, *Resources Ploicy*, 37, pp. 212–222. doi: 10.1016/j.resourpol.2011.05.001.

Muza, C. and Magadi, I. (2014) ‘Environmental Management accounting implementation in Zimbabwe mining sector.’, *IOSR Journal of Business and Management*, 16, pp. 82–92.

Nakajima, M. (2004) ‘On the differences between material flow cost accounting and traditional cost accounting - in reply to the questions and misunderstandings on material flow cost accounting’, *Kansai University Review of Business Commerce*, 1, pp. 1–20.

Nakajima, M. (2008) ‘The new development of material flow cost accounting (MFCA): MFCA analysis in Power Company and comparison between MFCA and Total Productive Maintenance (TPM)’, *Kansai University Review of Business Commerce*, 10, pp. 57–86.

Nakajima, M. (2010) ‘Environmental management accounting for sustainable manufacturing: Establishing management system of material flow cost accounting (MFCA)’, *Kansai University review of business and commerce*, 12, pp. 41–58.

Nakajima, M., Kimura, A. and Wagner, B. (2015) ‘Introduction of material flow cost

accounting (MFCA) to the supply chain: a questionnaire study on the challenges of constructing a low-carbon supply chain to promote resource efficiency', *Journal of Cleaner Production*, 108, pp. 1302–1309. doi: https://doi.org/10.1016/j.jclepro.2014.10.044.

Nakajima, M. and Kokubu, K. (2008) *Material flow cost accounting*. Second. Tokyo: Nihon Keizai Shimbun, Inc.

Nakano, K. and Hirao, M. (2011) 'Collaborative activity with business partners for improvement of product environmental performance using LCA', *Journal of Cleaner Production*, 19(11), pp. 1189–1197. doi: https://doi.org/10.1016/j.jclepro.2011.03.007.

Newman, A. M. *et al.* (2010) 'A Review of Operations Research in Mine Planning', *Interfaces*, 40, pp. 222–245.

Newmont Corporation. (2016). Operations and projects. www.newmont.com/operations-and-projects/default.aspx.

Van Nguyen, H. and Brooks, A. (1997) 'An Empirical Investigation of Adoption Issues Relating to Activity-Based Costing', *Asian Review of Accounting*, 5(1), pp. 1–18. doi: 10.1108/eb060679.

Ngwenya, B. and Busangavanye, walter (2016) 'Viability Challenges faced by Mining Companies in Zimbabwe', *International Journal of Original Research*, Volume 2.

Nind, M. and Todd, L. (2011) 'Prospects for educational research', *International Journal of Research & Method in Education*, 34(1), pp. 1–2. doi: 10.1080/1743727X.2011.552590.

Norman, G. (1990) 'Life Cycle Costing', *Property Management*, 8(4), pp. 344–356. doi: 10.1111/j.1559-3584.1969.tb05481.x.

Northey, S., Haque, N. and Mudd, G. (2013) 'Using sustainability reporting to assess the environmental footprint of copper mining', *Journal of Cleaner Production*, 40, pp. 118–128. doi: https://doi.org/10.1016/j.jclepro.2012.09.027.

NSW Parliamentary Counsel (2021) *National Environment Protection Council (New South Wales) Act 1995 No 4*. Environmental Protection Authority, New South Wales (EPA, NSW). Available at: https://legacy.legislation.nsw.gov.au/~/pdf/view/act/1995/4/whole.

Nyakuwanika, M., van der Poll, H. M. and van der Poll, J. A. (2021) 'A Conceptual Framework for Greener Goldmining through Environmental Management Accounting Practices (EMAPs): The Case of Zimbabwe', *Sustainability* . doi: 10.3390/su131810466.

Oduyemi, O., Okoroh, M. I. and Dean, A. (2014) 'Barriers to Life Cycle Costing Usage', in *30th Annual ARCOM Conference*. Portsmouth: Association of Researchers in Construction Management, pp. 783–791.

Oliveira, R., Camanho, A. S. and Zanella, A. (2017) 'Expanded eco-efficiency assessment of large mining firms', *Journal of Cleaner Production*, 142, pp. 2364–2373. doi: https://doi.org/10.1016/j.jclepro.2016.11.039.

Oliver, C. (1991) 'Strategic Responses to Institutional Processes', *The Academy of Management Review*, 16(1), pp. 145–179. doi: 10.2307/258610.

Olubodun, F. *et al.* (2010) 'An appraisal of the level of application of life cycle costing within the construction industry in the UK', *Structural Survey*, 28(4), pp. 254–265. doi: 10.1108/02630801011070966.

Opoku, A. (2013) 'The Application of Whole Life Costing in the UK Construction Industry: Benefits and Barriers', *International Journal of Architecture, Engineering and Construction*, 2(1), pp. 35–42. doi: http://dx.doi.org/10.7492/IJAEC.2013.004.

Organisation for Economic Co-operation and Development (OECD) (2002) *Coal and sustainable development - achieve balance in priorities*. Paris.

Ouoba, Y. (2017) 'Economic sustainability of the gold mining industry in Burkina Faso', *Resources Policy*, 51, pp. 194–203. doi: https://doi.org/10.1016/j.resourpol.2017.01.001.

Palmer, D., Jennings, P. D. and Zhou, X. (1993) 'Late Adoption of the Multidivisional Form by Large U.S. Corporations: Institutional, Political, and Economic Accounts', *Administrative Science Quarterly*, 38, pp. 100–131.

Papaspyropoulos, K. G. *et al.* (2012) 'Challenges in implementing environmental management accounting tools: The case of a nonprofit forestry organization', *Journal of Cleaner Production*, 29–30, pp. 132–143. doi: 10.1016/j.jclepro.2012.02.004.

Park, J. and Simpson, T. W. (2008) 'Toward an activity-based costing system for product families and product platforms in the early stages of development',

International Journal of Production Research, 46(1), pp. 99–130. doi: 10.1080/00207540600825240.

Parsons, R., Lacey, J. and Moffat, K. (2014) 'Maintaining legitimacy of a contested practice: how the mineral industry undetstands its social licence to operate', *Resources Policy*, 41, pp. 83–90.

Patton, M. Q. (2015) *Qualitative research and evaluation methods*. Fourth. London: Sage Publications.

Patzelt, H. and Shepherd, D. A. (2011) 'Recognizing Opportunities for Sustainable Development', *Entrepreneurship Theory and Practice*, 35(4), pp. 631–652. doi: 10.1111/j.1540-6520.2010.00386.x.

Paul, L. R. and Sadath, L. (2019) 'Choosing the Right Accounting Software for Organised Retail Environment', in *2019 International Conference on Computational Intelligence and Knowledge Economy (ICCIKE)*, pp. 505–510. doi: 10.1109/ICCIKE47802.2019.9004321.

Peprah, J. A., Opoku-Fofie, I. and Nduro, K. (2016) 'Factors Influencing Green Supply Chain in the Mining Sector in Ghana', *European Journal of Logistics, Purchasing and Supply Chain Management*, 4(1), pp. 32–50. Available at: www.eajournals.org.

Perera, O., Morton, B. and Perfrement, T. (2009) 'Life cycle costing in sustainable public procurement: a question of value'. International Institute for Sustainable Development.

Perez, F. and Sanchez, L. E. (2009) 'Assessing the Evolution of Sustainability Reporting in the Mining Sector', *Environmental Management*, 43(6), pp. 949–961. doi: 10.1007/s00267-008-9269-1.

Perring, M. P., Standish, R. J. and Hobbs, R. J. (2013) 'Incorporating novelty and novel ecosystems into restoration planning and practice in the 21st century', *Ecological Processes*, 2(1), p. 18. doi: 10.1186/2192-1709-2-18.

Petkova, V. *et al.* (2009) 'Mining Developments and Social Impacts on Communities: Bowen Basin Case Studies', *Rural Society*, 19(3), pp. 211–228. doi: 10.5172/rsj.19.3.211.

Phan, T. N. and Baird, K. (2015) 'The comprehensiveness of environmental management systems: The influence of institutional pressures and the impact on

environmental performance', *Journal of Environmental Management*, 160, pp. 45–56. doi: 10.1016/j.jenvman.2015.06.006.

Phyu, K. K. and Vongurai, R. (2020) 'Impacts of Adaptation Intention Towards Using Accounting Software in Terms of Technology Advancement at Work in Myanmar', *AU-GSB E-Journal*, 12(2), pp. 98–111. Available at: http://www.assumptionjournal.au.edu/index.php/AU-GSB/article/view/4501.

Pimentel, B. S., Gonzalez, E. S. and Barbosa, G. N. O. (2016) 'Decision-support models for sustainable mining networks: fundamentals and challenges', *Journal of Cleaner Production*, 112, pp. 2145–2157. doi: https://doi.org/10.1016/j.jclepro.2015.09.023.

Pokorná, J. (2016) 'Impact of Activity-Based Costing on Financial Performance in the Czech Republic', *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, 64(2), pp. 643–652. doi: DOI: 10.11118/actaun2016640206.

Pooe, R. I. D. and Mhelembe, K. (2014) 'Exploring the challenges associated with the greening of supply chains in the South African manganese and phosphate mining industry', *Journal of Transport and Supply Chain Management*, 18(1). doi: http://dx.doi.org/10.4102/ jtscm.v8i1.139.

Poverty Reduction Forum Trust (PRFT) & Zimbabwe Environmental Law Association (ZELA) (2012) 'Mineral resource governance and poverty reduction in Zimbabwe'. Harare: PRFT & ZELA. Available at: http://archive.kubatana.net/docs/povall/prft_report_on_mineral_resorc_govenance_121024.pdf.

Power, D. *et al.* (2015) 'Competitive Goals and Plant Investment in Environment and Safety Practices: Moderating Effect of National Culture', *Decision Sciences*, 46(1), pp. 63–100. doi: https://doi.org/10.1111/deci.12121.

Prno, J. and Scott Slocombe, D. (2012) 'Exploring the origins of "social license to operate" in the mining sector: Perspectives from governance and sustainability theories', *Resources Policy*, 37(3), pp. 346–357. doi: https://doi.org/10.1016/j.resourpol.2012.04.002.

Qian, D. *et al.* (2018) 'The impact of mining changes on surrounding lands and ecosystem service value in the Southern Slope of Qilian Mountains', *Ecological*

Complexity, 36(23), pp. 138–148. doi: 10.1016/j.ecocom.2018.08.002.

Qian, W., Burritt, R. L. and Monroe, G. S. (2018) 'Environmental management accounting in local government: Functional and institutional imperatives.', *Financial Accountability & Management*, 34(2), pp. 148–165. Available at: http://10.0.4.87/faam.12151.

Rajah, N., Rajah, D. and Jerie, S. (2012) 'Challenges in Implementing an Integrated Environmental Management Approach in Zimbabwe', *Journal of Emerging Trends in Economics and Management Sciences (JETEMS)*, 3(4), pp. 408–414. doi: 10.10520/EJC126565.

Ranängen, H. (2017) 'Stakeholder management theory meets CSR practice in Swedish mining', *Mineral Wconomics*, 30, pp. 15–29. doi: 10.1007/s13563-016-0098-z.

Ranängen, H. and Lindman, Å. (2017) 'A path towards sustainability for the Nordic mining industry', *Journal of Cleaner Production*, 151, pp. 43–52. doi: https://doi.org/10.1016/j.jclepro.2017.03.047.

Rankin, W. (2011) *Minerals, metals and sustainability: meeting future material needs*. Melbourne: CSIRO Publishing.

Rchid, D., Bouksour, O. and Beidour, Z. (2013) 'The activity-based costingmethod opportunity to assess and master the aircraft maintenance service cost for third party: a casestudy', *International Journal of Computer Science Issues*, 10(2), pp. 699–720.

Rebitzer, G. and Nakamura, S. (2008) 'Environmental Life Cycle Costing', in Hunkeler, D., Lichtenvort, K., and Rebitzer, G. (eds) *Environmental Life Cycle Costing*. Florida: Taylor & Francis, p. 232.

Reddy, V. R., Kurian, M. and Ardakanian, R. (2015) *Life-cycle Cost Approach for Management of Environmental Resources*. Springer Cham. doi: https://doi.org/10.1007/978-3-319-06287-7.

Reefke, H. and Sundaram, D. (2017) 'Key themes and research opportunities in sustainable supply chain management – identification and evaluation', *Omega*, 66, pp. 195–211. doi: https://doi.org/10.1016/j.omega.2016.02.003.

Rees, C., Kemp, D. and Davis, R. (2012) *Conflict management and corporate culture in the extractive industries: A Study in Peru*. Cambridge. Available at:

https://www.hks.harvard.edu/sites/default/files/centers/mrcbg/programs/cri/files/report_50_ConflictManagementandCorporateCulture.pdf.

Rieckhof, R., Bergmann, A. and Guenther, E. (2015) 'Interrelating material flow cost accounting with management control systems to introduce resource efficiency into strategy', *Journal of Cleaner Production*, 108, pp. 1262–1278. doi: https://doi.org/10.1016/j.jclepro.2014.10.040.

Rieman, D. J. (1983) *The Essential Structure of a Caring Interaction: A Phenomenological Study*, *ProQuest Dissertations and Theses*. Texas Woman's University PP - United States -- Texas. Available at: https://www.proquest.com/dissertations-theses/essential-structure-caring-interaction/docview/303327523/se-2?accountid=14648.

Rivoli, P. and Waddock, S. (2011) '"First They Ignore You…": The Time-Context Dynamic and Corporate Responsibility', *California Management Review*, 53(2), pp. 87–104. doi: 10.1525/cmr.2011.53.2.87.

Robinson, J. A., Torvik, R. and Verdier, T. (2006) 'Political foundations of the resource curse', *Journal of Development Economics*, 79(2), pp. 447–468. doi: https://doi.org/10.1016/j.jdeveco.2006.01.008.

Rodríguez-Olalla, A. and Avilés-Palacios, C. (2017) 'Integrating sustainability in organisations: An activity-based sustainability model', *Sustainability (Switzerland)*, 9(6), pp. 1–17. doi: 10.3390/su9061072.

Rohn, H., Lettenmeier, M. and Pastewski, N. (2011) 'Identification of Technologies, Products and Strategies with High Resource Efficiency Potential: Results of a Cooperative Selection Process', *International Economics of Resource Efficiency*. Physica-Verlag HD, pp. 335–347. doi: 10.1007/978-3-7908-2601-2_16.

Rolfe, J. *et al.* (2007) 'Lessons from the social and economic impacts of the mining boom in the Bowen Basin 2004-2006', *Australasian Journal of Regional Studies*, 13(2), pp. 134–153.

Ross, M. (2006) 'A Closer Look at Oil, Diamonds, and Civil War', *Annual Review of Political Science*, 9(1), pp. 265–300. doi: 10.1146/annurev.polisci.9.081304.161338.

Rossi, D. and Sihn, W. (2013) 'Life Cycle Oriented Evaluation of Product Design Alternatives Taking Uncertainty into Account BT - Re-engineering Manufacturing for

Sustainability', in Nee, A. Y. C., Song, B., and Ong, S.-K. (eds) *Re-engineering Manufacturing for Sustainability*. Singapore: Springer Singapore, pp. 99–104.

Rother, M. and Shook, J. (1999) *Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA*. Cambridge: Lean Enterprise Institute.

Rozar, N. M. *et al.* (2015) 'A Study of Success Factors in Green Supply Chain Management in Manufacturing Industries in Malaysia', *Journal of Economics, Business and Management*, 3(2), pp. 287–291. doi: 10.7763/joebm.2015.v3.196.

Rubin, K. S. (2011) *Qualitative interviewing: the art of hearing data*. Third. Los Angeles: Sage Publication.

Rushing, A. S., Kneifel, J. D. and Lippiatt, B. C. (2013) 'Energy price indices and discount factors for life-cycle cost analysis - 2013'. National Institute of Standards and Technology, p. 80. Available at: http://nvlpubs.nist.gov/nistpubs/ir/2013/NIST.IR.85-3273-28.pdf.

Sahu, H. B., Prakash, N. and Jayanthu, S. (2015) 'Underground Mining for Meeting Environmental Concerns – A Strategic Approach for Sustainable Mining in Future', *Procedia Earth and Planetary Science*, 11, pp. 232–241. doi: 10.1016/j.proeps.2015.06.030.

Salkind, N. . (2009) *Exploring research*. New Jersey: Pearson Education Inc.

Sangle, S. (2010) 'Empirical analysis of determinants of adoption of proactive environmental strategies in India', *Business Strategy and the Environment*, 19(1), pp. 51–63. doi: https://doi.org/10.1002/bse.651.

Sarkis, J., Gonzalez-Torre, P. and Adenso-Diaz, B. (2010) 'Stakeholder pressure and the adoption of environmental practices: The mediating effect of training', *Journal of Operations Management*, 28(2), pp. 163–176. doi: https://doi.org/10.1016/j.jom.2009.10.001.

Sarkis, J., Zhu, Q. and Lai, K. (2011) 'An organizational theoretic review of green supply chain management literature', *International Journal of Production Economics*, 130(1), pp. 1–15. doi: https://doi.org/10.1016/j.ijpe.2010.11.010.

Sartorius, K., Eitzen, C. and Kamala, P. (2007) 'The design and implementation of Activity Based Costing (ABC): a South African survey', *Meditari Accountancy Research*, 15(2), pp. 1–21. doi: 10.1108/10222529200700008.

Saunders, M. N. K., Lewis, P. and Thornhill, A. (2019) *'Research Methods for Business Students' Chapter 4: Understanding research philosophy and approaches to theory development*, *Researchgate.Net*. Available at: www.pearson.com/uk.

Scavone, G. M. (2006) 'Challenges in internal environmental management reporting in Argentina', *Journal of Cleaner Production*, 14(14), pp. 1276–1285. doi: https://doi.org/10.1016/j.jclepro.2005.08.011.

Schaltegger, S. (2018) 'Linking Environmental Management Accounting: A Reflection on (Missing) Links to Sustainability and Planetary Boundaries Linking Environmental Management Accounting: A Reflection on (Missing) Links to Sustainability and Planetary Boundaries', *Social and Environmental Accountability Journal*, 38(1), pp. 19–29. doi: 10.1080/0969160X.2017.1395351.

Schaltegger, S. and Burritt, R. (2000) *Contemporary Environmental Accounting: Issues, Concepts and Practice*. London: Routledge. doi: 10.4324/9781351282529.

Schaltegger, S. and Burritt, R. L. (2010) 'Sustainability accounting for companies: Catchphrase or decision support for business leaders?', *Journal of World Business*, 45(4), pp. 375–384. Available at: https://econpapers.repec.org/RePEc:eee:worbus:v:45:y:2010:i:4:p:375-384.

Schaltegger, S., Viere, T. and Zvezdov, D. (2012) 'Tapping environmental accounting potentials of beer brewing: Information needs for successful cleaner production', *Journal of Cleaner Production*, 29–30, pp. 1–10. doi: https://doi.org/10.1016/j.jclepro.2012.02.011.

Schaltegger, S. and Zvezdov, D. (2015) 'Expanding material flow cost accounting. Framework, review and potentials', *Journal of Cleaner Production*, 108, pp. 1333–1341. doi: 10.1016/j.jclepro.2014.08.040.

Schmidt, A., Götze, U. and Sygulla, R. (2015) 'Extending the scope of Material Flow Cost Accounting - Methodical refinements and use case', *Journal of Cleaner Production*, 108, pp. 1320–1332. doi: 10.1016/j.jclepro.2014.10.039.

Schmidt, M. (2015) 'The interpretation and extension of Material Flow Cost Accounting (MFCA) in the context of environmental material flow analysis', *Journal of Cleaner Production*, 108, pp. 1310–1319. doi: 10.1016/j.jclepro.2014.11.038.

Schoute, M. (2011) 'The relationship between product diversity, usage of advanced

manufacturing technologies and activity-based costing adoption', *The British Accounting Review*, 43(2), pp. 120–134. doi: https://doi.org/10.1016/j.bar.2011.02.002.

Schueler, V., Kuemmerle, T. and Schröder, H. (2011) 'Impacts of surface gold mining on land use systems in Western Ghana', *Ambio*, 40(5), pp. 528–539. doi: 10.1007/s13280-011-0141-9.

Schwab-Castella, P. *et al.* (2009) 'Integrating life cycle costs and environmental impacts of composite rail car-bodies for a Korean train', *International Journal of Life Cycle Assessment*, 14(5), pp. 429–442. doi: 10.1007/s11367-009-0096-2.

Scott, W. R. (1987) *Institutions and organisations: ideas and interests*. Thousand Oaks: SAGE Publications.

Scott, W. R. *et al.* (2000) *Institutional change and healthcare organisations: from professional dominance to managed care*. Chicago: University of Chicago Press.

Scott, W. R. (2103) *Institutions and organisations: Ideas, Interests, and Identities*. Fourth. Washington: SAGE Publications.

Seccatore, J. *et al.* (2014) 'A practical approach for the management of resources and reserves in Small-Scale Mining', *Journal of Cleaner Production*, 84, pp. 803–808. doi: https://doi.org/10.1016/j.jclepro.2013.09.031.

Selto, F. H. and Jasinski, D. W. (1996) 'ABC and high technology: A story with a moral', *Management Accounting*, 77(9), p. 37. Available at: https://www.proquest.com/scholarly-journals/abc-high-technology-story-with-moral/docview/229767803/se-2?accountid=14648.

Seuring, S. and Müller, M. (2008) 'From a literature review to a conceptual framework for sustainable supply chain management', *Journal of Cleaner Production*, 16(15), pp. 1699–1710. doi: https://doi.org/10.1016/j.jclepro.2008.04.020.

Shanahan, Y. P. (2008) 'Blinds R U A Case Study On Activity Based Costing', *Journal of Business Case Studies (JBCS)*, 4(1), pp. 39–54. doi: https://doi.org/10.19030/jbcs.v4i1.4743.

Sharfman, M. P., Shaft, T. M. and Tihanyi, L. (2004) 'A Model of the Global and Institutional Antecedents of High-Level Corporate Environmental Performance', *Business & Society*, 43(1), pp. 6–36. doi: 10.1177/0007650304262962.

Sherer, S. A., Meyerhoefer, C. D. and Peng, L. (2016) 'Applying institutional theory to the adoption of electronic health records in the U.S.', *Information & Management*, 53(5), pp. 570–580. doi: https://doi.org/10.1016/j.im.2016.01.002.

Shields, M. D. (1995) 'An Empirical Analysis of Firms' Implementation Experiences with Activity-Based Costing', *Journal of Management Accounting Research*, 7, pp. 148–166. Available at: https://search.ebscohost.com/login.aspx?direct=true&db=bsu&AN=9510062226&site=ehost-live&scope=site.

Shin, J., Sudhir, K. and Yoon, D.-H. (2012) 'When to "Fire" Customers: Customer Cost-Based Pricing', *Management Science*, 58(5), pp. 932–947. Available at: http://www.jstor.org/stable/41499530.

Sikdar, S. K. (2003) 'Sustainable development and sustainability metrics', *AIChE Journal*, 49(8), pp. 1928–1932. doi: https://doi.org/10.1002/aic.690490802.

Silverman, D. (2000) *Doing qualitative research: A practical handbook*. New Delhi: Sage Publication.

Simonds, R. (1995) *Levers of control: how managers use innovative control systems to drive strategic renewal*. Boston: Harvard Business Press.

Singh, R. K., Murty, H. R. and Gupta, S. K. (2007) 'An approach to develop Sustainability Management Systems in the steel industry', *World Review of Entrepreneurship, Management and Sustainable Development*, 3(1), pp. 90–108. doi: 10.1504/WREMSD.2007.012133.

Soam, S. *et al.* (2018) 'Life cycle assessment and life cycle costing of conventional and modified dilute acid pretreatment for fuel ethanol production from rice straw in India', *Journal of Cleaner Production*, 197, pp. 732–741. doi: https://doi.org/10.1016/j.jclepro.2018.06.204.

Sohal, A. S. and Chung, W. W. C. (1998) 'Activity based costing in manufacturing: two case studies on implementation', *Integrated Manufacturing Systems*, 9(3), pp. 137–147. doi: 10.1108/09576069810210312.

Soni, V., Singh, S. P. and Banwet, D. K. (2016) 'Sustainable coal consumption and energy production in India using life cycle costing and real options analysis', *Sustainable Production and Consumption*, 6, pp. 26–37. doi:

https://doi.org/10.1016/j.spc.2015.12.002.

Sparkes, R. (2006) ‘A historical perspective on the growth of socially responsible investment’, in Sullivan, R. and Mackenzie, C. (eds) *Responsible Investment*. London: Routledge, p. 382.

Speth, J. B. and Haas, P. M. (2006) *Global environmental governance*. Washington: Island Press.

Stål, H. I. (2015) ‘Inertia and change related to sustainability – An institutional approach’, *Journal of Cleaner Production*, 99, pp. 354–365. doi: https://doi.org/10.1016/j.jclepro.2015.02.035.

Stamp, M. (2015) ‘The socio-economic impacts - gold mining : commodity : gold’, *Inside Mining*, 8(7), pp. 14–16. doi: 10.10520/EJC173294.

Steffen, W. *et al.* (2015) ‘The trajectory of the Anthropocene: The Great Acceleration’, *The Anthropocene Review*, 2(1), pp. 81–98. doi: https://doi.org/10.1177%2F2053019614564785.

Sterman, J. D. (2012) ‘Sustaining Sustainability: Creating a Systems Science in a Fragmented Academy and Polarized World’, in Weinstein, M. P. and Turner, R. E. (eds) *Sustainability Science: The Emerging Paradigm and the Urban Environment*. New York: Springer Science and Business Media, pp. 21–58. doi: 10.1007/978-1-4614-3188-6_2.

Sterner, E. (2000) ‘Life-cycle costing and its use in the Swedish building sector’, *Building Research & Information*, 28(5–6), pp. 387–393. doi: 10.1080/096132100418537.

Stout, D. E. and Propri, J. M. (2011) ‘Implementing Time-Driven Activity-Based Costing at a Medium-Sized Electronics Company’, *Management Accounting Quarterly*, 12, (3): 1-11.

Stratton, W. O. *et al.* (2009) ‘Activity-Based Costing: Is It Still Relevant?’, *Management Accounting Quarterly*, 10, p. 31.

Strobel, M. and Redmann, C. (2002) ‘Flow cost accounting, an approach based on actual flows of materials.’, in Bennett, M., Bouma, J. J., and Wolters, T. (eds) *Environmental management accounting: information and institutional developments*. Dordrecht: The Netherlands: Kluwer Publishers, pp. 67–82.

Sulong, F., Sulaiman, M. and Norhayati, M. A. (2015) ‘Material Flow Cost Accounting (MFCA) enablers and barriers: the case of a Malaysian small and medium-sized enterprise (SME)’, *Journal of Cleaner Production*, 108, pp. 1365–1374. doi: https://doi.org/10.1016/j.jclepro.2014.08.038.

Swaffield, L. M. and McDonald, A. M. (2008) ‘The contractor’s use of life cycle costing on PFI projects’, *Engineering, Construction and Architectural Management*, 15(2), pp. 132–148. doi: 10.1108/09699980810852664.

Tai, Y.-H., Wang, W.-Y. and Katrichis, J. (2015) ‘The Impact of Improved Costing Methods on Customer Portfolio Management Activities’, in *Advances in Management Accounting*. Emerald Group Publishing Limited (Advances in Management Accounting), pp. 259–287. doi: 10.1108/S1474-787120150000025009.

Tai, Y. H., Wang, W. Y. and Chang, Y. H. (2012) ‘Product mix decisions integrated with ABC for better profitability management - the case of communications equipment firm in Taiwan’, *Chiao Da Management Review*, 32(2), pp. 37–76.

Tajelawi, O. A. and Garbharran, H. L. (2015) ‘MFCA: An Environmental Management Accounting Technique for Optimal Resource Efficiency in Production Processes’, *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 9(11), pp. 3758–3763. Available at: http://hdl.handle.net/10321/2517.

Testa, F. *et al.* (2014) ‘The effect of Integrated Pollution Prevention and Control regulation on facility performance’, *Journal of Cleaner Production*, 64, pp. 91–97. doi: https://doi.org/10.1016/j.jclepro.2013.08.003.

Thanh, C. N. and Thanh, T. T. (2015) ‘The interconnection between interpretivist paradigm and qualitative methods in education’, *American Journal of Education Science*, 1(2), pp. 24–27.

Theodoulidis, B. *et al.* (2017) ‘Exploring corporate social responsibility and financial performance through stakeholder theory in the tourism industries’, *Tourism Management*, 62, pp. 173–188. doi: https://doi.org/10.1016/j.tourman.2017.03.018.

Thomas, R. (2003) ‘Blending Qualitative & Quantitative Research Methods in Theses and Dissertations’. Thousand Oaks, California, pp. 1–26. doi: 10.4135/9781412983525.

Thomson, I. and Boutilier, R. (2011) ‘The social licence to operate’, in Darling, P. (ed.) *SME mining engineering handbook*. Colorado: Society for Mining, Metallurgy and Exploration.

Thottoli, M. M. (2021) ‘Knowledge and use of accounting software: evidence from Oman’, *Journal of Industry-University Collaboration*, 3(1), pp. 2–14. doi: 10.1108/JIUC-04-2020-0005.

Tost, M. *et al.* (2018) ‘The state of environmental sustainability considerations in mining’, *Journal of Cleaner Production*, 182, pp. 969–977. doi: https://doi.org/10.1016/j.jclepro.2018.02.051.

Tourais, P. and Videira, N. (2016) ‘Why, How and What do Organizations Achieve with the Implementation of Environmental Management Systems?—Lessons from a Comprehensive Review on the Eco-Management and Audit Scheme’, *Sustainability* . doi: 10.3390/su8030283.

Tran, M. *et al.* (2020) ‘The impact of supply chain quality integration on green supply chain management and environmental performance in Vietnam’s tourism industries’, *Uncertain Supply Chain Management*, 8(4), pp. 693–704.

Trotter II, R. T. (2012) ‘Qualitative research sample design and sample size: resolving and unresolved issues and inferential imperatives’, *Preventive Medicine*, 555, pp. 398–400.

Tsai, W.-H., Hsu, J.-L. and Chen, C.-H. (2007) ‘Integrating activity-based costing and revenue management approaches to analyse the remanufacturing outsourcing decision with qualitative factors’, *International Journal of Revenue Management*, 1(4), pp. 367–387. doi: 10.1504/IJRM.2007.015539.

Tsai, W.-H. and Hung, S.-J. (2009) ‘A fuzzy goal programming approach for green supply chain optimisation under activity-based costing and performance evaluation with a value-chain structure’, *International Journal of Production Research*, 47(18), pp. 4991–5017. doi: 10.1080/00207540801932498.

Tsai, W.-H. and Jhong, S.-Y. (2018) ‘Carbon Emissions Cost Analysis with Activity-Based Costing’, *Sustainability*, 10(8), p. 2872. doi: http://dx.doi.org/10.3390/su10082872.

Tsai, W. (1998) ‘Quality cost measurement under activity-based costing’, *International*

Journal of Quality & Reliability Management, 15(7), pp. 719–752. doi: 10.1108/02656719810218202.

Tsai, W. *et al.* (2011) 'Using activity-based costing to evaluate capital investments for green manufacturing systems', *International Journal of Production Research ISSN:*, 49(24), pp. 7275–7292. doi: 10.1080/00207543.2010.537389.

Tsai, W. *et al.* (2012) 'Integrating information about the cost of carbon through activity-based costing', *Journal of Cleaner Production*, 36(2012), pp. 102–111. doi: 10.1016/j.jclepro.2012.02.024.

Tsai, W. *et al.* (2013) 'A product-mix decision model using green manufacturing technologies under activity-based costing', *Journal of Cleaner Production*, 57, pp. 178–187. doi: 10.1016/j.jclepro.2013.04.011.

Tsai, W. H. *et al.* (2015) 'Integrating the activity-based costing system and life-cycle assessment into green decision-making', *International Journal of Production Research*, 53(2), pp. 451–465. doi: 10.1080/00207543.2014.951089.

Tsireme, A. I. *et al.* (2012) 'The influence of environmental policy on the decisions of managers to adopt G-SCM practices', *Clean Technologies and Environmental Policy*, 14(5), pp. 953–964. doi: 10.1007/s10098-012-0461-x.

Turner, L., Weickgenannt, A. B. and Copeland, M. K. (2020) *Accounting Information Systems: Controls and Processes*. Fourth. New Jersey: John Wiley & Sons Inc.

Ulhasanah, N. and Goto, N. (2012) 'Preliminary Design of Eco-City by Using Industrial Symbiosis and Waste Co-Processing Based on MFA, LCA, and MFCA of Cement Industry in Indonesia', *International Journal of Environmental Science and Development*, 3(6), pp. 553–561.

Unger, C. J. *et al.* (2015) 'A jurisdictional maturity model for risk management, accountability and continual improvement of abandoned mine remediation programs', *Resources Policy*, 43, pp. 1–10. doi: https://doi.org/10.1016/j.resourpol.2014.10.008.

United Nations (2016) *Transforming Our World: The 2030 Agenda for Sustainable Development*, *Resolution Adopted by the General Assembly A/RES/70/1*. New York. doi: 10.1201/b20466-7.

United Nations Environment Programme (UNEP) (2012) *Global Environmental outlook (GEO5): Environment for the future we want*, *Population and Development*

Review. Available at: http://www.jstor.org/stable/2807995?origin=crossref.

Untersteller, F. (2104) *Resource efficiency as key environmental and economic policy element of modern environmental policy*. Available at: http://dz.doi.org/10.1007/s00550-014-0336-1 (Accessed: 19 February 2019).

USDA Forest Service (2008) *Life cycle cost analysis for building is easier than you though*. Washington: United States Department of Agriculture. Available at: https://www.fs.usda.gov/t-d/pubs/htmlpubs/htm08732839/page01.htm (Accessed: 15 September 2019).

Valero, Antonio *et al.* (2014) 'How to account for mineral depletion. The exergy and economic mineral balance of Spain as a case study', *Ecological Indicators*, 46, pp. 548–559. doi: https://doi.org/10.1016/j.ecolind.2014.07.021.

Vasile, E. and Man, M. (2012) 'Current Dimension of Environmental Management Accounting', *Procedia - Social and Behavioral Sciences*, 62, pp. 566–570. doi: https://doi.org/10.1016/j.sbspro.2012.09.094.

Veiga, M. M., Angeloci-Santos, G. and Meech, J. A. (2014) 'Review of barriers to reduce mercury use in artisanal gold mining', *The Extractive Industries and Society*, 1(2), pp. 351–361. doi: https://doi.org/10.1016/j.exis.2014.03.004.

De Villiers, C. and Alexander, D. (2014) 'The Institutionalization of Corporate Social Responsibility Reporting', *The British Accounting Review*, 46(2), pp. 198–212. doi: http://dx.doi.org/10.1016/j.bar.2014.03.001.

de Villiers, C., Low, M. and Samkin, G. (2014) 'The institutionalisation of mining company sustainability disclosures', *Journal of Cleaner Production*, 84, pp. 51–58. doi: https://doi.org/10.1016/j.jclepro.2014.01.089.

Viviers, S., Venter, D. and Krüger, J. (2012) 'The relative importance of ethics, environmental, social and governance criteria', *African Journal of Business Ethics*, 6(2), p. 120. doi: 10.4103/1817-7417.111021.

Vlachý, J. (2014) 'Using Life Cycle Costing for Product Management', *Management : Journal of Contemporary Management Issues*, 19, pp. 205–218.

Wagner, B. (2015) 'A report on the origins of Material Flow Cost Accounting (MFCA) research activities', *Journal of Cleaner Production*, 108, pp. 1255–1261. doi: https://doi.org/10.1016/j.jclepro.2015.10.020.

Wagner, C., Kawulich, B. and Garner, M. (2012) *Doing Social Research: A Global Context*. London: McGraw-Hill Higher Education.

Wagner, M., Schaltegger, S. and Wehrmeyer, W. (2001) 'The relationship between environmental and economic performance of firms: what does theory propose and what does empirical eveidence tell us', *Greener Management International*, 34(1), pp. 94–111.

Walker, J. and Evers, C. (1988) 'The epistemology unit of educational research', in Keeves, J. (ed.) *Educational research, methodology and measurements: an international handbook*. Oxford: Pergamon.

Wan, Y. K. *et al.* (2015) 'Material flow cost accounting (MFCA)-based approach for prioritisation of waste recovery', *Journal of Cleaner Production*, 107, pp. 602–614. doi: 10.1016/j.jclepro.2015.05.024.

Weis, I. and Fine, M. (2000) *Speed bumps: a student-friendly guide to qualitative research*. New York: Teachers College Press.

Wessels, S. and Shotter, M. (2000) 'Organisational problems in respect of the implementation of activity-based costing in South Africa', *Meditari Accountancy Research*, 8(1), pp. 215–227. doi: 10.1108/10222529200000011.

White, A. *et al.* (1995) 'Environmental Cost Accounting for Capital Bugeting: A Benchmark Survey of Management Accountants'. Boston: U.S. Environmental Protection Agency, p. 107. Available at: https://p2infohouse.org/ref/03/02262.pdf.

Willis, J. (2007) 'Foundations of Qualitative Research: Interpretive and Critical Approaches'. Thousand Oaks: SAGE Publications, Inc. doi: 10.4135/9781452230108.

Wilson, A. H. (1996) 'The Great Dyke of Zimbabwe', in Cawthorn, R. G. B. T.-D. in P. (ed.) *Developments in Petrology: Layered Intrusions*. Elsevier, pp. 365–402. doi: https://doi.org/10.1016/S0167-2894(96)80013-3.

Witherite, J. and Kim, I. (2006) 'Implementing Activity-Based Costing in the Banking Industry - A case study describes some challenges to implementing activity-based costing', in *Bank accounting & finance*. New York: Aspen Publishers, pp. 29–34.

Wittneben, B. B. F. *et al.* (2012) 'Climate Change and the Emergence of New Organizational Landscapes', *Organization Studies*, 33(11), pp. 1431–1450. doi: 10.1177/0170840612464612.

Wong, M. S., Yip, T. P. and Mok, E. (2014) ‘Development of a Personal Integrated Environmental Monitoring System’, *Sensors* , pp. 22065–22081. doi: 10.3390/s141122065.

World Commision on Environment and Development (WCED) (1987) *Our common future*. Oxford: Oxford University Press.

Worrall, R. *et al.* (2009) ‘Towards a sustainability criteria and indicators framework for legacy mine land’, *Journal of Cleaner Production*, 17(16), pp. 1426–1434. doi: https://doi.org/10.1016/j.jclepro.2009.04.013.

Wu, S. *et al.* (2006) ‘Reliability in the whole life cycle of building systems’, *Engineering, Construction and Architectural Management*, 13(2), pp. 136–153. doi: 10.1108/09699980610659607.

Wu, Z. and Pagell, M. (2011) ‘Balancing priorities: Decision-making in sustainable supply chain management’, *Journal of Operations Management*, 29(6), pp. 577–590. doi: https://doi.org/10.1016/j.jom.2010.10.001.

Xiao, C. *et al.* (2018) ‘When are stakeholder pressures effective? An extension of slack resources theory’, *International Journal of Production Economics*, 199, pp. 138–149. doi: https://doi.org/10.1016/j.ijpe.2018.03.002.

Xu, X. (2020) ‘Application Research of Accounting Archives Informatization Based on Big Data BT - Data Processing Techniques and Applications for Cyber-Physical Systems (DPTA 2019)’, in Huang, C., Chan, Y.-W., and Yen, N. (eds) *Data Processing Techniques and Applications for Cyber-Physical Systems (DPTA 2019)*. Singapore: Springer Singapore, pp. 55–62.

Yagi, M. and Kokubu, K. (2018) ‘Corporate material flow management in Thailand: The way to material flow cost accounting’, *Journal of Cleaner Production*, 198, pp. 763–775. doi: 10.1016/j.jclepro.2018.07.007.

Yang, K.-M. and Chang, S. (2018) ‘Application of Activity-Based Costing to Green Industry for Profitability and Performance Enhancement -- Recycling of Blast Furnace Slag as an Example’, *Advances in Management & Applied Economics*, 8(3), pp. 27–59.

Yoon, B. and Lee, J. . (2019) ‘Corporate social responsibility and information asymmetry in the Korean market: Implications of chaebol affiliates’, *Journal of Asian*

Finance, Economics and Business, 6(1), pp. 21–31.

Yu, Y. (2006) 'The key to survival in the area of micro-power -making profit advantages using ABC', *Accounting Research Monthly*, 246, pp. 40–52.

Zaman, M. (2009) 'The Impact Of Activity Based Costing On Firm Performance: The Australian Experience', *International Review of Business Papers*, 5(4), pp. 200–208.

Zhang, Y. F., Hoque, Z. and Isa, C. R. (2015) 'The Effects of Organizational Culture and Structure on the Success of Activity-Based Costing Implementation', in *Advances in Management Accounting*. Emerald Group Publishing Limited (Advances in Management Accounting), pp. 229–257. doi: 10.1108/S1474-787120150000025008.

Zhou, Z. *et al.* (2017) 'MFCA extension from a circular economy perspective: Model modifications and case study', *Journal of Cleaner Production*, 149, pp. 110–125. doi: 10.1016/j.jclepro.2017.02.049.

Zhou, Z. F. and Xu, X. (2013) *Enterprise resource value circulation accounting research in the background of two-oriented society resource-saving and environmental-friendly: based on circular economy*. Beijing: Press of Economic Science.

Zhu, Q., Cordeiro, J. and Sarkis, J. (2013) 'Institutional pressures, dynamic capabilities and environmental management systems: Investigating the ISO 9000 – Environmental management system implementation linkage', *Journal of Environmental Management*, 114, pp. 232–242. doi: 10.1016/j.jenvman.2012.10.006.

Zhu, Q. and Geng, Y. (2013) 'Drivers and barriers of extended supply chain practices for energy saving and emission reduction among Chinese manufacturers', *Journal of Cleaner Production*, 40, pp. 6–12. doi: https://doi.org/10.1016/j.jclepro.2010.09.017.

Zhu, Z., Wang, K. and Zhang, B. (2014) 'Applying a network data envelopment analysis model to quantify the eco-efficiency of products: a case study of pesticides', *Journal of Cleaner Production*, 69, pp. 67–73. doi: https://doi.org/10.1016/j.jclepro.2014.01.064.

Zimmerman, J. (2016) *Accounting for Decision Making and Control*. Ninth. Boston: McGraw Hill.

Zollo, M., Cennamo, C. and Neumann, K. (2013) 'Beyond What and Why', *Organization & Environment*, 26(3), pp. 241–259. Available at:

https://www.jstor.org/stable/27068891.

Zucker, L. G. (1977) ‘The Role of Institutionalization in Cultural Persistence’, *American Sociological Review*, 42(5), pp. 726–743. doi: 10.2307/2094862.

Žukauskas, P., Vveinhardt, J. and Andriukaitienė, R. (2018) ‘Philosophy and Paradigm of Scientific Research’, *Management Culture and Corporate Social Responsibility*. doi: 10.5772/INTECHOPEN.70628.

APPENDIX A: SUMMARY OF PROPOSITIONS

Proposition number	Description
Content propositions	
Proposition Cp1	*Gold mining activities adversely affect the natural environment since they leave a strong environmental footprint, arguably more than any other industrial activity.*
Proposition Cp2	*EMA may hold much promise to be employed to manage the various challenges facing the gold mining sector.*
Proposition Cp3	*The EMA divisions of PEMA and MEMA may provide essential information for the sustainable management of the challenges facing gold mining.*
Proposition Cp4	*MFCA, as an EMAP, supports eco-efficiency decisions that enhance resource efficiency to improve a mining organisation's economic and environmental performance.*
Proposition Cp5	*Gold mining systems should have a management accounting system that determines wasteful activities and optimises costs.*
Proposition Cp6	*ISO standards play an essential role in the governance of environmental regulations and developing EMAPs such as MFCA.*
Proposition Cp7a	*MFCA can assist gold mining organisations in reducing waste to enhance the gold mining sector's economic and environmental performance.*
Proposition Cp7b	*MFCA can assist the gold mining organisations in economic and environmental performance through:* • *the reduction of waste* • *improved energy usage* • *improved decision-making and accountability.*
Proposition Cp8	*MFCA helps to achieve resource and energy efficiency since it assists in the speedy availability of waste information.*
Proposition Cp9a	*LCC may be implemented in conjunction with MFCA by the gold mining sector following the principles of sustainable development, thereby considering the economic, social, and environmental aspects of an investment project.*
Proposition Cp9b	*LCC may be implemented in conjunction with MFCA by*

Proposition number	Description
	the gold mining sector to facilitate: • *principles of sustainable development;* • *economic, social, and environmental aspects of an investment project;* • *the feasibility of environmental management strategies;* • *cost savings; and* • *enhanced decision-making.*
Proposition Cp10	*ABC may be used with the aforementioned accounting strategies to assist with product-related decision-making for the gold mining sector since it focuses on accurately assigning product overhead costs.*
Proposition Cp11	*The gold mining industry in a developing economy with limited resources may benefit through adopting and integrating various EMAPs, notably MFCA, LCC and ABC.*
Proposition Cp12	*Top management support is essential for successfully implementing all EMAPs.*
Proposition Cp13	*Social order within the mining sector may be based on a shared social reality. (Note that this may be a general proposition in other spheres of life).*
Proposition Cp14a	*The government and other regulatory bodies with rich resources could exert numerous forces on mining organisations to adopt greener practices and avoid penalties for failing to comply.*
Proposition Cp14b	*NGOs and other essential pressure groups assist in the diffusion of ideas among mining organisations, motivating them to adopt environmental management initiatives.*
Proposition Cp15	*Employees who are internal to a mining environment and the media who are external stakeholders may likewise exert pressure that motivates mining organisations to adopt strategies for greener gold mining.*
Proposition Cp16	*The government and other key stakeholders may adopt legislation that may accelerate the rate at which organisations comply with environmental regulations.*
Proposition Cp17	*Stakeholder engagement assists in building lasting beneficial relationships, and stakeholder mapping and identifying their needs is an essential strategy for mining organisations.*

Proposition number	Description
Proposition Cp18	*To be granted a social licence to operate (SLO), gold mining organisations should consider the societal needs of the communities in which they operate.*
Association propositions	
Proposition Ap1	*There is an association between accounting subject matter, EMA and EMAPs, for example, LCC.*
Proposition Ap2	*An association is needed between applying EMAPs and meeting the objectives and goals of a gold mining enterprise.*
Proposition Ap3	*Institutional forces, environment, and governance systems are associated with a country's rules and legislation.*
Proposition Ap4	*There is an association between stakeholder pressure and environmental management (involving EMAPs) strategy adoption.*
Proposition Ap5	*Aspects around social responsibility concerning sustainability have an association with the expected results of a gold mining company.*
Proposition Ap6	*There is an association between meeting the objectives/goals of a mining company (CSR) and expected results concerning cost savings and minimising environmental impacts.*
General propositions	
Proposition Gp1	*Communication and engagement is essential among stakeholders to create common vision.*

APPENDIX B: INTERVIEW PROTOCOL

My name is Moses Nyakuwanika, and I am doing research with Prof Breggie van der Poll and Prof André van der Poll, towards a PhD in management accounting, at the University of South Africa. I am inviting you to participate in a study entitled “An integrated framework of environmental management accounting practices to promote greener gold mining in Zimbabwe.” The purpose of this study is to develop an integrated framework of environmental management accounting practices to promote green gold mining in Zimbabwe.

Research Themes	Interview Questions	Research Objective	Research Propositions
Section A: Questions for participants in environmental management function			
Stakeholder influence	How does the environment in which you operate influence your organisation to adopt greener initiatives?	RO a	RP 1
	Do you think it is necessary for governments and other regulatory bodies to exert coercive pressures on organisations to adopt greener initiatives? Kindly explain your answer.		RP 2
	When you look at key stakeholders of the gold mining sector, which one exerts the highest amount of force and why?		RP 3
	Are you registered at any board that prescribe operating standards for the gold mining sector? If not, why not? If yes, how has the gold mining organisation benefited from the board?		
	What role is played by NGOs and other essential stakeholders in the diffusion of ideas and assisting the gold mining organisations to adopt environmental management initiatives?		RP 4

Research Themes	Interview Questions	Research Objective	Research Propositions
Section A: Questions for participants in environmental management function			
	Do you think stakeholder engagement helps in building lasting beneficial relationships? If so, how often do you engage stakeholders and which among your stakeholders do you mostly engage? And if not, why not?		RP 5
Impact of mining on the environment	What are the impacts of gold mining on the environment?	RO b	RP 6
	To what extent does it hold true that gold mining leaves the strongest footprint on the environment more than any other industrial activity?		
	Which strategies have been employed by your organisation in managing ecological damage? And how have these assisted?	RO c	
	How does the gold mining activity impact on surrounding communities?	RO b	
Waste accountability	Do you record waste quantity from your gold mining process in a separate waste record? If yes, how is it recorded? If not, how is the amount of waste generated by gold mining process determined?	RO c	RP 7
	Do you think it is necessary to track and record separately waste quantity and costs? Kindly explain?		
	Do you think knowing the amount of waste generated by the gold mining process is going to assist the industry in any way? Explain.	RO c	RP 8
	Is there any relationship or linkage between waste-reduction and economic and environmental performance of a gold mining organisation? Explain.		

Research Themes	Interview Questions	Research Objective	Research Propositions
Section A: Questions for participants in environmental management function			
	What are the drivers for improving gold processing waste-reduction decisions?		
	How does the gold mining sector account for waste? Is waste identified separately or assigned to overheads? Explain.		RP 7
	Do you have a waste reduction strategy? If not, why not? If yes, how has this been implemented and how has it been of help to you?		
	What are the major challenges in gold process waste-reduction?	RO c	RP 9
	What are the efforts that have been taken to address these challenges?		
Research Themes	**Interview Questions**	**Research Questions**	**Research Propositions**
Section B: Questions for participants in management accounting			
Accounting for gold process waste	Which accounting system is used within your organisation? Do you think the current accounting system is able to capture the entire flow of waste within the gold processing? Explain.	RO c	RP 8
	How does the accounting system in use support environmental management or eco-efficiency decisions?		
	Do you subscribe to any standard that prescribes to waste management? If yes, how has the standard been of assistance to you? How has the standard assisted you in making available waste information?		

Research Themes	Interview Questions	Research Objective	Research Propositions
Section A: Questions for participants in environmental management function			
	Do you provide any waste-related information to management for waste-reduction decision-making? If not, why? If yes, how has the information been rated?		
	Are there barriers in the provision of gold process waste information? If yes, which strategies have been adopted to try and address them?	RO c	RP 9
Integrated accounting system	Does the processing have a database management system? If yes, to what extent is it integrated? If integrated, do you use a data warehouse system?	RO d	RP 8
	Which one(s) among the MAPs (MFCA, LCC & ABC) have you been using and how have they benefited you?		
	How could the use of environmental management accounting practices (EMAPs) in an integrated system lead to lean production (sustainable development or environmental management)?	RO d	RP 9
	Do you think that the EMAPs you are using are closely related to the economic and environmental performance of your organisation? Explain.		
	What have been the barriers to the implementation of EMAPs?	RO d	RP10
	Which strategies have been adopted to overcome barriers to implementation of EMAPs? How has the progress been?		
	How has the EMAP in use promoted material efficiency and cost saving opportunities in the gold mining process?	RO d	RP 11

Research Themes	Interview Questions	Research Objective	Research Propositions
Section A: Questions for participants in environmental management function			
Systems perspective	Do you think that the planning process for the mining venture take a systems approach? If yes, explain. If not, why not?	RO c & d	RP 12
	If planning takes a systems approach or perspective, how has this assisted the gold mining processing?		RP 13
	Which system or technique are you using to estimate and gauge the total expenditure of a project?		
	How has the system in use assisted in managing the environment and reducing waste?		
	Do you think planning and operation of a gold mining project considers economic, social, and environmental aspects? If not, why not? If yes, explain.		
	Do you have a strategic environmental management plan? If not, why not? If yes, how has this assisted you? How often is it reviewed?		
	How has lifecycle thinking assisted you in cost savings and measuring environmental performance of the gold mining organisation?	RO c & d	RP 14
	Do you think knowing the different activities performed in gold mining and processing will assist with product related decision-making and accurate product costing? Explain.		
	Do you think top management support is essential for successful implementation of EMAPs? Explain.		

Thank you very much for your time.

APPENDIX C: FOCUS GROUP DISCUSSION QUESTIONS PROTOCOL

My name is Moses Nyakuwanika, and I am doing research with Prof Breggie van der Poll and Prof André van der Poll, towards a PhD in management accounting, at the University of South Africa. I am inviting you to participate in a study entitled "**An integrated framework of environmental management accounting practices to promote greener gold mining in Zimbabwe**." The purpose of this study is to develop an integrated framework of environmental management accounting practices to promote green gold mining in Zimbabwe.

CATEGORIES OF QUESTIONS ***(Krueger 2002:1-18)***

Opening [ice breaker]

1. *Please tell us your name and what your job entails or what you do?*

Introductory [allow participants to reflect on their experiences with the topic to give us hints about participants' reality]

1. *When you hear the words "environmental management," what comes to mind?*

Transition [setting the stage for "Key" questions]

1. *Are there any special skills one must have so as to manage the environment?*

Key [to drive the topic]

1. What are your views on the proposed framework?
2. What do you view as key in the proposed framework?
3. When you make a reflection, what are the new things you tried to implement to enhance environmental management and what are the things you tried to discontinue?
4. What helped you continue with the change and what has been the progress?
5. What role do your workmates and others have in your success?
6. Do you think the application of EMAPs (such as ABC, LCC) serve the purpose of resource efficiency, waste reduction and improved decision making?
7. Do you think meeting the goals of a mining company (such as resource efficiency, waste reduction and improved decision making) results in cost savings and minimisation of environmental impacts? Kindly explain?
8. Do you think being socially responsible and adoption of greener strategies would lead to cost savings and economic improvement?

Ending [questions to wrap up the discussions]

- **All-Things Considered questions** [each participant reflects on previous comments and identify the most important aspects that need action]

1. *Of all the environmental management aspects we discussed, which one is most important to you?*

- ***Summary question*** [Moderator recaps the discussions, state big questions & big ideas that emerged]

Thank you very much for your time.

APPENDIX D: ETHICAL CLEARANCE CERTIFICATE

UNISA university of south africa

UNISA COLLEGE OF ACCOUNTING SCIENCES RESEARCH ETHICS REVIEW COMMITTEE

Date: 6 October 2020

ERC Reference # : 2020_CAS_031
Name : M Nyakuwanika
Student no: 43136605

Dear Mr M Nyakuwanika,

Decision: Ethics Approval from 6 October 2020 to 5 October 2023

Researcher(s): Mr Moses Nyakuwanika (43136605@mylife.unisa.ac.za)
Supervisor(S): Prof HM van der Poll (vdpolhm@unisa.ac.za)
Prof JA van der Poll (vdpolja@unisa.ac.za)

Working title of research:
AN INTEGRATED FRAMEWORK OF ENVIRONMENTAL MANAGEMENT ACCOUNTING TECHNIQUES TO PROMOTE GREENER GOLD MINING IN ZIMBABWE

Qualification: PhD

Thank you for the application for research ethics clearance by the Unisa College of Accounting Sciences Research Ethics Review Committee for the above mentioned research. Ethics approval is granted for **interviews** for the period **6 October 2020 to 5 October 2023. A separate application needs to be submitted at a later stage for ethics approval of the focus groups.**

*The **low risk application** was **approved** by the CAS RERC on **6 October 2020** in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the CAS RERC.

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No fieldwork activities may continue after the expiry date **(5 October 2023)**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

*The reference number **2020_CAS_031** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Signature : **Prof Lourens Erasmus**

Chair of CAS RERC

E-mail: erasmlj1@unisa.ac.za
Tel: (012) 429-8844

Signature : **Prof Lungile Ntsalaze**

Executive Dean : College of Accounting Sciences

E-mail: ntsall@unisa.ac.za
Tel: (012) 429-2778

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

UNISA university of south africa

UNISA COLLEGE OF ACCOUNTING SCIENCES RESEARCH ETHICS REVIEW COMMITTEE

Date: 6 October 2021

ERC Reference # : 2021_CAS_037
Name : M Nyakuwanika
Staff no: 43136605

Dear Mr M Nyakuwanika,

Decision: Ethics Approval from 6 October 2021 to 5 October 2024

Researchers: Mr Moses Nyakuwanika (mnyakuwanika@gzu.ac.zw)
Supervisor: Prof Huibrecht M. van der Poll (vdpolhm@unisa.ac.za)
Prof John A. van der Poll (vdpolja@unisa.ac.za)

Working title of research:
AN INTEGRATED FRAMEWORK OF ENVIRONMENTAL MANAGEMENT ACCOUNTING TECHNIQUES TO PROMOTE GREENER GOLD MINING IN ZIMBABWE

Qualification: PhD and Non-degree

Thank you for the application for research ethics clearance by the Unisa College of Accounting Sciences Research Ethics Review Committee for the above-mentioned research. **Ethics approval is granted for conducting focus groups.** The certificate is valid for the period **6 October 2021 to 5 October 2024.**

*The **low risk application** was **approved** by the CAS RERC on **5 October 2021** in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the CAS RERC.

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No fieldwork activities may continue after the expiry date **(5 October 2024)**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:
*The reference number **2021_CAS_037** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Signature : **Prof Lourens Erasmus**

Chair of CAS RERC

E-mail: erasmlj1@unisa.ac.za
Tel: (012) 429-8844

Signature : **Dr Chisinga Chikutuma**

Digitally signed by Dr CN Chikutuma
DN: cn=Dr CN Chikutuma, o=Unisa: College of Accounting Sciences, ou=Head: Office for Graduate Studies and Research, email=chikucn@unisa.ac.za, c=ZA
Date: 2021.10.06 10:31:22 +02'00'

Acting head: Office for Graduate Studies and Research
By delegation from the Executive Dean: College of Accounting Sciences

E-mail: chikucn@unisa.ac.za
Tel: (012) 429-3401

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

APPENDIX E: LANGUAGE EDITOR CERTIFICATE

expertenglisheditorscc

CERTIFICATE

Expert English Editors CC 2007/147556/23
Member: J R Levey
editsa@gmail.com www.expertenglisheditors.co.za
P O Box 14686, Hatfield, 0028, South Africa (0)73 204 5392 /Cell +27 (0)82 862 3085

TO WHOM IT MAY CONCERN

This is to certify that I have edited this document for English style, language usage, logic and consistency; it is the responsibility of the author to manually accept or reject the suggested changes and interact with the comments in order to finalise the text. The references are to be finalised by the client too.

Author:	Moses Nyakuwanika
Thesis Title:	An Integrated Framework of Environmental Management Accounting Practices to Promote Greener Gold Mining in Zimbabwe
Degree:	Doctor of Philosophy in Accounting Sciences (Management Accounting)
Institution:	Faculty of Economics and Accounting Sciences Dept. of Management Accounting University of South Africa

Sincerely

Dr Felicity Horne for Expert English Editors
B. A. (Wits); T.T.H.D (Wits); B.A. Hons (Unisa); M.A. (Unisa); D. Litt. et Phil. (Unisa)

Electronically signed

2022-07-05