SUSTAINABILITY REPORTING

IN THE MINING INDUSTRY

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ABSTRACT

The purpose of this thesis was to examine the sustainability reporting of global mining companies. A review of prior literature indicated that sustainability has grown as a concept of interest in recent decades. Early studies concentrated on the characteristics of organisations producing sustainability reports and proffered different theories explaining why these reports are produced. While more recent research has focused on sustainability in the mining sector, no prior study had looked at the content of the sustainability reports of multiple mining organisations. This study, therefore, provides greater understanding of the concepts and themes used within mining companies' sustainability reports.

The study data drew on 104 electronically available sustainability reports collected from 32 mining companies covering the period 2010 to 2013. The mining companies were further classified according to their International Council on Mining and Minerals (ICMM) membership status. A content and thematic analysis was conducted using Leximancer software, a computer textual analysis program. The software analysed the data and produced concept findings, key themes, and concept maps from it.

The findings showed that the most frequently used concepts across all the sustainability reports were *community*, *employees*, *local*, *production,* and *safety*. At 27,727 interactions, the concept of *community* had the greatest number of interactions with other concepts. When the number of interactions was divided by the concept count, *education* was seen to have the highest number of interactions per concept appearance, followed by *power*, *consumption*, *coal,* and *employment.* The theme findings identified five theme groups: *Community*, *Safety*, *Production*, *Water,* and *Employees.*

The summarised findings for the individual companies revealed variation across the different companies. The count percentage of the second most frequent concept, compared to the most frequent, ranged from 99% to 49%. The third most frequent concept's average relevance score ranged from 97% 38%. When limiting the individual companies to their 5 most frequent concepts, 29 concepts were found to be in use across the 32 different companies. The most common concepts to rank in the top 5 overall were *operations*, '*company name', management, development,* and *mine.*

The findings revealed 65 concepts across the 4 investigated years; 22 of these concepts were found to be common concepts. The study identified 17 top 10 ranked concepts for

the 4-year period; however, 4 of these ranked consistently in the top 10. These were *community*, *production*, *report,* and *local*. The findings for the three different ICMM member categories revealed 19 concepts that ranked in the top 40 across all categories. The concepts of *community*, *employees*, *report*, *production,* and *local* all had an average rank inside the top 10, regardless of ICMM membership.

This study provided greater insight into the sustainability reporting practices of leading global mining companies. The findings revealed the concepts and themes that appeared within the sustainability reports. More research is needed to understand the different concepts and the reasons for the variability in reporting and reporting trends over time. This study has provided a preliminary review which can be used to better understand how mining companies are using sustainability reporting in light of the inherent paradox between sustainability and mining.

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Chapter 1 INTRODUCTION

1.1 Introduction

The term sustainability has emerged as the organisational buzzword of the late 20th century and early 21st century (Dyllick & Hockerts, 2002; Dobers & Strannegard, 2005). One possible explanation for this phenomenon is provided by Mueller (2005) who recognised sustainability as "one of those few words that seems to have only good connotations" (p. 8). According to McPeak and Tooley (2008), alignment with sustainability can benefit an organisation and doing so makes good business sense.

Sustainability is recognised as bringing organisations not only internal and external advantages but also the potential to move the business environment away from a purely economic-based system (Mueller, 2005; Timlon, 2011; Prior, Giurco, Mudd, Mason, & Behrisch, 2012). However, a number of obstacles have prevented sustainability from revolutionising the business environment. These difficulties stem from the fact that sustainability has no complete or consistent underlying framework. Thus, in the absence of an assurance process, the concept lacks credibility (Kolk, 2003; Adams & McNicholas, 2007; Aras & Crowther, 2009; Isaksson & Stemimle, 2009; Hrasky, 2012).

While recognising sustainability's potential, Stone (2003) was also aware of the Utopian nature of a sustainable reality. For her, sustainability appears to be "a worthy goal" but not a practicable possibility, as he goes on to ask: "but how likely is it to be achieved?" (Stone, 2003, p. 94). Although uncertainty surrounds the notion of sustainability and how it integrates with modern businesses, the lack of certainty has not stopped the rise of this concept in modern business.

Indeed, organisations are increasingly incorporating sustainability into their daily operations strategic planning, and reporting (Kolk, 2003; Hrasky, 2012), and have begun to embrace sustainability as the basis for reporting on their corporate social activity and progress (Simnett, Vanstraelen, & Chua, 2009; Dilling, 2010).

Hogner (1982) initially claimed that social disclosures were attempts to manage legitimacy. Subsequent studies have further tested this theory but they have produced mixed findings (see Deegan, Rankin, & Tobin, 2002; Guthrie & Parker, 1989; Watson, 2011). One means by which organisations attempt to maintain their legitimacy is through sustainability. They protect themselves by adopting the many different facets of

sustainability throughout their activities and they communicate this change to stakeholders through disclosures and reporting (Jenkins, 2004).

This practice is particularly relevant for the mining industry and a large number of mining organisations are now incorporating sustainability into their operations and disclosures (Peck & Sinding, 2003; Milne, Tregidga, & Walton, 2009; Perez & Sanchez, 2009; Himley, 2010). Mining takes many different forms and takes place in different corners of the world (Himley, 2010). The diversity in the mining industry is further emphasised through its varying uses and interpretations of sustainability (Jenkins & Yakovleva, 2006). The mining industry has traditionally provided the raw materials necessary to meet the demands of society in order to foster growth and development to the point where "today's global society is economically, socially and culturally dependent on minerals and metals" (Prior et al., 2012).

All mining companies share the same characteristic: they extract nonrenewable resources from the environment (Jenkins, 2004). Due to the finite nature of the planet's resources, mining, by its very nature, cannot be sustainable (Prior et al., 2012). This situation creates a very clear and interesting paradox between mining and sustainability (Fonseca, 2010).

Jenkins (2004) extended this point further by noting that, historically, the mining industry has taken a 'devil may care' attitude and used a financial-based cost benefit analysis to justify any damage caused by mining to society and the environment (p. 24). According to Peck and Sinding (2003), however, stakeholders are now becoming more aware and more demanding in light of the mining industry's questionable history. Nevertheless, Whitmore proposed that sustainability in mining has no effect on mining practices. He further showed that core mining activities have not altered. Despite this conclusion, the mining industry is attempting to create a perception that it is cognizant of the importance of sustainability by integrating sustainability-related concepts into its practices and reporting (Peck & Sinding, 2003). This development correlates with stakeholders' becoming more aware, informed, and connected (Elijido-Ten, Kloot, & Clarkson, 2010; Peck & Sinding, 2003; Ullmann, 1985).

The purpose of this study is to explore the concepts and themes of disclosures in sustainability reports prepared by the mining industry, in light of the accepted and obvious paradox presented by sustainability, in order to ascertain if there is any consistency in the material published by organisations. Specifically, this study

investigates the sustainability reporting of leading global mining companies. Concepts and themes will be identified from within the text of sustainability reports that form the basis of the analysis. The analysis intends to uncover the nature and commitment towards sustainability within the global mining industry. The remainder of this chapter provides a brief overview of this study.

1.2 Background

The purpose of this section is to provide some brief background on the development of sustainability. The first section covers how organisations have embraced sustainability. The following section looks at the evolution of sustainability reporting. The third section considers how sustainability has been applied in theory and practice, while the final section looks specifically at sustainability in the mining industry. First, however, it is important to go back to the start of sustainability in modern business.

1.2.1 Sustainability and business.

An organisation's involvement with sustainability can manifest itself in two different ways. First, the organisation can engage in sustainable behaviour. The extent of its involvement in sustainability can vary from a weak to a strong position (Gray, Owen & Adams, 1996; Himley, 2010). Second, organisations can disclose the extent of their sustainable behaviour through different media (Paul, 2008). These include issuing press releases, publishing disclosures on their websites, or formalised sustainable disclosures and performance as seen in sustainability reports.

Ideally, there should be a perfect correlation between sustainable behaviour and sustainable disclosure. Classen and Roloff (2012), in discussing organisational reporting, asserted that any corporate social responsibility (CSR) disclosure needs to be supported with action and evidence. It is only the actions of an organisation that reveal its true commitment towards, and the priority it places on, sustainability. However, Milne, Tregidga, and Walton (2009) challenged the relationship portrayed between a business and the natural environment. They suggested that disclosures can actually be used to conceal the economic and instrumental approach taken towards the environment.

Disclosures allow the public to gauge sustainable development and to, therefore, hold an organisation accountable for its behaviour. Disclosures relating to sustainability can include annual report disclosures, sustainability reports, website disclosures, scientific documents, and press releases issued to and published by the media (Paul, 2008;

Hrasky, 2012). However, measuring sustainability and sustainable development based on subsequent narrative disclosure does not provide independent, verifiable, or easily comparable data. Without sufficient and accurate information, stakeholders cannot easily understand an organisation's sustainable behaviour. This lack of knowledge thus limits the extent to which stakeholders can hold organisations to account.

Society has been forced to rely on sustainability reporting to measure and gauge an organisation's commitment towards sustainable development (Hrasky, 2012). According to Milne, Tregidga, and Walton (2009), the nature of the disclosures indicates that organisations are engaging in sustainability to satisfy external pressures and to gain internal benefits and efficiencies.

Aras and Crowther (2009) found an increasingly cynical view of sustainability in that it is largely a green-washing tool used to deceive. Classen and Roloff (2012) recognised that stakeholders have a sceptical view of corporate social responsibility (CSR) disclosures due to the strategic nature of the communication; "…because stakeholders assume that companies strategically communicate, that is to say, under-report on problems and failures and communicate mostly on strengths and may exaggerate them, they remain sceptical towards company reports" (p. 395). In addition to disclosures, Hrasky (2012) found variations in image usage within sustainability reports where images could also be used as a "rhetorical 'green-washing' tool in communication with stakeholders" (p. 154).

Kolk (2003) acknowledged sustainability reporting as a 'window-dressing' tool to address external pressures that would fade as public interest declined. Aras and Crowther (2009) in their study did not assume cynicism as a pure motive when employing sustainability. They did, however, accept that its effects were beneficial for corporations and investors in the short term. Milne, Tregidga, and Walton (2009) found that organisations were largely taking an economic and instrumental approach to sustainable development and integrating rhetorical disclosures either to mask a lack of substantial action or through pragmatism. These findings reveal inconsistencies and variations within sustainability reporting and further highlight the paradox of sustainable mining.

1.2.2 Sustainability and mining.

The 1987 Bruntland Report has been widely associated with the use and acceptance of the term sustainability (Stone, 2003). Since then, sustainability has become one of the dominant issues within the business environment (Mansdorf, 2010). The mining industry by its very nature cannot be considered sustainable due to the extraction of

nonrenewable resources from the environment (Kommadath, Sarkar, & Rath, 2012; Prior et al., 2012). This reality is compounded by the industry's history of showing little regard for social and environmental stakeholders (Jenkins, 2004).

Academic studies have investigated the effects of mining companies in local communities and environments. Examples include the release of toxic chemicals onto the land and into the waterways as well as the treatment of workers, indigenous populations, local villages, and developing nations (Peck & Sinding, 2003; Stern, 1995). Along with academic research, the media also report regularly on significant events relating to mining operations. The next paragraph lays out a number of recent and historical events associated with mining organisations.

Mining incidents have featured prominently in recent and historical disasters (Jenkins, 2004). Events where the extraction of nonrenewable resources has led to catastrophes include: the Deepwater Horizon rig's explosion and consequent oil spill in the Gulf of Mexico (www.bbc.co.uk); the methane explosion at Pike River mining operation on the West Coast of New Zealand (www.nzherald.co.nz); the breaking of a reservoir at an Aurul mining facility in Baia Mare, Romania which resulted in cyanide spilling into local rivers (www.bbc.co.uk); the discharge of effluent by Ashio Copper Mine in Japan which caused damage to farmland and rivers (Jenkins, 2004); the destruction of rain forests due to mining in the Amazon (www.theguardian.com), Sumatra (www.theguardian.com), and Papua New Guinea (www.nytime.com); the removal of indigenous tribes and peoples from tribal land to make way for mining operations and dams to generate power in many remote locations (www.theguardian.com). These incidents, along with many other questionable business activities, have led to further scrutinisation of the ethics and business practices of mining organisations.

In spite of these recent disasters, the mining industry has been proactive in aligning itself with sustainability in attempts to change past behaviour and current perceptions (Jenkins, 2004). The adoption of sustainability reporting by mining companies has increased since the formation of the International Council on Mining and Minerals (ICMM) in 2001. In January 2005, the ICMM established standards of public reporting relating to sustainable development reporting (Sustainable Development News, 2005).

The ICMM initially comprised 16 leading mining companies. This number has since risen to include 21 companies and 25 national and regional mining associations (www.icmm.com). The variety of mining companies now adopting sustainability reporting

suggests each organisation will present its own unique perspective based on different contextual factors. Despite guidance from the ICMM, mining companies have their own expectations. Consequently, after meeting ICMM minimum standards, organisations have complete discretion regarding other publications and disclosure mediums. To this extent, the mining industry is one of many industries now embracing sustainability.

1.2.3 Sustainability evolution.

The variety of businesses that incorporate sustainability into their stakeholder and shareholder reporting within the Oceania region shows how common sustainability is in 21st century business. Examples of industries and firms include: the banking sector (Australia and New Zealand (ANZ) Banking Group, Commonwealth Bank of Australia); the mining sector (BHP Billiton, Newmont); car manufacturers (Ford Australia); energy providers (Origin, Pacific Hydro, Pacific Rubiales Energy Corp; breweries (Lion Nathan, Asia Pacific Breweries); communication providers (Telstra); airlines (Qantas, Air New Zealand); and, consumables suppliers (Coca Cola Amatil). Although this list is not exhaustive, it highlights the variety of companies that are prepared to report sustainability information in addition to their financial performance.

Historically, organisations have extended traditional financial reporting and legal requirements through various forms of social and environmental disclosures (Hines, 1991; Wilmshurst & Frost, 2000; O'Donovan, 2002). Choudhuri and Chakraborty (2009), for example, identified many developments and changes to the different approaches to reporting. Such changes go beyond the requirements of accounting standards and legislative requirements.

Advanced reporting approaches include: environmental accounting; social accounting; triple bottom line; and, corporate social responsibility (CSR) (Jenkins, 2004). Despite each approach being specific and unique, they all communicate additional information to shareholders. Fundamental differences between each approach can provide insight into only specific concerns, however, and so fail to address all issues. Approaches to measuring and assessing the impact of an organisation have evolved, with sustainability being the most recent and common approach adopted by many global businesses (Simnett et al., 2009), leading Warde (2011) to argue that sustainability is not a new concept when considering the environment and economics.

Warde (2011) looked at historical environmental management by organisations and found evidence of previous attempts to ensure longevity of natural resources. While business models gradually shifted from economic performance to environmental efficiencies, the organisational focus, however, reverted to profit when placed under growth pressures. The need to produce more to meet growing demand and maximise shareholder returns shifted priority back towards sustaining short-term production and focusing on returns (Warde, 2011). Warde highlighted issues that arise when the focus is driven solely by organisations themselves.

When measuring and comparing organisations, it is difficult for stakeholders to Identify a change in attitude on the part of organisations because stakeholders are reliant on external disclosures. While early researchers studied annual reports (see Hogner, 1982; Guthrie 1983; Guthrie & Parker, 1989), more recent studies have focused on separate CSR and sustainability reports (see Coetzee & van Staden, 2011; Fonseca, 2010; Jenkins & Yakovleva, 2006; Peck & Sinding, 2003; Perez & Sanchez, 2009) as formal disclosures targeted towards shareholders and stakeholders. Furthermore, researchers studying multiple organisations have to use secondary data due to the limited availability of and access to primary data.

The growing body of research has focused on the definitions, theories, and motivations behind sustainability (Deegan, Rankin, & Tobin, 2002; O'Donovan, 2002). Despite developments in sustainability research, sustainability is still far from being a unified concept. This lack of consensus is evidenced by the number of alternative definitions of sustainability (Prezzy, 1989; Johnston, Everard, Santillo, & Robert, 2007), and in the significant variability in sustainability disclosures by organisations (Jenkins & Yakovleva, 2006; Milne et al., 2009).

Kolk (2003) revealed that sustainability has grown as a practice and reporting tool. Its use has become more prevalent in business as resources have become scarcer. This investment in sustainability has occurred whilst businesses have sought growth opportunities, competitive advantages, and increased profits (Kolk, 2003). Sustainability can be used strategically to provide advantages to organisations and meet increased scrutiny from society when the business climate becomes more challenging and competitive (Aamodt, 2010; Audi, 2009). Integrating sustainability as part of a risk management strategy can have flow-on effects to the wider community. However, most organisations are strategically choosing where and how they implement sustainability in

an attempt to legitimise their activities. Nevertheless, sustainability has provided more information for stakeholders.

Greater access to material via the Internet and social media allows information and news to be shared and communicated globally (Paul, 2008). As a consequence, users of this information are more alert to and aware of organisations and their activities than ever before (Classen & Roloff, 2012). Without leaving their own homes, individuals can raise concerns over the level of care organisations show for the natural environment and society. Society at large, and more particularly vested stakeholders, can more easily access, share, and discuss financial information, nonfinancial information, and performance more quickly than ever before. Despite more information being available in a variety of formats, users of the information are, however, limited to the details released by organisations.

Greater information and awareness have also raised stakeholder expectations in terms of acceptable business activity and behaviour and have, in turn, created a circular pattern that has ultimately increased the level of stakeholder expectations. As organisations respond to stakeholders, they provide more information, which further raises expectations. Although Warde (2011) revealed previous failed attempts to integrate business and nonbusiness ideals, Warde (2011) and Simnett et al. (2009) both agreed that sustainability offered an extension of accountability for organisations and managers which went beyond shareholders to incorporate members of society and the environment. As the rise in sustainability has evolved, the literature has discussed two main approaches to it. These will now be considered.

1.2.4 Sustainability approaches.

The two approaches to sustainability both promote the ideals of the concept. The increase in sustainability in business has been matched with parallel growth in academic literature and published material (Choudhuri & Chakraborty, 2009; Slaper & Hall, 2011). While capital stocks and exchange is an inherent part of sustainability (Hediger, 1999; Ziegler & Ott, 2011), Hediger (1999) extended this area further by identifying that balancing capital conservation and conversion presents an underlying conflict when seeking sustainable development.

The willingness of society to exchange capital has led to divergent views on sustainability. This divergence has "culminated in the mutually exclusive concepts of

"weak" and "strong" sustainability" (Hediger, 1999, p. 1121). The extent of an organisation's commitment towards sustainability can either be nothing, or vary from a weak to strong position (Gray, Owen & Adams, 1996; Himley, 2010).

The short-term focus on sustaining organisational performance is grounded in the neoclassical economic model of weak sustainability (Gowdy & McDaniel, 1999; Francaschi & Kahn, 2003; Luckert & Williamson, 2005). Weak sustainability considers natural and economic capital as substitutes (Hediger, 1999). Weak sustainability allows natural capital to be consumed, provided it is converted to an equal or greater level of economic capital and total capital is preserved (Luckert & Williamson, 2005). Social capital forms the third component within this model. Provided the aggregate of the three components is maintained, an organisation or society can achieve weak sustainability.

Whilst this approach provides a simple and practical representation of sustainability, the model has a number of limitations. One such issue is the difficulty in placing a value on natural goods in a monetary-based economy (Getzner, 1999). A second limitation in the weak sustainability model is that natural capital levels can decline but still be sustainable, provided that they lead to equivalent levels of economic and social capital. Despite achieving sustainability, this approach does not guarantee the preservation of natural capital stocks. A third limitation is that whilst sustainability can be achieved by organisations, it is difficult to operationalise its achievement for society. This failure is an even greater issue for strong sustainability (Hediger, 1999). Hence, Getzner (1999) recognised that embeddedness is a significant issue when trying to implement stronger sustainability approaches in a society.

The approach that emphasises the maintenance of natural capital is referred to as strong sustainability (Francaschi & Kahn, 2003; Luckert & Williamson, 2005). Strong sustainability presents an alternative to weak sustainability (Neumayer, 2003; Ott, 2003). It requires a fundamentally different approach. Gowdy and O'Hara (1997) used a hierarchy approach when considering the different capitals. Under this model, economic capital is contained within social capital which exists within natural capital i.e., planet Earth. Getzner (1999) noted that the economy is part of a much larger system and so should not be the focal point of development.

While this alternative view provides a deeper level of sustainability, it does not provide practical and operational directions for organisations and society to achieve strong

sustainability (Hediger, 1999; Málovics, Csigéné, & Kraus, 2008). The diagram shown in Figure 1.1 below highlights the difference between the two approaches.

Figure 1.1. Weak and Strong Sustainability Comparison
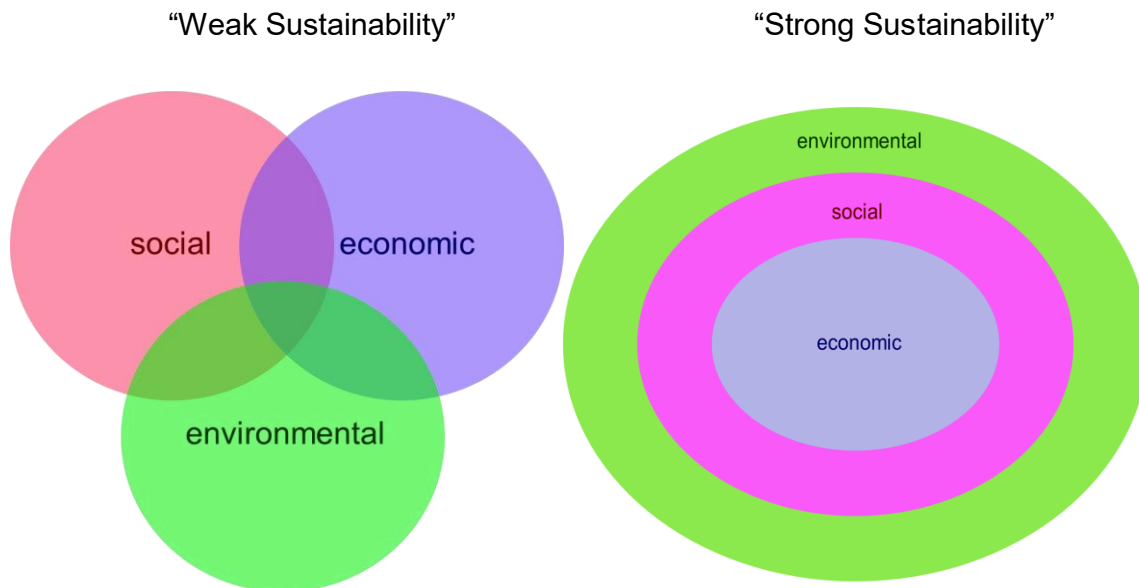
"Weak Sustainability"   "Strong Sustainability"

From "Weak sustainability and viable technologies" by Gowdy & O'Hara, 1997, *Ecological Economics*, *22*(3), p. 241

Strong and weak sustainability provide two unique approaches to achieving sustainability and sustainable development. They should not, however, be seen as alternative approaches, but rather as part of a continuum with nonsustainability at one end, weak sustainability somewhere in between, and strong sustainability at the other end (Robinson & Boulle, 2012). Hediger (1999) recognised that weak sustainability should be the minimum level for operationalising sustainable development. He specifically stated that "weak sustainability is not sufficient for sustainable development" (Hediger, 1999, p. 1128). Robinson and Boulle (2012) showed that weak sustainability offers a positive step forward for organisations wishing to embrace a culture that supports strong sustainability. This view recognises weak sustainability as an improvement; however, it represents a positive step only if the organisation continues to make progress towards strong sustainability.

1.2.5 Sustainability practicality for mining.

Robinson and Boulle (2012) questioned the role of organisations' embracing sustainability practices, as society is often left questioning what is truly being sustained

when an organisation adopts sustainability into its operations or reporting (Classen & Roloff, 2012). Weak sustainability does not preserve and maintain natural capital as it can be replaced by greater emphasis on economic performance (Hediger, 1999).

Alternatively, a strong sustainability approach does not place emphasis on economic development. Economic development is constrained by the larger social and environmental layers within which it exists. A strong approach requires a wider focus and very few organisations can achieve a strong sustainability approach. Therefore, most mining organisations are working within a weak sustainability framework (Himley, 2010).

Peck and Sinding (2003) described mining as the most socially and environmentally destructive activity possible. They believe the extraction of nonrenewable resources from the environment for the purposes of converting them into economic capital means, by its very nature, that mining cannot reach the ideals of strong sustainability. The mining industry is precariously caught between a society that has become reliant on the materials it extracts through unsustainable methods and a new society concerned about the impact of organisations on stakeholders. The strong sustainability model is inconsistent with the mining process and the removal of nonrenewable resources (Kommadathm, Sakar, & Rath, 2012; Prior et al., 2012). Mining is, however, not the only industry struggling with strong sustainability as the issue appears to go beyond that of a single industry.

Jain and Jain (2013) argued that measures need to change in order to achieve strong sustainability, changes in development, and national performance. The current financial-based Gross Domestic Product (GDP) regime focuses solely on economic, rather than sustainable, measures. Jain and Jain (2013) identified that weak sustainability focuses on individual aspects of sustainability and the substitution options available to each societal member. By contrast, strong sustainability requires societal members' working together and respecting the natural world as well as adopting appropriate measures and indexes to reflect these changes (Getzer, 1999; Jain & Jain, 2013).

Organisations are challenged to think and behave in a manner consistent with strong sustainability; yet organisations alone cannot create the difference required. Individually each organisation can control operational behaviour to be consistent with either weak sustainability or nonsustainability (Robinson & Boulle, 2012). This conflicting choice has also influenced the reporting requirements and expectations of organisations.

The need for, and extent of, reporting on environmental and social issues has been widely debated (Málovics, Csigéné, & Kraus, 2008; Simnett, Vanstraelen, & Chus, 2009). Discussion has extended to include the level of an organisation's involvement with stakeholders beyond economic capital. However, the lack of structure and a formal definition of sustainability highlight the difficulty faced by businesses (Franceschi & Kahn, 2003). This is relevant for the mining industry, an industry operating on the edge of society's expectations (Jenkins, 2004; Fonseca, 2010; Prior et al., 2012).

The mining industry's involvement with sustainability and its ability to operate sustainably is easily questioned given the apparent paradox between these two issues. However, it is stakeholders' uncertainty surrounding acceptable social and environmental behaviours that provides a greater challenge for the mining industry (Peck & Sinding, 2003; Jenkins, 2004; Whitmore, 2006; Watson, 2008; Perez & Sanchez, 2009; Fonseca, 2010; Himley, 2010; Prior et al., 2012).

In brief, focusing specifically on the mining industry provides a unique perspective on sustainability because of that industry's inherent conflict with (strong) sustainability ideals. Considering the language, concepts, and themes within the sustainability disclosures will reveal how organisations and the industry have gone about adopting sustainability. Furthermore, the similarities and differences in this industry's disclosures will help to provide insight into the extent and nature of the mining industry's commitment towards sustainability. The next section specifically outlines the purpose of this study.

1.3 Research Purpose and Objectives

The purpose of this study is to explore the sustainability reporting practices of mining companies in light of the paradox between sustainability and mining within that industry. Through studying its sustainability reporting, this research will allow greater understanding of what sustainability means to the mining industry.

The term sustainability has been widely used in the disclosure practices of many organisations within the mining industry . Through an examination of their sustainability reports this study seeks to understand mining organisations' application and commitment towards sustainability. In so doing, this inquiry will also provide a unique analysis of the mining industry's commitment towards sustainability through its use of innovative research methods. It is hoped this research will provide a new understanding of the sustainability practices of mining companies.

The sustainability reports of global mining companies will be analysed using computer-aided content analysis software to capture their language, concepts, and themes. Comparing the reports of mining companies will identify similarities and differences in their reporting practices. Sustainability reports over a four-year period will be analysed to reveal developments and trends in recent reporting practices. The primary research objective is to achieve a greater understanding of sustainability reporting within the mining industry.

The primary objective will be achieved by exploring the following research questions:

1. What are the dominant and common concepts and themes within mining sustainability reports?
2. What are the similarities and differences in the sustainability reporting practices of the leading mining companies?
3. How does the sustainability reporting of mining companies change over the period of the study?
4. Are there differences in the sustainability reporting of established mining companies compared to new mining companies?
5. What is the overall current state of sustainability in the mining industry and how has this changed from earlier studies?

1.4 Methodology and Method

This study adopts a pragmatic approach, applying mixed methods to determine the current level and quality of sustainability reporting in the global mining industry. The research methodology adopted is based on qualitative and quantitative analyses of sustainability reports from the mining industry.

The initial content analysis will identify dominant themes and concepts. This process is based on the qualitative paradigm, as it attempts to extract the themes and concepts from within the sustainability reports. Statistical tests will be applied to the data to compare and contrast the different organisations studied. The additional analysis applies quantitative methods to identify central concepts within the reports. The practical steps are explained in greater detail below and in Chapter 3.

The global mining companies selected for this study comprise members of the International Council on Mining and Minerals (ICMM) group and other nonmember organisations. ICMM members were further split into those which were members prior to

2009 (existing) and members who joined in 2009 or thereafter (new). Organisations were categorised into three groups according to ICMM membership. The three groups are:

1. Existing members ─ members of ICMM prior to 2010;
2. New members ─ members that joined between 2010 and 2013; and
3. Nonmembers.

A total of 25 global mining companies were selected for this study. The period 2010 to 2012 was selected to allow comparison over a four-year period collectively, and individually at a company level. Mining companies were chosen from different countries and regions to ensure representation of different societies and economic conditions; this strategy allowed for further analysis between alternative variables. Once a suitable sample had been selected and the sustainability reports obtained in PDF format, the sample reports were converted into a format that could be read by the software program.

A computer-aided content analysis software program was used to evaluate the sustainability reports. Leximancer software was chosen to identify the frequency and co-occurrence of words within text documents. The software aims to reveal prominent words, themes, and concepts, as well as links and associations between the words (Smith & Humphreys, 2006). An analysis of the key terms and concepts within the reports was conducted and these key terms and concepts were then further analysed across different companies to reveal similarities and differences between companies.

1.5 Scope

This research covered the 2010 to 2013 sustainability reports of 25 mining companies. The mining industry was selected because of the inherent contradiction between sustainability and the nature of mining, a paradox that becomes even more apparent given that most companies in this industry are extracting nonrenewable resources. Indeed, Whitmore proposed that sustainability in mining has no effect on mining practices and makes no material changes to operations.

The apparent clash between mining and sustainability should provide rich and meaningful data that will allow greater insight into and comparison of the industry's reports and actions. The mining industry was selected on the basis that it is a truly global industry with operations in a wide range of countries and regions and at different stages of development.

Organisations that are members of the ICMM are required to implement the ICMM Sustainable Development Framework which is based primarily on GRI reporting standards adapted for the mining and metals sector (icmm.com, 2012). Nonmembers are not committed to these reporting standards or to any sustainability framework. Nonmembers can voluntarily use GRI with the mining sector supplement, an alternative published method, or with an internally developed reporting framework.

This study focuses primarily on sustainability reports. To date, the literature has tended to concentrate on sustainability disclosures in annual reports (Yongvanich & Guthrie, 2007). This study, therefore, offers alternative insights by focusing on the concept and themes within sustainability. When compared with annual reports, company websites, media disclosures or any other form of sustainability disclosure, sustainability reports offer the best place to gauge an organisation's view on sustainability. Accordingly, organisations that produce integrated sustainability and financial reports will be recognised and compared with organisations producing separate reports.

1.6 Limitations

The exploratory nature of this research leads to an inherent level of subjectivity in various different areas. Hence, there are a number of limitations to this study. A brief summary of these limitations is presented here and discussed in greater detail in Chapter 6.

This research uses a sample of the sustainability reports of large mining companies. The results will reflect the practices of these companies, they may perhaps be extendable to other mining companies. That said, this research does not consider sustainability reporting in other industries. Finally, although the chosen sustainability reports are used to describe operations in different geographical locations, they should not be seen as representative of all organisations' sustainability reporting within those regions.

The focus of this study of 25 companies and their sustainability reporting is limited to a specific four-year period. Thus, it does not reflect any disclosures or changes before or after the selected period. Furthermore, no historical data is used that would allow comparisons to be made across these organisations; this research is concerned only with the recent sustainability reporting practices of these particular 25 mining companies. This research does not seek to examine the changes and developments in sustainability reporting, but rather focuses on the language, themes, and concepts within recent

sustainability reports. The sample will reveal dominant concepts and common themes across the industry in current reporting only.

The content analysis used in this research was conducted electronically using Leximancer software, a computer-aided content analysis program. This software enabled the review and analysis of a large number of companies' reports in a relatively short period. The accuracy and nature of the analysis is limited to the scope of the software and the parameters set by the user.

Despite the limitations of the study, it offers a valuable contribution to the research on sustainability reporting globally. It also provides insight into variations in the use of sustainability between different countries and regions; a lack of such data might account for some inconsistencies in earlier research.

1.7 Structure of thesis

The remaining structure of this report is outlined below:

Chapter 2   **Literature review:** This chapter provides a review of the sustainability literature. It examines the origins of sustainability and the developments in recent decades, reviews the many definitions of sustainability, and outlines sustainability for the purpose of this study. This chapter considers the role of stakeholder theory and legitimacy theory in sustainability disclosures. The chapter also examines research in sustainability reporting in the mining industry.

Chapter 3   **Research methodology and method:** This chapter presents an overview of the methodology adopted in this study. This chapter also discusses the use of Leximancer software, a computer-aided content analysis program used for data capture and analysis.

Chapter 4   **Results and findings:** This chapter presents the results obtained from applying Leximancer software analysis to the sustainability reports of the sample mining companies' reports. The findings include subsequent analysis based on the Leximancer results.

Chapter 5   **Discussion:** This chapter discusses the findings of the study and relates these to the themes identified in the literature review.

Chapter 6 **Summary, conclusions, and future research:** This final chapter summarises the research findings and concludes the research. The chapter discusses the limitations of this research in greater detail and suggests opportunities for future research.

Chapter 2 LITERATURE REVIEW

2.1 Introduction

There is general consensus among researchers that sustainability in the business environment is becoming increasingly common, and more complex (Deegan, 2002; Jenkins & Yakovleva, 2006; Kolk, 2003; Mansdorf, 2010; Perez & Sachez, 2009; Slaper & Hall, 2011; Yongvanich & Guthrie, 2007), and, according to McPeak and Tooley (2008), sustainability has grown rapidly in both the academic and business fields.

Sustainability has emerged as a leading and topical issue in practice (Mansdorf, 2010). Academic research has also evolved with studies focusing on sustainability concepts, theoretical aspects, practical developments, and its applications (Deegan, 2002; Guthrie & Parker, 1989; Patten, 1991; Slaper & Hall, 2008; Watson, 2011).

With the potential to revolutionise the business environment, sustainability has many internal and external advantages for organisations (Mueller, 2005; Timlon, 2011). Such advantages have flow-on effects that benefit the wider community (Kolk, 2003). Despite the potential benefits, sustainability has not materialised, in practice, as some had envisioned, and its relative business uptake has been low (Ballou, Heitger, & Landes, 2006; Jimena, 2006; Kolk, 2003).

Numerous obstacles have prevented the widespread implementation of sustainability (Kolk, 2003; Adams & McNicholas, 2007; Aras & Crowther, 2009; Isaksson & Stemimle, 2009). Limited knowledge and understanding of sustainability and its practical relevance in decision-making are common obstacles (Adams & McNicholas, 2007). Other obstacles include diversity in reporting topics, which creates uncertainty as to what should be included in reporting (Kolk, 2003); the initial investment of time and resource to establish sustainable practices and reduce risks (Aras & Crowther); financial costs and opportunity costs to the organisation; and finally, the strength of the relationship between reporting guidelines and reality (Isakasson & Stemimle, 2009). The practical implication of these obstacles has resulted in a relatively slow and calculated approach to sustainability on the part of organisations (Jimena, 2006; Kolk, 2003).

Organisations vary in how they embrace sustainability and report on their sustainable performance and development (Simnett, Vanstraelen, & Chua, 2009; Dilling, 2010). Sustainability disclosures are increasingly common for organisations and industries that

are perceived to have negative externalities (Kolk, 2003), and the mining industry has been particularly proactive in adopting sustainability (Peck & Sinding, 2003; Jenkins, 2004; Whitmore, 2006; Perez & Sanchez, 2009; Himley, 2010).

The already mentioned paradox inherent in the relationship between mining and sustainability creates many areas for investigation. The purpose of this section is to understand the developments in sustainability and disclosure, and to see how these developments are being implemented in mining organisations today. To that end, this literature review has been structured into three sections.

The first section reviews the evolution of sustainability. It discusses the multiple definitions of sustainability and the difficulty these create for its implementation. It covers research on the growing popularity of the sustainability concept that has seen organisations invest in sustainable processes and incorporate sustainability into their external reporting. This section will provide a framework for understanding sustainability in global mining organisations.

The second section covers the main theories underpinning sustainability, and social and environmental disclosures. This section looks at the research on the developments of such disclosures. It focuses on the most dominant stakeholder and legitimacy theories and concludes with a justification of the main theory used in this study.

The final section concentrates on the mining industry and the incorporation of sustainability into its disclosures and activities. Specifically, this third section considers the integration of social, environmental, and sustainability concepts in order to provide a better understanding of how the industry has advanced. This section uses concepts and themes already studied to provide a foundation for this research. Before focusing on mining, some more general concepts and developments of sustainability are reviewed.

2.2 Sustainability concept

Section 2.2 aims to present a general overview of the evolution of sustainability. Specifically, it recognises the multiple definitions of sustainability and the difficulty of implementing sustainability in practice. A review of this literature will provide greater understanding of sustainability and in so doing act as a foundation for a further review of the concept within a mining context.

It is not the purpose of this thesis to define sustainability or thoroughly review the many definitions of it. Rather, through the study of sustainability in mining, it aims to illustrate that sustainability has different meanings which depend on varying factors and contexts. Understanding sustainability disclosures begins with the catalyst for sustainability – the 1987 Brundtland Report.

2.2.1 Definitions of sustainability in the literature

The rise in sustainability is often credited to the World Commission on Environment and Development's (WCED) 1987 Brundtland Report titled *Our Common Future* whose definition of sustainability has become widely accepted, cited, and quoted (Franceschi & Kahn, 2003; Málovics, Csigéné, & Kraus, 2008; Stone, 2003). In terms of sustainable development, the United Nations report defined sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report, 1987, p. 24). Studies have continued to adopt and recognise the Brundtland definition; these include Getzner (1999), Hediger (1999), Franceschi and Kahn (2003), Tregidga and Milne (2006), Aras and Crowther (2008), Robinson and Boulle (2012), and Jain and Jain (2013).

The Brundtland definition has not been universally accepted as a definition of sustainability (Buhr & Reiter, 2006). Lindsey (2001, p. 1), for example, critiques the Brundtland definition as "so general that it defies practicality" and "a concept so general that everyone can agree to it" (as cited in Davidson, 2011, p. 351). The Brundtland definition has also been described as vague and meaningless (Lindsey, 2001; Davidson, 2011). This criticism has led to various attempts to clarify or portray sustainability in a different light or through an alternative agenda.

A number of alternative definitions have been used within academic literature since the Brundtland definition (Johnston, Everard, Santillo, & Robert, 2007; Prezzy, 1989). Pezzey (1989) provided reference to 35 definitions in the years immediately following the release of the Brundtland Report. When extended to cover a further 2 years, Johnston et al. (2007) found "around 140 alternative and variously-modified definitions of 'sustainable development' emerged" (p. 60). However, the most common, and the most commonly used, definition for sustainability still remains the 1987 Brundtland definition (Franceschi & Kahn, 2003; Malovis et al., 2008).

The number of alternative definitions of sustainability shows that there is little consensus amongst researchers (Buhr & Reiter, 2006; Malovis et al., 2008). Johnston et al. (2007)

note "it has been estimated that some 300 definitions of 'sustainability' and 'sustainable development' exist broadly within the domain of environmental management and the associated disciplines" (p. 60). Table *2.1* below provides a summary of the variety of definitions:

Table 2.1. Definitions of sustainability.

Year	Publisher	Definition of sustainability
1987	United Nations — Brundtland Report	"the ability to meet the needs of the present without compromising the ability of future generations … to meet their own needs"
1990	Reed and DeFillippi (in Aras & Crowther, 2008)	"Continuity"
1993	Hawken (in Aras & Crowther, 2008)	the carrying capacity of the ecosystem and input-output model
2000	Caneque	"satisfy our present needs without compromising the needs of future generations"
2003	Kaptein and Van Tulder	"Sustainable development requires that a company's performance be valued positively by the stakeholders in financial, environmental, and social terms."
2003	Zwersloot,	continuous improvement (in Aras & Crowther, 2008)
2005	Labuschagne, and Brent	"adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today, while protecting, sustaining and enhancing the human and natural resources that will be needed in the future"
2006	Carroll and Buchholtz	"The characteristic of an entity, such as an economic or environmental system, that is related to its ability to exist and flourish over an acceptably long period of time."
2007	Johnston, Everard, Santillo, and Robert	They give dictionary definition: "an activity or action [that] is capable of being sustained" (continued indefinitely) and a number of alternative definitions. Alternative 1: "harvesting or using a resource so that the resources is not depleted or permanently damaged." Alternative 2: "a lifestyle involving the use of sustainable methods" Alternative 3: "Sustainability demands ways of living, working and being that enable all people of the world to lead healthy, fulfilling, and economically secure lives without destroying the environment and without endangering the future welfare of people in the planet."

2008	Aras and Crowther	"Society must use no more of a resource than can be generated."
2009	Audi	"A business or business activity may be called sustainable if, functioning roughly as it does, it can continue indefinitely."
2009	Chouduri and Chakraborty	"Sustainability has traditionally emphasized the environment, although the focus of achieving sustainability encompasses other factors, such as economic development and social equity."
2010	Artitach, Lee, Nelson, and Walker	They interpret the 1987 report thus: "Corporate sustainability is considered to be a business and investment strategy that seeks to use the best business practices to meet and balance the needs of current and future stakeholders."

The variety of definitions in Table *2.1* indicates how the concept of sustainability is widely interpreted. Therefore, without complete agreement on a single definition, there remains significant diversity and debate within the literature on what sustainability is and what constitutes sustainable development (Malovis et al., 2008).

Nonetheless, acknowledging this diversity of definitions allows for comparisons which identify common threads. Franceschi and Kahn (2003) state that many of the earlier definitions shared similar themes and ideals. Hediger (1999) identifies three key concepts within the earlier definitions of sustainability. These are: equity, needs, and limitation. Elkington (1998) allows for evolution in the definition, which is consistent with the many new components that have been added to the myriad definitions within the literature.

More definitions now incorporate a long-term economic growth component (Franceschi & Kahn, 2003). One observation from the definitions of sustainability in Table *2.1* is the intensification of economic references since 2003. The economic element is not the only difference, however. Alternative philosophical and ethical perspectives on society and its members are creating differences between definitions (Hediger, 1999; Smith & Sharicz, 2011).

The presence of multiple definitions with alternative foci suggests sustainability means different things to different people (Johnston et al., 2007; Aras & Crowther, 2008). Attempting to define and measure sustainability at a global level has, consequently,

proven extremely difficult and, as Gray and Milne (2002) point out, taking this attempt to an industry or organisational level is even more challenging.

In light of the numerous definitions, Caneque (2000) provides an alternative point of view by identifying what sustainability is not:

- Economic growth without environmental concerns
- Environmental conservation at the expense or sacrifice of basic human needs
- Social programmes that lack a responsible wealth-creating mechanism to support society

However, the ease of defining unsustainable concepts and behaviours does not easily transfer into a definition of sustainability. According to Caneque, progress is, however, being made: "organizations are becoming more precise every day in defining not only what is sustainable, but also what will lead to sustainability" (2000, p. 145). The unsustainable behaviour historically seen in business is now queried through investigative journalism, increased awareness, and growing public influence to force change (Caneque, 2000). As predicted by Elkington (1998), definitions have evolved to reflect the changes, attitudes, and behaviours within the current business environment.

Elkington (1998) asserts that the definition of sustainability should not be static and that the developments in recent years indicate the definitions used in the past may not be relevant for the 21st century. Society and businesses have been forced to keep up to date, which has made them more adept in understanding what sustainability means and evolving conceptualisations of it (Caneque, 2000). However, understanding the need for definitions of sustainability to evolve with society and technology presents an even greater challenge for those trying to implement sustainability.

In the absence of agreement or a widely accepted and recognised definition, the potential for alternative definitions with different perspectives remains an ongoing concern. When Smith and Sharicz (2011) explored this issue their research revealed "a lack of a clear definition of sustainability which set in motion a whole systemic dynamic" (p. 73). This dynamic has practical implications that affect the way organisations and society embrace sustainability (Franceschi & Kahn, 2003; Smith & Sharicz, 2011). The next section looks at the main approaches to sustainability.

2.2.3 Dominant approaches to sustainability

Sustainability is becoming increasingly common in the global business environment (Simnett, Vanstraelen, & Chua, 2009; Dilling, 2010; Hrasky, 2012). Sustainability's emergence in modern business has grown from the early academic research by Robert Solow and John Hartwick on 'weak sustainability' in the 1970s (Neumayer, 2003). Since the 1970s, 'strong sustainability' has evolved as an alternative view with ideals that extended the views of weak sustainability and led to subsequent debate and ultimately two distinct approaches toward sustainability (Mansdorf, 2010; Neumayer, 2003; Slaper & Hall, 2011).

The increase in sustainability in business has been matched with parallel growth in related academic literature and published material (Choudhuri & Chakraborty, 2009; Slaper & Hall, 2011). Slaper and Hall (2011) note this growth in their study on triple bottom line (TBL) reporting: "Academic disciplines organized around sustainability have multiplied over the last 30 years" (p. 4). Research has focused on understanding sustainability and developing models to measure commitment and developments. Early research focused on the direct exchange between different capitals.

Capital stocks and exchange is an inherent part of sustainability (Hediger, 1999; Ziegler & Ott, 2011). Hediger (1999) extends this idea further by identifying that the underlying conflict of sustainable development involves balancing conservation and conversion. This balancing act creates inevitable challenges and trade-offs between sustainability and development. The willingness of society to exchange capital has led to divergent views on sustainability. Hediger (1999) recognises this situation has "culminated in the mutually exclusive concepts of "weak" and "strong" sustainability" (p. 1121). However, the reality is that the extent of an organisation's commitment towards sustainability can be either nothing, or vary from a weak to strong position (Grey, Owen & Adams, 1996; Himley, 2010).

Understanding the distinction between 'weak' and 'strong' sustainability is fundamental to reconciling the differences between attitudes, approaches, research, and reporting of sustainability. The next two subsections provide additional insight into the two approaches.

2.2.2.1 Weak sustainability

Weak sustainability is grounded in neoclassical economic theory (Hediger, 1999; Getzner, 1999; Luckert & Williamson, 2005). Weak sustainability is concerned with maintaining the same level of aggregate economic capital and natural capital (Hediger, 1999). This approach allows sustainability to be achieved, provided natural capital is converted to economic capital and aggregate capital stocks are maintained (Hediger, 1999; Luckert & Williamson, 2005).

Capital stocks are made up of natural capital and man-made capital. Getzner (1999) explains that the "weak sustainability rule presupposes that natural capital and man-made capital can be traded off against each other. As long as the "worth" of the capital, regardless of its composition, is non-decreasing over time, sustainability is achieved" (p. 171). Weak sustainability attempts to measure and value natural resources and capital to gauge if total capital is maintained within a weak sustainability model.

A slight variant on weak sustainability is the substitution model. The notion of substitutability is central to weak sustainability (Getzner, 1999; Victor, 1991). The model below shows how each of the three elements of sustainability constitutes a separate element. Once dollar values are placed on capital stocks, organisations can practise weak sustainability through capital exchange. The substitution model for weak sustainability is highlighted in Figure *2.1* below.

Figure 2.1. Weak sustainability model.
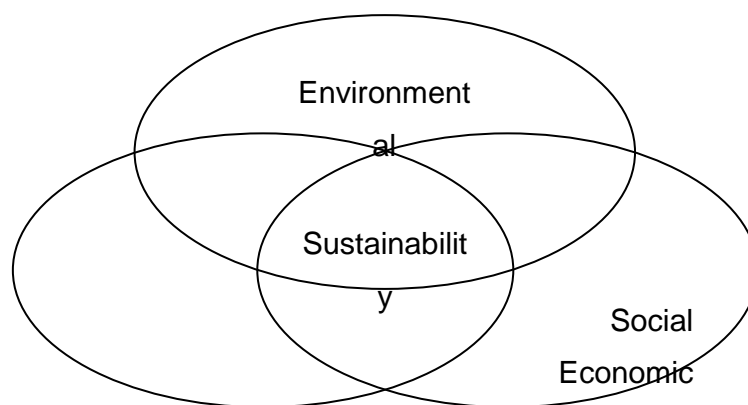
From "Building information modelling (BIM) for sustainable building design" by Wong and Fan, 2013, *Facilities, 31*(3/4), p. 140.

Converting natural capital into equivalent economic and social capital maintains the overall capital and is, therefore, sustainable. Sustainability is not achieved when there is an exchange between two elements. If natural capital is substituted for economic capital, but causes a negative impact on social capital, sustainability is not achieved within the model.

Sustainability growth is achieved when there is greater substitution between the three capitals. In the case of Figure *2.1* above, the central area in the model labelled "Sustainability" would increase and the remaining areas would decrease.

The model shows how sustainability can be achieved; however, it neglects the fact that, once removed, natural capital cannot be replaced easily with social or economic capital. As a result, weak sustainability has numerous shortcomings that have prevented it from becoming widely adopted by organisations (Getzner, 1999; Hediger, 1999; Luckert & Williamson, 2005).

Luckert and Williamson (2005) recognise that one fundamental issue with the weak sustainability model is that natural capital stocks will continue to decline despite satisfying the requirements of the model. According to the model, however, sustainability can be achieved despite the depletion of natural capital stocks over time if they are converted into economic capital.

A further critique of the weak model is the lack of distinction between renewable and nonrenewable natural capital (Hediger, 1999). Hediger (1999) criticises weak sustainability because renewable resources are not further separated into those that are easily harvested and those that are not directly used. If the nonrenewable resources are preserved, the focus starts moving away from weak sustainability into a stronger approach.

Further issues remain around how capitals are measured. Getzner (1999) critiques the economic and natural capital indicators used in weak sustainability as unrealistic. Even with complicated models used to ascertain the economic value derived from natural capital, comparing different types of capital is not as straightforward as suggested.

Despite such theoretical issues around weak sustainability, the model did provide ways for organisations to incorporate the three elements into practice and reporting. Elkington (1998) presented the concept of triple bottom line (TBL) in his book *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*.

TBL reporting introduced social and environmental elements to the traditional financial reporting of organisations (Choudhuri & Chakraborty, 2009; Slaper & Hall, 2011). TBL reporting has been recognised as a method of reporting on sustainability activity (Slaper & Hall, 2011; Gill, Dickinson & Scharl, 2008). Savitz (2006) defines the purpose of TBL reports as to "capture the essence of sustainability by measuring the impact of an organization's activities on the world . . . including both its profitability and shareholder values and its social, human and environmental capital" (as cited in Slapper & Hall, 2011, p. 4).

Weak sustainability provides greater responsibility towards the natural environment and society. Practically, through TBL reporting, organisations shifted their focus away from pure economics to encompass a wider focus which had been ignored previously. While this weak approach increases the responsibilities and considerations of business towards their immediate stakeholders, it does not deliver on all the ideals of sustainability.

2.2.2.2 Strong sustainability

One alternative to the weak sustainability approach, known as strong sustainability, emphasises the maintenance of natural capital (Francaschi & Kahn, 2003; Luckert & Williamson, 2005). Strong sustainability requires a fundamentally different approach to sustainable development (Neumayer, 2003; Ott, 2003). Strong sustainability places greater emphasis on natural and social capitals (Francaschi & Kahn, 2003; Gowdy & O'Hara, 1997; Luckert & Williamson, 2005; Ott, 2003).

Gowdy and O'Hara (1997) apply a hierarchy approach when considering different capitals. Under this model, economic capital is contained within society's social capital; it exists within natural capital i.e., the natural matter of planet Earth. Getzner (1999) notes that the economy is part of a much larger system and should not be the focal point of development. *Figure 2.2* below illustrates the relationship between the three different elements in a strong sustainability model.

Figure 2.2. Strong sustainability model.
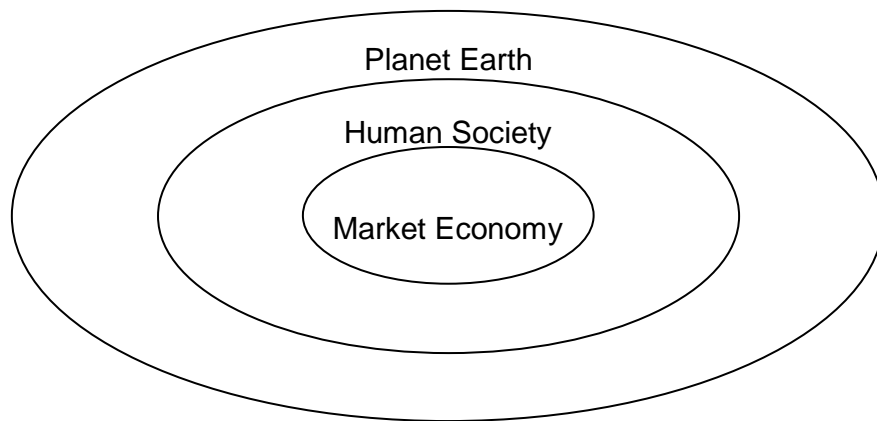
From "Weak sustainability and viable technologies" by Gowdy & O'Hara, 1997, *Ecological Economics*, *22*(3), p. 241.

Strong sustainability is concerned with maintaining the same level of natural capital and environmental assets overall (Hediger, 1999). This alternative approach is often referred to as ecological economics (Getzner, 1999) and includes environmental conservation (Hediger, 1999). Under a strong sustainable model, resource use is limited to prevent irreversibility and protect future flows and benefits (Luckert & Williamson, 2005).

Ziegler and Ott (2011) use 'sustainability science' to study the contention between weak and strong sustainability. They concluded from their analysis that greater interaction between sciences can promote deeper and more comprehensive questioning on real work and ethical situations. Through their analysis, which included different sciences and nonsciences, they found a "convincing case for strong sustainability" (Ziegler & Ott, 2011, p. 31). Strong sustainability allows growth and development (as identified in the WCED Brundtland definition) without compromising society and the environment.

Strong sustainability allows for a deeper and truer interpretation of sustainability, but does not offer a practical or operational direction for organisations to easily achieve and realise the full benefits of the approach (Getzner, 1999; Hediger, 1999; Malovis et al., 2008). Getzner (1999) recognises that embeddedness is a significant issue when trying to implement stronger sustainability approaches in a society. To achieve the advantages of strong sustainability, a greater level of commitment and collective change to consumption and development is required.

Understanding how to make the change is not simple; indeed, it provides many challenges for society (Getzner, 1999; Málovics, Csigéné & Kraus, 2008). The benefits

of strong sustainability are offset by the difficulty in realising the concept for organisations and society. In contrast, weak sustainability offers a more comprehensible approach, but it lacks the full commitment and benefit of strong sustainability. Both approaches share similar aspects important to improving current conditions and behaviours; however, the practicability of attaining weak, let alone strong, sustainability has not yet been demonstrated. Given the difficulty of changing society, it remains to be seen if sustainability will survive, or if something else will present itself as a viable alternative to it. The similarities between strong and weak have led to different interpretations and solutions and these will be considered next.

2.2.2.3 Alternative approaches

Malovis et al. (2008) acknowledge "it is difficult to operationalize and measure strong sustainability in practice on the micro (e.g. company) level" (p. 910). Understanding the ecological position of sustainability and the absence of guidelines for operations present a significant challenge for organisations (de Groene & Hermans, 1998; Malovis et al., 2008). Gerbens-Leenes, Moll, and Schoot Uiterkamp (2003) take things a step further by recognising that measures for strong sustainability in a system's perspective do not exist.

Johnston, Everard, Santillo, and Robert (2007) identifies an absence of an all-encompassing definition of sustainability. They acknowledge the work of Karl-Henrik Robert who took the heuristic approach to identify principles of sustainability. This approach, labelled The Natural Step Framework (TNS), lays out specific operational sustainability principles that aim to eliminate society's contribution to:

1. systematic increases in concentrations of substances from the Earth's crust;
2. systematic increases in concentrations of substances produced by society;
3. systematic physical degradation of nature;
4. conditions that systematically undermine people's capacity to meet their needs. (Johnston et al., 2007)

This alternative framework for sustainability attempts to integrate the capital elements of society, the economy, and the environment (Johnston et al., 2007). When defining and operationalising sustainability, the framework specifically recognises the impact society has had on the natural environment.

After taking issue with the existing sustainability models, Maler (2008) developed a quantitative model to operationalise sustainable development. The model is used to measure the resilience of our ecosystems. This approach attempts to test current levels against a future point that ultimately forces a change in a regime. The model incorporates the present value of future net benefits and the notion that, to achieve sustainability according to the Brundtland definition, wealth from one generation is transferred through capital stocks to later generations. These stocks include man-made capital, natural capital, and human capital.

Maler explains, "the present generation should save so much that the resources left to the next generation will enable them to reach at least the same welfare as the present generation are enjoying" (2008, pp. 18-19). For the purposes of the model, development is sustainable when the difference between capital stocks in two periods is positive. This approach attempts to model many difficult components of a complex and integrated system and accounts for complexity by applying a 'drift term' to include all external factors.

More complex and complete models can be seen in other studies including Dasgupta and Maler (2000), Arrow, Dasgupta, and Maler (2003), and Maler, Li, and Destouni (2006). These studies all attempt to measure sustainability and the global system using complex models designed to gain further understanding of the ecosystem. The complexity of the variables and the relationship between them help to provide greater understanding of sustainability. However, the complexity of these models also prevents them from becoming viable mainstream solutions to the problem of sustainability.

Approaches to sustainability such as those mentioned above attempt to provide more universal and quantifiable methods. They require increased detail and complexity in order to achieve holistic views to measure sustainability. Whilst current methods appear to offer a solution, without quantitative support, it is unknown if they will ultimately influence or alter the ecosystem or what role a single organisation can play within a larger system.

2.2.2.4 Sustainability approaches summary

There is an inherent trade-off between sustainability approaches. Weak sustainability provides a practical and achievable approach to sustainability. The model is relatively

straightforward and provides an improvement on traditional business models which focus solely on financial and economic objects.

Strong sustainability attempts to capture the ideals of the original Brundtland definition of sustainability to ensure that development does not exploit finite resources. However, it is difficult for individual societal members and groups to achieve those standards. Organisations, as members of society, are limited by the reach of their influence; this limitation makes operationalising strong sustainability a difficult task. To achieve strong sustainability, a collaborative change is, therefore, required.

More complex approaches to sustainability exist but move beyond the individual and take a more collective approach. On the one hand, these models raise important questions about what sustainability is and they attempt to quantify change and development. On the other, however, the complexity and practicality of these approaches make them less viable for organisations attempting to embrace sustainability.

Regardless of the theoretical differences, the practicality of sustainability remains a significant challenge, a challenge that has become evident as organisations attempt to operationalise sustainability.

2.2.3 Sustainability in practice

A number of studies (see Deegan & Gordon, 1996; Gray, Javad, Power, & Sinclair, 2001; Jones, Frost, Loftus, & van der Laan, 2007; Morhardt, 2010; Patten, 1991; Patten 1992) recognise that only a small number of organisations actively participate in and report on sustainability. These studies have tended to focus on the types and characteristics of organisations that implement or integrate sustainability. To support or argue their theories, these researchers have generally relied on the variety of sustainable disclosures or equivalent reports produced by companies to measure social and environmental performance (Yongvanich & Guthrie, 2007).

Initial studies identified that firm size, industry, and financial performance were all positively associated with sustainability (or equivalent environmental and social) disclosure (Deegan & Gordon, 1996; Gray et al., 2001; Jones et al., 2007; Patten, 1991; Patten 1992). Follow-up studies have, however, revealed that predicting sustainability disclosure is more complex, with other factors influencing reporting.

Kolk (2003) initially, and later supported by McPeak and Tooley (2008) and by Aras and Crowther (2009), found evidence that large organisations are more likely to produce sustainability reports. The finding is important when considering this reporting, as large organisations will have greater access to resources that allow them to produce sustainability reports. Aras and Crowther (2009) note that most large companies included some form of sustainability in their external reporting. Kolk (2003) finds not only that large organisations were more active in disclosing nonfinancial information, but also that they were more visible with their disclosures.

Whilst size was a common factor, it was not generalisable as regards size, variations were found between industries (Deegan & Gordon, 1996). Morhardt (2010) extends this finding further, concluding that size was not a simple linear indication of sustainability. Morhardt (2010) concludes from a study where a sustainability index was created for measuring and comparing 452 companies that "as corporate size reaches a certain threshold, sustainability reporting becomes independent of it" (p. 437). This assertion was based on the finding that when stronger Fortune 1000 companies were included in an analysis, the correlation between sustainability ratings and revenue weakened once revenue reached a threshold. This result indicated that once a revenue threshold is achieved, size and profitability have less of an impact on predicting sustainability involvement.

Consistent with the size relationship was the general assumption that only profitable firms engaged in sustainability. Jones et al. (2007), for instance, believe that organisations with higher returns have greater resources to direct towards sustainability-related projects. Their study found positive associations with multiple measures of financial performance. Morhardt (2010) finds that profitability explained additional reporting to a certain level. Such reporting was used to gain a competitive advantage; thereafter it became irrelevant. Morhardt concludes other factors have an influence, claiming "many considerations other than size contribute[ing] to development of good CSR practices and sustainability reporting in every sector" (2010, p. 447).

Alternative factors which can predict sustainability reports have also been identified (Patten, 1991). Patten finds that voluntary social disclosures were more likely to relate to public pressures variables rather than profitability. Similarly, Murray, Sinclair, Power, and Gray (2006) find no evidence of a relationship between market returns and environmental and social reporting. They do identify that, over time, organisations with

consistently high returns did have higher levels of disclosure. Dilling (2010) found that organisations were less likely to produce sustainability reports when there were higher long-term growth rates than when the rates were lower.

Additionally, organisations and industry influence an organisation's likelihood of producing sustainability reports (Deegan & Gordon, 1996; Dilling, 2010). Consistent with an earlier study by Gill, Dickinson, and Scharl (2008), Morhardt (2010) also finds evidence supporting differences between Asian, European, and American firms' reporting. These findings indicate the geographical differences that influence the reporting and disclosures made by organisations.

While the majority of the research has looked at commercial businesses, Adams and McNicholas (2007) focus on state-owned entities. Their study reveals both that individuals from state-owned organisations are more motivated to achieve sustainability and also that state-owned organisations have higher levels of accountability than privately held companies do. Adams and McNicholas (2007) use action research to help managers understand sustainability, subsequent reporting, and integration into planning and decision-making. One of their key findings is that this collaborative approach helped organisations to adjust and address a number of difficulties that arose for managers not familiar with the topic. The willingness of managers to be involved was an influencing factor. Although most studies have focused on the characteristics of companies publishing sustainability information, a couple have looked at the quality of the disclosures (Morehadt, 2010; Dilling, 2010). Morhardt (2010) excludes size as a predictor of reporting quality. However, Dilling (2010) looks in more detail at the characteristics that lead to producing high quality sustainability reports and identifies the following characteristics. They are: European-based organisations; companies in the energy or production sector; and, businesses that have higher profit margins. Organisations with these characteristics were likely to produce more meaningful sustainability reports. Whilst Dilling's study reflects only a snapshot in time, it does reveal the existence of similarities between organisations adopting sustainability reporting practices.

Daly (1990) warns about practicality issues when using sustainability and environmental factors in economic models. Findings from such studies do not imply causation or predict if an organisation will make sustainability disclosures. There are likely to be a number of

other influencing factors that will cause organisations to adopt and produce high quality sustainability reports.

Sustainability reporting has largely been a voluntary practice (Gray & Bebbington, 2000; Jones et al., 2007). Patten (1991) finds that voluntary disclosure relates more to public pressure than profitability. However, collecting and reporting sustainability information does place a cost on an organisation. In contrast to financial reporting, organisations are choosing to report directly or join bodies that require sustainability reporting. The motives for doing so are not easy to interpret, but the trend is evident.

The growth in reporting is enhanced by further changes in reporting practices (Choudhuri & Chakraborty, 2009). Reporting remains a conscious decision which comes from within the organisation, and that decision will be influenced by various internal and external factors. Aras and Crowther (2009) note that "more organisations perceive the importance of providing such information to external stakeholders" (p. 283). While understanding their characteristics provides insight into the organisations that have adopted sustainability but that understanding does not necessarily predict individual organisation reporting.

2.2.4 Sustainability reporting

Presently, organisations measure and report on sustainable activities using a variety of approaches including: sustainability reports (Choudhuri & Chakraborty, 2009); GRI reports and CSR reports (Jucan, 2011); TBL reports (Slaper & Hall, 2011); indexes (Slaper & Hall, 2011); and, online disclosures (Paul, 2008; Gill, Dickinson, & Scharl, 2008). In light of the many approaches, Choudhuri and Chakraborty (2009) acknowledge that there is no ideal reporting structure to best inform investors and stakeholders about sustainability performance. Businesses, however, do need to find effective ways to communicate.

Early attempts by businesses to move beyond traditional financial reports included environmental accounting, social accounting, triple bottom line (TBL), and corporate social responsibility (CSR) (Jenkins, 2004; Slaper & Hall, 2011). TBL reporting is recognised as a method of reporting on sustainability activity (Gill et al., 2008; Slaper & Hall, 2011). It adopts a similar approach to weak sustainability through reporting on social and environmental bottom lines along with the traditional financial bottom line (Gill et al., 2008). The TBL report allows organisations to report on a wide array of activities in

addition to the standard profitability and performance information provided in an annual report (Slaper & Hall, 2011).

Andrew Savitz's 2006 definition of TBL is commonly accepted inside and outside of academia (Slaper & Hall, 2011). For Savitz, the purpose of TBL is to "capture the essence of sustainability by measuring the impact of an organization's activities on the world . . . including both its profitability and shareholder values and its social, human and environmental capital" (Savitz, 2006, as cited in Slaper & Hall, 2011, p. 4). Defining TBL is not the issue; rather, operationalisation and subsequent measurement remain the greater challenge (Slaper & Hall, 2011).

There has been significant growth in TBL reporting including publications on company websites (Gill et al., 2008). Gill et al. look at online sustainability disclosures specifically. One of their main findings was that there were significant differences between firms from different continents. These differences are summarised in Table 2.2 below.

Table 2.2. Triple bottom line reporting focus by region.

Continent	Greatest amount of TBL Information
North America	Environmental and economic
Europe	Social indicators
Asia	Positive bias to their reporting

From "Communicating sustainability: A web content analysis of North American, Asian and European firms" (Gill, Dickinson & Scharl, 2008), *Journal of Communication Management*, *12*(3).

Their study of 39 firms across the oil and gas industry reveals clear distinctions in the nature of the information disclosed in terms of different geographical locations. Despite these findings' coming from online disclosures in one industry, they indicate that location and regional factors can influence the nature of TBL disclosures.

Corporate social responsibility (CSR) reporting has emerged as another alternative approach for reporting on the impact of organisations on stakeholders (Jucan, 2011). CSR recognises that the organisation exists within a larger society and so CSR helps to provide a movement away from weak towards strong sustainability. CSR has become

important for relationships with internal and external stakeholders (McPeak & Tooley, 2008).

Organisations that adopted CSR found that it resulted in a number of benefits. Kolk (2003) discovers that benefits can arise for organisations using CSR; these benefits include economic benefits from increased efficiency and lower costs, reduced risks, and improved relationships with stakeholders. Research indicates that companies which actively engage in CSR can also experience increased financial performance (Pava & Krausz, 1996; McPeak & Tooley, 2008).

Both TBL and CSR reporting provided a positive step forward and a move away from pure financial reporting. Jucan (2011) finds that companies that operated within 'social responsibility' had a greater chance of achieving sustainability. Aras and Crowther (2009) recognise there has been a "growth in the techniques offered for measuring social impact, and reporting thereon has continued throughout the last 25 years" (p. 283). Regardless of the approach taken, academic studies have revealed growth in the number of organisations that are reporting their sustainability performances (Kolk, 2003; McPeak & Tooley, 2008; Smith, 2011; Smith & Sharicz, 2011).

Firms are now actively disclosing their sustainability activity across different media (Paul, 2008). Increased reporting across different channels has created more informed and empowered stakeholders (Isaksson & Stemimle, 2009) who are demanding more information. Finding new approaches is also essential for targeting certain segments of the population (Mahadeo, Oogarah-Hanuman, & Soobaroyen, 2011; Moyers, 2005).

Isaksson and Stemimle (2009) observe that there is a growing expectation from stakeholders that organisations disclose their sustainability activity. Kaptein and Van Tulder (2003) explain that stakeholders, both primary and secondary, are looking to hold companies accountable for TBL and sustainability. Organisations now find themselves closely monitored by stakeholders; "companies are scrutinized by customers, shareholders, academia and journalists" (Isaksson & Stemimle, 2009, p. 168).

Traditionally, organisations would produce a sustainability report, or a supplement to, the annual financial report (Isaksson & Stemimle, 2009). However, firms are now targeting different stakeholders through specific online disclosures (Gill et al., 2008; Wheeler & Elkington, 2001) as well as providing traditional all-encompassing reports (Isaksson & Stemimle, 2009). Organisations are trying to balance short- and long-term performance

goals whilst employing focused reporting strategies to maintain stakeholder satisfaction (Isaksson & Stemimle, 2009).

Sustainability reporting is becoming an integral part of the internal policy and external disclosures of organisations (Aras & Crowther, 2009; Morhardt, 2010). Companies need to be strategic in implementing sustainability into their organisation (Audi, 2009). Adams and McNicholas (2007) find that, across different organisations, when managers actively participate in the creation of the sustainability report, their participation resulted in "the integration of sustainability issues into organisational planning and decision-making, and further facilitated the embedding of sustainability and accountability values" (p. 397).

Sustainability has evolved according to the context's requirement for a balance between an organisation's objectives and its stakeholder expectations. This requirement has not stopped organisations adopting sustainability, though there is significant variation in their sustainability practices (Milne, Tregidga, & Walton, 2009). Choudhuri and Chakraborty (2009) recognise there is no correct way for an organisation to disclose sustainable activity. Organisations need to adapt their reporting in line with the environment within which they operate. The issues facing sustainability are discussed in the next section.

2.2.5 Issues with sustainability

Despite the growing number of sustainability reports, there is significant disagreement about the conceptual and operational terms of sustainability (Hediger, 1999). Organisations face various challenges to incorporate and communicate sustainability. Hediger (1999) believes this challenge stems from multiple disciplinary perspectives as well as different philosophical and ethical interpretations.

The challenges which sustainability faces are similar those that accompanied previous attempts to incorporate social and environmental elements, and to move beyond financial reporting (Hines, 1991; Wilmshurst & Frost, 2000; O'Donovan, 2002). Choudhuri and Chakraborty (2009) point out that there have been many developments and changes as regards what information is reported. Reporting requirements and expectations are frequently changing and evolving. For sustainability to be effective within an organisation for any significant period of time, it should not just be reported, but also integrated into daily decision-making and operations (Audi, 2009).

One of the main issues facing sustainability is the degree to which it can be implemented by organisations, societies, countries, or industries (Franceschi & Kahn, 2003; Malovis et al., 2008). Generally, organisations have moved progressively towards making more sustainability-conscious decisions (Caneque, 2000). How the change is managed for an organisation incorporating sustainability practices is nonetheless a potential issue. Changes in organisational culture cannot be forced on employees (Aamodt, 2010). To be effective, this type of change requires development over time, and where it is not only modelled by senior management, but also brought in at the lowest level and then all the way through to senior staff (Aamodt, 2010).

Whilst sustainability has been adopted as a new approach to ensure greater harmonisation between businesses, the natural environment, and social factors; the social element is often neglected (Davies & Mullin, 2011; Kolk, 2004). In a study of sustainability reporting, Kolk (2004) identifies a number of developments in the information reported. In that study, the content of the 2002 sustainability reports of the largest 250 multinational companies was analysed, and the analysis showed that there was a significant environmental focus, with 71% of reports having a pure environmental focus. This percentage had declined as a 1999 review had shown a 98% environmental focus in reports for that year. Kolk credits the change in the focus of reports to the introduction of social and financial issues. Only 29% of reports from the 2002 study focused on multiple issues, with environmental and social issues being combined in 10% of reports. Social and financial issues appeared together in 1% of the company reports. Of the 250 companies, 18% report on environmental, social, and financial issues. When compared with the 1999 review, Kolk's finding reveals a movement towards more encompassing reporting, including more elements of sustainability, but also shows that further progress is still required.

Yet another issue facing sustainability is managing stakeholder perceptions of it. Miller and Nilsen (2011) find that the use of the terms 'sustainability' and 'recycling' in reporting lead to specific associations and assumptions. They claim "most people think about reusing paper, plastic, metal, and glass" (p. 55) as the main focus of sustainability rather than its multiple alternative applications. Further, Moyers (2005) suggests the presentation of climate change and sustainability issues influences the perception of stakeholders. Sustainability needs to continue to focus on all aspects facing stakeholders rather than simply topical issues.

Sustainability continues to face many challenges as it attempts to become an established mainstream concept. Gray and Milne (2002) further challenge the concept and current practice by stating: "there is no sustainability reporting in [the] public domain, anywhere in the world. This is because it is extremely difficult, if not impossible" (p. 6). They emphasise that sustainability reporting requires a standard of analysis and complexity that goes beyond a single organisation.

2.2.6 Conclusion

The lack of a universal definition of sustainability has not stopped it from becoming a widely applied concept. The 1987 World Commission on Environment and Development (WCED) meeting focused on integrating the components of sustainability during development (Hedren, 2009). Organisations that choose to embrace sustainability are faced with many challenges in terms of implementing sustainability and effectively reporting on their activity.

Looking beyond the individual organisation to society at large raises further questions as to the future direction of the concept. For all stakeholders, understanding the difference between weak and strong sustainability is fundamental to the concept's ability to move forward and to help achieve a more sustainable society. Hedren (2009) believes sustainability will simply be rhetoric "if the utopian dimension of politics and planning is neglected" (p. 220). For sustainability to be realised, it cannot be held out as a possibility; rather, it requires significant planning and process to ensure it is achievable for all society's members.

Although the concept exists, the implementation of large scale sustainable developments has not eventuated (Hedren, 2009). The inability to operationalise sustainability has often been cited and criticised, but the author believes that the current approach largely misses the point. The concept represents "hope and a call for a fundamental redistribution of political power, the right to natural resources, capital, technology, goods" (p. 224). Hedren concludes that the concept must be defined in such a way that the framework and politics are re-established in such a way that "utopian energies are again at the core" (p. 224). This call leaves organisations with the challenge of implementing sustainability from their core. A bottom-up approach can be fully integrated as opposed to trying to bolt sustainability on to current business practices.

Regardless of how and to what extent sustainability has been implemented, organisations have been quick to report on the change. Thus, changes to organisation practices and policies have been matched with numerous developments in nonfinancial reporting methods. The new reports include more information designed to communicate with different stakeholder groups. Understanding the various stakeholder influences on an organisations and the impact they have on their reporting is explored in the next section.

2.3 Disclosure and Accountability

The purpose of this section is to outline the developments in organisational reporting that have led to the inclusion of social and environmental disclosures in sustainability reporting. This section begins by considering Vilanova (2007) which queries for whom an organisation is run and, therefore, to whom it reports. Gray, Owens, and Adams (1996) recognises that the intended audience for disclosures indicates a degree of organisational accountability. Annual reporting, originally directed towards shareholders (Friedman, 1970; Hooper, Davey, Liyanarachchi, & Prescott, 2008), has slowly evolved to include a wider and more diverse network of stakeholders (Kakabadse, Rozual, & Lee-Davies, 2005; Sundaram & Inkpen, 2004; Vilanova, 2007).

2.3.1 Accountability and accounting

The extent of an organisation's accountability is widely debated within the literature (Hill & Jones, 1992; Shankman, 1999; Vilanova, 2007; Mahadeo et al., 2011). Gray et al. (1996, p. 38) describe accountability as "the duty to provide an account (by no means a financial account) or reckoning of actions for which one is held responsible." The variety of relationships and interactions between organisations and different societal groups requires different levels of accountability and responses (Phillips, 2004; Vilanova, 2007). However, traditional advocates like Freidman believed the only accountability was to shareholders (Keller, 2007).

Vilanova (2007) recognises that firms and management are often placed in positions where they must decide the purpose of the company and its subsequent reporting. Managers need to consider the shareholders who invest in and own the organisation as well as the stakeholders who have direct and indirect relationships with it (Vilanova, 2007). Stakeholders have unique relationships that depend on varying needs and expectations. Given that each stakeholder influences the performance of an organisation differently, management's relationships with these parties vary according to those

differing needs. Accountability requires the communication and reporting of essential actions, processes, outputs, and outcomes (Steccolini, 2004). Hence, managers must determine the extent of their firm's accountability to different stakeholders and ensure that this is sufficiently communicated.

Early studies into accountability focused on the capitalist approach which was primarily concerned with the relationship between management and shareholders (Friedman, 1970). Accounting was used as a function that reported on the organisation's performance, where accountability was arguably the most important principle and the basis of reporting (Hooper et al., 2008). Financial accounting alone was largely limited to the annual reports prepared primarily for shareholders (Hooper et al., 2008).

2.3.2 Shareholder approach

Milton Friedman stated "there is one and only one social responsibility of business ─ to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception or fraud" (1970, p. 6). Keller (2007) refers to the work of Milton Friedman as that of a neoclassical economist whose ideas stemmed from the founding work in the field by Adam Smith in the 18th century. Friedman believed that the approach of business should be concerned with increasing profits, which has more recently been interpreted as maximising shareholder wealth (Keller, 2007). Friedman's view became a seminal belief within modern business that evolved into a philosophy that a firm's focus should be directed primarily towards its shareholders best interests (Keller, 2007).

Kakabadse et al. (2005) review the development of CSR research from the 1950s to 2005. They recognise the dominance of shareholder theory prior to the 1950s. The Friedman approach led organisations to focus on the maximisation of shareholder wealth. Friedman's belief that profitability was the ultimate social responsibility of business meant firms were assessed according to financial results and shareholders' returns (Hubbard, 2009, Friedman, 1970; Kakabadse et al., 2005; Keller, 2007).

In the 1980s and 1990s, it remained common for companies to focus on shareholder value and returns (Sundaram & Inkpen, 2004). Keller (2007) poses that this emphasis

> has established a moral code for business based on efficiency of outcome
> and the assumed link of efficiency to self-interested behaviour. The result is
> that markets are the arbitrators of ethical outcomes, and profit maximisation
> as the ultimate moral code. (p. 159)

Decision-making centred on increasing shareholder wealth. Disclosures focused on communicating this intent along with the financial performance to current and future shareholders (Keller, 2007).

The focus on satisfying shareholders saw agency theory emerge as the leading paradigm in the financial economics literature (Jensen & Meckling, 1976; Ross, 1973). This field of study focuses on the relationship between owners (shareholders) and agents (managers) within organisations. Agency theory addressed the problem of ownership separation (Watts & Zimmerman, 1986).

In agency theory, the principal (owner) would motivate agents to fulfil their requirements and ensure that both the owners and agents satisfied their needs (Eisenhardt, 1989; Hill & Jones, 1992). One of the founding assumptions within agency theory is that individuals are self-interested (Eisenhardt, 1989) and, therefore, that the agent needs to be motivated to work for the principal and provide a return on the principal's invested capital. Agents were rewarded for behaviour that ultimately increased shareholder values.

Annual financial reporting communicated the necessary information to shareholders and was used to measure agent performance (Hooper et al., 2008). Agent remuneration and bonuses were often linked to the financial performance and growth of the organisation. This alignment of goals created accountability between the managers and shareholders. The focus of the agency relationship often neglected other stakeholders and curbed decision-making to satisfy shareholders' expectations (Vilanova, 2007).

Through improved control and mutual benefit, businesses were run more effectively and achieved profit maximisation goals (Friedman, 1970). Managers have a fiduciary duty to shareholders not only to protect their investment, but also to increase its value and provide a return for those capital investments (Clement, 2005; Marcoux, 2003). Financial statements prepared by management provided consistent and reliable information to shareholders to satisfy them on the financial performance of the company and assure them that they were getting a sufficient return on investment.

Vilanova (2007) recognises that managers were required to make decisions as to the direction and purpose of the organisation. In doing so, he asked: "should we trust managers' speeches or rather consider the firm's actual decisions?" (Vilanova, 2007, p. 147). Vilanova rightfully questions the extent of the commitment behind management comments. Accurate information was necessary to measure the performance of

managers. Relying on comments is not sufficient, and robust methods are required to support management comments.

Reliable reporting tools and measures were required to ensure performance was accurately reflected in the financial statements. Watts and Zimmerman (1986) believe that agency theory is one of the most significant explanation and prediction notions in accounting research. Differences between shareholders' expectations and the behaviour of managers can be reduced using appropriate techniques and controls, including budgets and accounting standards (Hooper et al., 2008). Agency research has extended beyond financial performance to include organisational behaviour (Hill & Jones, 1992), organisational theory, and strategic management (Eisenhardt, 1989; Kosnik, 1987).

Hill and Jones (1992) note that agency theory in a business ownership application is primarily concerned with the relationship between managers and shareholders. Financial performance and returns have been the founding components of modern business since its development in the 1960s (Friedman, 1970; Keller, 2007). Developments in recent decades show a change in focus beyond the traditional relationship as illustrated in Figure 2.3 below.

Figure 2.3. Evolution towards sustainability.
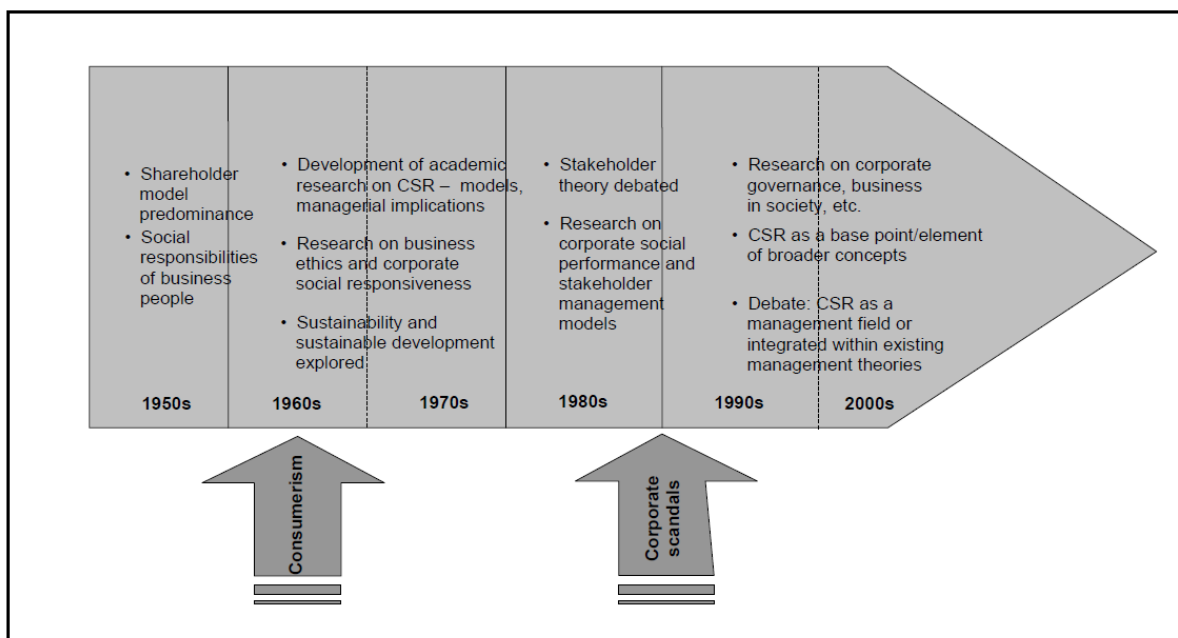
From "Corporate social responsibility and stakeholder approach: A conceptual review" by Kakabadse, Rozual and Lee-Davies (2005) *International Journal of Business Governance and Ethics, 1*(4), p. 279.

Kakabadse et al. (2005) recognise the emergence of wider CSR approaches that move beyond the narrow shareholder focus. These developments occurred largely within academic research, while business practice was reluctant to change without fully understanding the concept and expectations.

Deegan and Samkin (2004, p. 1074) observe that "many organisations are currently making public statements to the effect that they consider they do have responsibilities to parties other than just shareholders." The recognition of a wider role for organisations creates further accountability that has been followed with increased and more diverse reporting (Wilmshurst & Frost, 2000; O'Donovan, 2002). Mahadeo et al. (2011) identify that social and environmental reporting can be an accountability tool that also helps control stakeholders where their actions could influence the company in a similar way to shareholders' influence.

2.3.3 Developments in disclosures

Accounting research has expanded in recent decades and one area that has received significant attention is the accounting profession — as a social phenomenon (Burchell, Clubb, Hopwood, Hughes, & Nahapiet, 1980; Tinker et al., 1982; Guthrie & Parker, 1989). These early studies call for further research on the contributing social factors in the development of accounting practices and recognise a need beyond the traditional agency and financial relationships.

Gray et al. (1996) move beyond agency and focus on the role of information and disclosure along with the relationship between organisations and their stakeholders. Shocker and Sethi (1973) acknowledge that the main aim of business is to make a profit, but also note that organisations have a moral obligation to act in a socially acceptable and responsible fashion. Deegan and Samkin (2011) adopt a systems-based perspective and recognise that organisations are influenced by society and that they also influence members within society. The systems approach reflects the idea that organisations do not exist in isolation and that they represent social creations that survive only with society's acceptance (Reich, 1998).

Two distinct theories that are common within the systems-based perspective are stakeholder theory and legitimacy theory. Both theories recognise that accounting disclosure policies involve a strategy to influence the relationship between the organisation and other parties. Both theories have received traction in the literature, and

they attempt to explain social and environmental disclosures within annual reports. The following sections will explore both legitimacy and stakeholder theory literature.

2.4 Stakeholder Theory

2.4.1 Stakeholder recognition

The historical tendency for organisations to focus solely on shareholder returns expanded to recognise their interactions with a larger portion of society (Mygind, 2009) and evolved into a wider stakeholder mentality that extended the accountability and reporting responsibility of organisations that recognise these relationships (Mygind, 2009). Stakeholder theory provides a different perspective as regards the purpose of an organisation and the extent of its accountability.

The stakeholder theory professes that organisations should be run for the benefit of all stakeholders (Schaefer, 2007). Freeman and Reed (1983) define a wider group of stakeholders seeing them as: "any identifiable group or individual who can affect the achievement of an organisation's objectives or who is affected by the achievement of an organisation's objective" (p. 91). There are a variety of definitions within stakeholder theory in terms of who is a stakeholder, with traditional stakeholders being parties that had direct and easily defined relationships with an organisation (Isaksson & Steimle, 2009; Starik, 1995).

Stakeholder theory recognises that the organisation has a degree of responsibility and accountability that goes beyond shareholders (Hooper et al., 2008; Phillips, 2004). These groups extend beyond just those with direct exchanges or interactions with an organisation. Stakeholders now include indirect relationships such as those with communities and the natural environment (Isaksson & Steimle, 2009; Starik, 1995). Stakeholders can either influence or be affected by an organisation (Freeman, 1984; Ullmann, 1985; Prado-Lorezo, Gallego-Alvarez, & Garcia-Sanchez, 2009).

Despite the recognised conflicts between shareholder and stakeholder theories whereby some see them as total opposites, these theories share similar elements (Hill & Jones, 1992; Schaefer, 2007; Shankman, 1999). Agency theory could be construed as a weak form of stakeholder theory (Hill & Jones, 1992). Focusing on shareholders could be seen as a component of stakeholder theory. Shankman (1999) recognises that agency theory can fit within stakeholder theory; "agency theory can be subsumed within a general stakeholder model of the firm" (p. 319). A wider perspective can reduce risk and provide

a focus on the long-term survival of the organisation which has benefits for shareholders' investment over time (Shankman, 1999).

Organisations are not recognised as being independent of their environment. Rather, they have an influence on different stakeholders who in return impact the performance and future of the company (Phillips, 2004). Organisations need to recognise their larger impact. Langtry (1994) identifies a moral and ethical requirement for managers and businesses to consider when deciding those who have a 'stake' in an organisation.

The interaction between the organisation and its stakeholders creates a degree of accountability for the organisation that extends beyond its shareholders. Phillips (2004) argues that the need for stakeholder communication is a matter of moral obligation. Those groups who are affected by the organisation should be recognised and have some influence over how the company is run, given that the shareholders do not directly control the running of the organisation (Phillips, 2004).

2.4.2 Stakeholder theory in practice

The wider focus offered through recognition of the interactions with stakeholders has benefits for an organisation. Bosse, Phillips, and Harrison (2009) identify that stakeholder management leads to better relations with such groups and improved performance across the organisation. Stakeholder theory addresses issues of fairness that arose in traditional management approaches (Phillips, 1997) in that managers have to consider more than the financial outcomes when making decisions with wider stakeholders in mind.

The recent behaviour of many organisations and managers has altered the perception of the corporate environment. Clement (2005) discusses the need for businesses to consider wider impacts, identifying "the inappropriate behaviour that has occurred in the business world in recent years" (p. 255). Clement (2005) argues strategic benefits and risk reduction result when business leaders incorporate stakeholder theory into their business activities and decision-making. Greater concern and recognition of stakeholders is creating a movement towards greater social responsibility. Schaefer (2007) recognises that social responsibility does not require stakeholder theory; adopting stakeholder theory is, however, a positive step towards improved corporate social responsibility (CSR).

Recent developments in CSR are now moving the pendulum back towards a broader interpretation of value-creation as something that is for the benefit of the stakeholder (Mygind, 2009). Stakeholder theory provides a greater step towards organisations' recognising their social responsibilities. As Schaefer (2007) states, "the existence of a duty for corporations to exhibit social responsibility generally favours a stakeholder model of the corporation over a shareholder one" (p. 306).

In their review of research on social and environmental reporting, Mahadeo et al. (2011) conclude that a stakeholder approach was based on a "calculated and focused responsiveness of companies to a defined audience of stakeholders" (p. 160). This conclusion suggests that companies have identified their target audience or stakeholders and provide them with the necessary information to influence or respond to their concerns (Gray et al., 1996). Ullmann's (1985) study identifies that stakeholder power, strategic posture, and economic performance can be used to explain the variations in social disclosures of organisations. This study recognises the influence that powerful stakeholders can have over an organisation, a power which directly affects social and environmental disclosures.

Stakeholder power can influence the magnitude of disclosures from an organisation (Prado-Lorezo et al., 2009; Elijido-Ten, Kloot, & Clarkson, 2010). Prado-Lorezo et al. (2009) applied the Ullmann (1985) framework and found consistent results in their study of Spanish organisations. One major finding in their study was that the power of shareholders can be limited, while the government and creditors have a greater impact. Stakeholders in powerful positions can demand greater disclosure by organisations (Elijido-Ten et al., 2010).

Social and environmental reporting acts as an accountability mechanism to reflect an organisation's duty to account for its actions (Mahadeo et al., (2011). However, this mechanism is irrelevant if an organisation and its management consider and value only shareholders. Disclosures can be narrow and focus only on stakeholders who can impact the company (Mahadeo et al., 2011) rather than on all stakeholders that the organisation has a relationship with. This narrow focus can come at a cost, with some groups of stakeholders being neglected while others get a free ride on the back of services provided for other groups (Hooper et al., 2008).

For organisations to effectively maintain a relationship with stakeholders, they need to constantly monitor expectations within the dynamic environment within which they exist.

Phillips (1997) recognises there is no coherent framework for stakeholder management and that this lack of coherence causes problems when identifying and managing stakeholders. Phillips proposes that the principal of fairness can be applied to ensure mutually beneficial schemes and limit stakeholder free-riding. Bosse, Phillips, and Harrison (2009) identify that the benefits of fairness in the stakeholder approach result in reciprocity to all stakeholders and the firm's performance.

Stakeholder theory incorporates a wider focus and a greater level of accountability for organisations and management than other approaches (Mahadeo et al., 2011). While the approach acknowledges the presence of stakeholders, it does not, however, recognise the potential influence they have on organisations. Organisations can also be influenced by stakeholders depending on the nature and power of the relationship (Ullmann, 1985; Prado-Lorezo et al., 2009). Legitimacy theory, on the other hand, provides an alternative view that goes beyond stakeholder theory's wider focus to also acknowledge the influence these groups have on organisations.

2.5 Legitimacy Theory

2.5.1 Introduction

Legitimacy theory differs from economic-based theories that are grounded in self-interest in that it recognises that organisations are part of a wider social system (Deegan & Samkin, 2011). Legitimacy theory considers the relationship between society and organisations and incorporates the strategic management of an organisation's society and environment (Suchman, 1995). Legitimacy theory provides further insight into the motives underlying the nature of social and environmental disclosures (Lindblom, 1994). The need to report on the basis of accountability gives way to the notion of reporting to satisfy a social contract between organisations and stakeholders.

To gain acceptance from society, organisations must comply with social contracts (Deegan & Samkin, 2011). Social contracts are the basis of relationships with societal members which allow organisations to operate within that society (Magness, 2008; Shocker & Sethi, 1974). Lindblom (1994) stated that, from a disclosure perspective, "organisational legitimacy is a concept which has the potential to add insight into the nature of social disclosures provided by corporations and into the nature of the use of such disclosures by the public" (p. 3).

The purpose of this section is first to review the application of legitimacy theory to social and environmental disclosures and secondly, to consider specific studies that attempt to explain social and environmental disclosures using legitimacy theory.

2.5.2 Origins of legitimacy theory

One major feature of the recent literature has been its focus on the motives underlying social and environmental disclosures using legitimacy theory (Dowling & Pfeffer, 1975). Lindblom (1994) documented that corporate social performance and disclosures are attempts to enhance legitimacy and are substantially different from measures designed to meet legal requirements and economic exchange principles.

Lindblom identifies that legal and economic exchange factors fail to justify the need for social and environmental disclosures, saying

> The public would seek and the corporation would provide information only about corporate compliance with the law and/or traditional accounting measure of economic performance. If these traditional measures and disclosures are adequate for the public, there is no need for "social accounting", the disclosures of non-traditional measures of performance to meet the legitimacy assessment needs of the public. (Lindblom, 1994, p. 5)

Given the presence of social accounting, legitimacy is proposed as an alternative explanation to understand those social and environmental disclosures of an organisation that cannot be explained by good business practice (Lindblom, 1994). Different commitments and disclosures from organisations are required to address society and legal standards (Dowling & Pfeffer, 1975; Lindblom, 1994). Lindblom (1994) identifies that satisfying legal standards does not automatically give the organisation legitimacy:

1) Society's norms are dynamic and change at a faster rate than legislation;
2) Inconsistencies in society norms contrast the consistency of law. Legal requirements often provide a set minimum standard, and organisations may meet legal requirements but fall short of best practice or benchmark levels set by industry leaders.
3) Society can be willing to tolerate behaviours where legality is more rigid and legal sanctions for behaviours are difficult to obtain.

The notion of using voluntary disclosures further distinguishes legitimacy from legality (Lightstone & Driscoll, 2008). Lightstone and Driscoll (2008) investigate the ethical

issues around voluntary disclosures of qualitative information. They identify that voluntary disclosures by organisations exceed most legal reporting requirements and also that they are used to symbolically manage legitimacy.

An alternative view is that legitimacy is achieved through economic exchange (Benston, 1982; Perrow, 1970). Perrow (1970) claims that legitimacy of outputs through economic exchange can be achieved, stating: "if an organisation produces something that someone else wants, the purchase itself confers legitimacy upon the organisation and its output" (p. 98). According to Benston (1982), legitimacy is conferred solely through successful economic exchange. Donaldson and Preston (1995) recognises a simplistic model where market performance is the only dimension of social performance; "successful market performance thus provides both necessary and sufficient conditions for organisational legitimacy" (p. 65). These views imply that economic exchange can be considered a sufficient condition for legitimacy and, therefore, that good economics is all that is required for legitimacy (Lindblom, 1994).

Lindblom (1994) disputes the view that economic exchange is a substitute for legitimacy and argues that achieving organisational legitimacy through economic exchange implies that the market is the sole source of corporate legitimacy. Under this 'fundamentalists approach' where profits are returned to shareholders, economics is a proxy for a positive contribution to society and legitimacy (Lindblom, 1994). This perspective suggests that the only legitimacy required is achieved through outputs and profits, which is consistent with the views of Friedman and shareholder mentality. However, legitimacy requires more than economics and profits (Dowling & Pfeffer, 1975; Lindblom, 1994).

According to Lindblom (1994), social and environmental disclosures are motivated by a need to legitimise business activity beyond legislative or economic factors. Legitimacy is recognised as a separate and distinct concept which requires specific understanding and consideration by the organisation (Dowling & Pfeffer, 1975; Lindblom, 1994).

Lindblom (1994) recognises legitimacy as "a condition or status which exists when an entity's value system is congruent with the value system of the larger societal system of which the entity is a part" (p. 4). Whilst Lindblom attempts to explain legitimacy, Suchman (1995) provides a more recognised definition that considers legitimacy as "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (p. 574). Both definitions recognise that a relationship between the

organisation and society is managed by an often implicit 'social contract' (Shocker & Sethi, 1974; Mathews, 1993; Laszlo & Laszlo, 2002; Magness, 2008, Deegan & Samkin, 2011; Sacconi, 2011).

2.5.3 Social contracts

Fundamental to legitimacy theory is the belief that a social contract exists between the business and its society, and which is used to determine if the organisation is operating within society's expectations (Shocker & Sethi, 1974; Lindblom, 1994; Suchman, 1995; Magness, 2008). The conceptual framework of legitimacy theory "has its roots in the idea of a social contract between the corporation and society" (Magness, 2008, p. 541).

Organisations play a significant role in a growing global society by providing a place for different members to interact and exchange resources (Laszlo & Laszlo, 2002). Organisations subsequently develop significant relationships with a variety of societal members and are forced to adhere to the requirements of the social contract with such members (Shocker & Sethi, 1974).

Whilst it is difficult for an organisation to know and engage with all societal members, each member has certain expectations of the organisation. This relationship is recognised as a social contract (Mathews, 1993; Van Buren, 2001; Cragg, 2002; Pajunen, 2006; Deegan & Samkin, 2011; Sacconi, 2011). The social contract represents the collective expectations of each societal group and is used to judge the company as well as shape current and future action towards the company (Cragg, 2002; Pajunen, 2006; Sacconi, 2011).

Social contracts are not new concepts. Deegan and Samkin (2011) note that philosophers such as Thomas Hobbes (1588-1679), John Locke (1632-1704), and Jean-Jacques Rousseau (1712-1778) all discussed social contracts. Society places expectations on social institutions, including companies, to operate within the terms of social contracts regardless of the organisation's willingness to acknowledge any such contact (Shocker & Sethi, 1974).

The terms of the contract can be expressed or implied, and change over time. Furthermore, the organisation is expected to be aware of the terms and to uphold them. Shocker and Sethi (1974) explain that the survival and growth of an organisation is based on two components. First, "the delivery of some socially desirable ends to society in general" and, secondly, "the distribution of economic, social, or political benefits to

groups from which it derives its power" (Shocker & Sethi, 1974, p. 67). Organisations concerned with maintaining legitimacy will behave and disclose sufficient information to ensure they satisfy social contracts (Suchman, 1995).

The perception of legitimacy is vital to ensure that the organisation can continue to operate over sustained periods of time (Sacconi, 2011). Providing the organisation is operating within laws and regulations, its survival within the local community is determined by its legitimacy and thus its upholding of the social contract (Deegan & Samkin, 2011; Mathews, 1993). The contract has a multitude of implicit and explicit expectations that reflect the unique perspectives of different societal groups (Shocker & Sethi, 1974; Lindblom, 1994). Furthermore, the terms of the contract are evolving with dynamic changes within society and developments in technology (Laszlo & Laszlo, 2002; Lindblom, 1994). An organisation's legitimacy is attained through continually meeting societal expectations; however, it is not always achieved.

2.5.4 Legitimacy gap

When an organisation fails to meet society's expectations it creates a legitimacy gap that threatens its legitimacy (Dowling & Pfeffer, 1975, Lindblom, 1994). The gap could be actual, potential, or perceived (Lindblom, 1994). A perceived mismatch between organisational activities and societal values can develop into a legitimacy gap (Haniffa & Cooke, 2005). This misalignment can threaten an organisation's position and status within its society and broader social system (Mahadeo et al., 2011).

Failure to uphold the social contract can result in society revoking the organisation's contract (Deegan & Rankin, 1996). Deegan and Samkin (2011) show that breaching the social contract could change demand for the company's products or services; influence the supply of financial capital; create reduced access to labour or materials; and, increase lobbying to government to intervene with taxes, fines, or laws to prohibit the actions that do not conform with society's expectations. The difference between the expectation of how an organisation should act and how the organisation actually acts creates a legitimacy gap (Deegan & Samkin, 2011; Lindblom, 1994). Failure of a company to maintain its legitimacy can be costly and challenging for the long-term survival of the company. In response, organisations will engage in multiple strategies to ensure that their activities are perceived as legitimate (Dowling & Pfeffer, 1975).

Early studies showed that all disclosures were attempts to legitimise business activities (Hogner, 1982). Legitimacy is now considered in a wider context with distinctions

between proactive and reactive legitimacy strategies (Lindblom, 1994); institutional legitimacy versus strategic operational legitimacy (Sonpar, Pazzaglia, & Kornijenko, 2009; Suchman, 1995); and, three more generally recognised broad types of legitimacy: pragmatic, moral, and cognitive legitimacy (Palazzo & Scherer, 2006; Sonpar et al., 2009; Suchman, 1995). Legitimacy has grown to consider a wider number of factors and remains a common explanation for social and environmental disclosures.

2.5.5 Theory summary

There are a number of alternative ways to view social and environmental reporting. Each theory can be used to explain the social and environmental reporting of organisations, depending on their underlying beliefs. Both stakeholder and legitimacy theories provide a wider view which goes beyond the traditional shareholder approach. Some companies will be run on purely economic motives, whilst others will recognise the relationship with stakeholders. However, the motives underling any disclosures can vary depending on worldviews of the staff making the disclosures.

One change that cannot be argued with, however, is the growing presence of social and environmental reporting and, more recently, sustainability reporting. The next section reviews research related to developments of sustainability reporting in practice.

2.6 Sustainability Research

2.6.1 Introduction

This section looks more specifically at studies on the social and environmental reporting practices of organisations. Included are longitudinal studies that tested legitimacy theory through measuring changes in social and environmental disclosures over time. That review is followed by one on more recent sustainability research.

2.6.2 Sustainability benefits

Businesses have begun to adopt sustainability in the same way that they first began incorporating CSR, that is, by incorporating it in their reporting once they realised the benefits of doing so (Aras & Crowther, 2009). Whilst the motives for sustainable activity and reporting depend on each organisation and its stakeholders (McPeak & Tooley, 2008), there has been an increase in activity and reporting due to the perceived benefits. The concepts and ideas promoted in sustainability and CSR make good business sense and can increase company performance (McPeak & Tooley, 2008).

Studies that show the relationship between CSR activity and financial performance have yielded varying results, with the majority supporting a positive correlation (McPeak & Tooley, 2008). Aras and Crowther (2009), however, points to a 1996 study by Pava and Krausz that found companies defined as being socially responsible performed as well, in financial terms, as companies that were not. While this finding indicates that firms that engage in high levels of CSR are likely to perform well financially, it does not, however, imply causation. McPeak and Tooley (2008) report "a study conducted by Morgan Stanely in 2003 found that the best CSR performers in their sample also yielded the highest returns ... their conclusion was that good corporate management tends to produce better financial results and sustainability performance" (p. 5). There is, therefore, a link between financial performance and sustainability performance which is likely to be dependent on management driving both sustainable and economic performance (McPeak & Tooley, 2008).

It has already been mooted that integrating CSR into business results in multiple benefits (McPeak & Tooley, 2008). Some benefits are more tangible, and others less so. Choudhuri and Chakraborty (2009) find sustainability reporting to be an important element of corporate governance and dealing with organisational issues. Incorporating sustainability into board level decision-making creates an environment for consideration of new opportunities including innovation, efficiency, and accessing new markets (McPeak & Tooley, 2008). Environmentally and socially concerned businesses also attract a different type of investor. Socially responsible investors have become more noticeable (Choudhuri & Chakraborty, 2009), as they believe there is a positive correlation between CSR and financial performance (McPeak & Tooley, 2008). Managers are subsequently seeking new opportunities to include CSR or sustainability within their organisations.

Organisations that produce sustainability reports distinguish themselves from organisations that do not. One consequence of this difference is that stakeholders perceive organisations engaged in sustainability as having less risk (Aras & Crowther, 2009). Organisations that weave sustainability and CSR throughout the organisational strategy are perceived as having good corporate management and governance (McPeak & Tooley, 2008).

Sustainability reporting is not targeted solely at external stakeholders (Whitemore, 2006). Jucan (2011) notes that CSR is also a practical strategic management tool.

Sustainability disclosures can have internal benefits (Paul, 2008). Managers and staff can be involved and gain a better understanding of their company's ethical, social, and environmental goals. Paul (2008) recognises that this education can help lead to cultural change in the organisation and set new foci, priorities, and expectations. Further, these disclosures send a signal to other companies with similar beliefs and values, opening up possible business collaboration or trading opportunities.

To engage effectively with all their stakeholders, organisations need to have clear processes and policies in place (Kaptein & Van Tulder, 2003). Internally, updating systems and processes with a sustainability focus can improve operations. Formally documenting a code of conduct in the same accord can shape employee and organisation behaviour (Kaptein & Van Tulder, 2003).

Externally, having a dialogue with stakeholders is important (Kaptein & Van Tulder, 2003). Whilst it is not possible to meet all stakeholders' needs simultaneously, Kaptein and Tulder note that, through a wider involvement, better understanding of the sustainable developments can be achieved over time. Codes of conduct can also be used to hold organisations to account. They provide a way to measure and evaluate organisational and staff performance. Organisations that look to be more inclusive with stakeholders move from competition to cooperation (Kaptein & Van Tulder, 2003). Ultimately this shift can offer a proactive way for an organisation to move towards a strong sustainability position.

Although financial reports can often provide insight into business activities, they fail to provide insight beyond traditional financial performance (Choudhuri & Chakraborty, 2009). Thus, organisations will use sustainability reporting to try to limit or reduce their externalities (Kolk, 2003). Organisations with negative social and environmental business activities that face increased scrutiny try to minimise its potential impact through disclosure.

Organisations use many different mediums to report their sustainability activity. Paul (2008) finds that firms use external validation to verify disclosures. Furthermore, sustainability reports offer stronger evidence of such activities than do publications on websites or information disseminated through the media (Paul, 2008; Gill et al., 2008).

2.6.3 Sustainability costs

The notion of corporate sustainability is often described as an oxymoron, bringing together two ideas which seem incompatible. In recognising both the potential and Utopian nature of a sustainable reality, Stone (2003) also acknowledges that the practicality of making it happen appears impossible in that it is "A worthy goal ... but how likely is it to be achieved?" (p. 94). Trying to find harmonisation between these two apparent polar opposites does create a number of issues for defining, measuring, reporting, and comparing sustainability.

Stone (2003) saw the Brundtland Report as a challenge to find a future where the impact on the environment was minimal and progress and development were still possible. Meeting that challenge required a balance between the current and future generations. However, whilst providing direction, there were, from an anthropologist's perspective on sustainability, potential issues. First, there is difficulty in defining what is sustainable. Secondly, can sustainability be applied at a global level where the entire system can operate, on the whole, sustainably? Alternatively, can subsections or parts of a system act or behave sustainably?

Understanding sustainability also poses further problems, as people may understand the concept yet struggle to implement and behave accordingly. Additionally, there are a number of factors that can significantly impact sustainable behaviour, but which may be beyond the control of any one or small group of individuals.

Sustainability reports face a number of issues; like annual reports, there are measurability issues when trying to capture different components (Choudhuri & Chakraborty, 2009).These authors note that many of the intangibles included within sustainability are not easily quantified or valued in financial terms. This difficulty is compounded by the lack of a consistent framework (Hubbard, 2009). In an attempt to develop a new framework, Hubbard (2009) notes "there is no sign of consensus on a common reporting standard and the competing frameworks are impossibly complex" (p. 177). Whilst firms are producing reports, there is large variation across organisations and many fail to understand the measurement system used and incur additional costs when attempting compliance.

Hubbard (2009) proposes an alternative measure in the form of his Sustainable Balanced Scorecard which uses indexes to obtain a single measure from the scorecard. The scorecard provides measures on four to six relevant areas and the combined score

allows for comparison between organisations. However, using a single measure alone as a comparison tool does not explain the variation between scores, and different scores on different parts of the scorecard can effectively be offset against each other. Consequently, organisations that focus on different aspects of sustainability can end up with the same score but for different reasons. Organisations that use a combination of scores for different parts of the scorecard have a greater understanding of sustainability.

Hubbard (2009) recognises the importance of having a way to measure performance that is easily accessible and understandable for stakeholders. This type of performance measurement is important; however, it cannot come at the expense of losing information that helps to differentiate performance and fails to recognise the interrelationship between components of the balanced scorecard.

2.6.4 Legitimacy theory research

One of the most revealing studies was that of Mathews (1997) which reviewed 25 years of social and environmental accounting literature from 1971 to 1995. Whilst this study is not current due to developments since 1995, the key findings from this period provide insight into the evolution to sustainability. Mathews (1997) observed that between 1971 and 1980 the major focus of the research was on social accounting. The next period between 1981 and 1990 saw greater attention placed on environmental issues.

The final five years to 1995 saw an even greater growth in environmental accounting which combined with a significant decline in social accounting research. These findings provide an explanation for the lack of social disclosures within sustainability reporting as identified by Kolk (2004), and Davies and Mullins (2011). Mathews (1997) also highlights the separation between social and environmental issues in earlier research.

Hogner (1982) was one of the first researchers to advocate social disclosures by organisations and was motivated by the need to legitimise the organisation and its activities. Following this publication, there have been numerous studies with mixed findings (see Deegan, Rankin, & Tobin, 2002; Guthrie & Parker, 1989; Watson, 2011).

Initially, Hogner (1982) and then Guthrie and Parker (1989), Deegan et al. (2002), and Watson (2011) all attempted to gauge the extent organisations' endeavour to legitimise their activities through social and environmental disclosures. However, each applied specific methods and doing so contributed to inconsistent results. While some studies have found evidence of legitimising activities (Deegan et al., 2002; Hogner, 1982;

Watson, 2011), others have found evidence to the contrary (Guthrie & Parker, 1989). Wilmshurst and Frost (2000) observe that "prior research has not provided a consistent support for legitimacy theory" (p. 11).

In a study of U.S. Steel's corporate social reporting, Hogner (1982) finds some evidence supporting legitimacy theory for social responsibility reporting. The study draws on evidence from over eight decades of CSR disclosures within U.S. Steel's annual reports. Hogner suggests that his findings show a need for U.S. Steel to legitimise itself and its activities. Hogner further concludes from this study that corporate social responsibility themes had been used in reporting throughout the last century. In a similar study, Guthrie and Parker (1989) find evidence of CSR reporting in a 100-year study of the annual reports of Broken Hill Propriety Limited (BHP). While they recognise the existence of social and environmental disclosures within BHP's annual reports, they, however, fail to confirm legitimacy theory as an explanation for the social disclosures.

Understanding and explaining the motives for such disclosures has created considerable debate in the literature. Researchers widely acknowledge the presence of social and environmental reporting in historical annual reports (Hogner, 1982; Guthrie & Parker, 1989). Hogner argues that the CSR disclosures in U.S. Steel's annual reports are a response to social factors which led him to believe that such disclosures show a motivation and corporate need for legitimacy.

In an attempt to replicate Hogner's findings in a similar company, Guthrie and Parker (1989), as mentioned above, undertook an historical review of a 100 years of reports to shareholders in BHP Ltd. Applying a method consistent with Hogner, they found little evidence to support legitimacy theory. The historical analysis found a variable pattern of social disclosures that did not correlate with significant events at the same time. The authors stated: "the testing of legitimacy theory as an explanation for BHP's social disclosure report relied upon the matching of peak disclosure periods with periods of significant social, economic or political events affecting the company" (Guthrie & Parker, 1989, p. 351). Their study found insufficient evidence to confirm legitimacy theory as the primary explanation for the social disclosures.

Intrigued by the results of the Guthrie and Parker study, Deegan, Rankin, and Tobin (2002) also studied the social and environmental disclosures of BHP. In contrast to the earlier study on BHP, Deegan et al. find a positive correlation between community concerns for social environmental issues in the disclosures in BHP's annual report. They

conclude that their findings supported legitimisation motives for the company's social and environmental disclosures. In this study, they look at themes as well as specific measures. They do pay particular attention to the difficulty in measuring community concern and acknowledge that the limitations of the earlier Guthrie and Parker study were factors in finding support for legitimacy theory. Deegan et al. (2008) were able to produce findings consistent with Hogner's earlier work.

Similarly, Campbell, Craven, and Shrives (2003) find that whilst legitimacy theory explained some environmental disclosures in annual reports, these findings were limited. They note that the number of alternative choices for social disclosures challenges the usefulness of studying annual reports.

The findings of each study depend on the researchers' specific focus and methodology (O'Leary, 1985), and so debate between competing theorists extends to identifying inconsistent and unjustified methods as a possible explanation for differing results. Deegan, Rankin, and Tobin (2002) recognises that the limitations established by Guthrie and Parker's 100-year study of BHP social disclosures in the annual report were factors that contributed to the lack of support found for legitimacy theory. This finding highlights the importance of the research method and understanding the relationship between the variables being measured. Whilst the debate between methodologies continues, each study provides valuable insight into social and environmental disclosures. In addition, changing societal trends have also impacted on the way legitimation approaches have been implemented.

Legitimacy research has revealed the concept is more complex than possibly suggested in earlier research. Campbell et al. (2003) recognise that legitimacy can explain some, but not all, disclosures, and the explanation varies depending on the sector and/or industry. There are many variables that cannot be easily measured and controlled in a research context. When studying disclosures, it is difficult to establish and distinguish the extent and different forms of legitimacy (Classen & Roloff, 2012). De Villiers and van Staden (2013) find that organisations will reduce disclosures in an attempt to maintain legitimacy. Organisations have intentionally withheld information or decreased their disclosures to best manage their legitimacy. This strategy provides insight into legitimation attempts but can be very difficult to measure in studies of multiple organisations. Most research focuses on the disclosures made by organisations and excludes withheld information not made publicly available.

Classen and Roloff (2012) believe that simply making CSR disclosures does not directly result in legitimacy. Any disclosure needs to be supported with evidence of action. Furthermore, they recognise that stakeholders have a sceptical view of CSR disclosures due to the strategic communication surrounding them. This scepticism can lead to a view that disclosures are a form of green washing and token gestures rather than genuine attempts to make a difference. Legitimacy is not achieved through an action unless that action is the best sustainable action possible, given the resources at that point in time. The authors highlight an important link between legitimacy and reputation.

Patten (1992) explores the environmental disclosures of U.S. oil companies following the Exxon Valdez incident in Alaska in 1989. The oil spill was seen as a potential threat to the legitimacy of the petroleum industry and one consequence of this perceived threat was an increase in the number of environmental disclosures in annual reports. Patten's results are consistent with legitimacy theory.

Similarly, Deegan and Rankin (1996) use legitimacy to explain the changes in environmental disclosure policies within corporate annual reports following environmental prosecution in Australia. Their findings show that during this period there was significantly more environmental information in the year of prosecution compared to other years. Their study concludes that legitimacy theory explained the increased disclosures following environmental prosecutions.

Despite the number of threats and numerous strategies to minimise such threats, organisations have widely embraced sustainability reporting as a technique to maintain legitimacy. They are also proactive in maintaining their legitimacy when it is under threat (Lindblom, 1994). Changes to reporting immediately following threats to legitimacy indicate a direct relationship (Deegan et al., 1996; Patten, 1992). The ability to maintain legitimacy also depends on actions underpinning the disclosure (Classen & Roloff, 2012). In itself, however, making a disclosure is not sufficient to preserve legitimacy and forms only part of a larger strategy.

Other factors were explored by Wilmshurst and Frost (2000) who broke down the relationship and factors contributing to environmental disclosures by looking at the role of management. Specifically, their study explores the perceptions that lie behind management's approach to environmental disclosures and legitimacy implications. They consider the interceding variable of how a manager perceives their importance and the impact this perception has on the relationship between legitimacy and environmental

disclosures. They find support for legitimacy theory, with a positive correlation between some perceived influential factors and actual reporting. The most dominant factor for managers was shareholders' right to complete information. However, not all perceived factors correlated with environmental disclosures. The study highlights the influence management have in environmental disclosures and attempts to create, maintain, or restore legitimacy.

The findings from Wilmshurst and Frost (2000) indicate a need for better understanding of the variables and the relationship between environmental disclosures and legitimacy. They acknowledge the difficulty in defining and measuring what motivates organisations to make sustainability-related disclosures. However, one can assume that external factors will influence corporate management's decision to disclose information.

Companies have found themselves under increased scrutiny with growing demand that they are held accountable for their activities (Hines, 1991). In response to the increased attention, companies have used social and environmental disclosures that can strategically legitimise production processes and manipulate social perceptions (Archel, Husillos, Larrinaga, & Spence, 2009).These studies have shown that legitimacy theory has been widely used to explain the increased presence of sustainability reporting. The next section focuses specifically of sustainability in the mining industry.

2.7 Sustainability in the mining industry

The purpose of this section is to review the evolution of sustainability in the mining industry. This section looks specifically at research that includes mining companies and their social, environmental, and sustainability disclosures in an effort to provide an understanding of how sustainability has been applied in practice. Reviewing the previously established concepts, themes, and trends already studied will offer a basis for this research.

2.7.1 Introduction

The mining industry has moved widely in recent years to integrate sustainability into operations and disclosures (Whitmore, 2006). Whitmore observes that the mining industry has responded to criticisms, with claims of serious attempts to pay attention to social and environmental impacts. The increase in the number of social, environmental, and sustainability disclosures within the mining industry has also been matched by greater depth of disclosure (Jenkins & Yakovleva, 2006; Perez & Sanchez, 2009).

However, the growth of sustainability reporting in the mining industry has been offset by inconsistencies in the reporting practices of different mining companies (Peck & Sinding, 2003; Jenkins & Yakovleva, 2006; Whitmore, 2006; Yongvanich & Guthrie, 2007; Perez & Sanchez, 2009; Watson, 2011).

Fonesca (2010) identifies that communicating sustainability performance can be challenging due to the nature of the mining industry. Stakeholders' predisposition to distrust mining corporations has evolved over many years (Fonseca, 2010). Nevertheless, the mining industry has responded with increased disclosures to numerous stakeholders. Sustainability reporting is more prevalent in the mining industry now than ever before, with more organisations disclosing and an increase in the number of disclosures made by each organisation (Guthrie & Parker, 1989). That said, disclosure is not a new concept in the mining industry. Research has shown evidence of sustainability-related disclosures in the industry throughout the last century (Guthrie & Parker, 1989; Deegan, Rankin, &Tobin, 2002).

2.7.2 Historical review

Historical longitudinal studies have provided insight into the use of CSR and sustainability- related disclosures for single companies over long time periods. Hogner (1982) produced one of the earliest studies. Researching legitimacy theory as the basis for social responsibility reporting, he finds evidence of over eight decades of CSR disclosures within U.S Steel's annual reports. Regardless of the motivation, Hogner establishes that CSR disclosures have been widely used throughout the 21st century.

In an attempt to replicate Hogner's (1982) study on the CSR disclosures of U.S. Steel, Guthrie and Parker (1989) provide a historical analysis of the social disclosures in 100 years of annual reporting by the mining company Broken Hill Proprietary Company Limited (BHP). Despite not being able to draw the same conclusions regarding legitimacy theory as the primary rationale for disclosures, Guthrie and Parker find evidence of CSR disclosures in 1885, the starting point of the study. CSR disclosures across six main themes (environment, energy, human resource, products, community involvement, and other) were measured to the nearest quarter page. Photographs and graphics were not recorded in their analysis. They found a variable pattern of social and environmental disclosure, with different themes used sporadically. Further, they found that CSR components were emphasised for limited time periods before the focus shifted elsewhere. There was no evidence supporting legitimacy theory as the disclosures did

not correlate with "significant social, economic or political events affecting the company" (Guthrie & Parker, 1989, p. 351).

Motivated by the findings of the Guthrie and Parker (1989) study, Deegan, Rankin, and Tobin (2002) set out to study the social and environmental disclosures of BHP. They recognised a shortfall in the variable used by Guthrie and Parker to test legitimacy theory and so used a content classification for CSR similar to the one used by Guthrie and Parker (1989) and subsequent studies (see Gray, Kouchy, & Lavers, 1995; Hackston & Milne, 1996). In including *media attention* as a proxy for community concern, Deegan, Rankin, and Tobin's database differs in one area when compared with the database established by Guthrie and Parker.

Though their study does not go back as early as Guthrie and Parker's research did, Deegan, Rankin, and Tobin (2002) identify that social and environmental disclosures from 1983 to 1997 did correspond with community concern. Using *media attention*, they established a strong link supporting legitimacy and social contracts. This measure for community concern reflected society's views at the time of publication and so provides a better proxy for testing legitimacy. Deegan, Rankin, and Tobin (2002) also observe trends of greater social and environmental disclosures. This change was not, however, the only factor that could have contributed to the different findings.

The different recoding units applied by the Guthrie and Parker (1989) study compared to Deegan, Rankin, and Tobin (2002) could have contributed to the diverse findings. Where Guthrie and Parker measured CSR disclosures by quarter page disclosures, in contrast, a more recent study measured disclosures at the sentence level. Hackston and Milne (1996) find a high correlation between different recording measures of words, sentences, and proportion of pages. Deegan, Rankin, and Tobin (2002) conclude that the result should not be greatly influenced by the choice of sentences in their research compared to other studies. However, a weakness of these content analysis-based studies is that they record the presence of social and environmental disclosures only.

A limitation of both studies is that they focus on only one mining organisation and are not reflective of the mining industry as a whole. A further limiting factor was that organisations during that time period incorporated social and environmental disclosures within the annual financial reports. Disclosures within an annual report are secondary to the financial information provided for the shareholders. Neither Guthrie and Parker's (1989) study nor Deegan, Rankin, and Tobin's (2002) research measured the quality or

detail of these disclosures. The studies mentioned above confirm that sustainability-related disclosures have been evident within the mining industry for the last century. More recent studies reveal reasons why disclosures have become more common.

2.7.3 Recent trends

The studies on historical social and environmental disclosures by mining companies focused largely on annual reports (see Guthrie & Parker, 1989; Deegan, Rankin, & Tobin, 2002). Consistent with other industries, organisations in the mining industry make social, environmental, and sustainable disclosures in a variety of formats (Jenkins & Yakovleva, 2006).

In a study of the top 10 global mining companies, Jenkins and Yakovleva (2006) establish that in 1999, despite all 10 companies producing annual reports, only two companies produced stand-alone social and environmental reports. The other companies relied on disclosures contained in their annual report to communicate social and environmental information. By 2003, the number of companies producing stand-alone reports had increased to seven. The titles of reports varied significantly between companies and evolved into more sophisticated forms of reporting, including sustainability and CSR reports (Jenkins & Yakovleva, 2006). Separate sustainability-related reports increased the volume of sustainability disclosures.

Moving beyond the annual report offers greater insight into social and environmental issues. Coetzee and van Staden (2011), along with Fonseca (2010), offers an insight into sustainability disclosures through studying press releases and sustainability reports in addition to disclosures in annual reports. Not only has the Internet provided greater access to disclosures, it has also extended the reach of stakeholders to view disclosures globally with minimal cost and effort. Many mining organisations are now incorporating sustainability online, in annual reports, in sustainability reports, and through the media.

More recent studies have used larger sample sizes to better understand how the mining industry is incorporating sustainability (Peck & Sinding, 2003; Jenkins & Yakovleva, 2006; Yongvanich & Guthrie, 2007; Perez & Sanchez, 2009; Coetzee & van Staden, 2011). Perez and Sanchez (2009) focus on four major mining companies' sustainability reports between 2001 and 2006. A major conclusion from their content analysis is that "there is a clear evolution in [the] report's comprehensiveness and depth" (p. 949). Larger studies have revealed more depth and detail regarding the nature of sustainability disclosures.

Similar studies into sustainability disclosures in the mining industry revealed a potential issue with significant variety of disclosures between companies (Jenkins & Yakovleva, 2006; Yongvanich & Guthrie, 2007). In a specific study on the Australian mining industry, Yongvanich and Guthrie (2007) establishes that a variety of legitimacy strategies are used in voluntary sustainability disclosures. Their study of 17 mining companies in the top 100 Australian companies found that Lindblom's (1994) reporting strategies were adopted in varying degrees depending on the reporting issues at hand. Specifically, when an issue was widely reported, the strategy applied was based on changing perceptions or educating and informing relevant publics about actual changes in an organisation's performance through unbiased disclosures (Yongvanich & Guthrie, 2007). However, when a strategy of manipulating the perceptions of stakeholders was required, the focus shifted from deflecting attention from the specific negative issue to a more general and widely reported issue (Yongvanich & Guthrie, 2007).

In addition to deflecting attention, firms strategically reduce disclosures in an attempt to maintain legitimacy. In observing the changes in the volume of disclosures, de Villiers and van Staden (2006) finds that the mining companies in this study adjusted their disclosures at a greater rate than did the top 100 companies. De Villiers and van Staden (2006) establish that organisations do not simply make social and environmental disclosures to increase their legitimacy. They find that reducing disclosures can enhance the legitimacy of some economic and social elements. This finding suggests that, if done tactically, avoiding reporting a negative issue can maintain or enhance legitimacy.

The intent of a disclosure will determine the degree of bias. Yongvanich and Guthrie's (2007) findings, which were consistent with Lindblom (1994), observe that disclosures that tried to change perceptions were likely to be unbiased, while those attempting to manipulate perceptions would include bias. The variability of reporting within the mining industry indicates that there are biased and unbiased disclosures within sustainability reports. The timing of disclosures is important in managing perceptions and legitimacy.

Coetzee and van Staden (2011) analyses the frequency of safety disclosures made in the annual reports, sustainability reports, and press releases of South African mining companies following two major accidents within the region. The findings were consistent across the South African mining industry. The increased disclosure levels after the incidents suggest "that organisations do respond to increased stakeholder scrutiny threatening their legitimacy" (Coetzee & van Staden, 2011, p. 232).

Jenkins and Yakovleva (2006) finds significant variability in social and environmental reporting across the top 10 global mining companies. Through studying stand-alone social and environmental reports, the authors found that disclosures tended to be more sophisticated and stylish. The following points were noted:

- Reports covered a wider scope of issues;
- A trend towards sustainable development in CSR reports;
- The development of integrated policy statements and codes of conduct;
- Reports were prepared in accordance with the Global Reporting Initiative (GRI) guidelines;
- Increased levels of external verification of data contained in reports; and
- Increased presence of reporting and disclosure on the internet. (Jenkins & Yakovleva, 2006, p. 282)

Jenkins and Yakovleva (2006) observe an overall lack of uniformity of the disclosures in the mining industry. The authors found no consistent measure of CSR or progress towards sustainability. They believe that this lack of consistency prevented comparisons between different company's sustainability activity. The current trend of increasing disclosures is undermined by a lack of confidence in the data provided by mining organisations (Dando & Swift, 2003; Jenkins & Yakovleva, 2006).

Perez and Sanchez (2009) establishes that the increase in volume of social and environmental disclosures is complemented by an increase in the quality of disclosures: however, quality is not consistent across all sustainability components. This point is particularly relevant for "accessibility and assurance" and "economic performance" (Perez & Sanchez, 2009). The authors concluded that areas of improvement included data measurement techniques and more comprehensive third-party verification. To address this issue, organisations attempted to improve the credibility of their sustainability disclosures through reviews and assurance (Fonseca, 2010).

2.7.4 Assurance

Jenkins and Yakovleva (2006) establishes that most organisations had some external verification of data and disclosure. They recognise that a main issue is the lack of generally accepted auditing or accounting standards for reporting sustainability performance information. Perez and Sanchez (2009) sees third-party verification as a major issue facing sustainability in the mining industry.

After reviewing assurance provided on sustainability reports, Fonseca (2010) concludes "that mining companies had significant control over the practice" (p. 355). The International Council on Mining and Metals (ICMM) Assurance Procedure, introduced in 2010, was recognised as having potential positive implications for assurances (Fonseca, 2010). However, these guidelines and frameworks do not address all concerns and expectations of mining stakeholders, as the focus is on standards rather than sustainability issues (Fonseca, 2010).

Despite a variety of stakeholders having been involved in sustainable reporting and assurance, Fonseca (2010) emphasises the importance of discussion and raising awareness of issues surrounding sustainability in mining. He proposes that, as the concept evolves, it will improve disclosures and practices with benefits for all parties. Despite conflicting views on required standards which are hampering development, all discussion and progress is a positive step forward for the mining industry. Jenkins and Yakovleva (2006) recognises that one of the main contributing factors to the lack of uniformity in the industry is an absence of collaborative work between mining companies.

2.7.5 Moving forward

Jenkins and Yakovleva (2006) observes that the Global Mining Initiative (GMI) is a positive step forward; when their research was published only four of the top 10 global mining companies were members. Furthermore, they call for greater homogeneity in social and environmental disclosures. In the meantime, without direct guidelines and standards, companies across the industry continue to make sustainability disclosures without the guidance needed to bridge the gap between leading organisations. Deegan (2002) recognises that leaving disclosures to the discretion of management will not guarantee the provision of unbiased information. The findings of his media study indicate that management vary widely in their reporting strategy, based on their intended influence on society.

Himley (2010) acknowledges that mining companies present a version of sustainability and sustainable development that is in their interest and allows them to continue to operate. Through proactively framing sustainability in mining, the industry can frame and control its responsibilities (Jenkins, 2004). According to Prior, Giurco, Mudd, Mason, & Behrisch (2012), the mining industry's awareness of society's dependence on metals and minerals justifies mining operations, provided they are seen to operate within

acceptable limits. However, as mining companies influence society's perception of acceptable limits, they have the opportunity to frame the issue in their own best interests.

Fonseca (2010) believes that mining can be sustained, provided that it is technically and economically feasible. This view is consistent with weak sustainability in that it represents an effort to efficiently extract minerals and metals from the natural environment with minimal disruption to all stakeholders (Himley, 2010). Technological advances also improve efficiency in mining which allows greater access to new resources to meet society's growing reliance on natural minerals.

Sustainability in mining can be seen as a development agent (Himley, 2010). Whitmore (2006) observes that sustainable mining is not too different from mining throughout history, mining which has been associated with many disasters (Coetee & van Staden, 2011). He recognises that there has been a significant shift in rhetoric with little tangible change for the mine affected communities. Whitmore (2006) identifies that mining companies often move into regions, destroying the natural environment and disrupting the indigenous peoples, and with most profits leaving the area. Storey (2010) discusses the consequences of fly-in/fly-out (FIFO) mining arrangements that can be extremely destructive to the local community. He notes that in recent years, a FIFO method (no town) model was preferred to that of the 'new town' system. New towns faced problems once the mining operations ceased due to a heavy reliance on mining. Both approaches have significant implications for society, and sustainable organisations need to consider all factors from the outset.

2.7.6 Conclusion

Operating under a banner of sustainability, the mining industry continues to function in the same manner as it always has, and unless changes are made, the negative consequences for local communities and the natural environment will continue (Whitmore, 2006; Storey, 2010). Himley (2010) describes the mining industry's adoption of sustainability as 'weak sustainability'. In this instance, mining companies are publicly disclosing the benefits of operating sustainability with greater concern and care for all stakeholders. However, the real benefits are improved efficiencies and profitability without conflict and distractions from stakeholders.

Peck and Sinding (2003) describes mining as the most socially and environmentally destructive activity. Nonetheless, the mining industry has increasingly incorporated

social and environmental disclosures, and aligned itself with sustainability (Guthrie & Parker, 1989; Deegan et al., 2002; Yongvanich & Guthrie, 2007; Perez & Sachez, 2009).

The issue regarding the consistency and reliability of sustainability disclosures remains at the forefront of the mining industry. The lack of consistency surrounding disclosures creates difficulties for all parties involved and as highlighted by Jenkins and Yakovleva (2006): "The industry has not yet settled on one definitive title for the media of social and environmental disclosure" (p. 277). The challenge for mining companies is further complicated by the negative predisposition held my many stakeholders due to the nature and history of the mining industry (Fonseca, 2010).

Prior et al. (2012) acknowledges society's dependence on mining which creates a need for the activity. The demand for mining activities will continue. However, the growing concern over wider issues creates additional areas for mining companies to manage. Sustainability reporting is, thus, an important tool to balance interests.

Guthrie and Parker (1989) focuses on six main themes: environment, energy, human resource, products, community involvement, and other to capture remaining CSR disclosures. There has been significant growth since this initial study. Through understanding the themes and concepts that are already being reported, progress towards a unified understanding of sustainability disclosures can be made. The next section presents the methodology and method underpinning this research.

2.8 Summary

The purpose of this chapter was to review the literature on the evolution of sustainability. There was a specific focus on disclosure and the mining industry. This literature review was separated into three sections to provide an understanding of the relationship between sustainability and the mining industry.

The first section reviewed the evolution of sustainability. It discussed the multiple definitions of sustainability and the difficulty these create for implementing sustainability. It covered research on the growing popularity of the sustainability concept that has seen organisations invest in sustainable processes and incorporate sustainability into their external reporting. This section provided a framework for understanding sustainability in global mining organisations.

The second section covered the main theories underpinning sustainability, social, and environmental disclosures. This section looked at the research on the development of sustainability disclosures. The section also focused on the most dominant theories in stakeholder and legitimacy and concluded by justifying the main theory used in this study.

The final section concentrated on the mining industry and the incorporation of sustainability into disclosures and activities. Specifically, it looked at how the integration of social, environmental, and sustainability concepts will provide a better understanding of how the industry has advanced. This section identifies the concepts and themes that have already been studied in order to provide a foundation for this research. Before focusing on mining, the more general concepts and developments of sustainability were reviewed.

The literature review has revealed that prior research focused on the presence of sustainability disclosures (see Deegan et al., 2002; Gray, Kouchy & Lavers, 1995; Guthrie & Parker, 1989; Hackston & Milne, 1996; Hogner, 1982). The literature review showed that there has been limited research into the sustainability reporting of the mining sector as a whole. Most previous studies have focused on one or a narrow number of companies. Further, very few studies have investigated the concepts and themes used within sustainability reports.

Chapter 3 RESEARCH METHODOLOGY AND METHOD

3.1 Introduction

Research in education is a tool for learning (Ghauri & Gronhaung, 2010). The process enables researchers to work systematically and analyse issues or areas of interest. Research that follows robust methods results in greater understanding that ultimately expands knowledge. Collis and Hussey (2003) recognise research as "a systematic and methodical process of enquiry and investigation which increases knowledge" (p. 355). The methodology and method applied for the research will govern the usefulness and applicability of the findings. The method refers to the specific process undertaken. Whilst there are a multitude of approaches to take when carrying out research, a specific project will be grounded in a set of methodical principles to which a given research project adheres. The methodology and method applied for the research will govern the usefulness and applicability of the findings. The method refers to the specific process undertaken. Whilst there are a multitude of approaches to take when carrying out research, a specific project will be grounded in a set of methodical principles to which a given research project adheres.

The purpose of this chapter is to explain the positioning of the research and the process applied whilst conducting the research. The first section discusses some of the methodological paradigms commonly applied in research. Specifically, that section looks at the evolution of social research and the growing use of mixed method studies, a method that offers a hybrid approach between positivism and the traditional alternative paradigms. The second section outlines the method undertaken in this study. It first outlines the process used to select the mining companies used in the research, and then discusses the process used to analyse the collected data; the section finally discusses the process used to analyse the results. The third section outlines the research design for this study and justifies the study's chosen methods.

3.2 Research Methodology

According to Tashakkori and Teddlie (2003), there have been numerous changes in the methodology of social and behavioural research over the last 30 years. They recognise that these changes have influenced the purposes, worldviews, and methods of study. Early debate focused on the predominance of positivism-grounded quantitative methods and the emerging constructivism approach which applied qualitative methods (Gage,

1989; Datta, 1994; Morehouse, 1994; Tashakkori & Teddlie, 2003). Whilst the debate or 'wars' centred primarily on the merits of one approach and the weakness of the other (Gage, 1989; Datta, 1994; Morehouse, 1994), a third, mixed method, approach did emerge from this debate (Tashakkori & Teddlie, 2003).

3.2.1 Research paradigms

Different paradigms can be used when researching in the social and behavioural sciences, including accounting (Hooper et al., 2008). Paradigms represent a set of beliefs that guide action (Denzin & Lincoln, 2005). Furthermore, paradigms represent a set of overarching and interconnected assumptions about reality (Maykut & Morehouse, 1994). As a result, researchers ground their studies according to their experiences and worldviews.

According to Guba and Lincoln (1994), a paradigm is the worldviews or basic belief system that guides researchers and investigation. Burrell and Morgan (1979) recognise paradigms as "the very basic meta-theoretical assumptions which underwrite the frame of reference, mode of theorising and modus operandi of the social theorists who operate within them" (p. 25). Similarly, Guba and Lincoln (1994) and Creswell (2007) both recognise a paradigm as a consequence of the theorist's worldviews. Hence, each critical investigation has unique characteristics that underpin the research and govern the research process. The worldviews of the researcher will influence how he or she chooses to build knowledge as a consequence of his or her research findings (Guba & Lincoln, 1994). Without a consistent paradigm, methodology, and method, researchers cannot justify their findings as offering new knowledge.

Researchers acting within a paradigm will adopt a common set of philosophical beliefs and methodologies (Guba & Lincoln, 1994; Maykut & Morehouse, 1994). Traditionally, research was grounded in one of two approaches. Tashakkori and Teddlie (1998) present these two dominant paradigms as positivism and constructivism, whereas Guba and Lincoln (1994) defined the two main paradigms as positivism and naturalism. Maykut and Morehouse (1994) identify the two paradigms as positivist and phenomenological paradigms. Whilst different researchers attach different labels to the two major paradigms, they are inevitably variants of the main views of positivism and constructivism (Tashakkori & Teddlie, 2003).

3.2.1.1 Positivist paradigm

The positivist approach, or scientific approach, is recognised as the dominant paradigm and was the foundation of early research (Maykut & Morehouse, 1994), especially in 20th century behavioural and social sciences research (Tashakkori & Teddlie, 2003). This approach applies an objective enquiry using measurable variables and provable propositions or hypotheses. Research is concerned with the explanation and prediction of observable events. The researcher is objective and independent of the research (Maykut & Morehouse, 1994). Positivist researchers construct methods that ensure there is no personal influence or bias within the research process and employ value-neutral methods (Tashakkori & Teddlie, 2003). Through a systematic process and the breaking of parts into smaller components, the whole can be comprehended through an understanding of how the parts work.

Cause and effect relationships can be determined through the use of statistical processes to ensure results have not occurred by chance and are replicable by other researchers. The process allows for generalisability of the results and findings that are time- and context-free (Tashakkori & Teddlie, 2003). The positivist paradigm applies deductive logic using scientific methods that move from the general to the particular (Maykut & Morehouse, 1994). Researchers focus on specific measurable units of analysis and apply methods such as surveys, observational studies, and experiments. The main competing approach is the alternative paradigm (Maykut & Morehouse, 1994), and it is considered next.

3.2.1.2 Constructivist paradigm

The alternative paradigm is commonly referred to as the naturalist approach (Guba & Lincoln, 1994) or the constructivist paradigm (Tashakkori & Teddlie, 2003). Here, the focus is on understanding the meaning of an event or topic of inquiry. The researcher and the focus of study become coconstitutents. Constructivist researchers believe in multiple realities with the researcher being an important part of their reality. The researchers recognise that their values are important and influential in their research. Consequently, different researchers will construct different understandings of the same event because their past experiences will create a different reality. This variability makes generalisation difficult.

Inherent in this paradigm is a belief that cause and effect cannot be distinguished due to the multitude of variables that can and cannot be explained. The logic applied is

inductive; researchers follow the information that is discovered and explore emerging themes and trends. This process allows them to move from specific observations and findings to more general ones. Constructivist research focuses on, but is not limited to, people's words, actions, and communications to discover if there are patterns of meaning. A variety of methods can be used including in-depth interviews, focus groups, and document analysis.

3.2.2 Philosophical underpinning

The philosophical underpinning of any research is important as it helps to establish a basis for justifying the chosen research approach, and provides a framework for both resolving issues and the method of inquiry (Mayhut & Morehouse, 1994). These authors point out four philosophical areas related to research: *ontology, epistemology, logic,* and *teleology*.

Maykut and Morehouse (1994), initially followed by Tashakkori and Teddir (1998) and more recently Creswell (2007), provide consistent descriptions of these four areas; these views are summarised below:

- *Ontology* considers the nature of reality. This area questions the nature of the world, what is real, and what is required as evidence to support results or theories.
- *Epistemology* raises questions related to the origins and nature of knowing as well as the construction of knowledge. This philosophical question concerns the role values play in understanding, and the relationship between the knower and the known.
- *Logic* is concerned with the demonstration and verification of knowledge. Logic asks if the causal links between information are possible.
- *Teleology* looks at purpose. Specifically, it queries the purpose of the research and what contribution it can make to existing knowledge.

Understanding these four philosophical positions is important to understanding how knowledge is positioned and created.

Similarly, Guba and Lincoln (1994) establishes five axioms to distinguish each paradigm. They introduced a new axiom related to time and generalisations. This variable recognises that specific analyses of individual events are bound by the given context, while multiple events with a significant number of observations can be made time- and

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context-free. Tashakkori and Teddlie (1998) added a sixth axiom: inductive or deductive logic. This measure identifies the extent observations relate to their surrounding environment. Inductive logic draws on the specific and uses it to create a better understanding of the larger environment. In contrast, deductive logic takes and then simplifies a large number of general observations as a way to predict and understand individual occurrences.

When contrasted, the positivist and constructivist paradigms appear as distinct and alternative approaches with quite different philosophical foundations. Table 3.1 summarises their differences.

Table 3.1. Comparison of two traditional research paradigms.

Methodologies	Positivism	Constructivism
Ontology	Objective reality/objectivism	Subjective reality/subjectivism
Epistemology	The researcher and researched are independent.	The researcher and researched are inseparable.
Axiology	Research is value-free, free of bias.	Research is value-bound; research is linked with the bias of the researcher.
Causal Linkages	It is possible to have real causes that are either temporally precedent to or simultaneous with effects.	Causes and effects cannot be distinguished.
Generalisations	It is possible to have time- and context-free generalisations.	It is not possible to have time- and context-free generalisations.

The paradigm adopted by researchers is influenced by their past experiences, current worldviews, and research objective. Whilst the philosophical worldviews of the researcher are not directly visible in research and output (Slife & Williams 1995), they do have a significant influence over the methodology, research design, and methods adopted (Creswell, 2007). Researchers have traditionally fallen into two distinct groups in their approaches to research.

3.2.3 The paradigm debate

In recent years, debate has raged over which of the two paradigms is better or superior in terms of knowledge construction (Datta, 1994; Gage, 1989; Guba & Lincoln, 1994; Moreouse, 1994). Despite their differences, each paradigm has been effective in expanding human knowledge in ways that the alternative paradigm could not (Tashakkori & Teddlie, 1998). Furthermore, each camp has been critical of the other's approaches and has questioned the validity of its rival's output and findings (Tashakkori & Teddlie, 2003).

The debate over qualitative and quantitative methods is a consequence of the underlying paradigm within which the researcher is grounded; "questions of method are secondary to questions of paradigm ... not only in choice of method but in ontologically and epistemologically fundamental ways" (Guba & Lincoln, 1994, p. 105). Tashakkori and Teddlie (1998) note the strong associations in the literature between positivist and quantitative as well as constructivist and qualitative approaches.

The debate over paradigms has extended into research methods, with issues often identified at the qualitative and quantitative research method level. However, Guba and Lincoln (1994) suggest that both qualitative and quantitative methods can be applied to any research paradigm. The method used can be adapted to the paradigm and worldviews underpinning the research.

It has been argued that quantitative research does not fully recognise context, or that the setting of the research can influence the findings or results (Creswell & Clarke, 2011). Creswell and Clarke (2011) note that participants' voices are not directly heard or visible. Additionally, researcher bias or interpretation is seldom discussed or recognised in the research, yet these can have a significant impact in the research process.

Concerns have been raised about both positivism and quantitative research and constructivism and qualitative research. One major criticism of the constructivist approach is the claim that, because of researcher involvement, qualitative method findings are difficult to generalise. The possibility of creating biased interpretations and the often small number of participants in a study are also cited as weaknesses in the approach (Creswell & Clarke, 2011).

3.2.4 The new paradigm

Tashakkori and Teddlie (1998) recognise that research methodologies have developed over recent years and they introduce two additional emerging paradigms: the postpositivist and the pragmatic. The introduction of postpositivism recognises that adopting a purely positivist approach to research is extremely difficult (Guba & Lincoln, 2005). The demanding details required for positivist research make it extremely difficult for researchers to stay within the traditional framework; hence, the paradigm has been adapted to apply more workable guidelines. Furthermore, the new variation has addressed issues often criticised by researchers wedded to the alternative paradigm (Mayhut & Morehouse, 1994).

Tashakkori and Teddlie (1998) note that paradigm purists, who operate within a single paradigm, believe that the defining elements of each paradigm make it impossible to merge the main methods of research. They recognise that the theory underlying both quantitative and qualitative methods will not succeed. Their argument is based on the premise that their underlying philosophies differ. Despite the strengths of both approaches, additional paradigms have emerged in the forms of pragmatism (Tashakkori & Teddlie, 1998; Tashakkori & Teddlie, 2003; Creswell, 2007; Creswell & Clark 2011); critical theory (Guba & Lincoln, 2005); constructivism (Guba & Lincoln, 2005); and, the participatory or advocacy paradigm (Creswell, 2007). The following sections will look at pragmatism as the third possible paradigm.

During the mid-20th century many researchers framed the paradigm debate as a two-sided issue (Trow, 1957; Howe, 1988; Brewer & Hunter, 1989). The narrow approach of a single paradigm and the arguments between the two approaches prevented the use of a variety of conceptual and methodological tools for understanding the complexity of problems (Trow, 1957). Howe (1988) questioned why this narrow debate over paradigms should determine the type of investigation that a researcher could design:

> But why should paradigms determine the kind of work one may do with inquiry and more that the amount of illumination should determine where one may conduct a search? . . . Eschewing this kind of "tyranny of method" (Bernstein, 1983) – of the epistemological over the practical, of the conceptual over the empirical – is the hallmark of pragmatic philosophy. (p. 13)

A multimethod approach allows researchers to use a variety of techniques to better solve problems. Brewer and Hunter (1989) recognise that the multiple method approach

enables researchers to "attack a research problem with an arsenal of methods that have no overlapping weaknesses in addition to their complementary strengths" (p. 17). This approach places greater emphasis on the research question rather than on the method or worldviews that underpins the method and methodology (Tashakkori & Teddlie, 1998).

The pragmatic paradigm offers an alternative approach to other traditional one-dimensional paradigms. It rejects the earlier thinking that required research to be either positivist or constructivist (Tashakkori & Teddlie, 1998). A multimethod approach allows researchers to apply inductive and deductive logic. In addition, researchers can use both subjective and objective points of view. The table below identifies the key elements of the four methodological approaches mentioned above.

Table 3.2. Comparison of four paradigms used in social and behavioural sciences.

Paradigm	Positivism	Postpositivism	Pragmatism	Alternative
Research Methods	Quantitative	Primarily quantitative	Quantitative and qualitative	Qualitative
Logic	Deductive	Primarily deductive	Deductive and inductive	Inductive
Epistemology	Objective point of view. Knower and known are a duality	Modified dualism Findings are probably objectively "true".	Both objective and subjective points of view	Subjective point of view. Knower and known are inseparable
Axiology	Inquiry is value-free	Inquiry involves values, but they must be controlled.	Values play a large role in interpreting results.	Inquiry is value-bound.
Ontology	Naïve realism	Critical or transcendental realism	Accepts external reality. Chooses explanation that best produce desired outcomes.	Relativism
Causal linkages	Real causes prior or simultaneous with effect	There are some lawful, reasonably stable relationships among social phenomena. These may be known imperfectly. Causes are identifiable in a probabilistic sense that changes over time.	There may be causal relationships, but it will never be possible to pin them down.	All entities are simultaneously shaping each other. It is impossible to distinguish causes from effects.

This chapter earlier stated that the research methodology chosen was dependent on the researcher. Depending on the researchers' worldview and the subsequent paradigm they operate within, a method and approach that best allows them to increase knowledge in a chosen field will be applied. Researchers will generally stay within one paradigm; they are not, however, bound by that paradigm. There is freedom to change their worldviews as their knowledge and research develop. This freedom can be seen in the increased number of pragmatic worldviews which adopt mixed methods research (Tashakkori & Teddlie, 1998; Creswell, 2007; Ghari & Gronhaug, 2010; Creswell & Clark, 2011). The research design adopted for any research can be purely quantitative, purely qualitative, or any combination of the two which the researcher requires. Under a pragmatic worldviews researchers use different combinations of mixed methods when striving to best understand a research problem and advance knowledge.

The evolution of the pragmatic worldviews means that it is now widely adopted in research (Creswell & Clark, 2011). It offers an alternative to the two early approaches and overcomes the weaknesses of both methods (Creswell, 2007; Creswell & Clark, 2011; Tashakkori & Teddlie, 1998). "Pragmatists agree that research always occurs in social, historical, political and other contexts" (Creswell, 2007, p. 11). Pragmatism allows flexibility (Creswell, 2007). This flexibility allows research to be conducted using only one or a combination of qualitative and quantitative assumptions and methods. Researchers resolve the issue of how to best understand the problem and apply the most effective means available by looking specifically at *what* and *how* to research. Creswell concludes that within this framework, multiple methods, along with different worldviews, assumptions, and forms of data collection and analysis are possible, provided they are justified.

3.2.5 The approach taken in his research

This study adopts a mixed method approach grounded in a pragmatic philosophical worldviews because a variety of methods can be applied to better understand the similarities and differences in sustainability reporting. Furthermore, this research design allows for additional research which goes beyond the initial exploratory study and explores specific organisations in further detail.

The research focuses primarily on the study of the words, themes, and concepts in sustainability reports. The study of the language is based in the qualitative research paradigm. Words are analysed using a variety of methods including content analysis.

While this approach follows a qualitative-based research method, the study's use of statistical measures also incorporates quantitative research; both are approaches to content analysis (Neuendorf, 2001; Krippendorff, 2004). Building on the content analysis provided by Leximancer (a software program), the research uses thematic analysis to investigate the sustainability reports, focusing on the relationship between words, concepts, and themes as they appear in the text.

Despite the inherent paradox between sustainability and mining, the purpose of this study is to explore the sustainability reporting practices of mining companies. The sustainability reports of global mining companies are analysed using computer-aided content analysis software to capture their language, concepts, and themes. The thematic analysis of Leximancer's data includes a comparison of the similarities and differences of the mining companies' reporting practices. Greater detail on the different levels of analysis and the use of Leximancer software is presented in the next section, which also outlines the background to the method and the design applied in this research.

3.3 Research Method

This inquiry provides a unique analysis of the mining industry's commitment towards sustainability through its examination of sustainability reports and its use of innovative research methods. It aims to reveal the extent of mining companies' sustainability practices and their willingness to engage in 'strong' sustainability. Careful research preparation and design are fundamental to ensuring that meaningful analysis can be conducted and these issues are considered next.

3.3.1 Research preparation

This research focuses on sustainability disclosures by large mining companies around the world. Specifically, it looks at the disclosures made in sustainability reports or equivalent publications. In preparation for this research, an extensive literature review was undertaken of three distinct areas.

First, the literature review examined the evolution of sustainability and covered the many different definitions of sustainability. It also revealed the developments in sustainability and disclosures that have led to sustainability's becoming a major focus of business in the 21st century.

Second, the review presented two theories underlying organisations' sustainability disclosures. Literature on both stakeholder theory and legitimacy theory relating to sustainability reporting was reviewed. The literature identified the emergence of sustainability as a dominant reporting tool for discharging accountability and maintaining legitimacy.

Third, the literature on sustainability reporting by mining companies was reviewed. The initial search focused on social and environmental disclosures, before later expanding to cover studies of sustainability disclosures. Studies investigating sustainability disclosures within annual reports (see Deegan et al., 2002; Gray, Kouchy, & Lavers, 1995; Guthrie & Parker, 1989; Hackston & Milne, 1996; Hogner, 1982) were reviewed; however, these studies all focused on either a single or a small number of organisations only.

More recent studies included a wider focus (see Coetzee & van Staden, 2011; Fonseca, 2010; Jenkins & Yakovleva, 2006; Peck & Sinding, 2003; Perez & Sanchez, 2009) investigating a greater number of organisations and including separate sustainability reports. The literature review did reveal one significant variation between the details in the information disclosed by mining organisations (Jenkins & Yakovleva, 2006; Yongvanich & Guthrie, 2007). The larger studies provided more depth and detail regarding the nature of sustainability disclosures (Perez & Sanchez, 2009; Coetzee & van Staden, 2011).

The literature review did not identify any study or research that looked specifically at the relationship between concepts within sustainability disclosures across multiple organisations. It also failed to reveal specific trends or common themes within sustainability disclosures.

The literature review identified a gap in the accounting literature, creating the opportunity for a new area of study. The key research objectives for this research are, therefore, to:

- understand the sustainability disclosures of leading companies within the mining industry
- establish the main concepts and themes within sustainability disclosures
- compare and contrast the different sustainability disclosures of different mining organisations

- contrast reporting practices of companies that have established sustainability reporting practices with those of companies which have recently engaged in sustainability reporting
- make recommendations about sustainability disclosures based on this of global mining companies.

These research objectives produced the following research questions and these were used to guide the research design, data collection process, and data analysis. The study, therefore, asks:

1. What are the dominant and common concepts and themes within mining sustainability reports?
2. What are the similarities and differences in the sustainability reporting practices of the leading mining companies?
3. How does the sustainability reporting of mining companies change over the period examined in the study?
4. Are there differences in the sustainability reporting of established mining companies compared to those of new mining companies?
5. What is the overall current state of sustainability in the mining industry and how has this position changed from that seen in earlier studies?

The research objectives and questions provided the basis for the selection of the most appropriate research method. The process used to determine the most appropriate method to provide meaningful findings that would contribute to the existing knowledge on mining sustainability reporting is explained below.

3.3.2 Research design

To answer the research questions, a pragmatic approach was applied to the research methodology. Taking a pragmatic worldviews allows for a multimethod approach to exploring the sustainability reporting practices of mining companies (Tashakkori & Teddlie, 1998; Creswell, 2007; Ghari & Gronhaug, 2010; Creswell & Clark, 2011).

Selecting mixed methods provides the researcher with a wider choice of techniques. Adopting different perspectives enables richer information to be obtained, which, in turn, leads to more substantiated conclusions. The study of discourse, specifically text, is primarily the study of qualitative data. The input data can be interpreted using a variety of methods and approaches including quantitative analysis. This research applies both

content and thematic analysis to data produced from Leximancer software; this form of analysis is outlined in greater detail in the remainder of this section.

3.3.2.1 Content analysis

A content analysis can be used to analyse any published document (Bouma & Ling, 2004). Kondracki, Wellman, and Amundson (2002, p. 224) define a content analysis as a "process for systematically analysing messages in any type of communication." Content analysis is a research technique that makes "replicable and valid inferences from data according to their context" (Krippendorff, 1980, p. 21).

The history of content analysis became more widely recognised in the mid-20th century (Krippendorff, 2004). According to Krippendorf (2004), content analysis emerged out of an early 20th century journalistic analysis tool. Journalism students and researchers used this approach to summarise stories and investigate the focus or emphasis of newspapers. They used quantitative methods to summarise and categorise large bodies of text. Content analysis is a tool for studying both the text and its meaning; hence, a content analysis can apply both quantitative and qualitative approaches (Krippendorff, 2004; Neuendorf, 2001).

Use of this analysis technique expanded beyond journalism and mass communications studies to include psychiatry, psychology, history, anthropology, education, philology analysis, literary analysis, and linguistics (Stone, Dumphy, Smith, & Ogilive, 1966). The wide and varied uses of content analysis have allowed researchers in various different social sciences. The application of the technique in social and behavioural science fields such as health and nursing (Elo & Kyngas, 2007; Graneheim & Lundman, 2003), and nutrition (Kondracki, Wellman and Amundson, 2002) has increased the credibility of this research method.

Content analysis-based research is held to be empirically valid in social and environmental reporting research areas where disclosures are largely voluntary (Gray et al., 1995; Guthrie & Parker, 1990; Guthrie et al., 2004). It has also been widely used in accounting fields such as annual reporting (Beattie, 2005; Gray et al., 1995; Guthrie & Parker, 1990; Guthrie et al., 2004); CSR (Beattie & Thomson, 2007); and, intellectual capital (Campbell & Rahman, 2010). A content analysis is recognised as one of the most common research methods for assessing organisations' social and environmental disclosures (Milne & Adler, 1999). However, Beattie and Thomson (2007) noted that,

while the use of content analysis in the field of CSR and sustainability is more established, it requires greater transparency.

A content analysis can be conducted on many forms of data (Elo & Kyngas, 2007; Weber, 1985) applying various forms of analysis (Joseph & Taplin, 2011). While each study is unique, they all follow a similar process to ensure results are meaningful. According to Krippendorff (2004), using content analysis provides a number of benefits because content analysis procedures:

- operate directly upon the text/communication
- can potentially use both qualitative and quantitative analysis, if designed correctly
- allow comparison of documents over time and from different areas
- can assess the relationship between different factors
- can be conducted on unobtrusive measures – as both the sender and receiver of the communication are aware that it is being analysed.

Despite its many benefits, content analysis requires methods that ensure the results are reliable. Consequently, there are some issues related to the use of content analysis (Krippendorff, 2004). These include the fact that:

- breaking down words of the text into smaller units can be subjective and can change their meaning
- documents can be simplified and lose meaningful information
- if designed poorly, the findings are only qualitative or quantitative.

Content analysis can provide meaningful data, provided a clear method is adopted and analysis does not go beyond the limitations of the approach or apply causal relationships. This proviso can be achieved by determining and following a clear process from the outset. Whilst the process is standardised, it needs to be modified according in line with two main considerations. The first concerns is choosing a framework that to provide quantitative, qualitative, or combined level of analysis. The second centres on whether the content analysis is conducted manually or using computer software. Before presenting the process of this research in greater detail, both considerations need to be addressed more fully.

Qualitative and quantitative content analysis

Content analysis can apply various methods depending on the research objective. This form of analysis codes text (or content) into various groups (or categories) according to selected criteria or coding rules (Weber, 1985). Qualitative and quantitative data can be coded into predefined categories in order to determine patterns in the presentation and reporting of information (Guthrie et al., 2004).

Content analysis can be grounded in any research paradigm and can use quantitative and qualitative methods of inquiry. Elo and Kyngas (2007) discuss the process of conducting content analysis using both inductive and deductive approaches. They identify three main phases that are consistent across both approaches: preparation, organising, and reporting. The authors note that works on content analysis focus predominantly on quantitative methods and provide only brief descriptions on qualitative approaches.

Quantitative content analysis

The more traditional quantitative content analysis, termed a manifest content analysis (Kondraki et al., 2002; Krippendorff, 2004; Neuendorf, 2001), places most of its focus on the physical aspects of the text. This approach examines the actual presence and literal meaning of text. Analysis is at the surface level and reports on what can be directly measured or examined. The most common measure is a frequency count (Joseph & Taplin, 2011) or word count (Kondraki et al., 2002). This approach uses a simple and direct measure of the content of a text; hence, it provides an objective and easily repeatable coding method. This type of content analysis allows the message elements to be counted to determine themes, different emphases placed on ideas, and the amount of space allocated to each topic (Kondraki et al., 2002).

A quantitative content analysis generally applies a deductive methodology (Elo & Kyngas, 2007; Kondracki et al., 2002). This approach requires a researcher to use previous knowledge to determine coding schemes when performing the content analysis (Elo & Kymgas, 2007). In addition to drawing on the literature and existing knowledge, first running a pilot study to see what categories, key words, and themes emerge is effective as the starting point for determining the coding process (Kondraki et al., 2002).

Researchers have applied different methods to measure the magnitude of the disclosure (Joseph & Taplin, 2011). These authors identify that content analysis has been

conducted in one of two main ways: disclosure abundance and disclosure occurrence. Disclosure abundance is a traditional content analysis that measures the number or volume of a specific word or concept. In contrast, a disclosure occurrence measures the presence of a pre- established word or concept within data. A study using both methods to measure sustainability disclosures on Malaysian local government websites found that disclosure occurrence provides a more predictable measurement of sustainability reporting on websites (Joseph & Taplin, 2011).

When the volume of data is small, the difference between the two approaches reduces. However, as more data is analysed, each approach presents different findings. More data can show different volumes of words or concepts, and, using the abundance approach, where emphasis has been placed by the authors. However, in the occurrence approach, richer data can be found in terms of which specific list terms have been used. Both approaches are identified as legitimate in that they measure the extent of disclosures, but measure different concepts (Joseph & Taplin, 2011). Determining the volume is a purely quantitative measure; however, capturing specific occurrences of established words or concepts presents richer findings that can be used to generate qualitative output.

Qualitative content analysis

Qualitative approaches use a latent content analysis (Kondraki et al., 2002). This approach studies the inferred meaning (Kondraki et al., 2002) and allows a more in-depth investigation of the text. A latent content analysis is more complex but produces richer data and findings. Words and concepts can be explored within and between sentences. The relationship between different words and concepts can also be explored to show not only what has been included but the emphasis placed on these terms, thus going beyond the sheer volume of a term's usage. Understanding the relationship between concepts can reveal themes within the text. Such findings allow greater inference and offer a more in-depth analysis than is possible with quantitative data.

Each approach can produce accurate and meaningful data. However, one of the issues with all content analysis is the time taken to code documents, as well as the consistency and accuracy of coders. Consistent and reliable methods ensure the accuracy of results but they involve time and human effort. Alternatively, content analysis can be performed using computer-based programs.

Manual and computer-aided content analysis

Content analysis can be conducted manually or with the aid of computer software. Both approaches follow similar processes and designs. The fundamental difference lies in whether the reviewing of the document is done by a human reviewer or computer software. The method is, therefore, modified in line with the approach taken. The following paragraphs outline reasons for choosing or rejecting either approach.

Manual content analysis

When performing a manual content analysis, a researcher or multiple researchers will manually review the material and code the document. According to Bouma and Ling (2004) one of the most important steps is to establish clear criteria for recording data. Ensuring robust criteria for manual coding minimises potential subjectivity (Smith & Humphreys, 2006). Whilst research methods can be used to ensure consistency and reliability, the nature of documents analysed means that they do not always fit into the pre-established criteria and, therefore, require a degree of researcher judgement.

The influence of the human decision maker on the research cannot necessarily be identified (Nisbett & Wilson, 1977). Therefore, individuals may code the same document differently, despite using the same criteria. Furthermore, manual processing is time-consuming. Smith and Humphreys (2006) recognises that there are subjectivity issues when coding. Human coders need to remain constant throughout the coding process. Having multiple coders offers one way to overcome the time taken. This option allows more material to be coded, but introduces possible variability between coders.

One further factor related to time is the unit of analysis. Human coders will code the document at a page, half page, paragraph, or sentence level (Krippendorff, 2004). The smaller the block of text analysed, the more time it will take to complete the process.

Until recently, a manual content analysis was the only approach available when doing this form of research. Thus, robust methods had to be employed to ensure the accuracy and validity of the data recorded. However, technological advancements have made it possible to perform content analysis using computer software.

Computer-aided content analysis

A number of different software programs have been developed to run content analysis. Computer-aided content analysis still, however, requires manual data preparation. The initial process is similar to that used for manual content analysis but differs in that the

data is processed and analysed using software and algorithms (Adam, Gibson, Strong, & Lyle, 2009; Crofts & Bisman, 2010).

A computer-aided approach provides an automated way of analysing text, and eliminates the subjectivity of human decision makers (Smith & Humphreys, 2006). Moreover, Penn-Edwards (2010) suggests computer-aided coding is more efficient than manual coding, as it allows the researcher to analyse data without personal bias. It also increases the reliability and transparency of academic research, while facilitating reproducibility (Crofts & Bisman, 2010; Penn-Edwards, 2010). Lastly, it reduces the chance of missing themes that could have been overlooked if the data was coded incorrectly (Crofts & Bisman, 2010).

Numerous computer-based programs have been developed; they have provided researchers with new tools to understand large quantities of data. Kwon, Barnett, and Chen (2009) conducted a content analysis on different translations of the Universal Declaration of Human Rights. Their study compares the ZIPF software program, which was able to conduct a multilanguage analysis, with other programs like WORDLINK. They also employed programs, including UCINET, to construct concept maps and conduct further analysis. WORDLINK software applies a co-occurrence model (Kwon, Barnett & Chen, 2009). CATPAT is another computer-aided content analysis that looks at the word level of analysis (Kwon, Barnett & Chen, 2009) as does Leximancer (Bouma & Ling, 2004). Co-occurrence looks at the relationship strength and repetition between all possible word pairs (Danowski, 1993).

Benefits of using a computer-based approach include a reduction in human-coding subjectivity, and the time and money required to manually conduct the process (Smith & Humphreys, 2006). The software used to process large volumes of text is consistently applied from the first to last section of the document. No bias or fatigue can result, as can happen with human coders. Further, the software can analyse documents in a fraction of the time it takes to review them manually.

This research project used Leximancer software to conduct the content analysis because that software can conduct an automatic content analysis. Smith and Humphreys (2006, p. 262) note that the "Leximancer system performs a style of automatic content analysis." This form of content analysis goes beyond traditional approaches. It carries out key word searches by producing concept co-occurrence information as well as visual summaries in the form of a concept map.

Content analysis process

Researchers determine the nature and complexity of a content analysis in light of their research focus and the resources available (Neuendorf, 2001; Krippendorff, 2004). Both Neuendorf (2001) and Krippendorff (2004) recognise that the use and accuracy of content analysis vary depending on the time, funds, and precise focus of the researcher or research team.

The process of performing a content analysis requires the document to be broken down into manageable segments as determined by the researcher (Weber, 1985; Wellman & Amundson, 2002). Content segments vary according to the research objectives and can be broken down into words, sentences, paragraphs, pages, as well as phrases, theories, topics, concepts, and any other characteristics being analysed (Kondracki et al., 2002; Beattie & Thomson, 2007; Joseph & Taplin, 2011). Once identified and recorded, dominant components of the discourse are interpreted and discussed by the researcher (Leximancer Manual v3). This approach allows for a comparative analysis through examining the similarities and differences between groups (Weber, 1985).

A content analysis is an observation (Bouma & Ling, 2004) and an unobtrusive (Krippendorff, 2004) way to examine documents and publications. The first step is to establish the categories of classification. According to Guthrie et al. (2004), for content analysis to be effective, the following criteria should be met:

1. The categories of classification must be clearly and operationally defined
2. The classification into a particular category must be objective
3. The information needs to be able to be quantified
4. A reliable coder is necessary to uphold consistency.

When coding manually or using a computer, one of the main issues is defining the unit of analysis. Given the multiple approaches to conducting a content analysis, Bouma and Ling (2004) identify the steps required in conducting a manual content analysis and the importance of establishing clear criteria for recording data.

The first process of the content analysis, and any form of research, is to identify what is to be observed and how the observations are to be recorded (Krippendorff, 2004). This process requires the identification of different units. The sampling unit identifies the section of data or text to be included in the content analysis (Krippendorff, 2004). The

recording or coding unit is the section of text to be described or categorised (Krippendorff, 2004).

The choice of the unit of analysis is one of the most important choices in a content analysis (Campbell & Rahman, 2010). The choice needs to best represent the text without sacrificing the information's context (Beattie & Thomson, 2007; Campbell & Rahman, 2010). There are a variety of units of analysis; each has advantages and disadvantages. The most common units are:

- word
- sentence
- paragraph
- page proportion
- clause/phrase.

The option chosen will depend on the researcher's intended output data as well as the most effective approach to capture the meaning, or themes, or position of the discourse.

One approach to conducting a content analysis is selecting the word level. At its simplest, this analysis might highlight the presence of a specific word within a body of text, or the total number of times a word appears. However, specific words, when coded, can appear out of context (Campbell & Rahman, 2010, Milne & Adler, 1999; Sonnier, Carson, & Carson, 2008). A further issue with the word level is that the meaning of the word can be ambiguous and the intent of the writer can be lost. Focusing at the word level is also time-consuming.

Recording at the sentence level is seen as the most reliable measure (Milne & Adler, 1999). Focusing on sentences reduces the level of ambiguity, increases the intercoder reliability, and considers the sentence's context (Campbell & Rahman, 2010). This approach reduces both the extent and the detail of information the coder records. However, issues can arise if there are multiple meanings within one sentence or a need to infer meaning when a sentence forms part of a larger narrative (Beattie & Thomson, 2007; Campbell & Rahman, 2010; Steenkamp & Northcott, 2007; Weber, 1990). Boggs (2000) also recognises that different writers' varying of sentence length and structure can influence the information contained within the text. A more straightforward method is, therefore, to code at either the paragraph or page level.

Analysing at the phrase or clause levels offers another alternative (Beattie & Thomson, 2007; Campbell & Rahman, 2010). This level separates units according to their meaning in relation to a specific subcategory rather than using the structure of the text to determine the unit; "This offers the advantage of categorising the totality of narrative without the constraints of having to allocate meaning by words, sentences or paragraph" (Campbell & Rahman, 2010, p. 60). Whilst this approach better captures the meaning of the text, it requires coder judgement to determine each separate meaning within the text.

Having determined the unit of analysis, a coder then reviews the document and records the different units and their frequency. After reviewing the document, the count for each unit can be determined and used for further analysis. Computer-aided content analysis can be used to look at the count or frequency of words within the text. The software can now not only analyse words but also sentences and paragraphs, and the different words and concepts within the text. This research uses Leximancer software to perform the initial content analysis. The software also provides additional examination beyond a typical content analysis. By identifying themes based on the relationships between individual concepts within the analysed text Leximancer provides additional examination which goes beyond more traditional content analysis. The next section deals with thematic analysis.

3.3.2.2 Thematic analysis

Leximancer software can be used in a variety of different ways. Whilst marketing itself as content analysis software, the program offers more than a traditional content analysis in that it pays greater attention to qualitative characteristics of the material (Joffe & Yardley, 2003).

Thematic analysis is defined as an exploration of the themes within the data (Bryant, 2006) and this approach focuses primarily on the themes within text or discourse. Braun and Clarke (2006) suggest thematic analysis is a means of identifying, analysing, and reporting themes that occur within data. The method allows the researcher to organise multifaceted findings and present them in a logical manner (Attride-Stirling, 2001; Braun & Clarke, 2006). Through exploring themes, researchers attempt to record both message and intended meaning.

Thematic analysis can be useful in understanding the general or overarching ideas; however, it is often makes distinguishing the finer details difficult. A thematic analysis provides a way to understand and analyse qualitative data (Hartman & Conklin, 2012).

According to the authors, the analysis can help the researcher to recognise themes and patterns that appear within information. Attride-Stirling (2001) recognises that thematic analysis allows greater understanding of wider issues from within disclosures.

While thematic analysis is widely used, it has been criticised. Braun and Clarke (2006) maintain the technique is relatively ambiguous, as there is no precise agreement as to what constitutes the thematic analysis. When processing qualitative data, researcher subjectivity can result in different interpretations, create consistency issues, and present difficulty regarding replication (Attride-Stirling, 2001; Braun & Clarke, 2006). For the purpose of this study, these limitations are minimised through the use of Leximancer.

3.3.2.3 Conclusion

In order to address the research questions posed earlier, this study employs Leximancer for its concept and thematic analysis. In this way, the current research differs from a large number of previous studies on social and environmental disclosures (Hogner, 1982; Guthrie & Parker, 1989; Deegan, Rankin & Tobin, 2002). Using computer software allows for more accurate processing and reduced processing time compared to manual analysis. An additional benefit includes higher levels of analysis and comparison between categories, a benefit which is not easily achieved without computer processing. The specific research design used in this research is outlined in the next section.

3.3.3 Research process

Following the research preparation, the research took a pragmatic approach, applying mixed methods, to analyse sustainability reporting in the global mining industry. The research methodology adopted is based on qualitative and quantitative analysis of mining sustainability reports using Leximancer computer software.

The research method was broken into four stages, as outlined in *Figure 3.1*. Stage I was concerned with identifying a sample of large global mining organisations. Stage II consisted of the collection of sustainability reports. Stage III comprised the processing of the sustainability reports using Leximancer software. Stage IV included the evaluation of the content and thematic analysis.

Figure 3.1. Summary of research stages undertaken in this research.


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┌─────────────────────────────────────────┐
│   Data Preparation and Method Selection  │
└─────────────────────────────────────────┘
                    ⬇
┌─────────────────────────────────────────┐
│  Stage I. Sample Selection:              │
│      •  Identify mining organisations.   │
└─────────────────────────────────────────┘
                    ⬇
┌─────────────────────────────────────────┐
│  Stage II. Data Collection:              │
│      •  Source and download sustainability │
│         reports in PDF format.           │
└─────────────────────────────────────────┘
                    ⬇
┌─────────────────────────────────────────┐
│  Stage III. Data Processing:             │
│      •  Leximancer analysis              │
└─────────────────────────────────────────┘
                    ⬇
┌─────────────────────────────────────────┐
│  Stage IV. Analysis, Evaluation, and     │
│  Conclusion:                             │
│      •  Statistical inference            │
│      •  Conclusion                       │
└─────────────────────────────────────────┘
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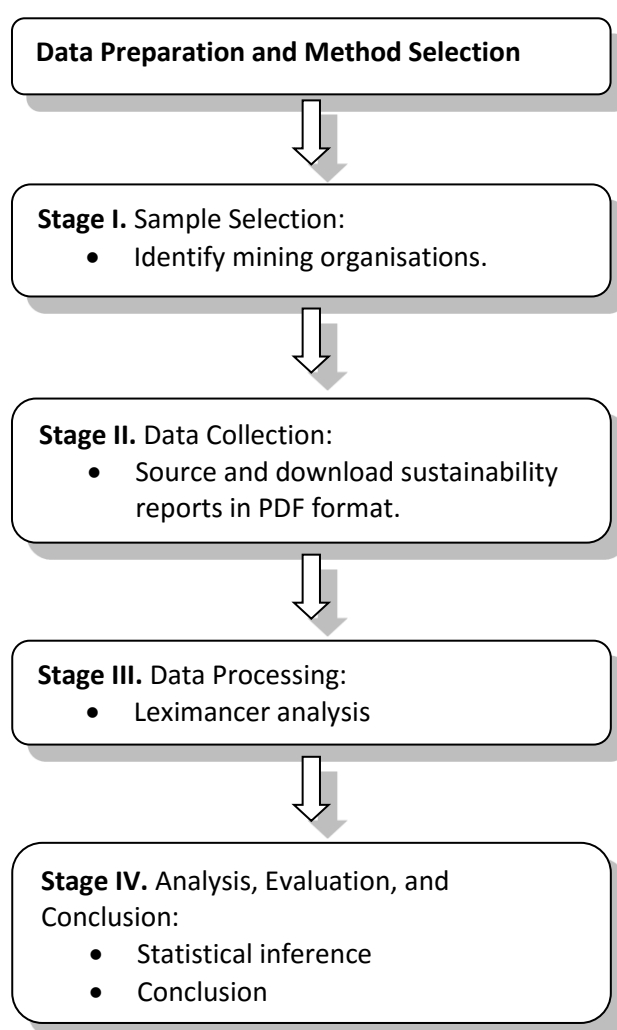
3.3.3.1 Stage I: Sample Selection

The literature review did not identify any previous research that had looked at multiple companies over a 4-year period. There was, therefore, no existing method or sample selection process to replicate. As a result, the process outlined below was developed to provide a wide and diverse research sample. The first phase in the sample selection was to generate a population of companies.

An initial online search identified the largest mining companies. Large mining companies were selected, because the literature review identified size and profit as predictors of sustainability reporting to a given point (Deegan & Gordon, 1996; Gray et al., 2001; Jones et al., 2007; Patten 1992). Identifying mining companies that matched these characteristics increased the likelihood of the company producing sustainability reports. The search identified two prominent sources of information about the mining industry online.

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The first was a website for the International Council on Mining and Metals (ICMM). According to its website, "ICMM is an international organisation dedicated to improving the social and environmental performance of the mining and metals industry" (www.icmm.com). The organisation was founded in 2001 by stakeholders associated with the mining industry. Mining companies can join the ICMM provided they follow a documented process and fulfil member commitments which include reporting. Organisations that are members of the ICMM are required to implement the ICMM Sustainable Development Framework which is based primarily on GRI reporting standards adapted for the mining and metals sector (icmm.com, 2012). The ICMM had 7 founding companies; since then an additional 15 companies have joined.

ICMM annually reviews the sustainability publications of its member organisations. Selecting ICMM members for this research guarantees having mining companies that produce sustainability reports as part of their ongoing commitment. Included within the ICMM member companies are six companies that joined the ICMM between 2009 and 2013. These companies produce an interesting point of comparison with the more established members. Choosing the ICMM companies provided one source of companies; however, given that these companies are required to meet the same minimum standards, the sample could include biases. Therefore, additional companies were required to increase of the overall sample size and to include companies not influenced by a third party.

Further online searches identified a PriceWaterhouseCoopers (PwC) annual publication entitled 'Mine.' PwC annually reviews global trends in the mining industry on the basis of the largest 40 mining companies. The list of 40 companies changes each year according to company performance and position. The report focuses on current and topical aspects relevant to the industry. Whilst sustainability is included within the report, there is no yearly in-depth review of the companies. The PwC list included companies that were ICMM members. These two online sources provided a basis for selecting the population of mining companies to study.

The fact that relatively few large mining companies produce sustainability required a nonrandom sample selection method. Consequently, both the ICMM member organisations and the PwC top 40 list of mining companies were used to generate a sample of mining companies. The small number of ICMM members meant all of them could be used. Included on the ICMM website disclosures was the year the companies

joined. The member companies could thus be split according to their length of membership. This distinction would potentially provide an interesting comparison between established ICMM members which had been producing sustainability reports for a longer period and those that had recently joined and started to produce sustainability reports.

According to the ICMM online publications, ICMM had 19 member organisations in 2009 (including 3 members which had joined in 2009). Between 2009 and 2013, three additional companies joined. Also within that period, two companies merged. This merger effectively created 22 possible companies to study. On the basis of their 2012 ICMM membership, members could be categorised as existing members and new members. New members would consist of the 3 which joined in 2009 and the additional 3 that had joined by 2012.

Comparable non-ICMM member companies were sourced from the annual PwC mining study. For the PwC top 40 companies, a selection criterion was established: only mining companies that appeared on the 2009 and 2013 PwC lists were considered. Excluding ICMM member companies, there were 14 additional companies in the PwC top 40 list for 2009 and 2013.

Overall, the study identified an initial sample population of 36 mining companies from the International Council on Mining and Metals' (ICMM) membership and the PwC top 40 largest mining company annual list. Organisations were categorised into three groups: pre-2009 members of ICMM, joining members for the period 2009 to 2013, and non-ICMM members that appeared in the PwC list only. *Table 3.3* below provides a summary of the sample mining companies used in this research.

Table 3.3. Mining companies by membership classification.

Existing ICMM Members	New ICMM Members	Non-ICMM Members
Anglo America	African Rainbow Minerals	Antofagasta plc
Anglo Gold Ashanti	Areva	China Coal Energy
Barrick	Codelco	China Shenhua Energy
BHP Billiton	Goldcorp	Eldorado Gold Corp
Freeport-McMoran	Hydro	Fortescue Metals Group
Gold Fields	Minerals & Metals Group	Grupo Mexico S.A. de CV
Inmet Mining		Impala Platinum Holdings
JX Nippon Mining & Metals		Jiangxi Copper Company
Lonmin		Kinross Gold Corporation
Mitsubishi Materials		Newcrest Mining
Newmont		Potash Corporation
Rio Tinto		The Mosaic Company
Sumitomo Metal Mining		Yamana Gold Inc.
Teck		Zijin Mining Group Company
Vale		
Xstrata		

A full list of companies, their profiles, and report dates can be found in Table 4.6. A full of the sustainability reports can be found in Appendix C.

3.3.3.2 Stage II: Data collection

After establishment of the sample of mining companies, the next step was to determine the type and period of sustainability disclosures. The current subsection, therefore, outlines the method of selecting the sustainability reports. To ensure the reports analysed for this research are similar in nature, the content and period of the reports needed to be consistent.

Report definitions

The majority of research methods continue to focus on corporate disclosures based on published corporate reports rather than online disclosures (Collison, Lorraine, & Power, 2003; Jenkins, 2004; McMurtrie, 2005). Reports are published documents that do not change and so represent important areas over a consistent time period. In contrast, online disclosures can be topical disclosures representing current events. The organisation can edit or amend such disclosures as required. Reports consolidate all significant events for a given period, often a 12-month period, as determined by an organisation.

When compared to traditional reporting, the Internet allows electronic versions of reports to be presented in an easily accessible and timely fashion. Organisations publish sustainability reports electronically and archive historical reports online. Doing so allows historical reports to be easily obtained and with no possibility of their having been altered. For the purposes of this research, only reports made available online were considered. One important consideration was that the reports needed to be in a format that matched the supported file types identified within the Leximancer manual (Leximancer, 2011, p. 44). For this reason, only electronic reports in a .pdf format were considered. The next step outlines the type of report analysed.

The next factor to consider is the content of the reports. This study offers alternative insights by focusing on the concepts and themes relating to sustainability. Yongvanich and Guthrie (2007) found that the literature to date has tended to focus on sustainability disclosures in annual reports. However, more recent studies focus on separate CSR and sustainability reports (see Coetzee & van Staden, 2011; Fonseca, 2010; Jenkins & Yakovleva, 2006; Peck & Sinding, 2003; Perez & Sanchez, 2009).

Organisations that produce integrated sustainability and financial reports were excluded, because integrated reports include concepts and themes that are not consistent with separate sustainability disclosures. Leximancer software processes either a single or multiple document/s for each analysis. It is not possible to review sections of a document. Therefore, for the purposes of this research, only stand-alone documents, not integrated financial and sustainability reports, were obtained and analysed. This decision prevents concepts found within the financial and commentary sections from skewing the results.

Four companies (Goldfields, Inmet Mining, Jiangxi Copper Company Limited, and Zijin Mining Group Company Limited) that produced integrated reports were excluded. Their elimination reduced the sample population to 32 companies. In addition, Potash Corporation produced integrated reports in 2012 and 2013. These reports were, therefore, excluded, although their stand-alone reports from 2010 and 2011 were included. Hydro's 2012 sustainability report was an extract from a larger report. However, as the report was made available as a separate document on the company's website, it was included.

As regards the companies that produced separate reports, the titles of the reports varied significantly. Reports were often located within the sustainability section of the website

but under a different title. The literature review showed that sustainability as a concept can have a variety of meanings and interpretations in the business environment (Franceschi & Kahn, 2003; Smith & Sharicz, 2011). Despite the 1987 Brundtland definition being widely referred to as a working definition (Buhr & Reiter, 2006), the literature review revealed there is no formal definition; rather, a variety of definitions are found (Johnston et al., 2007). This research does not focus specifically on sustainability per se. Rather, the thematic analysis allows themes and concepts to emerge from within the reports. Social and environmental concepts in a sustainability report will provide data which is just as valuable as social and environmental concepts presented in a report with a different title.

The evolution of social and environmental reporting into sustainability reporting has resulted in a variety of report titles. Morhardt (2010) recognises that sustainability reports are frequently referred to as CSR reports. Sustainability-themed reports offer the best place to gauge an organisation's view on sustainability when compared with annual reports, company websites, media disclosures, or any other form of sustainability disclosure. For the purposes of this research, the content of the reports is more important in answering the research questions than the name of the report.

Sustainability reports, for the purpose of this research, constitute stand-alone sustainability-themed reports. Whilst it is expected that most reports will include 'Sustainability' within their title, its inclusion is not expected for all companies. Alternative reports named CSR reports; TBL reports; reports to the community; or, any similar themed report were collected for analysis. These reports are produced annually by companies. However, one issue with a sample of 36 companies from around the world is their different reporting periods.

Report years

Once the selection of sample of mining companies and the type of reports to be obtained had been established, the next area for consideration was the report publication year. As a result of the diverse mining companies within the sample, their reports had differing reporting dates. This research adopted the reporting dates from the ICMM reports. The 2013 ICMM report included a review of sustainability reports from 31 December 2012 to 30 September 2013. For the purposes of completeness, the 2013 year covered 1 October 2012 to 30 September 2013. This range was adopted for all reporting years.

To analyse the trends of the sustainability reports, the period of analysis covered reports produced between 2010 and 2013, which gave an effective date range of sustainability reports produced between 1 October 2009 and 30 September 2013. The mining sustainability reports' dates for each year are shown in Table 3.4 below.

Table 3.4. Sustainability report date range by year classification.

Period	Year Start	Year End
2010	1 October 2009	30 September 2010
2011	1 October 2010	30 September 2011
2012	1 October 2011	30 September 2012
2013	1 October 2012	30 September 2013

Once the organisations, the type of report, and the reporting periods had been identified, the next stage was to obtain copies of the reports in .pdf format for Leximancer analysis.

Report collection

As Coleman (2004) notes, the Internet has emerged as a common medium for communication with stakeholders. Coleman (2005 as cited in Gill et al., 2008), recognised the importance of using the Internet to communicate sustainable activity. The Internet provides a forum for presenting information to specific stakeholders (Wheeler & Elkington, 2001). The growth in the Internet and electronic media has led to organisations' using new approaches to disclose sustainability information (Gill et al., 2008). However, the majority of research methodologies continue to focus on corporate disclosures based on published corporate reports rather than online disclosures (Collison & Lorraine, 2003; Jenkins, 2004; McMurtrie, 2005). By considering only disclosures made in reports made available online, this research breaks with that tradition.

This research obtained sustainability reports directly from company websites. Annual sustainability reports allow organisations to present stakeholders with an array of consolidated sustainability-related information. Historical reports provide information for a relevant period and cannot be altered as online information can.

Initially, each mining company's website was searched for its sustainability reports. Reports were often found within the sustainability or reporting sections of the website. Historical reports were obtained from archived files within the website.

If a sustainability report was not easily found, a search of the company website was used to locate the sustainability report. Reports that were not found using the search function were sourced from www.CorporateRegister.com. This website specialises in the distribution of sustainability reports. Members have access to sustainability report equivalents in its online database.

Some reports were not available online or within the corporate register website. In these instances, a general Internet search was conducted in an attempt to locate the sustainability report.

Instances where a sustainability report was not found online, or where the report was not in the correct format, were noted as unobtainable reports. Rather than going directly to the company to collect the reports, these companies were ignored, as the study's analysis is based on information easily available to stakeholders.

Once all sustainability reports were obtained, they were downloaded and saved in a compatible format that allowed multiple reports to be analysed by Leximancer. After the reports were downloaded, copies of the files were saved into different folders to reflect the different research questions. Files were saved into four different folders: a combined folder; an individual company folder; a folder for the corresponding year; and, a folder for the corresponding ICMM membership status. This strategy allowed all the files to be uploaded into Leximancer as one folder during the processing stage.

3.3.3.3 Stage III: Data processing

The third stage in the research was to process the sustainability reports using Leximancer. The explanation of this stage is split into two parts. The first subsection provides an overview of Leximancer, while the second subsection outlines the way the reports were processed in Leximancer.

Leximancer overview

Leximancer is a computer software-based lexicographic program (Crofts & Bisman, 2010; Leximancer, 2011; Penn-Edwards, 2010). It presents itself as an excellent tool for supporting academics in history, literature, media studies, sociology, and politics

(Leximancer, 2011). The validity of this claim is reflected in the published literature, with specific examples seen in the business, public sector, social studies, and education areas (Grimbeek, Bartlett, & Loke, 2004; Rooney, 2005; Rooney, McKenna, & Keenan, 2006; Beamish, Bryer, & Davies, 2006; Fisher & Miller, 2008; Young & Denize, 2008). Yet, this tool appears to be relatively underutilised in the accounting discipline, despite Crofts and Bisman (2010) suggesting it is highly appropriate for establishing relationships and acknowledging contextual conceptions.

The software was used in this research because it offers a number of advantages, from time savings and reduced coding issue to more complex and detailed analysis (Smith & Humphreys, 2006; Penn-Edwards, 2010). Using the software to undertake the content analysis saves significant time compared to a manual search and evaluation, and ensures more accurate and consistent evaluation of words and terms. Smith and Humphreys (2006) comment "coder reliability is not an issue for Leximancer; text segments are always coded in the same way, given the same parameter settings" (p. 265). Leximancer provides additional levels of analysis between concepts and themes not available with manual content analysis. Concepts are "collections of correlated words that encompass a central theme" (Leximancer, 2011, p.78). An overview on Leximancer and the types of analysis are presented in the remainder of this section.

The software converts "lexical co-occurrence information from natural language into semantic patterns in an unsupervised manner" (Smith & Humphreys, 2006, p. 262). The text coding software that can be used to examine written data, provided it is in a compatible format (Adam et al., 2009; Leximancer, 2011). The Leximancer program scans the text presented looking to see which words appear most often and which words appear with other words. Smith and Humphreys (2006) explain that "text is examined to select a rank list of important lexical terms on the basis of word frequency and co-occurrence usage" (p. 262).

Leximancer analyses text based on word frequency and co-occurrence of words (Smith & Humphreys, 2006). The software then identifies concepts embedded within the text. Leximancer defines concepts as words that generally travel together throughout the text (2014). Concepts that appear together throughout the text also form themes (Leximancer, 2011; Smith & Humphreys, 2006).

This analysis provides a summary of the themes and concepts, which can then be presented visually in the form of a conceptual map (Leximancer, 2011). Crofts and

Bisman (2010) show visually the relationship between themes and concepts (see Figure 3.2).

Figure 3.2. Simplified model of Leximancer.
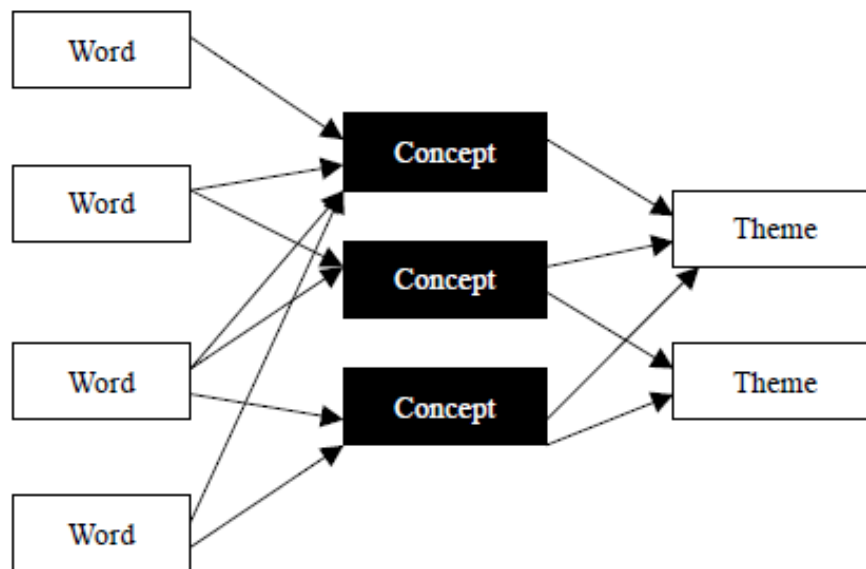
From "Interrogating accountability: An illustration of the use of Leximancer software for qualitative data analysis" Crofts & Bisman, 2010, *Qualitative Research in Accounting & Management, 7*(2), p. 188.

Smith and Humphreys (2006) note that the purpose of the Leximancer system is to identify the global context and significance of concepts. They further identify that the Leximancer system offers more than standard word searches and looks at the content and relationships; "the system goes beyond keyword searching by discovering and extracting thesaurus-based concepts from text data, with no requirements for a prior dictionary" (Smith & Humphreys, 2006, p. 262).

The software uses algorithms to access the relationship between words and concepts throughout the text (Adam et al., 2009; Crofts & Bisman, 2010; Leximancer 2014). Themes combine a group of concepts (Smith & Humphreys, 2006). They are visually represented in coloured circles on the map and known as emergent concept groups (Smith & Humphreys, 2006; Leximancer, 2011). The themes are heat-mapped, which means 'the 'hottest' or most important theme appears in red, and the next hottest in orange, and so on" (Leximancer, 2011, p. 14). The data is then read to identify relationships between words, and the generation of an asymmetric co-occurrence matrix (Smith & Humphreys, 2006).

Leximancer is recognised as useful within both quantitative and qualitative research. According to Crofts and Bisman (2010), the "algorithmic basis of Leximancer is strongly suggestive of a quantitative and positivistic approach to analysing data" (p. 187). However, the authors say the software can be used for qualitative methodologies. Through generating themes, Leximancer assists with interpretive-based research.

Text is next classified by the concepts to produce a concept index for the relationship between the text and the concept co-occurrence matrix. The co-occurrence frequencies of the concepts are used to create a two-dimensional concept map. "The connectedness of each concept in this semantic network is employed to generate a third hierarchical dimension, which displays the more general parent concepts at the higher levels" (Smith & Humphreys, 2006, p. 262). The processes to achieve the different types of analysis presented above are detailed in the following subsections.

Leximancer processing

Running analysis in Leximancer requires the creation of projects. Each project is a separate analysis requiring all the steps outlined below. For the purposes of this research, four project groups were created with each corresponding to a research question. Within each group, separate projects were required when the reports were split according to different variables.

Leximancer produces a manual that outlines the full process required to analyse reports. The manual can be obtained directly from the company website (http://info.leximancer.com/support/). Running each project requires four stages. Each stage must be done in order, as each stage is reliant on the prior stage's being completed. Leximancer operates a 'traffic light' system to indicate the status and completion of each stage.

The first step for each project is to load the files into Leximancer. Each report document needs to be loaded individually; however, multiple documents can be loaded for each project. To ensure that all documents required for each analysis had been loaded, separate folders were created containing copies of the reports relevant to each analysis. Any issues with the format of the reports were identified at this point. As the reports were saved in .pdf file formats, no changes could be made to the documents. The next two paragraphs define the analysis parameters for Leximancer.

The second step required the generation of concept seeds. This step has additional settings that can be changed to influence how the concept seeds are generated. This stage uses two separate steps. An initial exploratory analysis is conducted using the default settings. Adjustments can be made to 'Text Processing Settings' and 'Concept Seed Settings'. The settings used for this exploratory research were the default settings.

Manual adjustment and reviewing are required for text processing settings. The initial settings included merging word variants, which means that words like 'look', 'looked', and 'looking' are initially considered as a single concept. The analysis also identifies stop words like 'and'. The concept list ignores these words. Additional words can be added at this point, based on a review of the initial output.

The study reviewed the concept seed settings and left them as default, apart from changing the default setting for the total number of concepts. Prior studies (including Samkin & Schneider, 2008; Samkin, 2012) limited the number of concepts to 30. However, for the purposes of this exploratory study the maximum number of concepts was 40. This number allowed for additional concepts to emerge from the 104 sustainability reports analysed. The 40-item list was designed to identify the most prominent concepts whilst also tracking small concepts impacting the results. As the research included an analysis over time, having more concepts allowed better tracking of changes and trends. After the settings for the initial project were created, these were saved and used for subsequent projects.

The third step was thesaurus generation. The default settings were used for this stage. Leximancer allows the user to edit the concept seeds and thesaurus settings. Editing the concept seeds allows users to edit, add, or remove generated concept seeds. The thesaurus settings allow the system to generate a thesaurus of terms associated with each concept seed. A manual review is conducted at this point to review both the concepts and thesaurus to ensure there are no duplicate concepts due to plurals, abbreviations, or other influences.

The final step in the process is achieved through selecting 'Run the Project'. This step creates the concept map and here a number of changes were made. To ensure all concepts could be seen on the map, the percentage of visible concepts was increased to 100%. The theme size was increased from 33% to 50%. This adjustment reduced the number of overall themes, but increased the size of the more dominant themes. The map was then exported to create JPEG images and saved in a separate document for

later use if required. The Leximancer output also included a concept co-occurrence matrix which measured the concept interactions, and a thematic summary; these were saved into a Microsoft Word file for use in the findings section.

This process outlined above was adopted for the entire population of sustainability reports, and then repeated three times for each of the different ICMM membership groups, four times for the different year classifications, and 26 times for each individual company analysis.

3.3.3.4 Stage IV: Analysis

The final stage in the research process involved the analysis of the Leximancer output. For the purposes of this research, analysis was conducted at the concept and theme level, including the concept map. Additional comparisons were made for comparing the different categories of ICMM membership and report year. Individual companies were looked at in isolation and compared with the overall population findings.

The concept analysis was concerned primarily with the concept counts and ranks and also included concept interactions which reflect the number of times concepts appear within close proximity to each other throughout the texts. The thematic analysis sought to concentrate on the relevance of the concepts within each theme in terms of their relationship to the remaining concepts within the report. In the findings chapter, the concept map will be discussed. Combining the elements of the earlier findings will there reveal additional links between concepts.

3.4 Summary

This chapter presents the underpinning methodology and method of this research. This research is grounded in the pragmatic approach. This allows it to use elements of the positivist scientific approach and the constructive interpretive approaches to best understand sustainability reporting by mining companies.

The study incorporates elements of both qualitative and quantitative research. The interpretive approach allows qualitative information to provide further insight into the findings and better understanding of the quantitative data. This research methodology provides the flexibility needed to meet the research objectives and useful information from which to make recommendations, based on the current sustainability reporting practices of leading global mining companies.

After reviewing the literature on sustainability and the mining industry, the research process was structured to flow logically from research objectives and questions to appropriate methods for data collection, analysis, and evaluation. A sample of companies was selected from the ICMM membership and the PwC top 40 largest mining company list. Content analysis and thematic analysis were completed using Leximancer computer software. The findings from these analyses are presented in the following chapter.

Chapter 4 RESULTS AND FINDINGS

4.1 Introduction

Drawing on the Leximancer output, this chapter presents the findings from, and the subsequent analysis of, its thematic analysis of 104 mining sustainability reports. The processes used to obtain the Leximancer results were outlined in Chapter 3. The findings were separated into subsections with each subsection corresponding to the study's research questions.

In total, 104 sustainability reports were analysed using Leximancer. These reports came from 32[1] different mining companies over a 4-year period. The mining companies were classified according to ICMM (International Council of Mining and Metals) membership. As outlined in Chapter 3, ICMM member classification allowed a comparison across mining companies with different public commitments towards sustainability.

The 32 companies included 14 mining companies that were categorised as existing ICMM members (companies which were members prior to 2010), 6 as new ICMM members (companies which joined ICMM between 2010 and 2013) and 12 as non-ICMM members (companies which were not ICMM members). Each sustainability report was further classified by year.

The sustainability reports' publication dates were categorised according to ICMM review periods. Each year classification included a 12-month period from 1 October to 30 September. The 4-year period ran from October 2009 to September 2013. *Table 4.1* below summarises the number of sustainability reports analysed in terms of ICMM member status and year.

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[1] The total population from the sample was initially 36 companies; however, four companies did not publish separate sustainability reports online in a format compatible with Leximancer. If all 36 companies had produced a sustainability report for each year, the total possible number of reports available would have been 144. The 104 reports collect and analysed account for 72.2% of the potential number of reports to sample.

Table 4.1. Sustainability report summary by ICMM member status and year.

	2010	2011	2012	2013	**Total**
ICMM member status					
Existing ICMM	10	11	13	14	**48**
New ICMM	4	4	5	5	**18**
Non-ICMM	8	9	11	10	**38**
Total	**22**	**24**	**29**	**29**	**104**

The results are presented in separate sections reflecting the research questions for this study, i.e.,

1. What are the dominant and common concepts and themes within mining sustainability reports?
2. What are the similarities and differences in the sustainability reporting practices of the leading mining companies?
3. How does the sustainability reporting of mining companies change over the period of the study?
4. Are there differences in the sustainability reporting of established mining companies compared to new mining companies?

The chapter is structured as follows. Section 4.2 presents the generalised findings of the entire population based on the thematic analysis of all sustainability reports; it presents the dominant themes and concepts of the entire population. Section 4.3 presents an analysis of the individual companies' sustainability reports. This section compares and contrasts the different concepts used in the 4-year period for each mining company and compares these with those for the entire population. These two sections look globally and individually at the companies to identify the dominant themes and concepts. To understand trends and movements, additional variables are used to separate the data.

Section 4.4 analyses the different themes and concepts by year. A combined analysis by publication year, based on International Council on Mining and Metals (ICMM) reporting dates, demonstrates trends and movements across the 4-year time frame used in this study. Section 4.5 analyses the sustainability reports according to ICMM membership status. Companies are classified as existing, new or nonmember. This section identifies differences in the reporting of new, compared to established, mining companies.

Before presenting the findings for each analysis, the next section first explains the different Leximancer outputs used throughout the chapter.

4.1.1 Findings overview

The four sections that address each research question follow the same general format. Each section presents a combination of three distinct Leximancer outputs. The following paragraphs outline the structure followed with these three analyses.

Leximancer software first analysed the data at a concept level then moved to a thematic level and finally expanded to create an integrated concept/theme analysis. The combined analysis of the concepts and themes reveals additional relationships and summarises relationships visually through a concept map. Before viewing the concept map, it is important to start with the concepts which led to a map's thematic depiction.

Concept findings

The findings first focus on the concepts, as these provide the basis for more advanced analysis (Leximancer, 2011). Concepts are identified individually and collectively to reflect their usage within the sustainability reports. They are then analysed in terms of their frequency across the entire population. Concepts are then ranked by count, and finally their relevance score is calculated. The relevance score is a percentage calculated by dividing a concept count by the count of the most frequent concept.

A maximum limit of 40 concepts was set for the Leximancer findings. In some instances, however, fewer concepts were identified. The 40 concepts limit was employed to avoid too many concepts, because forcing too many concepts can create 'junk' findings. The Leximancer manual warns: "Be aware that if you force more concepts than are really found in the data, you can start getting junk concepts from among the noise" (Leximancer, 2011, p. 75). To better understand the dominant concepts, the analysis concentrates on between 5 and 10 of the most frequent concepts, depending on the analysis and variability between concepts.

The concept findings also include the relationship between concepts. The concept interactions are shown in a concept matrix. The matrix shows the co-occurrence between different concepts. The co-occurrence reflects the proximity of concepts. Interactions are based on the number of times each of the table's concepts pairs within five sentences with another concept.

Where relevant, segments from the reports are provided to illustrate the use of and relationships between concepts. The relationship and positioning of concepts determines the themes within the sustainability reports. Thematic analysis provides further insight into the importance and position of concepts and so the next section deals with that topic.

Theme findings

To provide greater insight into the concept analysis, Leximancer's output also includes themes. According to the Leximancer manual, "Concepts that appear together often in the same piece of text attract one another strongly, and so tend to settle near one another in the map space" (Leximancer Manual, 2011, p. 14). Such concept groupings are deemed to constitute themes. Themes are labelled according to the most dominant concept within the theme. This study set theme size at 60% to ensure tighter, stronger themes. This setting allows a range of between four and seven themes for each set of reports analysed. A lower theme size would produce more broad themes, while a higher theme size would reduce the number of themes. The 60% theme size provides a balance; while it ensures a variety of themes, it allows only the most dominant themes to emerge. Themes are first analysed by reviewing the concepts within them. The concepts then determine other measures.

The secondary analysis of themes is based on their connectivity and colour relationships with the wider data set. Connectivity refers to the relatedness of themes to concepts and provides a method for comparing themes. A "'connectivity' score [to] indicate[s] the relative importance of the themes" (Leximancer Manual, 2011, p. 29). Scores are given as percentages, reflecting the relationships of identified theme concepts relative to the remaining concepts. The relatedness reflects an association; it does not, however, indicate the strength or the number of associations. Colour reflects the relevance of themes. The concept map is heat-mapped, in that hot colours (red, orange) denote the most relevant concepts, and cool colours (blue, green) denote the least relevant. Thus, it is the combination of both measures that reflects the dominance of themes.

The interactions between concepts by way of themes provide meaningful information beyond traditional content analysis, and allow concepts to be analysed holistically. However, Leximancer can further enhance this information by displaying the relationship between concepts and themes visually via the concept map.

Concept map

The third section integrates the concepts and themes via the concept map. The concept map groups cluster concepts within themes. The visual map represents concepts that often appear close together within the same text. The concept map presents all concepts on nodes. Larger nodes indicate more frequent concepts. Lines directly linking nodes indicate relationships between concepts. Concepts that do not link directly may, however, link via a third concept (or multiple other concepts) within the text.

In the results and discussion chapters, concepts are identified using italics and lower case; themes are identified using italics and the first word is capitalised (e.g., henceforth, a concept such as community will appear as '*community*' and the theme of community will appear as '*Community*'.

The next section presents the collective findings of all sustainability reports analysed.

4.2 Entire Population Findings

This section presents the findings for the entire sampled population. Here, no attempt is made to separate the data by company, year, ICMM membership, or any other characteristic. The findings provide a holistic representation the themes and concepts within mining sustainability reports and serve as a point of comparison for the findings presented in the later sections.

The purpose of this section is to present the findings related to the first research question: What are the dominant and common concepts and themes within mining sustainability reports? The analysis of the entire sample population provides insight into both the dominant and common concepts and themes.

The themes and concepts identified by Leximancer are presented in a variety of formats. The first subsection presents the concepts as determined by Leximancer. The second subsection focuses on the themes. The third subsection looks more broadly at the relationship between concepts and themes through the concept map. The final section summarises the key findings for the entire population. The individual concepts identified from within the sustainability reports form the basis of the analysis and these are presented next.

4.2.1 Concept analysis

The concept analysis of all 104 sustainability reports identified a total of 36 concepts. Individual concept counts are shown in Table 4.2 below, along with each concept's rank based on count. Thereafter, Figure 4.1 presents the concepts on the basis of their frequency.

Table 4.2. Concept summary.

Concept	Count	Rank	Concept	Count	Rank
community	8,445	1	rights	2,415	19
employees	8,159	2	waste	2,369	20
local	5,730	3	services	2,284	21
production	5,700	4	plant	2,107	22
safety	4,713	5	facilities	2,054	23
support	4,244	6	employment	2,003	24
water	4,191	7	members	1,981	25
health	3,918	8	consumption	1,936	26
system	3,859	9	education	1,911	27
training	3,772	10	technology	1,840	28
programme	3,751	11	data	1,796	29
material	3,679	12	land	1,724	30
energy	3,468	13	compliance	1,678	31
people	3,448	14	power	1,455	32
emissions	3,355	15	construction	1,451	33
information	3,303	16	copper	1,420	34
human	2,546	17	coal	1,382	35
region	2,541	18	assurance	1,334	36

Figure 4.1. Concept counts for entire dataset.
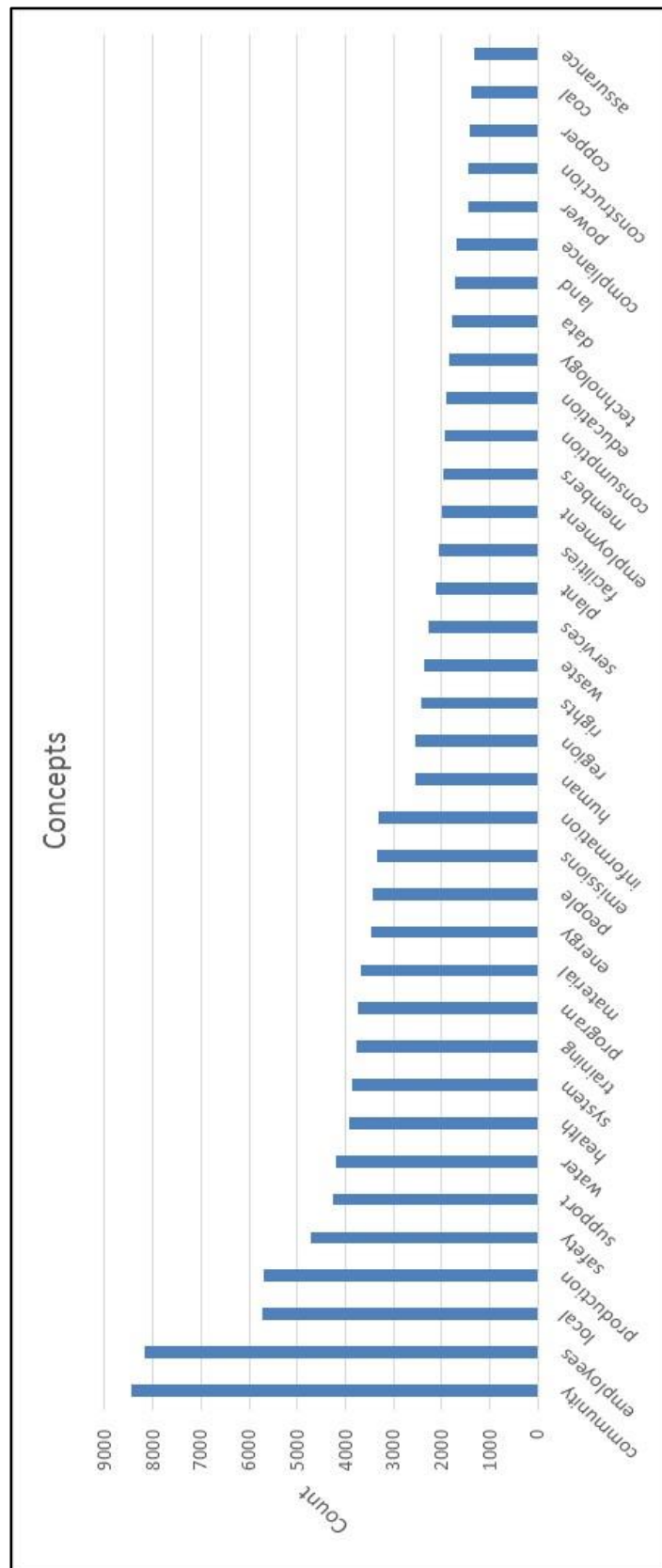
Figure 4.1 above shows a frequency comparison for concepts ranging from *community* down to *assurance*. Additional concepts that were not consistently used across this dataset but which emerged through looking specifically at companies, years, or ICMM memberships are presented in the following sections.

The concept of *community* was the most common concept; it appeared 8,445 times within the sustainability reports. The results indicate that the concept of community was found on average 81 times per sustainability report.

In addition to the quantitative measures produced by Leximancer, the output includes extracts from and references to each concept's occurrence in the text of the sustainability reports. This information provides qualitative data showing how language is used with each concept. Whilst it is not the purpose of this study to analyse the individual usage of each concept, the excerpts below do provide examples of how the concept of community was applied within the sustainability reports.

The section of text below, taken from the Barrick's 2009 Responsibility Report, exemplifies the use of the concept of community; the term appears three times within three sentences and it is linked to the concept of a programme:

> Barrick is proud of the contribution we have made in the area of community development at our sites and projects. It is often through sustainable programs and initiatives, developed with our community partners, that hope and future prosperity is sustained beyond the life of the mine. Over the last 25 years, we have seen many of our host communities prosper, showing visible sign*s . . .*

Anglo America used *community* in close proximity to *local*:

> The strategic planning element requires an operation to develop a vision of what it wants to achieve post mine closure through engagement with local stakeholders. Ultimately, all strategic plans will involve the mine relinquishing any 'surrogate government' role that it might have played during the life of the mine, in order to bring about long-term independence and sustainability in the surrounding community. The next step is to assess where the operation is in relation to what it wants to achieve post closure. This involves identifying knowledge gaps in the mine's current closure plan and defining what level of detail the closure plan should contain relative to the remaining time to closure. Scheduling, resource allocation and budgeting make up the final, detailed planning phase.

Employees was the second most frequent concept appearing 8,159 times and on average 78 times per report. *Local* (5,730) and *production* (5,700) were the only other concepts to appear more than 5,000 times across all the reports; on average, they made 55 appearances per sustainability report.

The least frequent concept was *assurance* which appeared 1,334 times across all the reports. This word averaged 13 times per report. Only slightly more frequent than *assurance* were *copper* (1,420) and *coal* (1,382). In addition to the least frequent concepts, certain concepts were noticeable by their absence. One such concept was *sustainability*. That concept, however, was found in the individual company analysis. Its results are presented in the next section.

Concepts that one might expect to find appearing together are treated as individual and exclusive concepts. For example, the concepts of *human* and *rights* will frequently be found together. Whilst these concepts are often used together as in the term 'human rights', each concept can also appear separately. Therefore, no attempt has been made to look at two concepts that appeared in such a way. However, the concept co-occurrence matrix identifies pairings of concepts based on the concepts identified above. These pairings are presented in the next section, followed by the thematic analysis and concept maps findings.

Concept interactions

In addition to the above results, Leximancer produced a concept matrix revealing the co-occurrence of different concepts. Appendix A provides the full table of all the concepts' interactions. Table 0.1 presents the concept matrix for the entire sample. The findings show 188,102 concept interactions occurred between the 36 identified concepts. The table also includes the individual pairings of the 36 concepts and the sum of the individual interactions per concept.

The findings revealed that the concept of *community* appeared 8,445 times and that it had 27,727 interactions with the remaining 35 concepts. Thus, of all the concepts, *community* had the greatest number of interactions. *Employees* had the second highest number of interactions with other concepts; it occurred 22,731 times. Nevertheless, the findings highlight a difference between the concepts of *community* and *employees*. Despite *community* having a greater count (by 286), its interaction difference was 4,996

more than that for *employees*. In percentage terms, that is 18% less than *community* despite having 3.4% fewer overall concept appearances.

A standardised summary of interactions is presented in Table 4.3. The table arranges the 36 concepts according to their average interactions; these are determined by dividing the number of interactions for each concept by the concept count. These findings show that *education* (ranked twenty-seventh for count) had the most interactions per concept. *Power* (ranked thirty-second for count) and *consumption* (ranked twenty-sixth for count) come second and third respectively. These findings show that, despite these concepts having relatively lower overall counts, when the concepts were used within the reports, a number of other frequent concepts were used in close proximity to them.

Table 4.3. Summary of concept interactions per concept.

Concept	Count	Interactions	Average	Concept	Count	Interactions	Average
education	1,911	8,690	4.5	emissions	3,355	11,339	3.4
power	1,455	6,243	4.3	region	2,541	8,563	3.4
consumption	1,936	7,843	4.1	community	8,445	27,727	3.3
coal	1,382	5,445	3.9	system	3,859	12,544	3.3
employment	2,003	7,756	3.9	safety	4,713	15,255	3.2
construction	1,451	5,534	3.8	waste	2,369	7,630	3.2
training	3,772	14,286	3.8	members	1,981	6,331	3.2
program	3,751	14,020	3.7	people	3,448	10,966	3.2
energy	3,468	12,874	3.7	material	3,679	11,461	3.1
technology	1,840	6,768	3.7	water	4,191	13,031	3.1
support	4,244	15,592	3.7	production	5,700	17,586	3.1
services	2,284	8,375	3.7	land	1,724	5,305	3.1
local	5,730	20,974	3.7	compliance	1,678	4,920	2.9
health	3,918	14,336	3.7	employees	8,159	22,731	2.8
facilities	2,054	7,378	3.6	data	1,796	4,753	2.6
plant	2,107	7,461	3.5	information	3,303	8,601	2.6
human	2,546	8,945	3.5	copper	1,420	3,653	2.6
rights	2,415	8,209	3.4	assurance	1,334	3,079	2.3

The summary presented in Table 0.1 in Appendix A does not account for the different counts for each concept and thus makes direct comparisons difficult. Another way that Leximancer can provide further analysis, however, is by scaling the interactions relative to the counts for the concepts. Here the total number of interactions is divided by the lowest concept count for the two concepts involved. This calculation produces a score

between zero and one; these scores are presented in Table 0.2 in Appendix A. Those scores show the strength of the direct relationship between two concepts.

The results in Table 0.2 are coloured-coded to signal an interaction score greater than 0.33. The darker colouring indicates a higher score relative to the other interactions. This coding is used to highlight the most frequent interactions between concepts based on their relative interactions. There were 41 concept interactions where the least frequent concept appeared within close proximity to the other concept a minimum of one in every three occurrences.

There is a noticeable difference between the leading concepts identified by the frequency analysis earlier in this section. *Community* had the greatest number of interactions consistent with a high frequency count. *Employees* had seven interactions above 0.33. The third concept to have the most interactions was *education*. That concept had six significant interactions with other concepts, all of which had greater overall frequency counts, indicating that the concept of *education* was often used in proximity to other significant concepts.

Only nine interactions had a score of 0.50 or over. Table 4.4 identifies these concepts. It also includes the findings for their individual counts, the number of interactions, and the score for each pairing.

Table 4.4. Concept interactions greater than 0.50.

Concept 1	Concept 2	Interactions	Score
energy (3,468)	consumption (1,936)	1,466	0.76
human (2,546)	rights (2,415)	1,721	0.71
community (8,445)	local (5,730)	3,885	0.68
consumption (1,936)	emissions (3,355)	1,185	0.61
community (8,445)	education (1,911)	1,077	0.56
energy (3,468)	power (1,455)	816	0.56
energy (3,468)	emissions (3,355)	1,852	0.55
safety (4,713)	health (3,918)	2,148	0.55
employees (8,159)	training (3,772)	1,935	0.51

As shown in Table 4.4, the pairing of *energy* and *consumption* has the highest interaction score at 1,466. When the lower concept count (1,466) is divided by that for the higher count (1,936) the resulting ratio is 0.76. Consequently, in 76% of cases where *consumption* appeared within the sustainability reports, *energy* appeared in close proximity to it. A strong relationship is also evident between *human* and *rights* (0.71) and with *community* and *local* (0.68).

To add more meaning to the data and to go beyond the scope of traditional content analysis, Leximancer performs a thematic analysis. The next section, therefore, looks more specifically at the thematic relationships between concepts.

4.2.2 Theme Analysis

Leximancer's thematic analysis clusters concepts that appear together, often within the same piece of text. Each theme is labelled according to the most prevalent concept within that group of concepts. The output for themes can be split according to the theme and concepts, and the connectivity and relevance. The theme and concepts cluster shows the individual themes and the concepts within each theme; connectivity and relevance explain the relationship between themes and their importance within the sustainability reports.

4.2.2.1 Themes and Concepts

Leximancer identified five dominant themes that capture the relationships between concepts at the 60% theme setting. Leximancer named these themes as: C*ommunity*, *Safety*, P*roduction*, *Water,* and *Employees*. Leximancer's default settings base a theme name on the most frequent concept within each theme. No attempt has been made to adjust the labels assigned by Leximancer to the themes.

These themes encompass the 36 concepts identified within the sustainability reports. Table 4.5 below shows the individual concepts (including counts) that make up each theme. The concepts within each theme show which concepts are often used in close proximity.

Table 4.5. Theme and concept summary.

Community	*Safety*	*Production*	*Water*	*Employees*
community - 8445	*safety - 4713*	*production - 5700*	*water - 4191*	*employees - 8159*
local - 5730	*health - 3918*	*material - 3679*	*energy - 3468*	*training - 3772*
support - 4244	*system - 3859*	*emission - 3355*	*consumption - 1936*	*human - 2546*
programme - 3751	*information - 3303*	*technology - 1840*	*waste -2369*	*rights - 2415*
people - 3448	*services - 2284*	*power - 1455*	*plant - 2107*	*employment - 2003*
education - 1911	*members - 1981*	*coal - 1382*	*facilities - 2054*	
region - 2541	*compliance - 1678*	*data - 1796*	*construction - 1451*	
land - 1724		*assurance - 1334*	*copper - 1420*	

The classification of concepts into themes is based on where the concepts lie within the sustainability reports relative to the other concepts. Concept groupings emerge from the data and are based on the concept settings with a theme size of 60%.

The themes, by contrast, are based on the position of concepts within the sustainability reports. To further analyse themes, Leximancer distinguishes the findings based on connectivity and relevance to provide richer and more meaningful data.

4.2.2.2 Connectivity and relevance

Rather than looking at the individual concepts within a theme, the findings are presented on the basis of the connectivity and relevance of each theme. Figure 4.2 depicts not only the five themes that emerged from the 104 sustainability reports but also provides additional information showing the connectivity and relevance of each theme within these sustainability reports. These measures show the importance of the concepts collectively to the overall sustainability report.

Figure 4.2. Theme analysis output.

Theme	Connectivity	Relevance
community	100%	
safety	63%	
production	60%	
water	58%	
employees	55%	
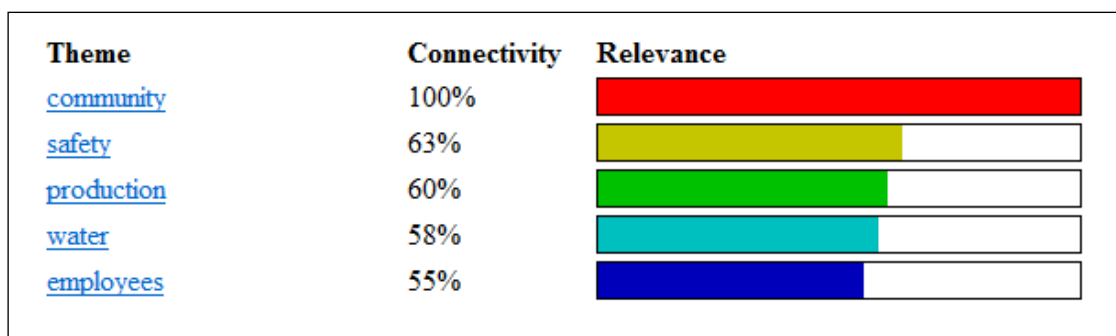
Figure 4.2 presents the connectivity percentage. The percentage score is "calculated using the connectedness of concepts within that theme giving us a way to measure the importance of a theme within the dataset" (Leximancer.com). The connectivity and relevance scores show the relative importance of each theme and show how the concepts within a theme relate to the remaining concepts within the sustainability report.

Community has a 100% connectivity score and is noticeably more important overall than the remaining themes. The remaining themes of *Safety*, *Production*, *Water,* and *Employees* vary by only 8% and there is little difference between them relative to *Community*.

The relevance chart uses a bar chart to present the connectivity scores. In addition to the scores given in the bar chart, the results are coloured according to a heat scale. Thus, with its red colouring and full bar chart shading, *Community* is depicted graphically as the most important theme. Whilst the remaining themes had similar connectivity scores, the heat mapping reveals significant differences with regard to the overall

importance of those themes. The golden colouring given to *Safety* reveals, for example, that the safety theme has more importance than the green theme *Production*.

The green heat map colouring indicates the dominance of the overall theme is neutral. While the overall combination of concepts is important within the sustainability reports, it is not as dominant collectively as other concepts. *Water* and *Employees* are both coloured blue, but their different shadings reflect the slight difference in their importance. Blue signals the relative insignificance of these concepts within the themes overall. The connectivity scores help distinguish themes by going beyond just concept counts. The findings for concept counts and connectivity are consistent.

This section provided a holistic summary of the relevance of the individual concepts within each theme. The concept map, which is considered next, further reveals the relationship between concepts and themes.

4.2.3 Concept map

The concept map shows visually the relationship between the concepts and how the concepts fit within the identified themes. The concept map graphically combines the concepts, through themes, in the form of a concept network. The 60% theme size ultimately determines which concepts fall within a particular theme. The theme grouping is shown on top of the underlying concept network.

Figure 4.3. Conceptual map for the entire population.
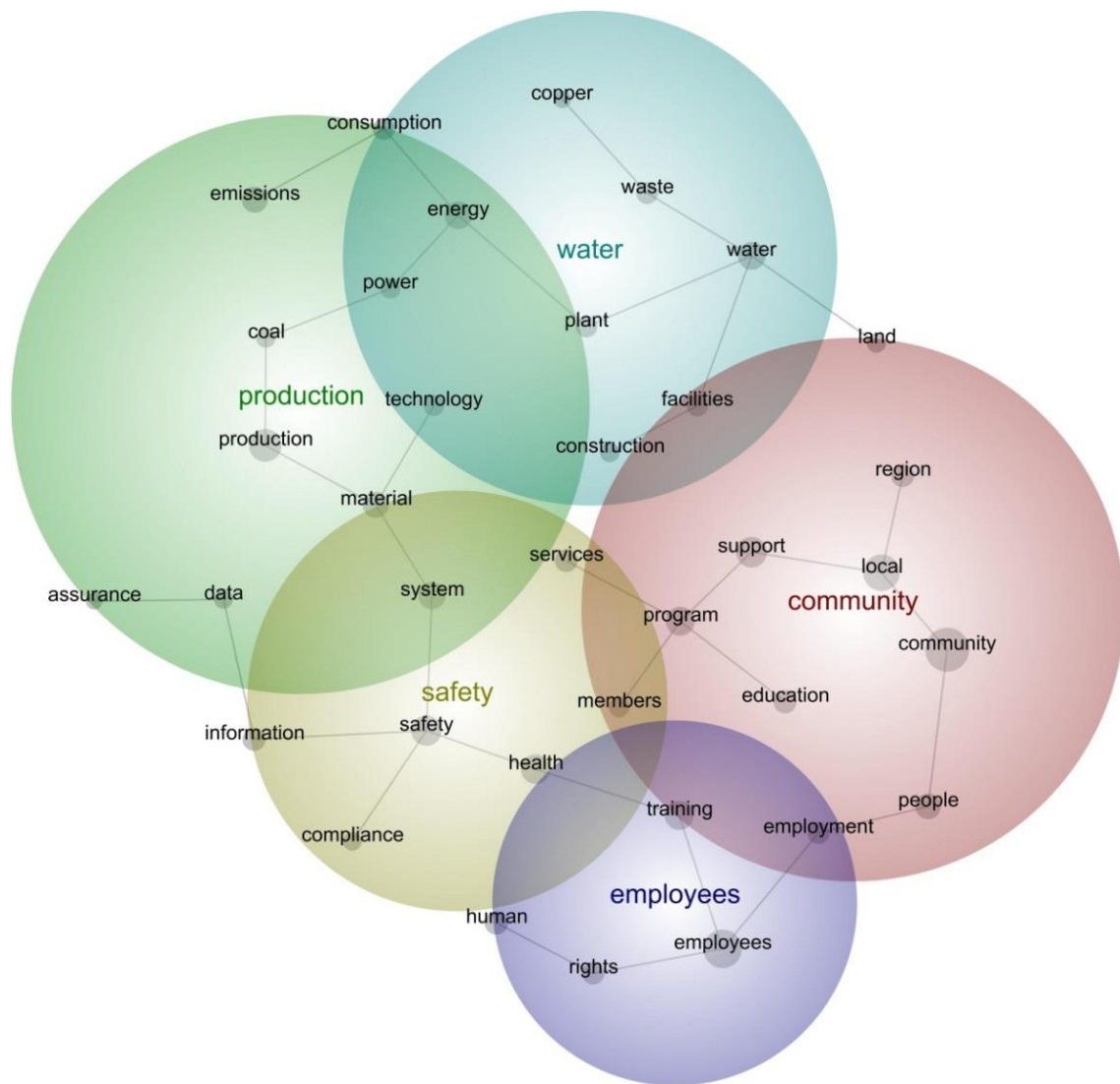
The concept map reflects the default cluster as determined by the initial analysis undertaken within Leximancer. No attempt was made to change the default clustering process to ensure consistent results. No other alterations have been made to Leximancer's default outputs to ensure consistency. Thus, the relationship between concepts presented in the concept map reflects how they appear within the sustainability reports. These relationships are shown through connections between nodes (concepts) and themes.

The next section consolidates the earlier findings and relationships as shown in the concept map. The section will present concept map findings by theme. The relationship between concepts will also be covered within the theme findings from the map.

Community

This study found Community[2,3] to be the most relevant theme emerging from the sustainability reports of all the mining companies analysed. Figure 4.2 revealed that the *Community* theme had 100% connectivity (relatedness), 37% more than the second highest theme, *Safety*. In *Figure 4.3*, *Community* also appears in red indicating the theme's significance.

The thematic analysis revealed that the concepts of *local, support, programme, people, education, region,* and *land* were used more often within close proximity to each other throughout all the sustainability reports. The theme circles in the map also show that the concepts of *employment*, *members,* and *facilities* closely relate to the concepts of the *Community* theme as they at times overlap with that theme. These relationships were not made evident in the earlier findings. The map also shows that the concept of *land*, which is included within the *Community* theme, associated directly with *water*. This finding shows that *land* is commonly found within proximity to the concepts of the theme despite having a more direct relationship within a concept from another theme.

Community is presented in the map with a relatively larger node. The map reveals that the *community* concept linked directly with *local* and *people*. These concepts were ranked second and fifth, respectively, for count. The extent of this relationship was not, therefore, established solely through the concept and theme findings.

Local was the second most frequent concept within the *Community* theme. The concept of *local* was, in turn, most closely linked to *region* and *support*. The concept of *people* provided a direct link to the *employment* concept in a different theme. The map's alignment of *Community*'s theme and concepts reveals that a large focus of the reports is based around the notion of *support*, *local,* and *communities*. These were also the three most frequent concepts within this theme.

Safety

The next strongest theme was *Safety*. *Safety* incorporates the concepts of *safety*, *health*, *systems, information, service, members,* and *compliance*. Overall, however, the individual concepts within this theme appear less often throughout the sustainability

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[2] The most frequent concept within a theme is the default name for each theme.

[3] The results and discussion chapters will distinguish themes with capitals (Community) and concepts with lowercase (community).

reports than other concepts do. *Safety* has direct associations with *information*, *compliance*, *system,* and *health*. Two other concepts fall within the theme, but do not have a direct link with *safety*. *Services* and *members* both fall within the *Safety* theme but link more closely with *Production* than with the *Community* theme.

Production

The third strongest theme was *Production*. This theme links to the operational aspects and concepts of mining organisations. The concepts within this theme were: *production, material, emissions, technology, power, coal, data,* and *assurance. Production* has the largest circle within *Figure 4.3* which reflects the spread of its core concepts in the sustainability reports. The concepts are not as closely related here, however, as within themes. Given that the operational aspects of mining can incorporate many elements, the terms are general, apart from *coal*.

Production has a connectivity percentage of 60%. This indicated that the concepts link with 60% of the remaining concepts within the reports and the 60% theme level. There is no consistent direct link between *emission* and the other concepts within the theme. This finding shows that, while *emission* is related to production concepts, it is more directly found around other concepts. This finding reflects the relationship between concepts across the entire population but not all organisations.

Water

The next strongest theme was *Water*. *Water* incorporates the concepts of *water*, *energy*, *consumption*, *waste*, *plant*, *facilities*, *construction,* and *cooper*. Water as a theme has a 58% connectivity (relatedness) within the text relative to *Community*. The blue colour indicates the overall theme was less dominant than were *Safety* and *Production,* despite having a similar connectivity score.

The theme overall includes a number of environmental factors. However, the distribution of the concept within the reports means *land* and *emissions* fall within other themes. Of all the other themes, *Water* has the highest degree of overlap with *Production*. The concepts within both themes are used in close proximity throughout the sustainability reports. *Water* includes *plant, facilities,* and *construction* and they do not fit directly within a *Water* or *Environmental* theme. This finding does show the strong association between the concepts within the text. *Water* also links to the *land* concept. Despite falling within

the *Community* theme, the concept links directly on the map to the *water* concept rather than to other concepts within its own theme.

Employees

The final theme identified from within the sustainability reports was *Employees*. This theme includes *employees, training, human, rights,* and *employment* concepts. With 55% connectivity and a dark blue colouring, this theme was less dominant within the sustainability reports than other concepts were.

The *employees* concept was the second most frequent across all of the concepts. However, the theme has a relatively low connectivity which indicates that, despite its high occurrence, the *employee* concepts are used in isolation. The *employees* concept was used significantly more times than the other concepts within the theme. *Employees* appeared 8,159 times within the sustainability reports, while the next most frequent word in the Employees category was *training* (3,772 times). *Human* and *right* appeared a similar number of times and were shown in the concept map to have a direct link.

4.2.4 Summary

This section presented the findings for the analysis of the entire population of sustainability reports. The findings were presented in three sections reflecting the different Leximancer outputs.

First, the concept analysis identified 36[4] dominant concepts. The concept counts were presented in Table 4.2. These findings revealed that the most frequent concepts across the sustainability reports were *community*, *employees*, *local*, *production,* and *safety*. Leximancer analysed the concept relationships and interactions within the sustainability reports. Table 4.3 showed that *community* had the most concept interactions. However, when standardised on count, *education* emerged as the concept with the highest number of interactions.

Secondly, Leximancer's thematic analysis identified five themes at the 60% level. These themes were presented in *Figure 4.3* along with the concepts around each theme. Themes were arrived at by grouping the concepts on the basis of how they appeared together, relative to all concepts throughout the sustainability reports analysed. The

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[4] The settings for the analysis was a maximum number of concepts of 40. The findings of the concept analysis presented only 36 concepts, indicating that only 36 concepts were of enough significance, given the settings outlined in Chapter 3: Methodology and Method.

relevance score showed the concepts within *Community* related better to the remaining concepts, scoring 37% more than the next theme, *Safety*.

Finally, the concept map presented visually the relationship between the concepts. The connections between concept nodes further revealed the key concept interactions. Directly connected concepts indicated a closer relationship within themes. The map also showed not only concepts which had indirect relationships with other concepts, but also which concepts provided the strongest link between themes.

The purpose of this section was to answer the study's first research question which was: What are the dominant and common concepts and themes within mining sustainability reports? In total, 36 concepts were identified across the 102 sustainability reports analysed and as the findings above showed, the most common concepts were: *community*, *employees*, *local*, *production,* and *safety*.

The interactions between the concepts revealed the concept pairings that occurred consistently across the reports. The most common pairing was *community* and *local*. The strongest pairing between concepts was *energy* and *consumption,* with a 0.76 interaction score.

Whilst the interaction between the concepts revealed individual relationships, the concept groupings formed larger themes. These groupings were presented in the thematic analysis and the concept map. The thematic analysis revealed five groups, as presented in Figure 4.2. The concept map, shown as Figure 4.3, visually summarised the concepts and themes, based on the associations and relationships that emerged from the sustainability reports.

This section revealed the collective findings across all the sustainability reports used in this analysis. The next analysis examines individual company findings to further understand the sustainability reporting practices of mining companies.

4.3.1 Company profiles

Table 4.6. Company summaries.

Company	Code	ICMM Classification	ICMM Year	Reports	Mining Focus	Headquarters	Stock Listings
African Rainbow Minerals	ARM	New member	2009	4	Ore and precious metals	Johannesburg, South Africa	JSE
Anglo America	AAM	Existing member	Founding	4	Precious metals, base metals and bulk commodities	London, UK	LSE, JSE
Anglo Gold Ashanti	AGA	Existing member	Founding	4	Gold	Johannesburg, South Africa	LSE, NYSE, GSE, JSE, ASE
Antofagasta plc	ANT	Nonmember	N/A	4	Copper	Santiago, Chile	LSE
Areva	ARE	New member	2011	2	Uranium	Paris, France	Euronext
Barrick	BAR	Existing member	2008	4	Gold	Toronto, Canada	TSX, NYSE
BHP Billiton	BHP	Existing member	Founding	4	Precious metals, base metals and bulk commodities	Melbourne, Australia	LSE, NYSE, ASE, JSE
China Coal Energy Limited	CCE	Nonmember	N/A	3	Coal	Beijing, China	HKEx
China Shenhua Energy Company Ltd	CSE	Nonmember	N/A	4	Coal	Beijing, China	HKEx, SSE

Company	Code	ICMM Classification	ICMM Year	Total	Mining Focus	Headquarters	Stock Listings
Freeport-McMoran Copper & Gold Inc.	FMM	Existing member	Founding	4	Copper, cobalt and molybdenum	Phoenix, USA	NYSE
Codelco	COD	New member	2011	3	Copper	Santiago, Chile	Santiago Stock Exchange
Eldorado Gold Corp	ELD	Nonmember	N/A	2	Gold	Vancouver, Canada	TSX, NYSE
Fortescue Metals Group Limited	FOR	Nonmember	N/A	4	Iron Ore	Perth, Australia	ASE
Gold Fields	GFI	Existing member	2007	0	Gold	Johannesburg, South Africa	JSE, NYSE, Euronext, SWX, NASDAQ Dubai
Goldcorp	GCO	New member	2009	1	Gold	Vancouver, Canada	VSE, NYSE
Grupo Mexico S.A. de CV	GMX	Nonmember	N/A	4	Copper and iron ore	Mexico City, Mexico	BMC
Hydro	HYD	New member	2011	4	Aluminium	Oslo, Norway	Oslo
Impala Platinum Holdings Limited	IPH	Nonmember	N/A	3	Platinum, nickel, copper and cobalt	Johannesburg, South Africa	LSE, JSE
Inmet Mining	INM	New member	2012	0	copper, zinc and gold	Toronto, Canada	N/A – Hostile takeover by First Quantum Minerals (2013)
Jiangxi Copper Company Limited	JCC	Nonmember	N/A	0	Copper	Guixi, China	SSE

Company	Code	ICMM Classification	ICMM Year	Total	Mining Focus	Headquarters	Stock Listings
JX Nippon Mining and Metals	JXN	Existing member	Founding	4	non-ferrous metal	Tokyo, Japan	TSE
Kinross Gold Corporation	KIN	Nonmember	N/A	2	Gold	Toronto, Canada	TSX, NYSE
Lonmin	LON	Existing member	2004	3	Platinum	London, UK	LSE, JSE
Mitsubishi Materials	MIT	Existing member	2002	2	Manufacture of basic materials, fabricated products and high-performance materials	Tokyo, Japan	TSE
Metals Group	MMG	New member	2009	4	Precious metals	Melbourne, Australia	HKEx
Newcrest Mining Limited	NWC	Nonmember	N/A	4	Gold	Melbourne, Australia	ASE
Newmont	NWM	Existing member	Founding	3	Gold	Greenwood Village, USA	NYSE
Potash Corporation of Saskatchewan Inc.	POT	Nonmember	N/A	2	Potash, nitrogen and phosphate	Saskatoon, Canada	TSX, NYSE
Rio Tinto	RIT	Existing member	Founding	2	Precious metals, base metals and bulk commodities	London, UK	LSE, NYSE, ASE

Company	Code	ICMM Classification	ICMM Year	Total	Mining Focus	Headquarters	Stock Listings
Sumitomo Metal Mining Co. Ltd	SMM	Existing member	2002	4	Mining, smelting, refining, and the manufacturing of semiconductor and advanced materials	Tokyo, Japan	TSE
Teck	TEC	Existing member	2006	3	Precious metals, base metals and bulk commodities	Vancouver, Canada	VSE, NYSE
The Mosaic Company	TMC	Nonmember	N/A	2	Phosphate and potash	Plymouth, USA	NYSE
Vale	VAL	Existing member	2006	3	Precious metals, base metals and bulk commodities	Rio de Janeiro, Brazil	BM&F Bovespa, NYSE, Euronext, HKEx, Bolsa de Madrid
Xstrata	XST	Existing member	2006	4	Precious metals, base metals and bulk commodities	Zug, Switzerland	LSE, SWX
Yamana Gold Inc.	YAM	Nonmember	N/A	4	Gold	Toronto, Canada	TSX, NYSE
Zijin Mining Group Company Limited	ZMG	Nonmember	N/A	0	Gold, copper and non-ferrous metals	Shanghang, China	HKEx, SSE

4.3 Company Findings

This section presents the findings for the individual companies used within the population analysis in the previous section. All reports for each individual company were analysed using Leximancer.

The purpose of this section is to understand the concepts on which each company places the greatest emphasis. The findings presented are limited to the top five concepts and the relevance score of each concept. The thematic analysis will look at the number of themes for each company at the 60% level in Leximancer. Concept maps were not included, as comparisons between 32 maps did not provide either meaningful data or useful comparisons when it came to answering the research questions. The analysis of company findings concludes with a comparison of the concept and theme findings across the companies.

4.3.2 Concept findings

This section presents the concept findings for the individual companies. The first findings presented in Table 4.7 include the top five ranked concepts for each company and the corresponding relevance scores.

The section that follows compares the collective findings across all 32 companies. The concept findings examine how concept usage and ranking vary between companies. The section includes a specific review of the concept of sustainability. The section concludes with a summary of the main findings across the different companies.

4.3.2.1 Concept summary

As the findings in Table 4.7 reveal, when looking only at the most frequent concept, *operations* emerged as the most common concept. It appeared in the reports of 15 of the 32 companies studied. Despite appearing only once in each instance, individual company names appeared eight times as the most frequent concept, while the concept of *company* appeared twice.

When the results are extended to include the second most frequent concept, the concept of *operations* appears a further six times. Individual company names and acronyms appear an additional four times and the concept of *company* is used a further three times. The concepts of *development* and *management* are the second most frequent concepts and are each used in the reports of three separate companies.

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The findings in Table 4.7 include the relevance scores. The relevance scores for the most frequent concepts were all 100%, as these concepts were used in turn to calculate a score for a subsequent concept. Given that each report varies in length and composition, comparing these standardised measures provides more meaningful findings than absolute count data can.

The average relevance score for the second ranked concept across the 32 companies was 82%. The relevance scores ranged from 99% (*operations* in Fortescue) to 49% (*use* in The Mosaic Company). The third most frequent concept's average relevance score was 74%; its range went from 97% (for *mine* in Barrick) down to 38% (for *operations* in The Mosaic Company). The average relevance score for the fourth most frequent concept was 66%. The range for this concept went from a high of 91% (for *MMG* in Minerals & Metals Group) to 35% (for *crop* in The Mosaic Company). The fifth ranked concept appeared on average 61% of the time compared to the most frequent concept. The range for these concepts was 90% (for *development* in Minerals & Metals Group) to 34% (for *employees* in The Mosaic Company).

The findings are presented according to the rank of the concept. No account has been taken of the count of the individual concepts. Table 4.8 shows that *operations* was a consistent concept across all companies. The concept was ranked in the top five for count in 78% of the mining companies. Only *company name*, *management,* and *development* appeared in the top five in more than half the companies. The second most common concept was the *company's name*. The use of the *company's name* featured in the top five ranked concepts in 59% of the reports. The concepts of *mine* and *community* appeared in over 25% of the top five counts.

Table 4.7. Top five concepts with relevance percentage for all companies.

Company	1st Concept		2nd Concept		3rd Concept		4th Concept		5th Concept	
AAM	development	100%	operations	97%	business	89%	management	81%	mining	65%
AGA	operations	100%	management	78%	Anglogold Ashanti	60%	business	59%	communities	59%
ANT	operations	100%	company	85%	mining	78%	management	60%	water	54%
ARM	operations	100%	ARM	89%	management	69%	report	65%	including	61%
BAR	Barrick	100%	operations	98%	mine	97%	including	74%	development	67%
BHP	operations	100%	community	67%	including	65%	development	52%	management	50%
CCE	development	100%	Company	95%	production	92%	coal	77%	mining	71%
COD	Codelco	100%	operations	72%	company	64%	management	58%	workers	55%
CSE	Company	100%	production	74%	operation	70%	development	69%	coal	68%
ELD	mine	100%	operations	93%	Eldorado	86%	use	75%	area	61%
FMM	operations	100%	mining	59%	including	58%	community	53%	development	50%
FOR	Fortescue	100%	operations	99%	management	83%	environmental	79%	mining	67%
GCO	operations	100%	Goldcorp	96%	mine	74%	sites	57%	management	45%
GMX	operations	100%	community	86%	development	86%	program	75%	projects	63%
HYD	Hydro	100%	including	59%	production	57%	employees	53%	work	51%
IPH	operations	100%	management	58%	year	56%	employees	53%	development	49%
JXN	operating	100%	activities	70%	Group	61%	development	60%	materials	55%
KIN	operations	100%	Kinross	97%	mining	86%	community	73%	including	68%
LON	Lonmin	100%	year	87%	employees	85%	management	78%	operations	72%
MIT	activities	100%	companies	93%	use	83%	operations	78%	materials	76%
MMG	operations	100%	management	94%	mine	92%	MMG	91%	development	90%
NWC	Newcrest	100%	including	80%	reporting	78%	community	72%	management	59%
NWM	operations	100%	mine	83%	community	79%	Newmont	70%	development	67%
POT	company	100%	production	97%	operations	96%	employees	81%	Potashcorp	81%
RIT	operations	100%	development	85%	management	71%	business	67%	use	66%
SMM	business	100%	activities	92%	management	88%	employees	83%	SMM	78%
TEC	operations	100%	development	74%	management	58%	work	46%	use	45%
TMC	Mosaic	100%	use	49%	operations	38%	crop	35%	employees	34%
VAL	Vale	100%	areas	52%	development	49%	management	42%	use	36%
XST	management	100%	development	87%	community	86%	business	86%	local	62%
YAM	operations	100%	Yamana	84%	community	67%	mine	62%	employees	56%
GFI	mining	100%	operations	92%	Gold Fields	71%	million	63%	development	58%

Table 4.8. Summary of highest ranked concepts.

Concept	1st Ranked Concept	2nd Ranked Concept	3rd Ranked Concept	4th Ranked Concept	5th Ranked Concept	Total	Percentage
operations	15	5	3	1	1	25	78%
'company name'[5]	9	4	2	2	2	19	59%
management	1	3	5	5	3	17	53%
development	2	3	2	3	6	16	50%
mine	1	2	6	1	3	13	41%
community		2	3	3	1	9	28%
employees			1	4	2	7	22%
including		2	2	1	2	7	22%
company	2	3	1			6	19%
use		1	1	1	3	6	19%
business	1		1	3		5	16%
production		2	2			4	13%
activities	1	2				3	9%
area		1			1	2	6%
coal				1	1	2	6%
group		1	1			2	6%
materials					2	2	6%
report			1	1		2	6%
work				1	1	2	6%
year		1	1			2	6%
crop				1		1	3%
environmental				1		1	3%
local					1	1	3%
million				1		1	3%
programme				1		1	3%
projects					1	1	3%
sites				1		1	3%
water					1	1	3%
workers					1	1	3%
Total	**32**	**32**	**32**	**32**	**32**		

The total number of concepts that ranked in the top five most frequent concepts across the 32 companies was 29. Included within these 29 concepts were 9 concepts that appear in one company's report only, and 7 concepts that appeared in two of the top five companies' reports. When the ranking of concepts is extended to include the top 10 concepts for all 32 companies, a total of 55 concepts was found.

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[5] [5] Company name is used to replace individual company names or company initials so the use of a company's name can be measured consistently across all companies.

The findings from the concept analysis across all companies show that the most frequent concepts were *management* and *operations*, both appearing in 28 of the 32 companies' reports, that is, 88%, of companies' top 10 most frequent concepts. The *company name* was also a frequent concept, where it appeared in 81% of the companies' top 10 most frequent concepts.

Development was the next most common concept, appearing 22 times in the top 10 concepts across the 32 companies. The fifth most frequent concept was *mine* which appeared in the top 10 ranked concepts of 21 companies. When the reports are analysed individually, the findings show that these concepts collectively were more commonly used than the other concepts within the sustainability reports.

The concept findings from the individual companies revealed there can be a large difference between the count of the highest ranked concept and the tenth ranked concept. For example, in the Vale sustainability reports, the tenth most frequent concept had a relevance score of 25%. Similarly, in Areva, the tenth ranked concept had a relevance score of 27%. In contrast, both Mitsubishi Materials and Sumitomo Metal Mining Company's tenth ranked concepts had relevance scores of 61% and 62% respectively.

Across all 32 companies, the average number of concepts with a relevant score of greater than 50% was 7.1. Therefore, across all the companies, only six additional concepts appeared in the report with a frequency of at least half the count of the most frequent concept. The range varied from 1 concept in The Mosaic Company to 14 concepts in Sumitomo Metal Mining Company.

In addition to looking at the findings from Leximancer, it is worth reviewing specific concepts in isolation. The next section, therefore, looks at how the concept of *sustainability* was applied within the top 40 concepts across all the individual organisations.

4.3.2.2 Sustainability concept

One area that is of interest is the use of sustainability as a concept within the reports. Leximancer allows specific concepts to be analysed and compared. Consequently, this section summarises how the concept of sustainability was applied within the reports.

Sustainability[6] was a top 40 concept in 15 of the 32 mining company reports. In the reports of three companies — Mitsubishi Materials, Sumitomo Metal Mining Co. Ltd, and JX Nippon Mining & Metals — CSR was used as a proxy for sustainability. Both Mitsubishi Materials and Sumitomo Metal Mining Co. Ltd produced CSR reports between 2009 and 2013, while JX Nippon Mining & Metals produced sustainability reports within that period. These three companies all have head offices in Tokyo and are listed on the Tokyo Stock Exchange.

Table 4.9 below presents the rank, count, and relevance findings for each of the 15 companies where sustainability was ranked within the top 40 concepts. The table, however, reveals that for 17 companies, sustainability did not rank anywhere within the top 40 concepts.

Table 4.9. Companies where sustainability was a ranked concept.

	Code	Rank	Count	Relevance
Company				
Anglo Gold Ashanti	AGA	11	309	42%
Anglo America	AAM	11	422	39%
Rio Tinto	RIT	13	95	38%
African Rainbow Minerals	ARM	10	517	37%
Lonmin	Lon	12	240	37%
Teck	TEC	8	355	37%
Xstrata (Glencore Xstrata)	XST	16	339	37%
Codelco	Cod	18	209	36%
Mitsubishi Materials[7]	MIT	30	152	31%
MMG - Minerals & Metals Group	MMG	23	231	31%
Sumitomo Metal Mining Co. Ltd[8]	SMM	30	189	25%
Vale	VAL	10	386	25%
The Mosaic Company	TMC	13	111	24%
JX Nippon Mining & Metals[9]	JXN	30	242	22%
Areva	ARE	27	97	15%

The findings in Table 4.9 above reveal that sustainability had its greatest relevance score within the Anglo Gold Ashanti sustainability reports. The concept was more frequent within this reporting 42% of the time, compared to the most frequent concept. The average relevance score across the 15 companies listed above was 32%. Analysis

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[6] Sustainability includes the terms sustainable, sustainability, and CSR.

[7] Indicates companies where CSR was used instead of sustainability

[8] Indicates companies where CSR was used instead of sustainability

[9] Indicates companies where CSR was used instead of sustainability

shows that when *sustainability* was present as a concept within the top 40 concepts, it would be used only a third of the time compared to the most frequent concept.

In addition to looking at the relevance score, the rank column shows where *sustainability* ranked for concept frequency relative to the other concepts. Sustainability ranked highest within the Teck sustainability reports where it was the eighth most frequent concept. *Sustainability* also ranked in the top 10 concepts in the reports of African Rainbow Minerals and Vale. The average rank for the *sustainability* concept across the 15 companies was 17.

Whilst it is possible to compare the rank and relevance scores for organisations as they are standardised measures relative to the other concepts within each company's sustainability reports, comparing counts is not possible. The count score is an absolute score and is useful for determining other measures and cannot be compared across different companies in any meaningful analysis. One observation that can be made, however, is that of the 15 companies where *sustainability* ranked amongst the top 40, based on the total count, the concept did appear more often within African Rainbow Minerals reports than it did in the reports of any other company.

Concept comparison is possible across companies due to the different Leximancer outputs. Nevertheless, theme comparison is more challenging due to the way themes are constructed on the basis of how concepts appear within the reports. The next section compares the general theme findings across the individual companies.

4.3.3 Theme comparison

This section compares how the concepts group into themes across individual companies. Each theme comprises a unique combination of concepts; therefore, direct comparisons between themes are not possible. Table 4.10 summarises the 32 companies in terms of the total number of themes found within the reports of each company. On average, the companies' reports contained 4.8 themes.

Table 4.10. Summary of the total number of themes.

Number of Themes	Number of Companies
4	14
5	12
6	5
7	1

Table 4.10 shows that the reports of 14 companies had four themes; a further 12 had five themes, and five had six themes. JX Nippon Mining & Metals was unique with its concepts forming seven themes.

While comparing themes based on the number of themes shows how many groups of concepts there are within the reports, doing so does not provide any detail about how the groups are made up. The table below, therefore, shows the theme connectivity score for each company.

Table 4.11 uses a descending scale to reveal the connectivity score for each theme. As the table shows, there is significant variation between all of the companies. This variability is highlighted in the case of Potash which has five themes, all with greater than 50% connectivity. In contrast, Teck has six themes with the highest theme having 100% connectivity, the next 29%, and the lowest 2%. The thematic analysis helps in understanding how the concepts group within the reports but does not provide meaningful information when comparison is conducted solely at a theme level across a large number of companies.

Table 4.11. Theme connectivity comparison by company.

	Themes	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6	Theme 7
Company								
ARM	4	100%	92%	47%	8%			
AAM	4	100%	55%	51%	38%			
AGA	4	100%	79%	72%	7%			
ANT	5	100%	82%	45%	23%	20%		
ARE	5	100%	96%	78%	69%	22%		
BAR	4	100%	59%	38%	19%			
BHP	4	100%	64%	50%	48%			
CCE	4	100%	87%	85%	29%			
CSE	5	100%	70%	49%	13%	2%		
Cod	5	100%	96%	71%	43%	8%		
ELD	4	100%	50%	40%	20%			
FOR	6	100%	94%	29%	14%	4%	1%	
FMM	4	100%	39%	24%	17%			
GCO	4	100%	69%	47%	8%			
GMX	5	100%	93%	92%	9%	4%		
HYD	5	100%	70%	22%	20%	15%		
IPH	5	100%	68%	63%	56%	36%		
JXN	7	100%	77%	54%	41%	33%	7%	3%
KIN	5	100%	86%	78%	77%	49%		
LON	5	100%	80%	52%	9%	2%		
MIT	5	100%	96%	50%	28%	9%		
MMG	4	100%	47%	36%	7%			
NWC	4	100%	62%	16%	1%			
NWM	4	100%	68%	47%	30%			
POT	5	100%	91%	68%	58%	52%		
RIT	6	100%	93%	58%	18%	15%	2%	
SMM	6	100%	63%	42%	41%	8%	2%	
TEC	6	100%	29%	28%	17%	6%	6%	
TMC	4	100%	69%	46%	11%			
VAL	6	100%	87%	57%	51%	16%	13%	
XST	4	100%	72%	31%	19%			
YAM	5	100%	68%	53%	31%	2%		

4.3.4 Summary

The individual company findings provided further insight into the sustainability disclosures for each company used within this study. The findings provided detail and insight for each company beyond what could be obtained from the entire population analysis. Comparisons between companies were, nevertheless, difficult. The analysis was based on the reports available for each company. In some cases, four reports were available whilst in others there were fewer. This variability must be considered when reviewing the results.

One partial way to overcome this problem was to use standardised measures. Comparing concept ranks and relevance scores offered a form of comparison between the different companies. The findings from this section applied an alternative concept analysis to the findings of the entire population. The results from analysing each company individually and then combining the results identified that the main concepts were *operations, management, company name*[10]*, development, mine,* and *community,* when analysing the top 10 concepts. When limiting the results of the top three ranked concepts, it was evident that *operations* stood out consistently as the most frequent concept within the reports analysed. This concept ranked in the top 3 of the 23 concepts found in the 32 companies analysed.

One analysis that was possible through studying the individual companies was the analysis of *sustainability* as a concept. The findings found the concept was ranked inside the top 40 concepts of 15 companies (12 as *sustainability* and 3 as *CSR*). The results showed that the concept, when present, averaged a 32% relevance score compared to the most frequent concept. Whilst the findings presented themes for each company, comparison was difficult due to the complex nature of individual themes that were beyond the scope of this research.

Understanding the concepts and themes at an individual company level provided additional insights into the sustainability reporting practices of mining companies. This understanding can be further enhanced by looking at how the reports changed over the

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[10] *Company name* is used to replace individual company names or company initials so the use of the name can be measured consistently across all companies.

Some of the entries in some of your Tables need to be adjusted to fall in line with this footnote i.e., 'Company' should become 'Company name'.

4-year period. The next section, therefore, presents the findings based on an analysis of each individual year in that 4-year period.

4.4 Year Findings

This section presents the findings produced by analysing all the sustainability reports on the basis of their year of publication. Analysing the reports by year provides greater understanding into sustainability reporting trends for the mining industry. The purpose of this section is to identify concepts and themes that are dominant over the 4-year period and also to discover new and emerging concepts that replace those that have become less prevalent.

For the purposes of consistency, sustainability reports were classified by year according to International Council of Minerals and Metals (ICMM) sustainability report annual reviews, as previously identified in the study's method section. These classification dates were applied to both ICMM and non-ICMM companies. Table 4.12 below summarises the different reporting dates for each analysis year and the number of reports analysed by Leximancer for each year. No distinction has been made on the basis of any other characteristics.

Table 4.12. Sustainability reports analysed by ICMM year classification.

	Sustainability Report Date Range		Reports Analysed
	Start	End	
Year			
2010	31 December 2009	30 September 2010	22
2011	31 December 2010	30 September 2011	24
2012	31 December 2011	30 September 2012	29
2013	31 December 2012	30 September 2013	29

Table 4.12 shows an increase in the number of reports in 2012 and 2013. However, this increase does not necessarily represent an increase in the number of reports published over the time period. It is important to clarify that the results above do not necessarily reflect a change in the number of reports produced annually by the companies. The findings also include reports from companies that fall into the "New ICMM" category. Some joined ICMM during the 4-year period, a factor which could partly contribute to the increase in the number of reports. Further, format issues meant that Leximancer could

not analyse some reports; others were not sustainability-focused and so were excluded from the research. These factors influenced the number of reports analysed.

In the analysis which follows the first part presents the Leximancer output on concepts, themes, and concept maps separately for 2010 through to 2013. The final section compares the findings across the four years. Changes and movements between years will then be used to establish trends over the four year period. Trends include emerging or reducing concepts and themes as well as consistent concepts or themes. First, the findings for the 2010 sustainability reports are presented.

4.4.1 2010 findings

This subsection presents the Leximancer output for 22 2010 sustainability reports. Appendix B contains the list of companies whose 2010 reports were analysed using Leximancer. Year findings are separated into three areas. First, the dominant concepts are presented, followed by examination of the themes, and, finally, how the concepts appeared within the sustainability reports. The final section presents the concept map which graphically illustrates the concepts and themes for the 2010 reports.

4.4.1.1 2010 concepts

The results presented in this section have been limited to the 10 most dominant concepts. Table 4.13 below summarises the findings for the 10 most frequently occurring concepts across four different measures: concept rank, count, relevance, and average count per report.

Table 4.13. Ten most frequent concepts from 2010 reports.

	Rank	Count	Relevance	Average per report
Concept				
community	1	1,661	100%	75.5
employees	2	1,658	100%	75.4
use	3	1,528	92%	69.5
report	4	1,419	85%	64.5
projects	5	1,139	69%	51.8
production	6	1,102	66%	50.1
local	7	1,067	64%	48.5
performance	8	1,039	63%	47.2
water	9	887	53%	40.3
safety	10	871	52%	39.6

Collectively, the total count for the top 10 concepts in 2010 was 12,371 across all 22 reports. Therefore, the top 10 concepts from the 2010 sustainability reports appeared an average of 562 times per report. The findings are next presented on an individual concept basis.

The Leximancer output revealed that *community*[11] was the most frequent concept in 2010. Across the 22 sustainability reports, the concept appeared 1,661 times, which equates to an average of 75.5 times per report. The second most frequent concept in 2010 was *employees*. That concept appeared 1,658 times across the 2010 reports, appearing just three times fewer than *community* did. The average number of times the concept was used per report was only 0.1% less than for *community*. The concept of *use* was the third most common, appearing 1,528 times, with an average of 69.5 appearances per report.

4.4.1.2 2010 themes

Five themes were identified to represent the 40 concepts at the 60% theme level. These themes were *Use*, C*ommunity*, E*mployees*, *Production,* and *Copper*. The concepts that fall within these themes are detailed in Table 4.14 and include the corresponding connectivity percentage for each theme.

Table 4.14. Themes and concepts from 2010 sustainability reports.

Theme and Connectivity:	Use – 100%	Community – 81%	Employees – 74%	Production – 56%	Copper – 3%
Concepts:	*use*	*community*	*employees*	*production*	*copper*
	report	*local*	*programme*	*water*	
	reduce	*projects*	*safety*	*company*	
	million	*year*	*performance*	*percent*	
	total	*support*	*health*	*rate*	
	energy	*people*	*training*	*facilities*	
	emission	*education*	*during*	*waste*	
	material	*region*	*services*	*period*	
	result	*organisation*		*tonnes*	
	information			*coal*	
	plant				
	time				

The concepts that fall within the *Use* theme have 100% connectivity with the remaining concepts. The concepts within *Community* link to 81% of the concepts. *Employees* had a connectivity score of 74%, and *Production* scored 56%. *Copper,* in contrast, had a

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[11] Concepts identified from Leximancer analysis will be shown in italics.

connectivity score of 3%. This result shows that whilst the concept of *copper* is ranked inside the top 40 for the year, it did not consistently appear within close proximity to the remaining concepts across the 2010 reports. The concept map provides further information on both the themes and concepts to better understand the findings from Leximancer.

4.4.1.3 2010 concepts map

This section builds on the concepts and themes presented above. Leximancer positions the concepts within the map based on the relationships within the sustainability reports. The concepts and themes for 2010 are shown in Figure 4.4 below.

Figure 4.4. 2010 Concept map.
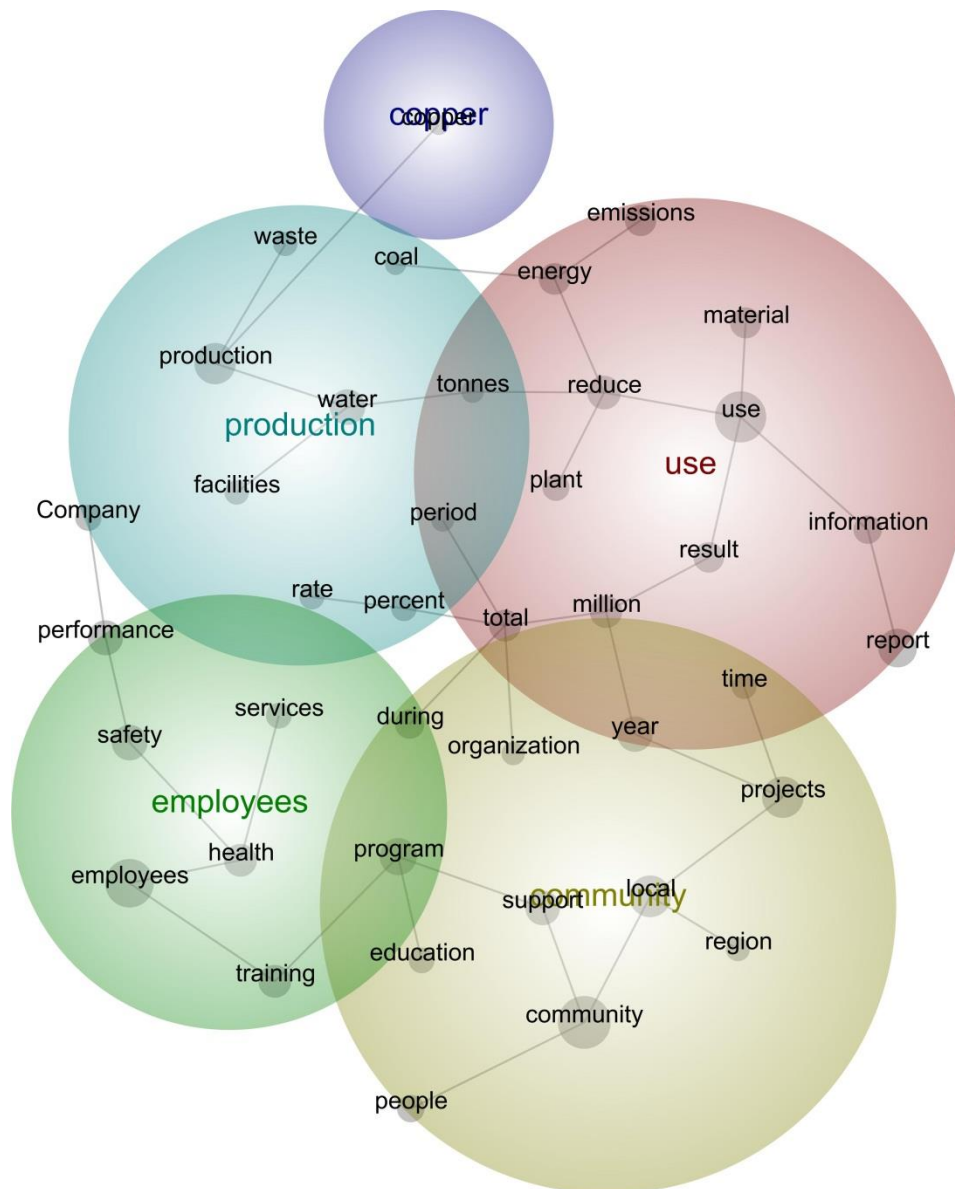
The concept map reveals the direct connections between concepts. The concept of *total* has the most connections with six direct links to other concepts. Considering, *total* ranked twenty-fourth for count, these findings indicate that whilst the concept was not as frequent as others, when it was present within the sustainability reports, it was likely to appear within close proximity to *period*, *rate*, *percent*, *million*, *during,* and *organisation*.

In contrast, only 19 concepts linked directly with one other node. These concepts, whilst appearing frequently inside the top 40 overall concepts, were likely to be found within close proximity to the corresponding node or a variety of other concepts.

Concepts that do not link directly within the sustainability reports may link via a common third concept. An example that illustrates this linkage is *coal* and *emissions*. The concepts, whilst appearing in relative proximity in the reports, do not link directly. However, the concept of *energy* acts as a linking concept within the reports. Concepts that are further away require additional concepts (nodes) to create a relationship within the texts.

This analysis was completed using a 60% theme size. The themes presented in the earlier section are shown graphically to better illustrate the relationship between concepts. The concept map presented in Figure 4.4 is heat-mapped by theme. The red of the the *Use* theme and the yellow of the *Community* theme show the concepts are more important than the cooler green and blue colours assigned to the remaining themes. This colour coding is consistent with the theme connectivity findings presented above.

The map shows how distinct the *Copper* theme is relative to the other concepts. The other themes all have two concept links to other themes. *Copper,* by contrast, is isolated from the remaining themes, linking only to *production*. The map also reveals that *production* and *community,* along with *use* and *employees,* are both exclusive at the 60% theme level. Based on the relationship between the concepts, there is very little commonality between the concepts within the themes across the 2010 sustainability reports.

4.4.1.4 2010 summary

The findings from 2010 were summarised through the concept map. The dominant concepts of *community*, *employees*, *use,* and *reports* identified earlier were evident with larger nodes in the map. The theme of *Use* had the highest connectivity, despite only

containing the third highest ranked concept; it is also the most dominant as indicated by its red colouring. Whilst the individual concepts may not have been as highly ranked, collectively they did link strongly within the 2010 sustainability reports.

These links are further emphasised in Table 4.15 below which shows the sum of individual concept counts for each theme. The *Use* theme has approximately 25% more concept appearances within the 2010 sustainability reports compared to *Community*. The higher presence of concepts contributes to the red heat-mapping within the concept map.

Table 4.15. Sum of concept counts per 2010 theme.

	Use	Community	Employees	Production	Copper
Sum of Concept Count	8,964	7,154	6,838	4,745	301

The concepts of *community* and *employees* had the highest individual counts; however, the remaining concepts within their respective themes were relatively less prevalent within the reports. The table above shows that the collective counts within the theme are similar. Both themes have significantly higher sums than the sums for remaining themes.

The theme of *Production* did not include any of the top five ranked concepts. The *Production* theme had a greater number of concepts than *Community* and *Employees*. The low overall sum of its count shows the theme is a collection of small concepts. This finding suggests that the concepts were not as frequent as others, but that, when they appeared, the concepts were in close proximity.

The single concept theme of *Copper* was an outsider relative to the other concepts and themes. The link to the remaining concepts came through *Production*. However, the separateness of this theme suggests that, despite being the thirty-sixth ranked concept, it was not often in proximity to other frequent concepts.

The next section looks at the results for publications from the 2011 sustainability reports.

4.4.2 2011 findings

This section presents the Leximancer output for the 24 sustainability reports from the 2011 year classification. A list of companies whose reports were used in the 2011 Leximancer analysis can be found in Appendix B. Reporting the findings for 2011 follows the same format as that for 2010, starting with the concepts.

4.4.2.1 2011 concepts

The results presented in this section have been limited to the 10 most dominant concepts. The results from 2011 are summarised in Table 4.16 below. The findings show that *employees* was the most common concept in 2011. Across the 24 reports, the concept appeared 2,102 times, which equates to an average of 87.6 appearances per report.

The second most frequent concept in 2011 was *community*. The concept appeared 2,071 times, 32 fewer than *community*. The average number of times the concept appeared within each report was 86.3. The concept of *use* was third, with *report* fourth, and *production* being the fifth most common. The remaining most frequent concepts are shown in the table below, along with their count and relevance scores.

Table 4.16. Ten most frequent concepts from 2011.

	Rank	Count	Relevance	Average per report
Concept				
employees	1	2,103	100%	87.6
community	2	2,071	98%	86.3
use	3	1,885	90%	78.5
report	4	1,754	83%	73.1
production	5	1,512	72%	63.0
local	6	1,407	67%	58.6
safety	7	1,185	56%	49.4
water	8	1,054	50%	43.9
support	9	1,023	49%	42.6
increase	10	974	46%	40.6

The total count for the top 10 concepts in 2011 was 14,968 across all 24 reports. Therefore, these concepts appeared an average of 624 times per report. Leximancer has the ability to look at concepts in isolation and how concepts link and relate within the text.

4.4.2.2 2011 themes

Leximancer identified five themes that represent the 40 concepts at the 60% theme level. These themes were *Use*, *Community*, *Employees*, *Increase,* and *Reporting;* they are presented in Table 4.17. Theme names are determined by the most common concept within in the theme. Table 4.17 below also presents the concepts that fall within each theme.

Table 4.17. Themes and concepts from 2011 sustainability reports.

Theme and connectivity:	Use –100%	Community – 74%	Employees – 69%	Increase – 50%	Reporting – 42%
Concepts:	*use* *production* *water* *system* *energy* *material* *emissions* *rate* *facilities* *waste* *copper*	*community* *local* *support* *programme* *people* *region* *employment*	*employees* *safety* *training* *health* *services* *education* *completed* *rights*	*increase* *million* *total* *company* *plant* *vale* *organisation* *coal*	*reporting* *during* *information* *period* *following*

The concepts that fall within the *Use* theme have a connectivity of 100% to the remaining concepts. In contrast, the concepts within *Community* relate to 74% of the concepts. *Employees* had a connectivity score of 69%. *Increase* scored 50%, while *Reporting* has the lowest at 42%. The concept map puts the findings from above into a graphical format that provides greater context for the nature of the relationships.

4.4.2.3 2011 concept map

The concept map in Figure 4.5 graphically portrays the relationship between concepts. Further, based on the position of the individual concepts, the map allows themes to be established. The concept findings are presented first, followed by those for the themes.

The nodes for *employees*, *community*, *use*, *report,* and *production* are larger than those for other concepts indicating these concepts were found more frequently within the reports. The connections between nodes reveal the concepts that often appeared together within the sustainability reports. Having five direct connections, *use* as a concept links to more concepts than any other concept does. The linking concepts from the 2011 reports were *production*, *total*, *material*, *system,* and *facilities*. *Use* was the third highest ranked concept in 2011. Its high number of links in the concept map shows the variety of its associations within the 2011 sustainability reports. Next, *employees* has four direct connections and *community* has three, despite having a higher overall concept count.

In addition to node size and the connections between nodes, the positioning of concepts within the map is reflective of the relative positioning of concepts within the sustainability reports. Concepts that appear close within the map appear relatively more often together within the reports. Concepts that appear furthest apart do not often appear together

within the reports. While the concepts of *emission* and *health* do link directly, they require numerous other concepts to construct a relationship.

Figure 4.5. 2011 Concept map.
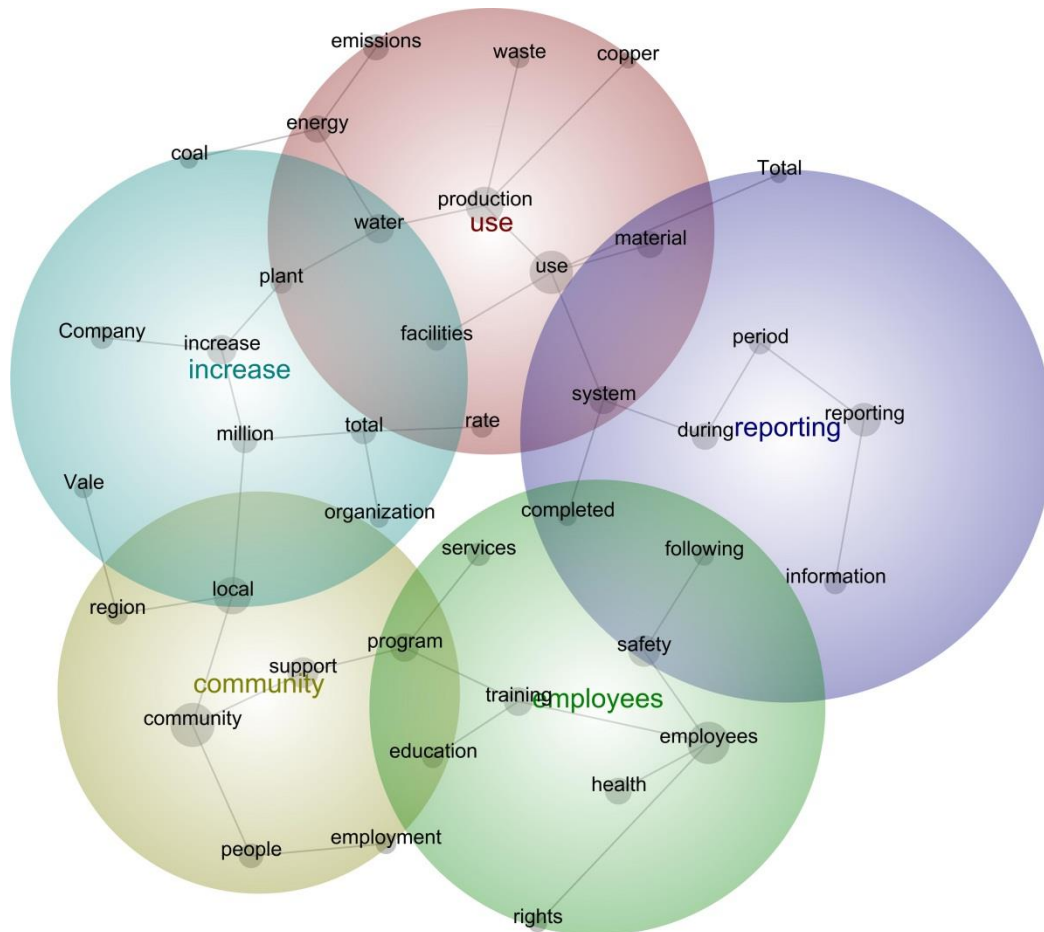
The positioning of concepts relative to other concepts determines the themes. The themes group those concepts which appear together relatively consistently within the reports. The concept map expands upon the theme analysis offered in the earlier section. The concept map reveals which concepts are central to a theme and those that build off the central themes.

Themes are heat-mapped to reflect their relative connectivity. The red colouring of *Use* indicates the strength of the theme. *Community*, coloured in yellow, is the second highest ranked theme. *Reporting* in a dark purple colour ranked the lowest, despite having a larger circle. The size of the circle reflects the diverse nature of the concepts that do not group within close proximity. The theme circle size does not, however, correspond to connectivity.

4.4.2.4 2011 summary

The concept map summarised the concepts and themes within the 2011 sustainability reports. The dominant concepts identified earlier ─ *employees*, *community*, *use*, *report,* and *production* ─ were evident with larger nodes in the map. The map shows how the concepts appear relative to the other concepts. The map uses heat colouring to show the dominance of the themes of *Use* and *Community* compared to the *Employees*, *Reporting,* and *Production* themes.

Table 4.18. Sum of concept counts per 2011 theme.

	Use	Community	Employees	Increase	Production
Sum of Concept Count	10,557	7,287	7,003	4,548	4,511

The concept count sums for each theme were presented in Table 4.18. The table shows *Use* contains significantly more concepts than the other themes do. Further, the table shows that while *Community* and *Employees* have similar total counts, they differ in terms of their connectivity and heat-mapping results. The concepts within *Community* are, therefore, more connected to the remaining concepts. The same applies to *Increase* and *Production*.

The next section looks at the findings from the 2012 sustainability report publications.

4.4.3 2012 findings

This section presents the Leximancer output for sustainability reports in the 2012 year classification. Twenty-nine reports were analysed for 2012. The list of companies whose reports were used in the 2012 Leximancer analysis can be found in Appendix B. Reporting of the findings for 2012 follow the same format as that used with the previous years, starting with the concepts.

4.4.3.1 2012 concepts

Once again, the presentation of the Leximancer results is restricted in this section to consideration of only the 10 most dominant concepts. Table 4.19 reveals that *community* was the most common concept in 2012. Across the 29 reports, the concept appeared 2,213 times, which equates to an average of 76.3 times per report. The second most frequent concept in 2012 was *report*. That concept appeared 1,699 times, 514 fewer than *community* did. The average number of times the concept appeared within each

report was 58.6. The concept of *local* had the third highest count, with *production* coming fourth and *safety being the* fifth most common.

Table 4.19. Ten most frequent concepts from 2012.

	Rank	Count	Relevance	Average per report
Concept				
community	1	2,213	100%	76.3
report	2	1,699	77%	58.6
local	3	1,428	65%	49.2
production	4	1,389	63%	47.9
safety	5	1,154	52%	39.8
support	6	1,026	46%	35.4
increase	7	969	44%	33.4
water	8	968	44%	33.4
health	9	962	43%	33.2
material	10	912	41%	31.4

The total count for the top 10 concepts in 2012 was 12,720 across all 29 reports. These concepts appeared an average of 469 times per 2012 sustainability report. As thematic analysis offers greater insight into the relationship between concepts and how they appear, that analysis is presented next.

4.4.3.2 2012 themes

Four themes were identified to represent the 40 concepts at the 60% theme level. These themes were *Community*, *Safety, Water,* and *Production*. As mentioned previously, theme names are determined by the most common concept within in a theme. *Table 4.20* below also presents the concepts that fall within each of the four themes identified above. The concepts' positions are determined by the Leximancer outputs; these are then grouped according to dominant concepts within a particular grouping.

Table 4.20. Themes and concepts from 2012 sustainability reports.

Theme and Connectivity:	Community – 100%	Safety – 69%	Water – 63%	Production – 32%
Concepts:	*community*	*safety*	*water*	*production*
	local	*health*	*materials*	*company*
	report	*people*	*energy*	*technology*
	support	*government*	*emissions*	*coal*
	increase	*information*	*million*	*rate*
	program	*established*	*total*	*copper*
	training	*services*	*facilities*	
	education	*based*	*waste*	
	time	*group*	*supply*	
	land	*members*	*plant*	
	completed	*skills*	*due*	
	data			

The concepts that fall within the *Community* theme have a connectivity of 100% to the remaining concepts. In contrast, the concepts within *Safety* relate to 69% of the concepts. *Water* had a connectivity score of 63%, while *Production* was the lowest at 32%.

The concepts within each theme reflect natural groupings at appear within the sustainability reports. The concept map puts the above findings into a graphical format; this map provides insight into the nature of the relationship between themes and concepts.

4.4.3.3 2012 concept map

The concept map in Figure 4.6 shows the findings that illustrate the relationship between concepts and themes in the 2012 reports. The concepts of *community*, *local*, *report,* and *production* have larger nodes than the remaining concepts, indicating higher relative frequency consistent with the concept analysis.

The lines linking concepts illustrate the concepts that appeared together more often across the 2012 sustainability reports. For the 40 concepts from 2012, only 15 link to one other concept. The remaining 25 concepts link to a minimum of 2 others. Four concepts linked to 4 other concepts. These were *production*, *water*, *increase,* and *support*. The link between *community* and *local* shows that the first and third ranked concepts often appeared together within the texts. Whilst the theme analysis showed these concepts in the same theme, the same did not apply to *report*.

The positioning of concepts determines the themes. Leximancer heat-maps themes to show their relative importance. Here, *Community* is coloured red to show the importance

of that theme and the concepts within it and to correspond to the 100% connectivity result derived from the thematic analysis. *Safety* is coloured yellow to indicate its importance relative to *Water* (green) and *Production* (blue). Theme colour, not size, shows the relative importance of each concept shown in the concept map.

Figure 4.6. 2012 Concept map.
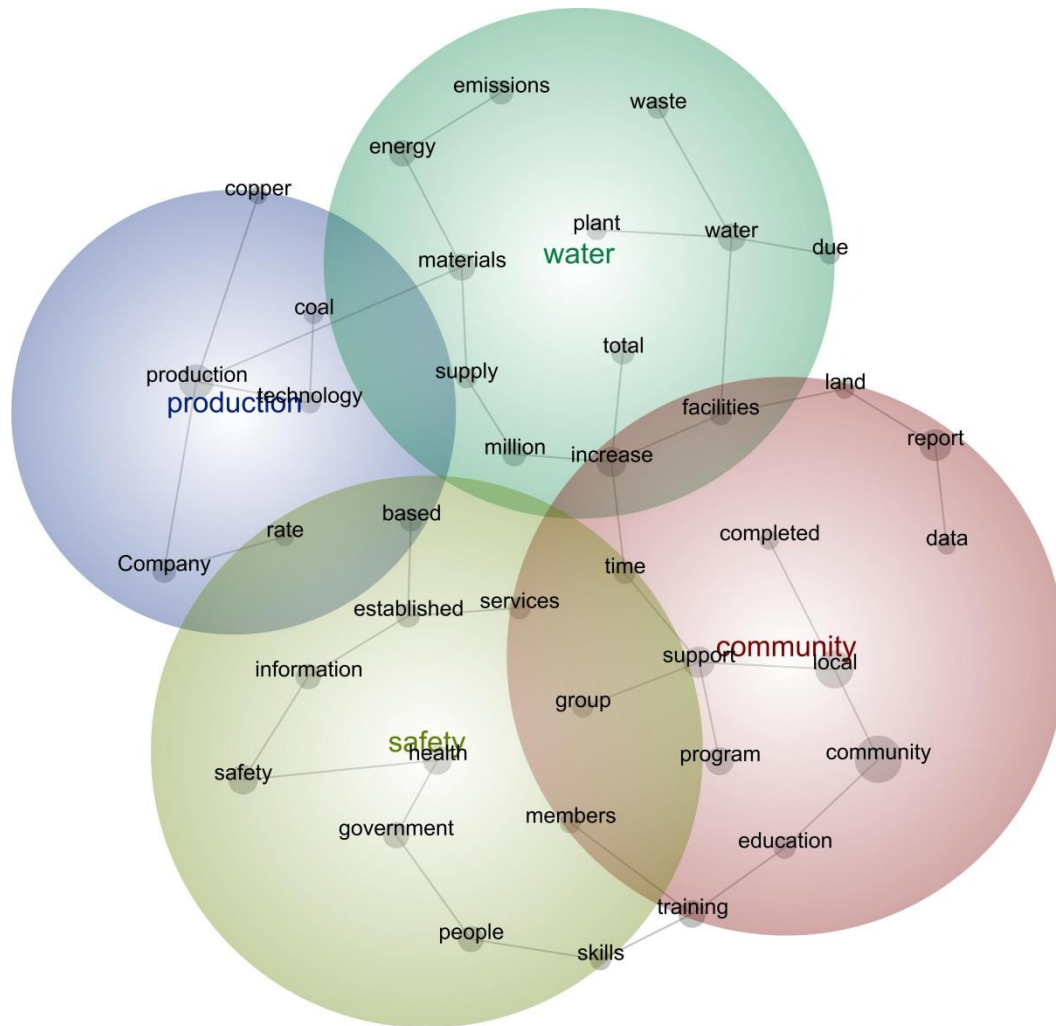
4.4.3.4 2012 summary

The concept map summarises the concepts and themes Leximancer found within the 2012 sustainability reports. The dominant concepts identified earlier, i.e., *community*, *report, local, production,* and *safety,* were evident through larger nodes in the map. The map used heat colouring to show the dominance of *Community* and *Safety* over *Water* and *Production*.

Table 4.21 presents the sums of the individual concepts from within each theme. *Community* has a significantly greater overall count relative to the remaining themes. This result is partly due to the fact the theme includes the top 3 individual concepts and a total of 5 from the top 10.

Table 4.21. Sum of concept counts per 2012 theme.

	Community	**Safety**	**Water**	**Production**
Sum of Concept Count	11,248	7,847	7,102	3,594

Safety has a combined count of 745 more than *Water*. Given both themes have the same number of concepts, the strength in the *Safety* theme comes from the frequency and positioning of the individual concepts relative to *Water*. The connectivity difference between the themes was only 6%, showing the difference is relatively small.

Production has just over half the concepts sum compared to *Water*. This result is partly due to its fewer number of concepts. The positioning of the concepts within the above map shows the concepts within *Production* are furthest away from the leading concepts within the *Community* theme.

The next section presents the findings for the 2013 sustainability reports.

4.4.4 2013 findings

This section presents the Leximancer output for the 29 sustainability reports from the 2013 year classification. A list of companies whose reports were used in the 2013 Leximancer analysis can be found in Appendix B. The findings for 2013 follow the same format used with the previous years' reports, starting with the concepts.

4.4.3.1 2013 concepts

Limiting the presentation to the 10 most dominant concepts, *Table 4.22* shows that *community* was the most common concept in 2013. Across the 29 reports, the concept appeared 2,835 times, which equates to an average of 97.8 times per report. The second most frequent concept in 2013 was *employees*. That concept appeared 2,607 times, 228 fewer than *community* did. The average number of times the concept appeared within each report was 89.9. The concept of *development* came third, with *use* coming fourth, and *report* being the fifth most common.

Table 4.22. Ten most frequent concepts from 2013 reports.

	Rank	Count	Relevance	Average per report
Concept				
community	1	2,835	100%	97.8
employees	2	2,607	92%	89.9
development	3	2,342	83%	80.8
use	4	2,314	82%	79.8
report	5	2,188	77%	75.4
process	6	1,929	68%	66.5
production	7	1,909	67%	65.8
local	8	1,907	67%	65.8
areas	9	1,805	64%	62.2
projects	10	1,717	61%	59.2

The total count for the top 10 concepts in 2013 was 21,533 across all 29 reports. Therefore, these concepts appeared an average of 743 times per report. The next section looks at how the concepts fall within themes for 2013.

4.4.2.4 2013 themes

Leximancer identified five themes that represent the 40 concepts at the 60% theme level. These themes were *Community*, *Use, Employees, Report,* and *Production* as presented in Table 4.23. Theme names are determined by the most common concept within in the theme. The themes are measured according to connectivity indicating the relative importance of each theme to concepts across the 2013 reports. Table 4.23 below also presents the concepts that fall within each theme.

Table 4.23. Themes and concepts from 2012 sustainability reports.

Theme and Connectivity:	Community – 100%	Use – 79%	Employees – 60%	Report – 58%	Production – 49%
Concepts:	*community*	*use*	*employees*	*report*	*production*
	development	*process*	*health*	*safety*	*energy*
	local	*water*	*programme*	*sites*	*million*
	areas	*year*	*training*	*systems*	*total*
	projects	*material*	*human*	*information*	*company*
	people	*emissions*	*rights*	*during*	*plant*
	region	*waste*	*members*	*assurance*	*located*
	education	*facilities*			*coal*
	vale	*data*			

The 2013 findings identified *Community* as the dominant theme. *Community* is made up of a collection of nine concepts. These concepts have 100% connectivity to the remaining concepts identified in the section above. The second highest ranked theme in

terms of connectivity was *Use*. That theme includes nine concepts that appeared often within close proximity across the 2013 reports. *Employees* was the third highest ranked theme with a connectivity score of 60%. This score is only 2% more than that noted for *Report* which scored 58%. Both themes consist of seven concepts each. The final theme was *Production,* with 49% connectivity. *Production* included eight concepts. The concept map provides a visual and alternative analysis of the sustainability reports and so provides further understanding of the relationships amongst concepts.

4.4.4.3 2013 concept map

This section contextualises the concepts and themes of the 2013 findings. The concept map in *Figure 4.7* presents the findings graphically to illustrate the relationship between concepts. Further, the map shows how themes were established based on the position of the individual concepts. The concept findings are presented first, followed by the themes.

The concept map depicts the concepts of *community*, *employees*, *development,* and *use* with relatively larger nodes than the remaining concepts due to the higher frequency of the concepts. The lines linking concepts illustrate the concepts that appeared together more often across the 2013 sustainability reports. The concepts of *process*, *use,* and *production* show the greatest number of linkages. Each of these concepts has a direct link to four other concepts, suggesting that these concepts are most often found near to these connecting concepts in the text.

In contrast, 16 concepts link with only 1 other concept. These concepts indicate a pairing between two concepts. When one of these concepts is present within the sustainability report, the linking concept is the one most likely to be in close proximity to it.

Figure 4.7. 2013 Concept map.

Figure 4.7. 2013 Concept map.
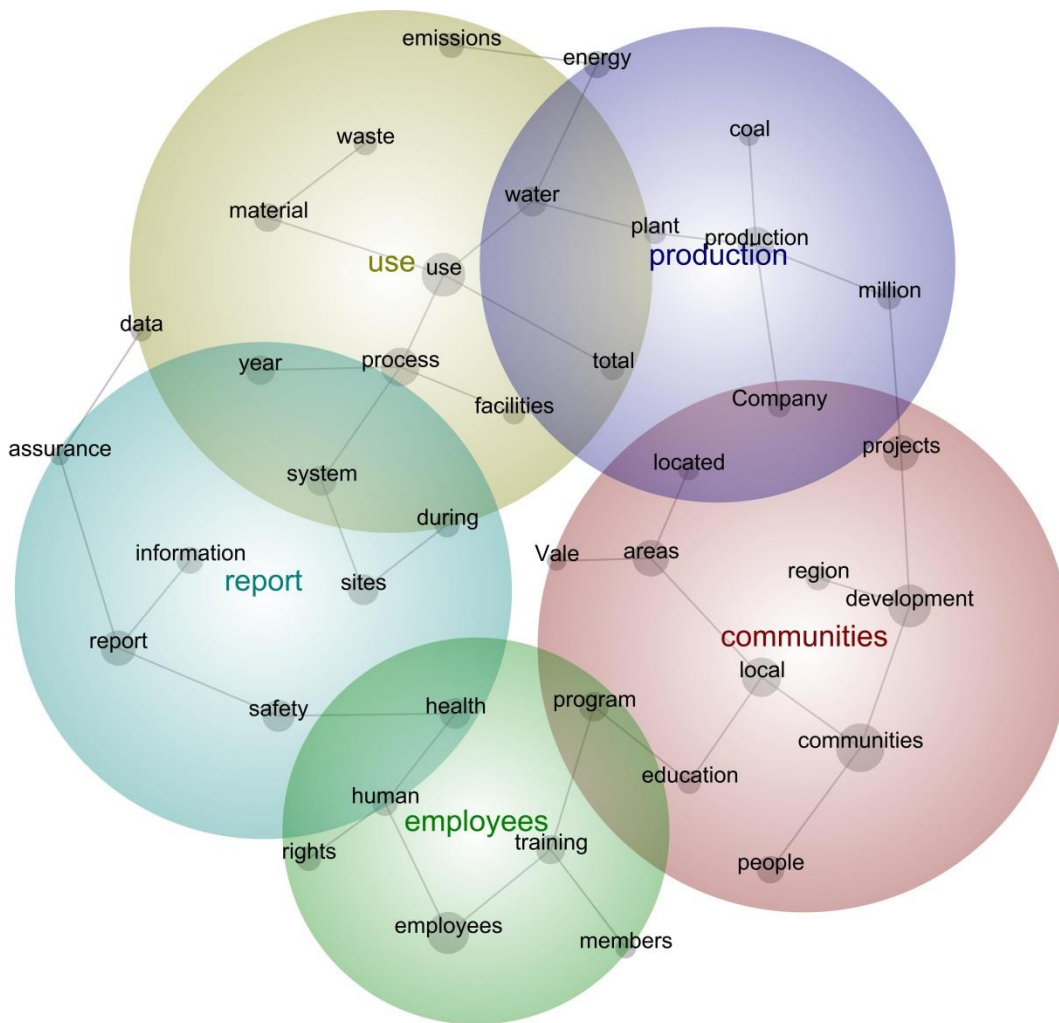
4.4.4.4 2013 summary

The concept map summarises the concepts and themes within the 2013 sustainability reports. The most frequent concepts: *community*, *employees*, *development*, *use,* and *report* are depicted with larger nodes. The positioning of each concept contributes to the themes and connectivity scores of the themes. The map identifies the dominant themes of *Community*, *Use*, *Report, Employees,* and *Production*. The red heat-mapping of *Community* reveals the dominance of that theme within the 2013 sustainability reports.

Table 4.24. Sum of concept counts per 2013 themes.

	Communities	Use	Report	Employees	Production
Sum of Concept Count	13,563	11,063	8,732	8,467	6,927

The concept count sums for each theme are presented above in Table 4.24. The table shows that the concepts within *Communities* appear significantly more frequently than do those of other themes. The concepts relating to *Use* appear 2,500 fewer times, despite the two themes having the same number of concepts. Furthermore, the table shows that *Report* and *Employees* have similar total counts, which is consistent with the similar connectivity scores identified for them earlier.

The heat-mapping in the concept map distinguishes the greater contrast between the themes; it colours *Reports* a neutral green and gives a cool blue for *Employees. Production* has a lower combined count than the other themes, despite having either the same or more concepts. This finding is consistent with the heat-colouring and connectivity score, revealing the concepts within the theme are less significant and prevalent within the text.

The previous four sections presented the findings for each of the 4 year classifications. The next section looks at the findings across the 4-year period at both a concept and theme level.

4.4.5 Multiple year analysis

The previous sections presented the results for each individual year. This section compares the findings across the 4 years looking at trends and changes in the sustainability reporting practices of companies.

To better analyse the results for each year, the results were standardised. Leximancer's output presents the findings by count and relevance. Relevance is useful for comparing concepts within a single analysis. In order to compare the findings across years analysed separately in Leximancer, the count has been divided by the number of reports analysed in each year.

The concepts and themes for each year are determined on the reports from each year. The same concept may present differently across different years. For the purposes of this section, concepts that appear slightly different due to plurals or tenses in different years are treated as the same (i.e., *community* and *communities* are treated as the same concept). The same approach was applied to themes.

This section first summarises the top 40 concepts across the 4 years. Concepts that consistently appear in the top 40, and those ranked inside the top 10 for each year, are further analysed. The next section looks at the trends over the 4 years, specifically

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identifying emerging concepts and those that disappeared. The final analysis in this section looks at the themes and how the concepts within these themes varied across the years.

4.4.5.1 Multiple year concept analysis

4.4.5.1.1 Total concepts

In total, 65 concepts ranked inside the top 40 concepts in any of the 4 years analysed. concepts.

Table 4.25 below shows the number of years the concepts appeared in the top 40 concepts.

Table 4.25. Comparison of concept appearance across years.

	Total	Percentage	Cumulative
Concept Appearance			
4 Years	22	33.8%	33.8%
3 Years	8	12.3%	46.1%
2 Years	12	18.5%	64.6%
1 Year	23	35.4%	100.0%

The findings in concepts.

Table 4.25 above show that 33.8%, or 22 concepts, appeared in the top 40 ranked concepts across all 4 years. Eight concepts (12.3%) ranked in the top 40 in 3 of the 4 years analysed. Therefore, 46.1% of the concepts were evident in the top 40 concepts analysed in at least 3 of the 4 years analysed. The remaining 53.9%, or 35 concepts, appeared once or twice within the top 40 concepts. To understand the more dominant concepts, the next section focuses on the movements of the top ranked concepts.

4.4.5.1.2 Common concepts across years

This section provides a comparison of the 22 concepts that appeared in all 4 years used in this research. Table 4.26 below includes all the concepts that were found in each of the 4 years. The table includes the concept count and rank for each year. The concepts are sorted according to their average rank over the 4 years.

The findings show that of these concepts, *community* is consistently ranked higher than all other concept. *Report* comes next. The remaining eight concepts' relative rank across

each year then begins to alter. *Production* which is ranked third highest in 2010, 2011, and 2013 is overtaken by *local* in 2012. *Safety* has the next highest average rank across the 4 years. In contrast, *coal* is ranked consistently as the thirty-ninth and fortieth most frequent concept.

Table 4.26. Common concepts across 4 years.

Concept	2010 Count	2010 Rank	2011 Count	2011 Rank	2012 Count	2012 Rank	2013 Count	2013 Rank	Average Count	Average Rank
community	1,661	1	2,071	2	2,213	1	2,835	1	2,195	1.3
report	1,419	4	1,754	4	1,699	2	2,188	5	1,765	3.8
production	1,102	6	1,512	5	1,389	4	1,909	7	1,478	5.5
local	1,067	7	1,407	6	1,428	3	1,907	8	1,452	6.0
safety	871	10	1,185	7	1,154	5	1,526	12	1,184	8.5
water	887	9	1,054	8	968	8	1,274	15	1,046	10.0
health	724	15	889	13	962	9	1,281	14	964	12.8
programme	815	12	889	12	888	13	1,181	18	943	13.8
training	736	14	877	15	902	11	1,170	19	921	14.8
material	690	17	861	17	912	10	1,183	17	912	15.3
information	704	16	761	21	889	12	1,147	20	875	17.3
people	668	18	869	16	866	15	1,081	21	871	17.5
emissions	636	21	847	18	702	18	939	23	781	20.0
energy	613	23	844	19	809	16	1,032	22	825	20.0
company	575	25	821	20	758	17	813	27	742	22.3
million	628	22	747	22	680	19	840	26	724	22.3
total	610	24	730	23	669	20	815	29	706	24.0
waste	409	30	531	28	516	25	699	31	539	28.5
facilities	373	31	500	32	522	24	606	32	500	29.8
plant	423	29	508	30	454	30	555	36	485	31.3
education	354	33	429	35	435	33	571	35	447	34.0
coal	238	39	331	39	308	40	436	39	328	39.3
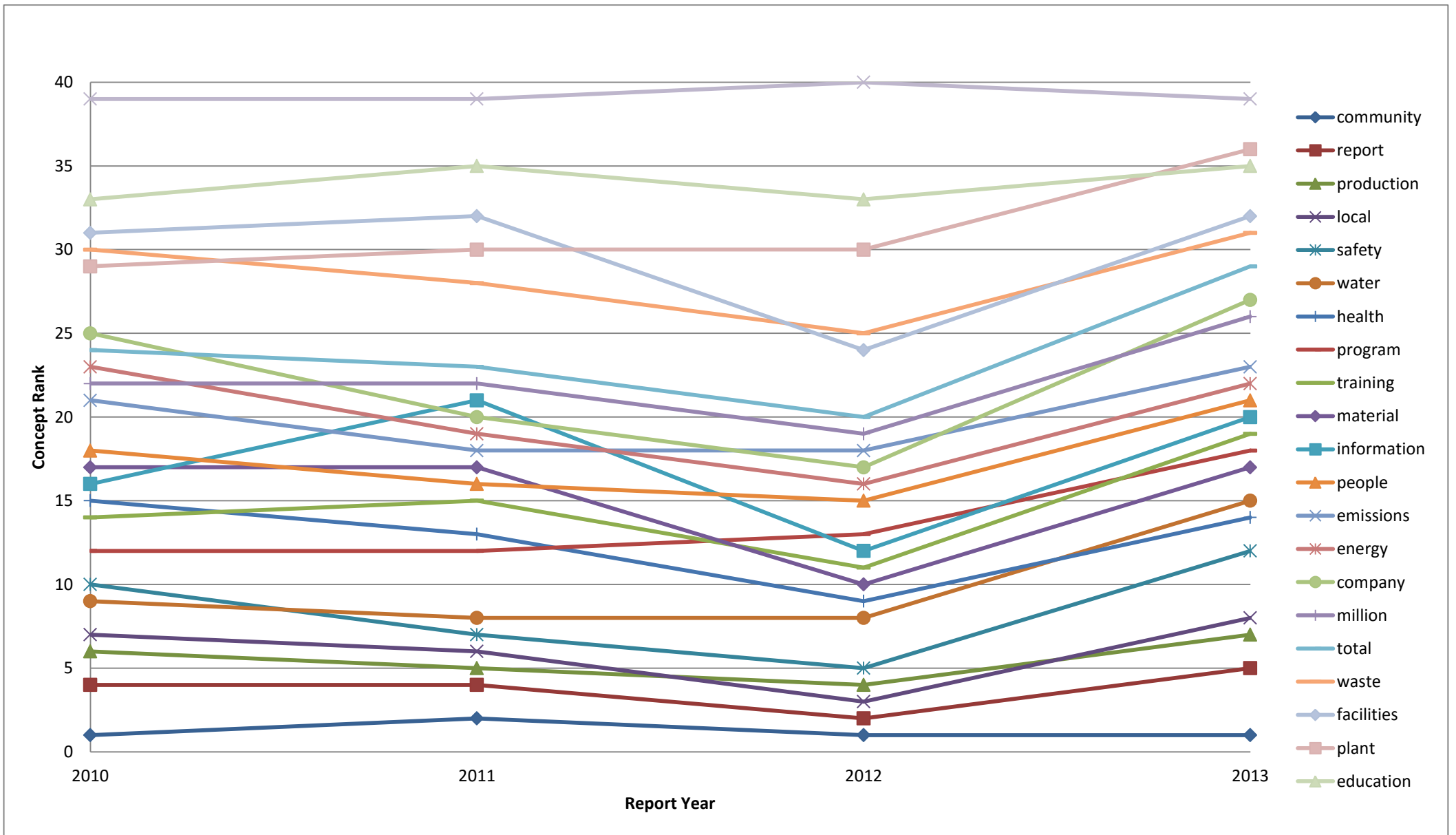
Figure 4.8. Concept ranks for concepts in top 40 across all years.

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One finding from Table 4.26 is that the concepts' use increased over the 4 years. The sum of all 22 concepts for 2010 is 16,203 compared to 25,988 in 2013. The increase in the total count does not reflect a significant change in the concept rank. Indeed, Table 4.26 later shows that the concepts that were ranked inside the top 40 in each of the 4 years remained relatively consistent. Figure 4.8's line chart further reveals that the concepts' ranks per year are all generally consistent across the 4-year period. Only the concept of *information* appears to have a change in rank over the period. Its ranking increased from 16 to 21-first between 2010 and 2011, before decreasing to 12 in 2012 and then increasing to 20 for 2013. The remaining plotted lines the concepts' ranks remain fairly consistent and without major changes from year to year.

Table 4.27. Trend of the concepts that appeared three times.

Concept	2010 Count	2010 Rank	2011 Count	2011 Rank	2012 Count	2012 Rank	2013 Count	2013 Rank	Average Count	Average Rank
employees	1,658	2	2,103	1			2,607	2	2123	1.7
use	1,528	3	1,885	3			2,314	4	1909	3.3
support	784	13	1,023	9	1,026	6			944	9.3
during	563	26	886	14			842	25	764	21.7
region	370	32	569	26			815	28	585	28.7
services	432	27	585	25	510	26			509	26.0
rate	287	37	475	33	346	38			369	36.0
copper	301	36	363	38	342	39			335	37.7

Only two concepts that appeared in all 4 years, i.e., *health* and *energy* had lower ranks in 2013 than they had in 2010. Both concepts, however, improved by one rank position over this period. A further three concepts, *community*, *material,* and *coal* saw no movement in their rank score over this period. The remaining concepts rank score increased in this period. The largest increases were for *water*, *programme,* and *plant*. The largest increase for consecutive years was made by the concept of *company,* where it went from a rank of 17 in 2012 to 27 in 2013. The largest decrease was *information* that was ranked twenty-first in 2011 to improve to twelfth in 2012.

One further observation is that 20 of the 22 concepts increased in rank from 2012 to 2013. Only *community* (ranked 1 both years) and *coal* (ranked 40 and 39 in 2012 and 2013 respectively) did not increase their rank in 2013. Figure 4.8 illustrates the general upwards trend for all concepts in 2013. This movement suggests that whilst these concepts were common across the 4 years, additional highly ranked concepts that were

not present in prior years were common in 2013. This observation is not, however, supported by statistical analysis.

In addition to the 22 concepts dealt with above, 8 concepts did appear in 3 of the 4 years. These concepts are shown separately. Three of these concepts — *employees, use,* and *support* — where all ranked in the top 10 for three of the years but did not feature in one year. The five remaining concepts averaged between 21.7 and 37.7 for a rank score across the 3 years they were ranked as a top 40 concept.

Table 4.27 shows that four concepts were present consecutively from 2010 to 2012 did not rank in 2013. One possible interpretation is that they were becoming less important. However, the ranks for the individual concepts were not increasing significantly over the preceding 3 years. Further, the 4-year period does not provide significant data to suggest the concepts are generally less important in mining sustainability reports. For this reason, concepts that appear in only one or two of the years studied do not provide meaningful information regarding trends. Similarly, there were new concepts that appeared for the first time in 2011 and became more prevalent in the following years.

Table 4.28. Comparison of concept appearance across years.

	Total	Percentage	Cumulative
Concept Appearance			
4Years	4	23.5%	23.5%
3 Years	4	23.5%	47.0%
2 Years	3	17.7%	64.7%
1 Year	6	35.3%	100.0%

4.4.5.1.3 Top 10 concepts by year

The previous section presented the findings specifically for the concepts that appeared in each of the 4 years. This section focuses in greater detail on the 10 most frequent concepts for each year. Table 4.29 below presents the 10 most frequent concepts for each year by average rank and the average number of concept counts per report for each year. Calculating the average count per report standardises each year and thus allows for the different number of reports analysed each year. The table is ordered according to the average rank based on years each concept was present amongst the top 10 concepts.

Table 4.29. Top 10 ranking concepts across each year.

	2010 Ave	2010 Rank	2011 Ave	2011 Rank	2012 Ave	2012 Rank	2013 Ave	2013 Rank	Weighted Average	Average Rank
Concepts										
community	75.5	*1*	86.3	*2*	76.3	*1*	97.8	*1*	**84.4**	**1.3**
employees	75.4	*2*	87.6	*1*			89.9	*2*	**84.9**	**1.7**
development							80.8	*3*	**80.8**	**3.0**
use	69.5	*3*	78.5	*3*			79.8	*4*	**76.4**	**3.3**
report	64.5	*4*	73.1	*4*	58.6	*2*	75.4	*5*	**67.9**	**3.8**
production	50.1	*6*	63.0	*5*	47.9	*4*	65.8	*7*	**56.8**	**5.5**
local	48.5	*7*	58.6	*6*	49.2	*3*	65.8	*8*	**55.9**	**6.0**
process							66.5	*6*	**66.5**	**6.0**
safety	39.6	*10*	49.4	*7*	39.8	*5*			**42.8**	**7.3**
projects	51.8	*5*					59.2	*10*	**56.0**	**7.5**
support			42.6	*9*	35.4	*6*			**38.7**	**7.5**
performance	47.2	*8*							**47.2**	**8.0**
water	40.3	*9*	43.9	*8*	33.4	*8*			**38.8**	**8.3**
increase			40.6	*10*	33.4	*7*			**36.7**	**8.5**
areas							62.2	*9*	**62.2**	**9.0**
health					33.2	*9*			**33.2**	**9.0**
material					31.4	*10*			**31.4**	**10.0**

Table 4.29 shows that of the 65 concepts to rank in the top 40 in any of the years, only 17 concepts appeared in the top 10 in any one year. Potentially, the range of concepts could have been from 10 (same concepts for all 4 years) to 40 (10 new concepts every year). Therefore, 7 new concepts become significant over the period.

When analysing the findings in terms of yearly movement, for 2010 to 2011, 8 concepts remained consistent with *support* and *increase* replacing *projects* and *performance*. For the 2011 to 2012 period, 2 additional concepts appeared in the top 10; these were *health* and *material* which came in at ninth and tenth respectively. These concepts replaced *employees* and *use*.

During the final year, i.e., 2012 to 2013, 3 new concepts emerged; these were *process*, *areas,* and *development*. *Development* was ranked the third highest concept in 2013. Three concepts (*employees*, *use,* and *projects*) that had previously appeared in the top 10, but not in the previous year, were included in 2013. The 6 concepts that dropped out the top 10 in 2013 were *safety*, *support*, *water*, *increase*, *health,* and *materials*. Both *water* and *safety* were ranked inside the top 10 concepts in all 3 preceding years. The table below categorises concepts by the number of years they were ranked inside the top 10 concepts for each year.

Table 4.29 indicates that only 4 concepts were consistently dominant across the 4 years, ranking inside the 10 most frequent concepts across each year. These concepts were *community, report, production,* and *local*. The average rank for these concepts across the four-year period showed those concepts ranked first, fifth, sixth, and seventh respectively.

The concepts that also came within the top five average ranks were: *employees, development,* and *use*. *Development* ranked inside the top 10 only once. It held that position in 2013, where it was the third most frequent concept. *Employees* and *use* ranked second and fourth respectively, and appeared three times inside the top 10. *Safety* and *water* were the only other concepts to appear in the top 10 concept ranks across 3 different years. Of the remaining concepts, three appeared twice in the top 10 rankings. In addition to *development*, 5 other concepts appeared once in the top 10, none of which ranked inside the top 5 in that particular year.

The findings showed that there were 17 top 10 concepts across the four years. This result reveals a core group of concepts. Ignoring the concepts that appeared only once, 11 core concepts appeared in at least 2 of the 4 years. These concepts are presented below, along with their average rank and weighted average concepts per report.

Table 4.30. Concepts with multiple appearances in individual years top 10 concepts.

	Top 10 Appearances	Weighted Average Count	Average Rank
Concepts			
employees	3	84.9	1.7
community	4	84.4	1.3
use	3	76.4	3.3
report	4	67.9	3.8
production	4	56.8	5.5
projects	2	56.0	7.5
local	4	55.9	6.0
safety	3	42.8	7.3
water	3	38.8	8.3
support	2	38.7	7.5
increase	2	36.7	8.5

Table 4.30 above presents the findings for concepts when the concept count fell within the top 10 for a given year. These results indicate that *employees* was common in the years where the concept was highly ranked. However, given that concepts would have

likely appeared in the reports in the year that they did not feature in the top 10 overall, the average count per report is only based on the years the concept was ranked in the top 10. Therefore, any comparison across concepts that did not appear in the same years is difficult.

This result suggests that when *employees* was a dominant concept, its use was frequent for that year. However, in 2012 the concept was not, in contrast, found to be dominant within the sustainability reports compared to *community, report, and production*.

4.4.6 Multiple year thematic analysis

The previous section presented the findings for the individual years. This section shows how the concepts grouped by theme. A thematic analysis clusters concepts that appear together often within the same piece of text. Themes are labelled according to the most prevalent concept within each grouping.

4.4.6.1 Theme analysis across years

The thematic analysis identified four or five groupings of concepts at the 60% theme level for each year. The findings in Table 4.31 below summarise the themes for each year, along with the respective connectivity scores for each theme.

Table 4.31. Theme name and connectivity percentage by year.

2010 Theme	2010	2011 Theme	2011	2012 Theme	2012	2013 Theme	2013
Use	100%	*Use*	100%	*Community*	100%	*Communities*	100%
Community	81%	*Community*	74%	*Safety*	69%	*Use*	79%
Employees	74%	*Employees*	69%	*Water*	63%	*Employees*	60%
Production	56%	*Increase*	50%	*Production*	32%	*Report*	58%
Copper	3%	*Report*	42%			*Production*	49%

Table 4.31 compares the findings for the thematic groups for each year. The most dominant theme has a connectivity score of 100% which shows the relative importance of that theme in relation to other themes. The next highest themes in each year had a connectivity score of between 69% and 81%, suggesting that the concepts within this grouping related well to remaining concepts. The third highest theme connectivity scores ranged from 60% to 74% showing the concepts within these themes related to approximately two-thirds of all concepts.

The findings show that only the *Community* theme was consistent across all 4 years. In addition, the themes of *Use*, *Employees,* and *Production* appeared in 3 of the 4 years. It is important to consider that themes are labelled according to the most frequent concept of the grouping of concepts that appear together within the texts. The results for each year are determined independently of other years. Therefore, it is important to look at the concepts within the themes to compare across years.

Community[12] was the only theme to appear consistently in all 4 years' reports. In 2010 and 2011, it was the second highest ranked theme on connectivity scores. In 2012 and 2013, *Community* ranked as the highest theme with 100% connectivity. These findings build on earlier sections which identified the concept of *community* as a leading concept across all 4 years. To better understand the theme of *Community*, the table below presents the concepts that fell within the theme for each of the 4 years.

Table 4.32. Concepts within the theme of *Community* by year.

Year:	2010	2011	2012	2013
Concepts:	*community*	*community*	*community*	*communities*
	local	*local*	*local*	*development*
	projects	*support*	*report*	*local*
	year	*programme*	*support*	*areas*
	support	*people*	*increase*	*projects*
	people	*region*	*program*	*people*
	education	*employment*	*training*	*region*
	region		*education*	*education*
	organisation		*time*	*vale*
			land	
			completed	
			data	

The results for the *Community* theme across the four years included 21 different concepts. Both *community* and *local* as concepts appear in the theme groupings for each of the 4 years. In addition, the concepts of *support*, *people*, *education,* and *region* appear in 3 of the 4 years. Two further concepts, *projects* and *programme*, appear in 2 of the 4 years. The remaining 13 concepts appeared only once.

Therefore, the concept of *community* is the highest ranked concept across the 4 years. *Local* was also common across all 4 years. *Local* was the second highest concept for the first 3 years analysed and third in 2013. This finding reveals that the concepts of

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[12] *Community* is used to describe the themes across years including both 'community' and 'communities'. The analysis conducted by Leximancer when analysing the sustainability reports combines these words and reports on the most dominant variation for each year.

community and *local* were closely related across all 4 years and were highly likely to appear within close proximity within the sustainability reports for the all years investigated.

The remaining concepts within the *Community* theme, whilst not appearing across all 4 years, share similar attributes. The concepts of *support*, *people*, *education*, and *region* form the concepts within that theme in 3 of the 4 years' results. These results show that these concepts, along with *communities* and *local*, appear together throughout the sustainability reports over all 4 years.

4.4.6 Year summary

This section presented the findings for the individual years analysed. The individual year findings provide a snapshot of the key concepts and themes for the given year. These are then combined and analysed in the final section.

The multiple year analysis identified 22 concepts common across the 4-year period. The combined analysis identified a total of 65 concepts that appeared in the top 40 concepts for any year. A further 8 concepts appeared in 3 of the 4 years. When comparing the concept ranks of the 22 common concepts, these concepts revealed no significant changes to them or trends.

The final concept analysis looked at the concepts that ranked in the top 10 for a given year only. When the concepts were limited in this way, 17 were used across the 4 years, with only 4 concepts consistently ranked in the top 10. These were *community*, *production*, *report,* and *local.* A further 4 concepts appeared in the top 10 in 3 out of the 4 years.

The final analysis looked specifically at the themes across the 4 years. One theme that was common across all years was *Community*. Each year this theme included the concepts of *community* and *local.*

Due to the varying nature of the concept map, no combined analysis was performed because it was thought that doing so would not offer additional or meaningful information. The next section presents the findings for the different ICMM memberships.

4.5 ICMM membership status findings

The previous sections presented the findings' analysis of the sustainability reports by year. This section classifies the companies according to International Council for Metals and Minerals (ICMM) member status. Member status is used to distinguish companies because membership is deemed to represent a commitment to sustainability.

The method section outlines the classification process undertaken when selecting the sample companies for this study. The three categories used are: Existing, New, and Nonmembers. The distinctions between the three are summarised below:

- Existing members were members prior to 2009
- New members joined ICMM between 2009 and 2013
- Nonmembers are those companies producing sustainability reports as part of the PWC mining analysis, but who are not ICMM members.

Once a company was classified according to member status, all reports relating to that company were included within the membership analysis. A full breakdown of company classification and number of reports analysed can be found in each subsection.

The findings by membership status are first presented by category. The Leximancer output for each membership grouping will include concepts, themes, and concepts map. Following the individual results, the final section will analyse each of the three outputs across the different membership statuses. The findings begin with existing ICMM members.

4.5.1 Existing members

This section presents the findings for the companies that were ICMM members prior to 2009. The findings presented include concepts, themes, and the concept map. The table below presents the companies that were classified as existing ICMM members.

Table 4.33. Existing ICMM member companies.

Company Name	Code	ICMM Status	Reports
Anglo America	AAM	Founding	4
Anglo Gold Ashanti	AGA	Founding	4
Barrick	BAR	2008	4
BHP Billiton	BHP	Founding	4
Freeport-McMoran Copper & Gold Inc.	FMM	Founding	4
JX Nippon Mining & Metals	JXN	Founding	4
Lonmin	LON	2004	3
Mitsubishi Materials	MIT	2002	2
Newmont	NWM	Founding	3
Rio Tinto	RIO	Founding	2
Sumitomo Metal Mining Co. Ltd	SMM	2002	4
Teck	TEC	2006	3
Vale	VAL	2006	3
Xstrata (Glencore Xstrata)	XST	2006	4

Fourteen companies were classified as existing ICMM members. ICMM was founded in 2001. Since 2001, additional mining companies have joined. Between them the 14 companies produced 48 sustainability reports for analysis.

4.5.1.1 Concepts

Table 4.34 below summarises the Leximancer output for the 10 most frequent concepts for existing ICMM members. The table includes the concepts, their rank, count, relevance, and average count per report.

Table 4.34. Ten most frequent concepts from existing ICMM companies.

Concept	Rank	Count	Relevance	Average per report
communities	1	4,982	100%	103.8
employees	2	4,463	90%	93.0
report	3	3,451	69%	71.9
local	4	3,338	67%	69.5
project	5	2,960	59%	61.7
products	6	2,880	58%	60.0
government	7	2,460	49%	51.3
materials	8	2,448	49%	51.0
safety	9	2,353	47%	49.0
year	10	2,233	45%	46.5

The findings in Table 4.34 above reveal the most frequent concept for the existing ICMM companies was *communities*. The concept appeared 4,892 times per report. On average, the next concept appeared 10.8% fewer times across the 48 reports analysed. This usage equates to an average of 103.8 times per report. The second most frequent concept was *employees*, which appeared 4,463 times with a relevance of 90%, 10% less than for *communities*.

The third most frequent concept was *report* appearing 3,451 times with a relevance of 69%. The fourth ranked concept was *local* which appeared 3,338 times and had a relevance score of 67%. Two other concepts had relevance scores greater than 50%; they were *projects* and *products* with scores of 59% and 58% respectively.

The next section presents the concept groupings by way of themes.

4.5.1.2 Theme

This subsection looks at the themes identified by Leximancer. Six themes were identified to represent the 40 concepts at the 60% theme level. These themes were *Community*, *Employees*, *Products, Report*, *Water,* and *Energy*. Theme names were determined by the most common concept within in the theme. The concepts that fall within these themes are detailed in the table below. Table *4.35* below also shows the corresponding connectivity percentage for each theme. Connectivity is a measure showing the relative importance of the theme. It shows how the concepts within a theme relate to the remaining concepts within the sustainability report.

Table 4.35. Themes and concepts from existing ICMM member sustainability reports.

Theme and Connectivity:	*Communities –* 100%	*Employees –* 53%	*Products –* 43%	*Report –* 36%	*Water –* 32%	*Energy –* 22%
Concepts:	*communities*	*employees*	*products*	*report*	water	energy
	local	health	*materials*	*safety*	total	emissions
	project	training	resources	information	facilities	waste
	government	human	*year*	group	million	copper
	programmes	rights	time	company	land	
	people	members	metals	assurance	plant	
	region		data			
	education					
	services					
	employment					
	Vale					

The theme findings show that six themes emerged from the sustainability reports of existing ICMM members. *Community* was the main theme; it contained 11 concepts, including 4 ranked in the top 10 most frequent concepts. The theme combines a variety of concepts related to people and the organisation. *Employees* was the next highest ranked theme with 53% connectivity. The theme included 6 concepts with 1 ranked in the top 10 for count. All concepts within the theme relate closely to employees and human resources.

The third ranked theme was *Productivity* with 46% connectivity. The theme included 3 top 10 ranked concepts and a further 4 from the remaining top 40. The fourth ranked theme was *Report* with 36% connectivity and 6 concepts. The final two themes were *Water* and *Energy* with 32% and 22% connectivity scores respectively.

The theme findings for the existing ICMM members are dominated by *Community,* with its concepts having 100% connectivity to all other concepts. The theme is supported by minor themes each with between 4 and 7 concepts and connectivity scores between 53% and 22%, which suggests that, despite there being six themes, the concepts are connected throughout the reports and that there are no unique or outlying themes.

The next section shows graphically the relationship between concepts and themes by way of a concept map.

4.5.1.3 Concept map

This section builds on the concepts and themes presented earlier in the existing ICMM member findings section. In Figure 4.9 below, the concepts are shown at every node. *Community* was identified in the concept analysis as the most frequent concept and is shown with a larger node. *Assurance* with the lowest count of the 40 concepts identified is shown with the smallest node. The nodes help to show graphically the relative dominance of each concept. The links between nodes reveal the relationships of concepts in greater detail than is provided by the theme findings.

Community had three direct links to *local*, *people,* and *programmes*. *Community* then has further connections with other concepts indirectly by way of these links. These links reveal natural pairings and relationships within the sustainability reports. Overall, there are 16 concepts with one direct relationship and 38 direct relationships between concepts. *Local* and *report* are the only 2 concepts that have four direct connections.

Figure 4.9. Existing ICMM members concept map.
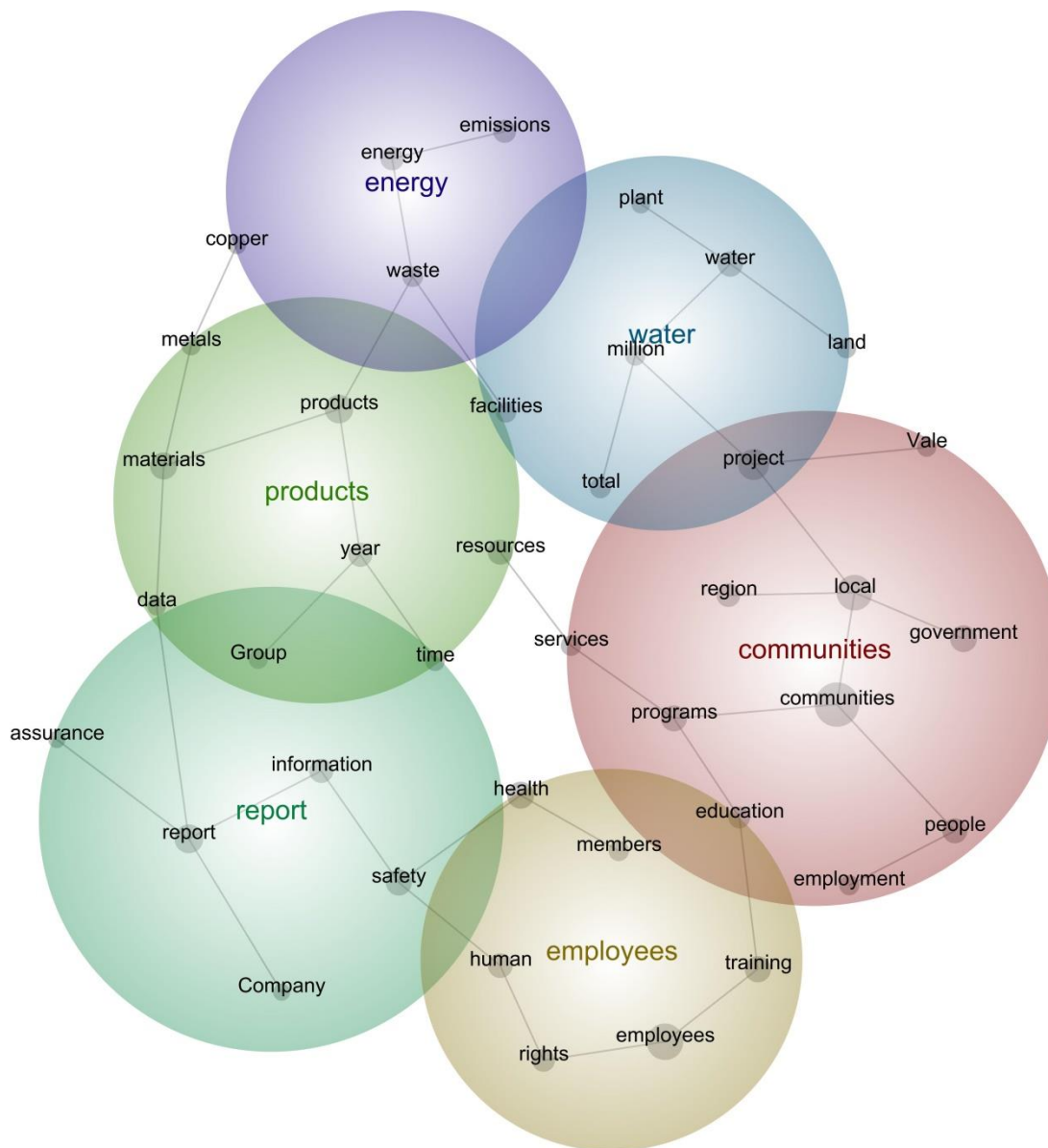
The size of a theme is not an indication of the importance of a theme. The concept map presented in Figure 4.9 is heat-mapped. The red colouring of the *Community* theme and the yellow of the *Employees* theme show the concepts are more important than the remaining themes which are represented by cooler colours. The blue and purple of *Water* and *Energy* reflect the lower importance of the concepts within the theme. This colour coding is consistent with the thematic analysis findings and connectivity scores presented above.

The map also reveals unique relationships between concepts and themes. There is a direct relationship between the concepts of *resources* and *services*. These concepts fall within different themes that do not overlap, which shows that whilst these concepts have

a strong connection within the reports, this connection is not consistent with the remaining concepts in each respective theme. This relationship is not evident from the concept and theme findings.

4.5.1.4 Summary

The concept analysis for the existing ICMM members identified that *communities* was the most frequent concept. The theme analysis showed the concept formed part of a theme that was connected to all remaining concepts. The concept map shows graphically the relationships within the sustainability reports. The *communities* concept is shown with the largest node. The *Communities* theme is heat-mapped red, emphasising the relative strength and importance of the theme. The next section presents the findings of the new ICMM members.

4.5.2 New members

This section presents the findings for the companies that joined ICMM between 2009 and 2013. Six companies were classified as joining ICMM members. In total, 18 of these companies' sustainability reports were analysed. The findings presented include concepts, themes, and the concept map. Table 4.36 presents the companies that were classified as new ICMM members.

Table 4.36. New ICMM member companies.

	Code	ICMM Status	Reports
Company Name			
African Rainbow Minerals	ARM	2009	4
Areva	ARE	2011	2
Codelco	COD	2011	3
Goldcorp	GCO	2009	1
Hydro	HYD	2011	4
MMG - Minerals & Metals Group	MMG	2009	4

4.5.2.1 Concept

Table 4.37 below summaries the Leximancer output for the top 10 concepts for new ICMM members. The table includes each concept's rank, count, relevance, and average count per report. The relevance of each concept is the count of the concept when compared to the count of the most frequent concept. The average count per report is the total count of the concept divided by the number of reports analysed for each year.

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Table 4.37. Ten most frequent concepts from new ICMM companies.

Concept	Rank	Count	Relevance	Average per report
mining	1	1,749	100%	97.2
report	2	1,611	92%	89.5
employees	3	1,532	88%	85.1
development	4	1,320	75%	73.3
community	5	1,301	74%	72.3
work	6	1,131	65%	62.8
ARM	7	1,124	64%	62.4
use	8	1,104	63%	61.3
projects	9	1,061	61%	58.9
production	10	979	56%	54.4

Table 4.37 above reveals the most frequent concept for the existing ICMM companies was *mining*. The concept appeared 1,749 times in total across the 18 reports analysed. This equates to an average of 97.2 times per report. The second most frequent concept was *report*, which appeared 1,611 times with a relevance of 92%. This concept results in an average of 89.5 appearances per report which is 7.7 fewer times than the appearance of the most frequent concept.

The third most frequent concept was *employees* appearing 1,532 times with a relevance of 88%. The fourth ranked concept was *development* which appeared 1,320 times and had a relevance score of 75%. Six other concepts had relevance scores greater than 50%; they were *community, work, ARM, use, projects,* and *production*. The next section presents the concepts' groupings by way of themes.

4.5.2.2 Theme

This subsection looks at the themes identified by Leximancer. Six themes were identified to represent the 40 concepts at the 60% theme level. These themes were *Mining*, *Employees*, *Production, Community*, *Report,* and *Water*. Theme names were determined by the most common concept within in the theme. The concepts that fall within these themes are detailed in the table below.

Table 4.38 also shows the corresponding connectivity percentage for each theme. Connectivity is a measure showing the relative importance of the theme. It shows how the concepts within a theme relate to the remaining concepts within the sustainability report.

Table 4.38. Themes and concepts from new ICMM member sustainability reports.

Theme and Connectivity:	*Mining –* 100%	*Employees –* 51%	*Production –* 50%	*Community -* 44%	*Report –* 36%	*Water –* 16%
Concepts:	*mining*	*employees*	*production*	*community*	*report*	water
	development	safety	*ARM*	local	company	million
	work	health	year	programme	information	plant
	use	training	results	people	data	waste
	projects	employment	emissions	Sepon	Codelco	
	support	workers	energy	region	period	
	industry		due			
	MMG		copper			
	total					
	time					

The theme findings show six themes emerged from the sustainability reports of new ICMM members. *Mining* was the main theme containing 10 concepts including 5 ranked in the top 10 for count. The theme combines a variety of concepts related to mining activities and the industry.

Employees was the next highest ranked theme with 51% connectivity. The theme included 6 concepts with 1 ranked in the top 10 for count. All concepts within the theme relate closely to employees and human resources. The third ranked theme was *Production* with 50% connectivity. That theme included 2 top 10 ranked concepts and a further 6 from the remaining top 40.

The fourth ranked theme was *Community* with 44% connectivity. The theme included 6 concepts with 1 ranked in the top 10. The final two themes were *Report* and *Water* with 36% and 16% connectivity scores respectively. *Report* included 1 top 10 ranked concept.

The theme findings for the new ICMM members were dominated by *Mining,* with its concepts having 100% connectivity to all other concepts. The theme is supported by minor themes each with between 4 and 8 concepts and connectivity scores between 51% and 16%. This finding suggests that despite there being six themes, the concepts are connected throughout the reports and there are no unique or outlying themes.

The next section shows graphically the relationship between concepts and themes by way of a concept map.

4.5.2.3 Concept map

This section builds on the concepts and themes presented above in the new ICMM member findings. In Figure 4.10 below, the concepts are shown at every node. *Mining* was identified in the concept analysis as the most frequent concept and is shown with a larger node. *Region* had the lowest count of the top 40 concepts and has the smallest node. The nodes' size help to show visually the relative presence of each concept within the reports whilst also revealing additional information. The connections between nodes reveal the relationships of concepts in greater detail than is provided by the theme findings.

These links reveal natural pairings and relationships within the sustainability reports. In some cases, concepts can link with multiple concepts. The concept of m*ining* had five direct links to *development*, *industry*, *use, projects,* and *MMG*. Beyond these initial relationships, *mining* has eight further indirect connections with other concepts. Overall, 17 concepts with one direct relationship and 39 direct relationships between all concepts were found. *Mining* was the only concept to have five direct connections. *Development*, *use*, *production,* and *report* all had four direct connections.

This analysis was completed using a 60% theme size. The themes presented in the earlier section are shown graphically to better illustrate the relationship between concepts. The size of theme does not reflect the importance of a theme. The positioning of the *Mining* theme central to the other five themes shows how its concepts were central to the reports and the links between the concepts are easily traced through the *Mining* theme. There is minimal overlap between the remaining themes. *Production* and *Report* are the only two themes with a significant overlap. No concept sits within the region of this overall, however.

Figure 4.10. New ICMM members concept map**.**
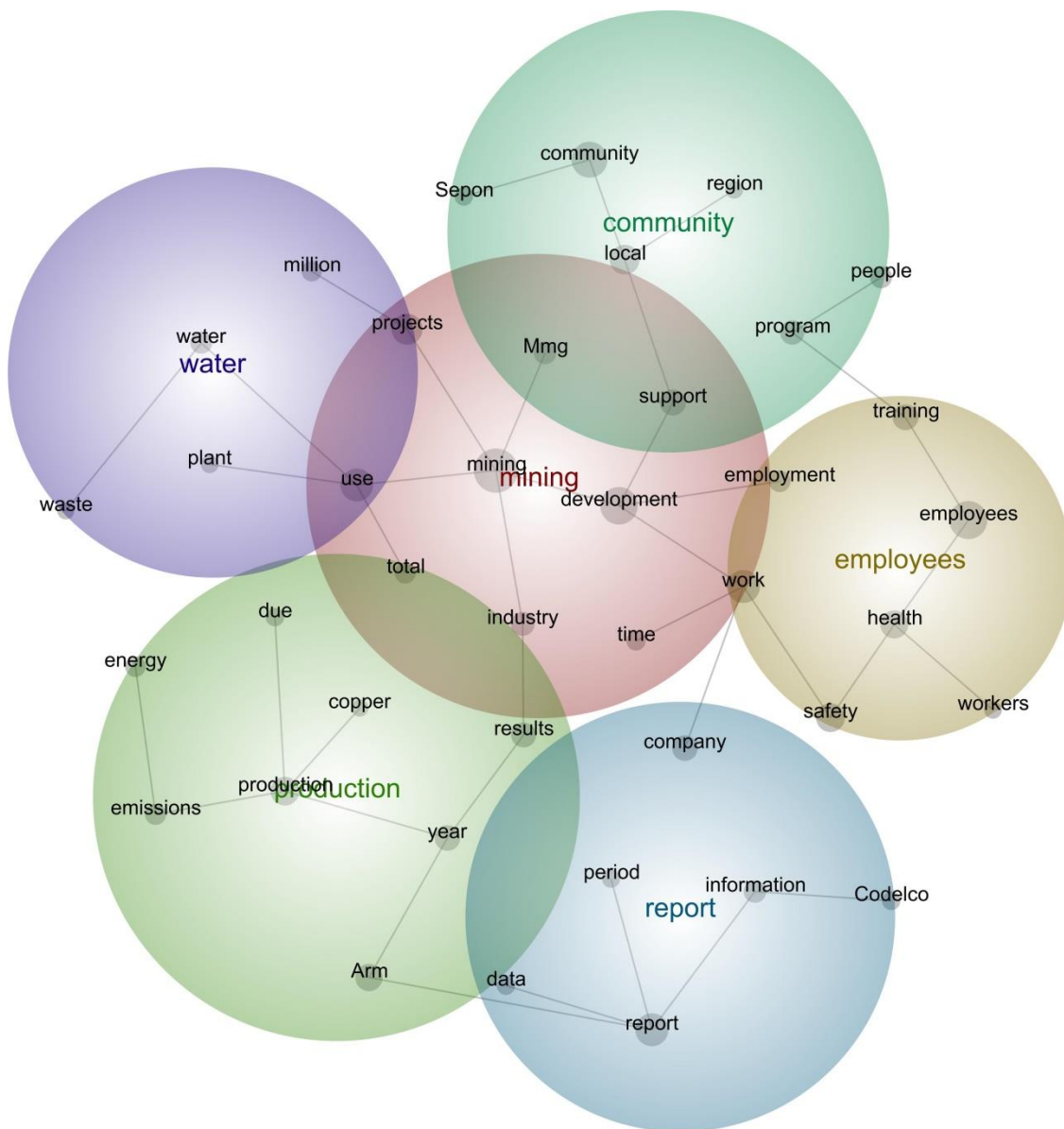
The concept map presented in Figure 4.10 is heat-mapped. The red colouring of the *Mining* theme and the yellow colouring of the *Employees* theme indicate that these concepts are more important than the cooler colours given to the remaining themes. The blue and purple of *Report* and *Water* reflect the lower importance of the concepts within these themes. This colour-coding is consistent with the thematic findings and connectivity scores presented above.

4.5.2.4 Summary

The concept analysis for the new ICMM members identified that *mining* was the most frequent concept. The theme analysis showed the concept formed part of a theme that was connected to all remaining concepts. The concept map shows graphically the

relationships within the sustainability reports. The *mining* concept is shown with the largest node. The *Mining* theme is central to the map and well-connected to the other themes. *Mining* is heat-mapped red emphasising the relative strength and importance of the theme. The next section presents the findings on the non-ICMM members.

4.5.3 Nonmembers

This section presents the findings for the companies that were non-ICMM members prior to 2013. The 12 companies classified as non-ICMM members provided 38 sustainability reports, as shown in Table 4.39 below:

Table 4.39. Non-ICMM member companies.

Company Name	Code	ICMM Status	Reports
Antofagasta plc	AMT	N/A	4
China Coal Energy Limited	CCE	N/A	3
China Shenhua Energy Company Ltd	CSE	N/A	4
Eldorado Gold Corp	ELD	N/A	2
Fortescue Metals Group Limited	FOR	N/A	4
Grupo Mexico S.A. de CV	GMX	N/A	4
Impala Platinum Holdings Limited	IPH	N/A	3
Kinross Gold Corporation	KIN	N/A	2
Newcrest Mining Limited	NWC	N/A	4
Potash Corporation of Saskatchewan Inc.	POT	N/A	2
The Mosaic Company	TMC	N/A	2
Yamana Gold Inc.	YAM	N/A	4

The next section presents the concept analysis of the non-ICMM members' sustainability reports from 2009 to 2013.

4.5.3.1 Concept The findings in *Table 4.40* below summarise the Leximancer output for the top 10 concepts for non-ICMM members. The table includes the rank, count, relevance, and average count per report.

Table 4.40. Ten most frequent concepts from non-ICMM companies.

Concept	Rank	Count	Relevance	Average per report
management	1	2,961	100%	77.9
community	2	2,711	92%	71.3
employees	3	2,514	85%	66.2
development	4	2,236	76%	58.8
reporting	5	2,041	69%	53.7
production	6	2,040	69%	53.7
use	7	1,951	66%	51.3
local	8	1,837	62%	48.3
company	9	1,756	59%	46.2
work	10	1,747	59%	46.0

Table 4.40 above reveals that the most frequent concept for the non-ICMM companies was *management*. The concept appeared 2,961 times per report across the 38 reports analysed. This number equates to an average of 77.9 times per report. The second most frequent concept was *community*, which appeared 2,711 times with a relevance of 92%. Thus, community appeared on average 71.3 times which is 6.6 fewer times than the most frequent concept — *management*.

The third most frequent concept was *employees,* appearing 2,514 times with a relevance of 85%. The fourth ranked concept was *development* which appeared 2,236 times and had a relevance score of 76%. Nine further concepts had relevance scores greater than 50%; they were *reporting, production, use, local, company, work, safety, water,* and *performance*.

4.5.3.2 Theme

This subsection looks at the themes identified by Leximancer. Six themes were identified to represent the 40 concepts at the 60% theme level. These themes were *Management*, *Community*, *Water*, *Newcrest,* and *Total*. Theme names were determined by the most common concept within the theme. The concepts that fall within these themes are detailed in the table below.

Table 4.41 shows the corresponding connectivity percentage for each theme. Connectivity is a measure showing the relative importance of the theme. It shows how the concepts within a theme relate to the remaining concepts within the sustainability report.

Table 4.41. Themes and concepts from non-ICMM member sustainability reports.

Theme and Connectivity:	*Management* – 100%	*Community* – 62%	*Water* – 45%	*Newcrest* – 5%	*Total* – 1%
Concepts:	*management*	*community*	water	Newcrest	Total
	development	*employees*	million	received	
	production	*local*	energy		
	use	programme	total		
	safety	support	emissions		
	work	training	plant		
	company	health	rate		
	reporting	people	power		
	system	education	tonnes		
	performance	services	percent		
	coal		waste		
	control				
	material				
	construction				
	equipment				
	information				

The theme findings show five themes emerged from the sustainability reports of non-ICMM members. *Management* was the main theme containing 16 concepts including 7 ranked in the top 10 for count. The theme combines a variety of concepts related to various activities associated within the mining industry. The theme is supported by two secondary themes.

Community was the next highest ranked theme with 62% connectivity. The theme included 10 concepts with 3 ranked in the top 10 for count. All concepts within the theme relate closely to the wider community and the people within it. The third ranked theme was *Water* with 45% connectivity. The theme included 11 themes in total, one more than *Community*, but none ranked in the top 10 for count. The *Water* theme includes concepts related to *operations* and *production*.

In addition to the three themes above, there were two minor themes. These were *Newcrest* and *Total*. *Newcrest* included two concepts, *Newcrest* and *received*. *Total* was a single concept theme. The connectivity scores for these themes were 5% and 1% respectively.

The next section shows graphically the relationship between concepts and themes by way of a concept map.

4.5.3.3 Concept map

This section builds on the concepts and themes presented earlier in the non-ICMM member findings. In Figure 4.11 below the concepts are shown at every node. *Management* was identified in the concept analysis as the most frequent concept and is shown with the largest node. *Total* has the smallest node as it had the lowest count of the 40 concepts identified. The nodes help to show the relative frequency of each concept graphically. The links between nodes reveal the relationships of concepts in greater detail than is provided by the theme findings.

Figure 4.11. Non-ICMM members concept map.

Management has four direct links to *safety*, *system*, *reporting,* and *performance*. There are a further five connections with other concepts indirectly by way of these links. These

links reveal natural pairings and link concepts within the sustainability reports. Overall, there are 17 concepts with one direct relationship and 38 direct relationships between concepts. *Use* is the only concept that has five direct connections. *Management* and *local* have four direct connections.

This analysis was completed using a 60% theme size. The themes presented in the earlier section are shown graphically to better illustrate the relationship between concepts. The size of a theme does not reflect the importance of a theme. The central positioning of the *Management* theme in relation to the other four themes shows how its concepts were dominant within the reports. The overlap between the remaining themes indicates the concepts within these regions appear regularly within close proximity to concepts in multiple themes.

The concept map presented in Figure 4.11 is heat-mapped. The red colouring of the *Management* theme and the yellow for the *Community* theme show the concepts are more important than the remaining cooler coloured themes. The blue and purple of *Total* and *Newcrest* reflect the lower importance of the concepts within these themes. This colour coding is consistent with the thematic findings and connectivity scores presented above.

The concept map also shows how the concepts within the two small themes of *Total* and *Newcrest* lie away from the majority of concepts and are not central to the sustainability reports.

4.5.3.4 Summary

The concept analysis for the non-ICMM members identified that *management* was the most frequent concept. The theme analysis showed the concept formed part of a theme that was connected to all remaining concepts. The concept map shows graphically the relationships within the sustainability reports. The *management* concept is shown with the largest node. The *Management* theme is heat-mapped red, emphasising the relative strength and importance of the theme.

The next section compares the findings across the three organisation classifications of existing, new and non-ICMM member organisations.

4.5.4 Concept analysis

This section consolidated the findings for each group to identify similarities and differences according to the different ICMM member status. The analysis shows that across the three member groups, there were concepts that were common in all three groups' reports, concepts that were present in only two of the groups' reports, and concepts that were unique to only one report group. The remainder of this section separates the concepts according to these distinctions. The first section presents the concepts common in all three ICMM member groups.

4.5.4.1 Common concepts

There were 19 common concepts across the three categories, as shown in Table 4.42. The highest two ranked concepts were *communities* and *employees*. Concepts were standardised to allow for differences in tenses/plurals (i.e., *community* and *communities*). Table 4.42 below presents these concepts by membership categories.

Table 4.42. Common concepts.

	Existing	New	Nonmember	Average
Common Concepts				
community	1	5	2	2.7
employees	2	3	3	2.7
report	3	2	5	3.3
production	6	10	6	7.3
local	4	12	8	8.0
safety	9	11	11	10.3
water	11	21	12	14.7
health	13	13	20	15.3
training	15	18	17	16.7
program	16	20	15	17.0
information	14	19	23	18.7
people	12	26	22	20.0
company	39	15	9	21.0
energy	17	29	19	21.7
emissions	19	24	24	22.3
million	24	27	18	23.0
total	23	25	21	23.0
waste	25	35	35	31.7
plant	35	37	28	33.3

Across the three categories, *community* and *employees* ranked as the highest concepts in the existing ICMM members' reports. The 2.7 rank average shows that the concepts were highly ranked regardless of the ICMM classification. *Employees* ranked as either the second or third most frequent concept. *Community* was ranked as the most frequent concept in the existing members group and second in the nonmember group, but fifth in new ICMM member companies. Both concepts ranked within the top five concepts regardless of ICMM status. Similarly, *report* was ranked in the top five of all ICMM classifications. These concepts appear to be central to the sustainability reports of mining companies.

Production is the only other concept to rank in the top 10 of all three ICMM groups. *Local* averaged a rank of 8.0 across all three groups but was the twelfth most common concept across the new ICMM member organisations.

The variation in concept use between the groups shows the different emphasis within the category types. The remainder of this subsection identifies instances where a concept was highly ranked in one or two groups but not a third. The next paragraphs will looks at instances where a concept is ranked highly by two groups but not the third. The following paragraph looks at where a concept is highly ranked in one but not the other groups.

One instance where a concept ranked high in two groups but not the third is the concept of *water*. Across the new and nonmember groups, the concept ranked eleventh and twelfth respectively. However, across the existing ICMM member organisations the concept ranked twentieth overall. Another instance is the concept of *health*. In both the existing and new ICMM member companies, the concept ranked thirteenth; however, in the non-ICMM member organisations the concept ranked as the twentieth most frequent. Another instance is the concept of *energy*. *Energy* ranked as the seventeenth most frequent concept for existing ICMM members and nineteenth for non-ICMM members, but twenty-ninth for the new ICMM members. There were also instances where a concept ranked lower in one group compared to the other two.

Whilst it was common for concepts to rank similarly in two groups but not a third, it was also common for the reverse to be the case. Here a concept would rank low in one but not the others. One instance is *company*. The concept of *company* was the ninth most frequent concept within the non-ICMM group, however, it was ranked fifteenth for new ICMM members and thirty-ninth for existing ICMM members.

There are instances where a concept was more frequent in one group's reports compared to those of both of the other groups. *People* is an example of one of these instances; it was the twelfth ranked concept in the existing ICMM member reports, but ranked twenty-sixth in new ICMM member reports and twenty-second in non-ICMM member reports. *Waste* is another instance where the concept was the twenty-fifth most frequent in the existing members' reports compared to thirty-fifth in both the new and non-ICMM members' reports. *People* and *waste* were both concepts that existing ICMM member companies used more frequently compared to companies in the other two categories. Therefore, the concepts were, by comparison, of greater significance to existing ICMM members than to other companies.

The above summary compares concepts that appeared in all three reports. There are, however, also concepts that appear in two sets of reports but not a third. These are presented in the next section.

4.5.4.2 Partial concepts

In addition to the common concepts, there were a further 14 concepts in two of the three classification categories. Table 4.43 presents these concepts by ICMM membership status.

Table 4.43. Partial concepts.

Existing ICMM (10)	New ICMM (11)	Non-ICMM (7)
copper (38)	copper (39)	-
data (37)	data (31)	-
-	development (4)	development (4)
education (32)	-	education (34)
employment (36)	employment (30)	-
material (8)	-	material (30)
project (5)	project (9)	-
region (21)	region (40)	-
services (31)	-	services (27)
-	support (17)	support (16)
time (30)	time (32)	-
-	use (8)	use (7)
-	work (6)	work (10)
year (10)	year (14)	-

Table 4.43 shows that the 14 top 40 concepts were present in the reporting of two of the three groups. The concepts' split across the groups found there were 10 concepts for

existing ICMM members, 11 for new ICMM members, and 7 for non-ICMM members. The remainder of this section will discuss key findings for the three groups in conjunction.

The highest ranked concept within the 14 concepts was *development*. In both the new and non-ICMM member groups, *development* was ranked as the fourth most frequent concept. The concept did not rank as part of the top 40 concepts for the existing ICMM members. Similarly, *use* and *work* were ranked in the top 10 concepts of new and non-ICMM member companies but not of the existing ICMM members. *Support* was the final concept not to rank in the 40 concepts used by existing ICMM members but which did feature within the other two groups' reports.

For the new ICMM members, there were 3 concepts that were present in the top 40 of the other reports but absent from their reports. These were *education*, *material,* and *services*. Only *material* was ranked highly within the existing ICMM member group. In the non-ICMM group, *material* was the thirtieth most frequent concept.

Certain concepts were unique to the ICMM member reports; these were: *copper*, *data, employment*, *project*, *region*, *time,* and *year*. The concept of *project* was the fifth most frequent for existing ICMM members and ninth most frequent for new ICMM members.

The majority of concepts that appeared within 2 of the top 40 lists had similar ranks. Overall, this result shows that when these concepts were found within the reports, the relative use of the concepts was similar. There were two exceptions: *material* and *region*. In the existing ICMM member company reports, material was the eighth ranked concept compared to a finding of thirtieth in the non-ICMM membership. Similarly, *region* was the twenty-first ranked concept in the existing ICMM findings and placed fortieth in new ICMM analysis. The next section builds further on concept variation by focusing on the unique concepts within each ICMM membership group.

4.5.4.3 Unique concepts

After removing 4 concepts that appeared in two or three of the reports' top 40 concepts, 34 remaining concepts were found to be unique to each sustainability report classification. These concepts appeared in the top 40 concepts in one of the groups. This finding does not mean that the concepts were not present in the other two ICMM categories' findings. Rather, it shows that these concepts were frequent concepts relative to their occurrence in the other groups' reports.

Table 4.44. Unique concepts.

Existing ICMM (11)	New ICMM (10)	Non-ICMM (14)
assurance (40)	*ARM (7)*	*coal (25)*
facilities (28)	*Codelco (28)*	*construction (31)*
government (7)	*due (33)*	*control (33)*
Group (26)	*industry (22)*	*equipment (38)*
human (20)	*mining (1)*	*management (1)*
land (33)	*MMG (23)*	*Newcrest (26)*
members (29)	*period (34)*	*percent (36)*
metals (34)	*results (16)*	*performance (13)*
resources (18)	*Sepon (38)*	*power (32)*
rights (22)	*workers (36)*	*rate (29)*
Vale (27)		*received (39)*
		system (14)
		total (40)
		tonnes (37)

Table 4.44 reveals that there were between 10 and 14 unique concepts in each group summary. Only 8 of the 35 concepts were ranked within the top 20 for each particular group. Therefore, the less frequent concepts account for the main variation and the unique concepts within each group. The remainder of this section looks at the higher ranked concepts.

One finding is that the most frequent concept for the new ICMM members was *mining* and this concept was unique to this group. The concept was not ranked significantly in the findings for the entire population. Similarly, the most frequent concept in the non-ICMM members' reports — *management* — was unique to this group and not ranked in the overall findings.

Company names account for some of the unique concepts; these names can appear as concepts if they were used frequently within one report relative to other concepts. The other unique concept ranked in the top 10, was *government*. Within the existing ICMM member group, the concept was seventh most frequent. The concepts of *resources* (existing member), *results* (new member), *performance* (nonmember), and *results* (nonmember) were the only other concepts to rank within the top 20 for count in each group.

The next section looks beyond individual concepts and presents the theme analysis across the three ICMM membership types.

4.5.5 Theme analysis

The individual analysis identified theme groups for concepts based on the concept's positioning and proximity within the sustainability reports. Table 4.45 compares the different themes across the different ICMM membership categories.

Table 4.45. Theme comparison.

Existing ICMM	New ICMM	Non-ICMM
Communities (100%)	*Mining (100%)*	*Management (100%)*
Employees (53%)	*Employees (51%)*	*Community (62%)*
Products (48%)	*Production (5%)*	*Water (45%)*
Report (36%)	*Community (44%)*	*Newcrest (5%)*
Water (32%)	*Report (36%)*	*Total (1%)*
Energy (22%)	*Water (16%)*	

Table 4.45 shows that *Communities* and *Water* appear in all three theme lists, indicating that these concepts were the most common within a connected grouping of concepts. Two further themes: *Employees* and *Reports* were common in two out of the three groups. The remainder of this section will look at the composition of the *Communities* and *Water* themes across the different company membership statuses. The first comparison is for the *Community* theme.

The *Community* theme was common to all three groups. As mentioned already, themes are ranked according to the connectivity scores within each category and connectivity represents the connections between the concepts. *Community* ranked highest in the existing ICMM members group with 100% connectivity and the theme was the second highest ranked theme for the non-ICMM members with 62% connectivity.

The variation in connectivity scores depends on the concepts within each theme. *Table 4.46* below presents the concepts that emerged from each ICMM member category.

Table 4.46. Community theme concepts by ICMM membership classification.

Existing ICMM	New ICMM	Non-ICMM
communities	*community*	*community*
local	*local*	*employees*
project	*programme*	*local*
government	*people*	*programme*
programs	*Sepon*	*support*
people	*region*	*training*
region		*health*
education		*people*
services		*education*
employment		*services*
Vale		

Table 4.46 above shows that the *Community* theme in the existing ICMM member group included 11 concepts. This is 1 more concept than was found for the non-ICMM members and 5 more than for the new ICMM members. The different number of concepts partially accounts for the difference in the theme connectivity scores. However, the individual concept rankings and general positioning of the concepts also influence the connectivity score.

The concept list reveals that the three groups share similar concepts in terms of *Community*. In addition to *community*, there are three further common concepts: *local*, *programme*, and *people*. These four concepts all formed part of *Community* theme within the entire population findings presented in section 4.2.2. This comparison reveals that these four concepts are consistently found together throughout the sustainability reports regardless of the ICMM membership classification.

Similarly, *Water* was a common theme across the three ICMM member groups. *Table 4.47* below presents the concepts within each theme. *Water* was different, as the theme had a generally lower connectivity rank compared to *Community*. *Water* was highest ranked in the non-ICMM member companies with a connectivity score of 45%. In the existing ICMM member group, the theme was ranked fifth with 32% connectivity and for the new ICMM members, the theme was ranked sixth with 16% connectivity.

Table 4.47. Water theme concepts by ICMM membership classification.

Existing ICMM	New ICMM	Non-ICMM
water	*water*	*water*
total	*million*	*million*
facilities	*plant*	*energy*
million	*waste*	*total*
land		*emissions*
plant		*plant*
		rate
		power
		tonnes
		percent
		waste

In the *Water* theme, the three groups' reports all shared three common concepts. These were *water*, *million,* and *plant*. This finding shows that, regardless of ICMM member status, these concepts were commonly used within close proximity in the sustainability reports. *Waste* was found in both the new and non-ICMM groups. *Total* was present in both the existing and non-ICMM groups' reports.

The lower connectivity scores for the themes show the contained concepts have relatively fewer connections with other concepts. The number of concepts within a theme limits the number of relationships. Themes with more concepts have the potential for more relationships. When used in the reports of non-ICMM members, the *Water* theme comprises 11 concepts, whereas the findings show it is made up of only 6 concepts for the existing member group and of 4 concepts in the new member reports. The higher number of concepts reveals the theme's greater relationships with the other themes and the higher connectivity score.

The theme comparison provides insight into how concepts that are common across the three member categories relate to other concepts. The fact that both *Community* and *Water* all shared common concepts for all three indicates that certain concept groupings are consistent across the difference company types.

Comparing the concept map across the three groups is difficult. The map does provide a greater level of understanding of the relative positioning of the concepts and themes within the sustainability reports. However, as a comparison tool, very little can be achieved by comparing the different groups. The main findings are covered within the concept and theme summaries.

4.5.6 Summary

The purpose of this section was to look at the findings across the different ICMM membership groups. The individual ICMM membership findings provide an overview of the key concepts and themes for each membership category. These are now combined and analysed in the final section.

The combined analysis revealed 19 concepts that ranked in the top 40 across all the ICMM membership categories. Included within these concepts were 5 that had an average rank within the top 10. The 5 concepts: *community*, *employees*, *report*, *production,* and *local* were all used similarly, regardless of the reporting company's ICMM membership.

In addition to these concepts, some additional concepts appeared in only two of the three membership categories. The concept of *development* ranked fourth for new and non-ICMM members, but was not ranked in the top 40 concepts used by existing ICMM members. Some concepts were unique to each category. There were 11 unique concepts for existing ICMM members, 10 for new ICMM members, and 14 for non-ICMM members.

In addition to the concepts, themes were compared across the different ICMM categories. The findings showed the themes of *Community* and *Water* were constant, and that there were common concepts within both themes.

Due to the varying nature of the concept map, no combined analysis was performed as such analysis would not offer additional or meaningful information. The next section presents the findings for the different ICMM memberships as a whole.

4.6 Conclusion

The purpose of this chapter was to present the findings from the Leximancer thematic analysis of 104 mining sustainability reports. The sustainability reports were first analysed collectively to understand the dominant themes and concepts within them. Further analysis was conducted to understand the differences between organisations, reporting years, and ICMM membership status.

The results were analysed at a concept level initially to identify the most prominent concepts within the reports. The second level of analysis was undertaken to bring out

the relationship between concepts via themes. The final level of analysis produced a concept map which showed graphically the relationship between concepts and themes.

The concept analysis identified that the most frequent theme across all sustainability reports was *Community*. Table 4.48 shows the top 10 concepts based on count across 36 concepts identified from the Leximancer analysis.

Table 4.48. Top 10 population concepts.

	Rank	Count
Concept		
community	1	8,445
employees	2	8,159
local	3	5,730
production	4	5,700
safety	5	4,713
support	6	4,244
water	7	4,191
health	8	3,918
system	9	3,859
training	10	3,772

In addition, to the concept analysis, Leximancer calculated the interactions between concepts. The concept of *community* had the most interactions at 27,727. When the number of interactions was divided by the concept count, *education* was seen to be the most frequent concept.

Table 4.49. Top 5 concepts interactions

	Count	Interactions	Average
Concept			
education	1,911	8,690	4.5
power	1,455	6,243	4.3
consumption	1,936	7,843	4.1
coal	1,382	5,445	3.9
employment	2,003	7,756	3.9

The concepts identified for the entire population were grouped into five themes. These are now presented in *Table 4.50* below. They represent the concepts that regularly appear together throughout the sustainability reports. The concept map presented in *Figure 4.3* summarises the findings for the entire population.

Table 4.50. Theme summary.

Community	*Safety*	*Production*	*Water*	*Employees*
community	safety	production	water	employees
local	health	material	energy	training
support	system	emission	consumption	human
programme	information	technology	waste	rights
people	services	power	plant	employment
education	members	coal	facilities	
region	compliance	data	construction	
land		assurance	copper	

The summarised findings for the individual companies were presented next. These findings revealed the variation that occurred with the different companies. The combined findings were summarised with the 10 most frequent concepts. When limiting the individual companies to the 5 most frequent concepts, 29 concepts were used across the 32 different companies.

The findings for the 4 different years were then considered. These findings revealed that across the years, 22 common concepts from the 65 concepts could be identified. As Figure 4.8 revealed, these concepts were used consistently across the 4 years with no significant changes in concept rank. There were 17 top 10 ranked concepts across the 4 years, only 4 of which ranked consistently in the top 10. These were *community*, *production*, *report,* and *local*. A further four concepts appeared in the top 10 in 3 out of the 4 years.

The final section presented the findings for the three different ICMM member categories. Here 19 concepts that ranked in the top 40 across all categories were found. Five of these concepts had an average rank within the top 10. The five concepts, *community*, *employees*, *report*, *production,* and *local* were all used similarly, regardless of ICMM membership. In addition, concepts that were present in two or one of the ICMM category findings only were identified.

The next chapter will discuss the relevance of these findings, noting consistencies and variances with prior literature.

Chapter 5 DISCUSSION

5.1 Introduction

The purpose of this chapter is to discuss the findings presented in Chapter 4. The findings will be extended to incorporate a wider context and the discussion will review the findings in line with the literature. Any similarities and inconsistencies in this study's findings when compared to those in previous research will be discussed in greater detail. This expanded review will also consider the practical implications of the findings presented.

5.2 Sustainability Concepts and Themes

Early research into sustainability focused largely on the presence of sustainability within the annual report (Deegan, Rankin, & Tobin, 2002; Hogner, 1982; Guthrie & Parker, 1989; Slaper & Hall, 2011). Jenkins and Yakovleva (2006) took this research further by looking at the 10 leading mining companies. Their study found that, despite all of them producing annual reports, only two companies produced stand-alone social and environmental reports. The findings from this research show that sustainability has developed significantly in the subsequent years.

This research analysed 104 sustainability reports from 32 companies over a 4-year period. This analysis shows how sustainability reporting has evolved and also that it is now possible to study separate sustainability reports in isolation from traditional annual reports. The findings supported claims by Simnett, Vanstraelen, and Chua (2009) as well as Dilling (2010) and Hrasky (2012) that sustainability reporting is becoming more common for global business. All the mining companies analysed in this study were listed on at least one stock exchange. Many of the companies had operations in more than one country.

The literature review showed that the early research focused on the motives for disclosing sustainability information (Dowling & Pfeffer, 1975; Lindblom, 1994; Suchman, 1995). Gray, Owens, and Adams (1996) observed that the intended audience for disclosures indicates a degree of organisational accountability. However, Kakabadse et al.'s (2005) review of the development of CSR shows that the accountability approach has clearly moved beyond accountability to the shareholder to embrace accountability to wide stakeholders. This shift is most evident with the concept findings for all

sustainability reports revealing that community was the most frequent concept. The theme analysis further revealed that the additional concepts of local, support, programme, people, education, region, and land were often used together throughout the sustainability reports, showing a strong focus on these concepts. The theme connectivity revealed these concepts had the strongest connections to all other concepts.

Whilst accountability and stakeholder theory provided some evidence to explain sustainability reporting, legitimacy theory emerged as a more plausible theory. Central to legitimacy theory is the concept of a social contract; organisations that fail to meet society's expectations breach the contract, creating a legitimacy gap that threatens the organisation's legitimacy (Deegan & Rankin, 1996; Dowling & Pfeffer, 1975, Lindblom, 1994). Furthermore, the terms of the contract are evolving as society changes and advancement in technology improves processes and communication (Laszlo & Laszlo, 2002; Lindblom, 1994).

This research differentiates itself from these initial studies and those of others (see Deegan et al., 2002; Hogner, 1982; Guthrie & Parker, 1989) by looking at the sustainability reports themselves rather than at the factors that might influence a firm's decision to produce a sustainability report. A more recent study by Perez and Sanchez (2009) focused on four major mining companies' sustainability reports between 2001 and 2006. A major conclusion from their content analysis is that "there is a clear evolution in [the] report's comprehensiveness and depth" (p. 949). The findings from this study support that observation). The variety of concepts found in the Leximancer analysis is further evidence of the complexity and depth of the sustainability topic as used by the mining industry. The findings showed this diversity as, across the 32 companies analysed, 29 different concepts ranked in the top five most frequent.

The overall concept findings reveal a diverse range of concepts appearing frequently within the sustainability reports. *Table 5.1* below presents the 10 most frequent concepts. The concepts relate to internal operations, concepts of health, safety, and training which presumably improve the work environment for employees as well as for external stakeholders.

*Table 5.1.*Most frequent concepts sorted by rank.

Concept	Rank
community	1
employees	2
local	3
production	4
safety	5
support	6
water	7
health	8
system	9
training	10

The findings show that the sustainability disclosures do not focus on one specific area. They encompass a diverse range of concepts. The concepts of community and employees appeared 25% more frequently than local did across all the sustainability reports. This finding shows that these two concepts were significantly more frequent than all other concepts. When looking at concept frequency as an indicator, that finding suggests that these concepts were central and the most important to the mining companies.

One of the interesting findings was the variation of concepts used by the 32 companies. The findings showed that the second through to the fifth most frequent concepts had reducing relevance scores. However, there were extremes at both the high and low end of the scales. The fifth most frequent concept on average appeared 61% of the time compared to the most frequent concept. However, in The Mosaic Company's reports, the second most frequent concept appeared only 49% and the fifth most frequent appeared 34%. In contrast, 12 companies' second most frequent concept appeared with a relevance score of more than 90% and, of these, four companies' third most frequent concept scored more than 90%. The Minerals and Metals Group reports' concepts which ranked second to fifth all had a relevance score of 90% or higher. These findings suggest that companies vary in the emphasis they place on certain concepts.

The concept findings above reveal the concepts that are used by mining companies and the relative emphasis placed on these concepts. Being the most used concepts, however, does not necessarily mean that those particular concepts are the most important. The relevance findings show how often concepts are used relative to other concepts. The findings across all 32 companies reveal the most frequent concepts; however, with a sample of different companies, the common concepts will combine to be

more frequent, while the slightly less frequent concepts appear less significant, especially when only a few companies emphasise those concepts.

In addition to the concept findings, the theme analysis provided greater insight into how the concepts appeared within the sustainability reports. The concepts within the Community theme appear consistent within a mining context. There are no obvious concepts that do not fit these concepts which indicates that related concepts appeared often together throughout the mining sustainability reports. This finding demonstrates that this group of concepts appears consistently across the sustainability reports.

Similarly, the Employees theme's concepts closely relate to each other and are all consistent. Both themes include a grouping of concepts which individually relate, and collectively appear to be consistent, within a mining sustainability report context.

The concepts contained within Safety also appear consistently. The theme includes broader concepts of systems, information, services, and members that are also applicable to other themes. The concepts within the Production and Water themes do not appear as consistent.

The theme of Production includes concepts that directly relate to mining production activities including production, material, emission, technology, power, and coal. The concept of data is also included which, along with technology, can apply more broadly. However, the concept of assurance does not automatically fit within this grouping.

The concepts within Water do not naturally align to the theme's label. It is important to remember that the label default is generated by the most frequent concept within that grouping. The concepts within Water may more closely reflect facilities. There are further concepts like copper which appears to fall within this grouping but do not directly relate to all other concepts within the group.

5.3 Membership Categories

Organisations are now voluntarily joining organisations like the ICMM where they make a commitment to not only report on their sustainability activity but also to adhere to key principles set by these independent organisations. The literature review identified that the mining industry has been particularly proactive in adopting sustainability (Peck & Sinding, 2003; Jenkins, 2004; Whitmore, 2006; Perez & Sanchez, 2009; Himley, 2010).

Kolk (2003) believed that sustainability disclosures were increasingly common for organisations and industries that are perceived to have negative externalities.

Perez and Sanchez (2009) established that the increase in the volume of social and environmental disclosures is complemented by an increase in the quality of disclosures. However, the literature review did not uncover studies that had looked specifically at the concepts included within the sustainability reports of a large group of companies.

McPeak and Tooley (2008) recognised the importance of incorporating sustainability into board level decision making and how its incorporation can create an environment for consideration of new opportunities including innovation, efficiency, and accessing new markets. The findings from the different ICMM classifications revealed the concept of development was the fourth ranked concept for both new and non-ICMM member companies but that it did not rank as a top 10 concept for existing ICMM members. Similarly, the concept of projects was a highly ranked concept for existing (fifth ranked concept) and new (ninth ranked concept) ICMM member companies only. Whilst these concepts can be used in a variety of different contexts, the findings show that the new ICMM member companies used these concepts relatively more than other concepts compared their use by existing and non-ICMM member companies.

Audi (2009) believed there was a need for companies to be strategic in implementing sustainability into their organisation. The implementation strategy should also include how sustainability is to be communicated. Aras and Crowther (2009), who were later supported by Morhardt (2010), identified that sustainability reporting was becoming an integral part of the internal policy and external disclosures of organisations. The findings from this research show that organisations are emphasising different areas within their reports. The use of common concepts revealed there are certain areas that are included within all sustainability reports. However, the variation across companies suggests there is scope and flexibility to focus on additional concepts.

Milne, Tregidga, and Walton (2009) found that there was significant variation in sustainability practices. The findings from this study's the individual company analysis also showed variation between companies' concept use. The variability is highlighted in the comparison of the tenth most frequent concept. Here the highest relevance score was 63%, whilst the lowest was 24%. This large range, therefore, shows different companies place different emphasis on concepts. In some instances, there can be a narrow focus on key concepts which will result in a significant decrease on the relevance

percentage. In contrast, focusing on a wide number of concepts more evenly will see high relevance scores for the tenth ranked concept. This high relevance scores of concepts in some companies like Mitsubishi Materials and Sumitomo Metal Mining Company further show that a variety of concepts were used frequently.

The large variation between the relevance score for the tenth ranked concept shows the different emphases within individual companies' sustainability reports. This observation is further highlighted by the number of concepts that have a 50% relevance score. The range varied from 1 concept in The Mosaic Company to 14 concepts in Sumitomo Metal Mining Company. Choudhuri and Chakraborty (2009) observed there is no correct way for an organisation to disclose sustainable activity. The findings above suggest that there is no best practice and that organisations are finding approaches to effectively disclose their sustainability activity.

Whitmore (2006) notes that sustainable mining is not markedly different from mining throughout history, mining which has been associated with many disasters (Coetee & van Staden, 2011). He recognises that there has been a significant shift in rhetoric with little tangible change for mine-affected communities. One field of prior research found that disclosures would change immediately following a major event that threatened legitimacy (Deegan et al., 1996; Patten, 1992). However, there were no significant global events during the 4-year period covered in the present study. The sample of companies was diverse in respect to mining operations in different continents; hence, an event affecting an individual company might not create a noticeable change in the combined analysis of all companies for a given year.

5.4 Year Comparison

Previous studies such as Hogner (1982) and then Guthrie and Parker (1989) analysed sustainability over multiple decades, whereas this research used only a four-year period. The findings revealed that were no significant changes in the concept ranks that were consistent across the 4 years. Furthermore, the findings did not suggest that additional concepts appeared or disappeared over the period used. However, as a relatively large sample of more than 20 reports was analysed for each year, changes relevant to an individual company might be offset within the larger sample.

When looking at 2012 and 2013 specifically, the year analysis revealed that for the concepts that ranked in the top 40 across all 4 years, 20 out of the 22 concept ranks'

increased. In addition to the increased ranking of these 20 concepts, a further 4 concepts were ranked in the top 40 in the first 3 years but not in 2013. This finding suggests that in 2013 new concepts were used more frequently within the mining sustainability reports.

In 2013 3 new concepts ranked in the top 10 compared to those for previous years. These concepts were development (ranked 3), process (6), and areas (9). In addition to these new concepts, 2 concepts that ranked highly in 2010 and 2011 and did not rank in 2012, reappeared in the top 10 concepts in 2013. These concepts were employees (2) and use (4).

To further emphasise the change in 2013, only 2 of the top 6 concepts had ranked in the top 20 in the previous year. Given the limited time period used in this study for analysis, determining if the change in focus in 2013 was a one-off or part of general change is difficult. Further years would need to be analysed to see if the new concepts retained their positions.

One concept that featured for the first time in 2013 only was assurance. The concept was identified in the overall analysis of all reports, but it only appears in the 2013 concept list in the separate year analysis. The concept was a topical issue identified in the literature review. After reviewing the assurance provided in sustainability reports, Fonseca (2010) concludes "that mining companies had significant control over the practice" (p. 355). Perez and Sanchez (2009) identified third-party verification as a major issue facing sustainability in the mining industry. Jenkins and Yakovleva (2006) observed that most organisations had some external verification of data and disclosure despite limited auditing standards and sustainability performance information.

The findings revealed that overall the assurance concept was the thirty-sixth most frequent when all sustainability reports were analysed. The individual year analysis revealed 2013 was the year the concept featured within the top 40 concepts. Further, it was more likely to appear as a main concept in existing ICMM member companies' reporting than in the reports of others. These findings support a positive change following the ICMM Assurance Procedure introduced in 2010 (Fonseca, 2010). Initially recognised as a positive change, the 2013 findings show the change is beginning to be realised in the reporting practice of the ICMM mining companies.

Jenkins and Yakovleva (2006) recognised that one of the main factors contributing to the lack of uniformity in the industry is an absence of collaborative work between mining companies. However, the ICMM is taking a positive step forward for the industry. Fonseca (2010) identified a change in the ICMM assurance procedure made in 2010 and, despite taking a few years to be realised, the concept appeared most often in the existing ICMM member sustainability reports. Whilst Jenkins and Yakovleva's (2006) views might apply to the industry in general, individual organisations that have taken a positive step forward have shown change. In addition to the change, there has been a growth in the number of ICMM member companies with six organisations becoming ICMM members between 2009 and 2013.

5.5 Sustainability Concept

One of the main issues facing sustainability is the degree to which it can be implemented by organisations, societies, countries, or industries (Franceschi & Kahn, 2003; Malovis et al., 2008). However, whilst firms individually cannot achieve the ideas of strong sustainability, they are finding ways to implement elements of sustainability into their activities and processes. Subsequently, sustainability reporting is becoming an integral part of the internal policy and external disclosures of organisations (Aras & Crowther, 2009; Morhardt, 2010). Companies need to be strategic in implementing sustainability into their organisation (Audi, 2009). However, one of the main issues identified from the literature is the lack of a single definition for sustainability (Franceschi & Kahn, 2003; Smith & Sharicz, 2011). The findings from this study further show the uncertainty surrounding the concepts. Despite the presence of sustainability reports, the concept of sustainability did not rank in the top concepts collectively. In the individual company analyses, the concept ranked in 15 out of the 32 most frequent concepts. The concepts highest rank was eight in Tech. In the year analyses, the concept ranked highly in 2013 only. These findings show that the concept did not feature frequently within the sustainability reports.

This somewhat surprising finding may possibly be explained if we think about the following scenario (although it has no scientific backing). First, pick a book or document that is on a field of interest to you. I am going to use cricket and assume the book is on the laws of cricket. In the laws of cricket, the wording uses many different terms relating to cricket but does not frequently use the word cricket relative to other concepts. The concept is an implied term that provides a context to the laws. However, the text largely

focuses on the laws and the jargon and terminology of the sport which are repeated throughout the document rather than the name of the sport. Therefore, when applying the same logic to sustainability, the findings showed the frequency of sustainability as a concept was low. The findings for low presence of sustainability could in part be due to the fact that the concepts collectively can be interpreted as the concepts that make up sustainability without regularly using the word itself.

Similarly, 'stakeholder' is a common term frequently used in the academic literature surrounding sustainability reporting. The concept did not appear in the findings section of this research. This finding highlights the academic nature of the term and the fact that it has little practical relevance in external reporting. Stakeholders are represented in the text through concepts like communities, employees, and suppliers. The presence of these concepts shows that stakeholders are important to sustainability reports and are largely addressed individually rather as a collective group.

5.6 Summary

This chapter has discussed the findings from the Leximancer analysis of 104 sustainability reports of 32 leading mining companies. The findings were analysed collectively to identify the dominant and common concepts and themes within mining sustainability reports. The concept cap was also analysed to provide a greater context for concept and theme findings. The findings showed that the most frequently used concepts across all the sustainability reports were *community*, *employees*, *local*, *production,* and *safety*. At 27,727 interactions, the concept of *community* had the greatest number of interactions with other concepts. When the number of interactions was divided by the concept count, *education* was seen to have the highest number of interactions per concept appearance, followed by *power*, *consumption*, *coal,* and *employment.* The theme findings identified five theme groups: *Community*, *Safety*, *Production*, *Water,* and *Employees*.

Further analysis of the individual companies revealed there was variation in the sustainability reporting. However, there were similar concepts across the different companies. The most common concepts to rank in the top 5 overall were *operations*, '*company name', management, development,* and *mine*. The sustainability reports were further analysed according to reporting period. These findings showed the common concepts that were reported consistently over the four years. Further analyse of the

reports were conducted according to the ICMM membership classification showed that whilst there were similarities in the reports, there were differences in the concept use.

This research shows that the overall current state of sustainability in the mining industry is strong. The concepts that are used within the reports are largely consistent with sustainability. Previous studies have not focused in depth on the content and themes within sustainability reports. This research has contributed towards filling this gap.

The next chapter will provide a summary and conclusion of the research.

Chapter 6 SUMMARY, CONCLUSIONS AND FUTURE RESEARCH

6.1 Introduction

The final chapter reviews the thesis by revisiting the research's original aims and addressing the way in which they were achieved. Further, the chapter includes the study's limitations as well as future research opportunities that have emerged from the findings. Finally, the importance of the research and the implications of the conclusions drawn for sustainability reporting and the mining industry are presented.

6.2 Review

Sustainability is recognised as bringing organisations not only internal and external advantages but also the potential to move the business environment away from a purely economic-based system (Mueller, 2005; Timlon, 2011; Prior, Giurco, Mudd, Mason, & Behrisch, 2012). Through studying its sustainability reporting, this research will allow greater understanding of what sustainability means to the mining industry.

The mining industry was selected because of the inherent contradiction between sustainability and the nature of mining. All mining companies share the same characteristic: they extract nonrenewable resources from the environment (Jenkins, 2004). Due to the finite nature of the planet's resources, mining, by its very nature, cannot be sustainable (Prior et al., 2012). This situation creates a very clear and interesting paradox between mining and sustainability (Fonseca, 2010).

Chapter 2 initially reviewed the concept of sustainability in the literature. It was apparent early on that there are multiple and diverse definitions of the concepts of sustainability within the literature (Johnston, Everard, Santillo, & Robert, 2007; Prezzy, 1989). Franceschi and Kahn (2003) found that many of the earlier definitions shared similar themes and ideals. However, they also observed that more recent definitions have evolved and now incorporate economic elements. The 1987 Brundtland statement is still widely referred to when defining sustainability (Franceschi & Kahn, 2003; Malovis et al., 2008).

The 1987 Brundtland Report has been widely associated with the use and acceptance of the term sustainability (Stone, 2003). Since then, sustainability has become one of the dominant issues within the business environment (Mansdorf, 2010). The mining industry by its very nature cannot be considered sustainable due to the extraction of

nonrenewable resources from the environment (Himley, 2010; Kommadath, Sarkar, & Rath, 2012; Prior et al., 2012). This reality is compounded by the industry's history of showing little regard for social and environmental stakeholders (Jenkins, 2004).

Society has been forced to rely on sustainability reporting to measure and gauge an organisation's commitment towards sustainable development (Hrasky, 2012). Kolk (2003) acknowledged sustainability reporting as a 'window-dressing' tool to address external pressures that would fade as public interest declined. Milne, Tregidga, and Walton (2009) found that organisations were largely taking an economic and instrumental approach to sustainable development and integrating rhetorical disclosures either to mask a lack of substantial action or through pragmatism. These findings reveal inconsistencies and variations within sustainability reporting and further highlight the paradox of sustainable mining.

The mining industry has been proactive in aligning itself with sustainability in attempts to change past behaviour and current perceptions (Jenkins, 2004). Academic studies have investigated the effects of mining companies in local communities and environments. Examples include the release of toxic chemicals onto the land and into the waterways as well as the treatment of workers, indigenous populations, local villages, and developing nations (Peck & Sinding, 2003; Stern, 1995)

The growing body of research has focused on the definitions, theories, and motivations behind sustainability (Deegan, Rankin, & Tobin, 2002; O'Donovan, 2002). Despite developments in sustainability research, sustainability is still far from being a unified concept. This lack of consensus is evidenced by the number of alternative definitions of sustainability (Prezzy, 1989; Johnston, Everard, Santillo, & Robert, 2007), and in the significant variability in sustainability disclosures by organisations (Jenkins & Yakovleva, 2006; Milne et al., 2009).

The mining industry's involvement with sustainability and its ability to operate sustainably is easily questioned, given the apparent paradox between these two issues. However, it is stakeholders' uncertainty surrounding acceptable social and environmental behaviours that provides a greater challenge for the mining industry (Peck & Sinding, 2003; Jenkins, 2004; Whitmore, 2006; Watson, 2008; Perez & Sanchez, 2009; Fonseca, 2010; Himley, 2010; Prior et al., 2012).

6.3 Research Objectives

The purpose of this study was to explore the sustainability reporting practices of mining companies in light of the paradox between sustainability and mining within that industry. Through analysing the sustainability reporting of mining companies, this research has provided a new understanding of what sustainability means to the mining industry.

The primary objective was broken down into the following research questions:

1. What are the dominant and common concepts and themes within mining sustainability reports?
2. What are the similarities and differences in the sustainability reporting practices of the leading mining companies?
3. How does the sustainability reporting of mining companies change over the period of the study?
4. Are there differences in the sustainability reporting of established mining companies compared to new mining companies?
5. What is the overall current state of sustainability in the mining industry and how has this changed from earlier studies?

The achievement of these objectives is outlined in the following sections.

6.3.1 Literature review

An extensive literature review was conducted in order to understand sustainability reporting within a mining context. Chapter 2 initially looked at the definitions of sustainability, recognising there were both multiple definitions but also a generally accepted definition stemming from the 1987 Brundtland Report. The review then focused on the motivations behind sustainability reports. It documented the developments from accountability to shareholders and stakeholders through to legitimacy theory as possible explanations for firms' engaging in sustainability. The literature review looked at the different characteristics of organisations producing sustainability reports as well as the benefits and costs of such reporting. The final section looked at prior research on sustainability and mining, it included a historical review and current trends. This literature review identified a gap in the current literature. This gap showed that little had been done in terms of looking at the concepts and themes within sustainability reports in the mining industry, thus highlighting the importance of this research.

6.3.2 Analysis and discussion of findings

This section provides an overview of the findings and discusses their importance. As discussed in Chapter 5, the main concepts to emerge from the mining sustainability reports were *community*, *employee*, *local*, *production,* and *safety.* These concepts appeared to be the most frequent when analysing the sustainability reports collectively. The findings revealed that the concepts formed five themes when grouped at the 60% theme size. These themes were *Community*, *Safety*, *Production*, *Water,* and *Employees*. Each theme contained between five and eight concepts. All themes had a high connectivity rating indicating that, across a large number of reports, the concepts within each theme relate to concepts in other themes.

When analysing the companies separately and the consolidating the individual findings, it was found that the concepts of *operations*, *company names*, *management*, *development*, *mine,* and *community* appeared in the top five concepts for at least 25% of the companies. The theme findings showed the concepts for each company grouped into between four and seven themes. The average theme size was 4.78, indicating that the concepts within individual companies' reports generally fitted into larger groups. The connectivity scores of some themes were low for individual companies indicating some themes contained isolated concepts separate from the main concepts identified.

The year and ICMM membership findings revealed there were strong consistencies across the sustainability reporting of the mining companies. The year analysis revealed 65 concepts across the 4 years analysed and 22 of these concepts appeared in all 4 years. Therefore, there was 33.8% consistency in concepts across the 4 years when looking at the top 40 concepts, and 12 of these concepts had an average rank of 20 or less. The trend analysis across years did not reveal any significant new trends or changes to the concept use. The only noticeable finding was that, of the 22 concepts, 20 concepts had a higher rank in 2013 compared to 2012. The ICMM membership comparison showed 19 concepts consistent across all three categories. Consistent with the overall findings, the highest two concepts were *community* and *employees.* The concept of *development* ranked highly for new and non-ICMM members but did not rank highly for existing companies. Similarly, the concept of *projects* ranked highly for both existing and new ICMM members but not for non-ICMM members. There were unique concepts that only ranked in each category. However, these concepts generally had higher ranks. The lowest ranked concepts unique to each category were *government*

(rank 7) for existing members, *mining* (rank 1) for new members and *management* (rank 1) for nonmembers.

The findings provided a unique insight into the sustainability reporting of leading global mining companies. Whilst the study has provided meaningful information, there were limitations that need to be considered when reviewing the findings. These limitations are addressed next

6.4 Limitations

This study was designed to be exploratory and to contribute towards filling a gap in the research. The exploratory nature of this research and the use of Leximancer have resulted in apparent limitations. Primarily, using Leximancer required the sustainability reports to be collected in a specific electronic format. As a result, companies and reports that were not readable in Leximancer had to be excluded. Further, to ensure the reports did not contain concepts that were not relevant to sustainability, integrated annual and sustainability reports were excluded, unless published separately online. This limitation reduced the potential number of reports available for processing from 144 to 104. Having more reports would have provided more complete data for analysing the sustainability reporting in the mining industry. In the year and membership category comparison, different numbers of reports were analysed for each category. The concept findings were standardised by calculating the average count per report. Having reports for all companies and periods would have provided more complete findings.

The sustainability reports analysed for the different companies varied in terms of length and content. Whilst the research attempted to understand this variation, reports that contain double the number of pages were likely to contain more concepts. Therefore, when comparing counts and concept frequency, analysis was limited to relative measures including rank and relevance. Sustainability reports' length can vary for numerous reasons. Reports with more pictures or tables will be longer. Further, the content will vary depending on contextual factors and the overall emphasis on sustainability. However, longer reports increase the likelihood of more concepts and different concepts' interactions. Additional shorter reports would have a concentrated content with fewer concepts and interactions.

When considering the frequency of concepts appearing in the sustainability reports using a content analysis, there was an underlying assumption that the greater the

frequency of a concept, the greater the emphasis on the subject. However, a concept can be discussed in great detail without high repetition of that specific concept. It is possible that the significant or important concepts for an organisation might be presented in the first pages of the report. It is also possible that less significant concepts are used regularly throughout the report in conjunction with over concepts. The Leximancer analysis would recognise these concepts as being more important and significant in terms of themes. The purpose of this research was to understand what concepts and themes appeared most often within the sustainability reports, not to establish what their presence means in each instance. The concept count is a measure and approximation for determining concept relevance. Without asking organisations directly, it is impossible to establish which concepts are more important and it is unlikely that such information would be provided. Therefore, using concept frequency provides a proxy for analysing the sustainability disclosures.

The analysis across different years provided an insight into the changes in a relatively short period of time. A longer time period would provide greater insight into how concepts change from year to year and over a longer period of time. An analysis across more years would also have tracked the trends of concepts.

Despite these limitations, this research helps to fill an apparent gap in the literature on sustainability and the mining industry. Understanding the concepts and themes within the sustainability reporting of multiple mining companies provides valuable insight previously not available through analysis.

6.5 Future research possibilities

This study provided insights into the sustainability reporting practices of global mining companies. The exploratory nature of the study has revealed opportunities for further research. As previously identified, there have been limited studies investigating the concepts and themes within the sustainability disclosures of the mining industry.

The analysis by year was used to identify trends from within the sample of mining companies. A more specific study using Leximancer could look specifically at trends of sustainability disclosures over a longer time span. Furthermore, companies that produced reports over the entire period could be separated from those that had started to produce their reports within the time frame. This separation would better reflect the

changes to reporting practices of existing companies compared to those of new companies which had recently started producing sustainability reports.

The sustainability reports were analysed according to year and ICMM membership category separately, excluding other possible factors influencing disclosures and content. A researcher(s) with more experience using Leximancer may be able to structure the research to analyse these two variables in conjunction. Further, additional variables could be analysed. The mining companies could be analysed on the basis of the location of the companies' head offices or stock exchange listing to see, for example, if geographical location had any influence on the sustainability reporting of mining companies. Alternatively, the companies could be analysed according to the different metals and minerals mined.

The analysis of relationships between concepts and themes has been touched upon only briefly in this research. An in-depth thematic analysis requires small sample sizes to be able to understand the many unique relationships between concepts. When providing a theme analysis across multiple documents or reports, there is significant variability in the grouping of concepts where themes can be influenced by many different relationships. Theme analysis would be more beneficial in trying to understand a single report where there is greater consistency rather than analysing multiple reports from a variety of sources.

This research used Leximancer software to analyse and gain insight into the sustainability reporting of the mining industry, an industry where there is an underlying paradox between sustainability and the extraction of nonrenewable resources. The growth in sustainability reporting is not, however, limited to the mining industry. A similar analysis using Leximancer could be conducted for different industries or extended to include disclosures made outside of sustainability reports.

6.6 Importance of the research and conclusions

Whitmore proposed that sustainability in mining has no effect on mining practices and makes no material changes to operations. The findings from this research show that the mining industry does report on concepts beyond the scope of its operations. As stakeholders, readers of these reports are reliant on these disclosures when trying to gauge an organisation's commitment beyond its operations. However, determining if sustainability has caused material changed to operations is difficult to ascertain.

Mining still involves the extraction of nonrenewable resources from the planet. Society has grown and developed on the back of using these materials. Society is still demanding these materials as mining operations continue globally. Whilst it is difficult to claim a cause and effect relationship between sustainability and mining, it can be assumed that mining operations and processes have evolved. The operations may now be more efficient and practising weak sustainability, but, more importantly, organisations are looking beyond their operations with sustainability in mind.

This research has shown that mining companies are reporting not only on concepts like *community*, *employees*, *local*, *product*, and *safety*, but also that these are the most frequently appearing concepts in their reports. The findings from this study suggest that these concepts are at the forefront of the organisations. Whilst material change might not happen overnight, these concepts are gradually becoming integrated into mining organisations. The sustainability reports analysed in this study provide evidence that this change has started.

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Table 0.1. Analysis of interaction between concepts.

Concepts

	community	employees	local	production	support	safety	health	training	program	water	energy	system	material	emissions	people	human	education	information	region	services	rights	consumption	employment	waste	plant	facilities	technology	members	power	construction	coal	land	compliance	data	copper	assurance	Count	Total Interactions	Average
community	8445	2086	3885	676	1974	1004	1382	1162	1526	911	361	584	479	279	1453	663	1077	577	1078	782	761	163	821	227	333	420	151	839	134	465	111	656	261	204	137	105	8,445	27,727	3.28
employees	2086	8159	1382	708	1098	1642	1535	1935	1254	345	292	803	389	236	1013	863	762	453	566	517	793	122	976	134	272	426	178	594	98	183	120	139	397	248	86	86	8,159	22,731	2.79
local	3885	1382	5730	540	1344	517	709	886	1061	765	261	433	352	198	948	370	724	371	965	637	421	126	702	248	395	384	166	500	160	407	135	477	180	158	116	51	5,730	20,974	3.66
production	676	708	540	5700	525	869	461	366	367	682	1082	683	1205	953	267	240	155	490	281	832	160	624	167	587	605	370	723	174	484	328	614	260	207	194	618	89	5,700	17,586	3.09
support	1974	1098	1344	525	4244	517	647	782	896	347	273	485	326	195	625	388	648	291	484	448	339	99	450	125	208	239	268	367	127	233	166	197	168	128	75	110	4,244	15,592	3.67
safety	1004	1642	517	869	517	4713	2148	767	622	267	253	834	417	185	504	354	263	433	232	315	300	81	255	133	163	227	256	285	118	164	216	81	360	220	90	163	4,713	15,255	3.24
health	1382	1535	709	461	647	2148	3918	605	675	319	126	557	246	125	500	384	608	334	291	393	270	52	297	110	74	229	78	265	40	105	70	100	292	157	65	87	3,918	14,336	3.66
training	1162	1935	886	366	782	767	605	3772	1062	225	152	446	222	133	630	559	778	233	329	304	485	61	538	90	132	244	136	309	55	155	71	76	217	66	37	38	3,772	14,286	3.79
program	1526	1254	1061	367	896	622	675	1062	3751	373	228	363	239	174	527	293	709	278	438	320	218	142	316	181	210	243	113	290	61	172	28	199	208	138	56	40	3,751	14,020	3.74
water	911	345	765	682	347	267	319	225	373	4191	720	625	472	696	205	156	186	195	359	247	127	590	111	866	574	516	247	122	280	313	186	443	150	184	167	60	4,191	13,031	3.11
energy	361	292	261	1082	273	253	126	152	228	720	3468	467	559	1852	87	78	72	164	142	206	51	1466	66	453	430	262	598	80	816	182	497	139	87	157	155	60	3,468	12,874	3.71
system	584	803	433	683	485	834	557	446	363	625	467	3859	459	383	244	294	181	458	180	213	209	249	129	328	291	273	350	158	248	211	214	133	326	374	110	249	3,859	12,544	3.25
material	479	389	352	1205	326	417	246	222	239	472	559	459	3679	450	184	209	110	576	143	325	149	271	107	702	281	263	374	146	159	193	135	133	157	303	371	355	3,679	11,461	3.12
emissions	279	236	198	953	195	185	125	133	174	696	1852	383	450	3355	54	59	47	188	134	135	36	1185	49	495	399	235	449	62	688	120	455	141	93	241	139	76	3,355	11,339	3.38
people	1453	1013	948	267	625	504	500	630	527	205	87	244	184	54	3448	378	350	175	366	258	391	23	524	64	109	142	62	228	47	130	42	193	88	60	54	41	3,448	10,966	3.18
human	663	863	370	240	388	354	384	559	293	156	78	294	209	59	378	2546	162	187	183	102	1721	47	253	70	42	93	104	156	23	40	37	84	196	75	48	34	2,546	8,945	3.51
education	1077	762	724	155	648	263	608	778	709	186	72	181	110	47	350	162	1911	145	207	245	104	37	231	53	78	155	58	173	26	118	24	64	82	23	29	6	1,911	8,690	4.55
information	577	453	371	490	291	433	334	233	278	195	164	458	576	188	175	187	145	3303	155	214	197	68	119	110	87	139	143	192	53	84	69	74	188	541	76	544	3,303	8,601	2.60
region	1078	566	965	281	484	232	291	329	438	359	142	180	143	134	366	183	207	155	2541	197	165	90	301	62	138	118	70	175	75	134	86	145	64	95	79	36	2,541	8,563	3.37
services	782	517	637	832	448	315	393	304	320	247	206	213	325	135	258	102	245	214	197	2284	84	117	190	125	114	152	88	142	67	133	71	127	97	60	71	47	2,284	8,375	3.67
rights	761	793	421	160	339	300	270	485	218	127	51	209	149	36	391	1721	104	197	165	84	2415	19	235	36	24	73	70	161	25	37	39	202	184	60	20	43	2,415	8,209	3.40
consumption	163	122	126	624	99	81	52	61	142	590	1466	249	271	1185	23	47	37	68	90	117	19	1936	28	282	270	150	249	27	542	71	248	63	46	121	91	23	1,936	7,843	4.05
employment	821	976	702	167	450	255	297	538	316	111	66	129	107	49	524	253	231	119	301	190	235	28	2003	29	69	84	66	185	35	95	40	79	105	55	30	19	2,003	7,756	3.87
waste	227	134	248	587	125	133	110	90	181	866	453	328	702	495	64	70	53	110	62	125	36	282	29	2369	323	420	195	38	162	154	145	266	111	86	193	27	2,369	7,630	3.22
plant	333	272	395	605	208	163	74	132	210	574	430	291	281	399	109	42	78	87	138	114	24	270	69	323	2107	302	214	69	370	252	192	209	50	42	137	3	2,107	7,461	3.54
facilities	420	426	384	370	239	227	229	244	243	516	262	273	263	235	142	93	155	139	118	152	73	150	84	420	302	2054	126	77	166	260	92	160	115	67	115	41	2,054	7,378	3.59
technology	151	178	166	723	268	256	78	136	113	247	598	350	374	449	62	104	58	143	70	88	70	249	66	195	214	126	1840	39	344	140	415	40	56	35	135	32	1,840	6,768	3.68
members	839	594	500	174	367	285	265	309	290	122	80	158	146	62	228	156	173	192	175	142	161	27	185	38	69	77	39	1981	38	64	30	65	102	57	36	86	1,981	6,331	3.20
power	134	98	160	484	127	118	40	55	61	280	816	248	159	688	47	23	26	53	75	67	25	542	35	162	370	166	344	38	1455	135	486	34	28	44	61	14	1,455	6,243	4.29
construction	465	183	407	328	233	164	105	155	172	313	182	211	193	120	130	40	118	84	134	133	37	71	95	154	252	260	140	64	135	1451	174	124	40	34	74	10	1,451	5,534	3.81
coal	111	120	135	614	166	216	70	71	28	186	497	214	135	455	42	37	24	69	86	71	39	248	40	145	192	92	415	30	486	174	1382	56	21	33	97	30	1,382	5,445	3.94
land	656	139	477	260	197	81	100	76	199	443	139	133	133	141	193	84	64	74	145	127	202	63	79	266	209	160	40	65	34	124	56	1724	44	59	27	16	1,724	5,305	3.08
compliance	261	397	180	207	168	360	292	217	208	150	87	326	157	93	88	196	82	188	64	97	184	46	105	111	50	115	56	102	28	40	21	44	1678	68	21	111	1,678	4,920	2.93
data	204	248	158	194	128	220	157	66	138	184	157	374	303	241	60	75	23	541	95	60	60	121	55	86	42	67	35	57	44	34	33	59	68	1796	28	338	1,796	4,753	2.65
copper	137	86	116	618	75	90	65	37	56	167	155	110	371	139	54	48	29	76	79	71	20	91	30	193	137	115	135	36	61	74	97	27	21	28	1420	9	1,420	3,653	2.57
assurance	105	86	51	89	110	163	87	38	40	60	60	249	355	76	41	34	6	544	36	47	43	23	19	27	3	41	32	86	14	10	30	16	111	338	9	1334	1,334	3,079	2.31

Table 0.2. Analysis of interaction between concepts.

Concepts	community	employees	local	production	support	safety	health	training	program	water	energy	system	material	emissions	people	human	education	information	region	services	rights	consumption	employment	waste	plant	facilities	technology	members	power	construction	coal	land	compliance	data	copper	assurance
community		0.26	0.68	0.12	0.47	0.21	0.35	0.31	0.41	0.22	0.10	0.15	0.13	0.08	0.42	0.26	0.56	0.17	0.42	0.34	0.32	0.08	0.41	0.10	0.16	0.20	0.08	0.42	0.09	0.32	0.08	0.38	0.16	0.11	0.10	0.08
employees	0.26		0.24	0.12	0.26	0.35	0.39	0.51	0.33	0.08	0.08	0.21	0.11	0.07	0.29	0.34	0.40	0.14	0.22	0.23	0.33	0.06	0.49	0.06	0.13	0.21	0.10	0.30	0.07	0.13	0.09	0.08	0.24	0.14	0.06	0.06
local	0.68	0.24		0.09	0.32	0.11	0.18	0.23	0.28	0.18	0.08	0.11	0.10	0.06	0.27	0.15	0.38	0.11	0.38	0.28	0.17	0.07	0.35	0.10	0.19	0.19	0.09	0.25	0.11	0.28	0.10	0.28	0.11	0.09	0.08	0.04
production	0.12	0.12	0.09		0.12	0.18	0.12	0.10	0.10	0.16	0.31	0.18	0.33	0.28	0.08	0.09	0.08	0.15	0.11	0.36	0.07	0.32	0.08	0.25	0.29	0.18	0.39	0.09	0.33	0.23	0.44	0.15	0.12	0.11	0.44	0.07
support	0.47	0.26	0.32	0.12		0.12	0.17	0.21	0.24	0.08	0.08	0.13	0.09	0.06	0.18	0.15	0.34	0.09	0.19	0.20	0.14	0.05	0.22	0.05	0.10	0.12	0.15	0.19	0.09	0.16	0.12	0.11	0.10	0.07	0.05	0.08
safety	0.21	0.35	0.11	0.18	0.12		0.55	0.20	0.17	0.06	0.07	0.22	0.11	0.06	0.15	0.14	0.14	0.13	0.09	0.14	0.12	0.04	0.13	0.06	0.08	0.11	0.14	0.14	0.08	0.11	0.16	0.05	0.21	0.12	0.06	0.12
health	0.35	0.39	0.18	0.12	0.17	0.55		0.16	0.18	0.08	0.04	0.14	0.07	0.04	0.15	0.15	0.32	0.10	0.11	0.17	0.11	0.03	0.15	0.05	0.04	0.11	0.04	0.13	0.03	0.07	0.05	0.06	0.17	0.09	0.05	0.07
training	0.31	0.51	0.23	0.10	0.21	0.20	0.16		0.28	0.06	0.04	0.12	0.06	0.04	0.18	0.22	0.41	0.07	0.13	0.13	0.20	0.03	0.27	0.04	0.06	0.12	0.07	0.16	0.04	0.11	0.05	0.04	0.13	0.04	0.03	0.03
program	0.41	0.33	0.28	0.10	0.24	0.17	0.18	0.28		0.10	0.07	0.10	0.06	0.05	0.15	0.12	0.37	0.08	0.17	0.14	0.09	0.07	0.16	0.08	0.10	0.12	0.06	0.15	0.04	0.12	0.02	0.12	0.12	0.08	0.04	0.03
water	0.22	0.08	0.18	0.16	0.08	0.06	0.08	0.06	0.10		0.21	0.16	0.13	0.21	0.06	0.06	0.10	0.06	0.14	0.11	0.05	0.30	0.06	0.37	0.27	0.25	0.13	0.06	0.19	0.22	0.13	0.26	0.09	0.10	0.12	0.04
energy	0.10	0.08	0.08	0.31	0.08	0.07	0.04	0.04	0.07	0.21		0.13	0.16	0.55	0.03	0.03	0.04	0.05	0.06	0.09	0.02	0.76	0.03	0.19	0.20	0.13	0.33	0.04	0.56	0.13	0.36	0.08	0.05	0.09	0.11	0.04
system	0.15	0.21	0.11	0.18	0.13	0.22	0.14	0.12	0.10	0.16	0.13		0.12	0.11	0.07	0.12	0.09	0.14	0.07	0.09	0.09	0.13	0.06	0.14	0.14	0.13	0.19	0.08	0.17	0.15	0.15	0.08	0.19	0.21	0.08	0.19
material	0.13	0.11	0.10	0.33	0.09	0.11	0.07	0.06	0.06	0.13	0.16	0.12		0.13	0.05	0.08	0.06	0.17	0.06	0.14	0.06	0.14	0.05	0.30	0.13	0.13	0.20	0.07	0.11	0.13	0.10	0.08	0.09	0.17	0.26	0.27
emissions	0.08	0.07	0.06	0.28	0.06	0.06	0.04	0.04	0.05	0.21	0.55	0.11	0.13		0.02	0.02	0.02	0.06	0.05	0.06	0.01	0.61	0.02	0.21	0.19	0.11	0.24	0.03	0.47	0.08	0.33	0.08	0.06	0.13	0.10	0.06
people	0.42	0.29	0.27	0.08	0.18	0.15	0.15	0.18	0.15	0.06	0.03	0.07	0.05	0.02		0.15	0.18	0.05	0.14	0.11	0.16	0.01	0.26	0.03	0.05	0.07	0.03	0.12	0.03	0.09	0.03	0.11	0.05	0.03	0.04	0.03
human	0.26	0.34	0.15	0.09	0.15	0.14	0.15	0.22	0.12	0.06	0.03	0.12	0.08	0.02	0.15		0.08	0.07	0.07	0.04	0.71	0.02	0.13	0.03	0.02	0.05	0.06	0.08	0.02	0.03	0.03	0.05	0.12	0.04	0.03	0.03
education	0.56	0.40	0.38	0.08	0.34	0.14	0.32	0.41	0.37	0.10	0.04	0.09	0.06	0.02	0.18	0.08		0.08	0.11	0.13	0.05	0.02	0.12	0.03	0.04	0.08	0.03	0.09	0.02	0.08	0.02	0.04	0.05	0.01	0.02	0.00
information	0.17	0.14	0.11	0.15	0.09	0.13	0.10	0.07	0.08	0.06	0.05	0.14	0.17	0.06	0.05	0.07	0.08		0.06	0.09	0.08	0.04	0.06	0.05	0.04	0.07	0.08	0.10	0.04	0.06	0.05	0.04	0.11	0.30	0.05	0.41
region	0.42	0.22	0.38	0.11	0.19	0.09	0.11	0.13	0.17	0.14	0.06	0.07	0.06	0.05	0.14	0.07	0.11	0.06		0.09	0.07	0.05	0.15	0.03	0.07	0.06	0.04	0.09	0.05	0.09	0.06	0.08	0.04	0.05	0.06	0.03
services	0.34	0.23	0.28	0.36	0.20	0.14	0.17	0.13	0.14	0.11	0.09	0.09	0.14	0.06	0.11	0.04	0.13	0.09	0.09		0.04	0.06	0.09	0.05	0.05	0.07	0.05	0.07	0.05	0.09	0.05	0.07	0.06	0.03	0.05	0.04
rights	0.32	0.33	0.17	0.07	0.14	0.12	0.11	0.20	0.09	0.05	0.02	0.09	0.06	0.01	0.16	0.71	0.05	0.08	0.07	0.04		0.01	0.12	0.02	0.01	0.04	0.04	0.08	0.02	0.03	0.03	0.12	0.11	0.03	0.01	0.03
consumption	0.08	0.06	0.07	0.32	0.05	0.04	0.03	0.03	0.07	0.30	0.76	0.13	0.14	0.61	0.01	0.02	0.02	0.04	0.05	0.06	0.01		0.01	0.15	0.14	0.08	0.14	0.01	0.37	0.05	0.18	0.04	0.03	0.07	0.06	0.02
employment	0.41	0.49	0.35	0.08	0.22	0.13	0.15	0.27	0.16	0.06	0.03	0.06	0.05	0.02	0.26	0.13	0.12	0.06	0.15	0.09	0.12	0.01		0.01	0.03	0.04	0.04	0.09	0.02	0.07	0.03	0.05	0.06	0.03	0.02	0.01
waste	0.10	0.06	0.10	0.25	0.05	0.06	0.05	0.04	0.08	0.37	0.19	0.14	0.30	0.21	0.03	0.03	0.03	0.05	0.05	0.02	0.15	0.01	0.01		0.15	0.20	0.11	0.02	0.11	0.11	0.10	0.15	0.07	0.05	0.14	0.02
plant	0.16	0.13	0.19	0.29	0.10	0.08	0.04	0.06	0.10	0.27	0.20	0.14	0.13	0.19	0.05	0.02	0.04	0.04	0.07	0.05	0.01	0.14	0.03	0.15		0.15	0.12	0.03	0.25	0.17	0.14	0.12	0.03	0.02	0.10	0.00
facilities	0.20	0.21	0.19	0.18	0.12	0.11	0.11	0.12	0.12	0.25	0.13	0.13	0.13	0.11	0.07	0.05	0.08	0.07	0.06	0.07	0.04	0.08	0.04	0.20	0.15		0.07	0.04	0.11	0.18	0.07	0.09	0.07	0.04	0.08	0.03
technology	0.08	0.10	0.09	0.39	0.15	0.14	0.04	0.07	0.06	0.13	0.33	0.19	0.20	0.24	0.03	0.06	0.03	0.08	0.04	0.05	0.04	0.14	0.04	0.11	0.12	0.07		0.02	0.24	0.10	0.30	0.03	0.02	0.10	0.02	
members	0.42	0.30	0.25	0.09	0.19	0.14	0.13	0.16	0.15	0.06	0.04	0.08	0.07	0.03	0.12	0.08	0.09	0.10	0.09	0.07	0.08	0.01	0.09	0.02	0.03	0.04	0.02		0.03	0.04	0.02	0.04	0.06	0.03	0.03	0.06
power	0.09	0.07	0.11	0.33	0.09	0.08	0.03	0.04	0.04	0.19	0.56	0.17	0.11	0.47	0.03	0.02	0.02	0.04	0.05	0.05	0.02	0.37	0.02	0.11	0.25	0.11	0.24	0.03		0.09	0.35	0.02	0.02	0.03	0.04	0.01
construction	0.32	0.13	0.28	0.23	0.16	0.11	0.07	0.11	0.12	0.22	0.13	0.15	0.13	0.08	0.09	0.03	0.08	0.06	0.09	0.09	0.03	0.05	0.07	0.11	0.17	0.18	0.10	0.04	0.09		0.13	0.09	0.03	0.02	0.05	0.01
coal	0.08	0.09	0.10	0.44	0.12	0.16	0.05	0.05	0.02	0.13	0.36	0.15	0.10	0.33	0.03	0.03	0.02	0.05	0.06	0.05	0.03	0.18	0.03	0.10	0.14	0.07	0.30	0.02	0.35	0.13		0.04	0.02	0.02	0.07	0.02
land	0.38	0.08	0.28	0.15	0.11	0.05	0.06	0.04	0.12	0.26	0.08	0.08	0.08	0.08	0.11	0.05	0.04	0.04	0.08	0.07	0.12	0.04	0.05	0.15	0.12	0.09	0.02	0.04	0.02	0.09	0.04		0.03	0.03	0.02	0.01
compliance	0.16	0.24	0.11	0.12	0.10	0.21	0.17	0.13	0.12	0.09	0.05	0.19	0.09	0.06	0.05	0.12	0.05	0.11	0.04	0.06	0.11	0.03	0.06	0.07	0.03	0.07	0.03	0.06	0.02	0.03	0.02	0.03		0.04	0.01	0.08
data	0.11	0.14	0.09	0.11	0.07	0.12	0.09	0.04	0.08	0.10	0.09	0.21	0.17	0.13	0.03	0.04	0.01	0.30	0.05	0.03	0.03	0.07	0.03	0.05	0.02	0.04	0.02	0.03	0.03	0.02	0.02	0.03	0.04		0.02	0.25
copper	0.10	0.06	0.08	0.44	0.05	0.06	0.05	0.03	0.04	0.12	0.11	0.08	0.26	0.10	0.04	0.03	0.02	0.05	0.06	0.05	0.01	0.06	0.02	0.14	0.10	0.08	0.10	0.03	0.04	0.05	0.07	0.02	0.01	0.02		0.01
assurance	0.08	0.06	0.04	0.07	0.08	0.12	0.07	0.03	0.03	0.04	0.04	0.19	0.27	0.06	0.03	0.03	0.00	0.41	0.03	0.04	0.03	0.02	0.01	0.02	0.00	0.03	0.02	0.06	0.01	0.01	0.02	0.01	0.08	0.25	0.01	

APPENDIX B

Table 0.3 Companies Report used for Each Individual Year Analysis.

2010 30/09/2009 - 30/06/2010	**2011** 30/09/2010 - 30/06/2011	**2012** 30/09/2011 - 30/06/2012	**2013** 30/09/2012 - 30/06/2013
African Rainbow Minerals	African Rainbow Minerals	African Rainbow Minerals	African Rainbow Minerals
Anglo America	Anglo America	Anglo America	Anglo America
Anglo Gold Ashanti	Anglo Gold Ashanti	Anglo Gold Ashanti	Anglo Gold Ashanti
Antofagasta plc	Antofagasta plc	Antofagasta plc	Antofagasta plc
Barrick	Barrick	Areva	Areva
BHP Billiton	BHP Billiton	Barrick	Barrick
China Shenhua Energy Company Ltd	China Coal Energy Limited	BHP Billiton	BHP Billiton
Codelco	China Shenhua Energy Company Ltd	China Coal Energy Limited	China Coal Energy Limited
Fortescue Metals Group Limited	Codelco	China Shenhua Energy Company Ltd	China Shenhua Energy Company Ltd
Freeport-McMoran Copper & Gold Inc	Fortescue Metals Group Limited	Codelco	Eldorado Gold Corp
Grupo Mexico S.A. de CV	Freeport-McMoran Copper & Gold Inc	Eldorado Gold Corp	Fortescue Metals Group Limited
Hydro	Grupo Mexico S.A. de CV	Fortescue Metals Group Limited	Freeport-McMoran Copper & Gold Inc
JX Nippon Mining & Metals	Hydro	Freeport-McMoran Copper & Gold Inc	Goldcorp (10& 11 online only)
Kinross Gold Corporation	Impala Platinum Holdings Limited	Grupo Mexico S.A. de CV	Grupo Mexico S.A. de CV
MMG - Minerals & Metals Group	JX Nippon Mining & Metals	Hydro	Hydro
Newcrest Mining Limited	Lonmin	Impala Platinum Holdings Limited	Impala Platinum Holdings Limited
Potash Corporation of Saskatchewan Inc.	MMG - Minerals & Metals Group	JX Nippon Mining & Metals	JX Nippon Mining & Metals
Sumitomo Metal Mining Co. Ltd	Newcrest Mining Limited	Kinross Gold Corporation	Lonmin
Teck	Newmont	Lonmin	Mitsubishi Materials

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Vale	Potash Corporation of Saskatchewan Inc.	Mitsubishi Materials	MMG - Minerals & Metals Group
Xstrata	Sumitomo Metal Mining Co. Ltd	MMG - Minerals & Metals Group	Newcrest Mining Limited
Yamana Gold Inc.	Vale	Newcrest Mining Limited	Newmont
	Xstrata	Newmont	Rio Tinto
	Yamana Gold Inc.	Rio Tinto	Sumitomo Metal Mining Co. Ltd
		Sumitomo Metal Mining Co. Ltd	Teck
		Teck	The Mosaic Company
		The Mosaic Company	Vale
		Xstrata	Xstrata
		Yamana Gold Inc.	Yamana Gold Inc.

APPENDIX C

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