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How Cognitive Diversity in Senior Management Teams can add Value
through Innovation and Improved Performance in the Mining Industry

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ABSTRACT

The mining industry has a reputation for being insular, traditional, highly technical and macho and is not adapting quickly enough to meet the demands of a world that is changing at an ever-increasing rate. Key disruptions in the mining industry are in technology, legislation, sustainability requirements and stakeholder expectations. This dissertation proposes that rebalancing cognitive diversity in mining's senior management teams will establish the industry's ability to proactively manage disruptive events and that the industry needs to change the way it designs and manages individuals, teams and organisations from a diversity perspective. These two research aims were met through analysing results from a literature review, and surveys and interviews of senior leaders from the mining industry.

A key finding from this research is that the industry is correcting its demographic imbalances although progress is slow and in reaction to social equality movements and legislation, rather than being proactive. Proactively managed cognitive diversity in senior management teams has been found to improve innovation and performance and there is an appetite for change regarding diversity and inclusion from senior leaders within the mining industry, although there is low awareness of cognitive diversity and its value.

The conclusion from this research is that to be effective at mitigating its largest risks and issues, the industry needs to leverage cognitive diversity within senior management teams. However, leaders currently do not have access to toolkits to be able leverage cognitive diversity and the mining industry lacks psychological safety and relatedness to allow diversity to be leveraged.

The key recommendations from this research were that more research is needed regarding how cognitive diversity can be leveraged within the mining industry, senior management teams in mining need to be more cognitively diverse, and leaders need a toolkit to help them to be successful in managing cognitive diversity.

Keywords:

Diversity in the workplace; Diversity; Cognitive Diversity; Diversity in the Workplace; Inclusion; Equality; Equity; Mining Industry; Extraction Industry; Resource Extraction; Mines & mineral resources; Leadership; Senior Management; Executives; Board of Directors; Corporate culture; Cognitive bias; Intuition; Change theory; Teams in the workplace; Work environment; Employee selection; Management; Creativity; Innovation; Job Performance; Organizational Development; Personnel Recruitment; Gender Differences; Employer Employee Relationship; Natural Resources; Fuels

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LIST OF ABBREVIATIONS

CSR	Corporate Social Responsibility
EDI	Equality (or Equity), Diversity and Inclusion
ESG	Environmental, Social and Governance
GDPR	General Data Protection Regulations
IT	Information Technology
KPI	Key Performance Indicator
LEAD ³	Leadership and Diversity to the power of three (framework)
MBTI [®]	Myers-Briggs Type Indicator [®]
R&D	Research and Development
STEM	Science, technology, engineering and mathematics

1 INTRODUCTION

Mining involves the extraction of geological resources and “..is one of the main activities for the world economy and creating social welfare.” (Amirshenava and Osanloo, 2019). It is essential to understand whether the mining industry can meet the future demand for the supply of commodities (Bleischwitz, 2020). The mining industry has a reputation for being insular and having high barriers to entry for individuals different to the industry norms (Abrahamsson and Johansson, 2020). For most senior management teams within the mining industry, these norms are usually white, middle-to later-aged male, and highly technical with operational STEM backgrounds specific to the mining sector, often within specific commodities and geographies; they must also conform to the industry’s accepted ways of working.

The mining sector has been largely reactive to changing macro global dynamics regarding sustainability, technology, legislation, and stakeholder requirements. The industry has not been proactive in meeting demographic diversity requirements and is instead reactive to social equality or equity, referred to in this report as equality, movements and legislation. Mining has had a poor EDI and discrimination track record (Renders, 2015). Renders argues that the industry encourages a culture that discourages whistle blowing, and that “..workplace experts say that as long as this silence prevails, mining companies can pretend like nothing is wrong.”. There is an increasing interest in senior management diversity; it has been found to improve executive creativity and decision-making, leading to better organizational outcomes (Reynolds and Lewis, 2017). This research intended to identify whether proactively leveraging cognitive diversity in senior management teams could result in improved innovation and performance within organisations in the mining industry. The specific objectives were to:

1. *Define* cognitive diversity.
2. *Identify* which benefits from cognitive diversity have been studied across industries and within senior management teams in mining.
3. *Explore* the understanding and levels of interest in, or commitment to, developing and leveraging cognitive diversity in the mining industry.
4. *Formulate* recommendations for further research and future approaches to cognitive diversity.

Research is focussed on the;

- depth of research on demographic and cognitive diversity within the mining industry,
- factors that impact the innovative performance of teams,
- value that can be achieved through cognitive diversity,
- positive and negative impacts of cognitive diversity on innovation and performance within senior management teams, and
- whether there is an appetite from senior leaders in the mining industry for cognitive diversity.

This research seeks to fill the existing knowledge gaps on the topic. The objective is not to detract from the criticality of social equality, which is a crucial aspect of the future of the global work environment. This research is intended to identify additional

opportunities to unlock the value of cognitive diversity within the mining industry; as Reynolds and Lewis avow, “Teams solve problems faster when they’re more cognitively diverse.” (Reynolds and Lewis, 2017). Figure 1 shows the route that was taken to get to the final thesis topic.

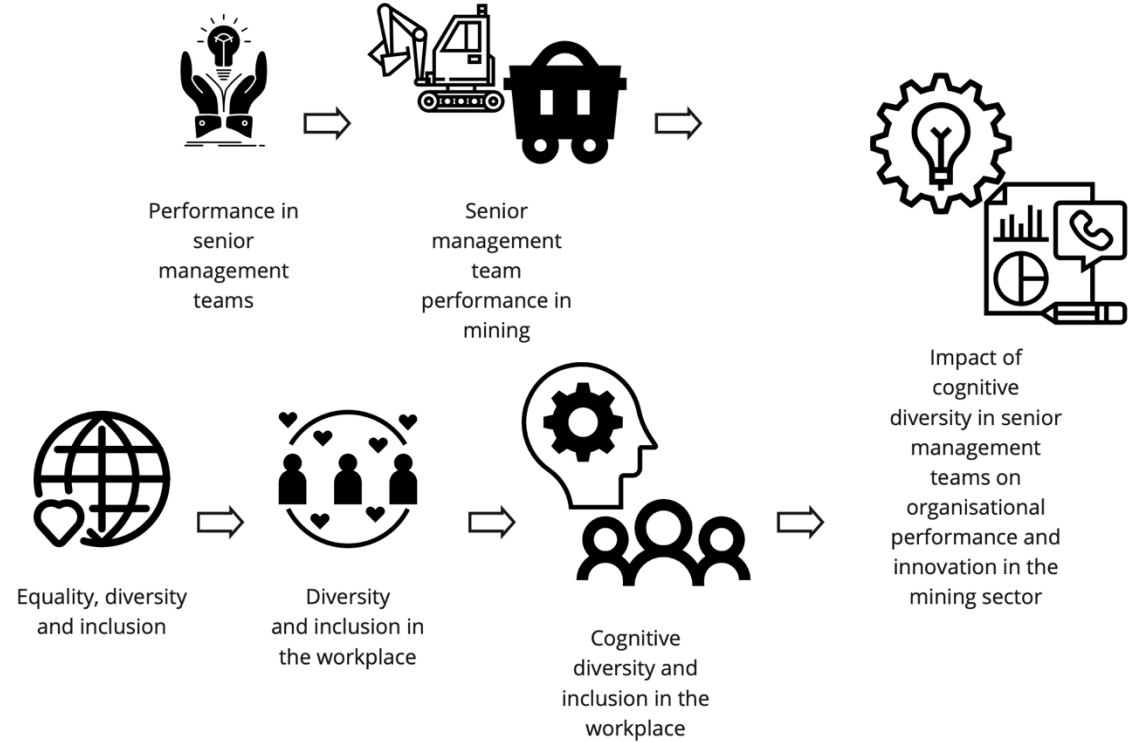


Figure 1 – Approach to development of the topic

2 LITERATURE REVIEW

2.1 Introduction

Interest in and perceived importance of EDI in the workplace has augmented over the last few decades (Edelman, Fuller and Mara-Drita, 2001; Garg and Sangwan, 2021; Oswick and Noon, 2014; Perriton, 2009). Equality is commonly associated with legislative and legal aspects of social justice (Perriton, 2009) related to demographic attributes such as age, gender, and race (Oswick and Noon, 2014). Oswick et al. also describe diversity as the broader distribution of differences in characteristics or attributes across a group of individuals and inclusion or inclusivity, referred to as inclusion in this report, is the mechanism to leverage value from diversity and integrate ideas, approaches, and attributes to improve problem solving and decision-making (Garg and Sangwan, 2021; Nishii, 2013).

Figure 2 shows how Senichev represented three layers of characteristics that can be used to describe the diversity of individuals within a workforce (Senichev, 2013). However, Senichev also points out that the definition and understanding of equality and diversity can differ significantly, particularly across different jurisdictions. Three broad types of diversity have been identified in academic literature: demographic diversity, experiential diversity, and cognitive diversity. Demographic diversity refers to characteristics that generally aren't changed within an individual ("Internal Dimensions" in Figure 2). Experiential and cognitive diversity are terms often used to describe other diversity characteristics ("External Dimensions" and "Organizational Dimensions") that may impact an individual's personality (O'Connor, 1998; Weigelt and Sarkar, 2009).

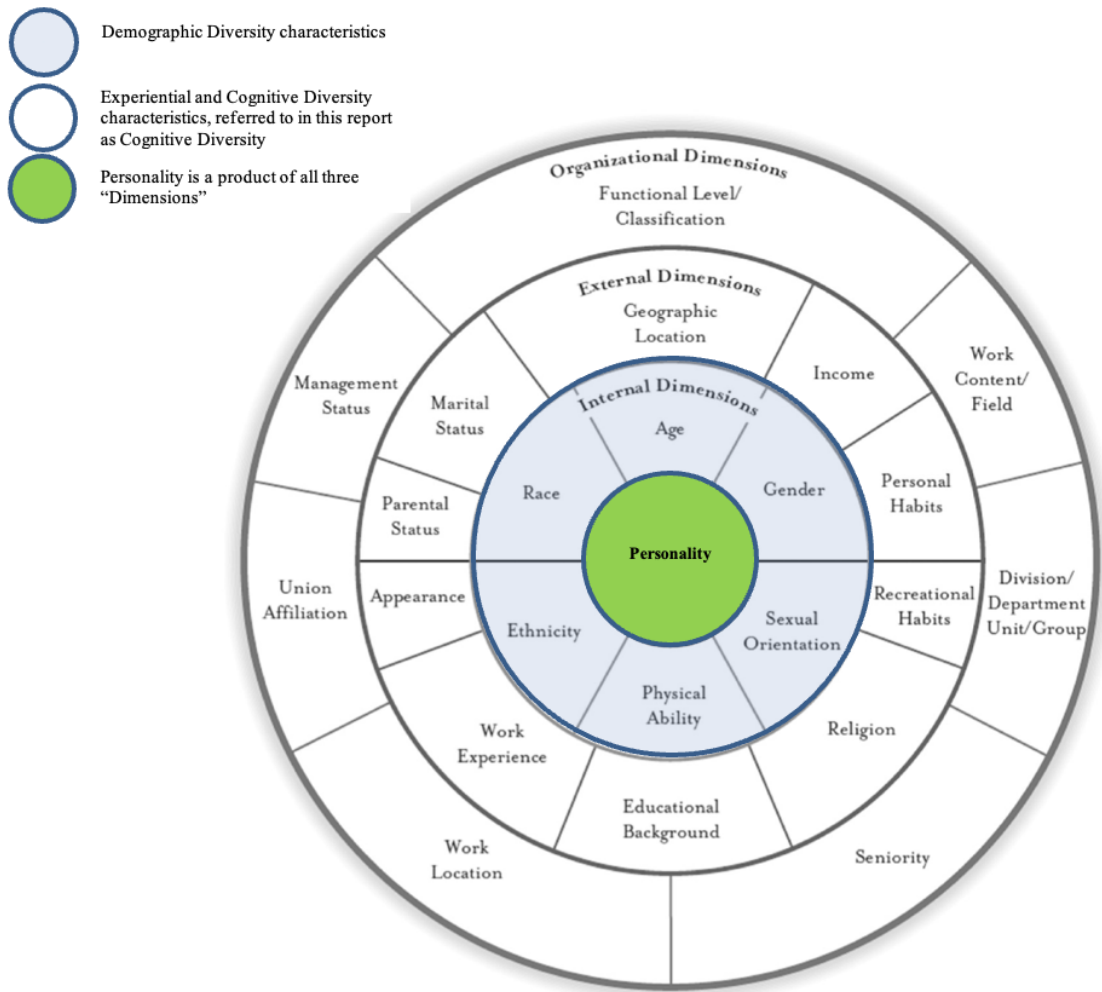


Figure 2 - Four layers of Diversity, adapted from Senichev (Senichev, 2013)

For the purpose of this thesis report, diversity outside of demographic characteristics will be referred to as cognitive diversity and is the specific component of diversity addressed in this research topic. Examples of cognitive diversity characteristics are demonstrated in Figure 2. These characteristics exist within any group of individuals, regardless of whether they are recognised or leveraged (Chen et al., 2019; Martins et al., 2013). There are correlations between demographic diversity and cognitive diversity since individuals with demographically different characteristics often have different cognitive characteristics (Chen et al., 2019).

2.2 Depth of Academic Literature on the Topic

The analysis below focuses on an article search of scholarly (peer reviewed) articles on the EBSCOhost database for key subject terms. Equality is the most researched topic within EDI, with almost 140,000 articles. There is a significant amount of literature on diversity in the workplace (Oswick and Noon, 2014), as demonstrated in Figure 3. The prevalence of diversity in literature has increased substantially, although the topic of inclusion has generally lagged (Garg and Sangwan, 2021; Shore et al., 2011) as shown in Figure 4, which also demonstrates a recent exponential increase in inclusion in the workplace, and could be reflective of an increased interest in the subject. Similar trends are observed for cognitive diversity, as demonstrated in Figure 5.

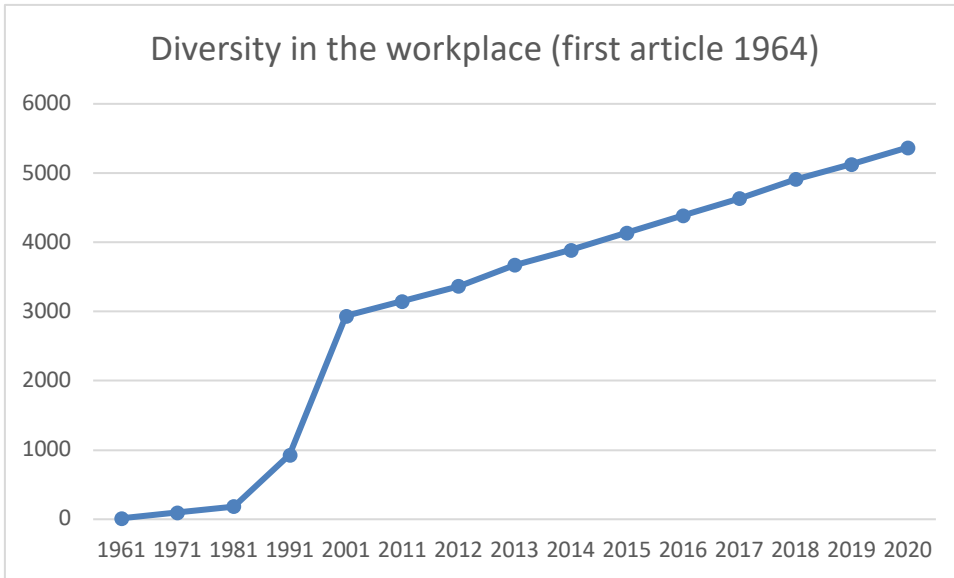


Figure 3 - Diversity in the workplace article count from EBSCOhost

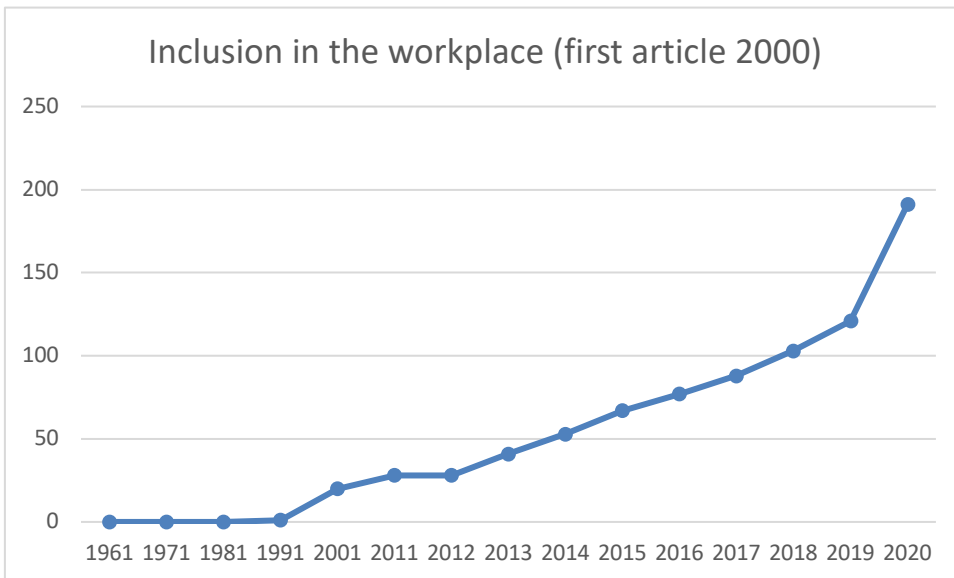


Figure 4 - Diversity in the workplace article count from EBSCOhost

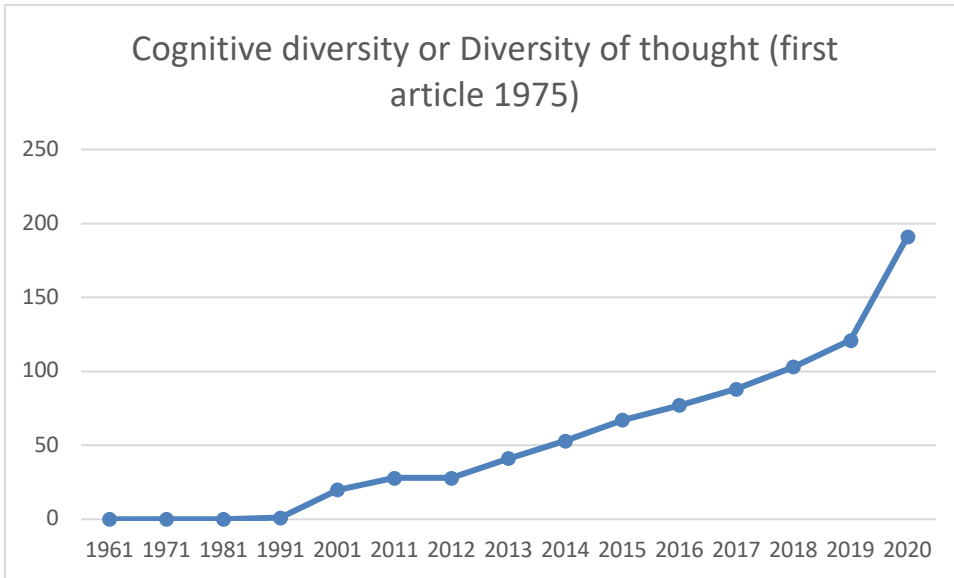


Figure 5 - Diversity in the workplace article count from EBSCOhost

Figure 6 shows that very few articles share search terms that combine “mining industry or extraction industry or mine or resource extraction” and “diversity in the workplace”. A similar case was evident when replacing “diversity...” with “inclusion in the workplace”, “cognitive diversity” or “equality”, demonstrating a lack of scholarly content on the topic of EDI within mining. Incidentally, there is a similar lack of diversity articles in other comparable industries such as manufacturing, as is evident in Figure 7, as well as in the oil and gas sector.

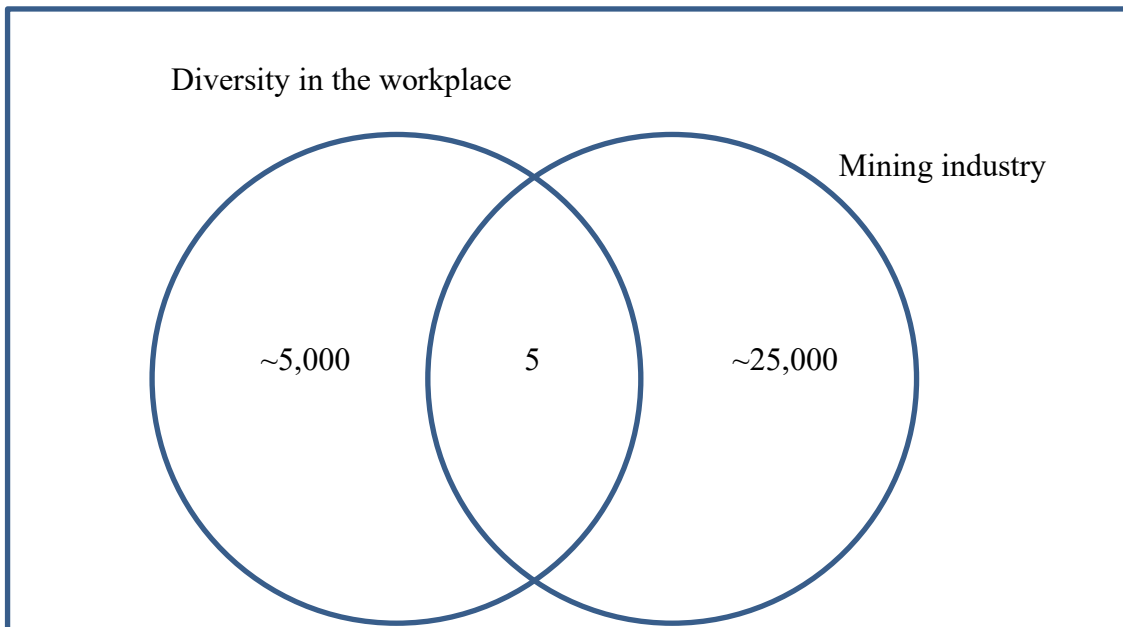


Figure 6 - Diagram showing EBSCOhost article counts for diversity and the mining industry

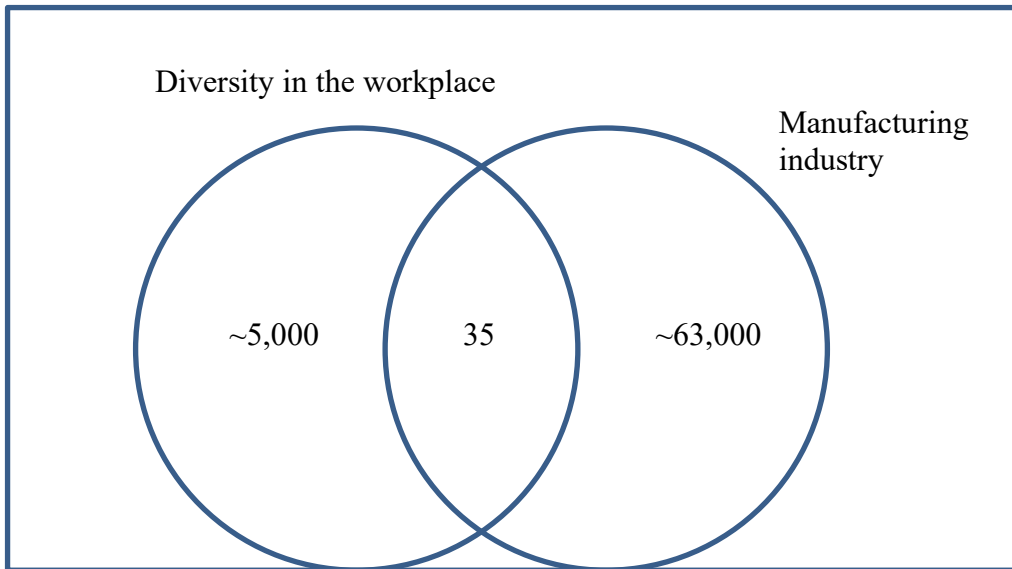


Figure 7- Diagram showing EBSCOhost article counts for diversity and the manufacturing industry

As shown in Figure 8, there is a scholarly connection between “diversity in the workplace” and “senior management or leadership or executives or board of directors”, with almost 600 articles sharing these subject terms. When replacing “diversity...” with “inclusion in the workplace” or “cognitive diversity”, there were only approximately 50 articles for each. The relative lack of research in inclusion and cognitive diversity in senior management teams could suggest that academia perceive less importance in these areas or that the topics haven’t evolved enough yet to gain traction.

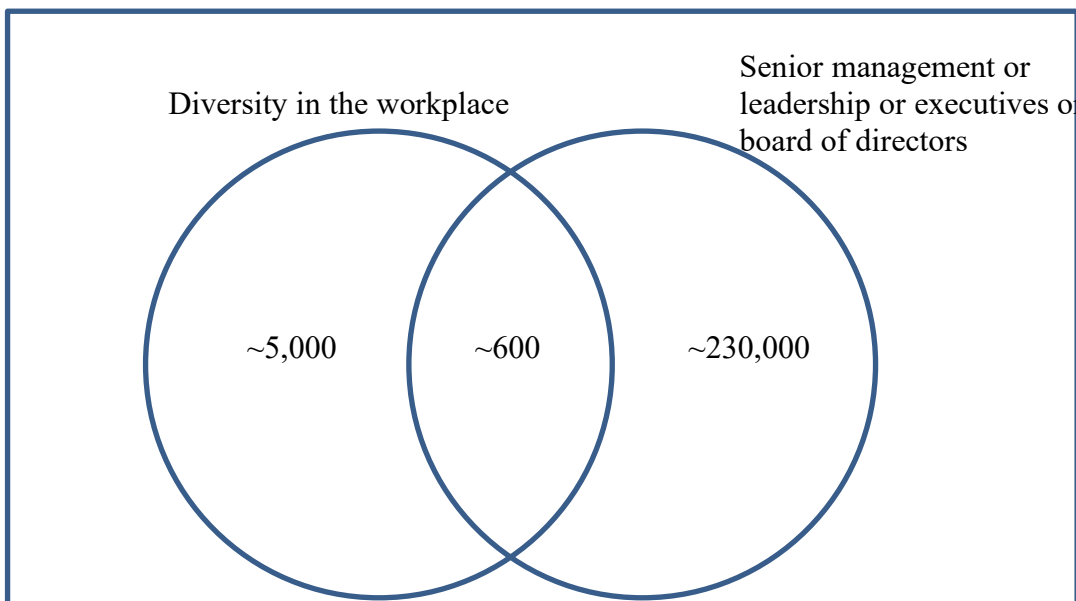


Figure 8 - Diagram showing EBSCOhost article counts for diversity and senior management

2.3 Diversity and Inclusion

2.3.1 Value of Diversity

Studies show that organisations that demonstrate a belief that value can be created by leveraging diversity within their workforce are seeing benefits and valuable returns (Hossain et al., 2020; Pennington, 2020; Swartz et al., 2019). Research has demonstrated that racial diversity (Richard, 2000) and gender diversity (Francoeur, Labelle and Sinclair-Desgagné, 2008) correlates with improved outcomes in situations requiring complex problem solving and innovation. Gender and racial heterogeneity bring cognitive diversity, leading to increased creativity, and better problem solving and decision-making (Richard, Kirby and Chadwick, 2013).

Some aspects of diversity have less importance for effective strategic decision making than others (Héroux and Fortin, 2016; Richard, Kirby and Chadwick, 2013; Simons, Pelled and Smith, 1999) and a limited amount of research demonstrates that demographic diversity alone has a lower impact on senior management team performance than cognitive diversity (Chen et al., 2019; Martins et al., 2013; Reynolds and Lewis, 2017). Studies suggest that whilst demographic diversity in managerial roles is increasing, mainly as a result of equality legislation and societal pressure on organisations, the roles that the traditionally non-dominant demographics or cognitive thinkers occupy are usually those with less organisational influence or power and, therefore, have less authority and impact (Maume, 1999). Yang & Konrad point out that improved performance in organisations only results from improved innovation if mutually beneficial internal and external conditions exist (Yang and Konrad, 2011).

2.3.2 Diversity and the link to Innovation

Demographic diversity and its impact on innovation performance within organisations has been more thoroughly researched than cognitive diversity (van Knippenberg, de Dreu and Homan, 2004; Martins et al., 2013; van der Vegt, Bunderson and Oosterhof, 2006). Research proposes methods to measure innovation (Zhou, Yim and Tse, 2005) although there is limited literature showing how this can be applied to mining. Research evidence indicates that well managed diversity in senior management teams results in increased performance in strategic innovation (Boone et al., 2019).

The board of directors can facilitate and foster executive pursuit of innovation or hinder progress (Héroux and Fortin, 2016). Diversity within the board of directors can be measured in terms of the individuals' characteristics, when combined with their support for R&D investment, these attributes can be utilised as a proxy for their support for innovation and organizational improvements (Héroux and Fortin, 2016; Talke, Salomo and Kock, 2011). Diversity in a company's board and executive management teams, particularly the inclusion of tenured and non-tenured senior team members, is positively associated with increased innovation performance (Héroux and Fortin, 2016; Talke, Salomo and Kock, 2011). Functional diversity within senior management teams improves innovation whilst having a dominant function in the team doesn't impact innovation (Héroux and Fortin, 2016).

Technology and improved access to information are becoming key drivers to improved business performance, particularly during the COVID-19 pandemic as teams have had

to become virtual (Hotter, 2020). However, IT competence is generally low for boards and executive management (Héroux and Fortin, 2016). The ability of executives and board directors to understand and embrace technology can have an influence on innovation performance (Héroux and Fortin, 2016; Liang, You and Liu, 2010). Several tools exist to help executives assess the strength of innovation within an organisation's culture (Rao and Weintraub, 2013). However, there is little academic literature on the impact that board diversity or the dynamic between the board and the executives has on innovation performance; this could be an opportunity for future research.

Functional diversity has important performance implications for innovation and organisational performance (Zhang, 2016). Senior management teams are essentially information processors; the knowledge advantages residing in functionally diverse teams can be leveraged, often by technology, to realize team innovation via information-based mechanisms (Wang et al., 2019). Group or team creativity is essential if an organization is to compete successfully and survive in the long-term. Enhancing group creativity requires organisations to motivate employees to consider divergent perspectives. Zhang proposes that organisations are increasingly depending on cross-functional teams made up of functionally diverse members from across various disciplines to improve creativity and innovation.

2.3.3 Inclusion and Exclusion in the workplace

Diversity management and employee inclusion aim to improve value from companies' human resources by developing, recognising, and utilising employee's attributes effectively and enhancing business performance by better leveraging historically disadvantaged employee groups, from either diverse cognitive or demographic backgrounds, and improving organisational value (Yang and Konrad, 2011). Yang and Konrad propose that whilst inclusion is linked to organisational effectiveness, there has been a lack of clear management recommendations from diversity management research. A key research question is whether historically marginalised groups can participate effectively within organisations and how best to gain value from their input.

Improving employee involvement through high-performance work systems to enhance knowledge, skills, and abilities, as well as improve engagement and empowerment for decision making for staff has been shown in multiple jurisdictions to improve organisational performance (Combs et al., 2006; Yalabik et al., 2008). Intergroup contact in diverse teams may be improved through employee involvement programmes and communications that leverage the potential of a demographically and/or cognitively diverse team (Yang and Konrad, 2011).

2.3.4 Measuring Diversity and the Value of Diversity in the Workplace

Aspects of diversity have been measured at the organizational level for many decades (Pennington, 2020), partially due to jurisdictional legislative requirements and organisational social responsibilities occasioned by social commitments and increasing shareholder expectations regarding CSR and ESG policies (Sinicropi and Cortese, 2021). Some organisations record these characteristics from the application stage of the recruitment process (Mulki and Stone-Sabali, 2021). However, some individuals prefer to not disclose certain information about themselves or falsify information to protect themselves from possible discrimination or persecution, and the demographic diversity

characteristics are mainly self-identified, raising data accuracy concerns (Hossain et al., 2020). Hossain et al. contend that privacy legislation may make it difficult to collect and store some sensitive data.

Cognitive diversity data is more difficult to manage across large workforces (Garg and Sangwan, 2021). However, it is possible to assess the cognitive diversity traits from Figure 2 of teams at the senior management level (Talke, Salomo and Kock, 2011). Talke et al. also suggest that many large organisations are already investing in personality tests for recruitment and team building such as those shown in Figure 9. Organisations can also access other cognitive diversity information, perhaps augmented from team building events or sales and marketing information, to assess whether their senior management teams possess the right cognitive diversity characteristics to improve the outcomes that teams are engaged in.



Figure 9 - Examples of some behavioural or personality profile assessments

There is a lack of standard, specific, and consistent leading and lagging metrics or key performance indicators (KPIs) for tracking cognitive diversity in organisations. In academic articles, the empirical measurement of how diversity associates with innovation or performance within organisations is often conducted using very complex frameworks and statistical modelling, increasing the likelihood of correlation errors and making it difficult for most organisations to be able to utilise them effectively (Martins et al., 2013). Storey presents a model that links to LEAD³ that is worthy of more research and assessment (Storey, 2013). There is an opportunity for future research and development in this area, and there may be something worth learning from the work already completed on KPI development within the CSR and ESG areas.

2.4 Team Performance and Effectiveness

Teams, rather than individuals, often make strategic decisions in organisations and, therefore, team performance greatly impacts decision outcomes (Boone et al., 2019). Team effectiveness is a result of many factors, including those in Figure 10 (Maynard et al., 2012). During the COVID-19 pandemic, employees working in multiple, virtual teams has become more prevalent (Garro-Abarca, Palos-Sanchez and Aguayo-Camacho, 2021), having potential positive and negative impacts on the innovation performance of individuals team members (Chen et al., 2021). The improvement in communication and knowledge sharing through development in accessible media and technology has impacted innovation performance (Grözinger et al., 2020; Hung et al., 2021).

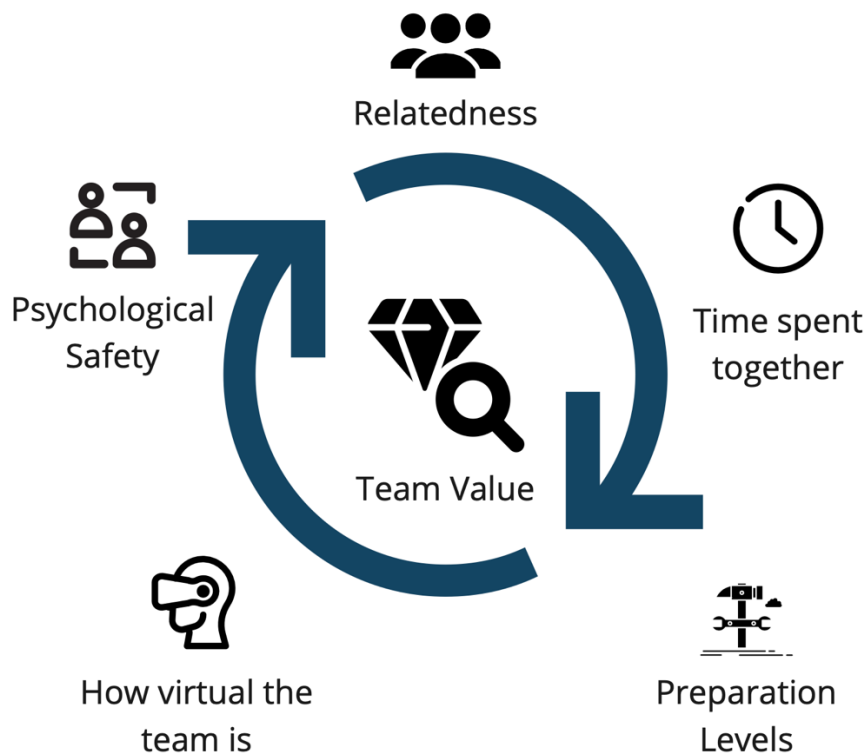


Figure 10 - Some of the key characteristics that make teams successful

Research shows that there are complex positive, negative, and correlating impacts of diversity on teams. Therefore, cognitive diversity's impact on team performance needs to consider many factors, particularly those relating to psychological safety and relationship conflict (Martins et al., 2013). The impact of cognitive diversity on team creativity or innovation performance remains largely unexplored (Chen et al., 2019). The results of some of the available research on the effects of cognitive diversity on team performance seems counter intuitive and correlating factors require further research (Bell, 2007).

Teams of different cognitions need demonstrable support for diversity by team managers or leaders; this increases the positive impacts of cognitive diversity whilst mitigating its negative impacts (Chen et al., 2019). Team performance on knowledge-based tasks can be negatively impacted by status-based contests based on expertness level disparities, ultimately impacting team dynamics (Martins et al., 2013). Innovative

performance has been shown to be improved by having the right environment and cognitive diversity characteristics although Chen suggests that there is insufficient research in both areas.

2.4.1 The Value of Cognitive Diversity for Senior Management Teams

If managed correctly, senior management teams with a diversity of backgrounds deliver improved innovation and performance (Talke, Salomo and Kock, 2011). Most research into cognitive diversity in senior management teams has used education, which is easily verifiable and observable, as a proxy for measuring background diversity (Héroux and Fortin, 2016; Talke, Salomo and Kock, 2011). Talke et al. demonstrate that company performance increases with a strong senior management team focused on leveraging innovation across its areas of functional expertise due to the access this brings to newer markets and technologies. Boone et al. further suggest that there are additional intangible benefits of diverse senior management teams that are yet to be explored widely in research, providing an opportunity for future studies. Most diversity research in teams is focused on permanent senior management team members and neglected the diversity of thought brought into organisations through other collaborating partners or stakeholder groups such as the supply chain, educational institutions, and professional bodies (Boone et al., 2019).

2.4.2 Diversity and Innovation in the Mining Industry

There is a limited body of research demonstrating that mining, and related sectors such as oil and gas, are significantly less innovative than other sectors like manufacturing (Boone et al., 2019; Héroux and Fortin, 2016). Most of the available literature are thought pieces written by consultancy firms or from non-peer reviewed articles that appear in various magazines and journals (Reynolds and Lewis, 2017); these tend to focus mainly on demographic diversity across the workforce and they generally advocate for the value of demographic diversity (Dixon-Fyle S et al., 2020; Nguyen A et al., 2019; Tsusak M, Krentz M and Reeves M, 2019). However, doubt remains on whether these are based on irrefutable evidence or whether they are being used as marketing tools to develop additional business opportunities and attract clients (Edmans, 2018; Fried, 2021; Klein, 2017). There is little academic literature or thought pieces related to the topic of the current report.

2.5 The future of Diversity in the Workplace

The future and direction of development of diversity in the workplace requires companies to balance the business case for change with the role that organisations should be playing to shape improved dynamics within society. Moreover, the battery limits between diversity and equality continue to increasingly blur and overlap (Klein, 2021). For instance, Nasdaq have recently requested for the Securities and Exchange Commission to require companies to comply with board diversity requirements to enable them to list on the exchange (Fried, 2021). California state is implementing diversity requirements for companies for compliance by the end of 2021, whilst firms such as Goldman Sachs no longer underwrite companies that do not meet prescribed diversity requirements (Green, 2021).

The pace of change in the area of diversity in the workplace means that academic, peer reviewed research has struggled to remain relevant and up to date due to the time it takes to build up credible, research-based empirical data sets and produce peer-reviewed reports. There is support for equality and diversity based on social equality because it is legislatively mandated and seems the right thing to do (Edmans, 2018). However, there is not much evidence that diversity alone improves business performance (Gosling, 2020). As demonstrated in this literature review, there is emerging evidence that an appropriate management and leadership approach to cognitive diversity can improve business innovation and corporate performance (Chen et al., 2019). More evidence-based work is required to enable organisations to harness this potential value and demonstrate their commitment to social equality; this will drive the diversity agenda into the future.

2.6 Literature Review Findings

A table of key questions based on the literature for senior leaders in the mining industry can be found in Appendix A.1. There is very little available academic content that is useful to senior managers in the mining industry who may wish to gain value from cognitive diversity within their teams. Workplace inclusion remains an underrepresented research area; EDI within the mining industry is not well researched. Research gaps and opportunities abound; additional research can provide useful information that could assist senior leaders to leverage cognitive diversity, particularly some methodologies or frameworks to measure and manage cognitive diversity within senior management teams and to link this to cognitive diversity's impact on organisational performance and innovation development.

3 METHODOLOGY

3.1 Methodology for research

Various methodology options were assessed for appropriateness for this thesis; the analysis is summarised in Appendix B.1. There is a potential to compile empirical data related to various individuals' diversity characteristics in order to measure cognitive diversity and then use the company performance in their sector as a proxy for performance impacts to analyse how team cognitive diversity impacts performance (Boone et al., 2019). However, Boone et al. (2019) also suggest that many other factors impinge on company performance; these were outside the scope of this analysis, making them confounding factors capable of causing errors. A contingency approach could also be considered for further research (Martins et al., 2013), although this was also disregarded due to the amount of data collection required and the complexity of the approach. The use of empirical data and a contingency approach were disregarded for this thesis. This thesis' methodology for research was to undertake qualitative research to test the findings of the literature review through surveys and a series of semi-structured interviews. The ethics requirements for the research were considered and approval for the research is included in Appendix B.2.

3.2 Selection of interviewees

Thirty-two senior leaders from the mining industry were contacted as potential interviewees; 25 accepted, six did not respond, and only one responded with a refusal to be contacted on the topic, saying "...that doesn't sound like it's for me.". Eighteen of the 25 were selected for interview to represent a small, although representative, cross-section of industry leaders. As shown in Figure 11, the eighteen senior leaders had a variation of characteristics, which enabled the researcher to gather qualitative data and determine if the themes identified in the literature review resonate with individuals working within the mining industry. The demographic diversity characteristic of interviewees was disregarded for this research since there is an unproven correlation between demographic diversity and cognitive diversity (Chen et al., 2019).

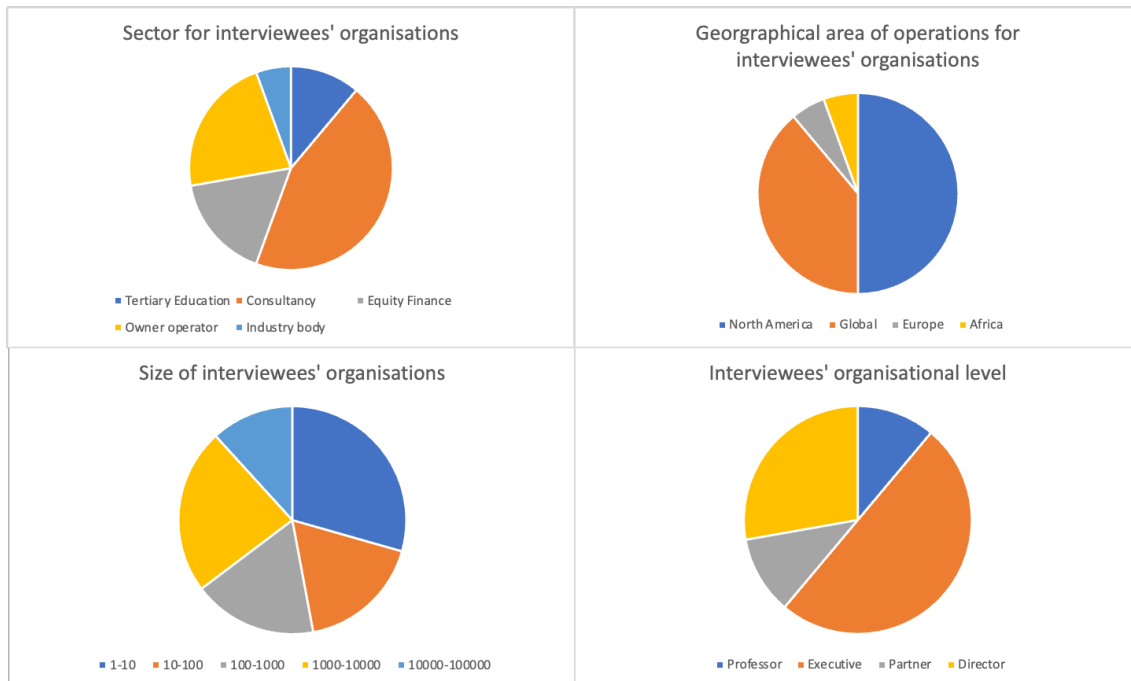


Figure 11 – Diversity of Interviewees

3.3 Data collection approach

The lack of empirical data regarding cognitive diversity and the lack of scholarly articles proposing methodologies for the quantitative analysis of empirical data related to this topic limits the amount of quantitative analysis that can reasonably be performed within the context of this thesis' topic (Senichev, 2013). The aim was to identify key themes, or lack thereof, within the responses from the interviewees and identify opportunities for further research. Data was collected primarily through a survey and semi-structured interviews with senior leaders from the mining industry.

The survey, shown in Appendix B.4, was established as a mechanism to introduce the topic to interviewees and have them start to consider their involvement in the interview. The survey was also used to collect data that could be used as a comparator to what was discussed in the interview and to see if there were any corrections to the survey results that were needed once interviewees were able to further understand the topic and the definition of the terminology used. The survey was kept high level and simplistic in order to generate some discussion in the semi-structured interview. The survey questions and how they logically interact is depicted in Figure 12. Apart from clarification during the interviews, there was no evidence-based verification or validation of the survey results.

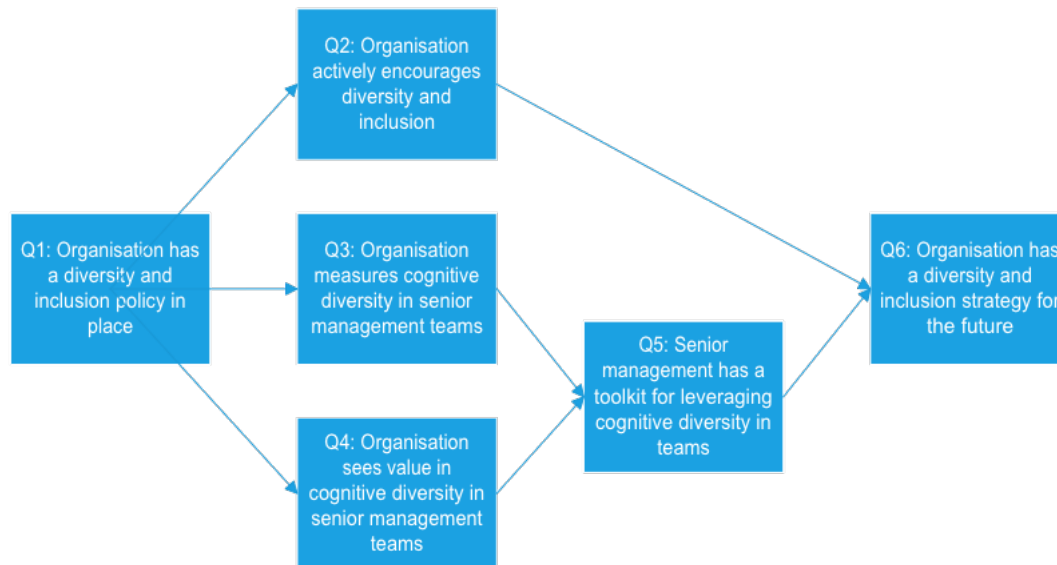


Figure 12 - Survey questions and logical links

The focus of the eighteen, 45 min, semi-structured interviews was on cognitive diversity within senior leadership teams and its potential impact on organisational innovation and performance within mining. Interviewees were volunteers and were asked to sign the ethics consent form in Appendix B.3 and complete the survey prior to the interview. The interview began with a discussion of what the topic meant to each participant and any questions that interviewees had on the survey itself. The diagram in Figure 2 was then used to introduce the interviewees to the definition of cognitive diversity used for the purposes of this thesis. The introduction was followed by the semi-structured interview, using the checklist of topics in Appendix B.5 to steer the conversation and ensure topics were covered adequately, and finishing with the interviewee's thoughts on how the topic may evolve within the mining industry into the future. The semi-structured interview was designed to gather views on the topic.

3.4 Analysis of data

The data collected was mainly qualitative. Analysis of the data commenced with an assessment of similarities and differences between the interviewees based on the survey results; the goal was to provide some information on the perspectives of the sample population. The questionnaire was designed to collect only a small amount of high-level quantitative data whilst providing some high-level background information on the interviewees' organisations and the interviewees' initial reactions to the thesis topic.

The interviews were designed to ensure that themes from the interviews could be easily identified, coded and compared to the literature review and survey. The discussions were curated to focus on each interviewees' organisation's current, intended and future approach to diversity and inclusion with the focus being the value derived from cognitive diversity within senior management teams in the mining industry. Due to the organic nature of the conversation and different topics discussed, a comparison of the usage of key words between different interviewees was not thought to add value and the analysis was disregarded for this thesis.

The predominant analysis methodology utilised was a qualitative assessment of the importance of themes and sub-themes. All sets of qualitative data were coded to identify

and compare core themes and sub-themes. Themes and issues were identified within the interviews and surveys and differences across the interviews were recognised, analysed and interpreted. These themes were then compared with the findings from the literature review to identify correlating or divergent systemic themes across the literature review, surveys and interviews.

4 FINDINGS

4.1 Survey Results

The two sets of data that were developed from the survey questions were;

1. raw survey data from when the interviewees took the survey prior to the interviews, and
2. corrected data based on the content of the interviews and clarifications on the intent of the questions once interviewees had been informed of the definition of terminology used.

The comparison between these can be seen in Figure 13 below and demonstrates that interviewees were more likely to be more optimistic about their organisation’s willingness to value, measure and manage diversity and inclusion and cognitive diversity in the pre-interview survey than during the interview itself.

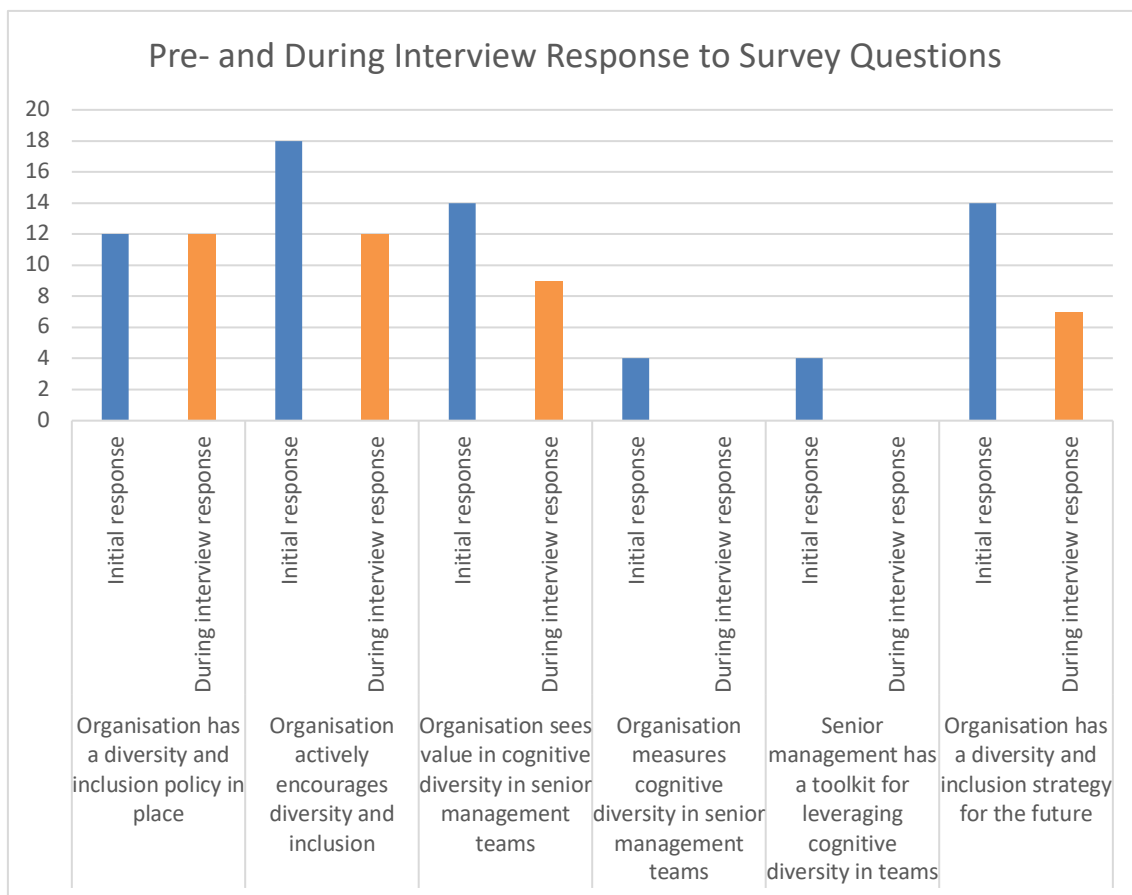


Figure 13 - Pre-and During Interview Response to Survey Questions

All interviewees claimed to know whether their organisations had diversity and inclusion policies; their responses were consistent during the pre-interview and interview phases. All survey responses prior to the interview indicated that they thought that their organisation encouraged diversity and inclusion. However, during the interview, a third of interviewees indicated that although this was how organisation communicated their intent to stakeholders, they felt this was not the reality in their organisations. A similar proportion of interviewees believed that their organisations

saw value in cognitive diversity in senior management teams, with over 75% of interviewees initially responding affirmatively; this reduced to 50% during the interviews.

Four interviewees initially said that their organisations measured cognitive diversity in the context of operating senior management teams. However, during the interview when the researcher clarified that this was intended as a reference to measurement after the recruitment process and with a focus on teams' performance rather than individuals, all interviewees admitted that very little had been done in this area. Similarly, the four interviewees who originally indicated that there were toolkits, methods, frameworks, templates, and exemplars (referred herewith as a "toolkit") that leaders could use to measure and manage cognitive diversity within senior management teams indicated that there was still a large gap to fill in this area in their organisations. Of the over 75% of respondents initially indicating that their organisations had a clear strategy for diversity and inclusion, 50% of these interviewees indicated during the interview that there was no formal, written strategy that had been agreed through organisational governance and communicated throughout their organisation and with stakeholders.

For the purposes of the following analysis, the adjusted responses after the interview were used. The responses to the survey were compared against the following organisational characteristics;

1. Size of the workforce
2. Geographical location of operations
3. Role of organisation within the mining industry

Patterns could be seen when comparing these organisational characteristics to the survey responses. The anomaly within the survey pool was an owner-operated mining company that operates in Africa. Although there was clearly a passion about diversity and inclusion and a practical application of this in their operations, this has not materialised in written documentation. For the purposes of this analysis, organisations with less than 100 people were deemed to be "smaller" and those with more were deemed to be "larger". Responses from interviewees working within consultancies were compared to non-consultancies and comparisons were made based on geographical regions of operation.

4.1.1 Comparison of Survey Responses based on Organisation Workforce Size

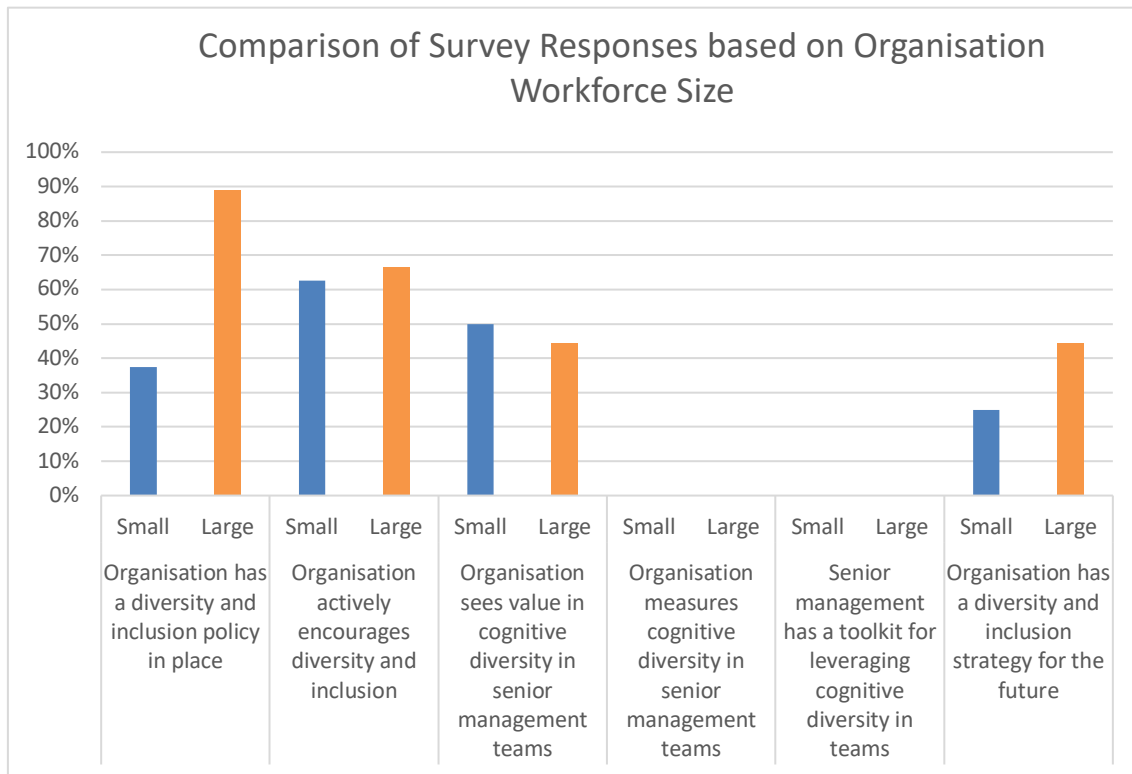


Figure 14 - Comparison of Survey Responses based on Organisation Workforce Size

From the smaller organisations, approximately 60% had little or no formal documentation related to diversity and inclusion, and approximately 75% had no formal diversity and inclusion strategy. Most of these smaller organisations were consultancies and mainly based in North America. All larger organisations, except for the African mining company, had also invested more time and effort in developing documentation for diversity and inclusion policies (100% in place) and strategies (approximately 50% in place). However, there was not a significant difference between smaller and larger organisations when assessing organisational support for diversity and inclusion and the value of cognitive diversity in senior management teams.

4.1.2 Comparison of Survey Responses based on Organisational Type

For ease of analysis, organisations were grouped as either consultancy or non-consultancy organisations. The results of the analysis are shown in Figure 15, below.

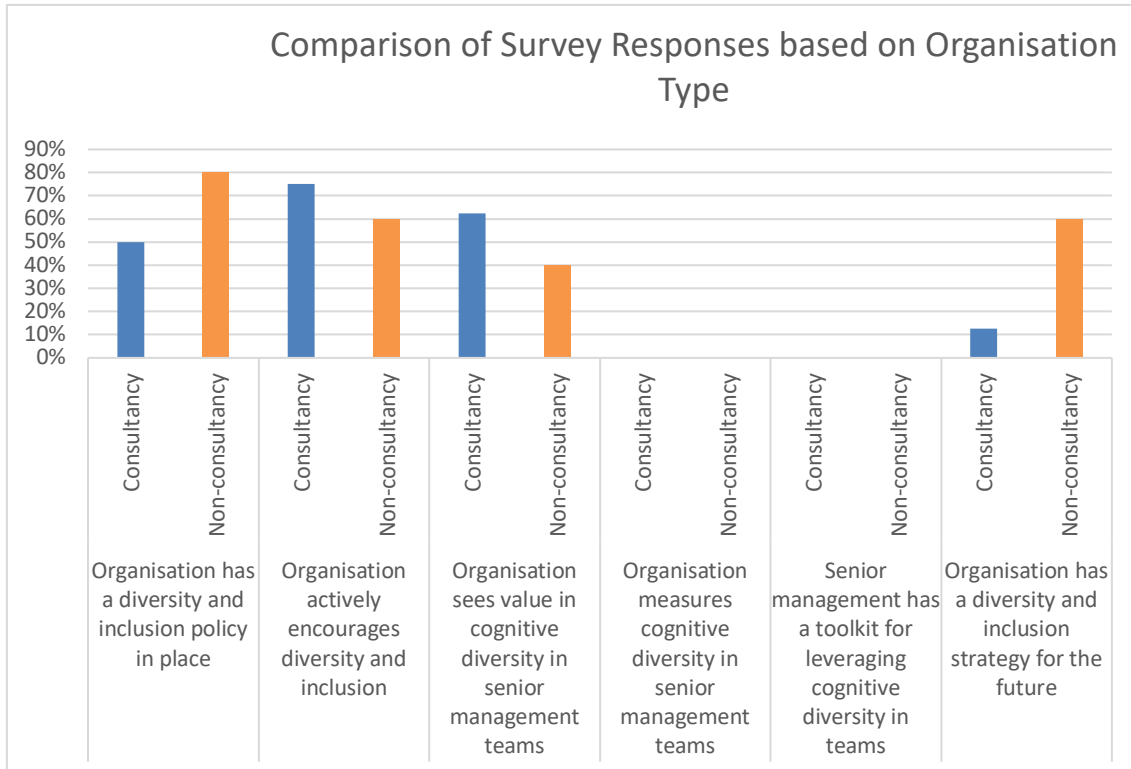


Figure 15 - Comparison of Survey Results for Organisational Type

When comparing Figure 14 with the results for the comparison between consultancies and non-consultancies shown in Figure 15, it should be noted that approximately 75% of the consultancy organisations assessed had less than 100 employees and therefore had less access to overhead resource to develop documentation, strategies and similar collateral. However, 20% more consultancies were reported to value cognitive diversity in senior management teams.

4.1.3 Comparison of Survey Results for Geographical Location

Half of the interviewees came from organisations that predominantly operated within North America. The remainder worked for (predominantly large) global organisations with one operating only in Europe and another in Africa. The European organisation and African company are referred to as “Other” in Figure 16.

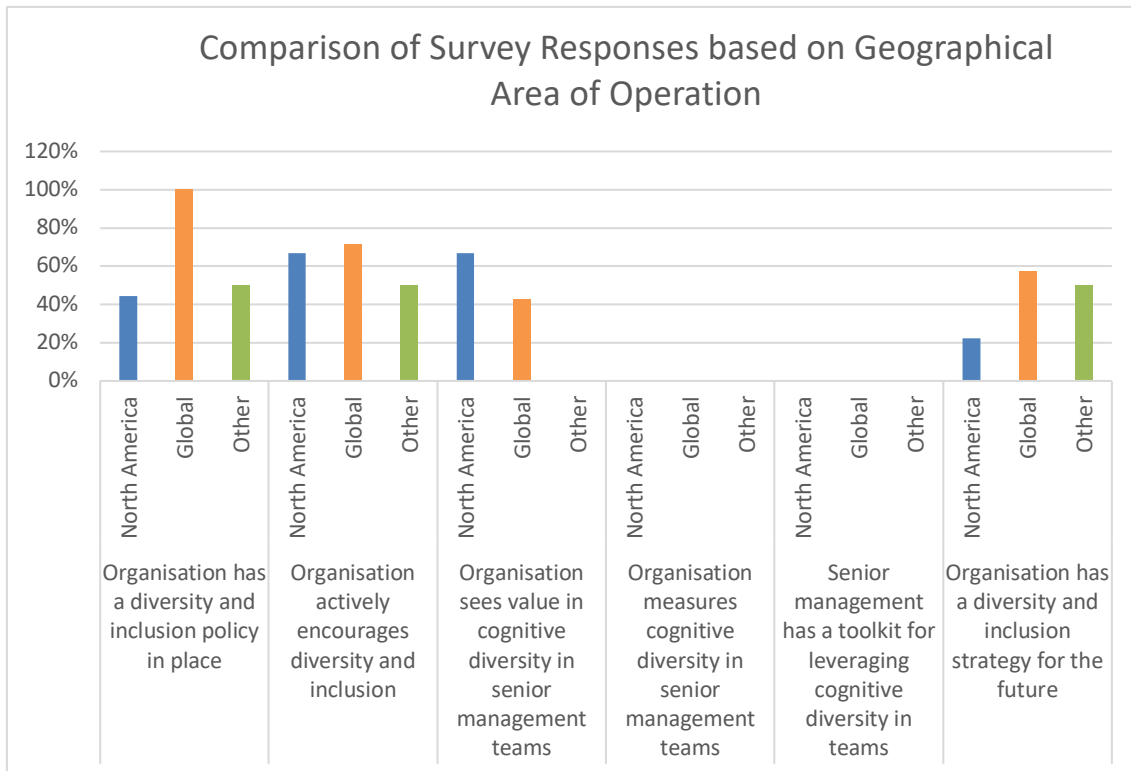


Figure 16 - Comparison of Survey Responses based on Geographical Area of Operation

When comparing Figure 16 to Figure 14 and Figure 15, it should be noted that the “Other” category only contains two organisations, one of which (the African mining company) has already been identified as an outlier. Global organisations have more documentation in place regarding strategies and policies, although there is little difference in terms of the value seen in diversity and inclusion between Global and North American based organisations. Other observations in the data from Figure 16 broadly follow observations made from Figure 14 and Figure 15.

4.2 Interview Findings

The most consistent topic discussed across all interviews was the belief that social equality and doing the right thing should be prioritised above the focus on how cognitive diversity can create value through innovation and performance. The commitment by interviewees to equality is consistent with references in the literature review, particularly Section 2.5 referencing Edmans et al., who highlighted that diversity’s value addition claims by consultancies in thought pieces are not always backed by rigorous academically peer-reviewed empirical data. The authors argue, and interviewees corroborated, that this may detract from the priority of promoting diversity and inclusion in organisational workforces, including senior leadership teams, to meet social justice requirements. Some discussion was had regarding equality although this has been disregarded for the purposes of this thesis. During the interviews, cognitive diversity was discussed within the context of individuals, teams, organisations and the mining sector.

4.2.1 Awareness and capability development

Based on the interviews, awareness of the importance of diversity within the mining industry is well established at the senior levels within the mining industry. The focus is on demographic diversity, particularly gender diversity, although to a lesser extent race and even age, which was discussed mainly in relation to the ability for the mining industry to adapt to technology changes and disruption. The predominant reference to ethnicity was by interviewees from North America who mentioned that the relationships between mining companies and indigenous communities were particularly important. Sexual orientation and physical ability were only mentioned by approximately 10% of interviewees.

Less than 25% of the larger, global organisations actively and consistently measure and manage cognitive diversity characteristics for individuals using psychometrics testing, mainly during the recruitment process. They also encouraged coaching for personal development, succession planning, and leadership development although the data and information was not being actively used in a consistent, controlled, or institutionalised way to develop and manage teams or organisations to improve outcomes or innovation and performance. Although interviewees agreed with the literature review findings in Sections 2.3.2 and 2.3.1 that there was value to be leveraged by well managed, diverse teams, they didn't believe that the mining industry was being proactive and intentional in its approach to managing diversity. There was also an appetite for more subject area knowledge and interest in the development of appropriate toolkits to help teams and organisations to measure and manage cognitive diversity in the future.

4.2.2 Culture and cultural change

Interviewees agreed that in its present form, the mining culture does not allow for demographic diversity in the workplace because of many factors, including the remoteness of many operations, thought to discourage women and other minorities from working in the industry, and its reputation as a macho, aggressive, difficult industry to work in. Organisational constructs are perceived as traditional, hierarchical, inflexible, and typified by a steep barrier to entry for individuals from outside of the sector. The significance placed on STEM disciplines was thought by interviewees to excluded individuals with other functional areas of experience and expertise.

Interviewees thought that mining discouraged cognitive diversity within senior management teams due to persistent, although improving, issues with low levels of psychological safety and poor relatedness for individuals who think differently and approach problems differently than the status quo. Although interviewees noted a perception that there is more demographic diversity in senior management roles, such as executive management teams and boards, they believed change is not happening quickly enough, and there is doubt that it brings sufficient cognitive diversity to the sector. Interviewees suggested that the cultural requirements for teams and organisations to leverage cognitive diversity is not being actively measured or managed. Cultural change is not happening sufficiently quickly, and the constructs of the organisational systems in mining are thought to be not flexible enough to adapt to change.

4.2.3 Current performance

Approximately a quarter of interviewees suggested that the mining industry was a leader in developing diversity in the past decades. However, all interviewees agreed that mining is not proactive enough around diversity and inclusion and is instead reactive to social equality movements such as Black Lives Matter and the #MeToo movement. These increase stakeholder and shareholder pressure through CSR and ESG requirements, increasing legislation in most jurisdictions. Interviewees suggested that little measurement is being conducted in any consistent way except through ESG and CSR reporting, although this is not being actively managed in any but the largest, global organisations. While diversity and inclusion performance is thought to be poor in the mining industry, this was not empirically proven by this research. There was no consistent way to measure, baseline and compare cognitive diversity across the industry or with other industries.

4.2.4 Demographic diversity versus cognitive diversity

All interviewees agreed that there is value to thinking about demographic diversity and cognitive diversity as separate, although related, considerations. There was support for representing the operational jurisdiction's demographics in the general workforce and in senior management teams, as well as focussing on opportunities for marginalised and minority community sections. Most interviewees described this as a reaction to social equality issues and as a potential value addition to companies through improved ESG and CSR credentials that was thought to provide a social license to operate, attract additional investment, and improve stakeholder relationships.

The topic required some increased levels of awareness for interviewees due to a lack of understanding of the terminology of cognitive diversity and related topics within EDI. Many interviewees agreed that increasing cognitive diversity in senior management teams created value and that this could lead to an increase in demographic diversity throughout a workforce through improved potential for senior management team breadth of understanding of social equality, sustainability, stakeholder, risk management, and community relations issues. Interviewees thought that improving cognitive diversity would improve decision-making within senior management teams and allow organisations to have more resilience to potential large-scale changes to the industry caused by disruptive events such as technology changes, social change, or global pandemics.

Half of the interviewees presented the theory that some demographically diverse candidates are chosen because they have similar experience or backgrounds to incumbent leaders, to make it easier to integrate them into teams and organisations. These interviewees surmised that unconscious or conscious bias that leads to the appointment of like-minded candidates means that senior management teams that may be becoming more demographically diverse are not necessarily becoming more cognitively diverse. Three interviewees mentioned that demographically different candidates were often recruited to roles with low organisational authority.

4.2.5 Future direction and strategy

Interviewees demonstrated an appetite for the mining industry to do more to be proactive about cognitive diversity in senior management teams; the lack of toolkits for

leaders to measure and manage cognitive diversity in teams was seen as an impediment. According to interviewees, the three key drivers for a requirement to improve cognitive diversity in senior management teams are;

- increasing demand for sustainability and value for money from operational host nations and commodity end users,
- increasing pace of change of technology, and
- change in the way that mining companies are valued and create value.

Approximately half of interviewees commented that end users of the value chain for, or beneficiaries from, commodities – whether the consumer of built products or the host nations wishing to benefit from investment – want to have increasing influence on sustainability aspects of mining. Host nations want more of the value chain to be in country as well as an investment in skills training, and social and economic improvements in the way that mining companies deliver within the operational environments. End users want more visibility over how commodity extraction is performed and the sustainability aspects of this as well as ensuring value for money for consumed goods.

All interviewees mentioned that the brisk rate of technological change, including automation, digitalisation, and big data analytics is disrupting the mining industry. It is thought that the current senior management teams in the mining industry are unprepared to deal with this; they are often not functionally diverse or do not possess the right diversity of expertise and experience in technology.

The key emergent change in the mining industry, identified by over half of the interviewees, is the way that shareholders, investors, and stakeholders value mining companies. The emergence of ESG and CSR from a legislative and social responsibility perspective have meant that mining companies are no longer valued solely based on short-term shareholder returns. Interviewees commented that junior and mid-tier mining companies, and supply chain service providers, must take longer-term, risk-based strategic views on investments and operations. The emerging key risks to the mining industry around sustainability, social change, and technological disruption require senior mining leaders to align corporate strategies over a time horizon that is much longer than they are currently contemplating. Interviewees reported that current senior management teams often do not have experience in dealing with longer strategic time horizons and this means that new ways of thinking and backgrounds are required for organisations to be successful in the medium to long term.

4.2.6 Governance, leadership and management

More than 75% of interviewees confirmed that appropriate governance is in place, particularly within larger, global organisations, to implement, measure and manage demographic diversity in senior management teams. However, making this more mature across the industry will require a longer journey. Interviewees from North America reported that quotas for demographic diversity and contractually binding agreements with demographics groups within society are helping, and interviewees generally believe that increasing demographic diversity will increase cognitive diversity and bring benefits to the sector. Interviewees agreed that the current focus is on demographic diversity in organisations with diversity policies in place, although some organisations are starting to consider including cognitive diversity into leading and lagging KPIs for

leaders and teams; most interviewees acknowledged that this is still at the infancy stage within the sector.

Interviewees broadly believe in the value of diversity in the mining industry, although they rely on qualitative or intuitive understanding of this value rather than empirical data driven or quantitative analysis. Most interviewees relied on information available on the internet, such as online industry journals and thought pieces produced by consultancies. Access to scholarly, academic, and peer-reviewed articles is more difficult and, therefore, less emphasis is being placed on this, although approximately a quarter of interviewees had interest in, and access to, material that was from peer reviewed, academic sources. No interviewees reported having adequate access to robust toolkits to guide them in the measurement and management of diversity within their teams. Interviewees widely acknowledge that there are not the right organisational constructs or emphasis on psychological safety and relatedness for demographic or cognitive diversity to be successfully achieved within the mining sector.

4.2.7 Value, measurement and KPIs

A quarter of interviewees reported that their organisation actively measured and tracked demographic and cognitive diversity during the recruitment stage, although many did not have a consistent post-recruitment approach to accomplishing the same. Some of the mining organisations used KPIs for leaders' exhibited values and behaviours as a proxy for measuring how they were creating a culture and environment that promotes workforce aspects such as diversity and inclusion. All interviewees felt that cognitive diversity in senior management teams would promote innovation within the team and throughout the organisation although there were no suggestions on how this has been or could be measured and managed.

Most of the interviewees thought that it would be useful to have a toolkit to allow them to measure and manage characteristics of diversity such as those demonstrated in Figure 2. Interviewees cautioned that the use of a toolkit could highlight some existing challenges around how safe the workforce feels about sharing some of the aspects of their individual diversity characteristics. However, most interviewees believed that senior management would be willing to share this information if their awareness of the potential value addition to their personal development and performance, as well as that of their teams and organisations, is cultivated and enhanced. KPIs regarding cognitive and demographic diversity could be developed although most interviewees thought that introducing this to short term incentive plan calculations would be problematic and counterproductive. Interviewees largely agreed that creating appropriate KPIs and measuring the industry by these would require significant organisational cultural change.

Most interviewees agreed that measuring and managing innovation was a challenge for their organisations although those who discussed this topic didn't have any recommendations to fill this gap. The link between innovation and cognitive diversity was recognised by most interviewees who discussed this topic although this was mainly through intuition and qualitative assessment rather than availability of any empirical evidence. Innovation aspirations of organisations within the mining industry were seen by interviewees as potential drivers for cognitive diversity if the link could be established, measured and managed.

4.2.8 Recruitment and retention

Employee recruitment and retention and supply chain engagement were identified by interviewees as pivotal areas to address regarding diversity and inclusion in the mining industry. Interviewees who discussed this topic identified the perception of cultural issues within, and the insular nature of, the mining industry, as reasons for the industry's difficulty to attract candidates from diverse backgrounds. Interviewees suggested that the focus is on recruitment of technical individuals with STEM backgrounds; other functional and transferable skills and experience were not as highly valued during recruitment, and after the hiring of these individuals, by mining organisations. Interviewees from approximately half of the smaller organisations reported a lack of robust processes in place to ensure that candidates from diverse backgrounds are considered for recruitment and promotion. Most interviewees referred to the systemic lack of process and cultural issues present within the industry as the reason why many individuals in the mining sector with adverse diversity characteristics from the mining "norm" often feel excluded and disengaged and this results in large numbers moving to other sectors. A half of the interviewees mentioned that there was a perception that senior leaders in the mining industry were "...pale, male and stale", and that although there was some progress to change the demographic balance within the industry, the industry needs more cognitive diversity being brought in from outside of mining.

4.2.9 Toolkits

Although interviewees mentioned some tools for assessing personality traits such as those in Figure 9, none of the respondents felt that they had a full toolkit to measure, manage, and leverage diversity characteristics in senior management teams (see Figure 2). Mostly, it was reported that leaders were not provided with adequate support, although a quarter of interviewees noted some level of functional assistance from Human Relations teams, to lead and manage their teams to deliver required outcomes. Interviewees all agreed that there was an opportunity for teams and organisations to deliver better outcomes through improved innovation and performance if support was made available to leaders.

Although the overall awareness among interviewees of cognitive diversity was relatively low, there was enthusiasm around the concept. Some respondents had deep, technical knowledge, and passion around diversity and inclusion; the discussions identified many opportunities for further research and some potential quick wins. Most interviewees were optimistic about the potential for broader cognitive diversity within senior management teams in the mining industry and that there is considerable value to be unlocked if this is achieved.

5 DISCUSSION AND CONCLUSIONS

5.1 Comparative discussion between literature review, survey and interviews

Interviewees were chosen due to their potential interest in the topic and, therefore, had a more positive stance. This could be considered a biased view; however, these individuals are more likely to implement change and influence the industry on this topic, and as such their opinions are relevant. Some survey data may have been flawed since respondents misunderstood terminology although this was corrected during the research. Analysis of interview data did not consider the mindsets and attitudes of interviewees on the day that could have impacted responses whilst they were in the interviews. Organisations capture data through engagement surveys and focus groups in a similar way, and their approach may require further investigation to ensure that data is reliable and accurate.

As demonstrated in Section 2.1, the topic has only emergent evidence in academic research, although several interviewees reported raising EDI issues within the mining industry for decades; mainly with a focus on demographics and social equality. Interviewees corroborated with literature review findings that due to the potential for large scale disruption in the mining industry from changes in technology, sustainability, and social equality, mining companies need to become more proactive to leverage value from both demographic and cognitive diversity in the sector. Details of themes and topics discussed are included in Appendix C.1 and groupings of these themes and topics across the different research streams are presented in Appendix C.2.

Findings from interviews in Section 4.2.4 are consistent with the literature review; increasing demographic diversity does not necessarily improve cognitive diversity and vice versa. Interviewees also agree with Maume that individuals from backgrounds that are traditionally underrepresented in senior management teams were mainly placed in roles with low authority (Maume, 1999).

5.1.1 Awareness and understanding of diversity

Consistent with findings regarding the lack of available academic literature, interviewees exhibited low awareness of the full spectrum of characteristics of diversity and how cognitive diversity can add value to senior management teams in mining. Misalignment on terminology between research resources reduced the ability for effective analysis and could result in reducing the pace of change around diversity in the mining industry. Based on the feedback from the interviews and the literature review, an update to the Senichev's diversity wheel, first presented in Figure 2, is proposed in Figure 17; it could be used as a tool to increase awareness of diversity's full spectrum and align on terminology if defined further.

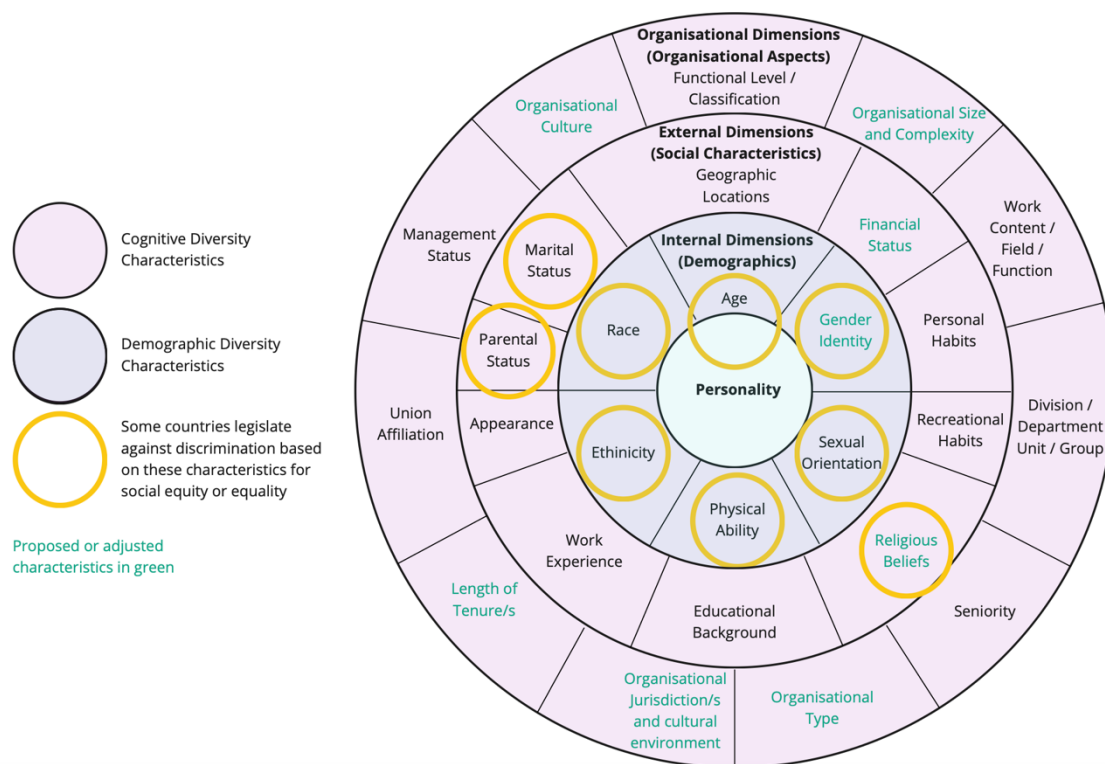


Figure 17 - Proposed updates to Senichev (2013) diversity wheel based on interviews and literature review

5.1.2 Gaps in the Research

Interviewees agree with Richard et al. that they have an appetite for more research around the theory that suggests that a diversity of skills and expertise brings more perspectives, leading to organizational success (Richard, Kirby and Chadwick, 2013). The disparity between the reputation of the mining industry, being low in diversity, and the high expectations of many sets of stakeholders including shareholders, host countries, and legislators for the mining sector to demonstrate more progress for EDI suggests that there should be more research in this area. Interviewees' identification of the imminent threat of disruptive changes from sustainability challenges, legislation, and technology should also warrant more academic attention for cognitive diversity within the sector. Interviewees agree with Reynolds & Lewis that the gap, currently filled by a proliferation of readily available although potentially unrealisable thought pieces, needs to be filled by reliable academic research (Reynolds and Lewis, 2017).

A potential gap was identified in the literature review and interviews regarding how the supply chain, stakeholders, and senior management teams' advisors impact the availability of cognitive difference. Although the literature review demonstrated a clear and well-established link between cognitive diversity and innovation and improved performance within organisations (Atuahene-Gima, Slater and Olson, 2005; Zhou, Yim and Tse, 2005), the ability of the mining industry to utilise cognitive diversity to be able to innovate is a relatively unexplored topic in academic literature (Chen et al., 2019) and the interviewees saw this as an area of opportunity for further exploration.

5.1.3 Thoughts on reasons for the apparent lack of diversity in the mining industry

Opinions from interviewees and findings from the literature review aligned on the reasons for the lack of diversity, particularly cognitive diversity, in the mining sector; these must be addressed before diversity can be leveraged within the industry. Interviewees and literature agreed that mining has a poor reputation for psychological safety and relatedness that results in exclusion of some parts of society. Interviewees corroborate the literature review's identification of a cultural barrier for diversity to be leveraged within the mining industry (Caron, Asselin and Beaudoin, 2019; Löow, Abrahamsson and Johansson, 2019; Tyuleneva and Tyuleneva, 2020) and that senior management teams in mining are seen predominantly as the domain for white, middle- to late-aged men (Abrahamsson and Johansson, 2020; Renders, 2015).

Interviewees mainly agreed that since mining companies often operate in remote, inhospitable environments, it may make it difficult for individuals, such as women who are often primary caregivers to families, who require more flexible working terms and conditions. Many interviewees thought that this reduced the pool of available resources, affecting negatively the potential for cultivating cognitive diversity within mining. Further, as the literature review established in Section 2.1, the approach to cognitive diversity differs geographically, based on whether the organisation is large or small, and according to organizational type within the mining industry. These differences require more investigation.

Both the literature review and the interview results suggest that companies are changing their governance and producing policies and strategies to leverage diversity (van Knippenberg, de Dreu and Homan, 2004; Martins et al., 2013; van der Vegt, Bunderson and Oosterhof, 2006). The focus continues to be on demographic diversity. Almost half of the interviewees agreed with the literature review findings that mining companies' traditional organisational structures are not appropriate for leveraging cognitive diversity, even if the outdated approaches to recruitment and retention were to be overhauled. The focus on STEM based functional resources also reduced the ability to attract resources from other functions which further reduced the potential to leverage different ways of thinking based on different backgrounds. Most interviewees considered that sweeping cultural change, which could be measured using tools referenced in Section 2.3.2 (Rao and Weintraub, 2013), was necessary for sustainable change in the industry that would result in leveraging cognitive diversity in the industry.

5.1.4 Measurement, management and leveraging diversity

Interviewees and the literature review (Rao and Weintraub, 2013) described an overwhelming lack of support for senior managers to successfully leverage diversity. There is no definitive methodology to measure the characteristics present in Figure 17 in individuals or to articulate the characteristics a team or organisation needs to deliver their required outcomes. Interviewees indicated that there is a need for a toolkit to help leaders meet the changing demands of teams and organisations as they experience change and disruption and to ensure that cognitive diversity is sufficiently leveraged to solve problems and resolve issues. Some interviewees reported success by some organisation's management of the relationships with indigenous populations in North America and this was supported by some further literature review (Caron, Asselin and

Beaudoin, 2019). The experience in North America has the potential to act as a learning opportunity for engagement of other groups within the to the industry.

5.1.5 The future of cognitive diversity in mining

The literature review, as well as the survey and interview results indicate that the future of diversity within the mining sector is uncertain (Abrahamsson and Johansson, 2020; Caron, Asselin and Beaudoin, 2019; Renders, 2015). However, according to interviewees, efforts are underway to improve the sector's performance in diversity management as the awareness of demographic and cognitive diversity increase. Both the literature review and the interviews confirmed the requirement for mining organisations to develop more diversity to meet the demands of disruption in technology, sustainability, legislation, and stakeholder expectations. There are some articles on how Industry 4.0 within the mining sector, often referred to as Mining 4.0, could be a force for change within the mining industry (Duarte, Rodrigues and Santos Baptista, 2020; Tylečková and Noskievičová, 2020) and how this could influence the current macho and traditional culture within the mining sector (Abrahamsson and Johansson, 2020; Löow, Abrahamsson and Johansson, 2019; Tyuleneva and Tyuleneva, 2020). Some studies reflect the work that the mining industry is doing to develop sustainability practices (Garnett et al., 2016), although the literature review and interview findings suggested this is presently more reactive than proactive.

Interviews and the literature review revealed gaps to be filled in the academic investigation into diversity and inclusion in the mining sector, as well as its impact on organisational effectiveness. Most interviewees saw the need to continue to focus on social equality followed by demographic diversity and inclusion before any real gains could be seen in leveraging cognitive diversity within senior management teams in the mining sector. Most interviewees also believe that this requires a time horizon that could be generational, unless disruption forced the mining industry to react more quickly.

The literature review and interviewees agreed that the mining industry needs to be more proactive regarding how it approaches the future requirements of and expectations for diversity in the future. An understanding from a historical perspective of the development of diversity in the mining industry and how this compares to other industries would be useful to understand performance to date and any opportunities for quick wins to change the culture and approach to diversity. The mining industry should be proactive in its approach to diversity to meet the requirements of potential disruptive events and emergent risks. A proposed approach to future organisational change management regarding diversity in mining is depicted in Figure 18.

The mining industry can work to predict future requirements of and expectations for demographic and cognitive diversity and become more proactive by implementing transformational change practices

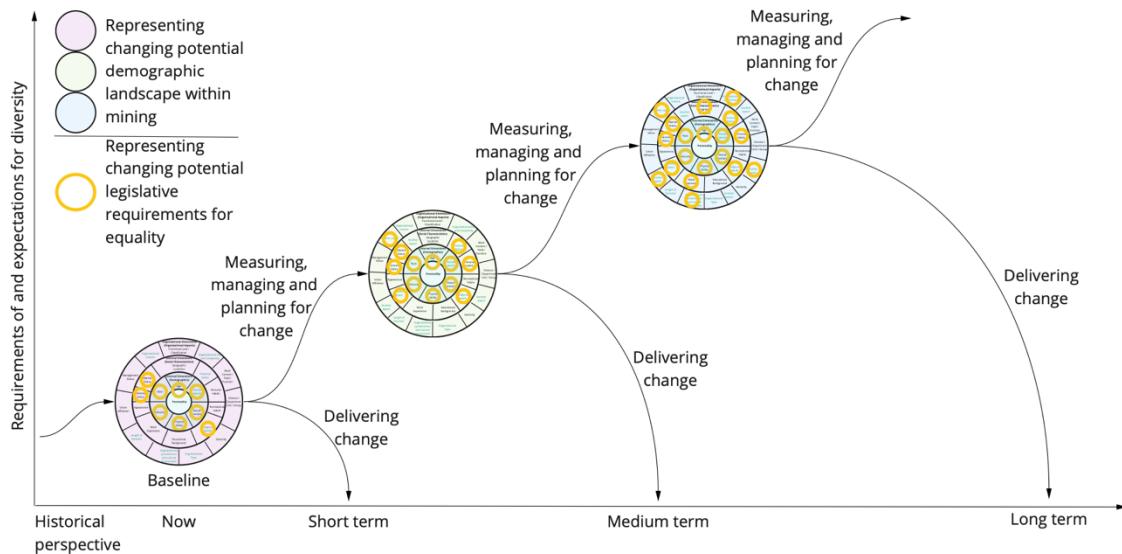


Figure 18 – Proposed approach to proactively managing diversity within the mining industry

5.2 Conclusions

The objective of this research was to understand the mining industry’s appreciation of whether cognitive diversity in senior management teams can add value through innovation and improved performance in the mining industry. The academic literature is lacking depth of research on the topic of cognitive diversity in the mining sector. Numerous research opportunities for the topic exist within EDI in the mining industry, since most research has focused on social equality and demographic diversity.

Awareness in the industry of cognitive diversity is low and it is crucial to raise the awareness of the benefits that cognitive diversity could bring to teams and organisations. Interviewees confirmed literature review findings that senior leaders in mining lack support mechanisms to be able to measure, manage and leverage cognitive diversity during recruitment and retention. Interviewees overwhelmingly supported the development and management of cognitive diversity and inclusion, and corroborated that this is seen by leaders in mining as pivotal for the industry to be successful in the future. The researcher’s reflections are included in Appendix D.1.

5.2.1 Recommendations

The key opportunity for additional research is to increase the understanding of how the traditional construct and culture of the mining industry, and its organisations and teams, is limiting the ability to develop, attract, retain and leverage cognitive diversity. The research can then be used to determine how the mining industry needs to change to enable the inclusion of individuals with cognitive diversity to the sector norm, and in turn leverage additional value. Improving awareness of the value of cognitive diversity to the mining industry will require education and result in cultural change that would need to happen over long-time horizons although the mining industry is only realistically likely to change when faced with having to react to a disruptive event or

series of events. It is recommended that the mining industry looks inwards, to identify good practice, and outwards, at what other industries have achieved, to find opportunities to emulate successes and learn from failures. Leaders require the development of appropriate and effective toolkits to be able to measure, manage, and leverage cognitive diversity within their teams and organisations as cognitive diversity has been found to improve innovation and organisational performance.

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APPENDICES

Appendix A Literature Review

A.1 Literature Review key findings

The key questions for senior leaders in the mining industry arising from the literature review are in the table below;

Where do senior managers or leaders believe their organisations are in terms of the diversity and inclusion journey?
Where do senior managers or leaders believe their teams are in terms of the diversity and inclusion journey?
Do senior managers or leaders believe that they have effective methodologies and / or frameworks to effectively measure the right KPIs around cognitive diversity in their teams?
Do senior managers or leaders believe that they are leveraging cognitive diversity in their teams to be able to deliver better innovation and performance?
What direction do senior managers or leaders believe that diversity and inclusion is going in the future within the mining industry, particularly around leveraging cognitive diversity in senior management teams to improve innovation and performance?

Appendix B Methodology

B.1 Methodology options considered

Research Method	To be used in the research?
Further literature review	Yes some although should be kept minimal unless something fundamental is uncovered during the interviews.
Case studies	If available examples are identified and offered for review during the interviews.
Surveys	Short survey of interviewees
Ethnography or situational / observational	No – not deemed appropriate during this phase
Experimental research (by scientists)	No – not deemed appropriate during this phase
Action research	No – not deemed appropriate during this phase
Quantitative vs qualitative research	Yes – the qualitative determination of themes that emerge from the interviews will be assessed. And opportunities for quantitative analysis will be identified although it is unlikely this will be appropriate during the duration of this thesis.

B.2 CURES Approval



21 July 2021

Dear Mr Houston ,

Reference: CURES/14217/2021

Title: How Cognitive Diversity can add Value through Innovation and Improved Performance in Senior Management Teams in the Mining Industry

Thank you for your application to the Cranfield University Research Ethics System (CURES).

We are pleased to inform you your CURES application, reference CURES/14217/2021 has been reviewed. You may now proceed with the research activities you have sought approval for.

If you have any queries, please contact CURES Support.

We wish you every success with your project.

Regards,

CURES Team

B.3 Interviewee consent form

Title of the project:	<i>How Cognitive Diversity can add Value through Innovation and Improved Performance in Senior Management Teams in the Mining Industry</i>
Name of the researcher:	Sam Houston
Researcher's contact details:	samhouston@samhouston.online +447960619021
University:	Cranfield University
Course:	Masters in Business and Strategic Leadership
Participant number:	## Random number inserted here
Date:	28 June 2021

Dear interviewee,

You have been invited to take part in Sam Houston's research Thesis '*How Cognitive Diversity can add Value through Innovation and Improved Performance in Senior Management Teams in the Mining Industry*'. The ethical guidelines of this study require that you read and sign this form, signifying that your participation is as a willing volunteer in the research and that the data collected can be used to inform the analysis for the research question. Data will be collected from each interviewee using a short survey and an interview.

The raw data collected in this survey and interview will only be used by Sam Houston in order to conduct analysis and satisfy the requirements of the research Thesis with Cranfield University. Overall findings will be included in the research report but will be presented anonymously and as themes without any reference to individual interviewees. All data collected will be anonymised and each interviewee will be assigned a number which will be used in naming conventions in temporarily stored files in order to further anonymise the data.

The survey will be a series of multiple choice and yes/no style questions to gain some high-level information on interviewees and their organisations. The survey will be conducted using Survey Monkey and only Sam Houston will have access to the results.

The interview will be an open-ended discussion format with opportunities to share thoughts and opinions and clarify any responses to the survey. The interview will be

recorded via Otter¹ and in order to protect confidentiality the data collected will be anonymised, with minimal personal information requested to inform the analysis.

The data will be stored on a secure restricted OneDrive folder and retained for the duration of the research project, following which it will be destroyed. Anonymised transcripts and survey results will not be published. No part of this research or report is to be used for commercial purposes. The researcher will not discuss the content of surveys or interviews with anyone except the interviewee.

This participation form will be kept securely and separately from all related research data.

By signing below, you are indicating that you have read and understand the above agreement and that you are happy for the data collected to be used anonymously in the research.

Email approval is acceptable and will be recorded with this consent form.

Name: _____

Signature: _____

Date: _____

¹ Otter – online app that transcribes and records interviews

B.4 Interviewee pre-interview survey

Interviewee Survey - MSc Sam Houston

Pre-interview survey

This survey is intended to provide some basic, preliminary information on interviewees and their organisations prior to the open format interviews. This will be used to save time during the interviews to allow more discussion time during the interviews themselves.

* 1. Please indicate your interviewee number, provided by Sam Houston prior to receiving this survey.

2. How many employees are there in your organisation?

0 - 100

100 - 1,000

1,000 - 10,000

10,000 - 100,000

Over 100,000

3. Does your organisation have a Diversity and Inclusion policy?

Yes

No

4. Does your organisation actively encourage Diversity and Inclusion?

Yes

No

5. Does your organisation actively measure cognitive diversity in its senior management teams?

Yes

No

6. Does your organisation see value in cognitive diversity in senior management teams?

Yes

No

7. Do your senior managers have access to a toolkit or framework to leverage value from cognitive diversity in their teams?

Yes

No

8. Does your organisation have a clear, well communicated, diversity and inclusion strategy for the future?

Yes

No

B.5 Topics for discussion during the Interviews

Question / checklist;

1. Does your company have a Diversity and Inclusion policy?
 - a. If yes; Does your company measure diversity in the workplace?
 - i. If yes; What factors of diversity does your organisation measure?
 - ii. If yes; Do you think diversity add value in your organisation? If yes; why? If no; why?
2. Does your leadership team recognise cognitive diversity within the team?
 - a. If yes; How is this measured in your team?
 - i. Do you believe that cognitive diversity adds value in your senior management team?
 - ii. If yes; Do you actively manage organisational and innovation performance that results from the cognitive diversity in your teams?
 1. If yes; What frameworks or methodologies do you use in your teams to get value from cognitive diversity
3. Do you think the mining industry could be doing more to develop and leverage cognitive diversity in senior management teams?
 - a. If yes; How do you think this could be achieved?
 - b. Do you think the mining industry is ensuring that teams have the right psychological safety and relatedness protocols in place to ensure inclusion?
4. Is there an appetite for more value to be driven from cognitive diversity in senior management teams within the mining sector?
 - a. How do you see this developing into the future?
 - i. What do you think the role of the executive team should be in developing cognitive diversity in senior management teams?
 - ii. What do you think the role of the board of directors should be in developing cognitive diversity in senior management teams?

Appendix C Findings

C.1 Tabulated findings from research

Source	Theme	Sub-theme	Statement	Importance
Interview	Individual performance	Culture	Culture of caring	
Interview	Mining	Culture	The mining culture doesn't allow for demographic diversity in the workforce	High
Interview	Mining	Culture	The mining culture doesn't allow for cognitive diversity in the snr mgt teams	High
Interview	Mining	Current performance	Mining was a leader in culture ten years ago	
Interview	Individual performance	Definition	Lack of consistency around the terminology of cognitive diversity	High
Interview	Individual performance	Definition	Add some aspects to dial; cultural environment to geographical location	
Interview	Individual performance	Definition	Add some aspects to dial; size of organisation that have experience with	
Interview	Individual performance	Definition	Add some aspects to dial; gender identification	
LinkedIn	Organisation	Definition	Add some aspects to dial; Organisation jurisdiction	
LinkedIn	Organisation	Definition	Add some aspects to dial; Organisation size	
LinkedIn	Organisation	Definition	Add some aspects to dial; Organisation type	
LinkedIn	Organisation	Definition	Add some aspects to dial; Organisational level	
Interview	Individual performance	Development	Coaching is available to those who need it	
Interview	Individual performance	Development	Use of psychometric testing for individual development	

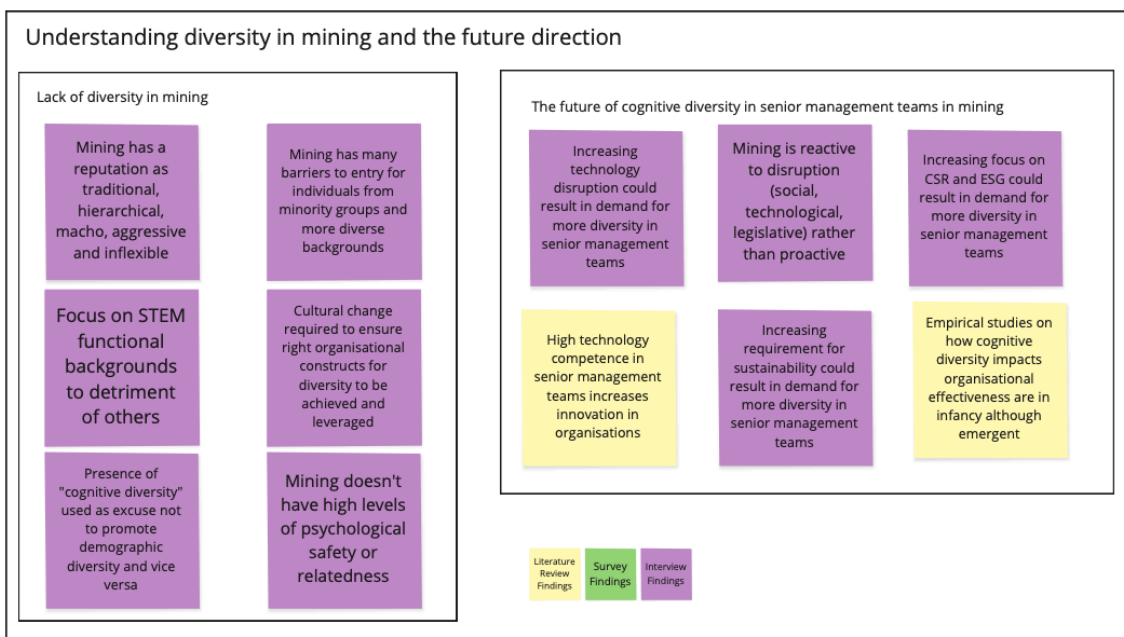
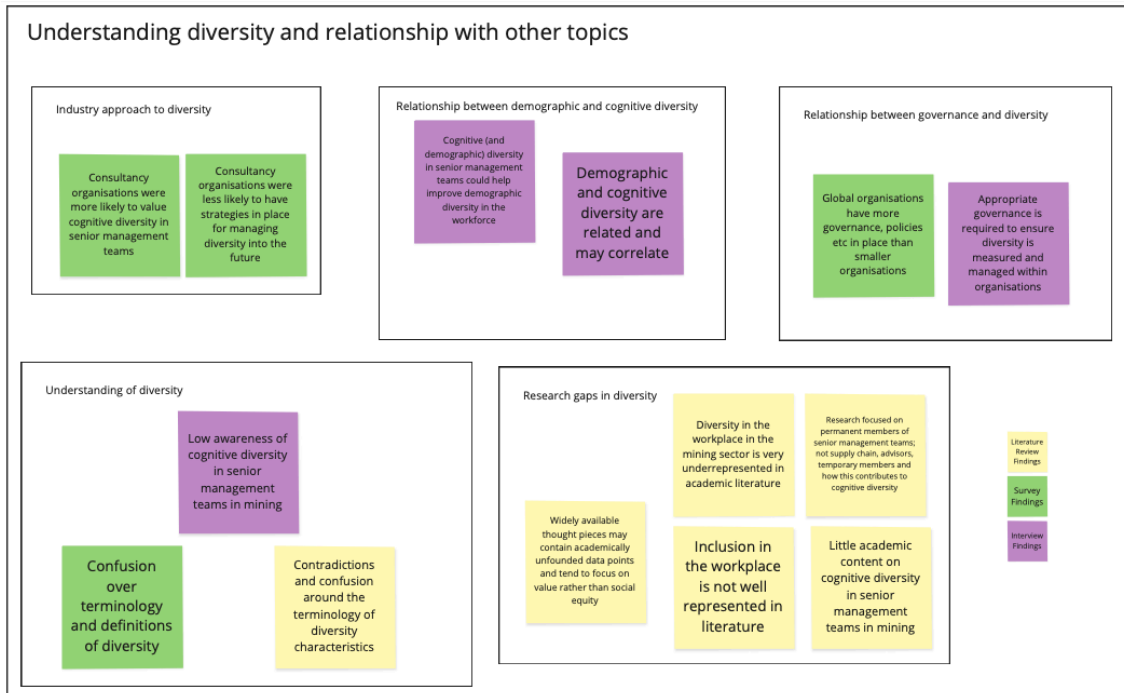
Interview	Team performance	Development	Coaching is available to those who need it	
Interview	Individual performance	Diversity	Demographic diversity correlation with cognitive diversity	High
Interview	Individual performance	Diversity	Demographic diversity diverging with cognitive diversity	High
Survey	Individual performance	Measurement	Org measure cognitive diversity in snr mgt team	High
Interview	Organisation	Diversity	Demographic diversity needs to be made first before cognitive diversity follows	High
Survey	Organisation	Diversity	Org encourages D&I	High
Interview	Organisation	Culture	Organisational cultures can prevent diversity of thought	
Interview	Individual performance	Measurement	Expectations are set re individuals' behaviours and values	
Interview	Team performance	Leadership	Expectations are set re teams' behaviours and values	
Interview	Mining	Future direction	Appetite to do more in the space	High
Interview	Mining	Future direction	Tech firms may decide to take over more of the value chain especially for eg Lithium / copper	
Interview	Mining	Future direction	Technology increases to remove requirement for remote operations will help diversity	High
Interview	Mining	Future direction	More focus on end user requirements, especially if end use is host nation	Very High
Interview	Mining	Future direction	Value measurement moves away from share price towards wider stakeholder value	
Interview	Organisation	Governance	Governance is in place to manage demographic diversity in snr mgt	
Interview	Organisation	Governance	Link with Risk Management	High
Interview	Organisation	Governance	Governance is in place to manage cognitive diversity in snr mgt	

Survey	Organisation	Governance	Org has D&I policy	High
Interview	Organisation	Governance	Link to Sustainability	High
Interview	Organisation	Governance	Quotas on demographic diversity bring cognitive diversity	
Interview	Organisation	Governance	Larger mining companies are seen as less agile and can't compete against industry upstarts	
Interview	Individual performance	Leadership	COVID impact on leadership	
Interview	Organisation	Leadership	Culture driven from the top	High
Interview	Organisation	Leadership	Hierarchy prevents diversity of thought	High
Interview	Mining	Leadership	There is a perception that there is a specific way that industry thinks leaders should be	High
Interview	Mining	Leadership	Pockets of leadership value and commit diversity (opp; awareness)	
Interview	Mining	Leadership	Snr mgt awareness of demographic diversity	High
Interview	Mining	Leadership	Snr mgt awareness of cognitive diversity	High
Interview	Team performance	Management	Psychological safety is actively managed	High
Interview	Team performance	Management	Relatedness is actively managed	High
Interview	Individual performance	Measurement	Use of background and experiences for individual development	
Interview	Individual performance	Measurement	Individual behaviours and values are measured	
Interview	Individual performance	Measurement	Could use the wheel and another lens of effectiveness to measure potential diversity effectiveness	Very High
Interview	Team performance	Measurement	Team behaviours and values are measured	
Interview	Organisation	Measurement	KPIs for teams and individuals cascaded	

Interview	Organisation	Measurement	We should measure impact of softer inputs as impacts on success, ie operating / business model etc	High
Interview	Organisation	Measurement	Quantitative assessment of value	
Interview	Organisation	Measurement	Qualitative assessment of value	
Interview	Senior Management Team	Measurement	Mining has low diversity	
Interview	Senior Management Team	Measurement	Senior management in mining has long tenure	
Interview	Senior Management Team	Measurement	Senior mining resource are mainly highly technical	
Interview	Individual performance	Recruitment	Use of psychometric testing for post recruitment	
Interview	Individual performance	Recruitment	Psychometrics used for recruitment	
Interview	Individual performance	Recruitment	Background and experiences used	
Interview	Organisation	Strategy	Strategy should be outcome focussed which should set diversity reqs	Very High
Interview	Organisation	Strategy	Culture should be aligned to strategic direction of the company	High
Survey	Organisation	Strategy	Org has an inclusion strategy for the future	High
Interview	Mining	Strategy	Strategy in most mining companies isn't long term enough to allow for long term diversity strategy	High
Interview	Team performance	Team framework	HR should not tell leaders how to run teams although provide framework	
Interview	Team performance	Team framework	Individual cognitive assessment used for team construct	
Interview	Team performance	Team framework	Availability of a team development framework	Very High

Interview	Team performance	Team framework	Team development is aligned to the corporate strategy	
Interview	Team performance	Team framework	Team behavioural performance is compared to team performance	
Interview	Team performance	Team framework	Creation of innovation doesn't need as much diversity as delivery of innovation	
Survey	Team performance	Toolkit	Snr mgt has a toolkit for leveraging cognitive diversity in teams	Very High
Interview	Team performance	Value	Qualitative link for cognitive diversity to innovation and different ways of solving problems	
Survey	Organisation	Value	Org sees value in cognitive diversity in snr mgt teams	High

C.2 Development of themes between literature review, surveys and interviews



Leveraging diversity

Literature Review Findings Survey Findings Interview Findings

Management of diversity

Not many frameworks for senior managers to leverage cognitive diversity in teams	Organisations do not have a toolkits etc to help them to measure, manage and leverage diversity
Frameworks, toolkits, templates and exemplars to help leaders manage diversity would add value	Strong appetite for support for senior managers to measure and manage diversity within teams

Diversity needs to be managed with intent to deliver value through innovation and improved performance

Cognitive diversity in team design

Strategic decisions are usually made by teams and could benefit from cognitive diversity if managed correctly

Cognitive diversity should be taken into account when designing teams

Teams do not seem to be formed with outcomes in mind or agile enough to react to changing requirements

Measurement of diversity

Some organisations measure and track diversity in recruitment although not after	Not enough is being done within mining to retain diversity in the workforce or senior management teams
Organisations do not systematically measure cognitive diversity in senior management teams	Measurement of demographic diversity happens in organisations although cognitive diversity less so

Appendix D Discussion and Conclusions

D.1 Researcher's self-reflections

This research was highly enjoyable and worthwhile. There was a great deal of optimism from the interviewees for what the mining sector can achieve in the future with cognitive diversity and this was inspiring. The topic requires a great deal of additional investigation and there is a lot of opportunity for the sector if it can rise to the challenge. It should not be underestimated how much of an effort it will take to make the industry wide cultural change that would be necessary to develop cognitive diversity and derive value from it. The fear is that without significant disruption or disruptive events this may require a multi-generational time horizon.