

Workplace diversity, equity, inclusion, and belonging: Firm bionic advantages in the era of mining modernisation.

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Abstract

The contemporary landscape of the mining industry is undergoing a profound metamorphosis, marked by an escalating significance of diversity, equity, inclusion, and belonging (DEIB) that has remained relatively unexplored. This study posits that within this transformative milieu, firms possess the potential to glean distinctive competitive advantages through their deliberate and comprehensive embrace of diversity and inclusion principles. This research examines the intricate tapestry of benefits, strategic methodologies, and intrinsic organism characteristics that underpin a symbiosis between firm performance and DEIB advantage by weaving together the socio-technological transformation theory and modernization theory strands. Employing an exhaustive systematic review of existing literature, our investigation culminates in crystallising a novel conceptual framework – the DEIBA theory. This innovative theoretical construct not only dissects the manifold economic, environmental, social, and innovative benefits that accrue to firms through their earnest commitment to DEIB but also casts a luminous spotlight on the strategic manoeuvres and core attributes intrinsic to the cultivation of such advantages. As the mining industry traverses uncharted territories propelled by technological leaps and societal shifts, our research augments the intellectual discourse by unravelling the unexplored facets of DEIB and its transformative impact. This paper thus aims to provide a framework that stands as a gateway to a realm where DEIB ceaselessly intertwines with the architecture of competitive advantage, beckoning the minerals industry to transcend conventional paradigms and forge a path towards a future where diversity, equity, inclusion, and belonging become not only essential ethical imperatives but also dynamic drivers of resounding organisational triumph.

Keywords: Diversity; equity; inclusion; belonging; bionics; mining modernisation; socio-technological transformation theory; ESG, innovation; diversity, equity, inclusion, belonging (DEIB) advantage.

32 1. Introduction

33 The mining industry is at a fork in the road, underscoring the urgent need for innovative
34 value creation and capture in the face of changing market dynamics that include the
35 urgency of clean sources of energy supply to contain galloping carbon dioxide
36 emissions, environmental concerns, the finite nature of minerals and metals, and
37 challenges of lower-grade deposits ([Kashan, 2021](#)). Due to deepening mines, as is the
38 case in South Africa, where eight of the top ten world's deepest mines are hosted,
39 extraction of minerals requires a lot more energy to extract, haul and process
40 incremental volumes of comparatively low-value ores ([Nwaila et al., 2022](#);
41 [Chipangamate et al., 2023](#)). Studies have shown that with deepening mines, there is a
42 growing need for more ventilation as working conditions worsen, which also requires
43 more energy, further increasing operational costs. In addition to geological and
44 economic complexities associated with the obtaining situation, the industry is grappling
45 to contain rising societal expectations ([Moffat and Zhang, 2014](#)) for meaningful
46 contributions to sustainable development goals ([Chipangamate et al., 2023](#); [Meesters
47 et al., 2021](#)) to achieve a social licence to operate ([Meesters et al., 2021](#)). Some of the
48 recent topical issues include improving the mining industry's human rights record and
49 governance standing ([Lauwo & Otusanya, 2014](#)). When viewed together, these
50 challenges have left the mining industry volatile, pressuring companies to question their
51 status quo and re-think their approaches to value creation ([Berman, 2012](#); [Deloitte,
52 2019](#)). The industry has slowly responded to these challenges through timely
53 transformative efforts, including applications of innovative technologies, such as artificial
54 intelligence, machine learning, the industrial internet of things, virtual reality, drones, and
55 autonomous driving ([Dehran et al., 2018](#); [Deloitte, 2019](#); [Rogers et al., 2019](#)). It is also
56 observed that the role of women and minority groups and how the industry behaves in
57 host communities slowly started to change in one of the traditional industries, known for
58 inflexibility and rigidity, signalling deep-rooted resistance to change. Meanwhile, the
59 underrepresentation of women and their low levels of STEM skills is not unique to mining
60 operations but the entire mining value chain, as highlighted by AUSTMINE when
61 launching the 'Accelerating Women in METS Programme' in July 2023 ([AUSTMINE,
62 2023](#)).

63 However, despite the urgent need for transformative thinking to solve the growing
64 challenges, literature on these developments and the related processes of value
65 creation for competitive advantages remain fragmented. Several theoretical lenses have
66 been utilised to understand the nexus of mining industry challenges and modernisation,

67 including modernisation theory (Sumner, 1982; Holcombe, 2006; Ntsoelengoe, 2019),
68 resource dependence theory (Rosyida et al., 2018; Li et al., 2019), stakeholder theory
69 (Freeman, 1984; Christopher et al., 1997; Ranangen, 2017), and actor-network theory
70 (Chipangamate et al, 2023). This paper approaches this phenomenon differently, opting
71 instead to explore it through a socio-technological transformation lens, as proposed by
72 Baygi et al. (2021). The theory dictates that firms benefit from accounting for and jointly
73 performing actions in a timely, attentive, and ongoing way. This implies that employees
74 are the critical mechanism for the firm to garner value as they creatively think and
75 implement strategies and actions to advance firm value, hence the important need to
76 treat them as key stakeholders. This notion aligns with other theories that advocate for
77 meeting the needs of diverse stakeholder groups (Freeman, 1984). Theoretical
78 arguments and empirical evidence support the notion that creating value for multiple
79 stakeholder groups allows a firm to enjoy more tremendous success and longer-term
80 viability than those with narrower orientations (Fisher, 2019). These arguments are
81 supported by resource dependency theory, which argues that a firm's depends on its
82 key resources to generate value and competitive advantage (Rosyida et al., 2018; Li et
83 al., 2019), and resource-based view theory which assumes that a firm's competitive
84 advantage originates from unique resources that are owned and controlled by the firm
85 (White et al., 2016).

86 Because the mining industry faces an acute shortage of skills, women and other
87 underrepresented minorities, including expatriates, have been identified as invaluable
88 resources. This has come with its own challenges; thus, diversity, equity, inclusion, and
89 belonging practices have been proposed to mitigate structural and legacy challenges
90 associated with women and minority groups participation in mining (Kansake et al.,
91 2021; Kachena & Spiegel, 2019). Clearly, DEIB initiatives create new opportunities and
92 challenges for firms in managing workplaces as a source of competitive advantage in
93 the era of modernisation (El-Amin, 2022). The extant theory provides insight into how a
94 firm may benefit from creating value for traditional stakeholders (e.g., Harrison et al.,
95 2010; Porter & Kramer, 2011; Priem, 2007; Tantalo & Priem, 2016), yet it does not
96 account for how firms interact and engage with diversity, equity, inclusion, and belonging
97 of women and underrepresented minorities. This is an important consideration because
98 more mining firms than ever are looking at diversity and inclusion (Kincaid & Smith,
99 2021; Peltier-Huntley, 2023) and, hence, they can generate advantages from creating
100 and/or engaging with diversity, equity and inclusion. Firms benefitting from doing so may
101 outcompete those who overlook this emerging yet important workplace trend. Diverse
102 and inclusive workplaces may provide firms with relational advantages that ultimately

103 facilitate growth, increase revenues, and/ or reduce costs for a firm, yet the mechanisms
104 underpinning that competitive advantage are not well understood (Kincaid & Smith,
105 2021; Sasikala & Sankaranarayanan, 2022). This paper proffers the various benefits
106 and tactics for creating competitive advantage from diversity, equity, inclusion, and
107 belonging in a modernising mining industry.

108 Unlike Actor-Network Theory, the socio-technological transformation theory adopted in
109 this paper allows us to shift from actor-centric orientations toward a flow-oriented
110 approach and vocabulary to offer an innovative theory of socio-technological
111 transformation that does not rely on self-contained actors or technologies as originators
112 of transformation (Baygi et al., 2021). By infusing insights from modernisation theory,
113 this article contributes to the socio-technology theory and strategic management
114 literature by identifying and describing an under-recognised yet increasingly important
115 source of firm advantage, which we term diversity equity inclusion belonging advantage
116 (DEIBA). DEIBA comes about when firms create and foster diversity, equity, inclusion,
117 and belonging in their workplaces and communities to form a source of competitive
118 advantage that comes from the firm's ability to generate innovations, superior financial
119 performance and social performance from DEIB. In so doing, firms also generate
120 distinctive benefits for the women in mining and the underrepresented sections of
121 society, which can create a self-reinforcing cycle of benefits between a firm, employees,
122 and the community.

123 This paper, therefore, aims to provide a framework that stands as a gateway to a realm
124 where DEIB is continuously intertwined with the architecture of competitive advantage,
125 signalling the minerals industry to transcend conventional paradigms and forge a path
126 towards a future where diversity, equity, inclusion, and belonging become not only
127 essential ethical imperatives but also dynamic drivers of resounding organisational
128 triumph. To achieve this aim, the paper pursues the following objectives:

- 129 1) Identify and categorise the dimensions of organisational benefits accruing mining
130 firms from engaging in DEIB.
- 131 2) Determine how and under what conditions different tactics can enhance the effect of
132 DEIB benefits on firm advantages (DEIBA).
- 133 3) Scope the intrinsic organisational attributes that play a role in how the different
134 benefits of DEIB will yield superior performance advantages.

135 Now that we have introduced the essential challenges the mining industry is grappling
136 with and the objectives for this paper, we next present the methods adopted in building
137 the framework for DEIBA theory.

138 **2. Methods**

139 This paper is divided into six sections to provide a systematic literature review of
140 workplace diversity and inclusion benefits, tactics, and firm attributes necessary for
141 garnering competitive advantages for mining firms as the industry is modernising. The
142 introduction focuses on the challenges facing the mining industry in the era of
143 modernisation, showing how the industry finds itself faced with multiple challenges in
144 terms of profitability, ESG and technology risks due to market dynamics. This second
145 section reviews the methodology, briefly describing how the review is achieved. We
146 systematically reviewed relevant literature on modernisation, socio-technological
147 transformations, diversity and inclusion, and competitive advantage from strategic
148 management literature. Section 3 looked at the conceptual foundations of modernisation
149 and the emergence of diversity and inclusion in the mining industry. In contrast, section
150 4 focuses on building propositions related to diversity and inclusion benefits, tactics, and
151 firm attributes for generating diversity inclusion advantage. In section 5, we position the
152 review in the socio-technological transformation theory, identifying the key assumptions
153 and terminology as a precursor to our theory building. Section 6 is the discussion, future
154 research opportunities and conclusions.

155

156 **3. Theoretical foundations**

157

158 *The concept of modernisation and the emergence of workplace diversity, equity,*
159 *inclusion, and belonging*

160

161 The concept of modernisation has a long history in social science literature, having been
162 utilised well before the 1970s. However, it was not until the 1970s that significant
163 progress was made in questioning the modernisation theory's applicability and academic
164 rigour. Bernstein (1971) disentangled some of the issues that arise in the sociology of
165 development and questioned the assumptions and implications of a particular mode of
166 conceptualisation based on the notions of modernity and modernisation, which has

provided the characteristic theoretical framework of the sociology of development. Building on the Bernstein's (1971) arguments, we identify two principal assumptions of modernisation theory as (1) that modernisation is a total social process associated with (or subsuming) economic development in terms of the preconditions, concomitants and consequences of the latter; (2) that this process constitutes a 'universal pattern'. However, these assumptions could be questioned considering that various writers have always had different emphases with respect to the meaning of modernisation due to, in part, its relationship with and derivation from an equally under-theorised concept of 'development'. For example, Lerner (1967) argued that modernisation is the social process in which development is the economic component, while Apter (1967) saw development, modernisation, and industrialisation in terms of decreasing conceptual generality. This is illuminated by some writers who stressed structural aspects. In contrast, for others, the concept of modernisation has to do with a transformation of culture and personality in so far as it is influenced by culture rather than by some aspect of social organisation or of human ecology (Stephenson, 1968).

The dynamics of modernisation theory consist of mechanisms such as the introduction of a market economy, monetisation, urbanisation, industrialisation, the spread of mass communications and of literacy, and so on, which are subsumed and related at the theoretical level in the differentiation-integration model of social change (Raj & Gopalknshna, 2020; Mathez & Loftus, 2023). This characterisation of modernisation is different from how it is conceptualised in the context of mining modernisation, where it has narrowly been used to refer to mechanisation, digitisation, and automation (Pelders and Schutte, 2021). Both these conceptualisations seem not to emphasise the process of cultural change and social relationships inherent in modernisation and requires more attention.

To gain a more vivid impression of the situation, a closer look at mining communities shows the most conspicuous symptom of the contemporary disorder in developing areas. Establishment of mines has attracted masses who clog host communities in anticipation of better opportunities. However, the reality is the development of a suffering mass of humanity displaced from the rural areas to the harsh peripheries of the great mining operations, and that few of them experience the 'transition' from agricultural to mining-industrial labour called for by the mechanism of development and the model of modernisation (Kasimba & Lujala, 2021). They are neither housed, nor trained, nor employed, nor serviced and therefore, languish on the periphery without entering any productive relationship with the industrial operations. These are the displaced persons

202 of the developmental process as it now typically occurs in most of the world, a human
203 mass that has been displaced from traditional agricultural life without being incorporated
204 into modern industrial life, which has a more significant impact on women ([Mehahad &](#)
205 [Bounar, 2020](#)).

206 Contemporary conceptualisations of modernisation have been criticised when applied
207 in emerging market contexts where modernisation theory can be stood on its head by a
208 mode of analysis which (1) approaches the study of development with a historical
209 method; and (2) is informed by questions more relevant to the pressing needs of the
210 present situation than those on which modernisation theory is predicated, which is to
211 say questions that do not disassociate the common concern with poverty, illiteracy and
212 unemployment from the structural analysis of power, and exploitation in their various
213 forms ([Emeh, 2023](#)). Building theory of modernisation in emerging markets calls for a
214 perspective in the social sciences with a potential for the analysis of the underdeveloped
215 world that is lacking in conventionally more acceptable procedures ([Bernstein, 1971](#)).

216 An important observation is that the processes through which the industrialised or
217 developed economies went through will be different from what the emerging economies
218 will go through because of the historical conditions of underdevelopment caused by
219 colonial history, which was not experienced by the developed countries ([Kumar, 2022](#)).
220 Unfortunately, modernisation theorists have kept at least half an eye on the historical
221 processes of developed countries. As such, it may not be appropriate to cut and paste
222 strategies and tactics that are designed from the traditional modernisation theory when
223 investigating modernisation in developing contexts ([Emeh, 2023](#)). Therefore, a more
224 promising approach is refraining from discussing modernisation as such and asking
225 what we mean by the 'modern world' and what the historical processes were that fronted
226 the modern world. Specific themes emerge which cut across the distorted comparative
227 perspective and atrophied dynamics offered by modernisation theory ([Bernstein, 1971](#)).
228 First, the modern world as an inclusive international structure of economic, political, and
229 cultural relationships represents a novel situation in the history of human society;
230 second, this situation was created principally 'through the midwifery of European
231 imperialism'. An explicit recognition of these factors is essential, therefore, to an
232 understanding of the historical environment of contemporary underdevelopment and
233 development ([Yende & Ntini, 2022](#)). Contemporary modernisation theory has
234 erroneously ignored the important role of relationships. For that reason, social theory
235 has failed to grapple with the outstanding feature of the 21st century, which is the

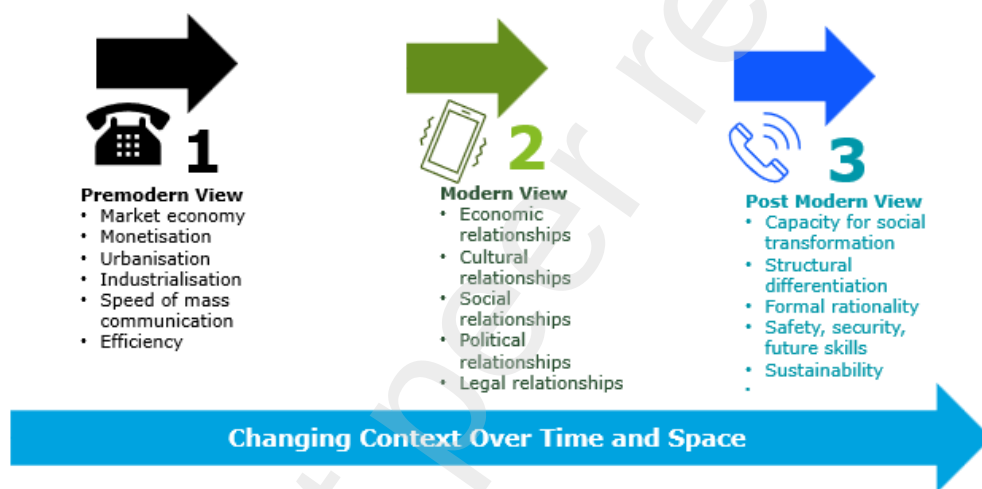
236 emergence of a world system of social relations. At its best, modernisation theory has
237 focused on the traditional-modern dichotomy.

238 For the mining industry, modernising forces are introduced against the backdrop of
239 developing countries that went through a period of colonialism and apartheid, in the case
240 of South Africa. The colonial system was designed to disadvantage certain sections of
241 society while advantaging others. It was characterised by certain forms of economic,
242 political, cultural, and racial exploitation, which polarised the colonial and colonised
243 societies ([Kumar, 2022](#)). A conversation of modernisation that does not capture this
244 important dynamic is destined to fail in delivering intended development objectives.
245 Because the indigenous economic enterprise was destroyed, denied outlets, or a large
246 part of its surplus appropriated for metropolitan purposes, indigenous people were given
247 limited room to be creative. Forming a labour force, a central theme in modernisation
248 literature generally means cheap and expendable unskilled labour compelled by various
249 means to work in European-owned mines and on European-owned plantations
250 ([Bernstein, 1971](#)). Because labour was seen as a means of production like any other
251 asset, there was no space for women, for example, to work in the mines.

252 Modernisation is the increase in the capacity for social transformation, whether the
253 capacity is utilised or not ([Roxborough, 1988](#)). However, this transformative capacity is
254 closely linked with the process of structural differentiation and an increase in the formal
255 rationality of social action. It is noted that one of the significant weaknesses of much
256 modernisation theory is not that it is ahistorical, but rather that its account of the actual
257 historical development of the West was a misleading and mistaken one, which magnifies
258 the distortions associated with examining emerging markets from this perspective
259 ([Bernstein, 1971](#)). A read of much of modernisation theorisation shows that the theories
260 suffer from what we see as the 'dichotomy syndrome'. Studies conducted in the South
261 African mining industry, for example, have indicated that there is limited participation of
262 stakeholders, including mining company management and employees, in equipment
263 design and development ([Pelders and Schutte, 2021](#)), citing historical context and
264 organisational culture as significant barriers to participation ([Ngobese et al., 2023](#)).

265 A broader definition of mining industry modernisation views it as transforming the mining
266 industry to make it safer, more efficient, cost-effective, and sustainable ([Chipangamate
267 et al., 2023](#); [Guarneros-Meza & Torres-Wong, 2022](#); [Minerals Council South Africa,
268 2019](#)). According to [Ngobese et al., \(2023\)](#) modernisation involves changes to people,
269 processes, and technologies. It aims to address challenges facing the mining industry,
270 including increased costs, decreased productivity, and OHS, environmental, and social

271 issues. Mining modernisation in emerging markets occurs in the context of the Fourth
 272 Industrial Revolution (4IR or Industry 4.0), characterised by the heightened use of
 273 innovative technologies (Pelders, 2019). As argued in this paper, a cut-and-paste
 274 approach to modernisation in the emerging market context would be ineffective. Leaning
 275 on the industrial revolution thinking ushered in through the 'Western Midwifery'
 276 conceptions is expected in emerging markets research, but in the hands of many less
 277 talented scholars, the looseness with which terms like industrialisation, transition, and
 278 modernisation are tossed around results in a certain level of ambiguity about the timing
 279 of these changes.



280

281 **Fig 1:** The evolutionary conceptualisation of modernisation

282 The study by Ngobese et al. (2023) cited the use of pre-identified themes for the
 283 questions in the data collection tools as a major potential source of bias in the data
 284 gathered to understand the role of stakeholder engagement in new equipment design in
 285 the South African mining industry. We argue that the bias was further compounded by
 286 using a traditional modernisation lens that was ahistorical in that the study assumed a
 287 homogeneous workplace in the research design. In a context like South African mining
 288 industry, there is so much heterogeneity which calls for a diversity-conscious approach
 289 to research and theorisation. Such an approach is surprisingly missing in extant
 290 research, considering some of the key studies recommend human-centred design
 291 approaches for equipment design and development to enhance participation and
 292 ergonomics (Horberry, Burgess-Limerick, and Steiner, 2015), yet completely ignore
 293 workforce diversity (e.g., Pelders and Schutte, 2021; Pelders, 2019 and Ngobese et al.,
 294 2023), equity, inclusivity and belonging (El-Amin, 2022). Human-centred design is

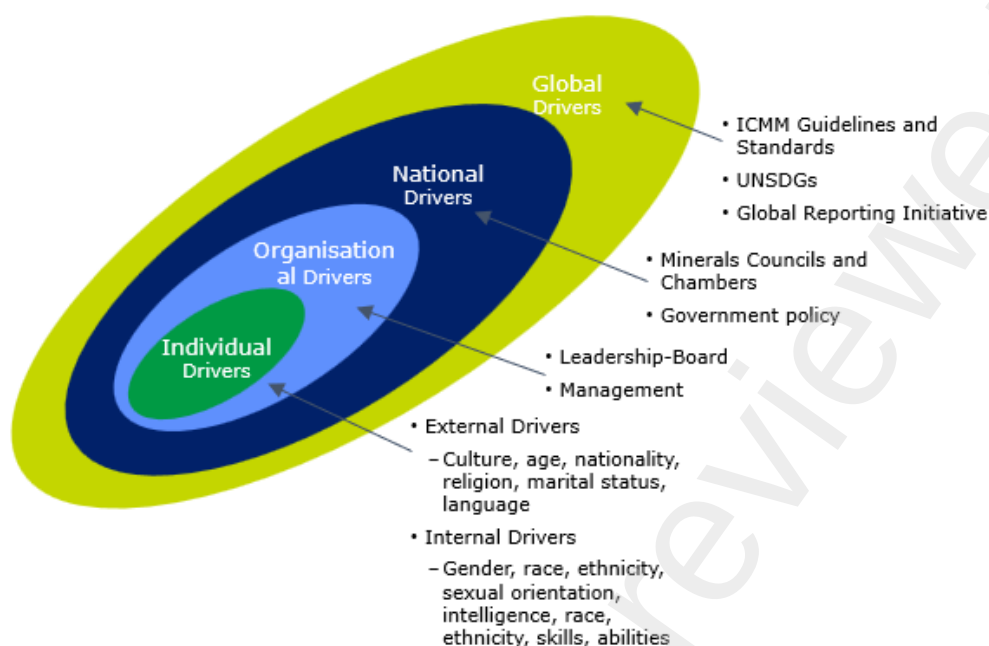
295 defined as an approach to interactive systems development that aims to make systems
296 usable and useful by focusing on the users, their needs, and requirements, and by
297 applying human factors/ergonomics, and usability knowledge and techniques. This
298 approach enhances effectiveness and efficiency, improves human well-being, user
299 satisfaction, accessibility, and sustainability; and counteracts possible adverse effects
300 of use on human health, safety, and performance (Tamers et al., 2020; Pelders and
301 Schutte, 2021).

302 Building on the human-centred approach thinking, we argue, therefore, that a broader
303 conceptualisation of modernisation that looks at the historical dynamics of the mining
304 industry workforce at different organisational levels, roles, race, and gender, and
305 organisational climate is too important to be ignored. This paper views the emergency
306 of workplace diversity as an important contributor to what we label workplace diversity,
307 equity, inclusion, belonging advantage (DEIBA) for the mining firm. Past studies have
308 demonstrated that workplace diversity practices are implemented in organisations when
309 the senior leadership identifies and resonates with both the instrumental beliefs and
310 moral values of workplace diversity (Ng and Sears, 2020). We conceptualise diversity
311 management as a form of organisational change, entailing a shift in demographics (i.e.,
312 increasing the proportion of women and minorities) and climate (i.e., the way things are
313 at the workplace) (Kossek et al., 2003), to create a shared sense of collective effort
314 where diversity is systematically acknowledged, valued, and effectively managed
315 (Friday and Friday, 2003).

316 The fact that early movements for diversity in mining occurred in the 1970s, which was
317 a period of broader conversations around modernisation, is not coincidental as this was
318 a period of questioning the traditional modernisation lens and focusing more on what
319 was prevailing in the world at the time (e.g., Lerner, 1967; Apter, 1967; Stephenson,
320 1968; Bernstein, 1971). The primary focus of early diversity movements was gender
321 diversity (Rolston, 2014). The current movement for D&I in mining began in the early
322 2000s, with the push for D&I in the tech industry (MCA, 2007). Notably, since 2012, the
323 mining industry has expressed widespread commitment to increasing diversity as a
324 strategy to encourage sustainable development, acquire social licenses to operate, and
325 address a looming retirement crisis (Chipangamate et al., 2023; Kincaid & Smith, 2021).
326 Diversity and inclusion are quite relevant in modernising mining research and practice
327 due to the assumption that people conceptualise their life according to their age, gender,
328 or race and the social experiences this exposes them to.

329 More recently, we have witnessed the mining industry increasingly turning to Diversity
330 and Inclusion (D&I) programs to address a range of challenges, including an ageing
331 workforce, increased public pressure, and growing demand for innovative technical
332 solutions to mining problems (Kincaid and Smith, 2021). A report by Ernest and Young
333 (2023) has identified skills shortage as a leading risk for the mining industry in the
334 foreseeable future. Academic research supports this industry observation, for example,
335 further attributing increased tailings storage facilities failure to skills shortages (see
336 Armstrong et al., 2019). However, a lack of information on DEIB initiatives in mining
337 contexts remains appalling, creating one barrier to adopting and developing these
338 programs for the industry. In a more global context, the United Nations Sustainable
339 Development Goals of 2015 emphasise the central role of diversity and inclusion for a
340 sustainable planet. Specifically, sustainable development goals on gender equality
341 (Goal 5), reduced inequality (Goal 10) and decent work and economic development
342 (Goal 8) are key drivers of diversity, equity, inclusivity, and belonging in the mining
343 industry (UN, 2015).

344 Meanwhile, the International Labour Organisation (2023) identifies various categories of
345 discrimination as prevalent in the workplace, including age discrimination, racial
346 discrimination, religious discrimination, and migrant workers discrimination and
347 important human rights, including equal rights, gender equality, men's rights, women's
348 rights, rights of disabled people, gender, HIV/AIDS. The International Council for Mining
349 and Metals (ICMM) (2023) established a position statement on members'
350 *collective* commitment to improving diversity, equity and inclusion in the industry and
351 positively influencing their communities. They argued that despite diverse and inclusive
352 workforces being more productive and profitable due to the varied perspectives they
353 bring to innovation and problem-solving and the respect of human rights, the global
354 outlook was not encouraging (Perks & Schulz, 2020). The mining industry is at the
355 bottom of industry rankings, with women's participation in mining having a paltry less
356 than 14% of the total workforce (Kansake et al., 2021; ICMM, 2023). In South Africa,
357 only 5% of women are in the total mining industry workforce (Botha, 2016; MCSA, 2023).
358 This is more concerning considering that women in large-scale mining are less likely to
359 hold technical positions which are generally higher paying (Parmenter & Drummond,
360 2022; ICMM, 2023). Women and other underrepresented groups are significantly more
361 likely to experience physical, sexual, and psychological violence, bullying, harassment,
362 discrimination, and assault within the mining workplace (Botha, 2016; ILO, 2021;
363 Kansake et al., 2021). This further worsens conditions for women participation in mining,
364 despite labour shortages.



365

366

367 **Fig 2:** The Diversity, Equity, Inclusion, Belonging Onion (DEIBO) shows drivers of
 368 diversity, equity, inclusion and belonging at different layers.

369 At the national level, mining councils and local chambers are fostering diversity, equity,
 370 inclusion and belonging in the industry (Mayes & Pini, 2014). For example, in Canada,
 371 the Mining Association of Canada adopted the Equitable, Diverse, and Inclusive
 372 Workplaces Protocol (EDIWP) to underscore the importance of focusing on equity,
 373 diversity, and inclusion as strategic priorities and shared values for the mining sector,
 374 recognising that people are a great asset and that an equitable, diverse, and inclusive
 375 workforce facilitates effective problem-solving, creativity and innovation (Measham &
 376 Zhang, 2019; MAC, 2023). This leaves no place for inequity, harassment, discrimination,
 377 violence, or hatred, in any form, in the mining sector. For example, in driving diversity
 378 and inclusion in the mining industry, the Minerals Council South Africa developed a
 379 policy framework to guide member mining companies to focus on the rights of
 380 indigenous peoples, women, national or ethnic, religious, and linguistic minorities,
 381 children, persons with disabilities, migrant workers and their families, as well as other
 382 groups in a society whose situation may render them particularly vulnerable to adverse
 383 impacts on their rights (MCSA, 2019). Mining organisations are embracing diversity and
 384 inclusion to remain competitive in the marketplace (Kincaid and Smith, 2021). In South
 385 Africa, South 32, a multinational mining operation, is guided by the UNSD Goals, UN

386 Global Compact, ICMM, and GRI and is a signatory to HESTA 40:40 Vision, an investor-
387 led initiative to achieve gender balance in executive leadership across all ASX300
388 companies by 2030, underscoring the mining company commitment to diversity and
389 inclusion (South 23, 2023). Together, these arguments suggest that a modern firm is
390 faced with changing demographics, increased government and societal pressure, and
391 the need to understand better and find a competitive advantage in an increasingly
392 diverse marketplace (Daniel, 2011).

393 4. Socio-technological transformation theory (STTT)

394 Considering the identified limitations of the modernisation theory in illuminating
395 modernisation in emerging markets, we utilise the socio-technological transformation
396 perspective to provide theoretical moorings to our exploration of DEIB in a modernising
397 mining industry. The STTT has been widely used mining industry modernisation
398 research, yet it has largely focused on Actor Network Theory (see Chipangamate et al.,
399 2023; Jensen & Sandström, 2020). STTT could be enhanced to capture ongoing digital
400 innovations that are transforming almost every aspect of our contemporary societies to
401 rendering our lives and work evermore fluid and dynamic. We conceptualise mining
402 modernisation as socio-technological transformation requiring us to shift from actor-
403 centric orientations toward a flow-oriented approach and vocabulary to offer an
404 innovative theory of socio-technological transformation that does not solely rely on self-
405 contained actors or technologies as mid-wives of transformation (Baygi et al., 2021). In
406 the same vein, we build on the work of Baygi et al. (2021) to theorise mining
407 modernisation with a DEIB orientation. To do that we borrow their vocabulary of *flowing*
408 *lines of action* and their *correspondences*, and the three modalities of correspondence,
409 namely: *timing*, *attentionality*, and *undergoing*, which together explain the dynamics of
410 creation, sensing, and actualisation of transformative possibilities for action along socio-
411 technological flows (Hund, Wagner, Beimborn, & Weitzel, 2021). This is an appropriate
412 approach as it helps us incorporate DEIB, which are socially constructed, with mining
413 modernisation which has typically been viewed as technological aspects of
414 mechanisation, digitisation, and automation (Pelders, 2019), instead of a socio-
415 technological phenomenon to be understood along an increasingly fluid and dynamic
416 digital world (Plekhanov, Franke & Netland, 2022).

417 Next, we define the vocabulary, starting with correspondence, which is the spatial and
418 temporal (trans)formative interweaving of co-responsive flows of action (Baygi et al.,
419 2021; Ingold, 2015). We argue that such interweaving of co-responsive flows of action
420 forms and transforms the trajectories of for example, tonality of this article, the vibe of

an academic institute, and indeed of mining industry modernisation. In the context of mining modernisation, the notion of correspondence, therefore, suggests that we shift our gaze away from spatial relations between the actors, toward temporal relations, or co-responsiveness, among ongoing flows of the process of modernisation (Grisold et al., 2023). As such, it specifically brings into focus the different temporal qualities, conditionalities, and directionalities of interweaving flows of action to account for their (trans)formative potentials (Hund et al., 2021).

Correspondence along flowing lines of action is a matter of timing, which concerns how new conditions of possibility for action are created along the flow. The appropriateness of the time of action is more important and not the ordering in terms of past, present, or future. Instead, it focuses on kairotic timing, which a) foregrounds the conditioning and (trans)formative dynamics of other temporal qualities of flows of action, such as their directionalities, tempos, intensities, rhythms, momentums, urgencies, and timeliness; b) goes beyond a single universal timeline; c) implies that not all moments are equal for action (Baygi et al., 2021). This calls for disciplined sensemaking and attentionality as important consideration for modernising mining firms.

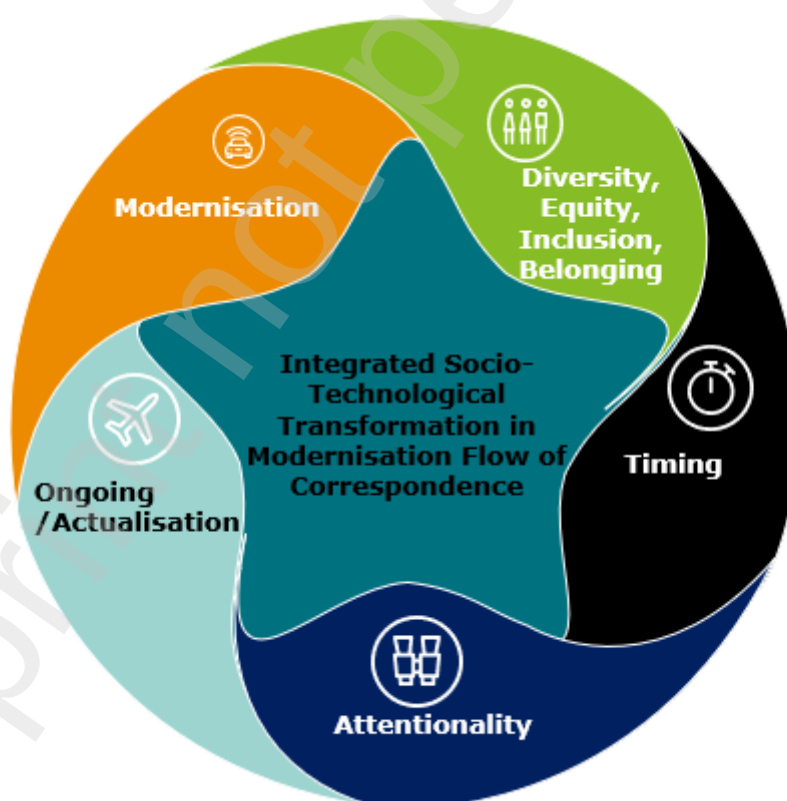


Fig 3: Integrated Socio-Technological Transformation in the modernisation flow of correspondence

440

441 Correspondence along flowing lines of action is a matter of attentionality, which
442 concerns how possibilities for action are sensed along the flow, such that sensing
443 possibilities for action is about being exposed and attuned to corresponding flows of
444 action (Baygin et al., 2021). It is closely related to kairotic timing in that sensing the
445 opportune conditions of possibility for action requires attentional attunement to the flow.
446 Importantly, actualising such possibilities entails undergoing. Correspondence along
447 flowing lines of action is a matter of undergoing, which concerns how possibilities for
448 action are actualised or realised along the flow (Ingold, 2017). Stated differently,
449 correspondence is about attentional undergoings along kairotic flows as opposed to
450 intentional acts over time. Baygin et al.'s (2021) modalities of timing, attentionality and
451 undergoing align with how Ingold's (2015) new conditions of possibility for action are
452 created, sensed, and actualised during correspondences among flowing lines of action.

453 **5. Benefits and tactics underlying DEIBA**

454 DEIBA is the notion that a firm can gain competitive advantage from engaging in creating
455 diversity, equity, inclusion, and belonging in their workplaces and communities to form
456 a source of competitive advantage that comes from the firm's ability to generate
457 innovations, superior financial performance, and social performance from DEIB. The firm
458 could leverage existing DEIB or the DEIB it pays attention to create. The advantage is
459 sustainable because the firm does not only garner its own benefits but also generates
460 distinctive value for the women in mining and the underrepresented sections of society,
461 which can create a self-reinforcing cycle of benefits between a firm and employees. To
462 assess the mining firm's benefits from workplace DEIB, it is important first to understand
463 the concept of value creation for firms.

464 **5.1 Shared value creation for the mining firm**

465 The main purpose of a for profit mining entity is to maximise the future value to
466 stakeholders, such as shareholders, employees, communities, suppliers, and
467 customers. The economic value is achieved by maximising return on invested capital
468 (Nadeem et al., 2020) in ways that mitigate business risk (Laukkanen & Tura, 2020) and
469 that produce returns for capital providers over a reasonable time horizon (Fisher, 2017).
470 Return on invested capital flows from the profits generated by a firm in relation to the
471 capital invested. Human capital is one such important flow, with the ability to perform all
472 the correspondence formulations of timing, attentionality and undergoing.

Mitigation of business risk is achieved when mining firms avoid actions and strategies that may negatively impact operations. Some of the leading risks for the mining firm include an ageing workforce and skills shortage (Sokolowski et al., 2022), community unrest (Caron et al., 2019), rapid technological changes (Litvinenko, 2020), supply chain risks (Van den Brink, 2020), and climate change (Sonter et al., 2020; Litvinenko, 2020; EY, 2023). The idea of time horizon accounts for how long it will take a firm to consistently turn a profit such that it generates a positive return on invested capital. However, from the socio-technological transformation perspective, this variable also accounts for kairotic timing of action in flow. Value is generated through timing, attentionality and undergoing to take advantage of opportunities through actualisation. The mining operation strive to do this by exploring, exploiting, processing, and marketing extractives at a price that exceeds costs. This is the main reason why modernisation is proposed as a panacea for deepening mines and declining ore grades in South Africa, to create and capture value (Bertayeva et al., 2019; MCSA, 2019). For the mining industry, what is more important is creating shared value, where all stakeholders benefit from the natural resources, typically mined in remote areas where land is commonly owned on a communal basis (Fraser, 2019).

For other industries, such as manufacturing and retailing, firms create value in the following ways: (1) increasing their volume of sales, (2) decreasing costs, (3) increasing their price point, or (4) undertaking a combination of these (Fisher, 2017). A mining firm does not typically determine the price or quality of ore but can control volumes and manage costs. Modernisation of the mining industry aims to increase volumes, extend the life of the mine, and improve blasting efficiencies while enhancing safety. Long-term shared value is created beyond the generation of immediate economic returns if mining firms provide benefits to stakeholders by meeting the deeper needs of customers, suppliers, employees, capital providers, local communities, and others who can affect or can be affected by a mining operation. More empirical evidence suggests that creating value for various stakeholder groups benefits the firm by building trust and social capital (Fraser, 2019).

The need for innovative value creation and capture in the mining industry is urgent because of changing market dynamics, including the urgency of clean sources of energy supply, environmental concerns, the finite nature of minerals and metals, and the challenges of lower-grade deposits (Kashan, 2021). The mining industry is left volatile, pressuring companies to question their status quo and re-think their approaches to value creation (Deloitte, 2019). The industry has responded to these challenges through timely

transformative efforts, including applications of innovative technologies, such as artificial intelligence, machine learning, the industrial internet of things, virtual reality, drones, and autonomous driving (Dehran et al., 2018; Deloitte, 2019; Rogers et al., 2019). As several studies suggest, the application of these technologies can increase productivity and efficiency and improve health and safety conditions in hazardous mining environments. Further, these technological innovations provide mining firms with learning opportunities to develop the knowledge and capabilities they need to deal with emerging threats and opportunities (Marin et al., 2015). Some typical threats that the mining industry is facing include social licence risk and skills shortages. Both could be addressed through DEIB in the industry. However, it remains unclear how DEIB garner advantages and benefits for mining firms.

Together, the arguments raised here suggest that value creation for mining firms can come directly from maximising economic returns, or it can come indirectly by providing increased value to members of a firm's essential stakeholder groups (Fisher, 2017). In both cases, innovation is key for creating and capturing value. Having examined the basics of value creation for firms, it is now possible to delve deeper into how a firm's engagement in diversity and inclusion may enhance value creation.

525

5.2 Workplace DEIB and mining firm value creation.

The garnering of firm value from engaging in DEIB is predicated on the assumption that a firm can effectively diversify its workplace, foster equity, engage in inclusivity, and belonging initiatives to the point where the firm benefits from cross-pollination of ideas and trust that builds within the workforce, enabling timely and attentional actualisation of opportunities. Further, it is assumed that DEIB is much more appealing to the broader stakeholder network, allowing the firm to garner legitimacy and a continuous flow of human, financial and social capital (Fisher, 2017). It is argued that DEIBA explores symbiotic relationships between two embedded mesolevel social units—a firm and a workforce—where a workforce is a unit embedded within the organisation, interacting and corresponding with its boundaries of stakeholders and their activities.

537

Below a certain level of DEIB, it is assumed that the firm will suffer from innovation malnutrition and the negative effects of a lack of trust and legitimacy from the various stakeholders, including funding from investors and stakeholders (Fisher et al., 2016). In

the case of a firm engaging in diversity and inclusivity, the benefits from those initiatives are assumed to flow once the firm has diversified and included enough to the workplace to be perceived as a legitimate participant and for both the mining firm and the workforce to begin to benefit from timely, attentive actualisation (Sasikala & Sankaranarayanan, 2022). If this assumption holds, then a firm may derive benefits that can be understood with respect to the innovation, economic, environmental, social and governance capital elements (Johansson & Ringblom, 2017), as discussed below. The theoretical basis for a firm creating DEIBA could be explained from the literature on the female sphere, which asserts that a female culture provides the basis for redefining the goals and restructuring the change process (Jaquette, 1982). The benefits, correspondence (timely, attentive, actualised) tactics, and firm attributes underpinning DEIBA are summarised in Figure 4, foreshadowing the following arguments and propositions.

5.2.1 Economic and financial benefits of DEIB

Evidence from research suggests that society benefits from a diverse workforce. The basic argument often raised is that an equitable representation of minorities and women in the workplace indicates social justice and equal employment opportunities (Johansson & Ringblom, 2017). In addition, workgroup diversity has been found to also yield economic benefits through a) enhancing customer relationships, b) creativity, flexibility, and innovation, c) reducing the costs associated with turnover, absenteeism, and lawsuit, d) promoting development and sustainable business advantage, e) promotes work and cost relationship effectively by using the better talent of employees (Suharnomo, 2017). A study of over 20 000 firms in 91 countries yielded results that suggest that companies with more women in leadership positions showed better financial performance than companies with fewer women in the upper echelons (Noland, 2016). Similarly, a 15-year panel data study of the Standard and Poor 1500 firms revealed that female representation in top management correlates positively with innovation (Deszo, 2012). The findings are not limited to a few studies because a meta-analysis of different firm sizes more generally demonstrate that employee diversity is related to more innovative performance, particularly on complex tasks (Suharnomo, 2017). Meanwhile, companies with functionally diverse top management teams hold product portfolios that contain more products that are new to the market or employ novel technologies than companies with homogeneous top management teams, and this benefits firm capital market performance (Tobin's q) (Talke et al., 2011).

574 Research in the mining sector in South Africa showed that worker participation in
575 equipment development can result in improved user acceptance and product quality
576 ([Pelders, and Schutte, 2021](#))

577 **6. Constraints of modernisation DEIB**

578 The modernisation of the mining industry has been slowed by the historical context and
579 workplace culture of the mining industry (including leadership, trust, training,
580 performance, and remuneration factors), which were found to be barriers to the
581 implementation of new technology ([Pelders and Schutte, 2021](#)). Although evidence
582 supports the notion that diverse work teams have the potential to be more creative and
583 innovative, make higher quality decisions, and yield superior joint performance than
584 homogeneous teams, rendering striving for greater work group diversity advantageous,
585 in practice, it has not been easy to achieve DEIB, or managing diversity and inclusion in
586 the workplace ([Patrick & Kumar, 2012](#)). One serious challenge has emerged from fusing
587 the younger generation of workers to work alongside the ageing workforce. This has
588 caused serious challenges for line managers who find themselves ill-equipped to deal
589 with this diversity ([Kansake et al., 2021](#)). Another important observation relates to the
590 divergence between the expected behavioural norms for each diversity category and the
591 actual norms exhibited. For example, we would say that elderly women are more likely
592 to handle labour issues better, yet sometimes this contrasts with their actual behaviour
593 in practice ([Patrick & Kumar, 2012](#)). Even in cases where these people could genuinely
594 exhibit diverse norms, identifying, selecting, and socialising new employees on their own
595 could create homogeneous as opposed to heterogeneous workplaces ([Pelders &
596 Schutte, 2019; Kincaid & Smith, 2021](#)). Therefore, it would be useful to look beyond
597 demographics, such that differences between individuals are also meaningful at a
598 deeper level and represent different approaches to the tasks ([Kansake et al., 2021](#)),
599 although their behaviours underpin and support the broader organisational goals and
600 values.

601 The fit-in-or-opt-out syndrome is a major challenge for women and minority groups who
602 join new work environments ([Duke, 2020](#)). New employees are pressured to fit in and
603 be like the rest of the employees to thrive for workplace legitimacy ([Kincaid & Smith,
604 2021](#)). Minorities exhibit behaviours like their peers and, in the process, diminish the
605 benefits of diversity. Alternatively, they fail to cope with the unattainable position of being
606 the minority in the workplace ([Duke, 2020](#)). Some of the challenges that have been
607 identified in literature include the difficult of balancing the individual needs of people and
608 group justice, dealing with resistance to change, ensuring group cohesiveness and open

609 communication, avoiding resentment and backlash of employees, and maintaining
610 respect for the performers, and maximising opportunities to grow for all members of the
611 organisation ([Suharnomo, 2017](#); [Kansake et al., 2021](#)).

612 Meanwhile, some scholars recognise the role that men could play in advancing diversity
613 due to their personal experiences; the need for greater economic good; and an ethical
614 commitment to equity ([Kincaid & Smith, 2021](#)). However, there are several barriers to
615 men advocacy including the difficulties inherent in: 1) negotiating power and gender
616 dynamics; 2) uncertainty as to how best to be an ally; 3) sustaining ally and advocacy
617 work long-term; and 4) establishing legitimacy as a male advocate ([DuBow & Ashcraft,](#)
618 [2016](#)). Taken together, these arguments and examples suggest the following
619 proposition.

620 *Proposition 1: Firm engagement in DEIB generates economic benefits stemming from*
621 *increased heterogenous knowledge sharing plus insights into cost reduction and*
622 *mitigating skills shortage risks, which contribute to DEIBA.*

623

624 **7. Economic benefits oriented DEIB tactics**

625 Worker engagement processes should include securing management commitment,
626 creating multidisciplinary teams, effective facilitation, shared understanding of needs,
627 training and development, and iterative design ([Pelders & Schutte, 2021](#)). Human-
628 centred design approaches and independent platforms for engagement on equipment
629 design requirements are recommended. It is argued that performance is strengthened
630 when firms make sure that individuals with different backgrounds work together, without
631 group-based prejudice and negative expectations spoiling the working relationship
632 ([Wang et al., 2023](#)). For example, in South Africa, in the apartheid era, white male
633 employees occupied senior positions while administrative positions were largely
634 preserved for white female employees ([Carim et al., 2022](#)). Elsewhere, studies in USA
635 revealed that a) Black workers receive less favourable performance appraisals and
636 advancement opportunities when they are late for work, while no such relation between
637 tardiness and rated performance was found for Whites, b) women and minorities receive
638 lower evaluations if they are pro-diversity, but men and whites who favour diversity do
639 not suffer this disadvantage, c) workers who feel discriminated against because of their
640 race not only have less positive job attitudes and are less likely to help others at work,
641 they also have poorer psychological and physical health outcomes, which together are

642 counterproductive, thereby compromising economic and financial performance of the
643 firm ([Ellemers and Rink, 2016](#)).

644 Three important tactics could be helpful for an organisation to reap the benefits of DEIB,
645 these are: a) safety: decisive social acceptance of diversity and inclusion- where the
646 organisation openly and explicitly develop a culture of tolerance and encourages
647 diversity for a physically and psychologically safe, healthy, and productive workplace.
648 Scholars have observed that the advent of technology has made it a lot more accessible
649 for women and the physically handicapped to enter the mining industry ([Peltier-Huntley,](#)
650 [2022](#)). Successful DEIB should guarantee the safety of women and minority groups. b)
651 security: shifting from diversity as core business to diversity as the core of the business-
652 women and minority groups would be more productive and psychologically secure when
653 drafted as core team members ([Lui et al., 2022](#)). Security also includes physical security
654 where women and minorities are not bullied, intimidated, or sexually violated.
655 Organisations must enforce strict anti-segregation and abuse policies and practices.
656 Organisations could also introduce diversity committees, multicultural workgroups,
657 advocacy groups, and language classes ([Valenzuela et al., 2022](#)); c) skills: Learning and
658 development-the organisation should provide adequate training for women and
659 minorities without compromising the development of other employees. Unless clear
660 policies, guidelines and practices are in place for the skilling and upskilling of women
661 and minority groups, there is a danger of modernisation excluding rather than ensuring
662 inclusivity ([Peltier-Huntley, 2023](#)). Intercultural training, workshops, personnel
663 development, formal recruitment, selection and assessment, mentoring or coaching are
664 all opportunities for enhancing the benefits of diversity and inclusion ([Suharnomo, 2017](#)).
665 A complication identified in the literature is that minority members feel more included
666 and satisfied and show more innovative performance in companies that explicitly
667 endorse a multicultural perspective, yet majority members feel more included when a
668 'diversity blind' perspective is adopted, thereby posing a dilemma for managers ([Lui et](#)
669 [al., 2022](#)). To make sure that the organisation caters for the minority and majority
670 employees at the same time, it is recommended that the benefits to the majority are also
671 communicated transparently to them so that they do not feel left behind ([Valenzuela et](#)
672 [al., 2022](#)). The skills development should include equipping line managers with the
673 prerequisite skills and expertise to handle diverse workplaces, including new employees,
674 minority employees, and employees with special needs (health, religious, and other
675 demographic peculiarities). Firms must focus on simultaneously building the capacity of
676 the current diverse workplace and, at the same time, emphasise building a pool of future

677 leaders through affirmative action plans, and establishing diversity roles and committees
678 ([Suharnomo, 2017](#)).

679 We propose that:

680 *Proposition 2 Improving psychological safety, security and building skills through training*
681 *and coaching for a diverse workplace strengthens the effects of economic and financial*
682 *benefits on DEIB advantage in modernising mining firms.*

683

684 **5.2.3 Environmental, Social and Governance Benefits**

685 In addition to the economic benefits, diversity and inclusion is also known to affect
686 broader business and community outcomes. These have often been labelled ESG
687 performance. ESG refers to the set of codes for a firm's operations that socially,
688 environmentally, and ethically sensible investors use to screen future investments
689 ([Chen, 2020](#)). From this standpoint, it is argued that ESG performance has important
690 implications on a firm's financial performance through increased investor support and
691 fostering goodwill. ESG is defined as the consideration of environmental, social and
692 governance factors alongside financial factors in the investment decision-making
693 process ([MSCI, 2019](#)). It is the mix of environmental and social activities of corporate
694 social responsibility (CSR) along with the corporate governance indicators ([Gerard,](#)
695 [2019](#)).

696 Extant literature suggests that diversity, equity and inclusion are important drivers of
697 ESG performance benefits. For example, when more different perspectives and
698 stakeholder groups are represented, a work team can cater to a larger variety of clients,
699 offer a broader range of products, and has the potential to build more community
700 credibility ([Doulatabadi, 2022; Williams Jr et al., 2022](#)). A study of residential and
701 business mobile phone records in the UK revealed that when there was more social and
702 spatial diversity in communication networks, communities showed a better record of
703 economic development, education, health, environmental quality, and less crime
704 ([Jongen & Scholte, 2022](#)). Research on the role of board diversity on the ESG
705 performance of firms is mixed; for example, [Velte \(2016\)](#) argued that board gender
706 diversity is an important aspect of corporate governance in inducing ESG performance,
707 whereas [Manita et al. \(2018\)](#) attested no significant relations between female members
708 of the BoD and ESG disclosure. However, considering these findings together could
709 explain the seemingly contradiction. For example, drawing from critical mass theory,

710 Yadav and Prashar (2022) investigated the implications of board gender diversity for the
711 environment, social, and governance (ESG) performance of Indian firms. It observed
712 that, a relatively small percentage of women directors has little impact on ESG
713 performance. Still, these relationships become more favourable when at least three
714 women directors are in place. Similarly, Menicucci and Paolucci (2022) investigated the
715 effects of board diversity in terms of board attributes (board size, board age, board
716 gender diversity, board independence and CSR (corporate social
717 responsibility/sustainability committee) on ESG performance in the banking sector in
718 Italy and found that the relationship between gender-balanced boards and ESG
719 performance is positive but the impact of female directors on ESG performance is non-
720 linear when a critical mass of women is reached. Similarly, Shakil et al. (2021) find a
721 strong positive relationship between board diversity and ESG performance in UK banks.

722 Therefore, where there is little or no relationship between ESG performance and
723 diversity could be explained in terms of either lack of critical mass or the inverted U-
724 shaped curve where beyond a certain threshold, diminishing benefits of diversity set in.
725 The explanation for women's higher performance in ESG is often attributed to their
726 nature as more sensitive toward sustainability initiatives than men because of female
727 psychological traits such as helpfulness, sensitivity, educational backgrounds,
728 psychological characteristics, and professional experience. However, there are also
729 circumstances when skilled women may be more expert than men in ESG issues.

730 At the managerial level of analysis, studies have found that firm-corporate governance
731 characteristics can be matched with firm-level carbon dioxide (CO₂) emissions. For
732 example, Altunbas et al. (2022) studied the relationship between gender diversity in the
733 workplace and firm carbon emissions and found that a 1 percentage point increase in
734 the percentage of female managers within the firm leads to a 0.5% decrease in
735 CO₂ emissions, documenting that this effect is statistically significant, when controlling
736 for institutional differences caused by more patriarchal and hierarchical cultures and
737 religions. More interestingly, the study showed that gender diversity at the managerial
738 level has stronger mitigating effects on climate change if females are also well-
739 represented outside the organisation, e.g., in political institutions and civil society
740 organisations. An analysis of results generated after the Paris Agreement further
741 showed that firms with greater gender diversity reduced their CO₂ emissions by about
742 5% more than firms with more male managers. This is explained by women's inclination
743 toward being less overconfident and having greater perception of risk, such that they
744 are less likely to underestimate the consequences of their decisions on the environment

745 or to overestimate their ability to come up with proper solutions. Some scholars have
746 argued that women seem to be more ethical than men as they are more inclined than
747 men to believe that questionable actions like taking bribes, breaking the rules, and
748 misusing private information are unethical (Arnaboldi et al., 2021; Hanousek et al., 2019
749 & Cardillo et al., 2021). Consequently, endorsing policies that are damaging to the
750 environment might be considered by women as unacceptable, even comparable to fraud
751 (Altunbas et al., 2022).

752 In emerging countries, such as South Africa, that have a long history of intercultural
753 mixing gain an advantage if their workforce reflects that diversity. They are able to
754 understand and better serve their stakeholders and attract and keep the best employees
755 from a diverse labour pool. All these diversity-derived benefits lead to greater
756 performance and higher profits (Daniel, 2011). Because of the articulated arguments,
757 we propose that:

758 *Proposition 3: Firm engagement in DEIB generates ESG benefits stemming from*
759 *increased legitimacy, which gives rise to social licence to operate and investor*
760 *confidence in the mining firm.*

761

762 **8. Environmental, social, and governance oriented DEIB tactics**

763 Regulators and standard-setting bodies are emphasising the gender diversity of the
764 board, equality, and inclusivity. Gender equality is one of the major agendas of the
765 United Nations Development Programme (UNDP) “2030 Agenda for Sustainable
766 Development Goals” to promote women’s empowerment (United Nations Development
767 Programme, 2015). Leveraging resources dependence and legitimacy theories,
768 scholars have demonstrated that diversifying boards and ESG reporting are important
769 tactics to enhance performance and build credibility, respectively. For example,
770 Resource dependence theory explains that firm performance depends on the critical
771 resources that board members hold such as background, psychological characteristics,
772 and experience (Kyaw et al., 2017; Manita et al., 2018). An important tactic for firms to
773 enhance their benefits from diversity, equity and inclusion would be to meticulously
774 identify and enrol diverse boards that are skilled and have the psychological
775 characteristics and experience that foster ESG performance. Such diverse boards would
776 leverage women’s expertise and inclination towards ESG deliverables, thereby helping
777 firms to take strategic decisions and navigate pressures from stakeholders with the help

of collective expertise and experience of the board members (Hillman and Dalziel, 2003; Post et al., 2015). Extant literature suggests that female board members have different perspectives and opinions compared to male board members (e.g., Burgess and Tharenou, 2002). Boards that have more women representation and more diverse independent board members are known to be more inclined to form sustainability-themed alliances which enhance corporate environmental performance (Post et al., 2015). Following the raised arguments, we propose that:

Proposition 4: ESG-oriented tactics in the form of ESG reporting and strategic enrolment of women board members strengthen the effect of ESG benefits on creating DEIB advantage through building credibility and legitimacy for the firm and enabling effective engagement with stakeholders.

5.2.4 Innovation and technology benefits of diversity and inclusion

Diversity and inclusion literature has identified innovation and technology benefits stemming from diverse and inclusive workplaces. The benefits are generated from enhanced creativity, flexibility, and innovation (Suharnomo, 2017). Innovation benefits from increased networks and utilisation of external resources for the good of the organisation. Daniel (2011) likened diversity to a Hubble Space Telescope, with multiple lenses to see along a broader spectrum of light than can the human eye, arguing this gives diverse companies multiple simultaneous views of a single issue, thereby providing a clearer and more accurate picture than their homogeneous competitors can achieve. Thus, diverse workplaces provide firms with creativity to innovate and solve complex or novel problems (Prieto et al., 2009). When technology is used to facilitate diversity, as is the case with the modernising mining industry, integrating diversity technology into the work experience is important for several reasons. Employees must be able to understand how the technology helps them do their job (Job relevance) and interact with it on a regular basis.

The benefits of using technology can be achieved when certain anchors are put in place. In diverse workplaces, it is important to ensure both computer self-efficacy and cultural self-efficacy, which means the degree to which an individual believes that he or she could perform a specific task/job in a culture-rich environment, something similar to a self-assessment of one's computer savviness and cultural IQ (the ability to manage under culturally diverse workplaces) respectively (Ott, 2018; Stoermer et al., 2021).

811 Research suggests that cultural intelligence is positively related to knowledge sharing,
812 which is important for innovation (Stoermer et al., 2021). Similarly, cultural anxiety is the
813 degree of an individual's apprehension, or even fear, when she/he is faced with the
814 possibility of having to deal with a culture-rich environment to avoid bad experiences
815 from crippling the employees. This is supported by computer playfulness and cultural
816 spontaneity to capture the wonder of the unexpected interactions that happen in cultural
817 exchanges. The processes call for correspondence, where timing, attentionality and
818 actualisation are pursued with a lot of adjustments. Where the target is luring the young
819 employees as a diversity strategy, increasing the perceived enjoyment and objective
820 usability is needed (Baygi et al., 2021). Put differently, technology can be sustainable if
821 it is relevant for encouraging diversity (which is commonly referred to as job relevance),
822 output quality (it must provide output that benefits the firm), and result demonstrability
823 (it should be possible to demonstrate value). Taken together, these arguments and
824 examples suggest the following proposition.

825

826 *Proposition 5: Firm engagement in diversity and inclusion generates innovation benefits*
827 *stemming from increased knowledge sharing and heterogeneity of creative thinking and*
828 *implementation of ideas from a diverse pool of workers and management.*

829

830 ***Innovation and technology benefits-oriented diversity and inclusion tactics***

831 Rhee and Stephens (2020) demonstrate that an innovation-orientated technology
832 assimilation strategy enhances innovation capability and generates competitive
833 advantage and superior financial performance for the firm. This is not a surprising finding
834 considering that employees' creative thinking and innovation behaviours at work are the
835 cornerstones of any organisational innovation (He et al., 2019). In addition to personality
836 and innovative willingness, there is a need for organisational committed support for
837 innovation to actualise at the right time. Senior management must always pay attention
838 to opportunities for supporting innovation, even if it is by celebrating innovative success
839 (Lee & Esteve, 2023). This creates an organisational innovation climate. In the mining
840 firm context, innovation could mean establishing new processes, new business models
841 or new uses for equipment which are more efficient or cost-effective. For example,
842 remote blasting and other surface-controlled underground machinery are innovative

843 ways that have given women the capacity to do previously men-only tasks (Lahiri-Dutt,
844 2022).

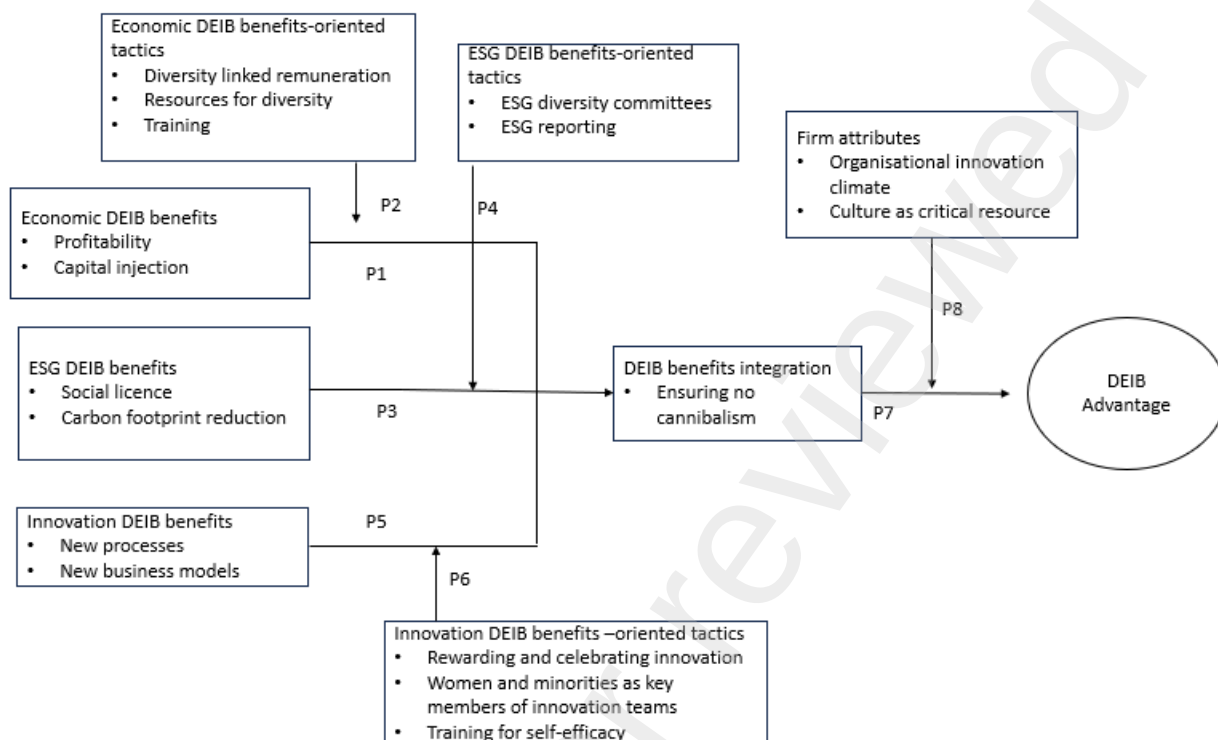
845 Further tactics for encouraging innovation in diverse workplaces could be understood by
846 distinguishing challenge stressors (arising when people see stressors as an opportunity
847 to develop) and hindrance stressors (i.e., arising when people see work stressors as
848 impossible to overcome and become helpless) (Cavanaugh et al., 2000). Previous
849 research reported positive relationships between challenge stressors and self-efficacy,
850 job satisfaction, and organisational affective commitment but negative relationships
851 between hindrance stressors and self-efficacy, job satisfaction, and organisational
852 affective commitment (He et al., 2019). Self-efficacy is generated from previous success,
853 vicarious experiences, persuasion from others, and physiological and emotional states,
854 such that an individual who sees supervisor support and receives information and
855 resources as appropriate for the job has higher self-efficacy. Therefore, organisations
856 must continue with an ongoing assessment process wherein challenge stressor
857 perceptions are constantly modified by experience and acted upon. Employees thrive in
858 an environment that encourages creative thinking and creative implementation.
859 Management must remain committed with resources and attention for ongoing
860 innovation to take hold in the organisation. We, therefore, proffer the following
861 proposition:

862

863 *Proposition 6: The DEIB advantage that flows to a mining firm from the benefits of*
864 *innovation is enhanced by senior management support, knowledge sharing, resourcing*
865 *(including for R&D), challenge stressing and documenting and celebrating innovation.*
866 *Diverse workplaces garner advantages when employees use creative thinking and*
867 *creative implementation.*

868

869



870

871 **Fig 4:** A theoretical framework of benefits, tactics, and firm attributes garnering DEIBA

872 5.2.5 Integration of DEIB benefits

873 The benefits of DEIB flow from different logic. For example, ESG benefits are sometimes
 874 viewed as a contradiction to the economic benefits of financial performance, profitability
 875 and expanding market share (DasGupta & Roy, 2023). On the other hand, some
 876 scholars argue that ESG performance contributes to financial performance (Toti &
 877 Johan, 2022). Evidence suggests that achieving a social licence to operate, for example,
 878 could be a source of access to resources in host communities (Moffat & Zhang, 2014).
 879 Considering this important argument, we proffer that Integration of all the identified
 880 benefits is important to ensure they do not cannibalise each other. Our model assumes
 881 that the pursuit of economic benefits should not be at the expense of ESG, or at the
 882 expense of innovation benefits generated by diversity. In other words, DEIB are
 883 mechanisms for the firm to achieve all three sets of benefits identified as economic, ESG
 884 and innovation. Organisation leadership must timely, intentionally actualise
 885 opportunities (Baygi et al., 2021) for taking advantage of the wide range of benefits for
 886 DEIB advantage. Following these arguments, we propose that:

887

888 *Proposition 7: The flow of diversity, equity, inclusion and belonging advantage that the*
889 *firm achieves is optimised when economic, ESG, and innovation benefits are integrated*
890 *and intertwined in a unified correspondence based on timing, attentionality and*
891 *actualisation.*

892 **5.2.6 Firm attributes for DEIBA**

893 Not all firms are the same, and because of that, they will not all be as effective as one
894 another in garnering benefits for DEIBA. Firms differ significantly in the nature of
895 workplace diversity, equity, inclusion and belonging. DEIBA is created when a firm and
896 its workers garner benefits from engagement in DEIB as the mining industry modernises.
897 The concept of modernisation, the dynamic nature of flows and correspondence (timing,
898 intentionality and ongoing) associated with DEIBA, and the types of benefits that accrue
899 from DEIB help distinguish which types of firms are most suited for DEIBA.

900 As highlighted previously, the original conceptualisation of modernisation was based on
901 the duality of traditional and modern. It has been criticised for being static and
902 uninspiring. Specifically, it has been criticised for failure to recognise the historical
903 context in which modernisation as a social process unfolds ([Navickienė, 2023](#)). For
904 understanding modernisation in emerging markets, the historical unfolding of events
905 becomes very critical, especially when discussing diversity and inclusion in the mining
906 sector that traditionally was very exclusive and heterogeneous, with women totally
907 excluded from working in the mines by law as the was the case in South Africa ([Nkomo,
908 & Balfour 2022](#)). A discussion about diversity that does not consider the
909 underdevelopment of emerging markets through colonialism will not adequately unpack
910 the intricacies and nuances of the modernisation processes. And DEIBA is predicated
911 on firms, and their employees, garnering three types of benefits-economic and financial,
912 ESG and innovation benefits, from undertaking DEIB. The foundational insights outlined
913 here point to two distinguishing features that make some firms better suited to DEIBA
914 than others: firms with a dynamic organisational climate and firms that leverage culture
915 as a key resource.

916

917 **Organisational climate as dynamic correspondence**

918 Diversity and inclusion are, by their very nature, change processes, and the complexity
919 is exacerbated in a mining industry undergoing modernisation. A static organisational
920 climate cannot inspire creative thinking and creative implementation. As mining firms

921 are modernising, there is a growing need for innovative thinking in how diversity and
922 inclusion could be achieved for creating diversity inclusion advantage. However,
923 innovation is a complicated and high-risk behaviour involving many uncertainties, such
924 that employees often encounter problems and risks that produce unclear results when
925 engaging in innovative behaviours regarding creative thinking and problem-solving (He
926 et al., 2019). As Hirst et al. (2018) argued creativity is not only a personal phenomenon,
927 but the organisational context is also an important factor that influences creativity,
928 underscoring the importance of both personal and organisational factors as the core of
929 individual creativity. Employees, therefore, make sense of organisational support for
930 innovation by interpreting various organisational management practices to determine
931 the presence of creativity and innovation behaviour to reduce the risk of punishment or
932 embarrassment (Durrah, 2022). This environment has been labelled as organisational
933 innovation climate, defined as a perceptual description of the organisation's work
934 environment, including whether the organisation is incentivised to innovate, the
935 resources provided by the organisation, and the level of innovation in management
936 practices (He et al., 2019), to garner DEIBA.

937 Drawing from socio-technological transformation theory, we argue that organisational
938 innovation climate must be created as correspondence for garnering diversity inclusion
939 advantage (Baygi et al., 2021). The organisation must pay particular attention to
940 opportunities for innovation and timely avail resources and support to diverse teams,
941 recognising the need for women and minority groups to be fully integrated into work
942 teams and diversity committees (Fraser, 2019). This allows for ongoing actualisation
943 where employees engage in creative thinking and creative implementation of tactics and
944 plans at the right moments for achieving DEIBA. Further, socio-technological
945 transformation theory assumes an organisation that allows for free information and
946 knowledge sharing, which are not bounded by departmental, cultural or gender or
947 demographic differences (Baygi et al., 2021). These boundaries diminish, allowing for
948 co-responsive interaction, innovative thinking, and creative implementation of tactics in
949 timely, attentional, ongoing ways to garner DEIBA (Hund et al., 2021). In Australia, risk
950 tolerance, creativity and trust were found to be the most critical values supporting
951 innovation in mining organisations (Kashan, 2021).

952 **Culture as a critical resource**

953 Firms may be heterogenous in the extent to which they draw on culture as a resource
954 to drive or support their strategy and forge relationships and connections with key
955 stakeholder groups, including employees and communities (Fisher, 2019). Cultural

resources refer to the manifestations of the values, norms, and preferences of individuals in a specific sector of society (Kellogg, 2011; Fisher, 2019; Kashan, 2021), as deliberately reflected in a firm's identity claims (Irwin, Lahneman & Parmigiani, 2018; Whetten, 2006), symbols (van Wijk & Finchilescu, 2008), and stories (Gattai & Natale, 2017). For example, research shows that several organisations fail to innovate due to a lack of a supportive culture (van Wijk & Finchilescu, 2008). The mining industry has been identified as having a dominant risk-averse mindset which is compounded with other barriers, such as capital intensiveness, frequent market fluctuations, and siloed and bureaucratic structures, such that developing an innovation culture is necessary for the future survival of the industry (Kashan et al., 2021).

Culture is an important resource in mining which has reached an inflection point characterised by an increase in the importance of social licencing for mining operations, the urgency of clean sources of energy supply, the finite nature of minerals and metals in the bedrock, and difficulties with lower-grade new deposits (which are typically difficult to access and often in geographically remote regions) (Gruenhagen & Parker, 2020). However, mining, being a traditional industry, is faced with cultural barriers to innovation like risk-aversion, rigid structures and top-down decision-making which have been found to slow down the creation and implementation of novel solutions (Bartos, 2007). In the context of diversity and inclusion, these structural rigidities prevent innovation and result in women and minorities failing to make a transformative impression.

Some scholars have even argued that organisational culture is more powerful than the organisation's strategy and structure (Zheng et al., 2010), influencing employees' behaviours beyond formal control systems, procedures, and authority (O'Reilly et al., 1991). To that effect, organisations that conceptualise culture as a key resource adopt an adhocracy culture (which offers flexibility and an external orientation) to support innovation (Hartnell et al., 2011; Naranjo-Valencia et al., 2011) through creativity, entrepreneurship and risk-taking. This is manifested as cultural values that promote innovation and are enforced by the organisation's structures, policies and day-to-day artefacts, practices, and procedures (O'Reilly and Tushman, 2008).

Therefore, cultural resources serve as a critical connecting point between a firm and its diverse workforce, and firms that leverage culture as a resource to drive or support their strategy are in a stronger position to generate the economic, ESG and innovation benefits associated with DEIBA. It is argued that firms benefit significantly from garnering critical thinking and implementation when they leverage culture as an essential resource.

991

992 *Proposition 8: Proposition 7: The economic, ESG, and innovation benefits that flow to a*
993 *firm from diversity, equity, inclusion and belonging are stronger for a firm that creates an*
994 *organisational innovation as correspondence (timely, attentional ongoing), and which*
995 *uses its culture as a key resource to garner competitive advantage.*

996 The two firm attributes—organisational climate as correspondence and culture as a key
997 resource—set apart a select category of mining firms that are more suited to DEIBA.
998 The category of firms with these attributes are more seamlessly and naturally able to
999 generate economic, ESG, and innovation benefits from engaging in diversity, equity,
1000 inclusion, and belonging, and those without these attributes may find it more challenging
1001 and less beneficial to establish and garner benefits from DEIB.

1002

1003 **9. Discussion**

1004 This article examined the benefits, tactics, and attributes that allow a firm to generate
1005 competitive advantages from engaging in diversity and inclusion as a key strategy. The
1006 theory developed here addresses calls for scholars to identify opportunities for DEIB in
1007 a modernising mining industry (Clausen & Sørensen, 2022) and elaborates on
1008 suggestions in prior research that diversity and inclusion may impact firm knowledge
1009 creation, competitiveness, and growth (e.g., Gallego, 2018).

1010 DEIBA complements prior competitive strategy perspectives, such as resource
1011 dependence theory (Freeman, 1984) and the resource-based view (Barney, 1991;
1012 Wernerfelt, 1984), and legitimacy theory (Dube & Maroun, 2017) in that it identifies
1013 highly relevant and important resources (women and the minority workers, and culture)
1014 for many modern-day firms and isolates an alternative set of means by which firms can
1015 increase competitive advantage in the market and create value for other firm stakeholder
1016 groups in the process (Fisher, 2017). Recognising DEIB as a source of firm advantage
1017 provides a partial explanation for why some mining firms, with resource constraints and
1018 limited power, can compete with and sometimes outperform larger, more established
1019 mining corporations as the mining industry reaches a tipping point on the modernisation
1020 trajectory. By effectively, timely, attentively and on an ongoing basis engage in DEIB -
1021 and generating economic, ESG and innovation benefits —these firms create value for
1022 multiple stakeholder groups and generate bionic competitive advantages. DEIB, thus, is
1023 a strategic consideration that may explain why and how some emerging mining firms

survive, thrive, and even outcompete more established and well-resourced incumbents, leveraging the integration of technology and people.

To elaborate on DEIBA and further explore its implications for research and practice, in the following sections we highlight the risks of firm engagement in DEIB, examine the implications of DEIBA for strategy and mine modernisation research, and consider the practical implications of DEIBA.

9.1. Risks and Challenges of Firm Engagement in DEIB

The focus of the theory developed here is on the benefits of firm engagement in DEIB. It is, however, important to flag out the possible risks and challenges for firms as they engage with DEIB. First, although DEIB may provide a firm with distinct economic benefits, the implementation of DEIB in the mining industry has been difficult due to the traditional resistance to change, which gives rise to inflexibility (Qi, 2020; Nwaila et al., 2022). As already noted, diversity and inclusion garner advantages when an organisational innovation climate exists, and organisational culture is regarded as a key resource; otherwise, diverse workplaces can breed segregation, and group incompatibility, which may result in high turnover (Ferguson and Koning, 2018). ESG benefits generated from DEIB are garnered under specific conditions. For example, studies show that certain thresholds of women should be achieved, and organisational diversity should be supported by external diversity in government and other stakeholder groups for DEIB to bear fruit (Gharbi & Othmani, 2023). Innovation benefits are garnered when people brought in as a strategy of diversity, and inclusion are innovative thinkers and implementers (DuBow & Ashcraft, 2016). Otherwise, diversity which is not based on merit could backfire.

Mining firms are quite unique in terms of the nature of work, the workplace environment and the stigma associated with women and minorities in the workplace due to historical legacies (Sasikala & Sankaranarayanan, 2022). When diversifying in emerging markets, these legacies must be taken into consideration. Another huge risk lies in incorporating Generation Z into the mining workplace. Their work patterns are totally different from past generations, which makes it difficult for managers to deal with them. This is compounded by the fact that diversity categories continue to rise with the emergence of digital nomads, hybrid employees, and remote employees (Nash, Jarrahi, Sutherland & Phillips, 2018). Where diversity involves the use of robots, there are ethical issues (Murashov, Hearl & Howard, 2016), especially in emerging markets where poverty and unemployment are high (Li & Wang, 2023).

Affirmative action has often been advanced to achieve DEIB. However, in practice, there is the danger of disenfranchising other workgroups if affirmative action is not well communicated and the benefits of this action to the other groups are well-articulated (Sunam, Pariyar & Shrestha, 2022). The logics of the minorities and majority worker groups rarely conform, thereby demanding that diversity-oriented firms be cognisant of this reality and make decisions accordingly (Hoang, Suh, & Sabharwal, 2022).

So even though mining firms can benefit from engaging in DEIB, giving rise to DEIBA, those same benefits can also create risks and challenges, which may have adverse effects and create firm disadvantages instead. From a theoretical standpoint, future research can examine the tensions between DEIBA and firm disadvantages from DEIB and identify mechanisms for mitigating such disadvantages. Meanwhile, from a practical standpoint, managers may benefit by being aware of the risks and challenges of DEIB such that they can avoid risks and maximise benefits for DEIBA.

9.2. Implications for Strategy and Socio-Technological Transformation Research

DEIBA leverages socio-technological transformation concepts to make issues related to diversity and inclusion theoretically and practically relevant for strategy and modernisation research. Although several strategy and modernisation scholars have used a socio-technological lens to study mine modernisation (e.g., Chipangamate et al., 2023), little research identifies DEIB as key drivers of organisational advantage or mechanism for mining firm growth. Furthermore, socio-technological systems theory studies generally utilise Actor Network Theory (e.g., Chipangamate, Nwaila et al., 2023). Incorporating the concept of correspondence into the strategy, mining modernisation, and diversity literature is helpful in generating a deeper understanding of how different elements of socio-technological transformation provide a competitive advantage for firms and serve as a means by which even less established mining firms might compete with more established and well-resourced incumbents. The DEIBA perspective proposed here opens many avenues for future research. First, although the theory developed here is focused on DEIB in modernising mining settings, the concept of DEIBA and the related economic, ESG and innovation benefits that stem from firm engagement in DEIB could be extended to other types of diversity modernisations and or employee groups other than women and minorities.

Second, there is an opportunity to develop measures of firm engagement in DEIB. This is necessary if the relationship between firm engagement in DEIB and bionic competitive advantage is to be empirically examined. That way, assessing and understanding the

magnitude of advantage that firm engagement with DEIB can generate would be pertinent. Admittedly, this could prove to be a difficult task considering that there are so many factors affecting firm performance and competitive advantage (Korherr & Kanbach, 2023), but as scholars become better at isolating and measuring sources of advantage (e.g., Fitza, 2014), it might be possible to assess how much advantage firms generate from engagement in DEIB. Third, it would also be valuable to delve into rich case study data of firms that have created diverse and inclusive workplaces. An analysis of this type of data may illuminate the mechanisms and processes that account for firm engagement in diversity and inclusion and what role firm managers, boards and others play in facilitating such diversity and inclusion. This should offer insights into the longitudinal processes that underlie firm engagement in DEIB.

10. Conclusion

The bionic advantages presented by the ongoing era of mining modernisation have brought to light a pivotal factor that propels firms towards unparalleled competitive prowess – the wholehearted embrace of diversity, equity, inclusion, and belonging principles. While the amalgamation of DEIB and competitive advantage has been a topic worthy of exploration, the empirical investigation into this nexus remains relatively embryonic, with prior research only offering tantalising glimpses into its potential. However, the comprehensive framework of DEIB advancement outlined in this paper casts a revealing spotlight on the multifaceted advantages, strategic methodologies, and distinctive attributes that empower certain enterprises to incorporate diversity and inclusion and strategically wield them as potent tools for gaining an edge in the market. By harnessing the power of DEIB, organisations reap an array of benefits extending beyond the confines of traditional business paradigms. The integration of diverse perspectives, experiences, and talents not only fosters a richer creative milieu but also fuels a wellspring of innovation, thus sculpting a unique competitive vantage point that is challenging for competitors to replicate.

Furthermore, the meticulously devised tactics elucidated within the DEIB framework equip firms with the means to attract top-tier talent and nurture a workplace culture that harnesses and amplifies the potential of everyone, regardless of their background or identity, an important aspect in an era when the mining industry faced with acute skills shortage. As the representation of women and minority workers within the workforce surges towards critical mass, the intrinsic connection between DEIB and competitive advantage assumes a heightened significance. Organisations that wholeheartedly grasp the DEIB framework and diligently implement its tenets are poised to capitalise on this

momentum, utilising the harmonious blend of diversity, equity, inclusion, and belonging as a driving force that propels them beyond industry standards. This burgeoning symbiosis is destined to transform the contemporary business landscape, steering it towards a future where enterprises flourish not merely by adapting to change, but by orchestrating it through the strategic orchestration of DEIB principles. Overall, the intricate interplay between workplace diversity, equity, inclusion, and belonging and the attainment of competitive advantage represents a realm ripe for exploration and strategic exploitation. This paper's approach to the DEIB framework lays bare the profound implications of this relationship, illuminating the path for enterprises to thrive amidst evolving paradigms and become architects of transformative change within their respective industries. The paper finds that DEIBA is a form of bionic advantage that flows from economic, ESG and innovation benefits, under conditions of an innovative organisational climate and when firms view culture as an important ingredient in their efforts. As the global workforce continues to evolve and diversify, the insights encapsulated within the DEIBA framework stand as an enduring testament to the bionic advantages that await those who dare to embrace diversity and inclusion as not just a strategy but as a dynamic catalyst for unparalleled success in the era of industries modernisation.

Competing financial interests

The authors declare no competing financial interests.

Data availability

No data was used for the research described in the article.

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