

The Fourth Industrial Revolution and the Political Settlement in South Africa's Mining Industry

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Abstract

Literature on the advent of 4IR has focused on the disruptive features of 4IR for the workplace and the role 4IR will play in enhancing economic growth and productivity. However, less is written about whether and how 4IR technologies may affect and be affected by the existing political settlement, especially in developing countries like South Africa. We investigate whether and how the adoption of technological advancements associated with

4IR would affect (and be affected by) the political settlements in South Africa's mining industry. We argue that the displacement of workers can shift the balance of power against organised labour and in favour of mining companies. Nonetheless, the impact of 4IR is not predetermined. South Africa's mining industry is a contested terrain, and the existing political settlement is likely to influence the process, pace, and extent of adopting 4IR technologies.

Introduction

It is widely acknowledged that technologies associated with the Fourth Industrial Revolution (4IR) may lead to the displacement of workers. The World Economic Forum (WEF) predicts that 75 million jobs may be displaced by 2022. At the same time, technological advancements are expected to create 133 million new roles (Schwab, 2018). Literature on the advent of 4IR has focused on the disruptive features of 4IR for the workplace and the role 4IR will play in enhancing economic growth and productivity. However, less has been written about whether and how 4IR technologies may affect and be affected by the existing political settlement, especially in developing countries like South Africa.

4IR is broadly described as the era of technological progress fusing the physical, digital, and biological realms. It is also distinguished by its exponential rate of occurrence and by its far-reaching ability to reorganise systems of production, communication, and transport (Schwab, 2016: 18). Political settlements, on the other hand, describe the distribution of power across relevant organisations (Khan, 2018).

In this paper, we seek to understand what the adoption of 4IR technologies, and the resulting displacement of workers, could mean for the political settlement in South Africa's mining industry. We explore the questions of whether and how the adoption of technological advancements associated with 4IR would affect (and be affected by) the political settlements in South Africa's mining industry. We use the case of South Africa's mining industry to argue that the wide adoption of technological advancements associated with 4IR has the potential to shift the balance of power in the mining industry. The displacement of workers in the mining industry could weaken trade unions in favour of the already strong mining companies. It would also weaken the alliance between trade unions and the ANC government. Weakening the alliance has implications for mobilising electoral support nationally and maintaining political power. Nonetheless, the impact of 4IR is not predetermined. South Africa's mining industry is a contested terrain, and the existing political settlement in the mining industry is likely to influence the process, pace, and extent of adopting 4IR technologies.

Understanding the potential impact of 4IR on the political settlement in South Africa's mining industry is important for several reasons. First, mining export earnings have contributed to and shaped the country's economy (Antin, 2013). Second, the economic rents generated by the industry's large mining companies have elevated the status of these companies within South Africa's political-economic landscape, with the distribution of rents triggering contestation (Auty, 2006). Third, the mining industry is still viewed as an important tool for inclusive economic growth and directly employs half a million people in the context of a 34.4% unemployment rate (Stats SA, 2021).

The Impact of Technology on the Labour Force

Early views on technology discourse have focused on technological determinism, the idea that changes in technology primarily influence social relations and economic development (Heilbroner, 1967). Critics of technological determinism argue that the effects of any given technology on society are either mutually reinforcing or depend on how the technology is implemented, as well as on the socio-political context (Smith and Marx, 1994; Scranton, 1995; Wajcman, 2002).

The advent of 4IR has been littered with literature emphasising the potential impact of 4IR on the labour force. One school of thought relates to the displacement effect of workers by technology. In their seminal paper, Autor et al. (2003) argue that technology can displace workers, where workers are engaged in tasks that can be simplified into algorithms for computers to perform (Autor et al., 2003: 1322).

Acemoglu and Restrepo (2018), on the other hand, argue that any technological effect on workers depends on the interaction between a 'displacement effect' and 'reinstatement effect' (Acemoglu and Restrepo, 2018: 4). The 'displacement effect' describes technology taking over work previously done by human labour and the 'reinstatement effect' describes the situation where technology creates new tasks where human labour has a comparative advantage over technological applications (Acemoglu and Restrepo, 2018: 3). As such, they hold that the introduction of technology does not automatically lead to the displacement of workers but rather it is the

type and mix of technologies that determines the fate of workers and the re-organisation of the workplace.

In 2019, the World Bank produced a report, *Changing Nature of Work*, in which it highlighted two effects of technology on work: changing skills and the emergence of new business models (World Bank, 2019: 5). Changing skills refers to the increased demand for skilled workers and skills grounded in deep human cognition and lifelong experiences (World Bank, 2019: 3–6). Such skills include higher-order problem solving, socio-behavioural skills, and predictive adaptability skills such as reasoning (World Bank, 2019). The new business model is the creation of new industries and jobs evolving around advanced digital production technologies such as Artificial Intelligence (AI), robotics, and automation (Bughin et al., 2018: 8).

The current literature on 4IR takes it as a given that the deployment of technological innovation will be widespread, disrupting the workplace and the role of workers. There lies a gap, however, in the knowledge about how the endogenous features of society, such as the distribution of political or economic power, could shape and be shaped by the impact of 4IR. Emphasising the potentially disruptive features of 4IR for workers and the workplace should acknowledge that decisions to adopt any technology should not be left to the logic of the market but must also consider non-market conditions. Also, the ‘reinstatement effect’ argument should be approached with caution as any discomfort, even if temporary, to some groups in society can lead to hardship and resistance, especially in developing countries with high unemployment rates (Mokyr, 1998). For example, technological innovations may be accompanied by a social response if powerful groups in society do not receive an acceptable distribution of benefits (Khan, 2010; Frederiksen, 2017).

This paper is set out in five parts. The first part evaluates the mining industry’s contribution to employment in South Africa. The second part looks at 4IR technology adoption in South Africa’s mining industry. The third part defines and describes the political settlement in the mining industry, with an emphasis on four stakeholders: mining companies, the ANC-led government, trade unions, and mining communities. The fourth part assesses the potential impact of 4IR on the political settlement and argues that the displacement of workers has the potential to shift the balance of power against

organised labour and in favour of mining companies. The paper concludes that the existing political settlement in the mining industry is likely to both be influenced by 4IR, as well as influence the process and extent of the adoption of 4IR technologies.

The Mining Industry’s Contribution to Employment in South Africa

South Africa is one of the most resource-rich nations in the world and has attracted large foreign investments. It has also created leading global companies such as Anglo American, De Beers, and Goldfields (Antin, 2013). The country has over 52 commodities and the world’s largest reserves of platinum, manganese, Chrome, Vanadium, and gold; as well as major coal and iron ore reserves (Lane et al., 2015). South Africa’s mining industry played a pivotal role in the country’s industrialisation and development. The industry also provided the impetus for the infrastructure that currently supports the more economically significant secondary and tertiary sectors (Antin, 2013; Hermanus, 2017).

The discovery of diamonds in 1867, followed by gold in 1886 on the Witwatersrand goldfields, was a turning point in South Africa’s political economy that marked the start of the state-led intervention in the recruitment of Black labour for the mines (Wilson, 2001: 101). The productivity of the mining industry was defined by the employment of cheap Black labour from South Africa and neighbouring countries. Black mineworkers were recruited into physically demanding and dangerous work underground, whilst their white counterparts were organised into skilled secondary roles (Mabasa and Chinguno, 2018: 304). These

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features still define the current distribution of power in South Africa's mining industry.

The country's remaining resource base is estimated to be worth over two trillion US Dollars, with the Platinum Group Metals (PGMs), gold, coal, and iron ore providing the most revenue (Antin, 2013; Goodman et al., 2019). Although the industry is well established, it has several productivity issues. Between 2007 and 2017, the industry declined by 4% and mining employment fell from a peak of 518,000 in 2008 to 464,000 in 2017 (Goodman et al., 2019). Even after experiencing a decline, mining remains an important sector of the economy, contributing between 8% and 10% of South Africa's GDP (Vandome and Khama, 2021). In recent times, the Minerals Resources and Energy Minister, Gwede Mantashe, has indicated that the mining industry has the potential to contribute 12% to GDP (Mantashe, 2021).

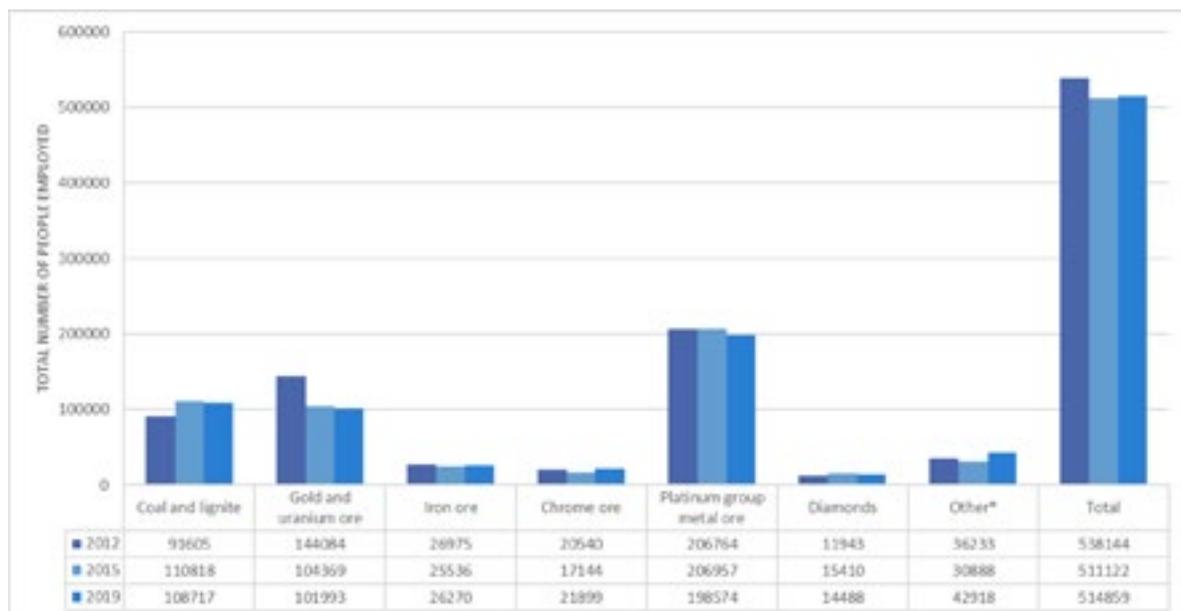
Figure 1 represents the total number of people employed in the mining industry (514,859) by June 2019. Employment changes differ by type of mine. The mining of platinum group metal ore employed the largest number of people (198,574; 38,5%), followed by coal and lignite (108,717; 21,1%) and gold and uranium ore (101,993; 19,8%) in 2019 (Stats SA, 2019a). In general, employment in the mining industry declined from 538,144 in 2012 to 514,859 in 2019 (a loss of 23,285 jobs) (Stats SA, 2019b).

The decline in the industry and resulting unemployment are due to several factors, including: ageing mines, deeper mineral ore deposits, and declining mineral grades (Goodman et al., 2019). The industry is also facing a dual challenge of high price volatility and high currency volatility. Other factors include labour unrest, debates on resource nationalism, higher than inflation wages, escalating energy costs (from the electricity provider Eskom), infrastructural bottlenecks, and skills shortages which are driving up the cost of production (Antin, 2013). Another concern is the growth of renewable energy sources and increasing disinvestment from fossil fuels.

4IR Technology Adoption in South Africa's Mining Industry

4IR was popularised by WEF Chief Executive, Klaus Schwab, in 2016. 4IR is best understood as four broad domains encompassing biotechnology, nanotechnology, new materials technology, and advanced digital production (ADP) technology (UNIDO, 2019: 3). Within mining, digital technologies are already being utilised in the identification of new reserve ores, enhancing efficiency in extraction activities and the maintenance of sites as well as greening a historically 'dirty' industry (Bughin et al., 2018: 22).

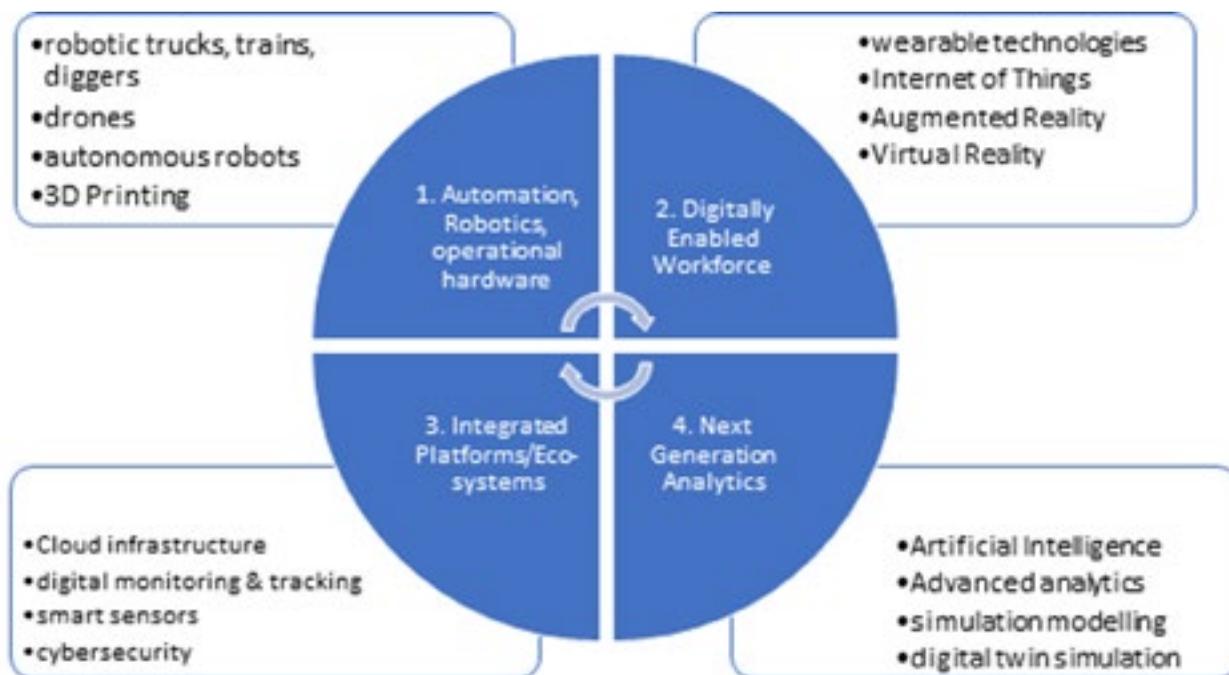
Figure 1: Employment in the mining industry, 2012–2019



[Source: Stats SA Mining Industry Report No. 20-01-03, Table C, 2019]

The World Economic Forum (WEF) white paper on digital transformation in the mining industry highlights the four themes which will characterise the digital transformation of the mine (World Economic Forum, 2017: 10).

Figure 2: Themes in the Digital Transformation of Mining



[Illustration adapted from WEF White Paper on Digital Transformation Initiative: Mining and Metals, 2017.]

South Africa's mines are less mechanised, a limitation that should intensify the need for digital transformation (Goodman et al., 2019). South Africa's mining industry has had a mixed response to digital transformation. Amongst the reasons for the variance is the fact that South Africa's mines are amongst some of the deepest in the world with complex ore bodies, therefore placing limits on the ability to digitise and automate immediately (Goodman et al., 2019). Another key obstacle is the shortage of a highly-skilled local workforce. South Africa had an average progress score of 29.9% for digital skills among the active population for 2019 and 2020 (Schwan and Zahidi, 2020).

Two separate surveys of South African mining executives revealed that mining companies were making significant investments into new mining technologies, with a focus on frontline technologies such as augmented and virtual reality (AR/VR), AI and automation (Croeser et al., 2020; Evans et al., 2021). Whilst these frontline technologies are enablers of remote work, enhance worker safety and reduce operational costs, they do not maximise

the intelligence of 4IR technologies. Technologies such as advanced analytics, machine learning, and advanced analytics allow for human and computer-supported analysis, interpretation of data insights and facilitate responsive decision-making (Croeser et al., 2020: 8). South African mines are investing less in latter technologies.

Evans et al. (2021) also reveal that 69% of South African mines understand the need for digital transformation and have made investments into specific task-related innovations; however, most of their activities remain in the planning phase (Evans et al., 2021: 9). Gold Fields and Anglo American have developed digital transformation strategies and are actively investing in the research and development to realise these. In 2018, Gold Fields presented their Mine of the Future which emphasised the establishment of digital culture as the precursor to a digital transformation (Bardien, 2018). Anglo American has also developed plans for their Future Smart Mining™ aimed at integrating advanced technologies, digitalisation, and environmental sustainability

principles to mechanise their mining practices (Anglo American, 2021).

Kumba Iron Ore, majority-owned by Anglo American, is amongst South Africa's largest pit mines. In 2014, it implemented a technology roadmap to improve mine safety and productivity, extend the lifespan of its two mines, and increase shareholder value (Anglo American, 2015: 45). Their technology roadmap strategy was segmented into three horizons, spanning eight years. Under the first horizon (2015–2018), the group's Kolomela mine was fitted with an automated drill that enabled remote mine drilling (Cornish, 2016). This new technology improved safety onsite by removing operators from the drilling site and shifting work to a controlling computer screen (Cornish, 2016). The mine has also reported improvements in 'drilling efficiency and drill hole quality, and [aims] to reduce drilling costs by 15%' (Cornish, 2016).

Exarro's Belfast Coal Mine in Mpumalanga is South Africa's first fully digital mine. The mine was completed in 2019 and boasts, as its key technology, the digital twin simulation (Mining Review, 2021). Digital Twin technology duplicates physical mining infrastructure into a virtual simulation, allowing managers to view mining activities live, effect requisite decisions, and increase productivity (Mining Review, 2021). Exarro has committed to hiring locals throughout its construction phase and to investing over \$20 million in developing indirect mining business opportunities. However, it is unclear if the mine will create many jobs for local miners, given that its operating activities are highly technical.

South Africa's mining industry has generally been slow to adopt digital transformation; however, mining companies consider 4IR technological advancements in their operations and strategic plans. Hitherto, South Africa's foray into digital transformation is limited to frontline technologies that complement the work of mine workers without displacing them, and there has been less implementation of advanced analytics technologies.

The Political Settlement in South Africa's Mining Industry

The Political Settlements Framework

The definition of political settlements has evolved from a narrow focus on explicit peace bargains and pacts between elites, to a broader analysis of how

organisational and political power is organised, maintained, and exercised (cf. Di John and Putzel, 2009; Jones, Elgin-Cossart and Esberg, 2012; Behuria, Buur, and Gray, 2017; Khan, 2018; Kelsall, 2020). In the latter approach, the concept is commonly defined as 'a combination of power and institutions that is mutually compatible and also sustainable in terms of economic and political viability' (Khan, 2010: 4).

In this paper, political settlements describe the distribution of power across the main stakeholders in the mining industry. The distribution of power is 'the relative holding power of different groups and organisations contesting the distribution of resources' (Khan, 2010: 1). The source of holding power can be income and wealth. Holding power can also be based on the historically-rooted capabilities of groups to mobilise and organise using various resources, such as ideologies, identity politics, and other cleavages (Khan, 2018: 645). Powerful groups or organisations need to have the capacity to engage and survive conflicts and impose costs on others whilst absorbing the costs imposed on them (Khan, 2010).

Although the distribution of power can be relatively stable and reproduced over time, incremental and disruptive changes to the political settlement can occur. Autonomous processes such as new technologies, political mobilisations, and economic opportunities can shift the distribution of power in society (Khan, 2018). These processes may also trigger new mobilisations by affected groups that can reverse, modify, or embed the changes. That is, if any excluded groups have sufficient power, they can, through their ability to contest, obstruct and oppose rules, undermine the adoption of technologies or associated policies (Frederiksen, 2017; Khan, 2018).

Khan's argument is also consistent with political economy approaches to technological change. According to Mokyr (1998), decisions to adopt any technology are not only left to the logic of the market. Technology innovations will likely be resisted by those who stand to lose through non-market mechanisms, such as labour strikes (Mokyr, 1998). It is not always straightforward to identify the losers and the magnitude of their loss or to determine the outright winners. However, if powerful groups in society do not get an acceptable distribution of benefits from the technology adoption, they will resist it (Mokyr, 1998). From this explanation, it is evident

why maintaining political stability or preventing violent conflict by sustaining the dominance of powerful groups may take priority over inclusive development policies.

The Political Settlement in South Africa's Mining Industry

The political settlement in South Africa's mining industry, by and large, mimics the national political settlement. The mining industry is predominantly white and foreign-owned (Netshitendze, 2018). South Africa's transition to democracy in 1994 involved a lot of compromises that reflected the strength of big businesses at the expense of redistribution and inclusion (Mondliwa and Roberts, 2018: 2). At the end of apartheid, large businesses in South Africa successfully lobbied the government against implementing structural changes that would shift the balance of economic power. Thus, the political settlement reached in 1994, and the resulting institutional arrangements, entrenched the market power of large companies (Mondliwa and Roberts, 2018).

Figure 3, adapted from Lane et al., 2015, identifies actors considered to be key in the current political settlement of the mining industry. These actors formed part of 'Operation Mining Phakisa', a multi-stakeholder process created in 2015 to address the crisis in mining (Letsoala, 2007; Hermanus, 2017).

Figure 3: Mining Constituents



Mining companies, the ANC-led government and organised labour groups (trade unions) are key actors with bargaining power and strong incentives to influence policy processes in the mining industry. Mining communities are a stakeholder group; however, they are discussed to a lesser extent because they are less coherent, and their bargaining power is much more challenging to determine. Assessing the relative distribution of power is generally a challenging task, but historical evidence and mobilisation activities provide important clues for the relative power of the different constituents in the mining industry (Khan, 2018). Rent distribution and changing labour dynamics are key to the political settlement in the mining industry (Frederiksen, 2017). The main challenge is balancing the often-conflicting interests of the key players in the settlement to ensure that mines are productive and profitable while sharing the benefits with the rest of society.

Business: Mining Companies and their Shareholders

South Africa's mining industry is facing significant economic, financial, and operational challenges, as well as a competitive global environment. These challenges are compounded by concerns about the factional divisions within the ANC's leadership (Vandome and Khama, 2021). Resource nationalism debates, falling commodity prices, labour unrests, rising demands by the government for increased rents and revenue from mining are some of the challenges facing the companies (Lane et al., 2015). Companies must grapple with the annual 'strike season' where unions and mine workers make demands for increased wages (mostly above inflation) and improved employment conditions.

Thus far, mines are perceived to not be doing enough to benefit society (Lane et al., 2015). The mines need to retain a 'social license to operate' while grappling with various challenges such as changing government, community, and labour expectations. Mining companies constantly face demands from the government, compounded by local community demands, about the role that mining should play in national development. Mining companies have, during these demands, exercised their power to protect their interests through divestiture and legally challenging legislature. For example, mining companies took the Department of Minerals Resources and Energy

to court over the application of the ownership rule of the Mining Charter (Who Owns Whom, 2020). AngloGold Ashanti sold the Mponeng gold mine in 2020 to focus on more profitable geographies, while Anglo American moved away from thermal coal operations considering global pressure to reduce carbon emissions (Vandome and Khama, 2021).

In general, mining companies in South Africa desire digital transformation; however, they struggle to get buy-in for the transformation because they are a major employer (Manuell, 2021). From the business perspective, digitalisation and automation will 'cut operation costs, increase safety and boost productivity without shedding jobs' because profitable mines tend to expand and create new jobs (Manuell, 2021).

The ANC Government

The government has mainly positioned itself as a custodian and has been concerned with maximising revenue from mining through its various policy instruments. It is also battling years of worsening socio-economic conditions and ill-prepared public institutions in the face of civil strife. South Africa's government often faces internal challenges where the multiple arms of government are not aligned and have policy inconsistencies. Most importantly, the government has to deal with the role of organised labour in the alliance. At the same time, the government is under pressure from communities for not delivering basic services or using resource revenues as a vehicle for achieving development (Lane et al., 2015). Most worrying is corruption allegations against the Minister of Mineral Resources and Energy, Gwede Mantashe, who is also an ally of the current president Cyril Ramaphosa (Vandome and Khama, 2021).

Under apartheid, mining companies operated with little to no restrictions, and they had no responsibilities towards the health of workers, mining communities, and reducing environmental degradation (Leonard, 2018: 2). In the new dispensation, the government has power and leverage through the Mineral and Petroleum Resources Development Act 2002 (Act No.28 of 2002), a law aimed at redressing historical socio-economic inequalities and ensuring the meaningful participation of historically disadvantaged persons in the sector (Minerals and Petroleum Resources Development Act, 2002). The act empowers

the minister to develop a Broad-Based Black Economic Empowerment Charter as a regulatory instrument for the industry. The controversial Mining Charter gives open-ended power to the minister to make discretionary arrangements (Mining Charter, 2018). The charter has been a point of contention by mining companies and communities. It took two years, multiple drafts, and a court case before it was approved by both the government and the mining industry (Dehm, 2019).

Despite the various accountability instruments, the mining industry continues to be criticised for its lack of Corporate Social Responsibility and violation of mining restrictions. Examples include Lonmin's failure to adhere to environmental laws and permits and African Rainbow Mineral starting mining activities without environmental authorisation on at least seven occasions (Dasnois, 2015). Also, there are no specific mechanisms in the Mining Charter to prevent the adoption of labour displacing technology, even though one of the objectives of the Charter is to advance employment and produce a skilled workforce to meet the demands of modern industry (Mining Charter, 2018).

President Cyril Ramaphosa has taken 4IR seriously. He appointed members of a Presidential Commission on the 4IR to recommend policies and strategies that would position South Africa as a competitive player in the digital space (Phakathi, 2019). The Commission reported that South Africa has not fully benefited from previous industrial revolutions, and that failure to respond to the technological changes associated with 4IR would threaten the country's industries and the well-being of its people. The Commission recommended that the country's 4IR strategy should focus on investing in human capital development, technology infrastructure, and ICT (Presidential Commission on the Fourth Industrial Revolution, 2020).

The Commission's report notes that digital technologies have the potential to enhance productivity in mining and that the emphasis should be on renewable energy, robots, and electric vehicles to reach Climate-smart Mining. Although the report does not estimate the potential job losses or gains in mining that would result from adopting 4IR technologies, it acknowledges that the labour force is a key cause for concern. The report also acknowledges that there are ideological

tensions that exist regarding redistribution and growth, especially since there is already a low growth rate, high unemployment, and job losses in several sectors such as mining (Presidential Commission on the Fourth Industrial Revolution, 2020). Finally, whilst the initiative is commendable, the Committee's recommendations do not provide a practical strategy for immediate implementation to address the realities and challenges we are already facing.

Organised Labour

President Ramaphosa often refers to a 'social compact' between government, business, and labour. This compact has thus far been dominated by organised labour and has marginalised many, causing numerous labour unrests (Vandome and Khama, 2021). Organised Labour has historically played an important role in South Africa's mining industry and transition to democracy (Buhlungu et al., 2008). The successful unionisation of Black workers under the National Union of Mineworkers in 1982 was a significant gain not only for worker rights but the broader political struggle for non-racialism in South Africa. Post-apartheid, unions have continued to play an important role in South Africa's democracy, supported by the country's progressive labour legislation which makes provisions for centralised bargaining (Buhlungu et al., 2008). Organised labour is usually concerned with increasing its membership and being able to influence government policy. Losing support, through job losses, is thus a great concern. Organised labour also has a role to play in the governing alliance, and thus their quest is to continuously fight for relevance (Lane et al., 2015).

Khan (2018) argues that the only way we can understand the distribution of power in society is to look at its history and how organisations have mobilised and won or lost power in the past. The National Union of Mineworkers (NUM) has been at the forefront of labour representation and often uses mass strikes to achieve its goals. It organised the first legal strike by black mineworkers in 1984, following a decline of global commodity prices which later resulted in 60% of the workers losing their jobs within a decade (Antin, 2013). The 2012 Marikana massacre, where violent protests led to the death of 34 miners, is an example that made visible the violent conflict over the distribution of rents in the mining industry. These

protests erupted after negotiations over a substantial wage increase between protesting mineworkers and Lonmin (a multinational platinum producer) collapsed (Antin, 2013).

The Marikana tragedy was not primarily associated with NUM, which is a close ally of the ANC, but rather its rival union, the Association of Mineworkers and Construction Union (AMCU). AMCU has threatened the monopoly of NUM and has become the largest union in platinum mining (Antin, 2013). AMCU's rise was facilitated by the perception among mineworkers that NUM had become too strongly allied with the government. Another key example of the mobilising power of unions is the 2014 labour strike in the platinum industry. The strike occurred over wage disputes and dissatisfaction with working conditions. It affected the three largest platinum producers, as well as the global platinum supply chain (Bohlmann et al., 2014). The strikes lasted for five months and only found resolution when mining companies reached an agreement with the main unions. It was the largest and most expensive strike in the country's history (Bohlmann et al., 2014). More recent examples include NUM members organising a six-week strike at Gold Fields' South Deep mine, which cost the company R6 million (approximately US\$370 000) per day. The strike, which ended in December 2018, began after the company announced plans to retrench 1,100 employees. AMCU also organised a five-month strike, which ended in April 2019, over wage disputes at Sibanye-Stillwater's gold mines (Who Owns Whom, 2020). Again, in 2019, Amplats reinstated

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643 employees who had taken part in a three-week unprotected strike at the Mototolo mine in Limpopo. The company reinstated the workers after an agreement was reached with the General Industrial Workers Union of South Africa (Giwusa) (Who Owns Whom, 2020). These are some significant examples of the holding power of unions in South Africa.

Organised Labour has recognised that digitalising mines is taking place globally and within South Africa. Labour seems to understand this in the context of the modernisation of older mines and addressing safety concerns for mine workers. This was expressed in an August 2019 joint parliamentary committee meeting of Mineral Resources and Energy with Trade Union Stakeholders. Trade unions agreed that technology was a critical input into the modernisation and enhanced productivity of mines and mine safety, but that this intervention must be for the overall benefit of workers (Parliamentary Monitoring Group, 2019). The challenge, however, is that trade unions do not seem to be deeply engaged in pro-active responses to address any potential worker and workplace disruption resulting from the modernisation of mining.

In an analysis of trade union responses to technologically-driven changes in South Africa's manufacturing industry, Hlatshwayo finds that trade unions have not seriously considered the potential impact of 4IR technologies on labour as a cause for deeper inquiry or research (2017: 101). In general, Hlatshwayo views organised labour as being reactive to the technology changes taking effect in the workplace and that unions are engaging with what has already been implemented by mine executives, rather than shaping which technologies should be implemented and the preparation of workers for these transitions.

Mining Communities

Communities living near mines or relocated by mining companies usually benefit the least from the industry. Mining communities contest the imposition of externalities, and these contests are usually resisted by national-level elites (Frederiksen, 2017). Yet, community influence is difficult to determine, especially since mining companies border many communities. It is equally challenging to identify key actors in the communities. Mining companies have been criticised

for mostly engaging with traditional and communal authorities, further undermining the representation of communities (Dehm, 2019). Frederiksen (2017) argues that mines tend to focus their energy and investments on stakeholders that are most likely to affect them and that projects and resources are usually targeted to local elites with the understanding that they will trickle down to communities.

The Potential Impact of 4IR on the Political Settlement in South Africa's Mining Industry

The government, labour, business and community organisations use the National Economic Development and Labour Council (NEDLAC) as a vehicle to negotiate and facilitate consensus on economic, labour, and development issues facing South Africa. NEDLAC's 2019 report on the Futures of Work in South Africa concludes that 4IR is a given, that production could happen without people, and that due to a lack of appropriate skills, the labour force in South Africa could be replaced by robots and be automated (NEDLAC, 2019). The previous section on the political settlement in South Africa's mining industry showed that the three main stakeholders are aware of 4IR and agree that it will impact South Africa's socio-economic context. Thus, the question of whether 4IR will impact society is irrefutable for all stakeholders. The question, needing further elaboration, is how technological advancements associated with 4IR would affect (and be affected by) the political settlements in South Africa's mining industry.

The application of digital transformation has resulted in greater productivity in some developed nations. In Sweden, the application of new technology has not resulted in job losses (Johansson, 2021: 20). In Australia, automation technology is predicted to displace 40,000 frontline mining jobs whilst creating 69,000 new jobs (NERA and METS Ignited, 2019). NEDLAC's 2019 report highlights a set of scenarios about what work could look like in South Africa in 2030. In the worst-case scenario, termed the 'dead-end', businesses would have made minimal investments in skills development but would adopt new technologies to remain profitable and protect their interests. Organised labour would have focused on protecting existing jobs and organising strikes. The government would have focused on maintaining votes and would not have put measures to mitigate the negative outcomes of technology (NEDLAC, 2019).

The worst-case scenario is consistent with Khan's (2018) argument that in developing contexts, the most powerful organisations often have interests that constrain broad-based growth (Khan, 2018: 646).

In the best-case scenario, business, government, and labour would cooperate for the benefit of society. The skills gap would be closed, labour would be augmented by 4IR, and production would increase. In the short run, jobs would be lost. However, in the long-term, increased production would create new jobs. Though the impacts of technologies associated with 4IR will only fully unfold if these technologies are adopted widely, a description of the existing political settlement in the mining industry provides clues for a likely outcome. If the track record of union action is anything to go by—protracted and at times violent strikes that cost companies millions—then the result is likely to be more complex than any scenario could predict or capture.

In South Africa, digitisation is expected to create about 4.5 million jobs across many sectors and displace 3.3 million existing jobs by 2030 (Magwentshu et al., 2019: 4). In the mining industry, it is estimated that there could be a net loss of 87,000 jobs and that 20 percent of the mining industry would be automated by 2030 (Magwentshu et al., 2019: 4). In the context of South Africa's high unemployment, the projected job loss of 17% of the total number (514,859) employed in the industry in less than a decade is significant. The job loss would be significantly more than the 23,285 or 4.42% experienced between 2012 and 2019. If the trade unions accept the 'short-term' loss, as highlighted in the best-case scenario, there could be a shift in the distribution of power in the mining industry. Previous disruptions that range from price and exchange rate volatility and labour protests have not shifted the distribution of power, and thus the political settlement. The displacement of a large number of workers in the mining industry could weaken trade unions in favour of the mining companies. It would also weaken the alliance between trade unions and the ANC government.

Given the slow growth rate and decrease in employment in the mining industry over time, it is reasonable to conclude that unions have been weakened and that their influence is waning. However, the role of organised labour in the

technology transitions taking place in the mining industry, especially as it relates to workers, remains critical. The importance of this has been recently highlighted in the inclusion of trade unions, such as AMCU and NUM, into the Department of Science and Innovation and the Mineral's Council of South Africa initiative titled the Mandela Mining Precinct (MMP). The MMP aims to improve and modernise the mining industry through research, planning, and cooperation between stakeholders (Mahomed, 2021). Organised labour also has an important role to play in the governing tripartite alliance, and must continuously fight for relevance (Lane et al., 2015). The dominance of NUM has been eroded by AMCU, bringing a spotlight to the tripartite alliance. The various strikes have demonstrated the holding power of AMCU, as its protracted strikes imposed serious costs to the mining industry. As such, the political settlement in the mining industry is evolving, and any disruptions or potential job losses will exacerbate the already existing tensions at the expense of the ruling alliance. A weakened alliance would have implications for mobilising electoral support nationally and maintaining political order in the country.

According to Khan (2010), a political settlement needs to be sustainable in terms of economic and political viability, and herein lies the dilemma. The existing settlement in the mining industry has thus far been politically viable; however, the industry is not growing. South African miners find themselves at a critical juncture, needing to accelerate the adoption of productivity-enhancing technologies to remain sustainable. Miners are confronted with the realities of an industry in decline, international competition, and the constant tension between equity and economic efficiency (Frederiksen, 2017). The existing political settlement is made up of actors with varied and often conflicting preferences. Tensions remain between mining companies, government, workers and host communities around job creation, decent wages, good working conditions, and environmental protection. And although 4IR is predicted to provide opportunities to improve worker health and safety, and reduce the environmental impact of mining activities, fundamental changes in the mining industry will not be seamless.

The brutal disputes between labour unions, the threat of escalating mass protests, excessive wage demands, and previous calls for the nationalisation of mines have

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hurt the industry in recent years. The tripartite alliance has yet to propose a convincing policy agenda for the mining industry, but any major crisis in South Africa’s mining industry poses a great risk for the economy and the urgent need for inclusive development. Also, a further loss in employment resulting from mining digitalisation would go against what the tripartite alliance stands for in principle, which is redress for past injustices and transformation of both the mining industry and national economy towards inclusive growth and development. A loss in employment also contradicts one of the objectives of the Minerals and Petroleum Resources Development Act, which is to promote employment and advance the social and economic welfare of all South Africans.

It is likely that while the technologies associated with 4IR would certainly benefit South Africa’s declining mining industry, the speed and degree of adopting these technologies may depend on the existing settlement being able to reproduce itself without excluding organised labour. There are still major opportunities that lie ahead as the industry has untapped reserves. Yet, the politics of the mining industry are likely to remain complex and heated, with continuing costs from the policy uncertainty (Butler, 2013). The main stakeholders can and have exercised agency, but the outcomes of their agency are limited by how flexible the structure of the political settlement is. Companies surveyed in the 2020 Future of Jobs report from the WEF identified several barriers to the adoption of new technologies in the mining industry, such as the skills gaps in the local labour market, lack of flexibility of the

regulatory framework, and a lack of interest among the leadership (Schwab and Zahidi, 2020).

The nature of the political settlement in South Africa, and the mining industry, may have profound consequences for the process of 4IR technology adoption, and who benefits as a result. Since political losers can be a barrier to technology adoption (Acemoglu and Robinson, 2000), changes in the political settlement in the mining industry as a result of 4IR are likely to be incremental over long periods instead of sudden and disruptive as some would advocate (Khan, 2018). Thus, the impact of 4IR is not predetermined, it must be part of a vision shared by all, including the workforce that would operate the new technology and those who may be potentially displaced and excluded by it (Mondliwa and Roberts, 2018).

Conclusion

South Africa’s mining landscape is deeply complex and its actors are often at odds when it comes to the issue of 4IR and the modernisation of mines, insofar as it impacts employment. The adoption of 4IR technologies in South Africa’s mines has been slow, owing to the deep and difficult geology of the country’s mines and the relative expense of modernising. This notwithstanding, mines are mechanising, as highlighted in the billions of investments being made by South Africa’s mining executives, and through the creation of new digital mines such as Exarro. At this pace, however, it may be too early to conclude the effects of 4IR technologies on employment and workplace trends. It is possible that 4IR technologies may not diffuse widely or the technologies adopted would involve more reinstatement rather than a displacement of workers. What is evident, however, is that South Africa’s mining industry is a contested terrain; organised labour can mobilise massively and wield violence through protest which hits at the economic bottom-line of mining companies. Equally, however, if South Africa’s organised labour does not sufficiently start to interact with the realities of 4IR’s transformative technologies proactively, it may cede its influence.

To the extent that 4IR technologies affect employment and worker stability, there may be resistance palpable enough to disrupt the implementation of such technologies. The global roll-out of 4IR technologies alone and promises of enhanced productivity and

market efficiencies is not enough to determine its adoption by societies. Rather, the endogenous features of society such as the political-economic climate need to be included within this discussion. In the context of South Africa, the existing political settlement in the mining industry is likely to be influenced by 4IR, but also to influence the process and extent of adopting 4IR technologies.

The effects of technological change, therefore, cannot be taken for granted even in best-case scenarios where capital is available and inputs such as skilled labour and infrastructure are present. Attempts to adopt or transplant technologies will run into social barriers that will be difficult to foresee and understand. Given the proliferation of new technologies in modern society, the debate about the impacts of technology on society will likely continue, but they should focus on contextual accounts that consider the complex societal forces which influence and are influenced by technological changes. The political economy of technological change must take centre stage when analysing the impact of the 4IR on developing countries such as South Africa.

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