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QUARTERLY RESEARCH REPORT

The mental health dimension of Covid-19

Community Participation in COVID-19 Mitigation

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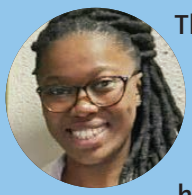
THE MENTAL HEALTH DIMENSION OF COVID-19:

Extent of its Consideration in SA Mining Sector Health Interventions

Martin Kaggwa and Khokhelwa Zokwana



This article introduces the aspect of mental health in the broader debate of mitigating the effects of Covid-19 in South Africa, focusing on the country's mining sector. Basing on literature on health matters, the article highlights adverse effects caused by pandemics such as Covid-19 on the mental health of infected people and the broader community. The article examines how stakeholders in South Africa's mining sector have responded to the Covid-19 pandemic, and it critically assesses the extent to which their response considered the mental health aspect. It is observed that despite the acknowledgement of the mental health effects of Covid-19 by some of the stakeholders, none of the interventions put in place were directly intended to address the mental health dimension of the Covid-19. With this realization, it is recommended that interventions that specifically target mental health of those infected and affected by the Covid-19 in the country in general and in the mining sector in particular need to be added to the set of the existing interventions. Otherwise, there is a real risk that part of the Covid-19 effects in the country may not be addressed. The adverse effects on mineworkers and their communities of omitting the mental health dimension in Covid-19 mitigation interventions can potentially end up being more severe than the immediate and visible health effects of being infected. Hence, it is recommended that health interventions to manage the effects of Covid-19 in the mining sector need to be expanded to include interventions that target mental health consequences of the pandemic. This recommendation could form part of Trade Union demands to employers in the sector, since the ultimate burden bearers of un-attended mental health problems are the workers.

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Introduction

Like the rest of the world, the South African economy has been severely affected by the Covid-19 pandemic. The country's mining sector is one of the sectors that were harshly affected by the first wave of the Covid-19 pandemic. Nonetheless, the sector was proactive in coming with mitigation measures for the pandemic to the extent that when the second wave arose, the sector was not disproportionally affected.

One may, therefore, be tempted to conclude that the health interventions undertaken by the mining sector were successful. This may not be entirely true if one is to consider the mental health dimension of Covid-19. In contrast to physical health which is easily observable and the effects of which are immediate, mental health is subtle and some of its effects take time to manifest.

Defined as the state of mental well-being, mental health can be a source of constant physical exhaustion, lack of concentration, anxiety and poor decision making which culminates in low of productivity and physical safety risks in the workplace. The consequences of poor mental health can also lead to poor decision making in real life situation that face mineworkers.

Mental health can have far reaching negative effects on workers in general, and mineworkers in particular that may be ignored because of its subtle character. Mental health has a bearing on productivity, hence the aspect is of interest to employers. The occurrence of stress, depression and anxiety among workers coming from unbalanced mental health often results in reduced work performance and increased absenteeism (Wagner, et al., 2016) directly affecting productivity. Productivity, on the other hand, has a bearing on workers' remuneration and benefits which makes it a critical aspect of interest to workers and trade unions. So addressing the mental health aspect of mineworkers is not only a health issue but also a business performance imperative.

It is prudent to assess the extent to which mental health has been considered in the mining sector health interventions. Otherwise, there is a risk that some health effects of Covid-19 may not be adequately dealt with, the consequences of which may end affecting workers beyond the period of the pandemic.

This article assesses the extent to which the mental health dimension has been considered and catered for in the Covid-19 mitigation measures in the mining sector. This is done in recognition that exclusion of mental

health in interventions meant to address Covid-19 effects in the mining sector, makes the health intervention strategy incomplete.

The rest of the article is organized as follows:

- Section 1 provides the introduction and background to the study.
- Section 2 looks at the literature on mental health during pandemics like the Covid-19.
- Section 3 examines how stakeholders in the mining sector (government, business, and organized labour) have responded to the Covid-19 pandemic in the sector.
- Section 4 assesses the extent to which the sector response to Covid-19 by all stakeholders took into account mental health.
- Section 5 provides the conclusion and recommendations.

Pandemics and mental health

There is significant literature on the impact of previous pandemics on mental health of affected parties that one can draw to appreciate that indeed Covid-19 has and will affect people's mental well-being (Esterwood & Saeed, 2020). A study of the effects of SARS Cov -1 that erupted in Asia in 2003 found that for some health workers that dealt with the pandemic, there was an increase in alcohol abuse and dependence syndrome (Wu, et al., 2008). These changes in behavior among health workers generally affected their mental health. Persistency of adverse mental health symptoms such as depression were also noticed in health workers even after the official declaration that the pandemics were over (Liu, et al., 2012).

Whether it was the case of Anthrax in America in 2001, Ebola epidemic in Central Africa in 2014 or Middle East Respiratory Syndrome (MERS) in Korea in 2015, study on effects of such epidemics pointed to adverse mental health for parties directly or indirectly involved (Jeong, et al., 2016), (Morganstein & Ursano, 2020), (North, et al., 2009).

Specific to Covid-19, the pandemics has had a big impact on mental health of those that have contracted the virus, health workers and the entire country populations (Xiong, et al., 2020). Covid-19 has created additional health problems such as stress, anxiety, depressive symptoms (Vindegaard & Benros, 2020), insomnia, denial, anger and fear (Torales, O'Higgins, Castaldelli-Maia, & Ventriglio, 2020) which directly affect people's mental health. The adverse effects on mental health can be attributed in part to social distancing and mandatory lockdowns that many countries implemented, isolation periods for the infected and suspected infected, anxiety of getting sick, suspension of economic activities, loss of income, and fear of what the future holds (Giorgi, et al., 2020).

The mental health issue becomes more critical with the recognition of a possibility that some new mental health problems specific to Covid-19 not known or categorized before may emerge (Heitzman, 2020). It is probable that as a result of Covid-19, new mental disorders, trauma and symptomatic stress response that does not meet the diagnostic criteria of a psychiatric disorder will arise (Esterwood & Saeed, 2020). The number or people with mental disorders is likely to increase during and after the Covid-19 period (Panchal, et al., 2020).

In coming up with interventions and strategies, more focus has been put on physical medical effects of the infected parties and less on the subtle but important mental health effects of the pandemic (Vindegaard & Benros, 2020).

The emergency of pandemics is not a new phenomenon. The world has experienced at least ten pandemics in the last century among which has been the Spanish flu, the H3N2 pandemic, HIV/Aids, Severe Acute Respiratory Syndrome (SARS) and the H1N1 pandemic (Balita-Centeno, 2020). As such, there is reasonable literature on the effects of pandemics. Through the exploration of previous pandemics impacts including their psychological dimension it is possible to deduce the holistic impact of Covid-19 in short to medium terms even if it is a fairly new pandemic.

Literature on pandemics points out that some of the effects of pandemics are psychological. The psychological effects of Covid-19 have already been picked up in some recent studies. Studies in Bangladesh have found that Covid-19 is associated with major psychological impact (Mamun, et al., 2021). This realisation underlines the need to come up with strategic psychological support measures over and above managing infection and providing treatment.

South Africa's mining sector response to Covid-19

Government

n response to Covid-19 government, as the regulator, issued directives on what measures need to be followed in workplaces in the face of the pandemic. These directives where issued under the Department of Labour and Department of Health, mainly.

In October 2020, the Department of Labour issued Consolidated Directions on Occupational Health and Safety Measures in certain workplaces. Broadly these directions included protocol pertaining to:

- Covid-19 workplace risk assessment and protective plans that had to be put in place. Protective measures prescribed included daily screening of employees.
- Workplace procedures to be followed when a positive case is identified.

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- Social distancing and ventilation requirements and implementation in the workplace.
- Establishment of Covid-19 workplace control plan which included but not limited to sanitization and disinfection of workplaces and provision of PPEs.
- Administrative measures to be established in the workplace. These included the submission of a record of risk assessment for companies employing more than 50 employees and reporting of confirmed positive cases. The administrative measures further set out the appointment of a Compliance Officer to ensure that the prescribed measures are implemented.

The directives issues by the Department of Labour in respect to Covid-19 mitigation were generic and focused on workers in the workplace and the people who interacted with workers in the workplace. Moreover, their emphasis was on what ought to be done to avoid infection and how to deal with workers that test positive.

The mental health dimension of the pandemic to the infected and affected was not considered in the Department of Labour regulation and as such none of the mitigation measures were directed towards dealing with it.

Specific to the mining sector the Department of Mineral Resources and Energy (DMRE), acting under the Mine Health and Safety Act of 1996, issued Guidelines for a Mandatory Code of Practice (COP) on the Mitigation and Management of Covid-19 Outbreak in May 2020 (Mineral Council of South Africa, 2020).

The DMRE COP set out minimum requirements and best practices for the compilation of a COP for the prevention, mitigation and management of Covid-19 that all mines and SAMI had to comply with (DMR, 2020). The explicit aim of the COP was to prevent infections in the workplace for mine workers returning to work and other stakeholders that interact with mineworkers in and around the mines. Mines had to develop their respective COP following DMRE guidelines. Beyond the COP mines had to also develop an implementation plan corresponding to the COP details.

The DMRE stipulated that the following aspects should be included and explained form part of each mines COP:

- Risk assessment and review
- Start-up and on-going procedure for mines
- Covid-19 Management Programme
- Monitoring and reporting
- Compensation for occupationally acquired Covid-19

The COP guidelines issued by DMRE did not recognize, that returning mineworkers could be having mental health problems caused by mine shut down due to Covid-19 and subsequent change of the of the workplace environment. The mental health problems could include anxiety about job security and meeting work targets with the new work protocols that had been introduced in the mines.

One would have expected that under the Covid-19 Management Programme, some consideration or recognition of the potential mental health effects of the pandemic would be done, but this was not the case. A questionnaire probing mental status of workers could have been administered to returning workers to establish those who needed counselling for example.

Business – Mining Council of South Africa

The Mineral Council of South Africa (MCSA) as is a key stakeholder in health and safety in the mining sector; came up with Standard Operating Procedures (SOP) for addressing cases of Covid-19 in March 2020. These SOPs were supposed to be shared and implemented by all members of the Council. At the center of MCSA SOP is the identification of Covid-19 risk in mining environment and how to manage and minimize these risks (MCSA, 2020, pp. 8-13).

The MCSA SOPs stipulated that members should:

- Develop a Covid-19 infection policy and procedures to deal with identified or suspected infection. The policy and procedures should include establishing a dedicated number on which health workers could be reached, screening protocol and Covid-19 related information management.
- Consciously take steps to prevent infection of workers at the mining sites but also those non-mineworkers visiting the mines for one reason or another. The steps included improved hygiene in the workplace, provision of PPEs and workplace sanitization.
- Undertake engineering controls that involve isolating workers from high risk areas and potential exposure for medium to very high-risk jobs. The engineering control were to be supplemented by administrative controls that included deliberate information sharing on Covid-19, minimize face-to-face interactions and Covid-19 screening.
- Put in place procedures to be followed by a mine in case of suspected or confirmed case of Covid-19 case.

Like in the case of government, the identification of workplace problems related to Covid-19 by MCSA did not take into consideration the aspect of mental health. Without the recognition of the mental health dimension, the proposed mitigation measures under the SOPs did not include an intervention to address the mental health dimension of the pandemic.

Organized Labour

Trade Unions, on the other hand, did not come up with specific mitigation measures that had to be implemented in the mines but rather took on the role of the watch-dog. They wanted to make sure that employers conform to regulation set by government but also identify implementation gaps, if any in these regulations.

With their members located within different mines, the unions were able to keep track on the level of infection at mines and also observe the extent to which employers were conforming to regulation as set by government.

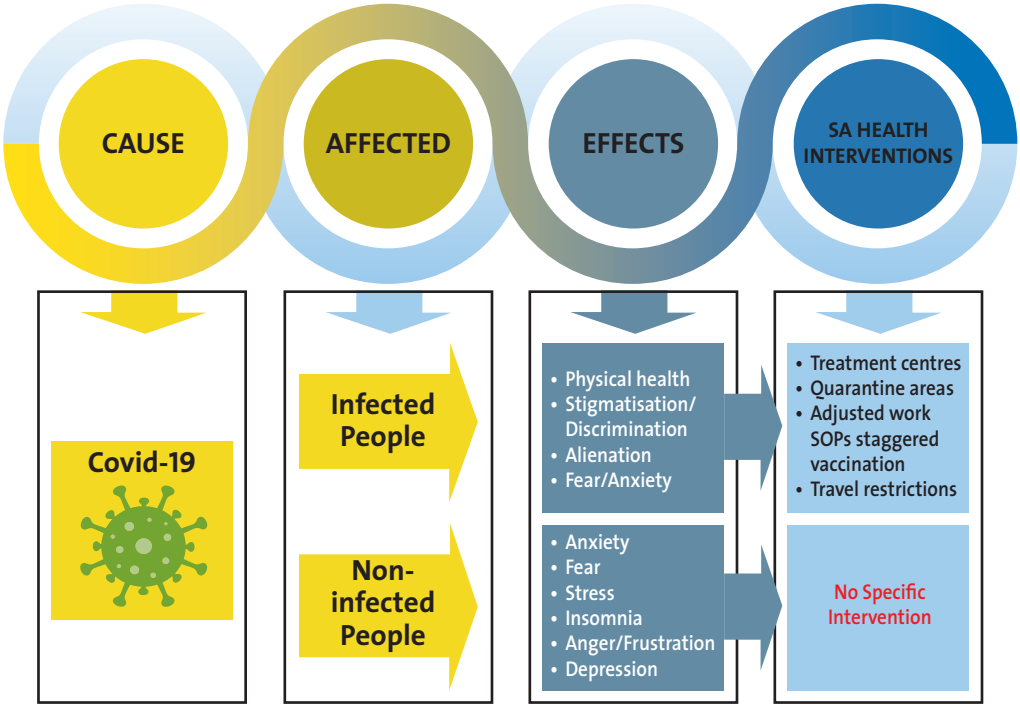
The National Union of Mineworkers was very active and visible in ensuring that mineworkers do not become the sacrificial lamb of the Covid-19 in the process of the employers trying to remain profitable despite the pandemic challenges. Mid 2020 at Modikwa Platinum Mine, for example, the NUM raised concern and alerted all stakeholder of the continued use of breathalyzers and biometric systems at the mine the use of which could spread the pandemic among mineworkers (Industriall, 2020). In a related case, the Union raised concern over the mining companies that were allowing back mineworkers to the mines before they were tested as had been stipulated by government (Chilwane, 2020). The monitoring and awareness raising efforts by the NUM on the extent to which the mines were complying with the set SOPs play a role in ensuring that mines conform to set regulation to limit spread of Covid-19 among mineworkers.

In its most recent involvement on Covid-19, the NUM together with other trade unions in the mining sector committed itself to collaborate with the MCSA to ensure that all mineworkers are provided with factual information so that they may be willing to fully immunize when the program for the sector commences (Mining Journal , 2021). The Unions recent efforts on Covid-19 still do not reflect awareness and the intention to mitigate mental health effects of Covid-19.

The mental health dimension of South Africa's response to Covid-19

With the exception of putting the entire country on lockdown, South

Figure 1: Cause-Effect of Covid-19 and SA Health Interventions



Africa's approach to deal with the Covid-19 pandemic has focused, mainly, on the people that have been infected with the virus than those who aren't. Before commencement of targeted vaccination, other parties like the people that are at a higher risk of getting the virus such as health care workers and elderly were not the focus of active interventions.

In articulating the Covid-19 pandemic problem, all stakeholders in the mining sector seem to agree on the cause of the problem but less on the affected and on the effects. The difference and gaps in articulating the affected and the effects in turns leads to limits in intervention measures being suggested.

Regarding the cause of the problem, everyone agrees that it is the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-Cov-2) virus or simply referred to as Covid-19. In as far as the affected parties are concerned, there is recognition that there are two parties – those infected or have been tested positive of the virus and those that are affected by the virus but have not necessarily been infected. It is important to note though that stakeholders have disproportionally put more focus on infected people and less on the affected people. In some cases, one gets the feeling that some stakeholders consider the infected people as the only affected people.

In line with the disproportionate focus on the infected workers, the articulation of the effects of Covid-19 has tended to focus on the effects to the infected. The main effects of Covid-19 that stakeholders have highlighted include physical health, stigmatization, alienation and to a lesser extent anxiety. The pandemic effects to the affected and not necessarily infected such as anxiety, fear, stress, frustrations and depression have received far less attention.

It is not surprising, therefore, that when it comes to health interventions to address effects of Covid-19 in the mining sector, almost all the interventions focus on effects to the infection section of workers. There is a glaring gap on health interventions that specifically target Covid-19 effects to the affected segments of mineworkers.

The broad articulation and approach to mitigation of the effects of Covid-19 in South Africa is summarized in Figure 1 above. The figure makes explicit where the gaps in Covid-19 health interventions are and to whom these interventions should have focused.

Concluding remarks

There is goodwill among all stakeholders in the mining sector to fight against the Covid-19 pandemic and to find a solution to all its effects on the sector. It is recognised that the mining sector is an important economic contributor to the country and with key linkages to other sectors of the economy. As such, failure to

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protect the sector from the impacts of Covid-19 would have a significant negative effect not only on the sector but on the country at large.

Despite the general good will, stakeholders in the sector – government, industry, and labour – have tended to focus on managing and controlling the physical health aspect of Covid-19. Little attention, if any, has been directed to the mental health dimension of the pandemic. Yet mental health is a real issue of concern for mineworkers.

The location and nature of mining activities often creates mental stress for mineworkers. Some of the mental stress comes as a result of separation from one's family, remoteness of mines, and the general mining environment among others.

Covid-19 has added to these mental stress factors of mineworkers. It has created more job and income uncertainties, it has caused the death of fellow mineworkers and has drastically changed the mining workplace to a rigid high tension place of work. The increased mental stress or poor mental health of mineworkers is likely to manifest itself in low productivity, tensions in the workplace, and probably hostile labour relations. These are indirect but real problems emanating from the mental health dimension of Covid-19. They require solutions, which solution should be part of the overall Covid-19 management and mitigation. This requires an improvement of Covid-19 mitigation intervention in the mining sector, to make them holistic and not focus only on the physical health aspects of the pandemic.

For the holistic management and mitigation of Covid-19 effects in the mining sector it is important that interventions targeting mental health effects of the pandemic be added to the current arsenal of mitigation measures. Otherwise there is a real risk that some of the effects of Covid-19 will remain unattended and the consequences will only be realized in the long term. So mental health needs to be on the agenda of any forum discussing how to manage the effects of Covid-19 in the mining sector and the country at large.

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COMMUNITY PARTICIPATION IN COVID-19 MITIGATION:

A Case Study of Khutsong Township, Carletonville

Mpho Nchabeleng and Martin Kaggwa


The South African mining sector experienced an alarming number of Covid-19 cases during the country's first phase of the pandemic. As of 4th June 2020 there were 527 positive Covid-19 cases and 72 recoveries. The sector remains vulnerable to the pandemic, given its unique work environment that needs people to work in close proximity. To respond to the pandemic, the sector introduced a variety of measures aimed at addressing the impact of Covid-19. The question whether these interventions were adequate remains particularly important in the context of the emerging voices that the country may experience more waves of Covid-19 infections. This article seeks to determine whether community participation was part of Covid-19 mitigation measures in the mining sector, using Khutsong Township in Carletonville as the case study. Literature on managing and controlling pandemics indicate that community participation is an important element of containing pandemics. This article draws on literature on pandemics and documents review of Covid-19 mitigation measures implemented in the Carletonville mining area, particularly around Mponeng mine. A case is made that community participation was not a key component of Covid-19 mitigation in Khutsong Township. From this realisation it is proposed that going forward, all stakeholders including union representatives should ensure that community participation is part of the Covid-19 mitigation measures in the mining sector. Otherwise, there is a risk that control measures implemented by the mines within the mining space will be diluted by miners mixing with communities in their residential areas.

Introduction

Covid-19 is possibly the most disruptive disease the world has ever experienced. The disease did not only unsettle the health of the people but their social and economic lives as well. Economic activities of countries became stagnant, with most people losing their jobs and companies closing down (Barker, et al., 2020).

Countries introduced measures to reduce the spread of Covid-19. For example, in the United States, the country introduced customs and border patrol prohibitions for persons that came from countries with most positive cases (De Kadt, Gotz, Hamann, Maree, Parker, 2020). Similarly, the South African government enacted the Disaster Management Act to control the spread of Covid-19. Through the Act, the South African government introduced restrictions on the movement of people and the closure of non-essential economic activities and other interventions to mitigate the spread of Covid-19 (Disaster Management Act, 2020).

At a sector level, South Africa's mining industry was not spared. By mid-2020, the sector was reporting Covid-19 infections in mines across all provinces of the country. In Gauteng, at Mponeng mine at Carletonville 196 workers had tested positive for Covid-19 as of 26 May 2020 (NUM, 2020). Additionally, 11 workers had tested positive across all Sibanye Stillwater mines in the West Rand (News24, 2020). In Limpopo, at the Impala Platinum Marula Mine, 13 workers contracted the virus. In North West, two miners at Kalgold Gold Mine had also tested positive for Covid-19, and 51 positive cases in the Thembelani Mine in Rustenburg (News24, 2020); (AfricanMiningMarket, 2020).

It is important to note that measures to control Covid-19 are particularly challenging to implement in the mining sector given its unique characteristics. Mining involves working in congested conditions underground and uses cages as transportation, which increases the likelihood of respiratory disease infections like Covid-19 (Khongsai, et al., 2020).

In an effort to limit and manage infections, the mining industry introduced a number of interventions which included operating with a 50% workforce, developing and implementing Covid-19 control Standard Operation Procedures (SOPs), and provision of PPEs in the workplace among other interventions. There is a risk that control measures implemented by the mines within the mining space will be diluted by miners mixing with communities in their residential areas. This realisation points to the need to have community participation in the Covid-19 interventions spearheaded by the mines.

Against this background, this article assesses whether community participation was part of Covid-19 mitigation interventions in Khutsong Township in Carletonville. The choice of Khutsong Township as a case study was based on the high number of Covid-19 cases that were recorded at Mponeng Mine. The rest of article is arranged as follows:

- Section 2 presents the importance of the community in management and controlling of pandemics. It further highlights cases where community participation played a key role in the control of a pandemic.
- Section 3 looks at the Covid-19 control measures that were implemented by all stakeholders in the Khutsong Township. The section also assesses the extent to which community participation was part of these interventions, given community importance in pandemic control.
- Section 4 concludes with some recommendations on how mining areas comparable to Khutsong Township could improve on their Covid-19 control interventions going forward.

Importance of Community Participation in Managing Pandemics: Literature Review

There are numerous studies on community participation in countering different challenges (Owusu, 2014); (Barker, et al., 2020); (Agonnoude Mwsenge, 2010). However, this article will only review literature on community participation in the health sector and on how it relates to the control of pandemics in particular.

The word 'community' is defined differently based on context in the literature. In the health sector community is firstly defined by demographics, describing a group of people living in a specific neighbourhood and vicinity. The second definition involves a group of people that share the same interests and identities. The third definition relates to a community as a target population or risk group (Kilewo Frumence, 2015); (UNAIDS, 2015); (Barker, et al., 2020). For the purpose of this article, community is considered as a group of people in the same geographical location who face a common risk (as captured in definition one and three from the literature above).

Similarly, the term 'participation' holds different connotations in the literature. Participation can be defined as an active process where beneficiaries participate in projects with an intention to solve their own problems (Han, et al., 2018); (Campbell Mzaidume, 2002) (Sevelius, et al., 2020). It can be seen as a process were individuals and families assume responsibility for their own health and welfare in this process of community participation

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(Khongsai, et al., 2020). Primarily, community participation is about putting local people at the forefront of any project that concerns them, from the initiation phase to the completion of that particular project.

Community participation can be either effective or non-effective. The latter can also be seen as superficial community participation. For community participation to be considered effective it should include informing, consulting, involving, collaborating, and partnering with communities and also contributing to citizen-led strategies (Marston, Renedo, Milesa, 2020).

An important way to judge the effectiveness or to measure the meaningfulness of community participation is by using the model developed by Arnstein (Arnstein, 1969). The model provides levels of community participation and their characteristics, from the lowest level where community participation is just in name, to the highest level of effective and meaningful community participation. There are three levels: the lowest level, the intermediate level, and the advanced level. Activities at lowest level include manipulation and therapy of community members into community participation. At the intermediate level, community participation takes the form of tokenism, consisting of informing, consultation, and appeasement of communities in dealing with a specific aspect of mutual interest. At the advanced level of community participation, citizen power is exercised. At this level, interventions or projects are implemented in partnership; there is delegated power, and citizen control (Arnstein, 1969).

Arnstein's hierarchal community participation model has been criticised by some scholars in terms of its applicability in cases where community control is not the ultimate goal of communities, when communities do not have capacity to take control of interventions or when the aspect of interest is contested (Molaba, 2016); (Mbelengwa, 2016); (Madzivhandila Maloka, 2014)(Kilewo Frumence, 2015). Nonetheless, the model provides a practical framework to understand and assess community participation. It is for this reason that this article applies the model in the assessment of community participation in the management of Covid-19 in Khutsong Township.

Community participation in pandemic control and management generally involves structured approaches to sharing information, collaborative problem solving,

collective action, participation in decision making, and transparent accountability with community leaders and stakeholders, along with formal government authorities (George, Mehra, Scott, Sriram, 2015).

The role and empirical effectiveness of community participation in managing pandemics has been widely documented (Marston, Renedo, Milesa, 2020) (Gregson, Nyamukapa, Sherr, Mugurungi, & Campbell, 2013). According to (UNAIDS, 2015), Community participation 'often support public health systems by filling critical gaps, they work effectively with marginalized populations, provide supportive services that support clinic-based care or extend the reach of health services into the community'. The successful story of reducing HIV infections in Uganda by the country's The AIDS Support Organization (TASO) was attributed to a large extent on community participation in planning and roll-out of preventative measures (UNAIDS, 2015); (Hasunira, 2010). There also recorded successful stories of using community participation in control of HIV pandemic in the United States, China and even in Southern Africa countries (Asthana Oostvogels, 1996); (Han, et al., 2018); (Wallerstein, et al., 2019).

Even with acknowledgement of the usefulness of community participation in management of pandemics, there is a risk that the aspect is reduced to being just rhetoric rather than an applied tool. From the literature it is pointed out that lack of recipient consultation, engagement of local people, and other factors render community participation ineffective (Marston, Renedo, Milesa, 2020); (Arnstein, 1969). This realisation points to the need for proper and deliberate efforts to include affected communities in Covid-19 interventions. It calls forth for all stakeholders, including trade unions, government, and mining companies to prioritise community participation in the Covid-19 interventions they plan (to the extent that this is possible) as a way of increasing the likelihood of getting the desired outcomes.

It should be noted though that there are various barriers when it comes to the implementation of community participation that need to be addressed. Often, the communities' expectation of participating in public projects and the reality of the communities' participation are often miles apart (Wallerstein, et al., 2019).

In a nutshell, literature points out the important role of community participation in managing pandemics. It also provides empirical cases of where community participation was part of the successful mitigation and control of a pandemic. Despite its importance, there is caution that community participation can be superficial and its implementation can be constrained by prevailing circumstances. Notwithstanding these limitations, there is a high likelihood that effective interventions to control Covid-19 in specific communities will be enhanced with community participation. It is against this background that the next section looks at the extent of community participation in Covid-19 mitigation in Khutsong Township using Arnstein's model.

Community Participation and Covid-19 in Khutsong Township, Carletonville

This section seeks to assess whether community participation was part of Covid-19 interventions in Khutsong Township, given its importance in pandemic control and management as articulated in the previous section. The section starts with providing some background information on Khutsong Township before it goes into detailed analysis and adjudication of community participation in the Covid-19 interventions that were implemented by different stakeholders in the township.

Khutsong Township, Carletonville

Geographically, Khutsong Township is part of the Merafong Local Municipality on the West Rand of Gauteng. It is situated 88, 8 km from Johannesburg (West Rand District Municipality Profile., 2020). Khutsong Township has the biggest population in the Merafong Region, according to Statistics South Africa Community Survey (Merafong City Local Municipality, 2016). Khutsong Township attracts migrant labour from areas around South Africa and neighbouring countries, such as Mozambique, because of its gold mining history (George, Mehra, Scott, Sriram, 2015). The township also has the highest unemployment and poverty rates in the municipality (West Rand District Municipality Profile., 2020).

The geographical, demographical, and social economic characteristics of Khutsong Township make it vulnerable to pandemics as there are so many people living together in poor dwellings. Khutsong Township is a fair representation of many townships in the mining areas in South Africa. It is for this reason that it was chosen as the case study.

It is important to note that geographical considerations and the community participation aspects have often been jointly part of pandemic mitigation strategies in the past. The geographical consideration focused on eliminating the risks by identifying health trends in a particular area, tracking the spread of a disease in the area, and deriving means to improve health services in assisting the targeted group (Rifkin, 2014); whereas community participation efforts were directed towards mobilizing, collaborating and empowering the community members to participate in their own health activities

(Agonnoude Mwsenge, 2010). Hence geographical consideration played a role in choosing Khutsong Township as a case study on community participation and Covid-19 mitigation efforts.

Interventions in response to COVID 19 in Khutsong Township: The extent to which they involved Community Participation

Khutsong Township, just like any other place in South Africa, was not exempted from the scourge of Covid-19. To mitigate the spread of Covid-19, various stakeholders came together to come up with interventions of slowing down the spread of the disease. The key stakeholders that were involved in Covid-19 response in Khutsong Township were AngloGold Ashanti and the Provincial Department of Social Development. Broadly, the stakeholders provided water access points, isolation facilities, Covid-19 Personal Protection Equipment (PPE), and distributed food parcels, blankets, and toiletries (AngloGoldAshanti, 2020). The question remains though of the extent to which community participation was part of the above initiatives.

Community participation as espoused by Arnstein can be effective or superficial in any project or intervention. To assess whether community participation was part of an intervention, one needs to look at specific indicators rather than just the mentioning of community participation. Drawing from Arnstein disaggregation of elements of community participation, this article uses the following specific parameters to establish if indeed the Covid-19 intervention in Khutsong Township involved community participation. The parameters used to adjudicate community participation are:
a) informing,
b) consulting,
c) involving,
d) collaborating,
e) partnering with communities, and
e) contributing to citizen-led strategies.

Table 1 below summaries the extent to which each of the above elements happened or did not happen in the Covid-19 mitigation interventions in Khutsong Township. Most of

Table 1: Community Participation Adjudication in Khutsong Township

Criteria for Adjudication	Definition of Criteria	What happened	Source (Evidence)
Informing communities about planned interventions	• Communities are informed and made aware about interventions.	• The mining company teamed up with local government officials to distribute food parcels and blankets to the vulnerable members of the community. Since this exercise was successful, it means that targeted beneficiaries were informed about the intervention. So one can conclude that there was implicit evidence of informing.	• AngloGold Ashanti humanitarian efforts on Covid-19 available at https://www.agacovid19.com/. • Merafong Local Municipality 2020 – 2021 IDP documenet available at http://www.merafong.gov.za › IDP Document 2020 .
Consulting	• Communities are invited and given an opportunity to provide opinions, comments, views and feed-back on planned intervention.	• According to AngloGold Ashanti website on Covid-19, there was no mention of communities having been consulted or given an opportunity to provide input to the planned Covid-19 interventions prior to their commencement.	• AngloGold Ashanti humanitarian efforts on Covid-19 available at https://www.agacovid19.com/.
Involving	• Communities are jointly undertaking responsibilities and actions at all stages of the intervention, from decision-making process to the implementation process.	• The mining company involved the local government officials to identify vulnerable community members mainly the elderly, orphans, people with disabilities and homes led by children as the beneficiaries of food parcels and blankets; but there was no deliberate effort to actively involve identified vulnerable members of communities in taking responsibility of the intervention.	• AngloGold Ashanti humanitarian efforts on Covid-19 available at https://www.agacovid19.com/. • Merafong Local Municipality 2020 – 2021 IDP document available at http://www.merafong.gov.za › IDP Document 2020 .

Criteria for Adjudication	Definition of Criteria	What happened	Source (Evidence)
Collaborating	• Communities are contributing with their skills and knowledge and sharing their resources to influence intervention outcomes.	• AngloGold Ashanti worked with healthcare providers to strengthen community health and hygiene. • AngloGold Ashanti worked with a local masks supplier to donate to the Merafong municipality. • AngloGold Ashanti provided two hospitals that will be used for isolation of Covid-19 patients from the community. • Sibanye-Stillwater, AngloGold Ashanti, Sasol and Imperial Logistics worked together to distribute hand sanitisers produced by Sasol to schools, health facilities, and taxi ranks within their host communities. • There was evidence of collaboration and sharing of expertise and knowledge among implementers of the Covid-19 intervention but not with the communities. Communities were passive recipients of the already pre-determined goods and services.	• AngloGold Ashanti humanitarian efforts on Covid-19 available at https://www.agacovid19.com/. • https://www.timeslive.co.za/politics/2020-09-29-mining-hospital-donated-for-covid-patients-to-become-permanent-facility/ • Gauteng Department of Health media statement dated 14 May 2021 https://www.gauteng.gov.za/Publications/5C4D11A8-2FC0-46D0-B390-FC454D9868FC • Sibanye-Stillwater media release dated 23 July 2020 https://thevault.exchange/?get_group_doc=245/1595499701-JointmediareleaseSibanye-StillwaterSasolImperialSanitiserdonationsFinal.pdf
Partnering with Communities	• Communities are implementing jointly agreed solutions.	• AngloGold Ashanti worked with various taxi associations to place water tanks at taxi ranks to improve hands hygiene. So, to some extent there was an element of partnering but these were with intermediary parties and not directly with communities.	• AngloGold Ashanti humanitarian efforts on Covid-19 available at https://www.agacovid19.com/.
Contributing to Citizen-Led Strategies	• Communities are let to take the lead in decisions and long-term plans that directly affect them.	• According to AngloGold Ashanti website on Covid-19 action plans, there was no mention of targeted communities taking a lead in decisions pertaining to mitigation plans that directly affect them.	• AngloGold Ashanti humanitarian efforts on Covid-19 available at https://www.agacovid19.com/.

Author compilation; (AngloGoldAshanti, 2020); (Marston, Renedo, & & Milesa, 2020), (George, Mehra, Scott, & &Sriram, 2015)

this information is from AngloGold Ashanti website. However, for validity and reliability purposes, the information was cross-examined with the Mineral Council of South Africa's information on Covid-19. The Mineral Council of South Africa represents 90% of mining companies in South Africa; AngloGold Ashanti is one of them (Mineral Council South Africa, 2020). Based on documents in the public domain, of the six criteria of effective community participation in a solution-seeking intervention, there is evidence for only one that was met in as far as Covid-19 interventions in Khutsong Township where concerned. There is evidence of involvement, collaboration, and partnership in implementing the interventions but these were mainly with peer implementing parties and not with the community. There is a possibility that communities could have been involved, but this was not mentioned in any of the documents reviewed. Moreover, it very unlikely that all stakeholders could fail to mention or capture the important role that the community played in the interventions if it had happened.

Concluding remarks

Although the Covid-19 mitigation measures adopted by all stakeholders in Khutsong Township had an element of community participation,

overall the aspect was insignificant. To the extent that community participation is critical in increasing effectiveness of interventions aimed at controlling and managing pandemics, more could have been achieved and in a faster way if the Covid-19 interventions in the Khutsong mining township had actively involved communities. Community participation enhances effectiveness of other interventions aimed at controlling and managing a pandemic particularly in situations workplaces are located in close proximity to communities.

As the country wades through the 3rd wave of the Covid-19 infections, it is important that all stakeholders recognise and introduce the community participation element in their plans for controlling and managing of Covid-19 infections. The introduction of community participation in Covid-19 control strategies in the mining sector is particularly crucial for trade unions because they are supposed to be the custodians of workers' interest, and by extension the custodians of worker communities' well-being.

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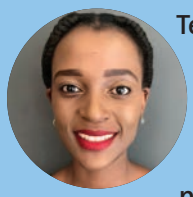
THE EFFECTS OF TECHNOLOGY-INDUCED CHANGE IN WORKPLACES ON THE WORK OF TRADE UNIONS: Reflections

Pulane Mafoea-Nkalai and Sharon Mohlala

Technology is changing the workplace. More than ever before, it is now possible to work remotely, to constantly monitor workers through cameras and trackers, to capture production and productivity data in real time, and of course to replace workers with intelligent machines. The Covid-19 pandemic has accelerated the rate at which many employers are considering or introducing these workplace changing technologies. The changes in the workplaces have a definite effect on the well-being of workers and, by extension, on the work of trade unions. This article reflects on the impact of these workplace changes due to the use of technology, as well as what trade unions in general and the National Union of Mineworkers (NUM) in particular can do to protect and cushion members in these changing workplaces. The article specifically recommends that trade unions ought to ensure through bargaining that workers are reskilled and educated, considering how technology will affect work. Further, if trade unions are to continue to be an effective safeguard for workers in the context of technology-induced workplace changes, they must engage in partnerships with other international unions. They should also create an environment where even casual and temporary workers are welcome.

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Introduction

In the last few decades, the introduction and influence of technology in the workplace has become more apparent, and the need for using technology in the workplace is greater than before. This is because technology has, over the years, been proven to make production faster and cheaper for the employer (Hlatshwayo, 2017). There are concerns that technology will affect and change the standard and normal way of work and is, thus, impacting workers. These concerns have been elevated by the effects of Covid-19, and the rising need for remote working. Some people have argued that the Forth Industrial Revolution will significantly change work as we know it, and that this change is inevitable. These workplace changes may significantly alter labour relations, thus posing serious challenges to the role of the trade unions. The main objective of trade unions is to defend and promote the interests of workers in the workplace. Through collective bargaining strategies, trade unions are able to safeguard members against exploitation, they negotiate for better salaries and better working condition, as well as better social benefits. This role has become threatened under the new working norms. For instance, because of remote working, homes instead of offices have become workplaces, working conditions and hours have become flexible, unstable, and unpredictable. In some sectors like mining and construction, this might bring exploitation of workers, job insecurities, and union membership loss if workers lose their jobs.

This paper discusses the impact of these workplace changes on South Africa's trade unions particularly the NUM, and the role the unions can play to mitigate the negative effects of the 4IR like exploitation, salary cuts and possible job losses.

The paper is organized as follows:

- Introduction - setting the scene on changing nature of work due to the introduction of new technologies and methods of work.
- Theoretical framework – theories that explain trade unions organization and recruitment.
- The role that unions can play to cushion negative effects brought by technological changes.
- Conclusion and recommendations.

Background: How technology is changing work

Over the last few decades there has been an emphasis, particularly in the economic and political spheres, on how technology is changing work and the implications of these changes on the economy and on workers in general. Of late, the debates have centred around how the Forth Industrial Revolution (4IR) is rapidly changing the world of work. The 4IR is considered to be an integration of the digital and physical spheres, consisting of the introduction of new technologies such as robotics, Internet of Things, artificial intelligence, cloud computing, 3D printing, and advanced wireless technologies to name but a few. More important is how these changes will affect workers and the unions. There are concerns and questions about the future of trade unions as the world of work changes. Although there are differing views on the implications of these technological changes for workers, there is no doubt around whether the changes are happening or not. What is not so clear is the effect of these changes especially on trade unions.

There is a lot of literature on how work has changed over time, particularly as a result of technological changes. Academics and researchers have explored the extent and magnitude of these changes and how they impact on different groups of workers (Smith, 1997); (Spreitzer, Cameron, & garrett, 2017). For Smith, the broader changes in technology, the economy and even in society have contributed to the new work arrangements. Spreitzer et.al found that there are two forms of the new world of work; on the one hand it is for high skilled workers who have a choice over the work arrangements suitable for them, and on the other hand low skilled workers who scuffle to make a living and depend on what the employer decides. Accordingly, the latter (low skilled workers) are a concern for trade unions because they are more likely to experience exploitation and job losses as compared to more skilled workers. In addition, low skilled workers are likely to be in non-standard work arrangements, with no work contracts.

There are far-reaching changes occurring in the way that work is organised within companies and the public sector (European Commision, 2002). Due to new technologies, new ways of performing day-to-day tasks and approaches are formed, creating new forms of work. For businesses, these new approaches bring benefits as they promote competitiveness and effectiveness (European Commision, 2002). By contrast, these new forms of work pose serious challenges for trade unions for a number of reasons. The main reason is that the new forms of work are characterised by flexible work, and non-standard work arrangements, and are subjected to inconsistent definitions and inadequate measures (kalleberg, 2000) making it difficult for unions to organise such workers (Spreitzer, Cameron, & garrett, 2017).

There are various factors that are influencing what change is taking place at workplaces; these factors include technology, economics, as well as demographics. There is no denying that work is changing under the auspices of the Internet of Things, robotics, and artificial intelligence. Many jobs have been made redundant as a result of machines and robots taking over. As an example, in the past there were many workers in car assembly lines; however, now cars are assembled by industrial machines and robots. (Visser, 2019) argues that this process can be referred to as de-industrialization, and that it has been going on for some time. This is particularly worrying for trade unions as it poses multiple challenges. Among the difficulties that trade unions face is membership loss due to changes in the workplace, and change in the economic structure. For example, in the mining sector the introduction of mechanisation will inevitably result in job losses. The results of membership loss in a trade union are dire, it effectively means less representation as well as decreased subscriptions. It is equally devastating for the labour movement when members lose formal jobs and are absorbed in casual and precarious jobs.

Another way in which technology changes the world of work is in changing the skills required in these new forms of work. According to the (World bank, 2019)) whilst there is a decline in demand for skills that can be replaced by technology, there has also been an increase in demand for cognitive skills and skill combinations linked to the ability to adapt. Proponents of the 4IR argue that workers who are not able to adapt to these technological changes will be left behind, thus affecting worker organisations. As an example, in March 2021 Kumba Iron Ore, a subsidiary of Anglo-American SA, announced the intention of restructuring and the retrenching of workers in selected operations. The company cited 'the need to accelerate efforts to ensure both organisational effectiveness and efficiencies through an organisational restructure'. They referred to an approach called the 'Work Smarter work stream of Tswelelopele' as their main reason (Khumba Iron Ore, 2019) . However, the implications of 'work smarter' are severe for workers as well as the unions. Under the work smart stream, some jobs will be changed completely. This means that the purpose, complexity, skills, and knowledge required for roles will change. However, others will not change but the number of workers in those roles will be cut because of increased technological assistance. Finally, some jobs will be terminated and no longer exist in the structure.

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These dramatic changes in the structure and availability of jobs is also concerning for the unions.

These changes are occurring not only in mining but in all the sectors of the economy. For instance, (Hlatshwayo, 2017) found that technological changes in the manufacturing sectors tend to lead to reorganization of skills and the forming of few groups of skilled workers as opposed to the entire workforce. Job roles are changing, which means that the union must be proactive in terms of lobbying for the skilling and re-skilling of their members. Further, they must find ways to retain skilled workers. Jobs that were previously done by manual workers such as drilling, for example, will now be conducted by machines. As a result, the worker might need to be re-skilled in order to operate the machine. Despite the challenges described above, trade unions continue to be relevant. They continue to search for alternative ways of organising and recruiting. Furthermore, trade unions have to also address carefully the challenges brought by the technological changes. For trade unions there are three basic concerns to address, namely:

1. What will be the prominent industries and occupations of the future?
2. How will workers in non-standard employment be represented at work?
3. What changes will the union need to make in light of the future of work?

The challenge for trade unions is how to ensure that workers in these non-standard jobs are represented. This is particularly worrying as these changes in the workplace weaken trade unions' collective bargaining, which is central to the functions of trade unions.

Theoretical framework

This section discusses the theories of trade unionism with regards to the changing nature of work due to new technologies that are being introduced in the workplace. Firstly, technology has a direct impact on how work is conducted in that job roles change. As a result, workers must be skilled and re-skilled for their new roles, such as moving from performing manual work to operating a machine. Secondly, technology enables flexibility in the workplace, for example working remotely. Thirdly,

technology advancements promote freelance and temporary contracts, which is a concern for unions. This is because trade unions depend heavily on permanent employment as it provides an opportunity for collective bargaining.

Trade union recruitment and organising is underpinned by various theories of labour economics and theories of sociology. In most cases, Karl Marx's theory of class conflict is often used as a reference point for understanding the roles and functions of trade unions. From Marx's perspective, trade unions are important in bringing about essential and necessary changes against capitalism. This is because when workers are united their strength grows, allowing them to collectively bargain and fight against exploitive capitalist forces. As one of the first social theorist, Marx investigated the working conditions in the factories that were mushrooming due to the industrial revolution. He criticized how changing from independent craftwork to working for an employer in a factory caused isolation and disempowering f or workers, and de-skilled them (Crossman, 2019). In addition, Marx feared that the machines acted as a great competitor to the worker, almost rendering the worker redundant (World bank, 2019).

It is, therefore, clear that debates around technology and workers are as old as the industrial revolution. (Gunzburg, 1985) argues that as a concept 'changing nature of work' or 'new forms of work organization" is definitely not new. Yet the current debates on how the 4IR is changing the world of work and how trade unions in particular are facing extinction are pitched as though it is a new concept. Manuel Castells, for example, offers a good theoretical understanding about the technological changes in the workplace. In his work on 'network society', Manuel argues that there is a shift from the industrial to an information age. He cautions that whilst the work process maybe 'globally integrated, labour tends to be locally fragmented' (Castells, 2000) cited in (Gartman, 1976) that this is because digital connectivity allows for work to occur within endless spaces and places, yet workers are becoming more isolated. Therefore collective bargaining, which is the basis on which unions are founded, ends.

This later theoretical aspect can then be linked to Tannenbaum who postulated that trade unions are rebel movements against automation. In fact, trade unions' resistance to new technologies in the work place can be located in this Tannenbaum 'rebellion theory'. For Frank Tannenbaum (a historian, sociologist, and criminologist) trade unions were seen as rebellion movements against automation, as a means to protect the interests of workers. The theory holds that as time moves forward and industries change, machines become a threat to the security of employment for workers. This is exactly what the 4IR is doing and has already done in most industries. Frank Tannenbaum (Tannenbaum, 1921) believed that it was the supremacy of machinery in the workplace that would escalate trade unionism.

Tannenbaum believed that the future of trade unions lay in their ability to focus on the immediate needs of workers. A union that is able to indicate to workers that they have a voice is more likely to even gain more members to recruit, and retain old members (Whatishumanresource, 2018). Tannenbaum insisted that workers should resist the effects of automation on their job security by resorting to industrial democracy (Tannenbaum, 1921). Industrial democracy argues that workers must have a voice in their places of work by participating in decision making through their unions and committees, while having a representative. As a result, based on this theory, trade unions are formed as a response to alienation and loss of community in the workplace as automation would leave the worker at the mercy of the employer.

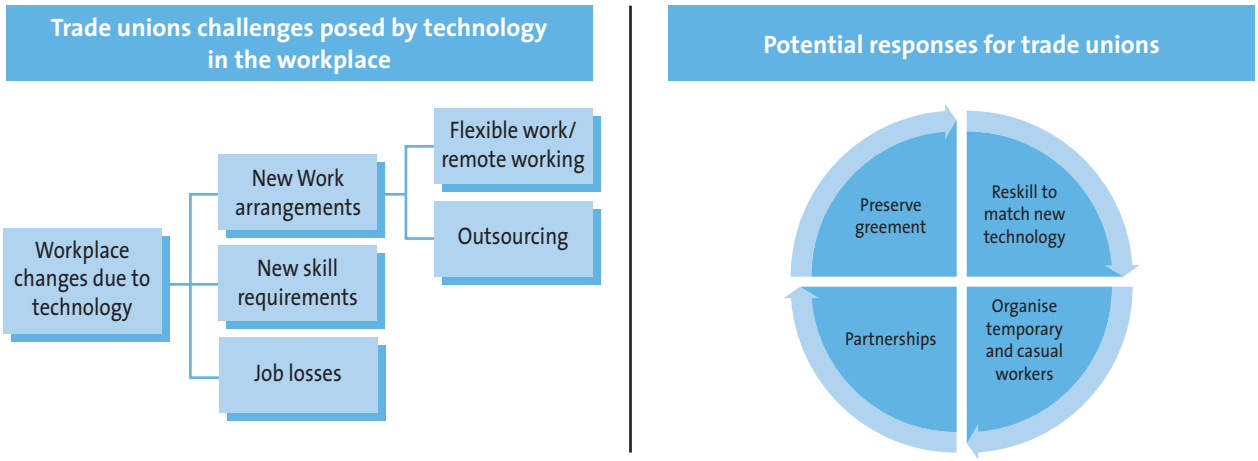
In essence, based on both Marx and Tannenbaum's theories that technology stands as a threat to workers, it is imperative that the union by all means stands as a resistance force against any form of total worker elimination in the workplace. Instead, it is in the best interests of unions to invest in beneficial agreements with employers. Through these agreements, employers and unions can work hand in hand in keeping unions relevant and workers secure. The union, along with workers and employers, should have discussions on identifying gaps that could benefit the worker even with the changing nature of work.

Given the emphasis both Marx and Tannenbaum's theories place on workers' unity and the strength that comes with that, these theories are most relevant in providing direction on how unions should respond to these changes in the workplace. These workplace changes weaken the security of individual workers and the collective bargaining of trade unions, thus creating a new economic and social order. So, it is important for trade unions to ensure that regardless of the form and standard of work, workers are united. This implies that unions need to look into new forms of recruitment; and uniting even unorganised and casual workers.

The roles that unions can play to cushion negative effects of 4IR

Trade unions have one of hardest roles to play in terms of easing the negative effects of technology in the workplace. This, however, is not necessarily new as revolutions have been happening over the decades. The concern should be more around whether South Africa is indeed ready

Figure 1: Responses for the trade unions to the changes brought about by technology in the workplace



for the transition to the 4IR, and how unions will address the social divide between the labourer and higher-level employee. Unions have to come up with strategies to work hand in hand with employers, so as to ensure the security of jobs. In his study (Mpafa, 2018) argues that the 4IR is most likely going to undermine the bargaining power of trade unions. The 4IR definitely puts trade unions in a position of uncertainty; it also makes one to ask if trade unions really have a voice regarding the current changes in workplaces.

There are some proactive actions that trade unions can take in order to soothe the transition for workers (GLU, 2019): as per illustration below:

- Through the re-skilling of current workers and skilling of new workers.
- Lifelong learning or education.
- Preserving collective bargaining agreements and social protection.
- Developing strategies and working with the International Labour Organisation to develop responses to digitisation.

Re-skilling and skilling

One of the biggest challenges is that most workers provide manual labour for companies. Although this has been the case for a long time, it is changing very fast. The dynamics of work are changing and the only way that trade unions cannot be left behind is if they participate by contributing to the changes (Mpafa, 2018). This can be done through the re-skilling of older workers and skilling of new workers. Older workers would most likely be familiar with the workplace environment and how everything is done, it is more a matter of how trade unions can ensure that they are still relevant. As a result, they would be re-skilled in such a way that they move away from manual labour to operating machinery. However, this may not necessarily indicate that all jobs will be preserved because technology is meant to quicken production while the employer cuts on costs such as labour.

In terms of skilling new workers, the unions should do more research on what particular skills are needed with the changing environment. This is especially true in that there are over 40 million educated unemployed young people (Armstrong, Parmelee, & Santifort, 2018). As a result, trade unions would need to look more into organising and engaging in the skilling of such people and retaining them in partnership with employers and other relevant stakeholders.

Education

Educating workers about the 4IR and how it will affect work and working conditions is of paramount importance. This is a way of preparing workers about what possible outcomes to expect with regards to the 4IR. If workers are not prepared, the effects could be dire both mentally and financially. The outcome of the effect of the 4IR is loss of jobs and the requirement of new skills, and the best way to prepare for the outcome is through lifelong education (Armstrong, Parmelee, & Santifort, 2018). Both workers and up-coming workers must be prepared. This will help them ask questions around what they can personally do to stay relevant and be protected in the workplace as well.

Preserving agreements

This component is particularly important for trade unions and their members. When trade unions bargain with employers for certain policies and social protection, these agreements can be used as leverage to hold employers accountable when changes occur in the workplace. Even with the changes that may be taking place, trade unions can ensure that the agreements are altered on a need basis, and only if they do, of course, benefit the worker.

Such agreements are a valuable instrument for trade unions and their members. Expectations and commitments between employers and the unions are clearly laid out.

The agreements could aid trade unions and employers with the retaining and skilling of workers and having a social plan for workers.

Partnerships

Partnerships among unions and the International Labour Organisation could prove to be a beneficial relationship. Partnerships like these could basically serve as platform for unions to come together and brainstorm on how they as an entire movement can remain relevant and contribute to the 4IR. In as much as unions tend to compete against one another for membership, it is imperative that they put the competition aside and come together for a common purpose.

Organising temporary and casual workers

Perhaps one of the significant changes that trade unions are going to have to do is to find ways in which temporary and casual workers can be organised. In order for the unions to successfully ease the negative effects of the changing nature of work due to new technologies, they will have to be pro-active. The pressure and increase in non-standard employment make it highly important for trade unions to organise and represent workers beyond the normal workplace. One way is maybe to offer support, representation, and partnership to workers with non-standard employment even if they are not union members. In addition, the unions may ensure that there is relevant content and incentives that would attract temporary and informal workers to join unions, even with the changing nature of work. In being pro-active, the unions must make sure to engage in continuous research and development, so as to identify gaps in the market that would aid in assuring members of job security. It is also imperative that the unions use the immediate needs of workers as leeway to attract them to joining.

Conclusion

The technological advancements in the workplace have brought about massive changes in many industries. This has in turn affected many aspects of work such as the nature of work, the security of work, and even salaries to mention but a few areas of concern. As a result, organisations such as trade unions are expected to be concerned with how they will, first of all, remain relevant; secondly, how they will retain their current members; and, lastly, continue to successfully recruit new members. The issue of recruitment and retaining of members will be determined by how relevant trade unions remain, with all the changes coming with the 4IR.

There is much that the unions can do to ensure that they are not left behind in the transition. It is also highly important to note what level of development South Africa lies in. Questions that ought to be asked include:

- Is South Africa is ready for the 4IR, and if so, in which compartments of employment?
- In which provinces are these found?
- Which fields of employment are still able to provide employment for manual workers?

In as much as the Fourth Industrial Revolution has already changed many sectors, it is important to also note that some sectors may still be moving slowly towards the 4IR. As a result, the unions can draw lessons from workplaces that are already transitioning so as to be better prepared for those that will still transition.

Recommendations

In light of what was discussed, it is important for the NUM not to be left behind with all the changes taking place in the workplace. The NUM must seek to come up with plans that would ensure their contribution and participation in the 4IR, lest they will be left behind.

The following recommendations can aid NUM in adapting to the changing workplaces:

- The union must invest in agreements with employers for the re-skilling and skilling of workers.
- Trade unions must seek to diligently provide good services that speak to the immediate needs of workers in order to retain them and also gain new members despite the changing nature of work and workplaces.
- Trade Unions should continuously research and keep themselves informed of the effects of technologies on their members with the intention of taking pro-active steps to protect them.
- The unions must make sure to valuably participate in the revolution, if they cannot stop it, by finding gaps and opportunities through which they can participate and stay relevant.

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A DECENT HOME OR DIGNIFIED ACCOMMODATION AT WORK:

The Dilemma of Trade Unions in Advocating for Improved Housing Conditions for Mineworkers

Zolisa Mpange

Trade unions are expected to be the custodians of workers' interests and workers' well-being. In fact, unions lose credibility and membership, in the long term, when they cease to be seen as promoters of workers' interests. Improving housing conditions is one of the workers' interests that unions have been promoting with varying levels of success. Based on research undertaken in seven mining provinces of South Africa, this article makes the case that the unions' efforts to improve housing conditions of mineworkers have been made harder by the varying housing preferences of mineworkers. The majority of workers are more concerned about owning and improving houses in their home areas rather than around the mines. This article suggests that for housing improvement interventions to be more effective, housing preferences of mineworkers have to be considered in the structuring of these interventions. This requires unions and other stakeholders to be pro-active in keeping track of the changing housing preferences of mineworkers, and to align their interventions to the preferences.

High-density compounds (Allan, 2003)

Introduction

South Africa's mining sector has always relied on migrant labour from other South African provinces that are distant from the mines, and from neighbouring countries. The provision of housing has been part of the terms and conditions of employment of most mineworkers in South Africa, because the mining sector has always been dependent on migrant labour. Historically, mining companies provided low-income black migrant workers - almost exclusively men - with accommodation in barrack-style hostels. These hostels often housed a dozen or more men in a room. These single-sex hostels were central to housing provision in the mining environment (Makaula, 2017; Marais & Cloete, 2013).

Organised labour played a huge role in driving new housing policies and legislation, with campaigns against migrant labour and the hostel system (Bezuidenhout & Buhlungu, 2011). The arrival of the National Union of Mineworkers (NUM) in South Africa's mining sector introduced a new priority - family life and housing - into the collective bargaining system which up till then had been strictly limited by apartheid legislation. This approach transformed the housing system in the mining sector altogether.

The mining companies then started to steer away from hostels, fashioning their housing benefit schemes with the preferences of organised labour in mind. Mines started offering living-out-allowances (LOA) to mineworkers who preferred not to live in the accommodation provided by the mines (Drewes & Van Asmegen, 2008).

Despite the many housing interventions that have been initiated, the quality of housing for mineworkers remains a challenge. In fact, one of the reasons to which the Marikana tragedy of 2014 is attributed is the lack of adequate and acceptable houses for mineworkers. In an

High-density compounds (Allan, 1992)

attempt to understand why housing for mineworkers remains a challenge, research was carried out to ascertain details of existing mineworkers' housing benefit preferences. This was considered an important step in guiding unions' position on how to participate in improving the state and forms of housing benefits of their members in isolation or in conjunction with other parties.

Based on research undertaken in seven mining provinces of South Africa, this article makes the case that unions' effort to improve the housing conditions of mineworkers have been made harder by mineworkers' changing housing preferences. There is a risk that what the unions are currently advocating in terms of housing benefits may not be what the members want. It is, therefore, important that the unions keep track of their members' preferences so as to be able to effectively advance their interests.

Housing conditions of mineworkers before legal recognition of unions

The housing system of migrant labour in South Africa was established in the 20th Century (Leon Commission Report , 1995). The history of housing for migrant mineworkers is linked to colonialism, apartheid, and racial discrimination. White mineworkers were treated as superior to black mineworkers. Company housing for individuals was determined by two factors. The individual had to be senior and, consequently, the individual had to be white. White high-income mineworkers were commonly provided with housing as a fringe benefit. Conversely, mining companies housed black mineworkers, classed as migrants, in high-density compounds (migrant hostels), despite their inhumane conditions (Chatham House Report, 2014).

Rex (1974) describes these hostels as 'a kind of bachelor barracks to which workers retire when off-shift to bunk beds in communal dormitories and receive their food in a specially provided communal kitchen'. Demissie (1998) highlights that the design of mine housing was intended to function in three different ways.

These functions were:

- to separate the mineworkers from the rest of the community;
- to act as a deterrent against uprising; and
- as a basis for fragmenting mineworkers' solidarity.

Above all, this housing system was designed to divide the higher-grade white workers from the lower-grade black workers and create an elite amongst the workers.

Unions' housing demands after unions legal recognition

During the 1980s, the hostels became a hotbed of political action. Mineworkers became increasingly unionised after the legal recognition of unions in 1982. Dissatisfaction with the hostels, or more specifically the quality of the hostels, was one of the major causes of strikes (Makaula, 2017; Demissie, 1998).

In the late 1980s, the demand for improved living conditions moved beyond the compounds. The NUM demanded that mineworkers be allowed to seek alternative housing in communities close to the mining operations.

Mining companies gave concessions, starting to allow mineworkers to live in alternative housing. However, considering that the mining companies had historically provided housing and food for mineworkers, mineworkers who did not live in the hostel requested housing assistance. During this period in the early 1990s, the NUM called for an LOA for mine employees who lived outside the compounds (Crush, 1992c). The LOA was a benefit that already existed for mine employees, but had been preserved for white employees only. Most of these white employees were managers and skilled employees who lived in urban areas in the mining towns.

The trade union negotiated for the LOA to be granted to all mineworkers. The mining companies conceded and started paying the LOA selectively, first to skilled black mineworkers. In successive wage negotiations with the mining companies, the NUM continued to

Freedom Park informal settlement was one of the housing options for black mineworkers in Rustenburg Platinum Mines (Allan, 2003)

call for an LOA for all mineworkers. These negotiations took place in the transition period to democracy between 1990 and 1994. During this time, it had become clear that the apartheid state was collapsing. Repressive apartheid laws were being abandoned and mineworkers started moving to settlements around mining operations. No more legal considerations prevented the mining companies from paying an LOA, which paved the way for its wide-scale introduction.

The LOA became a negotiated benefit after the advent of democracy in 1994. The LOA was incorporated into employees' wages by most gold mining companies. The LOA was introduced in 1996 by the platinum mining companies (Bezuidenhout & Buhlungu, 2011).

However, it became clear after the introduction of the LOA that the amount was not enough to pay for decent rental housing. The only areas where migrant mineworkers could possibly afford to rent was in local black townships. However, most of these townships were located far away from mining operations because of apartheid spatial planning (Demissie, 1998). Furthermore, these townships lacked capacity and were not meant to provide rental housing. Most households had space to accommodate only family members. These limited rental housing options left migrant mineworkers with two choices. They could either rent or build an informal structure in an informal settlement, or they could rent backroom shacks or rooms in local townships (Demissie, 1998).

Current housing conditions of mineworkers and the different benefits they receive

Mining companies have broadened the scope of housing benefits for mineworkers, as opposed to the apartheid-era approach of accommodating black mineworkers in high-density compounds. The companies have done this by upgrading hostels and providing various housing benefit options for mineworkers who do not wish to live in mine houses. The upgrading of hostels to single flats and family hostels, and the provision of various off-mine housing options have provided privacy and reduced overcrowding for mineworkers. The provision of various off-mine housing options has led to the majority of mineworkers in South Africa opting for off-mine housing.

There are six different forms of housing benefits currently received by mineworkers in South Africa's mining industry, namely:

- bond repayment subsidy;
- fixed interest rate at subsidised level for mineworkers buying houses;
- payment towards a deposit on a house for a worker buying a house;
- accommodation on mine property;
- living out allowance; and
- housing allowance.

A common form of housing benefit received by mineworkers is a housing allowance followed by living out allowance. Only a few mineworkers receive homeownership benefits.

Most mineworkers use housing benefits to rent rather than own property in townships or villages around mining areas. The main challenge that mineworkers face regarding the homeownership benefit is that mines only provide homeownership benefits when a mineworker wants to buy a house in designated towns close to their mining operations. They do not allow mineworkers the freedom of choice between owning a house

Royal Bafokeng Platinum Waterkloof Estate employee home ownership scheme in Rustenburg (Royal Bafokeng Platinum, 2014)

in mining areas or in their place of origin. For instance, in September 2014, Royal Bafokeng Platinum launched their Waterkloof Estate employee homeownership scheme, and the housing scheme is only available to mineworkers who want to buy houses on the mining site. But most (94%) of the workers that were interviewed from Royal Bafokeng Platinum reported that they opted for LOA/housing allowance other than the Waterkloof Estate employee homeownership scheme because they do not see Rustenburg as their permanent home.

Also, the rand value of housing benefits received by mineworkers in South Africa is not enough to cover the cost of the rent of a decent house in mining areas. Mineworkers are unable to afford decent rental housing at the market rate, due to the high cost of housing. This high cost of housing may be caused by a rise in demand for off-mine housing in mining areas, resulting in an increase in the price of housing in these areas.

As a result, mineworkers choose not only a safe and attractive area in which to live in mining areas, but also a neighbourhood that is appropriate to the rand value of the housing benefit they receive. So, most mineworkers live in residences that are inadequate for their needs.

Mineworkers current housing preferences

Mineworkers prefer to receive various types of housing benefits from mines, but the largest proportion of workers prefer a housing allowance. The majority of mineworkers prefer to receive housing allowance (42.5%), followed by those who prefer bond repayment subsidy (18.7%), payment towards a deposit for a worker buying a house (13.5 %), living out allowance (11.3 %), fixed interest rate at subsidised level for workers buying houses (7.9 %), accommodation on mine property (4.8 %), and other unspecified benefit (1.3 %).

Mineworkers prefer receiving housing benefits that promote rental of decent and affordable accommodation outside of accommodation provided by the mine in townships followed by suburbs, when they are at work. Off-mine housing gives mineworkers more freedom of choice in terms of housing options than on-mine housing. Mineworkers are looking for houses to rent in affordable neighbourhoods, and they want houses that are adequate for their needs.

In addition to receiving housing benefits that promote rental of decent and affordable accommodation off mine property, mineworkers prefer receiving housing benefits that promote home ownership in their place of origin. Most mineworkers already have homes in rural areas and as such, do not see mining areas as their home. Instead, some mineworkers want to be assisted to improve their rural home by extending their existing, owned homes. Others want to be assisted to purchase either a site and build or purchase a new or secondary housing unit in rural areas.

Mineworkers need good housing around mining areas, but also want a home in their place of origin, given that a home is more than just a physical shelter or a residential environment to them. The physical shelter is provided to protect people, whereas the creation

of a home represents deep social structures (Morris & Winter, 1996). In the same way, the residential environment consists of not only the dwelling unit but the site and setting, neighbours and community, municipality and public services, habitability and accessibility, rights and responsibilities, costs and benefits (Oliver, 2006a). Yet a home is more than that to mineworkers, for it is not only physical and economic but emotional, symbolic, and expressive. In many different cultures, owning a place to live can be seen as an achievement. So, there is no better place to be a homeowner for mineworkers than in their place of origin.

However, in addition to mines only providing homeownership benefits when mineworkers buy houses in mining areas, the other challenge regarding homeownership in the place of origin is that it is not possible to obtain financing for houses in rural areas, as the land belongs to tribal chiefs. As a result, successful collaboration between organised labour, mines, traditional leaders, government, and building suppliers is important in this regard.

Concluding remarks

The main lesson of this article is that for unions not to lose credibility and membership, and to be seen as promoters of workers' interests, they need to recognize that housing benefit preferences of mineworkers have changed overtime. This means that the demands for improved housing conditions of mineworkers have to change too. The demands for improved housing conditions of mineworkers must move beyond mineworkers being allowed to seek alternative housing in communities close to the mining operations. The unions' demands must take into cognisance that although mineworkers need dignified accommodation in their places of work, they are more concerned about owning and improving houses in their home areas rather than around the mines. The fuller the expression given to mineworkers' housing preferences through mine-level housing structures and other stakeholders, the more housing improvement interventions will be more effective. This requires unions and other stakeholders to be pro-active in keeping track of the changing housing preferences of mineworkers; and unions need to align their interventions to these preferences.

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TOWARDS CLEAN ENERGY: Learnings from the Japanese Experience with Clean Coal Technologies

Tankiso Pitso

South Africa is under pressure from environmentalists and advocates of clean energy to stop coal energy generation due to its adverse effects on the environment. The country is endowed with the second largest coal reserves in the world and generates 90% of its energy from burning coal. Coal mining and power generation through burning coal provide employment to a significant number of South Africans. The decision to move away from coal energy generation entails stranding of coal reserves, job losses, and making redundant the massive infrastructure that supports coal energy generation. Consequently, such a decision cannot be taken lightly by the country. It is against this background that this article explores whether the Japanese experience with Clean Coal Technologies (CCTs) provides South Africa with the possibility to continue generating energy from coal but in a cleaner way. The Japanese experience with clean coal technology reveals that there are technologies that can indeed make coal energy generation cleaner, but they come at a high cost and could make energy costs in the country uncompetitive. This article recommends that South Africa should do more research on the acquisition and implementation costs of some of Japan's clean coal technologies so as to establish their financial and economic viability in the country. These technologies include: a) circulating fluidized-bed combustion technology (CFBC) which is about mixing biomass with coal, and b) coal partial combustor (CPC). Without information on costs and viability, one may not write-off the possibility that South Africa can still make use of its coal reserves to drive its national development agenda in a cleaner way.

Photo by S. Hermann & F. Richter, Pixabay

Introduction: Unpacking the logic of clean coal technologies

Coal remains one of the crucial energy resources globally, but it also produces a large amount of carbon dioxide (CO_2) and other air pollution compounds such as SOx, NOx, soot and mercury (Kuramochi, 2015). These pollutants contribute to global warming, floods, and changing rainfall patterns. It is widely believed that continuing to burn coal to generate electricity has a major impact on the environment and contributes to climate change. To address this challenge, clean coal technologies have become popular in the current climate change discourse. The development of clean coal technology (CCT) is a main issue around the world, and so is the aim to reduce Co_2 emissions. Multiple countries both developed and developing are deploying these technologies. However, research reveals that CCT in Japan is considered to be the most advanced.

Clean coal technologies are seen as not the panacea to reducing carbon emissions but are viewed as a viable part of solutions aimed at mitigating climate change (Guan, 2017). These technologies will allow the continued use of coal as source of energy. There is also on-going debates as to whether countries should invest in clean coal technologies so as to lessen the environmental impact caused by coal generated power (Barnes, 2019). Governments from both developed and developing countries are putting some of these clean coal technologies to test (Subramanian, 2017). To further boost the efforts to address climate change, it will be a good step for South Africa to pay attention to these developments around CCTs and adopt and pilot some.

In the case of Japan, coal consumption has rapidly increased since the end of the 1990s. Japan has around 95 coal-fired plants that combine to supply 41,273 megawatts (MW). The country also accounts for 4% of the world's total greenhouse gas emissions (Normile, 2018). Following the Hiroshima nuclear disaster, the country turned more to coal power. However, the Japanese government is promoting R&D on clean coal technology (CCT) to increase energy efficiency and carbon capture capability, and to simultaneously decrease pollutant emissions (NEDO, 2019). Japan has succeeded in implementing the technologies not because it was cheap to do so, but as a policy shift to make sure the country meets its energy demands while limiting the pollution from coal-fired plants. To achieve the status of being a user of advanced clean coal technologies in the world, Japan's political will is to be credited.

Specific to South Africa, coal remains the primary source of electricity. The country is said to be the world's 14th biggest source of carbon dioxide (CarbonBrief, 2018). Concerns are that South Africa needs

to reduce the CO_2 emissions. As the developments around cleaner energy take place the Minister of Energy, Mr Gwede Mantashe, made a plea to the coal sector to invest in clean coal technology in order to mitigate the effects of climate change (IOL, 2019). This leaves Eskom as a state utility to take the lead. Although South Africa committed through the Integrated Resource Plan (IRP), which is the country's energy blueprint, to introducing clean technologies the idea has not been fully realized (IRP, 2019).

The South African government commits to promoting coal technologies through research and development. The country is realizing a need to adopt the following technologies:

1. super-critical coal-power plants,
2. fluidised-bed combustion,
3. underground coal gasification,
4. integrated gasification combined cycle, and
5. carbon capture and storage (NDP, 2018)(NDP, 2030).

The World Bank loan for Medupi power station development also has a clause that emphasises that the project should adopt cleaner technologies (Power Technology, 2018). Indeed, Medupi Power Station has an installed generation capacity of 6x 800 MW units and utilises a supercritical boiler and turbine technology designed to operate at higher temperatures and pressures, which allows for better efficiency of the power station (AFBD, 2018). In South Africa, CO_2 reducing technologies have been researched and piloting is emerging but at a slow rate with large amounts of investment needed (SANEDI, 2018). This study investigated the potential for carbon dioxide (CO_2) Capture and Utilisation (CCU) as a greenhouse gas (GHG) mitigation solution in South Africa. The study took place from 2016 and was completed in 2018. The study was a collaboration between SANEDI and Wits University (SANEDI, 2018, Wits Clean Coal Research, 2018). The study revealed that *'in reviewing of CO_2 sources and capture technology, it is not economically viable to capture CO_2 for either storage or utilisation from relatively dilute sources of CO_2 including coal-fired power stations'* (SANEDI, 2018).

It is important to support further research around clean coal technologies for adoption, piloting, and utilisation. The view by AFBD (2018) is that the cost of these technologies and policy support are seen as a challenge for South Africa to adopt these technologies (AFBD, 2018). This means that not much of cost analysis and clear policy direction has been done.

This paper becomes part of the discourse in the country about what technologies can be deployed domestically and why. The paper attempts to achieve these objectives:

1. To draw important lessons from Japan's experience with CCTs.
2. To ascertain if the coal sector can prevent job losses by deploying CCTs.
3. To document concerns by both opponents and advocates of CCTs as part of solution to cut CO_2 emissions.
4. To provide recommendations based on reflections on Japan's experience with CCTs.

Clean Coal Technologies in Japan

This section looks at clean coal technologies implemented in Japan. In the case of Japan, use of coal remains part of the energy mix because other energy alternatives cannot meet the baseload for the country's energy needs. As such, the country invested in clean coal technologies to offset Co_2 emissions which contaminate the environment, as it continues to rely on coal generated power. The country offers very good lessons because about 70% of Japan's coal-fired power comes from supercritical and ultra-supercritical plants which are advanced CCTs in cutting CO_2 emissions in coal plants (WNA, 2018). Although there are other technologies such as carbon capture and storage (CCS), in Japan CCS has not being implemented. The reasons include cost, and careful consideration in protecting seawater and marine life should the leakages of CO_2 happen because CCS stores CO_2 under the seabed. It is a lesson for South Africa to also be cautious before considering CCS and sites of CO_2 storage. Nonetheless, there has been reports of surveys for potential CO_2 storage sites (WCA, 2019).

Japan took an initiative to support High Efficiency and Low Emissions (HELE) technologies, and research and development was the foundation of the entire process (Barnes, 2019). The country supported the feasibility studies through research and development to make sure that some clean coal technologies are tested and then commercialised. The following clean coal technologies are commercialised in Japan and are proven to assist in reducing CO_2 emissions.

1. **Circulating Fluidized-bed Combustion Technology (CFBC):** This technology is simply about mixing biomass (plant & animal material) with coal to reduce smoke. The CFBC is also capable of using low-grade coal, biomass, sludge, waste plastics, and waste tires as fuel (JCOAL, 2013). CFB is advantageous as it burns low rank coals because of its unique flameless, low-temperature combustion process (Subramanian, 2017). In South Africa CFBC can work, as biomass waste can be collected and used. The advantage of CFBC is said to be that it is flexible, efficient, water-constrained and can be applied to ensure the optimal use of coal.
2. **Advanced Pressurized Fluidized-bed Combustion Technology (A-PFBC):** This technology is just an

Photo by Adigun Ampa, Unsplash

advancement from the previous (CFBC) technology but in A-PFBC the temperature is increased to higher levels to recover high temperature steam which then leads to low CO2 emissions. The temperature is increased at the inlet of the gas turbine from approximately 850 degrees Celsius to approximately 1,350 degrees Celsius, thus attaining more efficient power generation (approximately 46% net efficiency) (JCOAL, 2013). In simpler terms, high temperatures produce steam and coal burns without too much CO2 release. The advantage is that modifications can be done on turbines. The Eskom plants may be checked for feasibility for use of this technology.

3. **A Coal Partial Combustor (CPC):** It is about adding air pressure and coal at a higher temperature and during the process, it produces cleaner gas and efficient power generation (Barnes, 2019). This means, when temperatures are higher, coal burns effectively with less smoke. Checking the power plants for retrofitting may be done by engineers on plant designs for technology adaptation in Eskom plants. The advantage of this technology is that it does not require additional resources but just pumping of air. Adjustments that can be done at the power plants depend on engineers and plant designers and that will determine the costs and what capabilities are needed.

Experiences of CCTs in Japan

Efficacy

Since the introduction of CCTs in Japan, the country has seen a reduction in CO2 emissions. The efficacy data shows that coal power station efficiency in Japan has increased from about 38% to 45%, and the pollutant emissions per generated power unit from coal power plants decreased as compared to developed countries (Guan, 2017); (WNA, 2018). In simpler terms, with the use of CCTs, Co2 emissions are reduced. The CO2 emissions from coal power stations have been reduced in Japan (CarbonBrief, 2018). Use of clean coal technologies has ensured that the pollutants from coal power stations are minimized for the benefit of the environment and the country's goal of maintaining stringent air emission standards.

Infrastructure

Japan has huge coal power generation infrastructure. This was an advantage in adapting the clean coal technologies to the coal fleet. The country has a total of 150 coal-fired plants (Arai, 2021). This is massive infrastructure which a country could not easily phase out or abandon; thus Japan invested in clean coal technologies to continue to use this coal infrastructure. This is an advantage that South Africa also has with its coal-fired power stations. The country cannot phase out and abandon coal power stations anytime soon, but it can invest in CCTs to generate energy in cleaner

ways, taking advantage of the available coal plants infrastructure.

R & D Support and finance

Japan gives great lessons in terms of the application and acquisition of CCTs. The country invested in research and development to support technological development and the viability of the CCTs. Although there is no available data on total spending on the R & D, it is clear the government allocated funds from the national budget. Currently, the Japanese government plans to allocate budget for the development of carbon capture utilisation and storage technology and carbon recycling up to ¥53bn. In addition, it plans to also allocate ¥231bn, up by 16.2%, to further develop energy saving and renewable power technology (ArgusMedia, 2020). The cost allocation estimates for renewable power technology are higher. This is an indication that even renewable energy infrastructure is still costly. It is clear that the financing of the clean coal initiative in Japan is part of the national developmental agenda. What comes as a key lesson here is that concrete research and financing of these CCTs was a bedrock for CCTs feasibility in Japan.

Contention about Clean Coal Technologies: Coal as a polluter and are CCTs impractical?

There are some who see the need to continue use of coal by applying CCTs. On the contrary, others see coal as a polluter and CCTs as a fairy-tale. In this sense, the advocates of CCTs are pro-coal for the reason that there is a need to balance climate change mitigation and ensuring socio-economic sustainability. A core assumption held by proponents of clean technologies is that clean coal technologies will help the countries to continue to achieve socio-economic goals by use of coal done in an environmentally responsible manner while ensuring energy security and addressing high unemployment rates (Barnes, 2019). This is a pertinent argument as coal supplies over one-third of global electricity generation (Normile, 2018).

Photo by Chris LeBoutillier, Pixabay

However, opponents of coal and CCTs view coal as a polluter. Opponents of fossil fuels are putting countries including South Africa under pressure to curtail coal generated electricity due to its adverse effects on the environment. The opponents argue that for the Paris agreement to reach global warming limits of 1.5°C, the electricity production from existing coal plants needs to be reduced as it far exceeds the range of such policy scenarios (ClimateAnalytics, 2019). It is further argued that the countries must get rid of coal. Organisations such as Green Peace argue that the costs of clean coal technologies is too much for South Africa and such investments can be used to develop other alternative sources of cleaner energy (GreenPeace, 2020). Opposing views argue that since countries have committed to phasing out coal power generation by 2030, it must be used meantime and there is no need to support CCTs or fossil fuels.

Efficacy Data

The advocates of CCTs believe that these technologies are reducing CO_2 emissions at around 30-40% efficiency rate. In Japan's case, clean coal technologies are proven to be efficient to a certain degree, running at 42-48% thermal efficiency in Japan (Barnes, 2019). There is more and more belief that the on-going research to advance the efficiency of these technologies will bear fruits.

However, the counter argument rests on the lack of concrete data at the global level - which might be the cause for the debate and

the scepticism towards CCTs. It is strongly argued that clean coal technologies are unreal as there in no concrete evidence and sufficient data that these technologies are efficient in cutting CO2 (Coca, 2018). Thus, the information about how effective these technologies are needs to be well documented to cement a case for further commercializing of CCTs. This shortfall weakens the stance for rapid implementation of these technologies. In this sense, opponents still argue strongly against the deployment of clean coal technologies as fossil fuels are regarded as the source of CO2 emissions.

Cost of the CCTs

The cost of CCTs remains part of the discourse. The proponents of CCTs admit that they are costly but the costs are falling down. However, the weakness of this assumption is that no tangible data is available. In addition, (Barnes, 2019) argues that the cost of clean coal technologies will fall if more dedication towards research and development to further improve efficiency of these technologies and bring costs down is demonstrated. It is also contended that CCT costs will always be high as plant equipment has to be specifically designed for each plant, as the seams are different (IEA, 2021). Other technologies simply require installation to already existing coal plants.

The case against CCTs is centred on costs. There is an objection that these technologies are expensive. However, the cost varies per each technology. CCS is the most expensive clean technology because of the infrastructure requirements. However, due to commercialisation in First World countries, the cost is falling as research develops ways to minimize costs of implementing these technologies (IEA, 2021). This provides an opportunity for South Africa to continue gathering evidence on the feasibility of implementing these technologies domestically. A drop in cost means South Africa may be at an advantage in implementing some of these technologies.

Even though the CCTs are considered to be expensive, it is better than the cost of phasing out coal in terms of job losses. The mining of coal will have to stall, resulting in job losses of approximately 92,230 people (MineralsCouncil, 2020). There are 46,665 employees in the electricity generation sector (generation, distribution, and technical services) (Eskom, 2019). Thus, abandoning coal will result in many livelihoods being negatively affected.

Technicalities of deploying CCTs

The waste from coal generated electricity is the reason why CCTs are developed to capture Nitrogen Oxides (NOx), Sulfur Oxides (SOx), and CO2 emissions. There is a concern about leakages of stored pollutants, such as CO2 by carbon capture and storage (Flude&Alcade, 2020). Also, the waste material and treatment of these reaction products have been part of discussions, as well as the CCTs and their quality (life span). There is also some unreliability due to breakdowns that then leads to leakages (AustraliaInstitute, 2019). It is clear that these technologies do have their own drawbacks. Clearly, with time, some advances will have to take place to ensure efficiency.

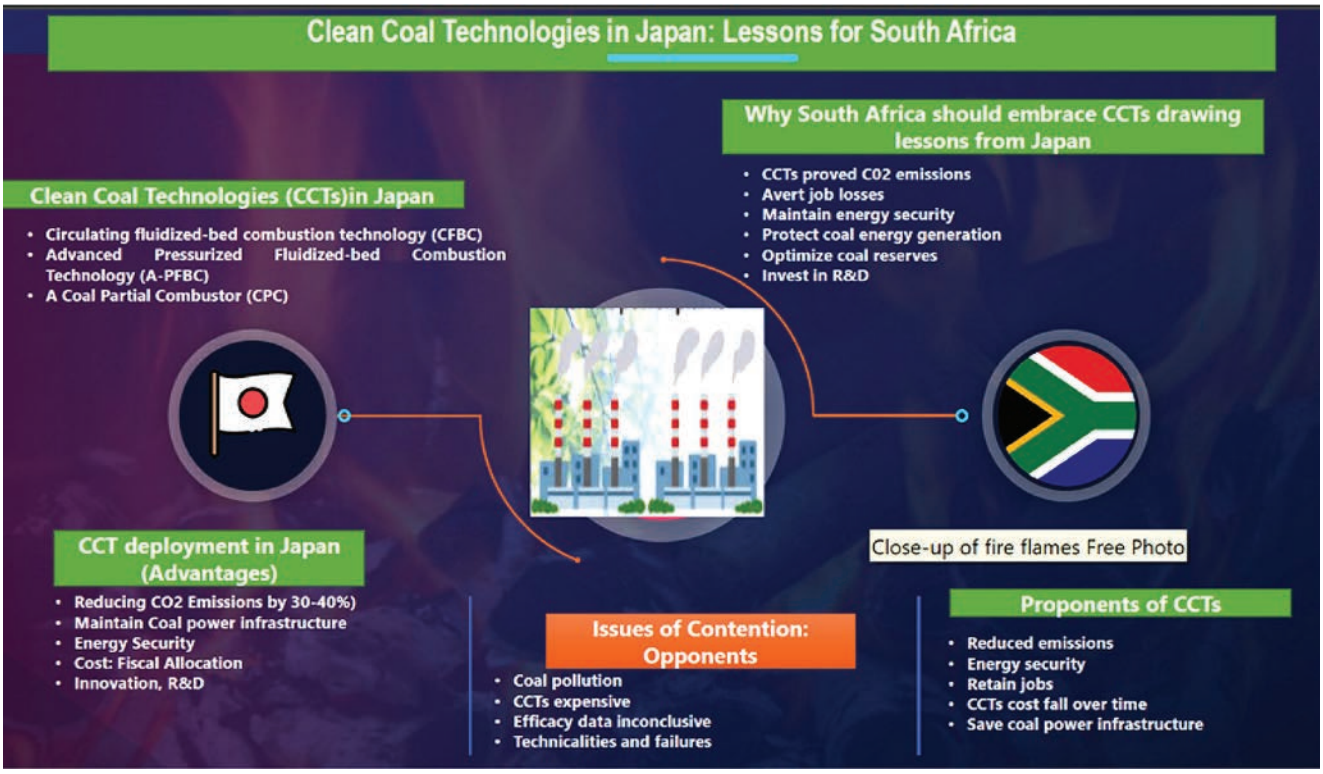
Coal power Infrastructure

Pro-coal voices argue that the massive coal infrastructure that supports coal electricity generation will be left redundant. All the power stations that have been built including Medupi and Kusile will be left as white elephants and the country would have lost its investment. It is clear that these coal-fired plants provide affordable energy to the country. On the contrary, opponents of fossil fuels argue for shutting down of coal-fired power stations as they are the source of Co2 emissions. However, for South Africa, the consequences of a complete shutdown of Eskom coal-fired plants will be dire. If South Africa completely abandons coal it means the country will have to abandon its coal reserves. South Africa has coal reserves estimated at about 66-billion tons (EngineeringNews, 2020). This will mean the loss of this huge resource.

Why South Africa should embrace CCTs

South Africa as a developing country is also confronted with the dilemma of achieving energy security, saving jobs, and adhering to global agreements on transitioning to clean energy generation that limits CO2 emissions. However, phasing out coal will be a costly process for the country including the stranding of coal reserves, loss of jobs, abandoning coal electricity generation, and making redundant the massive infrastructure which supports coal electricity generation and distribution. These important concerns are elaborated upon in the following section.

From Japan's experience we can learn that clean coal technologies do reduce carbon emissions. With financing plans, these technologies can be implemented. As such, efforts must be spent on researching more about the costs - whether there are ways to install cheaper clean technologies at Eskom plants. Therefore, before reaching the conclusion that CCTs cannot be feasible due to costs and other considerations, it is paramount to further undertake research about the cost implications in the South African context. Notably, South Africa has not undertaken research that has proven beyond doubt that CCTs can be adopted and implemented in Eskom power plants, from both



a cost and an efficacy point of view. Although SANEDI and academia generally are commissioning studies on CCTs, much needs to be done to reach scientific conclusions. South Africa still needs coal generated electricity for baseload, and for achieving its developmental agenda.

Coal employs many people in South Africa. Kaggwa (2019) argues that if coal goes under, many jobs will be lost. Coal still has a significant role to play for economic development and energy security by securing the baseload (Kaggwa, 2019); (Liedtke, 2020). South Africa has an abundance of coal. Liedtke of Seriti Resources argues that South Africa is faced with numerous economic and societal challenges and advocates for accelerated, responsible transitioning towards integrating the use of carbon capture and storage in clean coal power generation. Liedtke further argues that lessons should be derived from countries like Japan which achieved higher efficiencies and lower carbon emission rates in their coal-fired power stations (Liedtke, 2020). He echoes sentiments that are in line with the substance of this paper. HELE technologies have proven efficient in Japan; it is feasible to implement them in South Africa if a holistic approach is undertaken.

The diagram on the following page provides a summary of the study.

Conclusion and Recommendations

Undoubtedly, South Africa still relies on coal generated electricity. Coal constitutes 69% of the primary energy supply (DMRE, 2020).The plans to facilitate rapid transition to clean energy generation have not yielded tangible results. The country's energy security is not guaranteed as South Africa still encounters load-shedding. To avoid blackouts, well-thought out gradual phasing out of coal-fired plants is suggested. In addition, there is a possibility that some technologies can be implemented as Japan has done, but the cost implications need to be investigated.

The paper makes the following recommendations:

- South Africa should do more research on the acquisition and implementation costs of some of these Japanese clean coal technologies: circulating fluidized-bed combustion technology (CFBC) and coal partial combustor (CPC).
- The energy sector and the state must establish financial and economic viability of the commercialisation of CCTs. This is vital in ensuring that clean coal technologies can be affordable for a country.
- Without scientific data, one may not write off the possibility that South Africa can still make use of its abundant coal reserves to drive its national development agenda in a cleaner way.
- Clean coal technologies will not be a panacea for Co2 emissions reduction, other efforts and alternatives need to be assessed. Thus, there has to be investment in renewable energy sources such as solar and wind energy.

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SAM TAMBANI RESEARCH INSTITUTE

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The Sam Tambani Research Institute (SATRI) is a registered Public Benefit, Non-profit Company that was founded by the National Union of Mineworkers (NUM) and Mineworkers Investment Trust (MIT) in 2012.

The Institute's major objective is to undertake research and analysis of substantive and primary issues affecting the welfare of workers and workers' communities in general, but especially workers in the mining, construction and energy sectors of Southern Africa. From the research conducted, SATRI aims to produce publications and recommendations that inform policies and interventions related to the welfare of workers' and their communities.

Recognising that interventions aimed at improving workers and workers' communities welfare have become complex and require a great deal of factual information, SATRI gathers and analyses such information through its targeted research agenda.

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