The impact of working “eleven shift fortnight” schedule on labour efficiency in a gold mine within a South African setup

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ABSTRACT

This study reports on the impact of the working “11 shift fortnight” schedule at a selected gold mine in the Welkom area in South Africa on labour efficiency and utilisation. The main question was that is this schedule a bottleneck. Production employees work for at least five or six consecutive days, an average of 10 hours daily to be able to complete the job of the day. South African gold mines have become deeper, and the places of work are far from the entrance to mine stations, which lead to challenges such as the supply of material, compressed air and other resources needed for the safe production. Employees travel long distances underground before they start doing productive work. Production is based on targets to be achieved and not working hours. The study was quantitative in nature. Questionnaires were used to collect data on demographics and constructs intended to extract the data with a response rate of 75% on a population of 200. The impact of the 11-shift fortnight on the employees includes fatigue where most employees are continuously tired due to lack of rest, employees frequently getting sick which leads to high labour unavailability, employees not being able to spend enough time with their immediate families and relatives which compromises family structures. The main factors contributing negatively to labour productivity as per the survey are material or tools, services and safety issues. This has an impact on the performance of the team because their performance is measured on their output. This 11-shifts fortnight shift arrangement is a hindrance to mine productivity. Labour utilisation and efficiency, safety, social life and labour availability are negatively affected. Management is, therefore, advised to adopt some of the recommendation given in this study to mitigate the effect of this schedule on productivity.

Key Terms: 11-shift fortnight, bottleneck, job quality, long working hours, labour efficiency, work-life balance, gold mine.

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CHAPTER 1 INTRODUCTION

1.1 BACKGROUND

This study is being undertaken in the operations management context within the underground gold mining sector in South Africa. South African mines are among the deepest mines in the world. Some mines are four kilometres deep. It is accepted that the deeper the mine is, the higher the operating costs are. Deeper mines are also less productivity (Mineral Council of South Africa, 2018).

In most of these deep mines, actual production sites or workplaces are far from the shaft station. As a result, workers spend almost 50% of their time travelling to and from their respective workplaces or production sites. This significantly increases the operating costs and reduces the time spent by the workers to carry out actual production.

On average, South African gold mines are the most expensive to operate in the world, with sustaining production costs averaging at US$1,035/Oz compared to the global average of US$818/Oz. The labour component is also the primary cost driver, responsible for 53% of the total costs, followed by electricity at 20% (Mineral Council of South Africa, 2018).

The mining industry often uses shift work schedules intending to have a productive working mine around the clock. Such shifts are:

- fixed morning;
- afternoon shift;
- night shift; and the
- rotational shift.

The majority of the production employees work the morning shift. Essential services employees work rotational shifts. This means that they alternate between the three shift types: morning, afternoon and night. These employees are attending essential services at the mine such as pump stations, lamp-rooms and control-rooms.

Local gold mines have clung to the 48-hour working week for decades. Since the 1970s, this has mostly taken the form of the “11-shift fortnight”. This arrangement gives employees a

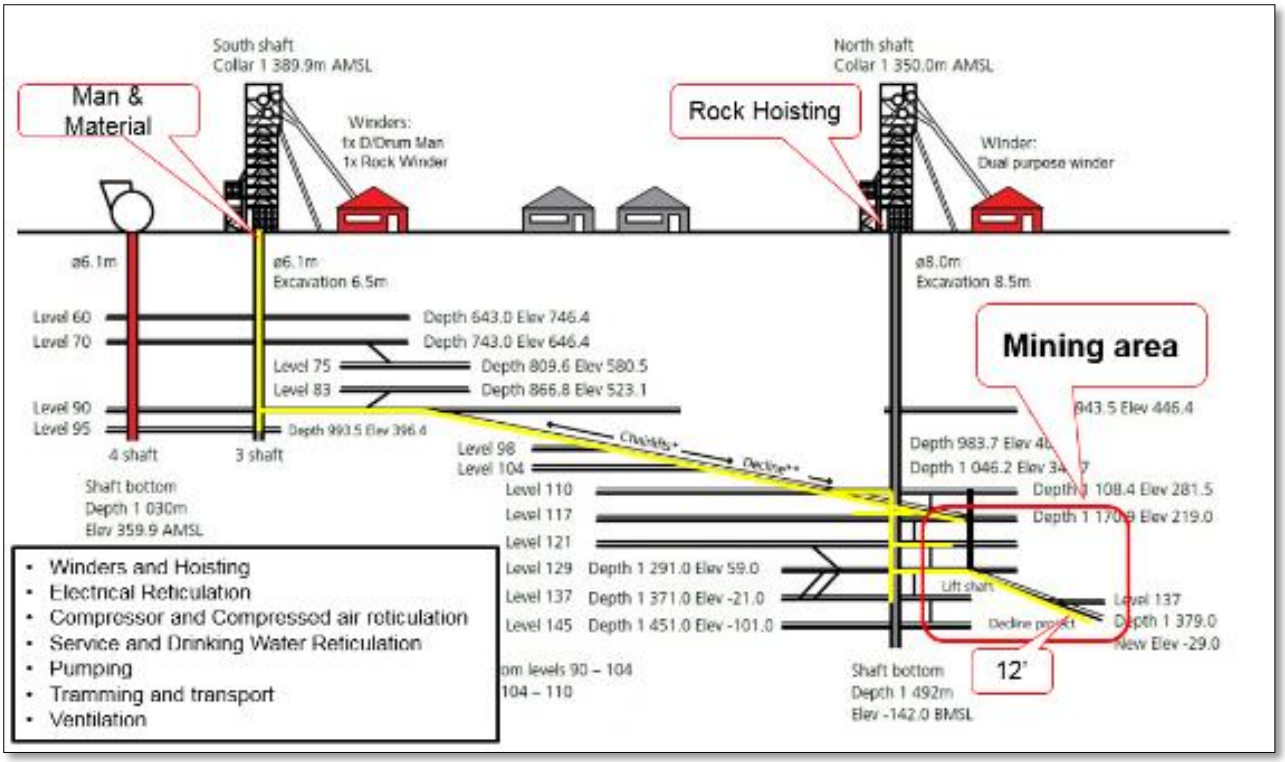
two-day break every other weekend: a worker works six days one week, then five days the next, with everyone taking Sundays off.

The focus of the study is to decipher the impact of the 11-shift fortnight arrangement on labour efficiency, given the current mine set up.

1.2 MINE SETUP AND OVERVIEW OF THE CHALLENGE

The mine set up is indicated in figure 1-1 below. It consists of the North Shaft and South Shaft. The South Shaft complex is equipped with a man and material winder and a rock winder that is now only utilised as an emergency winder. There is no mining taking place at the South Shaft side as all the ground that was available for mining has been depleted. All mining activities are taking place at the North Shaft complex side.

Figure 1-1: Underground mine layout



Due to financial and other challenges, the North Shaft was never equipped to accommodate man and material hoisting at the same time. Although the North Shaft complex is equipped with the dual-purpose winder, it is mainly utilised for rock hoisting. All employees access

their respective workplaces via the South Shaft. They travel underground from the South Shaft along the route indicated by the yellow line on Fig 1-1 to their respective workplaces.

Given the current setup of the mine and infrastructure challenges, travelling time to the workplaces has becomes a big challenge. Employees travel unproductively long distances underground to arrive at their workplaces before they start productive duties of the day. Travelling time to and from the workplace takes about three hours in total. From the eight hours twenty-three minutes (8h23m), they are left with only five hours twenty-three (5h23m) to perform their daily duties.

It is not possible to safely complete the daily tasks within these limited hours; therefore, employees are forced to work more hours to achieve the daily call. As a result of working in such an unique work system, many employees complain of physical fatigue, psychological challenges and social problems (Alqahtani, 1997).

There have been several studies conducted about shift work, especially in European countries. These focused on the effects of shift work on employee's work performance, social behaviour and attitudes. There has not been a study assessing the impact of “eleven shift fortnight” night schedule as a bottleneck on labour efficiency. Assessing the impact of “eleven shift fortnight” work schedule bottleneck and other factors on labour efficiency in a gold mine will be the theme of this study.

1.3 THE PROBLEM STATEMENT

Currently, many mines are not able to achieve their safe blast within the specified normal working hours as per the agreement (eleven shifts per fortnight) with the labour unions. This shift pattern has been in use since the inception of mining in South Africa.

On average, production employees work an average of ten (10) hours daily for at least five or six consecutive days to be able to blast at the end of the day. This working arrangement of eleven shifts per fortnight has turned to be a bottleneck to the productivity of the mine. Since gold mines have become deeper, and workplaces are far from the entrance of the mine or shaft stations, employees have to travel long distances underground before they start doing productive work.

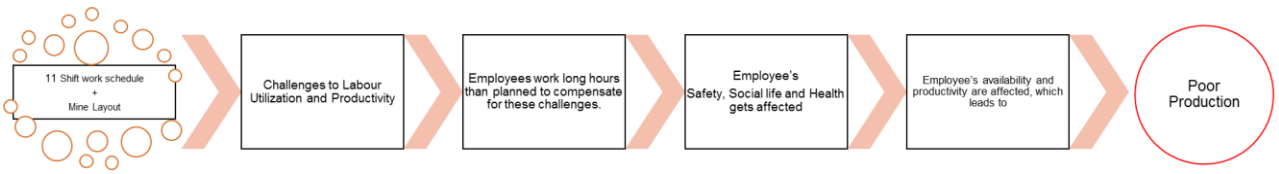
From the above-stated background, it is evident that the current work arrangement (eleven shifts per fortnight system) that is still being utilised in most South African gold mines can be regarded as a bottleneck to the mines.

In addition to the reasons mentioned above for long working hours in mining, there are also other challenges of the working day. Both avoidable and unavoidable delays result in wasted time spent underground. Accidents, instruction stoppages by the Department Mineral Resources (DMR, 2020) (Section 54 and Section 55), labour shortages, problems with machinery and a range of other challenges in the social organisation of production, often mainly due to managerial inefficiencies, further contribute to mining requiring and maintaining relatively long working hours.

The question, based on the excessive travelling times, is if employees should work longer shifts (shortened or compressed week) to give them a better chance to achieve an effective shift and blast, and in the process, work less to ensure that number of hours per week or month complies to the Basic Conditions of Employment Act and Regulations (No. 75 of 1997) section 9(1) (SA, 1997) and the Minerals Act (No. 50 of 1991) (SA, 1991). Labour utilisation and efficiency, safety, social life and labour availability are negatively affected.

Goldratt and Cox (2004) indicate that it may turn out that real bottlenecks are not because of capacity limitations but because of inaccurate planning and management. Hence the problem statement is whether eleven shift fortnight working schedule in the deep gold mines in South Africa is a bottleneck to mine's operation.

Figure 1-2: "11-shift fortnight" causation



Source: The organisation understudy

The above figure 1-2 indicates the causation of eleven shift fortnight to labour efficiency, which leads to reduced productivity.

1.4 PURPOSE OF THE STUDY

The overall aim of the study is to identify the relevance and the impact of “11-shift fortnight" working arrangement in a deep gold mine in South Africa on labour efficiency, labour utilisation, labour productivity and labour availability. Furthermore, it is to find other pertinent factors such as effects on employee safety, fatigue, and social life in this setup where employees need to travel long distances underground before reaching their respective workplaces.

Labour utilisation is defined as the percentage of time a team or individual employee is available for productive work during a scheduled shift. On the one hand, labour productivity is concerned with the amount of output (square meter, meters or tons) that is obtained from each employee. It is defined as the percentage of time that the team or individual employees are at the workplace with tools performing a productive job. According to Aljuhani (2002), labour availability is the number of employees available for productive work.

1.5 RESEARCH QUESTION

The main research question for this study is as follows:

- What is the impact of “11-shift fortnight” working arrangement on mine performance metrics?

1.6 RESEARCH OBJECTIVES

The main objective of this study is as follows:

To identify the relevance and the impact of “11-shift fortnight” working arrangement in a mine where employees need to travel long distances underground before reaching their respective workplaces to labour efficiency, utilisation, productivity, availability and the safety of the employees.

The sub-objective is to

- Explore other factors and their relative importance in negatively affecting labour productivity in the mining industry.

1.7 FOCUS AREA OF THE STUDY

This study will be conducted in the deep gold mines around Welkom area, Free State Province, with employees that are having workplaces that are far away from the shaft entrance. This mine in the Welkom area was selected for study as it is one of the deepest gold mines.

The target population of this study comprises of gold mine management, head of departments, employees (such as artisans, miners, CAT4-8, and others) who works underground. The target group will be divided into department such as:

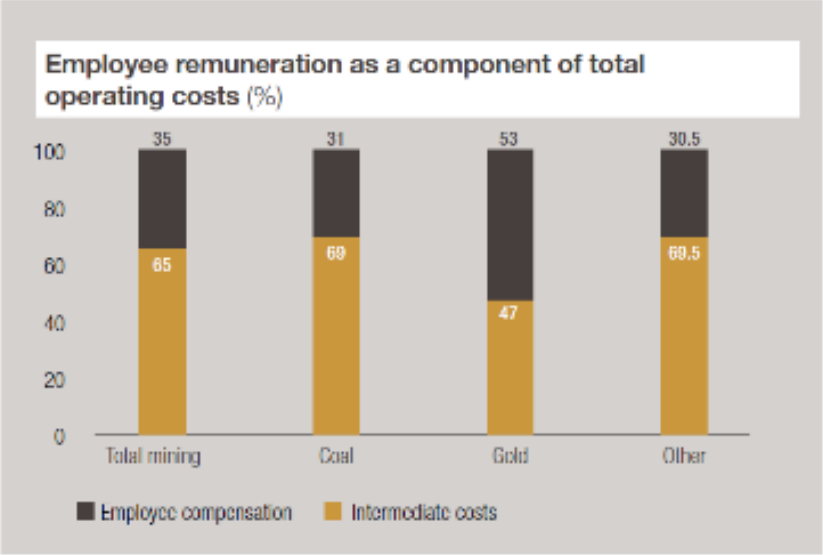
a) Mining department;

b) Engineering department; and

c) Services department (Ore Reserve department, Occupation Hygiene department and Safety department).

The mine is arranged in such a way people travel for about one hour and thirty minutes (1h30m) to get to their workplaces. In this study, the researcher is looking at labour efficiency because labour is the most expensive resource in the South African gold mining industry. At about 53% of the total cost, remuneration by far represents the most significant component of input costs in the gold mining industry (Fig 1-3); this is far more than in any other mining sector (Mineral Council of South Africa, 2018).

Figure 1-3: Employee remuneration as a component of total operating costs



Source: Mineral Council of South Africa (2018)

Moreover, enhancing productivity per man-hour is one of the most significant savings in manpower, and that can be a powerful incentive to any mine (Aijuhani, 2002:307).

The study will concentrate on mine employees who are directly affected by this problem which are employees working underground and their head of departments (HOD).

The results of this study can be generalised to other gold mines that are:

a) working “11-shift fortnight” working arrangement and
b) having workplaces that are far away from the shaft entrance or stations.

1.8 RESEARCH METHOD

A quantitative research design will be adopted for this study because the researcher wants to get a sample and generalise the findings of the population in the study. This research approach is associated with objectivity where numbers are involved, analysis and interpretation of the collected data. The chosen design allows the researcher to generalise the results from a sample to any population of interest, and to measure the incidence of various views and opinions in a chosen sample.

1.9 DATA COLLECTION

Both primary and secondary data will be collected for this study. The investigator can gather the primary information on the variables of interest for the general purpose of the study by means of delivering questionnaire to the employees during mining and engineering safety meetings as well as observing selected teams and recording the findings. The secondary data will be collected from the HR department and also from the safety department during the period of the study.

Data collection is summarised as:

- Non-participant quantitative observation - data will be collected by observing selected teams and recoding the findings as being observed.
- Questionnaire - data will be collected delivering questionnaire to the employees during mining and engineering safety meetings.
- Reports – the researcher will collect reports from Human Resource (HR) department and also from the safety department during the period of the study.

1.10 RESEARCH TOOL

Structured questionnaires will be used to conduct the survey. Questionnaires pose a series of questions to the participants, whose responses will be tabulated into percentages or frequency counts or statistical indexes and these results will be used to draw inferences about a particular population based on the sample of participants (Leedy and Ormrod, 2013).

The questionnaire will consist of closed-ended questions that will prompt the respondent to choose an option from a pre-defined list. Closed-ended questions are opted for because they are efficiently coded and statistically analysed without the need for responses first to be translated like it is with open-ended questions.

Questions will be categorised into one of these research headings as follows:

- Demographics;
- Employee rooster;
- Employee work hours;
- Family and social life;
- Job satisfaction;

- Shift work satisfaction;
- Fatigue questions;
- Team performance;
- Observation study; and
- Other factors that affect labour productivity and efficiency.

The questionnaire will be tested initially on a pilot sample of three to five respondents in order to verify the duration it would take to complete and to check for any potential threats to the instrument's internal validity because unreliable instruments can influence results (Maree and Van der Westhuizen, 2010). After conducting the pilot study, any errors picked will be rectified before sending the questionnaire out to potential respondents to ensure that the results are not distorted.

1.11 RESEARCH POPULATION

The research population is defined as an overall or total entity in which the researcher's interest is invested (Wilson, 2016:45). Reaching out to the whole fraternity or population in which the research is examined is most likely impossible. Identification of a group of people (smaller in number than the population), collection of individuals, objects or events about which the researcher intend to make inferences is critical (Alvi, 2016:11). For this study, the research population will be all the employees of the organisation under study, which is one of the deep gold mining companies in South Africa.

1.12 SAMPLING

A sample is a subset of the population and includes some of its members. The sampling design that will be used for this study is the probability technique, where the elements in the population have some known, non-zero chance or probability of being selected as sample subjects (Sekaran and Bougie, 2013).

The researcher will use a stratified random sampling technique to ensure that specific groups within the unit under study are sampled and represented as per Table 1 below. Proportionate stratified random sampling will be used for this study. On this type of strategy,

the number of elements from each stratum is selected concerning its proportion in the total population (Kumar, 2019). This will be employees who work underground.

Table 1-1: Respondents

Department	Total Population/ Department	Percentage of strata	Sample size/ Department
Mining	1059	65.7%	212
Engineering	493	30.6%	99
Safety	13	0.8%	3
Ore Reserve	36	2.2%	7
Ventilation	10	0.6%	2
Total	1611	100%	322

The stratified sampling technique is probably the most efficient among all probability designs. It is the right choice when differentiated information is needed regarding various strata within the population, which are known to differ in their parameters in the sense that for the same number of sample subjects, it offers precise and detailed information (Sekaran and Bougie, 2013).

Zikmund and Babin (2007) stated that there are "three factors that the appropriateness of a sampling technique and these are a) the level of precision (closeness to the proximity population) or, (b) confidence level (how sure the researcher can be) and (c) degree of variability (margin of error)". The sample size needs to be relatively big enough to make sure all insights that are considered crucial are included.

1.13 DATA ANALYSIS

Techniques of descriptive and inferential statistical analysis techniques will be applied to the data through the use of statistical software such as R or IBM SPSS (Version 26).

1.14 RELIABILITY AND VALIDITY

Reliability refers to the consistency and stability of the measurement process and validity refers to how well the research model investigates what it intends to investigate, and to what

extent the researcher gained access to the informant's knowledge and meaning (Smallbone and Quinton (2004).

Research validity will be maintained through appropriate structural alignment of primary data against the research framework and research objectives. A pilot test of surveys will be conducted with three to five respondents to ensure that the questionnaire is not ambiguous. After the pilot run, necessary adjustments will be made, and after that, the actual research survey will be conducted.

1.15 SIGNIFICANCE OF THE CHALLENGE

The importance of this study is to make mine management and all stakeholders aware of the impact of "11-shift fortnight" in a mine where employees travel long distances to their workplaces and impact of other factors to labour efficiency. This will help management to formulate corrective actions to the problems presented.

The majority of gold mine's employees are migrants, mainly coming from the Eastern Cape, Lesotho and Mozambique. The flexibility of working arrangements may allow migrant employees to return to their homes and families more frequently.

The research would give some insight into the problem and offer suggestions to the mine management on how to reduce the negative impact of this bottleneck.

CHAPTER 2 LITERATURE REVIEW

2.1 INTRODUCTION

This chapter deals with the theoretical foundation used in this study. This theoretical framework involves a literature review on the “eleven shift fortnight” schedule and its impact on the efficiency of labour in a South African gold mine. It also includes findings from other researchers on the same topic.

It covers the state of the mining industry in South Africa, the regulatory framework, the impact of working long hours and discusses the literature on bottlenecks and their management. The chapter then ends with concluding remarks of what based on the theoretical and empirical perspectives of other published works.

2.2 OVERVIEW OF THE MINING INDUSTRY IN SOUTH AFRICA

The mining industry in South Africa started in 1867. It began with the accidental discovery of an alluvial diamond on the shores of the Orange River. These alluvial diamonds were scattered all over the surrounding area, originally in yellow earth and subsequently beneath the blue hard rock that would come to be called kimberlite

The discovery of diamonds led to the rapid development of the diamond mining town of Kimberly. During the 1880s, about 95% of the world's diamonds were unearthed by the mines around Kimberley (Bright, 2013; Minerals Council South Africa, 2018).

In the year 1886, gold was another significant discovery in South Africa’s mining history. The discovery of gold at a town called Langlaagte on the Witwatersrand was the most productive reef in the world and accounted for approximately 40% of the country’s total gold stocks. This discovery of gold soon catapulted the fast-emerging mineral industry of South Africa.

During the same time of the gold discovery, the South African’s first considerable tons of coal was discovered in Witwatersrand Basin. These discoveries enabled the cities and towns around the reef to develop very quickly. In the ensuing years, Johannesburg city, which was located on a short gap at the East-West running reef was at the forefront of those operations. Up to today, it is still the most prominent financial hub in Africa and is home to

some of the biggest mining companies in the world. (Bright, 2013; Minerals Council South Africa, 2018).

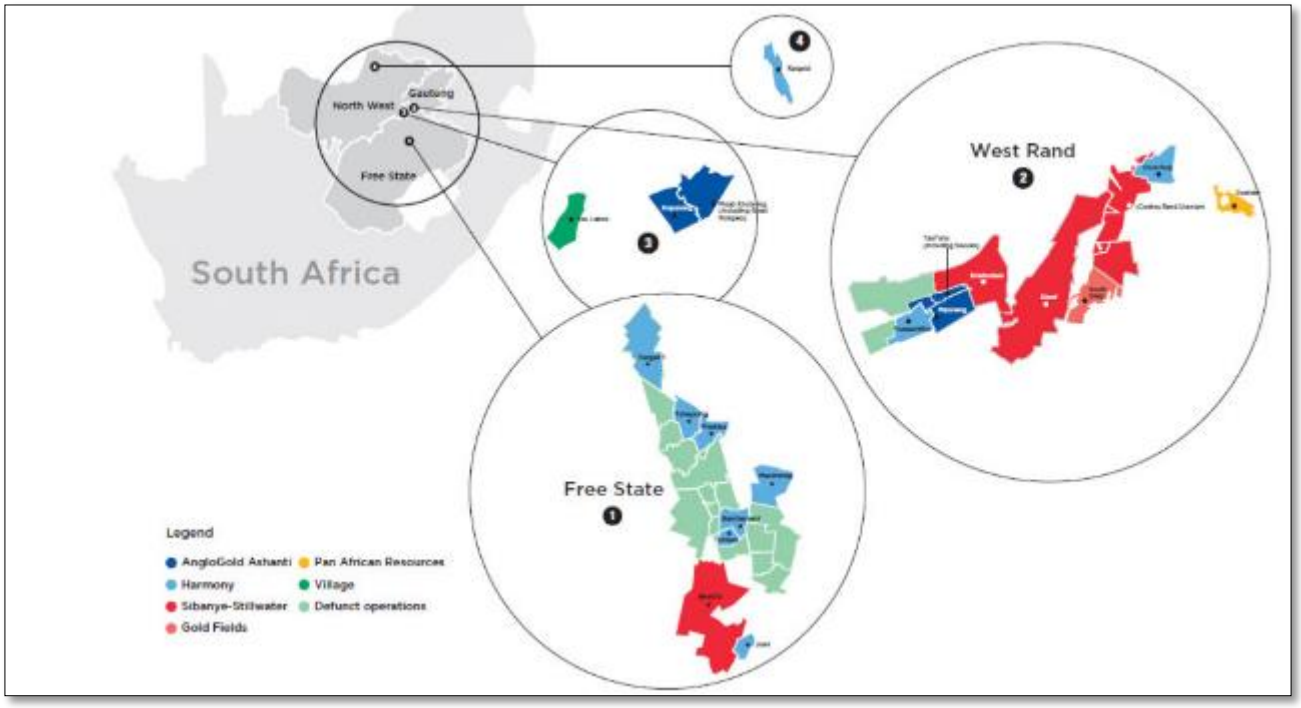
The discovery of gold in the late 19th century spawned the development of the city of Johannesburg, Egoli, or the City of Gold, and numerous towns around the gold diggings, including Barberton and Pilgrim's Rest. In the 20th century, the large gold mines on the West Wits line were established, and towns like Carletonville and Klerksdorp became important and busy centres around the world-famous gold mines: Kloof, Driefontein and Western Deep Levels.

South Africa does have other smaller gold producers outside of the Witwatersrand, in the form of Archaean greenstone belts. The main gold producing greenstone belts are the Barberton greenstone belt and the Kraaipan greenstone belt. In 1946, the Free State Province gold had been discovered on a farm approximately a 160 kilometres North of its capital city Bloemfontein.

Drilling was the preferred method to discover gold at locations that were pinpointed by the newly established geological developments. It did not take long for the mining industry to develop roots in the area, and not long after, in 1947, the city of Welkom was established. Over the years Wekom expanded rapidly and remains a vital producer of uranium, mineral ore and gold (Minerals Council South Africa, 2018).

The gold reef basin stretches over an arc of roughly 400km across the Free State, North West and Gauteng provinces in South Africa as represented on figure 2-1 below.

Figure 2-1: Location of Gold Mines



Source: Mineral Council South Africa (2019)

The mining industry once contributed up 21% to the South African's Gross domestic products (GDP) in its peak years. In recent years, the industry has contracted and now surpassed by other sectors such as service and manufacturing industries.

However, the mining industry remains a key economic activity as it is the sixth biggest economic sector in the country. Due to its history on a global scale, the South African mining industry can show off its expertise in technology and innovation and offers a wide range of research and development activities.

In addition to its platinum and gold benefits, the South African country has first-class leading processing systems covering carbon steel, stainless steel, and aluminium. Two of the largest mining companies in the world have roots in South Africa. The first largest mining company in the world, BHP Billiton, came from the merger between the Australian BHP Group and South Africa's Billiton while the second-largest mining company in the world is Anglo American Plc. With the London Stock Exchange as its primary listing and the secondary listing in Johannesburg, Anglo American Plc. has numerous large subsidiaries such as

Anglo Platinum, Anglo Coal, Impala Platinum and Kumba Iron Ore (Bright, 2013; Minerals Council South Africa, 2018).

South African mining continues to be attractive, with the country having one of the richest mineral and metal reserves in the world. In addition to gold, coal, platinum, manganese, palladium, titanium and uranium, South Africa remains one of the leading global producers for various minerals. South Africa also hosts the world's leading mining companies as the gateway to the African mining industry (Mineral Council South Africa, 2019).

More than any other industry, mining has assisted in shaping South Africa. The mining industry turned a predominantly rural economy into an industrial economy; cities and towns were developed and substantial foreign capital attracted. This called for the creation of stock markets, higher institutions and high skills development. The mining companies of South Africa became the first companies in the world to introduce an insurance scheme for their workers.

In addition, the companies spent a large amount of money in setting up entities like the Institute of Medical Research in South African. In summary, mining inspired the development of the humanities and communities as well as technology (Minerals Council South Africa, 2018; 2019).

Although the mining industry is no longer the leading economic sector in South Africa's economy, it is still a significant player of the country's foreign exchange income. Mining is still dominating the economies of four of the nine provinces and many major cities. Coal is used to supply 90% of electricity in South Africa (Mineral Council South Africa, 2018).

In 2019, mining in South Africa was accountable for around 60% of the country's exports per year. The industry value was R 452, 67 billion (USD 33,17 billion). South Africa plays a major role in diamond mining, and also chrome and coal, providing 90% of the country's electricity requirements.

South Africa has platinum group metals reserves and coal reserves that are expected to last for at least 335 years and 256 years, respectively. Currently, mining projects in South Africa represent 8% of the country's GDP, boasts a total annual income of nearly R500 billion. Furthermore, mining companies are one of the country's major employers, employing around 500 000 workers directly (Mineral Council South Africa, 2018, 2019).

It can be noted on table 2-1, the sector contributed R350.8 billion (nominal) or 7.3% to the gross domestic product (GDP) in 2018 (in 2017 the contribution was 7.5%), the sector contracted by 1.7%. For many years, lucrative foreign direct investments have been drawn to South Africa by the mining industry. While the most known minerals and mineral metals are gold, diamonds, platinum and charcoal, South Africa also hosts several lesser minerals, such as chromium, vanadium, titanium (Mineral Council South Africa, 2019).

Table 2-1: Key mineral statistics for South Africa: 2008-2018

Description	Units of measure	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Year-on -year % change 2017 to 2018
Gross domestic product													
Direct contribution of mining to GDP (value add)	R millions nominal terms	197,643	200,824	230,350	261,575	267,344	288,300	287,488	281,523	317,724	343,672	350,882	2.1%
Direct contribution of mining to GDP	R millions constant 2010 prices	230,663	218,830	230,350	228,646	221,990	230,772	226,791	234,247	225,035	234,522	230,514	-1.7%
Mining GDP growth rate	% year-on-year	-5.3	-5.1	5.3	-0.7	-2.9	4.0	-1.7	3.3	-3.9	4.2	-1.7	
Direct contribution of mining to GDP	US$ equivalent	23,952	23,802	31,459	36,064	32,563	29,875	26,510	22,079	21,601	25,815	26,514	2.7%
South African GDP (market prices)	R millions nominal terms	2,369,063	2,507,677	2,748,008	3,023,659	3,253,852	3,539,977	3,805,350	4,049,884	4,359,061	4,653,579	4,873,899	4.7%
South African GDP (market prices)	R millions constant 2010 prices	2,708,601	2,666,940	2,748,008	2,838,257	2,901,078	2,973,175	3,028,090	3,064,236	3,076,466	3,119,983	3,144,539	0.8%
Mining's contribution as % of total GDP nominal terms	%	8.3%	8.0%	8.4%	8.7%	8.2%	8.1%	7.6%	7.0%	7.3%	7.4%	7.2%	
Mining's contribution as % of total GDP real terms	%	8.5%	8.2%	8.4%	8.1%	7.7%	7.8%	7.5%	7.6%	7.3%	7.5%	7.3%	
Fixed investment													
Direct contribution of mining to fixed investment (GFCF)	R millions nominal terms	59,084	64,574	63,555	68,420	72,106	80,609	85,615	63,791	53,864	77,178	91,098	18.04%
Direct contribution of mining to fixed investment (GFCF)	R millions constant 2010 prices	62,349	65,969	63,555	65,953	65,438	67,333	66,995	48,606	38,797	53,949	61,072	13.20%
Total private sector fixed investment (private GFCF)	R millions nominal terms	376,918	342,142	341,517	380,410	406,000	470,179	511,839	525,404	545,608	579,589	607,599	4.83%
Total South African fixed investment (GFCF)	R millions nominal terms	556,997	539,440	529,431	578,014	625,643	721,234	775,950	822,576	846,552	873,223	886,428	1.51%

Table 2-2: Key mineral statistics for South Africa: 2008-2018 (Continued)

Employment per commodity: 2018

	Gold	PGMs	Diamonds	Chrome	Iron ore	Manganese	Coal	Industrial minerals	Other minerals	Total
2008	166,423	199,948	18,474	12,279	13,257	3,976	65,484	13,352	25,533	518,725
2009	159,926	184,162	11,601	10,966	13,728	5,003	70,791	13,254	22,363	491,794
2010	157,019	181,969	11,467	13,982	18,216	5,879	74,025	13,118	23,231	498,907
2011	144,799	194,745	12,047	16,911	22,360	7,460	78,580	13,013	22,961	512,874
2012	142,200	197,752	12,332	19,762	23,380	8,685	83,244	13,795	23,719	524,869
2013	131,738	191,260	13,579	18,358	21,127	9,842	88,039	13,623	6,805	509,909
2014	119,007	186,864	15,356	18,658	21,794	9,971	86,106	13,031	6,330	492,931
2015	115,029	186,465	18,313	18,450	20,554	8,639	77,747	12,866	5,727	480,205
2016	116,572	172,556	18,789	15,449	16,651	7,242	77,259	13,222	5,797	458,291
2017	112,901	172,760	18,038	16,968	17,510	7,780	82,372	13,029	6,219	463,901
2018	100,189	167,041	16,361	18,935	18,613	9,352	89,647	12,712	6,121	456,438

Source: Department of Mineral Resources and Energy

Employee earnings per commodity: 2018

Rm	Gold	PGMs	Diamonds	Chrome	Iron ore	Manganese	Coal	Industrial minerals	Other minerals	Total
2008	15,960	23,344	2,164	1,306	1,668	672	11,021	1,103	3,649	60,886
2009	17,371	24,879	1,790	1,457	2,178	737	12,815	1,210	3,654	66,092
2010	19,878	26,688	1,956	2,082	3,037	946	14,186	1,326	4,217	74,319
2011	20,841	30,482	2,141	2,755	6,507	1,278	16,069	1,402	5,499	86,972
2012	22,238	34,393	2,408	3,434	4,691	1,565	17,446	1,598	5,857	93,630
2013	23,930	37,710	2,871	3,841	4,848	1,947	18,949	1,680	1,387	100,753
2014	23,383	35,652	3,663	4,047	5,692	2,302	20,595	1,810	1,311	102,146
2015	24,578	44,955	4,678	4,417	6,219	2,199	19,932	1,924	1,235	114,085
2016	28,761	45,926	5,073	4,214	5,895	2,118	21,112	2,074	1,301	120,515
2017	30,168	49,484	5,430	4,734	5,826	2,391	22,442	2,129	-	128,558
2018	27,677	51,412	5,198	5,518	6,641	3,002	25,924	2,201	1,592	134,454

Source: Mineral council South Africa (2019)

Table 2-1 indicates that, while the number of people employed in the gold sector has been on the decline since 2007, total employee earnings have increased from R15.9 billion in 2008 to R27.6 billion in 2018.

South Africa was the main producer of gold in the world for many years. At the beginning of the 21st century, the prestige of the gold sector was fading, as mines have become deeper to get hold of the rich reef patches. In 2018, South Africa accounted for 3.3% of world gold production. Even though South Africa holds the world's deepest gold mines, the country has the third-largest gold reserves (60 000 tones) in the world after Australia (9 500 tonnes) and Russia (8 000 tonnes) (MINERAL Council South Africa, 2019).

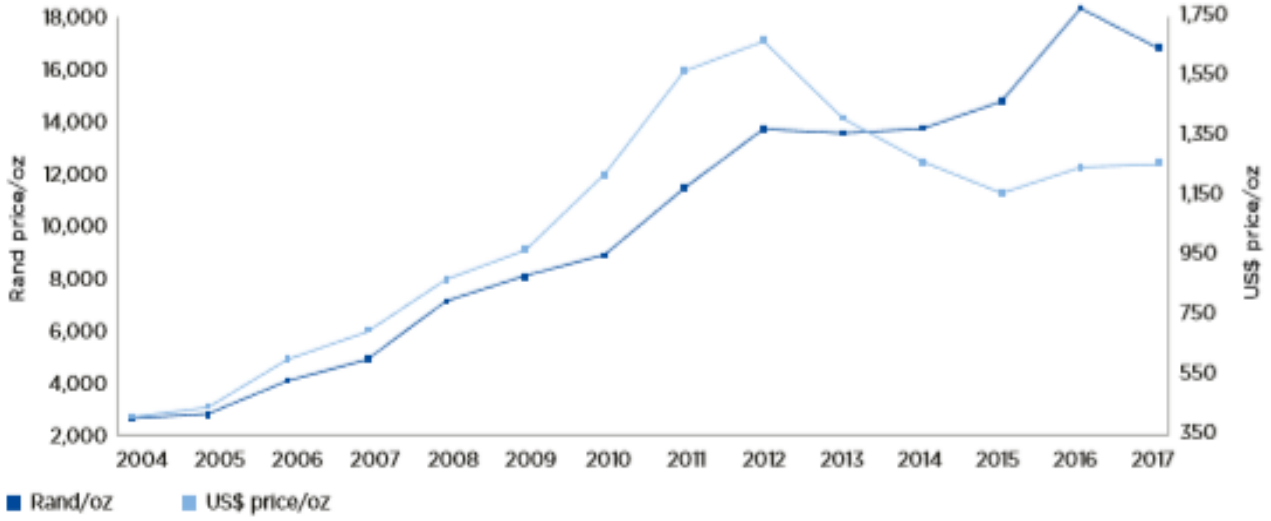
Table 2-2: South African gold production and sales

	Production	Local sales		Export sales		Total sales		World production	SA share
	Tonnes	Tonnes	R'000	Tonnes	R'000	Tonnes	R'000	Tonnes	(%)
2007	253	13	2,081,731	229	35,953,993	243	38,035,724	2,497.8	10.1
2008	213	9	1,997,761	190	43,994,483	199	45,992,244	2,429.9	8.7
2009	198	7	1,701,334	181	46,994,169	187	48,695,503	2,612.0	7.6
2010	189	7	2,055,698	177	51,037,449	184	53,093,147	2,793.6	6.8
2011	180	10	3,633,111	176	65,258,302	186	68,891,413	2,880.8	6.3
2012	155	11	4,862,748	165	71,961,757	176	76,824,504	2,959.1	5.2
2013	160	10	4,192,863	151	65,793,912	162	69,986,775	3,118.1	5.1
2014	152	9	3,450,902	136	59,898,125	145	63,349,026	3,202.9	4.7
2015	145	16	7,385,852	118	55,314,075	134	62,699,927	3,289.5	4.4
2016	142	25	14,919,703	104	60,572,047	129	75,491,750	3,397.3	4.2
2017	137	34	17,799,800	120	65,099,682	154	82,899,482	3,441.9	4.0
2018	117	66	35,201,487	64	34,482,018	130	69,683,505	3,502.6	3.3

Source: Mineral Council South Africa (2019)

During the same period, the price of gold fell dramatically from previous highs, while the world economy fell sharply in the aftermath of the 2008 global financial crisis (Fact sheet, 2018; Mineral Council South Africa, 2018).

Figure 2-2: Average Annual Gold Price: Rand versus US$

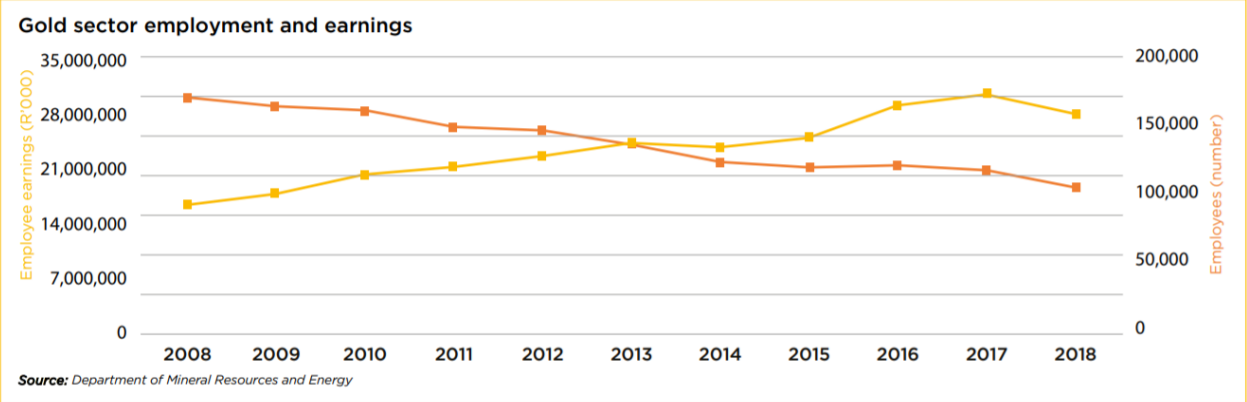


Source: Mineral Council South Africa (2018)

Since the 1980s, gold employment has continued to fall, with about 100,189 workers employed at present. Simultaneously, productivity decreased, and wages increased. Nevertheless, gold mining remains a key employment factor in many communities across the country, and each worker in the gold industry supports five to ten other dependents. On

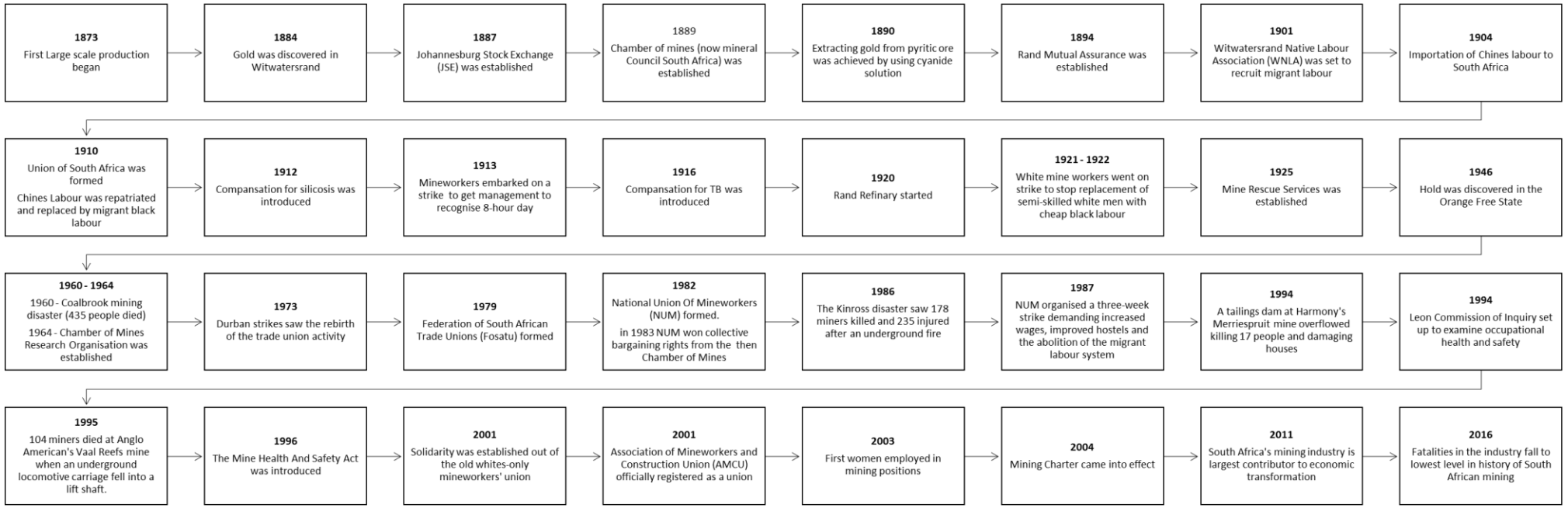
the other hand, each direct job in the mining sector leads to two other indirect jobs elsewhere (Facts and figures, 2019; Mineral Council South Africa, 2019).

Figure 2-3: Employment and earnings: South African gold mines



Source: Mineral Council South Africa (2018)

Figure 2-4: Gold Mining History Timeline



Source: Mineral Council South Africa (2019)

2.3 LAWS, REGULATIONS AND STANDARDS IN THE SOUTH AFRICAN MINING INDUSTRY

The mining industry in South Africa is managed by the Department of Mineral Resources, with headquarters in Pretoria, South Africa. The Department of Mineral Resources has regional offices in each of the nine provinces of South Africa. The minister enforces the laws. Apart from the minister, there is an appointed Director General and Deputy Director General who have delegated power to make different decisions on behalf of the minister.

Furthermore, the mining industry in South Africa is also governed by the common law of South Africa derived from Roman law principles through Roman-Dutch law. These principles are often described and enunciated in case law, which case law also places judicial interpretation upon legislation such as MPRDA. The law of delict is also relevant in a mining context.

The Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA), which is the prevailing law on acquisitions or the rights to conduct reconnaissance, prospecting and mining, regulate the South African Mining Law (SA, 2002). The MPRDA was implemented on 1 May 2004 and substituted the former hybrid system of a common-law system with statutory interference.

There are several other laws addressing subsidiary matters such as royalties, title registration and health and safety. The law addressing royalties is the Mineral and Petroleum Resources Royalty Act (No. 28 of 2008) and the law addressing title registration is the Mining Titles Registration Act (No. 16 of 1967) while the law addressing health and safety is the “Mine Health and Safety Act (No. 29 of 1996) of (SA, 1967, 2002, and 2008).

Several working hours’ schedules are associated with safety and health threats such as exhaustion and performance impairments and increased exposure to certain risks. Similar to other occupational safety and health problems, employers have a general obligation to ensure that employees, as far as possible, are not exposed to the hazards or threats that may result during working hours. Employers should mitigate these risks by implementing a systemic risk management process.

The Mineral Act (No. 50 of 1991) Regulations (MAR) 4.14.1 states that "Except as is provided for in regulation 4.14.2 no employee shall work, or be caused or permitted to work, in or at a mine for more than 48 hours in any consecutive seven days, exclusive of the time taken in getting to and from the place where the work is performed: Provided that any time is taken in excess of 60 minutes by persons employed underground to cover the distance from the shaft head or other entrance to the mine to their working place and back again, shall for this regulation, be deemed to be time worked" (SA, 1991). This regulation indicates clearly that travelling time of employees underground to and from their workplaces is regarded as time worked. Labour utilisation may, therefore, not be calculated by the time spent underground.

In addition, the legislation addresses issues, such as extended hours, shifts and call work that could occur in some working time arrangements. This incorporates several known risk factors in the workplace, which should already be addressed where workplace safety and health hazards are likely. It is the starting point for a workplace or industrial risk management process to tackle issues that might affect safety and health in the working time arrangement. This regulation gives a high level of general guidance as different workplaces and industries have different working hours' arrangements.

Looking at the Basic Conditions of Employment Act (No. 75 of 1997) (BCEA) of South Africa, section 9 states that "an employer may not require or permit an employee to work more than:

(a) 45 hours in any week; and

(b) nine hours in any day if the employee works for five days or fewer in a week; or

(c) eight hours in any day if the employee works on more than five days in a week" (SA, 1997).

This regulation contains provisions concerning the arrangement of work and, in particular, its impact upon the health, safety and welfare of employees. Issues that are included are shift work, night work, rest periods during working time, family responsibilities and work by children.

2.4 THE IMPACT OF WORKING LONG HOURS IN MINING

Shift work can be defined as a work schedule rule in which a worker replaces another to do the same job within a 24-hour period. Shift work compels a worker to invert his or her normal activity-rest cycle forcing adjustments to body routines. This adjustment is worsened when an employee works long hours (Castelluci and Altamirano, 2017).

As knowledge continues to grow, there has been some evidence that sleep deprivation, sleep disturbance and fatigue are health risks usually linked to long working hours. Fatigue was also established as a potential health threat in work involving shifts or daily or occasional night work (Geiger-Brown et al., 2012; Patterson et al., 2012).

Studies by Caruso and Waters (2008), Ferguson and Dawson (2012) and Lorenz (2008) confirmed that specific problems associated with working longing hours, are a decreased physical and mental capacity, work-related stress symptoms, increased exposure to threats such as pollution, hazards and sound, and other longer-term health effects.

Such health risks can have negative impacts on workplace safety standards and accident prevention efforts. Given these safety and health problems related to working long hour schedules, the balance between ' work-life ' and ' personal life ' can be adversely affected. This, in turn, can influence a person's fitness for work (Ferguson and Dawson; 2012; Lorenz, 2008).

The number of hours one works in Japan is a topical issue. According to the ministry of health of Japan, the numbers of workers with heart disease, cérébrovascular disease and mental disorders due to work have risen by about three times over the past decade, as revealed by statistics from the Japanese Ministry of Health, Labour and Welfare (Japanese Ministry of Health, Labour and Welfare, 2020). As a result, working long hours is a matter that is dealt with quickly in the interests of the health of employees.

Working long hours can also lead to the development of karoshi (sudden death by cardiovascular or cerebrovascular diseases due to overwork) and karojisatsu (suicide due to overwork). However, in many countries long hours of work are the norm. South Korea, according to statistical data of the Organization for Economic Cooperation and Development (OECD, 2012), had the longest average annual hours of work between 1980 and 2007. In

2008, Korea, was dethroned by Mexico and became the country with the second longest average annual working hours. Similar to Japan, karoshi became recognised as an issue in Korea in the early 1990s (Cheng et al., 2012). Korea started to deliberately reduce their number of hours of work.

There have been investigations on the relationship between shift work and various outcomes such as all-cause mortality (Holtermann et al., 2010), disease (especially cardiovascular disease) (Liu and Tanaka, 2002), biological indices such as variation in heart rate, blood pressure (PR), arrhythmia in the respiratory sinus and etc., sleep, depression, alcohol use, body weight index, fatigue, and overall health status.

Mixed results have been obtained: positive, negative and no relationship have been reported. Despite this, the impact of long working hours on human well-being is still a hotly debated topic. Investigators suggest that contradictions in the results are due to numerous elements such as the definition of long hours of work, participants' characteristics, including shift work, results in measurement, and potential covariates (Tomioka et al., 2011; Schluter et al., 2012; Grosch et al., 2006).

Several studies have highlighted the correlation linking shift work and a person's well-being. Shift work is believed to be harmful to the employee’s well-being. Increased “myocardial risk, coronary events, ischemic stroke, GI symptoms, patricidal ulcers and metabolic syndromes” were linked with shift work activities. Furthermore, increased chance of breast cancer has also been identified for females who work night shift (Knutsson and Bøggild, 2010; Antunes et al., 2010; Wright et al., 2012).

Trinkoff et al. (2011) and Geiger-Brown et al. (2012) effectively linked working hours with fatigue and decreased levels of alertness, potentially resulting in more adverse events. However, it was also found the type of industry, its context and the tasks that are conducted affect the extent that longer shifts have on a negative influence on performance.

2.5 BOTTLENECK AND THEORY OF CONSTRAINS

The mine in this study does not have an infinite capacity nor is its process flow perfectly matched at every step; the mine has at least one bottleneck. The “11-shift fortnight’ schedule, a traditional scheduling paradigm has been identified as one of the bottlenecks.

2.5.1 Definition and origins of bottleneck

Goldratt and Cox (1994) are recognised as the founders of the theory of constraints. In their book (The Goal), Goldratt and Cox (1994) concluded that “bottleneck is any resource whose capacity is equal to or less than the demand placed upon it”. Other authors defined bottleneck as “A bottleneck is a department, facility, machine or resource already working at its capacity and which therefore cannot handle any additional demand placed upon it” (BusinessDictionary.com: 2019).

Both these authors based their explanation on the capacity of a resource. Unfortunately, they failed to consider that other bottlenecks are not necessary capacity based. In an attempt to find a universal definition for bottlenecks, Mukherjee and Chatterjee (2006:15) concluded that a "set of constraints with a strictly positive average shadow price is defined as a bottleneck". This definition gives an overall perspective of what a bottleneck is regardless of the specific classification of the bottleneck. It is not only based on a capacity of a resource. Mukherjee and Chatterjee (2006:139) point out that there are five classifications of bottleneck:

- *Capacity based bottleneck*: this is a bottleneck as defined by Goldratt and Cox (2004: 139).
- *Critical path-based bottleneck*: a resource or process that takes the longest time in operation for a specific demand. In this case, the capacity might be more than enough, but operational time might be too long. The critical path in a project restricts the achievement of a lower project completion time.
- *Structural based bottlenecks*: the inherent structure of the production environment might also be a bottleneck. This might be the design of the whole infrastructure that constrains the production chain.
- *Algorithm-based bottleneck*: shifting bottleneck.

- *System performance-based bottleneck*: Mukherjee and Chatterjee (2006:4) concluded that their definition is the universal definition for the bottleneck that accommodates all five classifications of the bottleneck.

2.5.2 Theory of constraints

Theory of constraints is the management concept that was developed by Goldratt and Cox 2004: 139) to assist managers who want to increase throughput, decrease inventory and decrease operating expense of an organisation to answer the following questions on:

- What to change?
- What to change it to?
- How to cause the change?

Theory of constrains focuses and pays attention to system constrains that restricts the output (throughput) of the entire system. The aim is to identify those constraints and put measures in place to maximise their outputs.

Goldratt and Cox (2004: 139) concluded that there are five steps (figure 2-5) to be followed to increase throughput. Those steps are as follows:

- identify the system constrain
- decide how to exploit the system constrain
- Subsidiary everything else to the system constraint. This is a first step and the cost-effective step to consider when exploiting constraint(s),
- elevate the system constraint(s). to increase the capacity of constraint will cost money and
- if previous step constraint has been broken down, go back to step 1, prevent inaction from becoming a constraint.

Unfortunately, Goldratt and Cox (2004) failed to consider that it is not always possible or feasible to exploit constraint(s). After conducting a feasibility study, a manager may decide to:

- Increase the capacity of the resource,
- re-design the whole system to meet the demand,
- accept constraint as it is. In this case, the only thing to do is to maintain it in such a way that breakdowns are eliminated or minimised.

Figure 2-5: Five focusing steps cycle

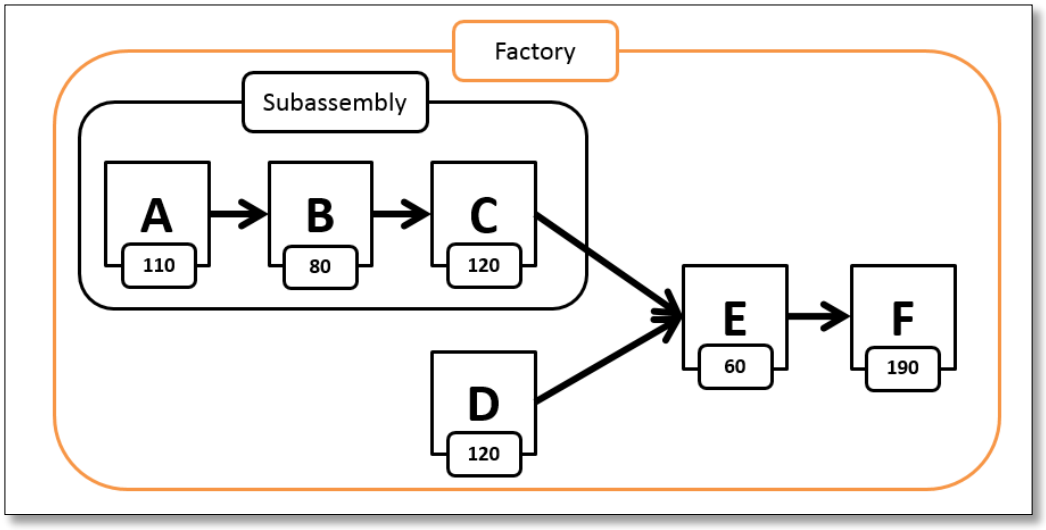
Source: Stephano (2014)

2.5.3 Bottleneck vs constrains

Hohmann (2014) concluded that "a bottleneck is a resource with a capacity less or equal to demand while constraining a limiting factor to organisation's performance. It is an obstacle to organisations' ability to achieving their goals".

A constraint is a resource operating at capacity or rate less than that of its predecessor. The bottleneck is a constraint that determines the capacity of the entire system. In the diagram below (Fig 2-6), if the demand per day is 100 units, both B and E will be regarded as constrains as their capacity is less than that of demand. Only E is regarded to be a bottleneck because any improvements to B will not improve the capacity of the factory (E determine the capacity of the factory).

Figure 2-6: Constrain vs Bottleneck



Source: Hohmann (2014)

A constraint can be called bottleneck, but a bottleneck is not always a constraint (Hohmann 2014).

2.5.4 Reasons for bottlenecks

There are several reasons why there are bottlenecks, and these are (Hohmann, 2014):

- *Inadequate design or focus*: the design of the resource or the system was not meant to produce the required demand or due to poor design or due to what I call "temporary measures permanently". To increase the capacity of small design, in many cases, the whole system has to be re-design depending on the nature of the bottleneck.
- *Unplanned events*: a failure or damage to the part of the production process that may temporarily or permanently restrict the system. This may also include decisions taken because of economic challenges such as the recession of 2008.
- *The inherent variability of the process*: the sequential process and the nature of the system cannot be altered.

Each process will always have a bottleneck. It is, therefore, the duty of the manager and the rest of the staff to understand bottlenecks in their organisation. Managers may use the steps offered by Goldratt and Cox (2004) to exploit the bottleneck.

Although Goldratt and Cox (2004) are the founders of the theory of constraints, their definition only covers capacity constraint(s). Mukherjee and Chatterjee (2006) concluded that their definition is universal.

2.6 PREVIOUS STUDIES

Several studies have examined the impact of long work hours on workers' occupational injuries and illnesses. Table 2-4 below provides a list of some of those studies. Most of the studies were conducted in the health industry. However, there is a lack of studies conducted undermining, and this is a gap in which this study would be able to close.

Table 2-4: Previous studies that have examined the impact of long work hours on workers' risk for occupational injuries and illnesses

#	Year	Authors	Document	Industry
1	2013	Caruso and Waters	Negative Impacts of Shiftwork and Long Work Hours	Health
2	2014	Bannai andTamakoshi	The association between long working hours and health: A systematic review of epidemiological evidence	General
3	2014	Griffiths et al.	Nurses' Shift Length and Overtime Working in 12 European Countries	Health
4	2012	Ferguson and Dawson	12-h or 8-h shifts? It depends.	General
5	2008	Caruso and Waters.	A review of work schedule issues and musculoskeletal disorders with an emphasis on the healthcare sector.	Health
6	2008	Lorenz	12-hour shifts: an ethical dilemma for the nurse executive	Health
7	2013	Lobo et al.	A concept analysis of nursing overtime	Health
8	2010	Bae and Brewer	Mandatory overtime regulations and nurse overtime.	Health
9	2015	The National Institute for Occupational Safety and Health.	Work schedules: shift work and long work hours.	Health

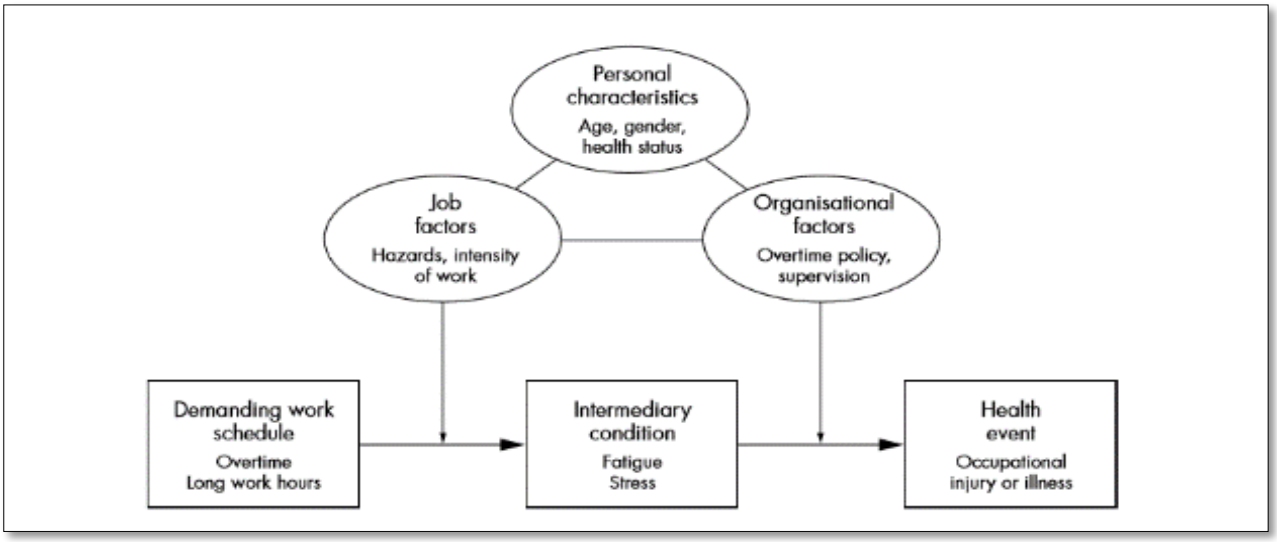
10	2011	Saksvik et al.	Individual differences in tolerance to shift work—a systematic review	Health
11	2010	Olds and Clarke	The effect of work hours on adverse events and errors in health care.	Health
12	2013	Bae and Brewer	Presence of nurse mandatory overtime regulations and nurse and patient outcomes.	Health
13	2012	Patterson et al.	The shift length, fatigue, and safety conundrum in EMS.	Health
14	2013	Stimpfel et al.	How differing shift lengths relate to quality outcomes in pediatrics.	Health
15	2013	Stimpfel and Aiken	Hospital staff nurses' shift length associated with safety and quality of care.	Health
16	2012	Nelson	Long work hours for nurses	Health
17	2010	Clifford	The effects of fly-in/fly-out commute arrangements and extended working hours on the stress, lifestyle, relationships and health characteristics of Western Australian mining employees and their partners.	Mining
18	2004	Dembe et al.	The impact of overtime and long work hours on occupational injuries and illnesses: new evidence from the United States	General
19	1994	Duchon et al.	Extended work days in mining and other industries: a review of the literature.	Mining
20	2011	Torkington Sarah Larkins Tarun Sen Gupta	The psychosocial impacts of fly-in fly-out and drive-in drive-out mining on mining employees: A qualitative study	Mining
21	1997	Meijman	Mental fatigue and the efficiency of information processing in relation to work times.	Transport

22	2000	McCartt et al.	Factors associated with falling asleep at the wheel among long-distance truck drivers.	Transport
23	2012	Stewart	Labour time in South African gold mines: 1886-2006	Mining

2.7 CONCEPTUAL FRAMEWORK

The conceptual basis for this study is adapted from a theoretical model proposed by Michel Shuster and Susan Rhodes in 1985 (figure 2-6). In this model, overtime and long hours of work are presumed to affect the risk of workplace accidents by precipitating various intermediary conditions in affected workers, such as fatigue, stress, and drowsiness.

Figure 2-6: Conceptual model of the relationship between demanding work schedules and occupational injuries and illnesses



Source: Schuster and Rhode (1985)

The pathway linking a demanding work schedule to the intermediary condition and ultimately to a workplace accident can be mediated by a variety of individual and environmental factors, including personal characteristics (for example, age, gender, health status, job experience), job factors (for example, the intensity of work, exposure to hazards), and organisational factors (for example, overtime policy, supervision).

This study analyses the association between exposure to overtime and extended work schedules and the incidence of reported work-related injuries and illnesses, adjusting for the influence of several mediating factors, including age, gender, occupation, industry sector, and geographical region. The specific mechanisms by which fatigue, stress, or other intermediary conditions bring about a workplace accident are not investigated in this study.

CHAPTER 3 RESEARCH METHODS

3.1 INTRODUCTION

This section discusses the methods of research carried out in the design and development of research approaches, research methodology development, the primary instrument for data collection and related issues. The chapter explains, among other topics, how the author chose the study and research design. The experiment selected for the subject under review is a quantitative research project that is adopted using a structured questionnaire.

The researcher has created the fieldwork in this chapter because of the aims and objectives of the study and given an assessment of the topic from the research in the literature review. The primary purpose of this chapter is to collect data to help the researcher meet the research questions and goals outlined in Chapter 1.

3.2 RESEARCH DESIGN

The following figure 3-1 depicts the process the researcher will follow to design the field study and executed it methodically. It also indicates the process that was followed by the researcher for the fieldwork to be designed and carried out methodically:

Figure 3-1: Research Process

Source: Sekaran and Bougie (2013)

Figure 3-1 describes the research process as a model for data collection, calculation and evaluation based on the study's research questions. The design chosen for the study is empirical with the aim to identify the relevance and the impact of “eleven shift fortnight” working arrangement in a mine where employees need to travel long distances underground before reaching their respective workplaces and any other factors to labour efficiency, utilisation, productivity, availability and the safety of the employees.

3.3 RESEARCH APPROACH

A quantitative research design will be adopted for this study because the researcher wants to get a sample and generalise the findings of the population in the study. This research approach is associated with objectivity where numbers are involved, analysis and interpretation of the collected data, and it is also possible for the researcher to remain detached and objective. The chosen design allows the researcher to generalise the results from a sample to the population of interest, and to measure the incidence of various views and opinions in a chosen sample.

3.4 DATA COLLECTION

Both primary and secondary data will be collected for this study. The primary information on the variables of interest for the general purpose of the study can be gathered by the investigator by means of delivering questionnaire to the employees during mining and engineering safety meetings as well as observing selected teams and recording the findings. The secondary data will be collected from the HR department and also from the safety department during the period of the study.

Data collection is summarised as:

- Non-participant quantitative observation - data will be collected by observing selected teams and recoding the findings as being observed.
- Questionnaire - data will be collected delivering questionnaire to the employees during mining and engineering safety meetings.
- Reports – the researcher will collect reports from Human Resource (HR) department and also from the safety department during the period of the study.

3.5 RESEARCH TOOL

Structured questionnaires will be used to conduct the survey. Questionnaires pose a series of questions to the participants, whose responses will be tabulated into percentages or frequency counts or statistical indexes and these results will be used to draw inferences about a particular population based on the sample of participants (Leedy and Ormrod, 2013). The questionnaire will consist of closed-ended questions that will prompt the respondent to choose an option from a pre-defined list. Closed-ended questions are opted for because

they are easily coded and statistically analysed without the need for responses first to be translated like it is with open-ended questions.

Questions will be categorised into one of these research headings as follows:

- Demographics;
- Employee rooster;
- Employee work hours;
- Family and social life;
- Job satisfaction;
- Shift work satisfaction;
- Fatigue questions;
- Team performance;
- Observation study; and
- Other factors that affect labour productivity and efficiency.

The questionnaire will be initially tested on a pilot sample of three to five respondents to verify the duration it would take to complete and to check for any potential threats to the instrument's internal validity because unreliable questionnaires can influence results (Maree and Van der Westhuizen, 2010). After conducting the pilot study, any errors picked will be rectified before sending the questionnaire out to potential respondents to ensure that the results are not distorted.

3.6 RESEARCH POPULATION

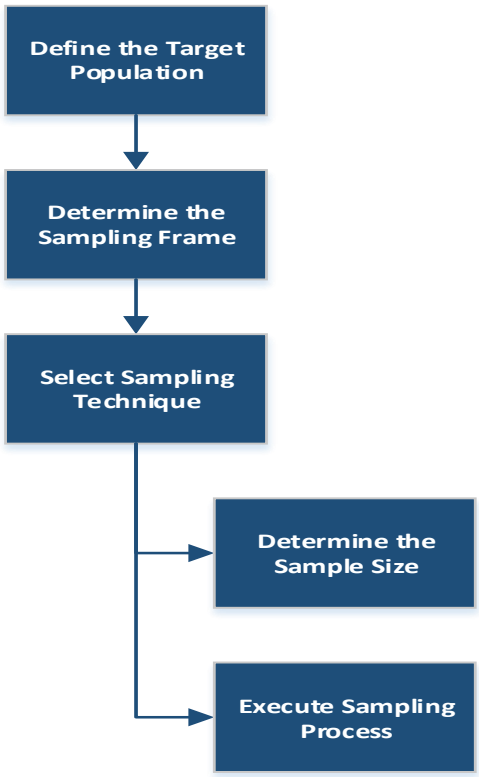
The research population is defined as an overall or total entity in which the researcher's interest is invested (Wilson, 2016:45). Reaching out to the whole fraternity or population in which the research is examined is most likely impossible. Identification of a group of people (smaller in number than the population), collection of individuals, objects or events about which the researcher intend to make inferences is critical (Alvi, 2016:11). For this study, the research population will be all the employees of the organisation under study, which is one of the deep gold mining companies in South Africa.

3.7 SAMPLING

A sample is a subset of the population and includes some of its members (Sekaran and Bougie, 2013). The sampling design that will be used for this study is the probability technique, where the elements in the population have some known, non-zero chance or probability of being selected as sample subjects (Sekaran and Bougie, 2013).

The following process in Figure 3-2 will be recommended when selecting a sample:

Figure 3-2: Sampling Process



Source: Sekaran and Bougie (2013)

The researcher used a stratified random sampling technique to ensure that specific groups within the unit under study are sampled and represented as per Table 3-1 below. Proportionate stratified random sampling is used for this study. On this type of strategy, the number of elements from each stratum is selected concerning its proportion in the total population (Kumar, 2019). This will be employees who work underground.

Table 3-1. Respondents

Department	Total Population/ Department	Percentage of strata	Sample size/ Department
Mining	1059	65.7%	212
Engineering	493	30.6%	99
Safety	13	0.8%	3
Ore Reserve	36	2.2%	7
Ventilation	10	0.6%	2
Total	1611	100%	322

The stratified sampling technique is probably the most efficient among all probability designs. It is the right choice when differentiated information is needed regarding various strata within the population, which are known to differ in their parameters in the sense that for the same number of sample subjects, it offers precise and detailed information (Sekaran and Bougie, 2013).

Zikmund and Babin (2007) stated that there are "three factors that the appropriateness of a sampling technique and these are a) the level of precision (closeness to the proximity population) or, (b) confidence level (how sure the researcher can be) and (c) degree of variability (margin of error)". The sample size needs to be relatively big enough to make sure all insights that are considered crucial are included.

3.8 DATA ANALYSIS

Techniques of descriptive and inferential statistical analysis techniques will be applied to the data through the use of the statistical software R or IBM SPSS.

3.8.1 Descriptive Statistics

Firstly, the participants' demographics will be analysed in order to generate descriptive statistics. The reason behind generating descriptive statistics is to understand the spectrum of the participants of the research. This will be followed by generating descriptive statistics of the variables by calculating the frequencies or averages of all the variables or constructs.

This is to comprehend the participants' positions and opinions on the mentioned variables. The following descriptive statistics will be performed:

- Mean, median, and mode will be used to find points of central tendency. The mean is the arithmetic average of the values in the data set, the median is the exact centre value of the numerical array, and the mode is the value that appears most frequently in the data set (Leedy and Ormrod, 2013).

- Standard deviation will be used to measure the average variability of values in the data set around the mean.

3.8.2 Cronbach Alpha

The internal accuracy of the questionnaire will be checked using the Cronbach alpha coefficient (table 3-2). Reliability measurements that are larger than 0.70 are generally considered acceptable, while values below 0.50 are considered to be unacceptable, (George and Mallery, 2003). These reliability classifications are described in the following table.

Table 3-2: Cronbach's alpha

Cronbach's alpha	Reliability	Colour
> 0.90	Excellent	
0.80 – 0.89	Good	
0.70 – 0.79	Acceptable	
0.60 – 0.69	Questionable	
0.50 – 0.59	Poor	

Source: George and Mallery (2003).

3.8.3 Correlation analysis

To measure the strength and direction of the association between the variables, the product-moment correlation coefficient of Pearson, denoted by r, is applied. The following r interpreting guidelines have been used (Nangolo and Musingwini, 2011):

.01 to .10 or -.01 to -.10 no or very weak positive or negative (-) relationship	
.11 to .30 or -.11 to -.30 weak positive or negative (-) relationship	
.31 to .50 or -.31 to -.50 moderate positive or (-) negative relationship	
.51 to .80 or -.51 to -.80 strong positive or (-) negative relationship	
.81 to 1.0 or -.81 to -1.0 very strong positive or negative (-) relationship	

3.8.4 Relative Importance Index (RII)

RII will be used to determine the respondent's perception of the relative importance of the factors influencing employee engagement. RII will also help to identify the most critical health issues (impacts) as perceived by the respondents.

3.9 RELIABILITY AND VALIDITY

Reliability refers to the consistency and stability of the measurement process and validity refers to how well the research model investigates what it intends to investigate, and to what extent the researcher gained access to the informant's knowledge and meaning (Smallbone and Quinton, 2004).

Research validity will be maintained through appropriate structural alignment of primary data against the research framework and research objectives. A pilot test of surveys will be conducted with three to five respondents to ensure that the questionnaire is not ambiguous. After the pilot run, necessary adjustments will be made, and after that, the actual research survey will be conducted.

3.10 ETHICAL CONSIDERATIONS

Ethics are norms or standards of behaviour that guide moral choices about our behaviours and our relationship with others. The aim of ethics in research is to ensure that no one is harmed or suffer adverse consequences from research activities (Cooper and Schindler, 2003).

The author believes that it is very vital that one comply with professional ethics when conducting a study. Ethics are a system of moral principles and a branch of philosophy which defines what is right for individuals and society (Urban, 1930). Marušić et al. (2011) defined

ethics as moral principles and rules that the researcher must adhere to when researching to ensure that respondents are not deceived, harmed in any way or forced to participate in the research process.

- Harm to the respondents: the study will not expose mine employees or any participants to any harm, be it physical, emotional or psychological.
- Violation of privacy: To ensure privacy, the author has taken into consideration issues of privacy and anonymity. Before participants participate in this study, the researcher will read out loud the letter of concern and ensure that the participant understands his/ her right.
- Deception of respondents: the researcher will explain the purpose of the study in details to the participant before the study continues. The purpose of this study is to determine the impact of "eleven shift fortnight" schedule in South African gold mines.

3.11 RESEARCH LIMITATIONS

The gull-wing is the limitations encountered during the research:

- Availability of the participants - due to different shift times, therefore it became very difficult to get hold of them.
- Level of literacy - since most of the employees not educated and therefore, they it became difficult for the majority to answer the questionnaires on their own.
- Language barrier - some participants come from other neighbouring countries whereby English is not a medium of instruction or a second language; therefore, it was difficult for the participants to complete the questionnaires.
- Unwillingness to participate - since the researcher is part of the management of the mine, some individuals were unwilling to answer the questionnaires because they thought their answers would be used against them.
- Time limitation – No dedicated time for the research because the researcher is a permanent employee and because the researcher was still completing other modules for the programme.

3.12 SUMMARY

This chapter outlined the purpose and rationale for the research methodology and process for the study. A quantitative research design was adopted to respond to the research questions and /or objectives of the study. The chapter also covered the population target, sampling technique, reliability, validity, limitations and ethical considerations for the research study.

CHAPTER 4 PRESENTATION OF RESULTS AND FINDINGS

4.1 INTRODUCTION

Chapter four details all the results and findings obtained. The analyses are presented in the following subsections: section 4.2, which provides the reliability of the data performed through Cronbach analysis, followed by section 4.3, which analyses the demographics of the respondents.

After that, descriptive statistics of each item or variable is presented under section 4.4, whereby frequencies and percentages were identified. Relative importance index was used to rank factors that negatively affect labour productivity in the mining industry, and this is presented under section 4.5.

Labour unavailability of employees for production is analysed under section 4.6. A cause and effect diagram is created under section 4.6 through fishbone. The strengths, weaknesses, opportunities, and threats based on the survey that was conducted, and the findings came out after that for the organisation are identified are section 4.7. Section 4.8 concludes the chapter.

In total, 200 questionnaires were distributed, and 150 were returned, which is about 75% response rate. The returned questionnaires included both manual and online survey. The mine employs 1713 individuals of which 673 individuals' forms part of stoping and development activities. This study mainly focused on the individuals who are involved in the stoping and development activities across the organisation.

From 150 returned questionnaires about 114 were usable for this study which represents 57% of the expected population. The questionnaires were structured as per the following sections:

- Demographics (D);
- Shift work (SW);
- Job satisfaction (JS);
- Team performance (TP);
- Shift satisfaction (SS);
- Fatigue (FQ); and

- Factors that negatively affect labour productivity and efficiency in the mining industry (FNLPE).

4.2 CRONBACH'S ANALYSIS

Table 4-1a: Cronbach analysis

Item	Mean	SD	Range	Cronbach alpha
SW1	1,6	0,68	(1-3)	0,71
SW2	2,2	0,78	(1-3)	0,62
SW3	2,4	0,7	(1-3)	0,61
SW4	1,8	0,65	(1-3)	0,62
SW5	1,8	0,70	(1-3)	0,67
SW6	1,9	0,75	(1-3)	0,65
SW7	1,6	0,69	(1-3)	0,70
Total SW	**1,9**	**0,42**	(1-3)	**0,69**
JS1	1,6	0,9	(1-3)	0,89
JS2	1,6	0,91	(1-3)	0,88
JS3	1,9	0,98	(1-3)	0,88
JS4	1,7	0,96	(1-3)	0,88
JS5	1,8	0,95	(1-3)	0,88
JS6	1,8	0,95	(1-3)	0,88
JS7	2,1	0,98	(1-3)	0,88
JS8	1,4	0,77	(1-3)	0,89
JS9	1,8	0,98	(1-3)	0,88
JS10	1,5	0,87	(1-3)	0,88
JS11	1,5	0,86	(1-3)	0,88
JS12	1,9	0,97	(1-3)	0,88
JS13	1,1	0,47	(1-3)	0,88
JS14	1,4	0,76	(1-3)	0,88
JS15	1,6	0,82	(1-3)	0,87
Total JS	**1,7**	**0,55**	(1-3)	**0,89**

Table 4-1b: Cronbach analysis

Item	Mean	SD	Range	Cronbach alpha
TP1	1,4	0,78	(1-3)	0,82
TP2	1,1	0,46	(1-3)	0,82
TP3	1,2	0,66	(1-3)	0,82
TP4	1,1	0,46	(1-3)	0,82
TP5	1,3	0,75	(1-3)	0,81
TP6	**1,5**	**0,73**	(1-3)	**0,81**
TP7	1,2	0,57	(1-3)	0,81
TP8	1,3	0,67	(1-3)	0,82
TP9	1,3	0,67	(1-3)	0,81
Total TP	**1,3**	**0,42**	(1-3)	**0,83**
SS1	3,4	1,5	(1-5)	0,59
SS2	2,2	1,4	(1-5)	0,61
SS3	2,9	1,6	(1-5)	0,53
SS4	2,9	1,4	(1-5)	0,48
SS5	2,1	1,3	(1-5)	0,55
SS6	2,9	1,6	(1-5)	0,67
Total SS	**2,7**	**0,85**	(1-5)	**0,63**
FQ1	3	1,4	(1-5)	0,94
FQ2	2,6	1,5	(1-5)	0,95
FQ3	2,5	1,4	(1-5)	0,94
FQ4	2,3	1,3	(1-5)	0,95
FQ5	3,1	1,4	(1-5)	0,95
FQ6	2,5	1,4	(1-5)	0,94
FQ7	2,2	1,4	(1-5)	0,94
FQ8	2,3	1,5	(1-5)	0,94
FQ9	2,7	1,4	(1-5)	0,94
FQ10	2	1,3	(1-5)	0,94
FQ11	2,5	1,5	(1-5)	0,94
FQ12	2,3	1,5	(1-5)	0,94
FQ13	2,5	1,5	(1-5)	0,94
Total FQ	**2,5**	**1,1**	(1-5)	**0,95**

Table 4-1c: Cronbach analysis

Item	Mean	SD	Range	Cronbach alpha
MPI1	2,3	1,4	(1-5)	0,83
MPI2	3,2	1,5	(1-5)	0,76
MPI3	3,9	1,5	(1-5)	0,74
MPI4	3,5	1,4	(1-5)	0,71
MPI5	3,4	1,5	(1-5)	0,73
Total MPI	**3,3**	**1,1**	(1-5)	**0,79**
LI1	3,6	1,6	(1-5)	0,85
LI2	3	1,5	(1-5)	0,84
LI3	3,4	1,5	(1-5)	0,83
LI4	2,9	1,6	(1-5)	0,84
LI5	2,9	1,5	(1-5)	0,83
Total LI	**3,2**	**1,2**	(1-5)	**0,87**
MI1	3,5	1,6	(1-5)	0,84
MI2	3,3	1,5	(1-5)	0,81
MI3	2,9	1,6	(1-5)	0,88
MI4	3,3	1,5	(1-5)	0,83
MI5	3,6	1,6	(1-5)	0,83
Total MI	**3,3**	**1,3**	(1-5)	**0,87**
TM1	3,1	1,6	(1-5)	0,81
TM2	3,3	1,6	(1-5)	0,81
TM3	2,8	1,6	(1-5)	0,83
TM4	3,9	1,4	(1-5)	0,82
TM5	3,4	1,5	(1-5)	0,81
TM6	3,3	1,6	(1-5)	0,81
Total TM	**3,3**	**1,2**	(1-5)	**0,84**
MTI1	3,9	1,5	(1-5)	0,89
MTI2	4	1,4	(1-5)	0,90
MTI3	3,9	1,4	(1-5)	0,88
MTI4	3,9	1,4	(1-5)	0,88
MTI5	3,9	1,5	(1-5)	0,88
Total MTI	**3,9**	**1,2**	(1-5)	**0,91**

Table 4-1c: Cronbach analysis (continued)

SRI1	**3,9**	**1,5**	(1-5)	0,86
SRI2	3,6	1,6	(1-5)	0,79
SRI3	3,4	1,6	(1-5)	0,79
Total SRI	**3,6**	**1,4**	(1-5)	**0,87**
SFI1	3,9	1,5	(1-5)	0,90
SFI2	3,7	1,5	(1-5)	0,69
SFI3	3,6	1,7	(1-5)	0,81
Total SFI	**3,7**	**1,4**	(1-5)	**0,86**

From Tables 4-1a to c above, the entire constructs have Cronbach's alpha higher than 0.70. This is an acceptable level of internal consistency with this specific sample, according to George and Mallery (2003).

However, “Shift Work (SW)” and “Shift Satisfaction (SS) questionnaires have an alpha of 0.69 and 0.63, respectively, which is below an acceptable level of 0.70. The reason for a low alpha value might be due to a small number of questions on a test or poor interrelatedness between the test questions. If more relevant items were added to the test, this would have improved the alpha values.

4.3 DEMOGRAPHICS ANALYSIS

The demographic data included the gender, age, marital status, divorced before or after joining the mine, analysis if the participants stay with their families’ full time, residential analysis for the participants and their level of occupation at the mine. The results based on these analyses is presented in Figure 4-1 to 4-9 below.

Figure 4-1: Gender

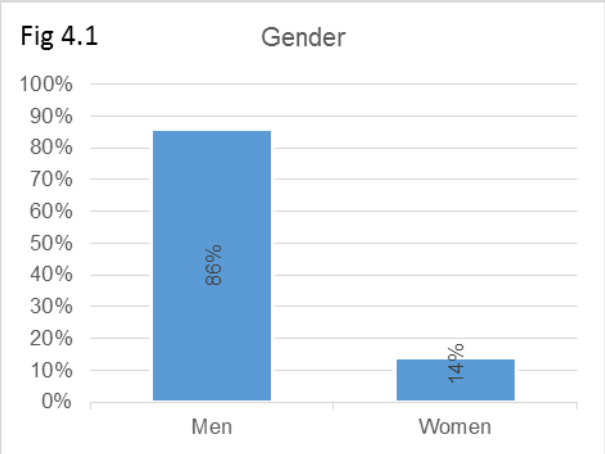
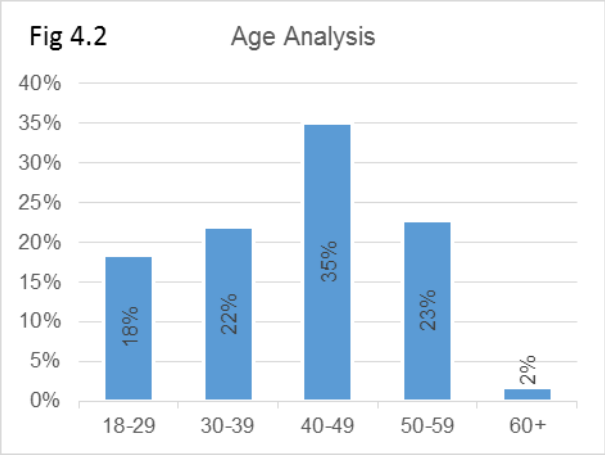


Figure 4-2: Age Analysis



Firstly, participants were asked to indicate their gender and age brackets. As shown by Fig 4-1 above, 86% of participants were men, while only 14% were women. The statistics are aligned to the fact that women make up only 12% of the mining industry operational workforce (Mineral Council South Africa, 2017).

Secondly, the age analysis showed that about 60% of the participants, which forms part of the operational workforce of the mine, are above the age of 40 years old. This is an indication that people in mining are the older generation because they started with mining before 1994. Prior to 1994, mines did not take into consideration the academic qualifications of employees during recruitment. The mines employ only 40% of the participants from the younger generation. Historically, the mining industry has been dominated by older men, but this is changing as now women are joining the mining operational workforce.

Figure 4-3: Marriage Status

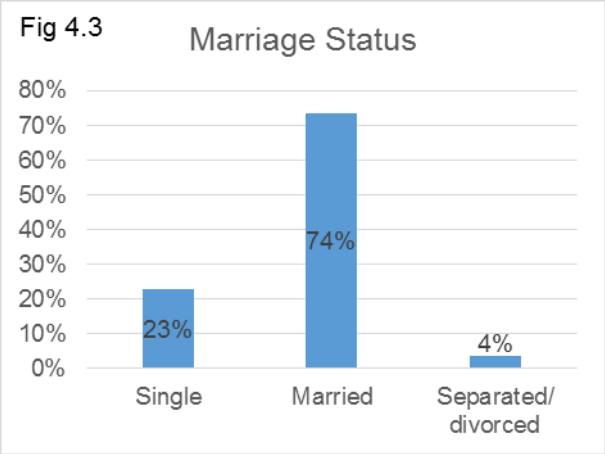
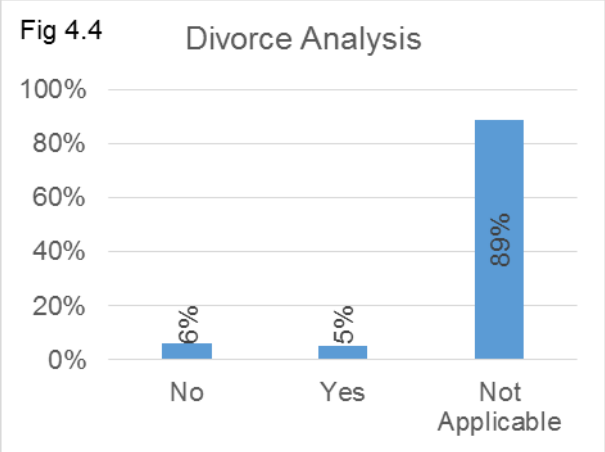


Figure 4-4: Divorce Analysis



Thirdly, participants were asked to specify their marital status. Those that have separated or divorced from their spouses were further asked to specify the time of the divorce: before or after joining the mine; the mining industry is known for working long hours that could be taxing to any marriage.

The results indicated that most of the participants (74%) are married, 23% are single, and only 4% have been separated from their spouses, as indicated in Fig 4-3. Some 4% of the participants are separated or divorced from their spouses, only 5% of participants were separated or divorced after joining the industry. This is illustrated by Fig 4-4.

Figure 4-5: Family Residential Analysis

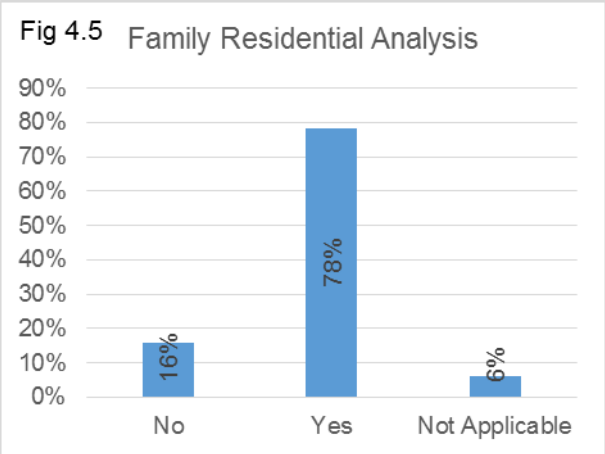
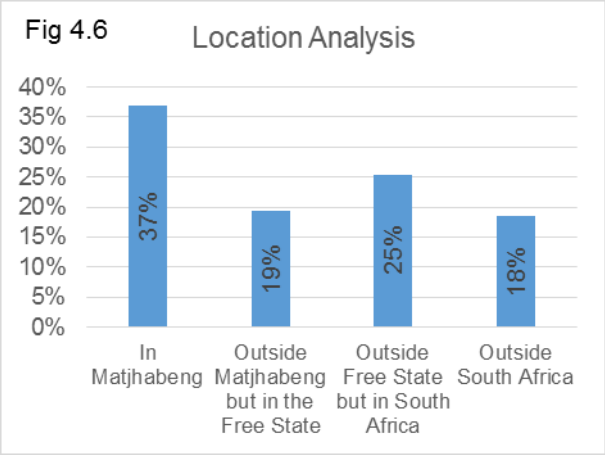


Figure 4-6: Location Analysis



Fourthly, the participants were asked to indicate if they are staying full time with their families while working at the mine. About 78% of the participants do stay with their immediate families (see Fig 4-5), while 16% of them do not.

Up to 6% of the participants did not say if they are staying with their families or not. The reason why most of the participants are staying full time with their families while working at the mine is because majority (56%) of the participants are residing within Free State Province whereby most (37%) of the participants reside at Matjhabeng which is a municipality where the mine is located. Fig 4-6 provides an analysis of the participants' location while working at the mine.

The participants are mainly from stoping and development. This is the reason why most of the participants are “Service Persons” and “Electricians” from engineering department because those are the most involved occupations around the department as well as “miners, shift boss, stope team members and winch operators” from the mining department which are the core skill for this department. Base on the clocking history report from HR, these occupations mostly work long hours; hence, they were chosen as the focus of the study (See Fig 4-7 – Fig 4-9).

Figure 4-7: Engineering Department Occupation

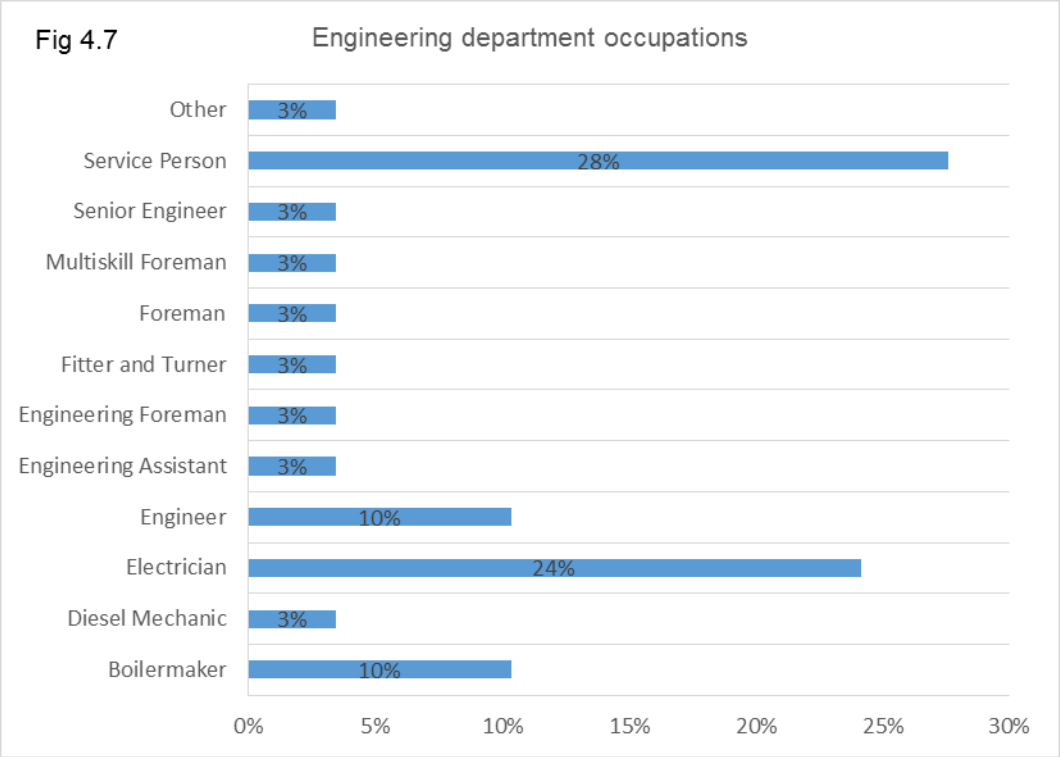


Figure 4-8: Mining Department Occupation

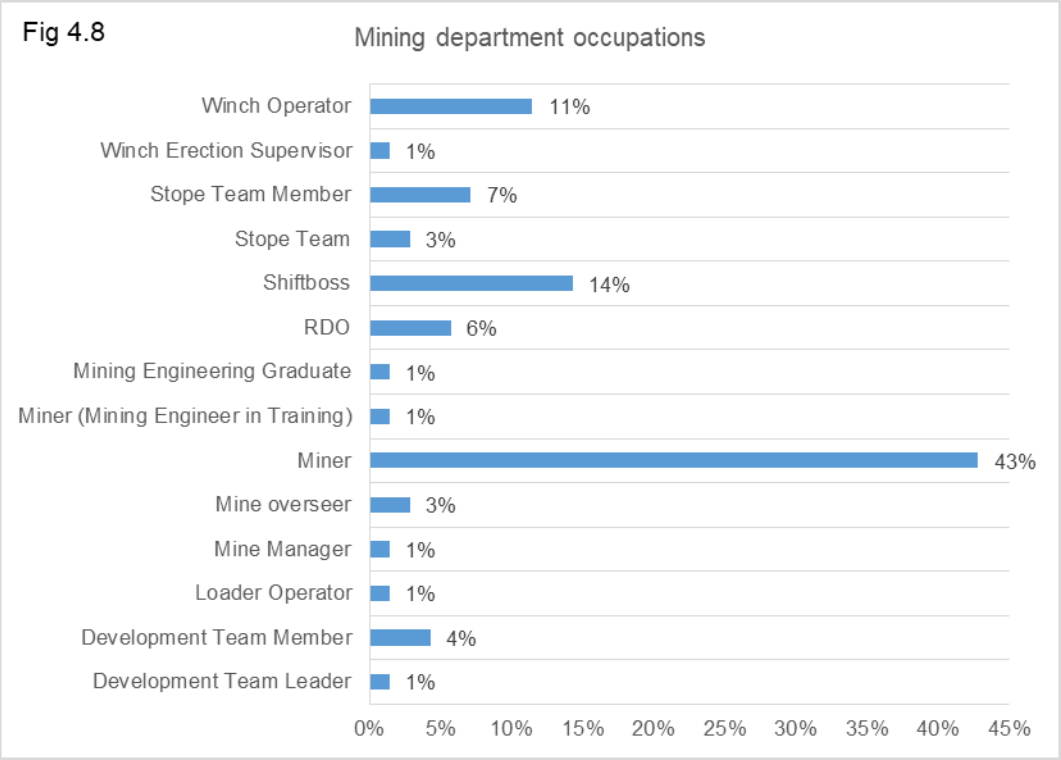
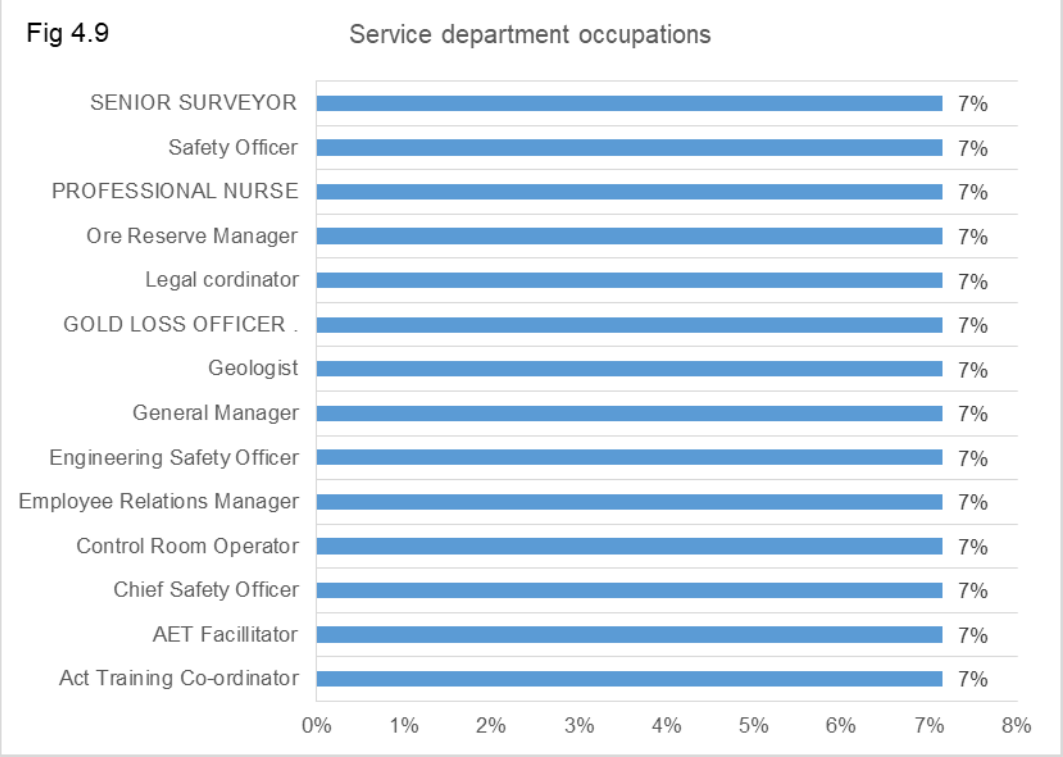


Figure 4-9: Service Department Occupation



4.4 DESCRIPTIVE STATISTICS

This section provides the descriptive statistics of the variables/sections. The frequencies or averages of all the variables or constructs were calculated.

4.4.1 Shift work analysis

Employees were asked to point out their work experience within the mining industry. Evident from Fig 4-10 below majority (48%) have more than 15 years of experience. This is in line with the age analysis from Fig 4-2 since most of the participants are more than 40 years old. Most of the participants are working morning shift which is between 05:00 and 13:00. (See Fig 4-11).

The standard length of the work shift is 8 hours per day as per Fig 4-12. However, most of the participants work more than 8 hours, as indicated in Fig 4-13. Majority (86%) of the participants work a shift of 8-14 hours a day, while 4% of the participants work more than 14 hours shift per day. This is also confirmed by Fig 4-14; 46% of participants indicated that they work a total of more than 63 hours a week which averages to 12.5 hours a day. To cope with the long working hours, the participants are using energy boosters such as caffeine (Fig 4-15).

Figure 4-10: What is your experience within the mining industry in years?

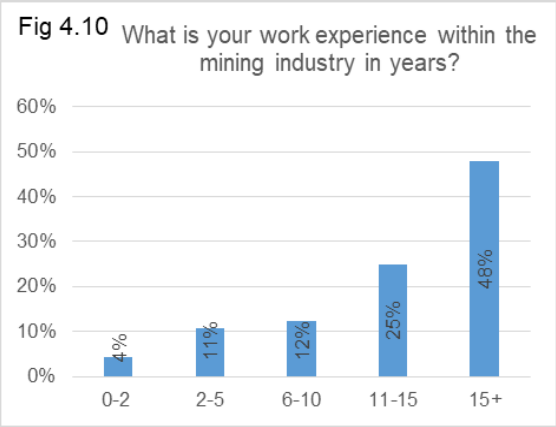


Figure 4-11: Which shift do you work?

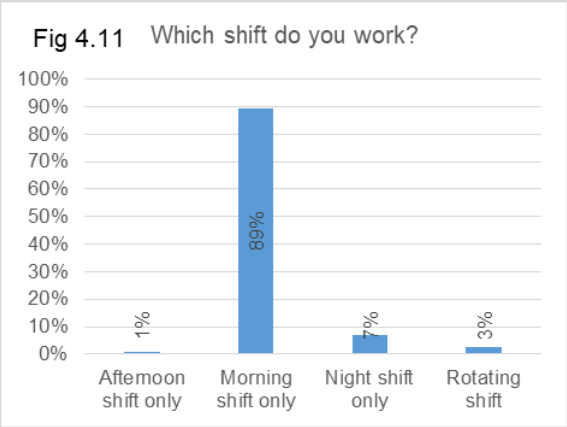


Figure 4-12: What is the length of your shift?

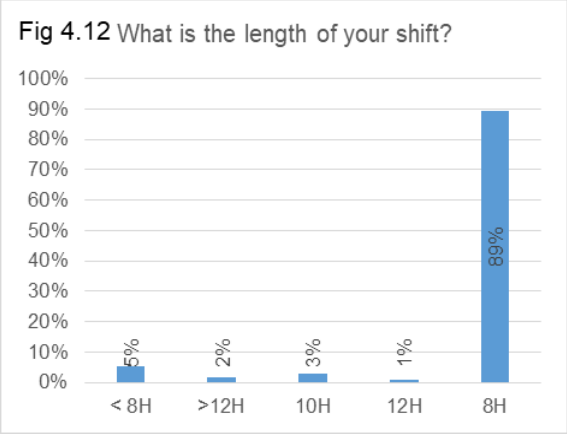


Figure 4-13: How many hours do you actually work per shift?

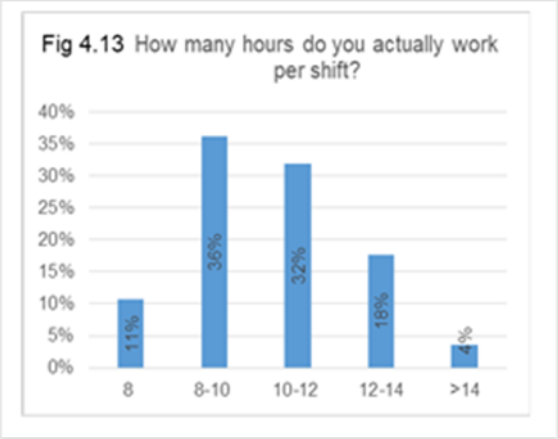


Figure 4-14: what are your total working hours a week? (Average over four weeks)

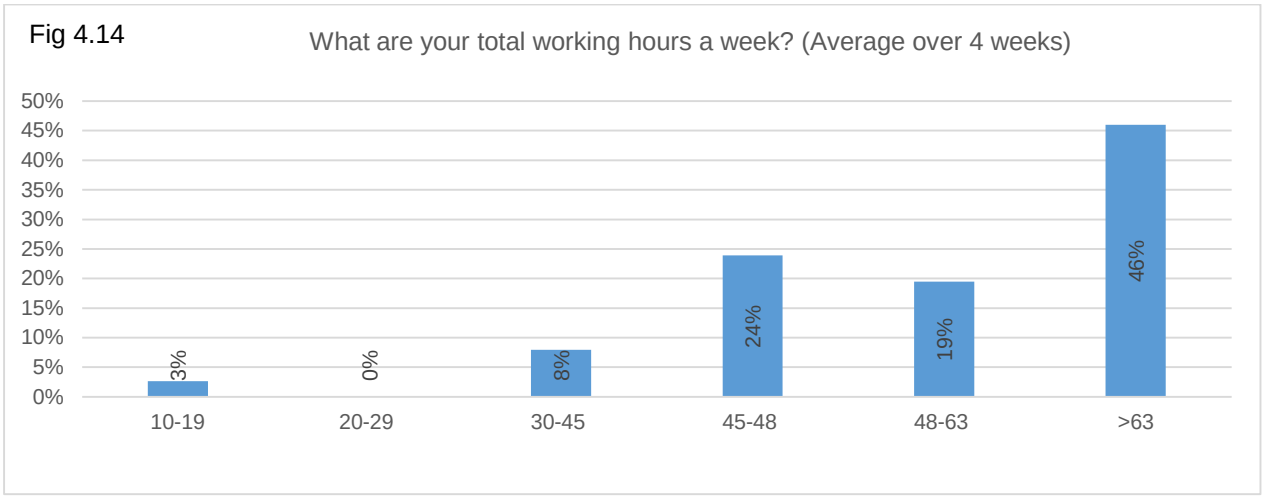


Figure 4-15: Have you used any of the following substances to cope with shift work?

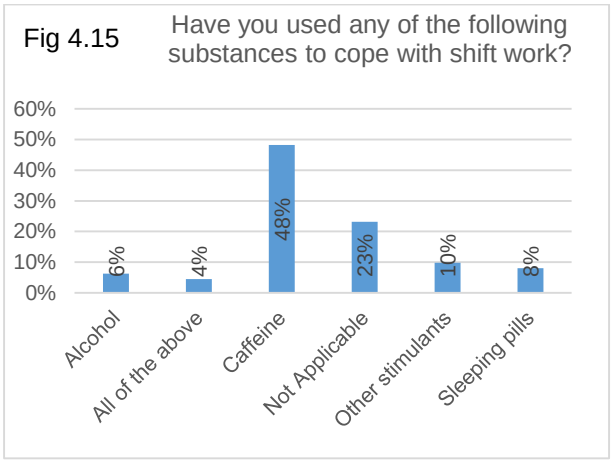
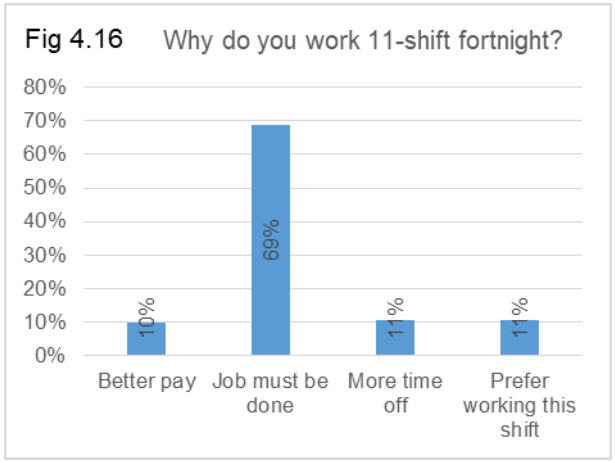


Figure 4-16: Why do you work 11-shift fortnight?



The participants have indicated that the reason to work 11-shift fortnight is that the job must be done (Fig 4-16). Most of the participants have worked 11-shift fortnight for more than two years, as indicated by Fig 4-17 below.

Figure 4-17: How long have you worked 11-shift fortnight in years?

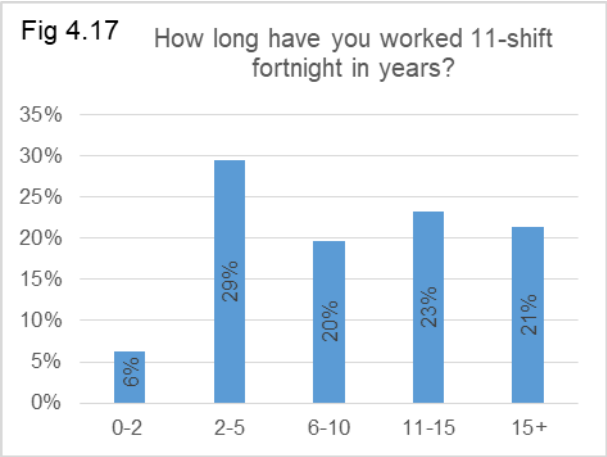
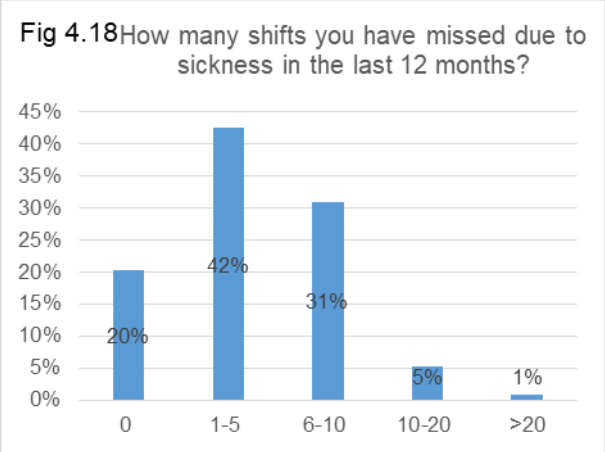


Figure 4-18: How many shifts you have missed due to sickness in the last 12 months?

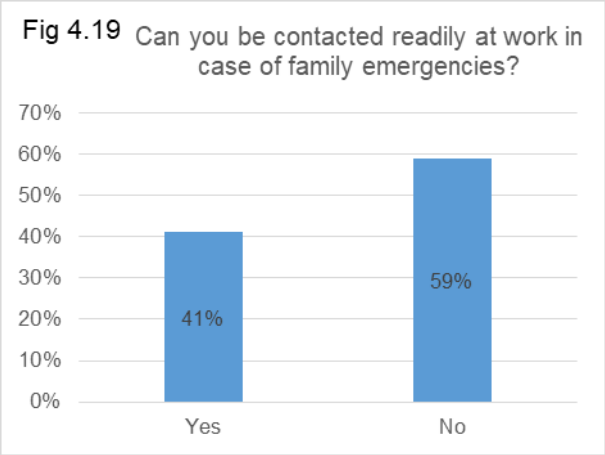


Approximately 42% of the participants have missed more than 1 and less than 5 shifts due to illness in the last 12 months. Some 31% of the participants have missed more than 6 but less than 10, and 5% of the participants have missed more than 10 but less than 20, of their shifts (see Fig 4-18).

Employees working in the stoping and development sections work their shift underground whereby mobile phones are not working, and telephones are not always close by to the

workplace. Fig 4-19 shows that 59% of the participants cannot be easily contacted by their families for emergencies while at work.

Figure 4-19: Can you be contacted readily at work in case of family emergency?



From Fig 4-20 below, 55% of the participants have indicated that their shift lengths vary daily due to no specific knock-off time. However, 63% of the participants have suggested that their shift starting times do not change every week. Close to 72% of the participants indicated that they do have a break of more than 12 hours before the next shift starts and that the roster design complies. However, due to the nature of long working hours, the 12-hour break before the next shift, is, in reality, usually less than 12 hours.

Figure 4-20: Shift Variations

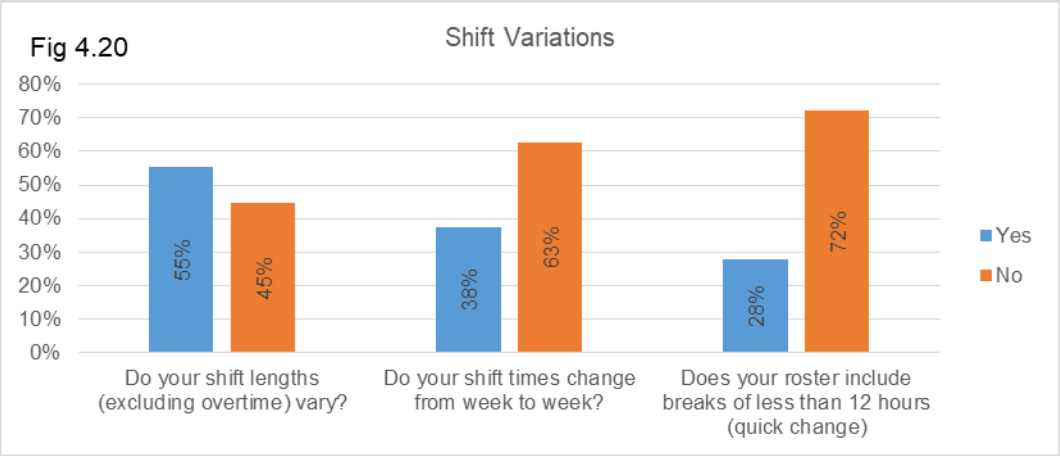
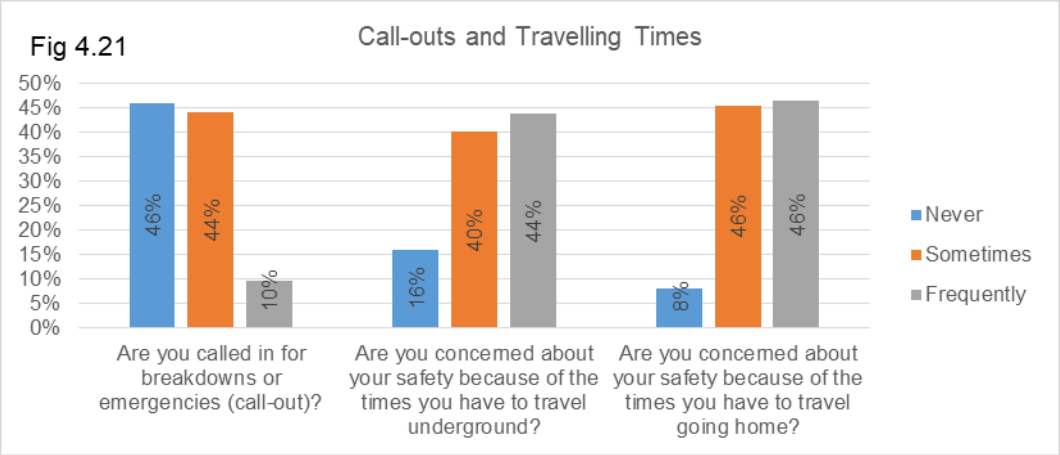


Fig 4-21 shows that the participants are usually called in for breakdowns or emergencies outside their normal working shift. About 46% of the participants have never been called in,

44% are sometimes called, and 10% are frequently called in for breakdowns and emergencies.

Figure 4-21: Call-outs and Travelling times



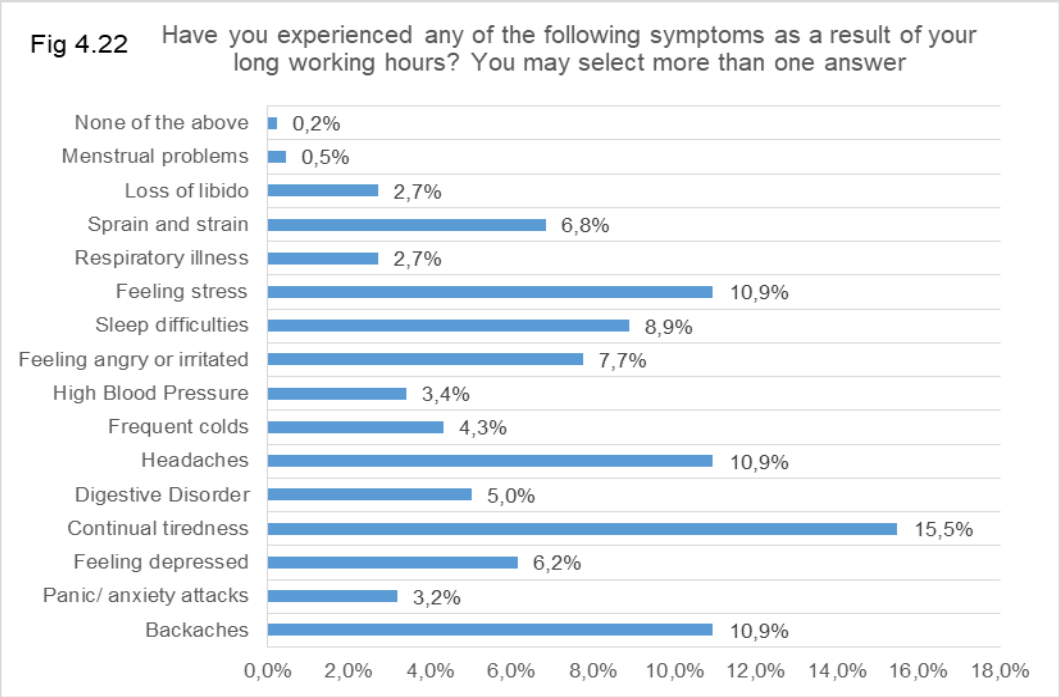
Employees who are frequently called in for breakdowns and emergencies outside their normal working hours are usually electricians, engineers and service people. The reason why some employees are called in for breakdowns and emergencies is that they are not always in all the shifts, and they do not form part of every crew. Those are sometimes called for emergencies only, for example, when there is an emergency such as fire, incidents and fall-off-ground incidents or accidents, are shift bosses and some of the employees from the service department. Employees like miners, team leaders, winch operators and the rest never get called out.

Also, participants were asked to specify if they are concerned about their safety because of times travelled underground (Fig 4-21). 16% of the participants are not concerned, while 40% of the participants are sometimes concerned, and 44% of the participants are frequently concerned about their safety because of travelling times underground. Travelling for an extended distance underground affects the face times and also contributes to employees having fatigue. That means even before the employees start working; they are already tired from travelling.

The other question asked were for the participants to advise if they are concerned about their safety because of the times they have to travel going home (Fig 4-21). About 8% of the participants are not concerned of the times they have to travel going home. However, 46%

of the participants are sometimes and frequently worried about their safety in this regard. Based on the survey of this study, most of the employees reside in Matjhabeng district, which means they do not stay in the mine's hostel. This means that employees have to travel between 25 and– 55 kilometres to and from the mine. Due to their knockoff times and the travelling time going home, they are exposed to road accidents and criminal activities.

Figure 4-22: Have you experience any of the following symptoms as a result of your long working hours?



In Fig 4-22 the participants indicated that they have experienced all the symptoms indicated in the questionnaires due to long working hours. However, the most topical symptoms are:

- continuous tiredness ranked number 1 at 15,5%;
- backaches, headaches as well as feeling stress, all ranked number 2 at 10,9%;
- sleeping difficulties ranked number 3 at 8,9%;
- feeling angry and irritated ranked number 4 at 7,7%;
- sprain and strain ranked number 5 at 6,8%; and
- digestive disorder ranked number 6 at 5%.

Table 4-2: 11-shift fortnight experience versus Age

11-shift fortnight experience versus Age	18-29	30-39	40-49	50-59	60+	Total
15+	0	7	22	23	2	54
11-15	5	9	12	2	0	28
6-10	3	7	3	1	0	14
3-5	9	2	1	0	0	12
0-2	4	0	0	0	0	4
Total	21	25	38	26	2	112

Table 4-3: Sickness versus 11-shift fortnight experience

Sickness versus 11-shift fortnight experience	0-2	3-5	6-10	11-15	15+	Total
Continual tiredness	1	7	8	20	32	68
Feeling stress	1	5	4	14	24	48
Backaches	2	8	7	13	18	48
Headaches	2	6	8	15	17	48
Sleep difficulties	3	5	3	11	17	39
Feeling angry or irritated	1	6	5	6	16	34
Sprain and strain	1	4	1	10	14	30
Feeling depressed	1	3	2	7	14	27
Panic/ anxiety attacks	2	4	13	4	3	26
Digestive Disorder	1	3	2	8	8	22
Frequent colds	2	5	1	5	6	19
High Blood Pressure	1	2	1	5	6	15
Respiratory illness	0	4	1	3	4	12
Loss of libido	1	3	1	4	3	12
Menstrual problems	0	1	0	1	0	2
None of the above	0	0	0	0	1	1
Total	19	66	57	126	183	451

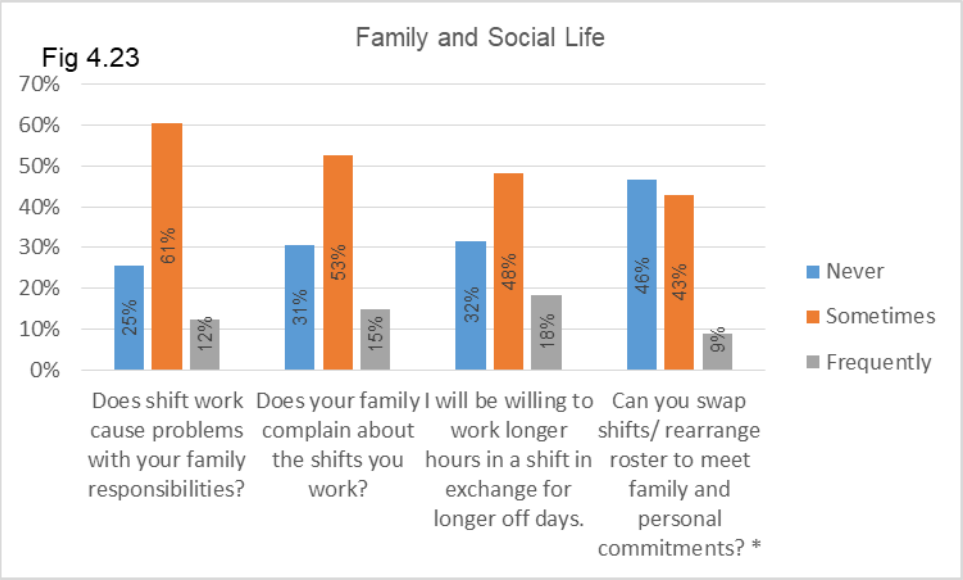
Table 4-4: Sickness versus Age

Sickness versus Age	18-29	30-39	40-49	50-59	60+	Total
Continual tiredness	12	15	23	18	0	68
Backaches	9	16	16	7	0	48
Headaches	13	10	16	9	0	48
Feeling stress	10	8	18	12	0	48
Sleep difficulties	10	7	15	6	1	39
Feeling angry or irritated	10	5	13	6	0	34
Sprain and strain	7	7	10	6	0	30
Feeling depressed	4	5	9	8	1	27
Digestive Disorder	6	3	7	6	0	22
Frequent colds	7	3	5	4	0	19
High Blood Pressure	4	3	3	5	0	15
Panic/ anxiety attacks	5	2	6	1	0	14
Respiratory illness	4	3	2	3	0	12
Loss of libido	5	3	4	0	0	12
Menstrual problems	0	2	0	0	0	2
None of the above	0	0	1	0	0	1
Total	106	92	148	91	2	439

Fig 4-23 below, provides an analysis of how the participants view their family and social life. When asked if the shift work causes problems within their families, this is how they answered:

- 12% of the participants indicated that shift work "frequently" causes problems with their family responsibilities;
- 61% of the participants indicated that shift work "sometimes" causes problems with their family responsibilities; and
- 25% of the participants indicated that shift work "never" causes problems with their family responsibilities.

Figure 4-23: Family and Social Life



The questionnaire sought to establish if employees' families complain about their shift work and the general responses were:

- 15% of the participants indicated that their families "frequently" complain about their shift work;
- 53% of the participants indicated that their families "sometimes" complain about their shift work; and
- 31% of the participants noted that their families "never" complain about their shift work.

Employees were asked to indicate whether they are willing to work longer hours in a shift in exchange for longer off days. The responses are summarised below:

- 18% of the participants indicated that they are "frequently" willing to work longer hours in a shift in exchange for longer off days;
- 48% of the participants indicated that they are "sometimes" willing to work longer hours in a shift in exchange for longer off days; and
- 32% of the participants indicated that they are "never" willing to work longer hours in a shift in exchange for longer off days.

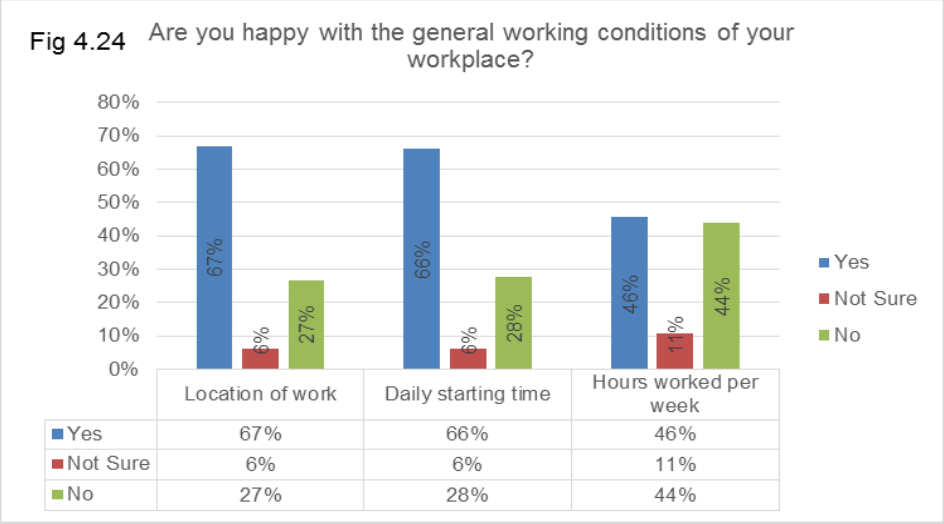
Furthermore, when asked if they can swap/rearrange roster to meet family and personal commitments, this is how they answered:

- 9% of the participants indicated that they could "frequently" swap/rearrange roster to meet family and personal commitments;
- 43% of the participants indicated that they could "sometimes" swap/rearrange roster to meet family and personal commitments; and
- 46% of the participants indicated that they could "never" swap/rearrange roster to meet family and personal commitments.

4.4.2 Job satisfaction

Participants were asked to specify if they are generally satisfied with their job by answering some job satisfaction questions. These results appear in Figures 4-24 to 4-27:

Figure 4-24: Are you happy with the general working conditions of your workplace?



	Location of work	Daily starting time	Hours worked per week
Yes	67%	66%	46%
Not Sure	6%	6%	11%
No	27%	28%	44%

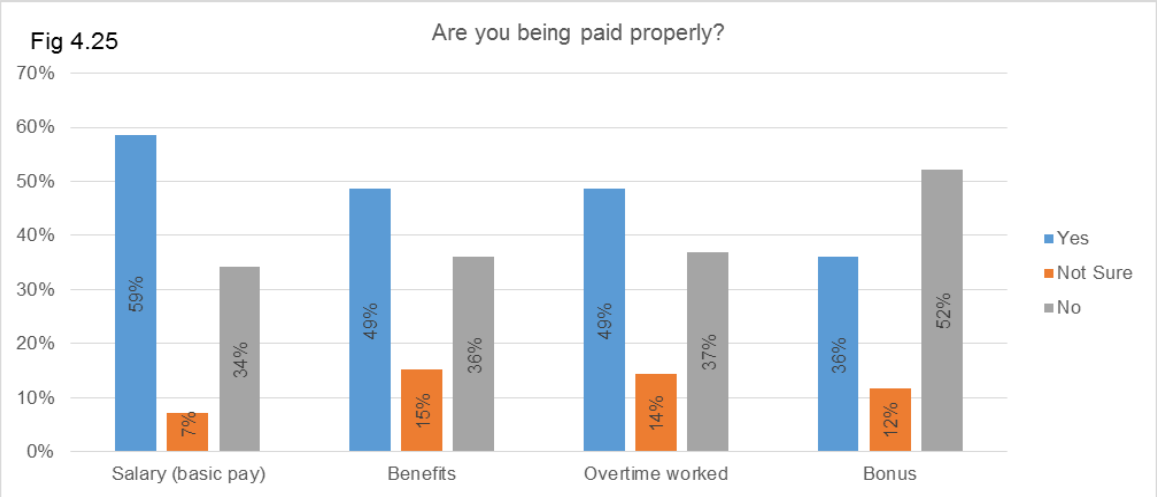
Firstly, when asked whether they were with the general working conditions,

- 67% of the participants indicated that they are happy with the location of their work, while 27% are not happy;
- 6% are not sure;
- 66% of the participants are happy with their daily starting time, while
- 28% are not;
- 6% are not sure;
- 46% of the participants are happy with the hours they worked per week, while

- 44% are not.

Secondly, employees indicated how happy they were with their remuneration (basic salary, benefits, overtime worked and bonuses) and fig 4-25 summarises the responses.

Figure 4-25: Are you being paid properly?

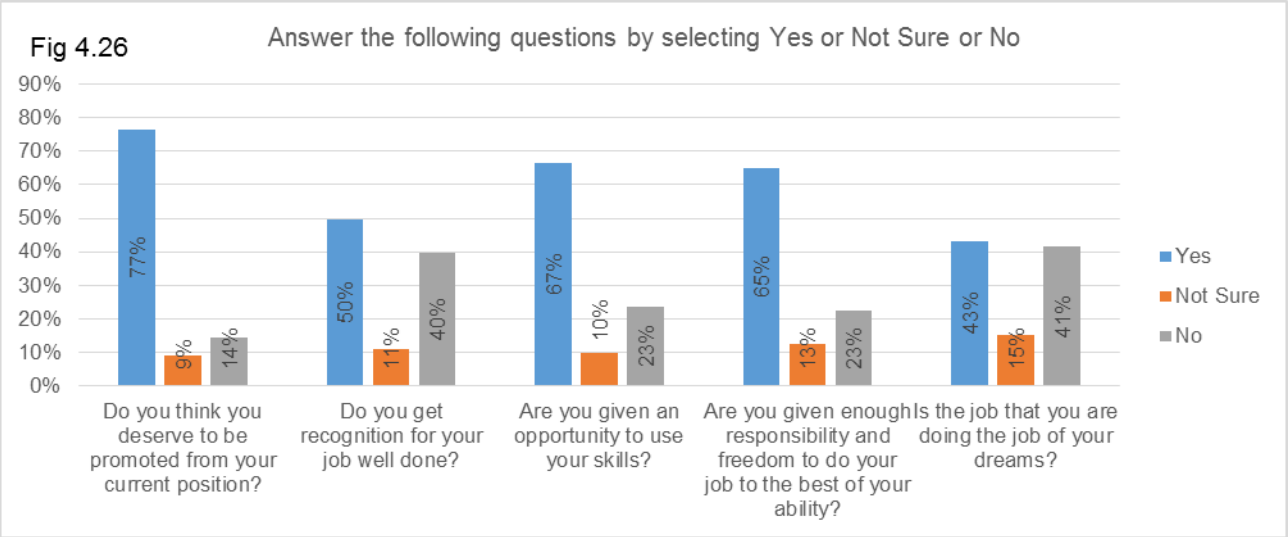


Most of the participants showed that they are being paid well for a basic salary (59%), benefits (49%) and overtime worked (49%). However, most of the participants were not happy with the bonuses paid to them, as only 36% were happy, and 52% were not happy.

Thirdly, employees were prompted to indicate if they deserve to be promoted from their current positions. From Fig 4-26 above then:

- 77% of the participants noted that they deserve to be promoted;
- 14% said “no”, while
- the rest were not sure.

Figure 4-26: Job satisfaction



Also, employees were asked if they get recognised for the job well done. About 50% of the participants said "yes", and 40% said "no" and the rest were not sure.

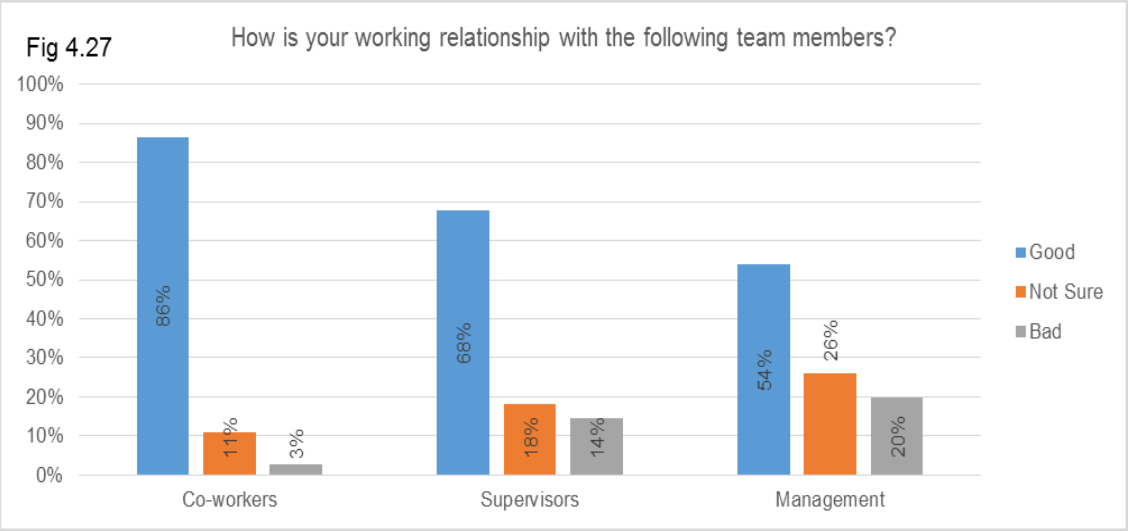
Another question which was asked was for the participants to designate whether the organisation allows them to use their skill. 67% said "yes", and 23% said "no" and the rest were not sure. A follow-up question was whether the participants were given enough responsibility and freedom to do their job to the best of their ability.

- 65% said "yes";
- 13% said "no"; and
- 23% were not sure.

The last question asked under Fig 4-26 was for the participants to indicate if the job they are currently doing is their dream job. 43% said "yes", and 41% said "no" and the rest were not sure.

Figure 4-27 prompted comments on workgroup dynamics. Participants were also required to indicate how their working relationship is with their team members (co-workers, supervisors and management).

Figure 4-27: How is your working relationship with team members?



- 86% of the participants indicated that they have a good relationship with their co-workers;
- 3% of the participants have a bad relationship with their co-workers; and
- 11% were not sure.

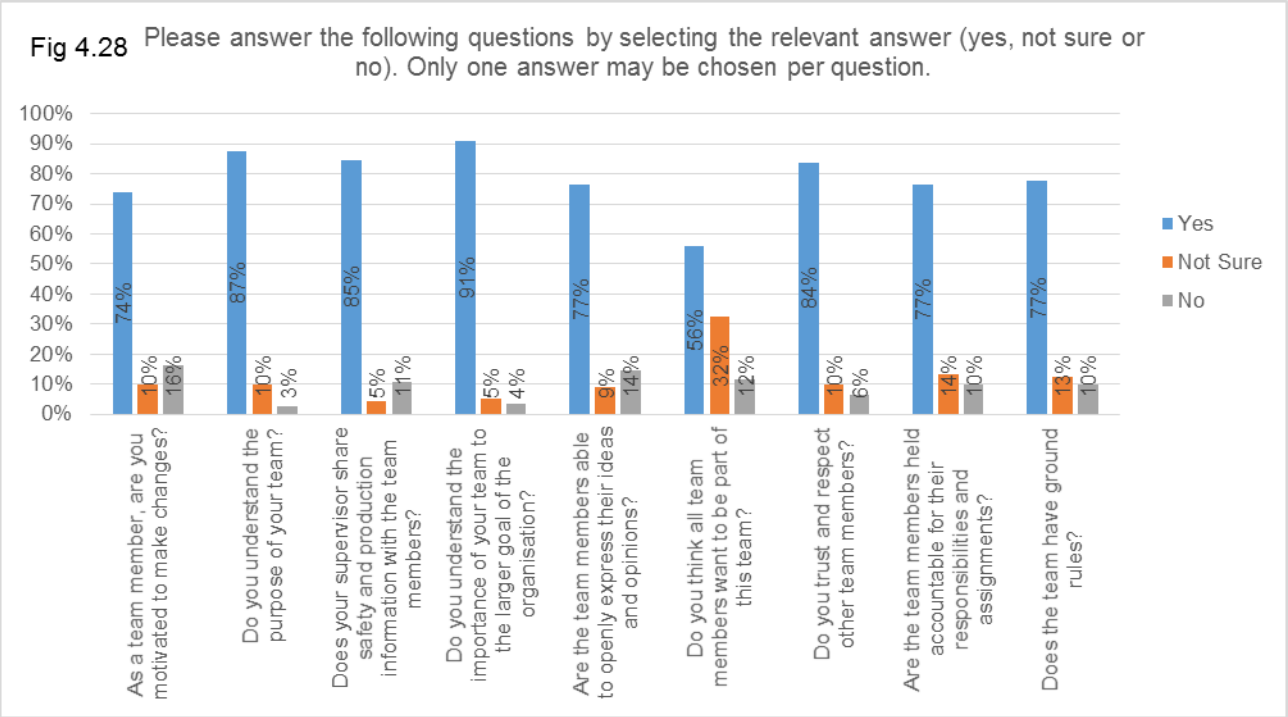
Furthermore, 68% of the participants specified that they have a good relationship with their supervisors, 14% of the participants have a bad relationship with their supervisors, and 18% were not sure.

Furthermore, 54% of the participants pointed out that they have a good relationship with their management, 20% of the participants have a bad relationship with their management, and 26% were not sure.

4.4.3 Team performance

Participants were asked to answer either "yes", "no" or "not sure" to the nine questions to assess team performance. These results are presented in Fig 4-28.

Figure 4-28: Team Performance



- 74% of the participants pointed out that as team members, they are motivated to make changes;
- 16% said they are not motivated; while
- 10% of the participants were not sure about the answer.

Some 87% of the participants indicated that they understand the purpose of their team while 3% did not. Only 10% were not sure about their answer.

On whether the supervisor shares information, 85% of the participants confirmed that their supervisor share safety and production information with the team members, 11% indicated that their supervisor does not share the safety and production information with the team members and 5% were not sure with their answer.

On whether employees understand the purpose of the team, 91% of the participants indicated that they understand the importance of their team to the larger goal of the organisation, 4% did not understand the importance of their team to the larger goal of the organisation. In comparison, 5% were not sure about their answer.

Asked about the openness of the team, 77% of the participants confirmed that as a team member, they could openly express their ideas and opinions. About 14% did not agree to the fact that as a team member, they can openly express their ideas and opinions while 9% were not sure of their answer.

On team cohesiveness, 56% of the participants showed that all team members want to be part of their team, while 12% did not think that all team members want to be part of their team while 32% could not decide on the answer.

On issues of trust and respect, 84% of the participants indicated that they trust and respect other team members, 6% of the participants indicated that they do not trust and respect other team members while 10% were not sure of the answer.

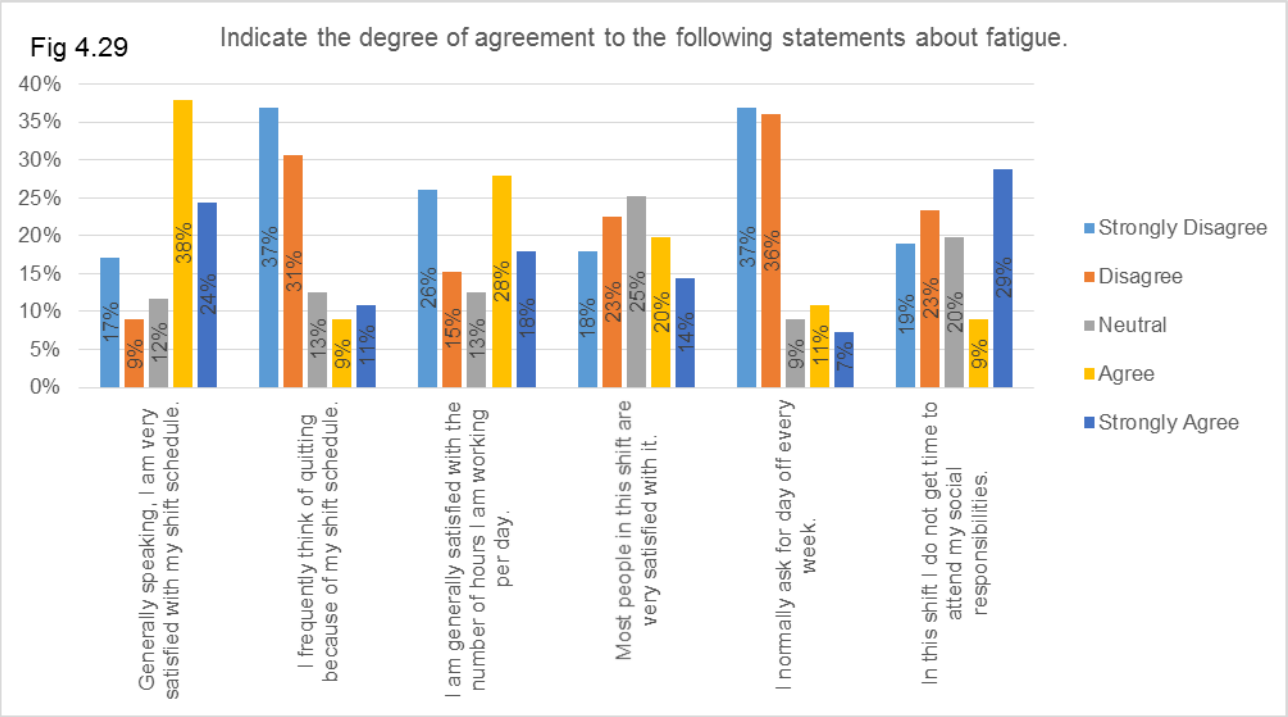
Regarding team member accountability, 77% of the participants agreed that their team members are held accountable for their responsibilities and assignments. 10% did not agree that their team members are held responsible for their duties and jobs, and 14% of the participants were not sure about their answer.

Lastly, 77% of the participants believe that the team has ground rules, 10% did not agree that the team has ground rules, and 13% were not sure about the answer.

4.4.4 Shift satisfaction

The participants were required to indicate their level of agreement to the statements regarding fatigue (see Fig 4-29).

Figure 4-29: Shift satisfaction



The participants indicated that they are generally satisfied with the shift schedules. This was seen from 62% of the participants who agreed to the statement. However, 26% of the participants indicated that they are not generally satisfied with the shift schedules. While 12% were not entirely sure which answer to choose.

About 68% of the participants indicated that they do not think of quitting because of the shift schedule, but 20% of the participants do think about it because of their shifts. 13% cannot decide on the answer.

As for the statement “I am generally satisfied with the number of hours I am working per day”, half of the participants were happy and half were not happy. This is evident from the numbers as 46% of the participants who said are happy with the number of hours they are working and 41% of the participants who said are not happy with the number of hours that they are working.

Participants were asked to indicate whether their co-workers are satisfied with the same shift they are on. Some 34 of the participants agree that their co-workers are satisfied with the same shift they are together working on, 25% of the participants are not sure, and 41%

of the participants do not agree that their co-workers are satisfied with the same shift they are together working on.

Furthermore, employees were asked to confirm if they normally ask for a day off every week, and the results were as follows: Only 18% of the participants usually ask for a day off every week, while 73% of the participants do not ask for a day off every week. 20% of the participants did not say whether they do or do not ask for a day off every week.

Another question which was asked under shift satisfaction section was whether participants do get time to attend their social responsibilities. A total of 38% of the participants indicated that they do not get time to attend to their social responsibilities while 42% of the participants disagree with the statement that they do not get time to attend to their social responsibilities and 20% of the participants were not sure on how to answer the question.

4.4.5 Fatigue

Employees were asked to indicate the degree of their fatigue levels by answering 13 questions. The results are summed up in fig 4-30 below. A total of 22% of the participants "always" experience problems with tiredness, 14% of the participants "usually" experience problems with fatigue, 34% of the participants "sometimes" experiences problems with fatigue. About 15% of the participants "rarely" experience problems with tiredness while 14% “never” experiences problems with fatigue.

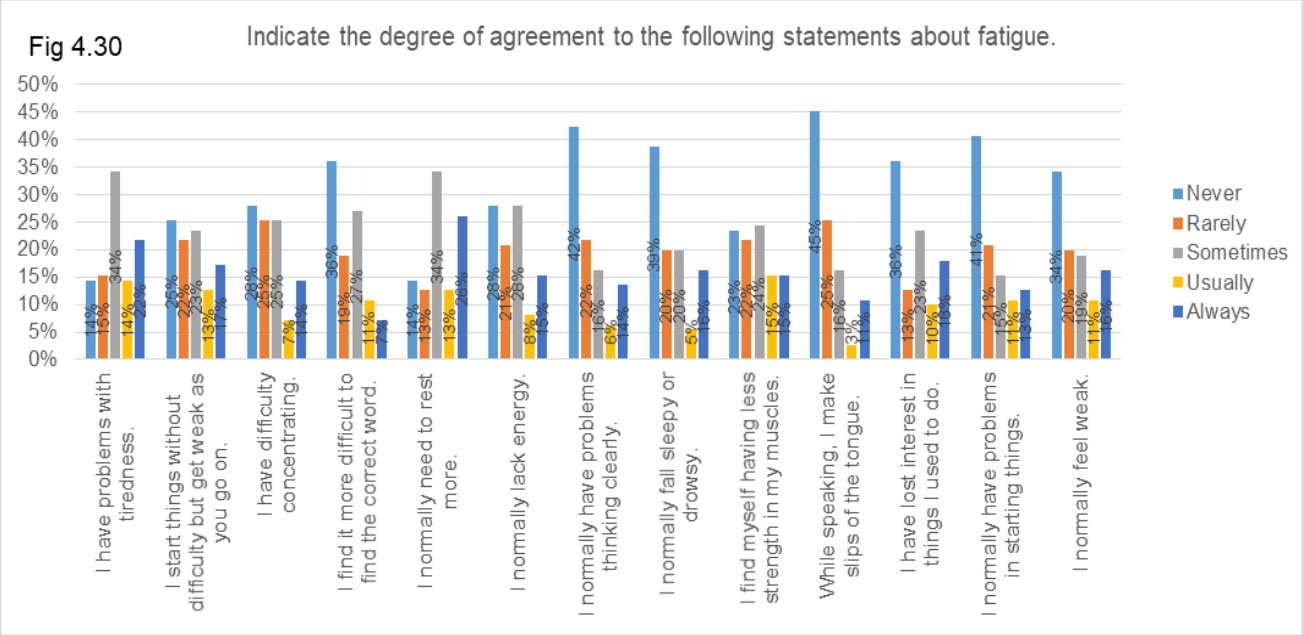
In the same vein, 17% of the participants “always” start things without difficulty but get weak as you go on while 13% of the participants “usually” start things without difficulty but get weak as they go on and 23% of the participants “sometimes” start things without difficulty but get weak as you go on. About 22% of the participants “rarely” start things without difficulty but get weak as you go on while 25% “never” start things without difficulty but get weak as you go.

A total of 14% of the participants “always” have difficulty concentrating while 7% of the participants “usually” have difficulty concentrating and 25% of the participants “sometimes” have difficulty concentrating. About 25% of the participants “rarely” have difficulty concentrating while 28% “never” have difficulty concentrating.

On the fourth question, 7% of the participants “always” find it more difficult to find the correct word, 11% of the participants “usually” find it more difficult to find the correct word, 27% of the participants “sometimes” find it more difficult to find the correct word. About 19% of the participants “rarely” find it more difficult to find the correct word while 36% “never” find it more difficult to find the correct word.

On the fifth question, 26% of the participants “always” need to rest more; 13 % of the participants "usually" need to rest more, 34% of the participants “sometimes” need to rest more. About 13% of the participants “rarely” need to rest more, while 14% “never” need to rest more.

Figure 4-30: Fatigue



By answering the sixth question, 15% of the participants “always” lack energy, 8% of the participants “usually” lack energy, 28% of the participants “sometimes” lack energy. About 21% of the participants “rarely” lack energy, while 28% “never” lack energy.

On the seventh question, 14% of the participants "always" have problems thinking clearly. In comparison, 6% of the participants "usually" have problems to think clearly, and 16% of the participants "sometimes" have problems to do so. About 22% of the participants "rarely" have problems thinking clearly while 42% "never" have problems thinking clearly.

The eighth question revealed that 16% of the participants “always” fall sleepy or drowsy, 5% of the participants “usually” fall sleepy or drowsy, 20% of the participants “sometimes” fall sleepy or drowsy. About 20% of the participants “rarely” fall sleepy or drowsy while 39% “never” fall sleepy or drowsy.

On the ninth question, 15% of the participants “always” find themselves having less strength in their muscles, 15% of the participants “usually” find they have less strength in their muscles, 24% of the participants “sometimes” find themselves having less strength in their muscles. About 22% of the participants “rarely” find themselves having less strength in their muscles while 23% “never” find themselves having less strength in their muscles.

The tenth question showed that 11% of the participants “always” make slips of the tongue while speaking, 3% of the participants “usually” make slips of the tongue while speaking, 16% of the participants “sometimes” make slips of the tongue while speaking. About 25% of the participants “rarely” make slips of the tongue while speaking while 45% “never” make slips of the tongue while speaking.

A total of 18% of the participants "always" lose interest in things they used to do, 10% of the participants "usually" lose interest in things they used to do, 23% of the participants "sometimes" lose interest in things they used to do. About 13% of the participants "rarely" lose interest in things they used to do while 36% "never" lose interest in things they used to do.

The twelfth statement showed that 13% of the participants “always” have problems in starting things, 11% of the participants “usually” have problems in starting things, 15% of the participants “sometimes” have problems in starting things. About 21% of the participants “rarely” have problems in starting things while 41% “never” have problems in starting things.

The last statement revealed that 16% of the participants “always” feel weak, 11% of the participants “usually” feel weak; 19 % of the participants "sometimes" feel weak. About 20% of the participants “rarely” feel weak while 34% “never” feel weak.

4.4.6 Factors affecting the mining industry negatively

Under this section, participants were asked to indicate other factors and the extent to which they are negatively affecting labour productivity in the mining industry. These seven are:

1. Manpower issues;
2. Leadership issues;
3. Motivational issues;
4. Time issues;
5. Material/ Tool issues;
6. Services issues; and
7. Safety issues.

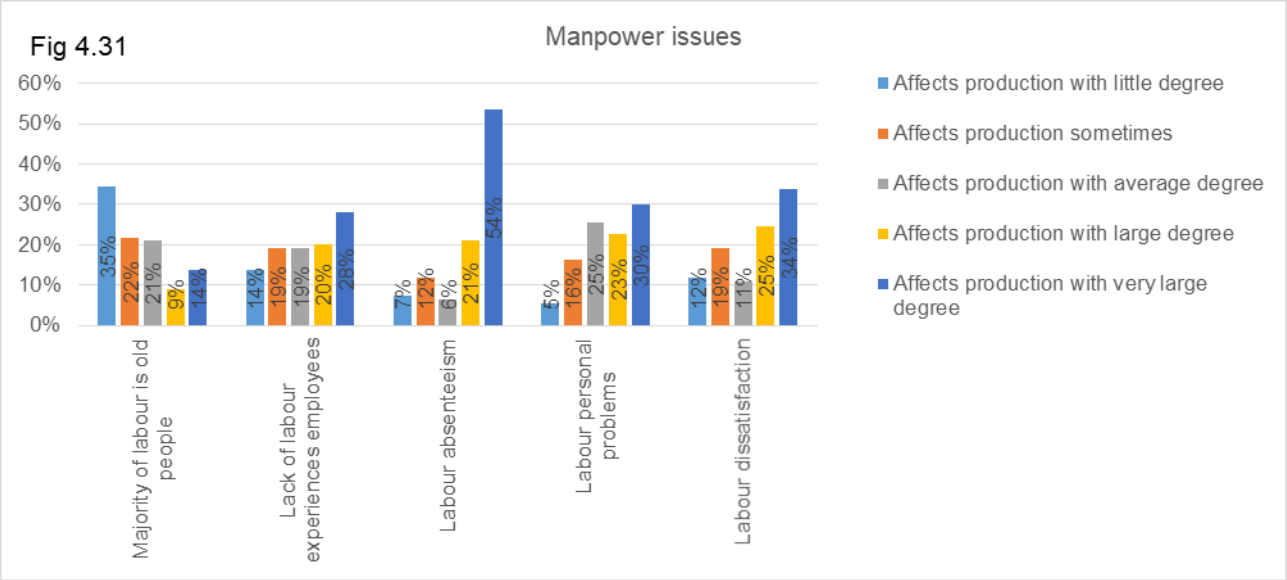
4.4.6.1 Manpower Issues

Five constructs were measured under this and were

- Ageing manpower;
- Experience at work;
- Labour absenteeism;
- Labour Personal problems; and
- Labour dissatisfaction.

The findings about manpower issues are displayed in Figure 4-31 below.

Figure 4-31: Manpower Issues



- **Ageing Manpower Issues**

  About 14% of the participants pointed out that production can be affected to a very large degree due to majority of the labour force are old people, 9% of the participants indicated that production could be affected to a large degree because the majority of labour force consist of old people. Some 21% of the participants indicated that production could averagely be affected because of age, while 22% of the participants indicated that the ageing workforce can sometimes affected production. In comparison, 35% of the participants indicated that production can be affected marginally because of the majority of the labourforce are old people.

- **Experience at work**

  A total of 28% of the participants indicated that production could be affected to a very large degree by lack of experienced employees. In comparison, 20% of the participants pointed out that production can be affected to a large degree by lack of labour experienced employees and 19% of the said production can be averagely affected by the experience component. As well, 19% of the participants indicated that production could sometimes be affected by this, while 14% of the participants indicated that production could be affected to a little degree.

- **Labour Absenteeism**

  A total of 54% of the participants pointed out that production can be affected to a very large degree by labour absenteeism, 21% of the participants indicated it could be affected to a large degree, while 6% said it could be affected averagely. Furthermore, 12% of the participants indicated that production could sometimes be affected by labour absenteeism and 7% of the participants indicated that production could be affected with a little degree by labour absenteeism.

- **Labour Personal problems**

  Close to 30% of the participants said that labour personal problems affects production to a very large extent, while 23% of the participants indicated that production could be affected to a large degree due to labour personal problems and 25% of the participants indicated that production could be affected in an average degree due to labour personal problems. Furthermore, 16% of the participants indicated that

production could sometimes be affected due to labour personal problems and 5% of the participants indicated that this has a limited effect on production.

- **Labour dissatisfaction**

  A total of 34% of the participants showed that dissatisfied labour could affect production to a very large extent, 25% of the participants indicated that production could be affected to a large degree due to labour dissatisfaction. Meanwhile, 11% of the participants indicated that production could be affected in an average degree due to labour dissatisfaction, 19% of the participants indicated that production could sometimes be affected. In comparison, 12% of the participants indicated that production could be affected with a little degree due to labour dissatisfaction.

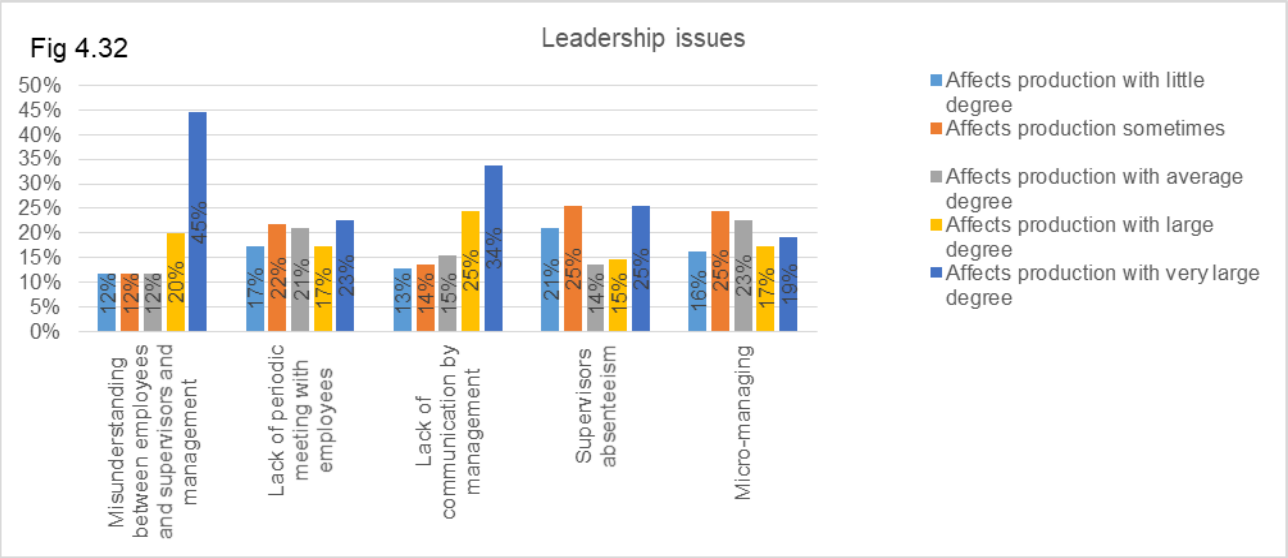
4.4.6.2 Leadership Issues

Under leadership, five constructs were measured:

- Misunderstanding between employees and management;
- Lack of periodic meetings;
- Lack of communications;
- Absent supervisor; and
- Micromanaging.

The results are summarised in figure 4-32 below.

Figure 4-32: Leadership Issues



- **Misunderstanding between employees and management**

  A total of 34% of the participants indicated misunderstandings between employees, supervisors and management affected production to a very large degree, 25% said to a large degree, 11% said it affects averagely. Some 19% of the participants indicated that production could sometimes be affected, and 12% of the participants indicated that production could be affected with a little degree due to a misunderstanding between employees, supervisors and management.

- **Lack of periodic meetings**

  Close to 23% of the participants indicated that production could be affected to a very large degree due to lack of periodic meetings with employees, 17% said it affected to a large degree, 21% pointed out that it affects averagely, 22% of the participants indicated that production can sometimes be affected due to lack of periodic meetings with employees and 17% of the participants indicated that production can be affected with a little degree due to lack of periodic meetings with employees.

- **Lack of communications**

  The lack of communication by management to the employees affects production: 34% of the participants said to a very large degree, 25% indicated to a large degree, 15 % said it affects averagely, 14% indicated sometimes, while 13% said it has little effect.

- **Absent supervisor**

  Supervisor's absenteeism affects production: 25% of the participants said to a very large degree, 15% of the participants indicated that production could be affected to a large degree, 14% indicated averagely, 25% said sometimes, while 21% of the participants indicated that production could be affected to a little degree due to supervisor's absenteeism.

- **Micromanaging**

  About 19% of the participants showed that production is very largely affected due to micro-managing, 17% said largely affected, 23% of the participants indicated it is somewhat affected, 25% of the participants said it could sometimes be affected due to micro-managing while 16% said it has little effect.

4.4.6.3 Motivational Issues

Five motivational constructs were also measured:

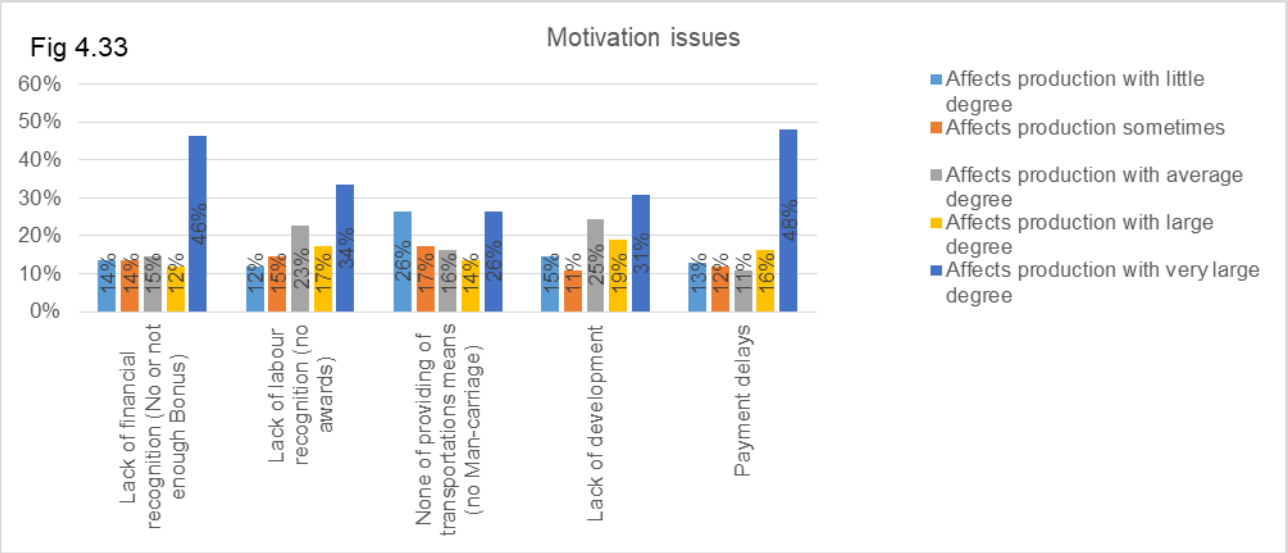
- Lack of financial recognition;
- Lack of labour recognition;
- No transport provided;
- Lack of development; and
- Payment delays.

The results are summarised in figure 4-33 below.

- **Lack of financial recognition**

  About 46% of the participants indicated that due to lack of financial recognition (no or not enough bonus) affects production to a very large degree, 12% to a large degree, and 15% of the participants to an average degree. In addition, 14% of the participants indicated that production could sometimes be affected, while 14% of the participants indicated that production could be affected with a little degree due to lack of financial recognition (no or not enough bonus).

Figure 4-33: Motivation Issues



- **Lack of labour recognition**

  A total of 34% of the participants indicated that production could be affected to a very large degree by lack of labour recognition (no awards), 17% of the participants to a large degree, 23% of the participants pointed out to an average degree, 15% indicated sometimes, while 12% of the participants indicated that production could be affected to a little degree.

- **No transport provided**

  If transport for manpower (no man carriage) is not provided, this affects production: 26% said to a very large degree, 14% said to a large degree, 16% said to an average degree while 17% of the participants indicated that production could sometimes be affected and 26% of the participants indicated that production could be affected to a little degree due to not providing transportation means (no man-carriage).

- **Lack of development**

  About 31% of the employees said that production is to a very large degree due to lack of development, 19% said to a large degree, 25% to an average degree, 11% of the participants indicated that production can sometimes be affected due to lack of development and 15% of the participants indicated that production can be affected with a little degree due to lack of development.

- **Payment delays**

  A total of 48% of the respondents indicated that production can be affected to a very large degree by payment delays, 16% to a large degree, 11% to an average degree, 12 % indicated it is somewhat affected, and 13% of the participants indicated that production can be affected to a little degree due to payment delays.

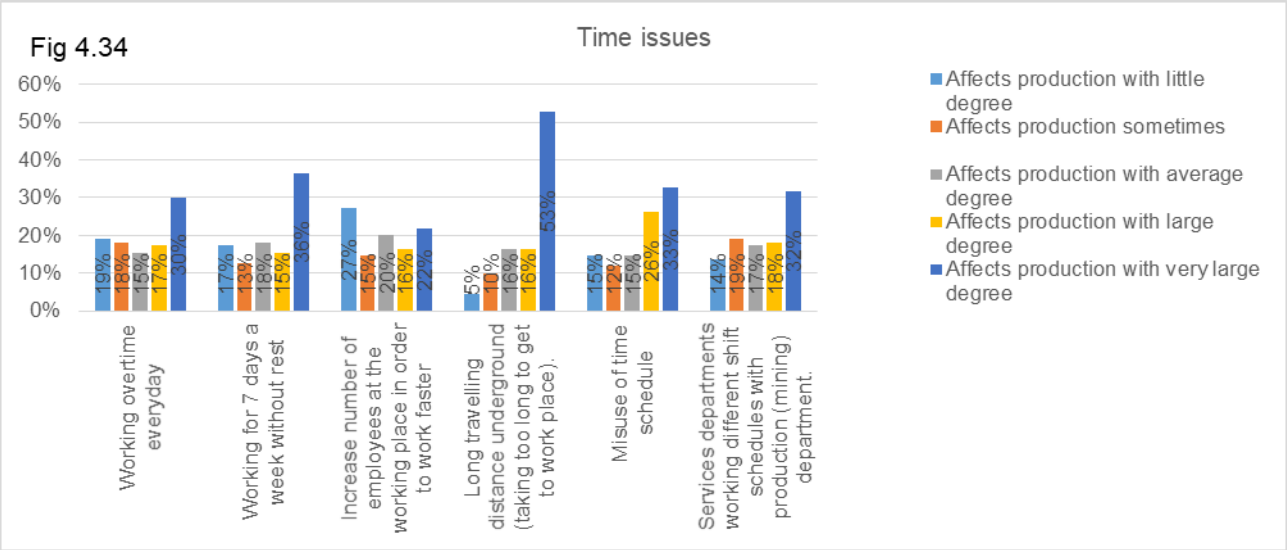
4.4.6.4 Time Issues

Under time issues, six constructs were measured here:

- Working overtime;
- Working seven days without rest;
- Increasing employees to speed up work;
- Long travelling times underground;
- Misuse of time schedule; and
- Services department working a different shift.

The results are summarised in figure 4.34 below.

Figure 4-34: Time Issues



- **Working overtime**

  The statement in review was that working overtime affects production at the mine and 30% of the participants indicated that production could be affected to a large degree by to working overtime every day; 17% said it affects production largely, 15% said it affects averagely, 18% indicated it does sometimes while 19% of the participants indicated that working overtime has little effect on production.

- **Working seven days without rest**

  About 36% of the participants indicated that production can be affected to a very large degree by working for 7 days a week without rest, 15% said to a large degree, 18% said the effect is average degree, 13% of the participants indicated that production can sometimes be affected while 17% of the employees said the effect is little.

- **Increasing employees to speed up work**

  The researcher wanted to find out if an increasing number of employees at the working place in order to work faster helps production volumes to increase. 22% said it increases to a very large degree, 16% said it increases to a large degree, 20% said it has an average effect, 15 said sometimes, while 27% indicated that it has little effect on production.

- **Long travelling times underground**

  If employees endure long travelling times to and from the actual place of work, then production would be negatively affected, the responses were as follows: 53% said to a very large degree, 16% said to a large degree, 16% said to an average degree while 10% of the participants indicated that production could sometimes be affected and 5% of the participants indicated that production could be affected to a little degree due to due to long travelling distance underground (taking too long to get to the workplace).

- **Misuse of time schedule**

  Some 33 % of the employees indicated that production could be affected to a very large degree by the misuse of time schedules while 26%, 15%, 12% and 15% said

the misuse of time schedules has large, average, sometimes affects, and has little effect at all on production respectively.

- **Services department working a different shift**

  Service departments at the mine work different shift schedules from mining production. 32% of the participants indicated that production could be affected to a very large degree by this, 18% showed that it affects to a large degree, 17% said it affects to averagely, 19% said sometimes, and 14% of the participants indicated that production could be affected to a little degree.

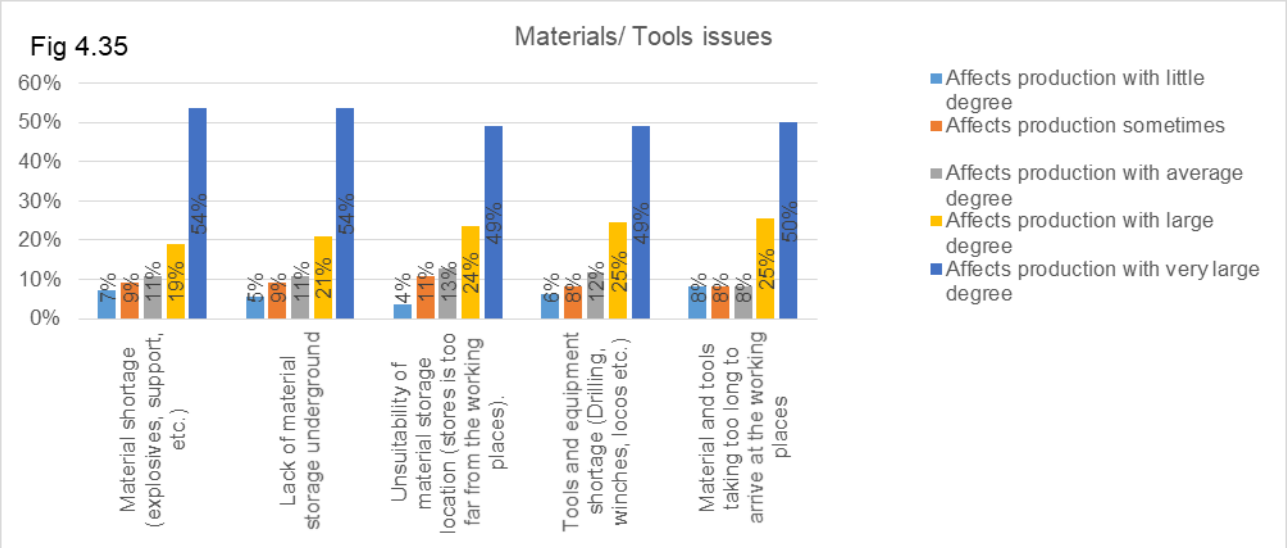
4.4.6.5 Material / Tool Issues

Five material and tool constructs were measured:

- Material shortage;
- Lack of material stored underground;
- Storage too far from worksite;
- Tools and equipment; and
- Tools and equipment taking too long to arrive at workplace.

The results are summarised in figure 4-35 below.

Figure 4-35: Material/ Tools Issues



- **Material shortage**

  The question was that does material shortages (explosives) and support affect production. Up to 54% of the participants indicated that it does a very large extent, 19% said it does to a large degree, 11% said it affects in an averagely way. In comparison, 9% indicated it affects sometimes, and 7% of the participants indicated that production could be affected to a little degree by the material shortage (explosives, support and others).

- **Lack of material stored underground**

  Production material should be stored underground to be made available when needed. Employees were asked to rate how production is affected by lack of storage: 54% said it is affected to a very large degree 21% said it is to a large degree, 11% indicated it is to an average degree, 9% of the participants indicated that production could sometimes be affected by to lack of material storage underground and 5% said the effect is minimal.

- **Storage site too far from work sites**

  Employees were asked to share their views on how production was affected by unsuitability of material storage location (stores is too far from the working places). 49% said production is affected greatly, while 24% said the effect on production is large, 13% indicated the effect is average. Another 11% said this sometimes affects production and the last 4% said the effect on production is little.

- **Tools and Equipment shortage**

  This question enquired if a shortage of tools and equipment (such as drilling, winches, or locos) negatively affect production. In response, 49% of the participants indicated that it does to a very large extent, 25% said it does to a large degree, 12% said it affects in an averagely way while 8% indicated it affects sometimes and 6% of the participants indicated that production could be affected to a little degree by tools and equipment shortage (such as drilling, winches, or locos).

- **Tools and equipment taking too long to arrive at workplace**

  Employees were asked to share their views on how production was affected by tools and equipment taking too long to arrive at the workplace. 50% said production is affected greatly, while 25% said the effect on production is large, 8% indicated the effect is average. Another 8% said this sometimes affects production and the last 8% said the effect on production is little.

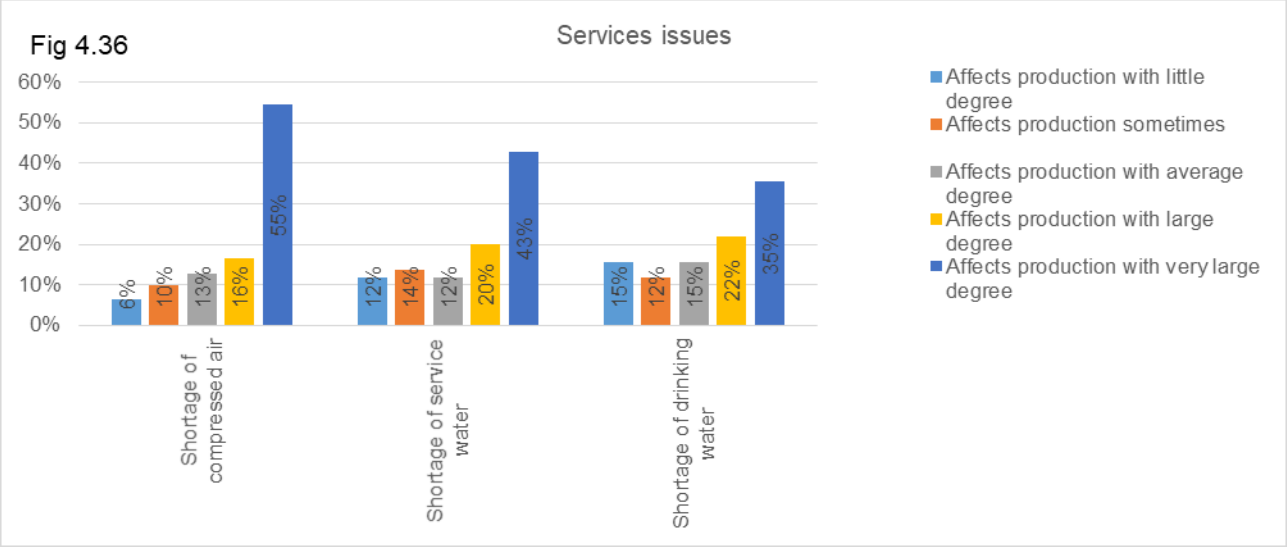
4.4.6.6 Services Issues

Three services issues were measured:

- Shortage of compressed air;
- Shortage of service water; and
- Shortage of drinking water.

The results are summarised in figure 4-37 below.

Figure 4-36: Service Issues



- **Shortage of compressed air**

  Some 55% of the employees indicated that production could be affected negatively to a very large degree by shortage of compressed air. At the same time, 16%, 13%, 10% and 6% said the effect of shortage of compressed air on production large, average, sometimes affects and has little effect at all on production in that order.

- **Shortage of service water**

  This question was: Does the shortage of service water affect production? 43% said it does to a very large degree, 20% - to a large degree, 12% to an average degree, 14% of the participants indicated that production could sometimes be affected, while 12% indicated it is affected to a little degree.

- **Shortage of drinking water**

  Some 35% of the employees indicated that production could be affected negatively to a very large degree by shortage of drinking water. At the same time, 22%, 15%, 12% and 15% said the effect of shortage of drinking water production large, average, sometimes affects and has little effect at all on production in that order.

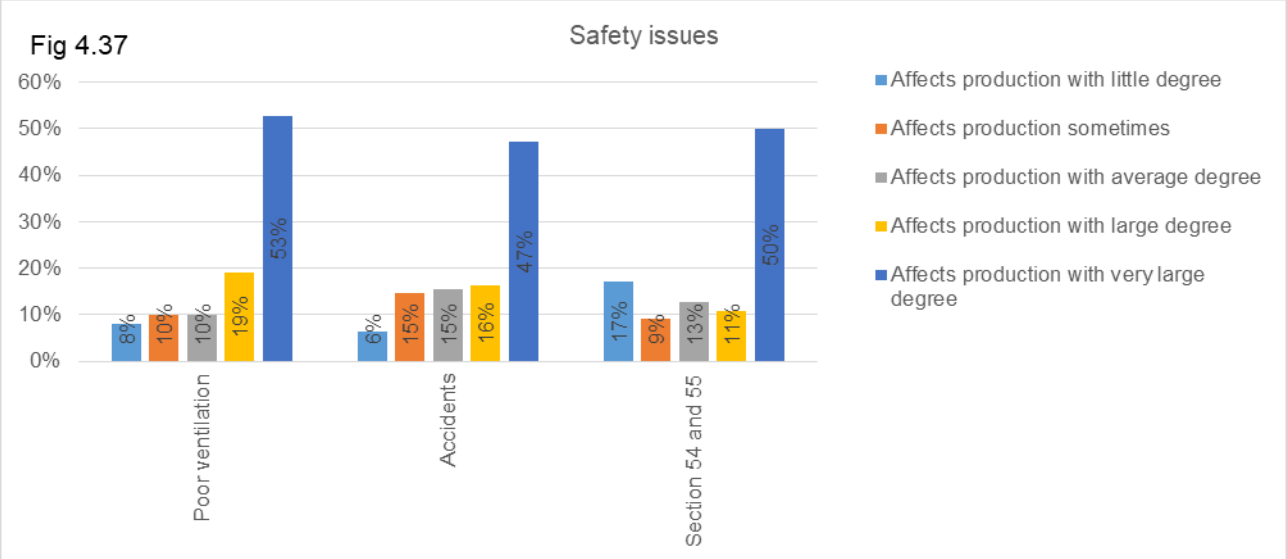
4.4.6.7 Safety Issues

Three safety issues were also measured:

- Poor ventilation;
- Accidents; and
- Section 54 and 55

The results are summarised in figure 4-37 below.

Figure 4-37: Safety Issues



- **Poor ventilation**

  The question enquired if poor ventilation affects production? Some 53% said it does to a very large degree, 19% said to a large degree, 10% to an average degree, 10% of the participants indicated that production could sometimes be affected, while 8% indicated it is affected to a little degree.

- **Accidents**

  Some 47% of the employees showed that production could be affected to a very large degree by accidents, 16% to a large degree, 15% indicated it has an average effect, another 15% said it affects sometimes, and 6% of the participants indicated that accidents have little effect on production.

- **Section 54 and 55**

  A total of 50% of the employees indicated that production could be affected to a very large degree by sections 54 and 55. At the same time, 11%, 13%, 9% and 17% said the effect of section 54 and 55 is large, average sometimes affects and has little effect at all on production respectively.

4.5 RELATIVE IMPORTANCE INDEX

Shown below in table 4-5 are the factors and their relative importance or gravity in negatively affecting labour productivity in the mining industry. The factors were derived from the seven constructs, which are manpower, leadership, motivation, time, material, services and safety.

Based on these ranking results, 9 criteria (above 80) were highlighted to have high important levels in affecting. Employees ranked these as:

- Labour absenteeism;
- Long travelling distance underground (taking too long to get to the workplace):
  - Lack of material storage underground;
  - The unsuitability of material storage location (stores is too far from the working places);
  - Material shortage (explosives, support, etc.);
  - Tools and equipment shortage (Drilling, winches, locos etc.); and

- Material and tools taking too long to arrive at the working places.

- Shortage of compressed air; and
- Poor ventilation.

Table 4-5: Relative importance index

Manpower issues	RII
Labour absenteeism	*80*
Labour personal problems	71
Labour dissatisfaction	70
Lack of labour experiences employees	66
Majority of labour is old people	49

Leadership issues	RII
Misunderstanding between employees and supervisors and management	75
Lack of communication by management	71
Lack of periodic meeting with employees	61
Supervisors absenteeism	60
Micro-managing	60

Motivation issues	RII
Payment delays	75
Lack of financial recognition (No or not enough Bonus)	73
Lack of labour recognition (no awards)	69
Lack of development	68
None of providing of transportations means (no Man-carriage)	59

Time issues	RII
Long travelling distance underground (taking too long to get to the workplace).	*81*
Misuse of time schedule	70
Working for 7 days a week without rest	68
Services departments are working different shift schedules with production (mining) department.	67
Working overtime every day	64
Increase the number of employees at the working place in order to work faster	58

Material/tool issues	RII
Lack of material storage underground	*82*
The unsuitability of material storage location (stores is too far from the working places).	*81*
Material shortage (explosives, support, etc.)	*81*
Tools and equipment shortage (Drilling, winches, locos etc.)	*80*
Material and tools taking too long to arrive at the working places	*80*

Service issues	RII
Shortage of compressed air	*81*
Shortage of service water	74
Shortage of drinking water	70

Safety issues	RII
Poor ventilation	*80*
Accidents	77
Section 54 and 55	73

4.6 LABOUR UNAVAILABILITY FOR PRODUCTION

Labour unavailability is divided into two sections which are health-related and management related. Health-related issues are those that account for employees who are not at work because they are sick or they were injured in accidents. Management labour unavailability is related to absent without permission (AWOP), unpaid leaves, attending of meetings, suspensions, department of mineral and resources stoppages and other administrative issues.

According to labour unavailability (absenteeism) table (table 4-6), there is a total average of 231 employees who are not at work every month. Out of the 231 employees, 101 employees are absent due to health-related issues, while 130 employees are not at work due to management related issues.

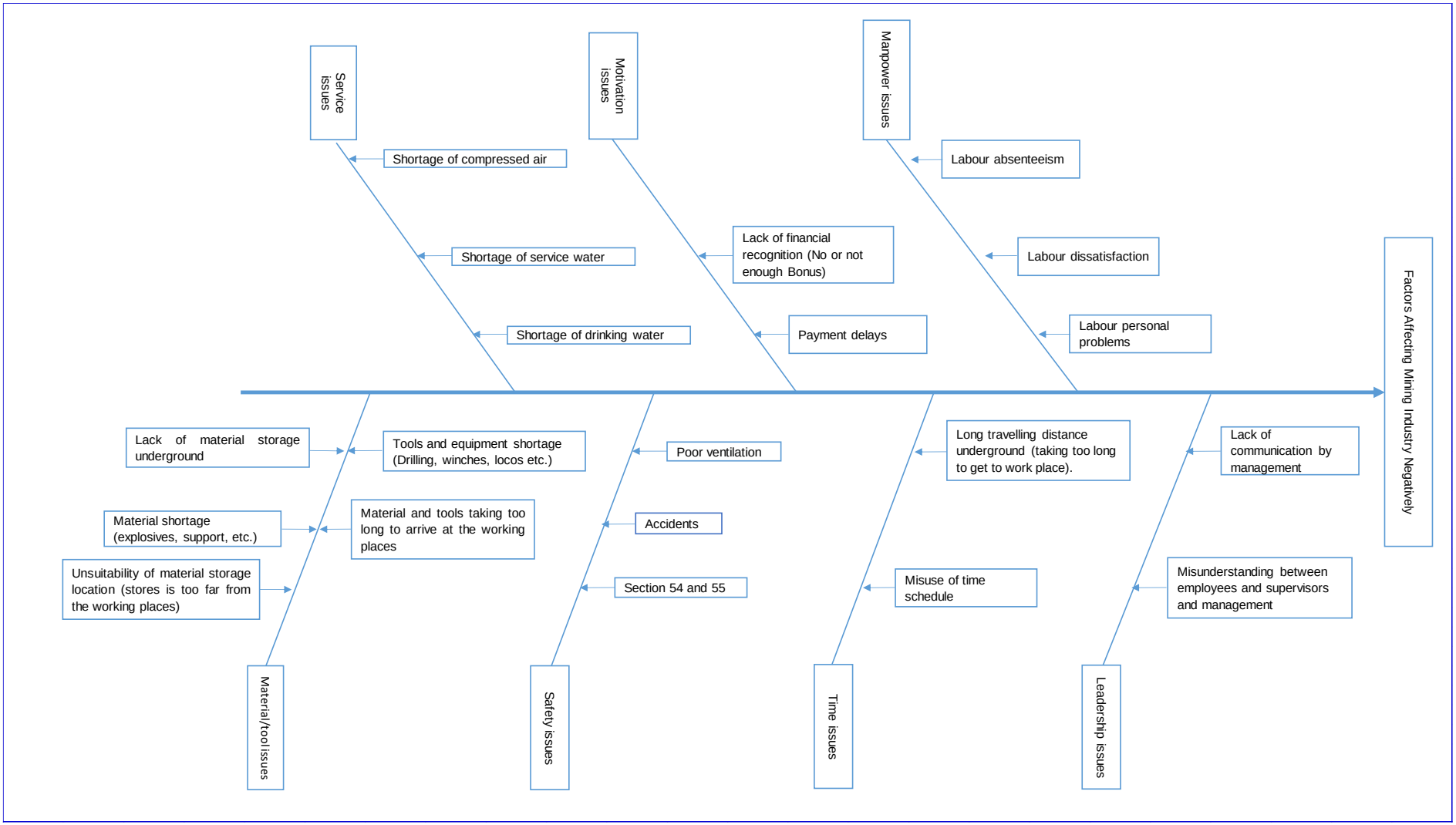
Table 4-6: Labour unavailability (absenteeism)

	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Yearly Averages
Equivalent Head Count	1766	1769	1775	1783	1798	1796	1881	1885	1861	1870	1872	1868	1876	1831
Exclusions (P, R, E, r, O)	354	307	407	316	381	764	318	407	526	442	378	332	326	404
Leave (L, l)	147	162	163	126	125	146	135	152	140	126	145	167	166	146
Potential Employees	1265	1300	1205	1341	1292	886	1428	1326	1195	1302	1349	1369	1384	1280
Total Production Employees	1045	1064	981	1120	1041	727	1173	1074	961	1051	1108	1128	1144	1047
Unavailable Employees	220	236	224	221	251	159	255	252	234	251	241	241	240	233
Leave % (Leave/ Equivalent Head Count)	8,3%	9,2%	9,2%	7,1%	7,0%	8,1%	7,2%	8,1%	7,5%	6,7%	7,7%	8,9%	8,8%	
Unavailable Employees														
Health Related Unavailables														
Sick (S, s, C, c, G, l)	83	84	87	76	81	61	84	83	88	107	92	99	91	86
TB (F, f)	4	3	1	0	0	0	4	3	1	1	1	0	1	1
OHC/ COF (n)	6	8	7	7	7	5	14	8	6	8	7	5	5	7
Mine Accident	4	4	4	3	2	2	0	2	2	2	5	5	4	3
PD449 (p) (not fit to work)	2	2	3	6	6	1	4	4	3	3	4	5	5	4
HTS (heat tolarence checks)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MDX/ XDR (X, x) (serious TB)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Health Related	**99**	**101**	**102**	**92**	**96**	**69**	**106**	**100**	**100**	**121**	**109**	**114**	**106**	**101**
Health Related %	**45%**	**43%**	**46%**	**42%**	**38%**	**43%**	**45%**	**40%**	**43%**	**48%**	**45%**	**47%**	**44%**	
Management Related Unavailables														
AWOPS and Unpaid Shifts	11	11	11	10	20	7	10	9	9	8	9	6	10	10
HOST Meeting Shifts (Q)	9	12	8	12	40	10	10	14	14	12	12	11	14	14
Misalligned shifts (q, z, h, o, ?)	13	10	14	12	16	21	14	13	16	14	12	11	15	14
Leave Other (H, J, j, K, V, B)	28	24	21	21	20	18	24	31	23	28	30	27	25	25
Suspension (k, o)	4	3	4	2	1	1	1	1	1	2	2	7	8	3
Other Events (I, y, Y, 8, a)	6	8	6	8	18	4	5	8	7	7	9	7	8	8
RTW 3 & 7 (4, 5)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DMR stoppage	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Strike Action (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Management Related	**122**	**135**	**122**	**127**	**154**	**90**	**129**	**151**	**133**	**130**	**133**	**127**	**133**	**130**
Management Related %	55%	57%	54%	58%	62%	57%	55%	60%	57%	52%	55%	53%	56%	
Unavailable Employees	**221**	**236**	**224**	**219**	**250**	**159**	**235**	**251**	**233**	**251**	**242**	**241**	**239**	**231**

4.7 FISHBONE ANALYSIS

A cause and effect diagram presented through fishbone analysis is created to explore factors and their relative importance that negatively affect labour productivity in the mining industry.

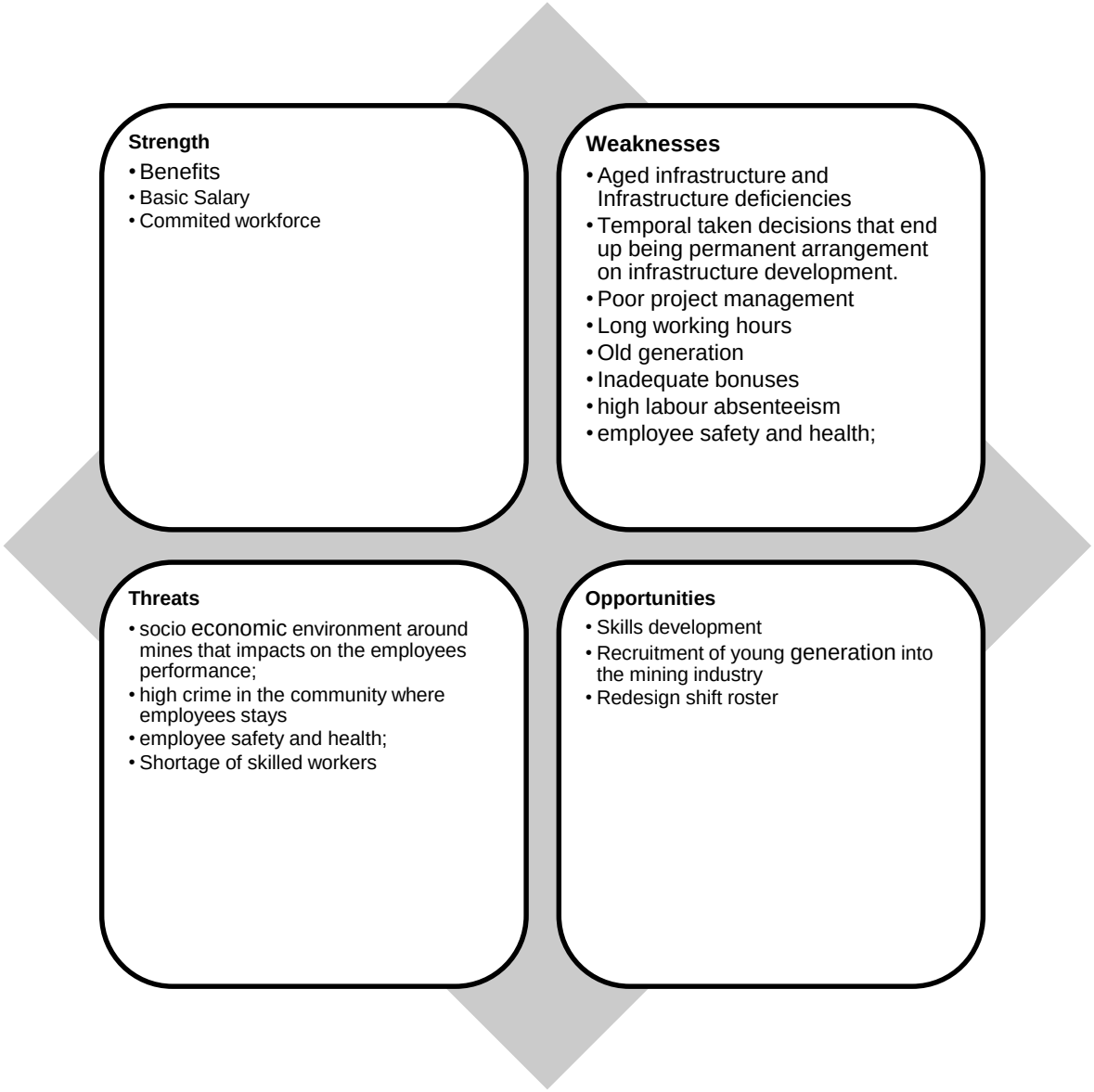
Figure 4-38: Factors that negatively affect labour productivity in the mining industry



4.8 SWOT ANALYSIS

A strategic planning technique is presented to identify organisation strengths, weaknesses, opportunities, and threats based on the survey that was conducted, and the findings came out after that.

Figure 4-39: SWOT Analysis



4.9 CONCLUSIONS

Chapter 4 detailed all the results obtained when the research data was analysed to achieve the objectives of the study. The first objective is “to identify the relevance and the impact of “11-shift fortnight” working arrangement in a mine where employees need to travel long distances underground before reaching their respective workplaces to labour efficiency, utilization, productivity, availability and the safety of the employees."

The survey highlighted that people who work “11-shift fortnight” schedule are working long hours, experience fatigue and health-related issues, lack of attending to their social responsibilities and increasing the possibility of employees getting injured and compromising the family structure.

The second objective is “exploring other factors and their relative importance that negatively affect labour productivity.” The participants indicated that material, services and safety issues are the major factors that negatively affect labour productivity in this mine

CHAPTER 5 DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

Chapter five looks at the discussion (section 5.2) of the results analysed in the preceding chapter, introduces the findings found and relates them to the research goals (section 5.2), and then concludes (section 5.3) whether the objectives have been achieved. The recommendations were made under section 5.4 based on the observations described in section 5.2. Future research is discussed in section 5.5 on what can enhance this report.

5.2 DISCUSSION

According to the research results, the mining industry is comprised of an older generation with no academic qualification, and these individuals joined the industry towards the end of apartheid-era whereby basic conditions of employment were non-existence and working long hours was a norm for every employee.

However, this generation will be exiting the industry at the age of 60. The millennials with academic qualifications and knowledge of basic conditions of employment are already joining the industry and working long hours seem to be an obstacle. Therefore, the management of the mining industry needs to come up with a shift schedule that will minimise working long hours without necessarily affecting the production.

Based on the outcome of the survey, working long hours does not necessarily lead to family separation or divorce. This has also been proven by the fact that employees of the mine are staying full time with their families around the location of the mine. Therefore, this statement alludes that working long hours does not lead to separation or divorce.

The outcome of the survey has proven that the majority of the employees have more than 15 years of working experience whereby most of them are working during the morning shift. It has also been noted that from the employees who have been working in the organisation for more than 15 years, majority of them have worked 11-shift fortnight for most of their working experience whereby according to Fig 4-17 employees have been working excessive hours for the same period. This is a call for concern as the impact of working long hours for such a long time can have severe consequences on the health of employees. This can also

be noted from Fig 4-22 and Tables 4-2, 4-3 and 4-4, whereby most of the employees who have worked more than 15 years have contributed to most of the sicknesses.

According to the basic conditions of employment, section 9(1)(c), an employee may not be permitted or required to work more than 8 hours per day if the employee works for more than five days in a week. Since the majority of the employees have worked more than 8 hours a day, then the organisation is not complying with the basic conditions of employment.

Also, this is indicative that the normal 8-hour shift allocated daily is not enough for the daily work that is needed to be completed. From Fig 4-29, most participants indicated that they need more rest because they cannot complete the daily task within the scheduled time. In the absence of more rest, the employees opt for using energy boosters (caffeine) to keep themselves energised and alert (see Fig 4-16). According to de Mejia and Ramirez-Mares (2014.), the use of caffeine has its health consequences.

The location of the mine and the starting time of the shifts are not coming out as concerns as indicated by Fig 4-24. However, the percentage of employees who are happy about hours worked per week is low. This is a cause for concern as it is indicating that half of the employees are not entirely happy with the 11-shift fortnight schedule.

The organisation offers benefits like housing allowance for employees who are not residing at the hostels, underground benefits for employees who are working underground and shift benefits. All these benefits come in the form of monetary value. Most of the employees are happy with these benefits, as indicated by Fig 4-25.

The normal working hours in the organisation is eight hours. Any excess hours worked during normal working days are not regarded as overtime since mining departments' shift ends when the task of the day is completed regardless of whether that is within or outside the normal eight hours. Mining department employees start working overtime hours if they work on their day of rest. As for the rest of other employees, any excess hours worked after normal eight hours and hours worked on their day of rest are regarded as overtime. Majority of employees are happy with overtime pay-outs as indicated by Fig 4-25.

A sound bonus payment system is one which both the individual and the company gain from the performance. The objective of the bonus scheme is to incentivise employees who have reached or even exceeded their monthly targets. The philosophy of incentive is supported by giving each crew a specific goal or target to achieve. The scheme's structure is in such a way that there is a pay rate for each set outcome for different shifts. The actual rand value paid to each employee depends on the amount of the output. The monetary pay-out is commensurate with the production tonnage.

According to this survey, the employees have indicated that they are not satisfied with the bonus paid. Mine's history suggests that for the past five years, the rate per output (factor) has increased by at least 8% while the output (production) has decreased by at least 24%. The decrease in production is due to some challenges that the mine has gone through over these years.

Some of those challenges include working places that are very far from the shaft entrance and also infrastructure arrangement challenges as it has been highlighted in this survey. This means that the final rand value that is paid to each employee has decreased. These might be the reasons why employees are not happy with the bonus pay-outs.

Under normal circumstances, most people will indicate that they deserve to be promoted as already indicated by Fig 4-26. However, promotions in an organisation are dependent on merit and availability of the position. This means that under normal circumstances, it is unlikely that everyone will be promoted.

According to the survey results with regards to the recognition of a job well done, the results are not satisfactory as half of the employee are not satisfied. This is a call for concern.

Underground work in the mining industry is teamwork. The team comprises of co-workers and supervisors. Hence team members must have a good relationship and trust amongst themselves. If there is no functional relationship and trust between the members, it opens up a room for errors, whereby the impact is putting the safety of fellow employees at risk and a decline in productivity.

Effective coordination of people's activities is essential if an organisation is to run smoothly and achieve its goals. In turn, coordination depends on the relationship between managers, supervisors and employees. If this relationship is characterised by poor communications, vaguely defined duties or hostility, a team or department within an organisation will not function very well. Managers, supervisors and employees have distinct roles and responsibilities. A manager is responsible for directing the activities of his/her department or team while supervisors occupy an intermediate position between the manager and employees. For a team to accomplish the goals set by the organisation, managers need to engage supervisors and employees frequently by creating a positive and supportive work environment. Supervisors must view the manager as their go-to person when problems arise, or a decision must be made that is beyond their authority. Likewise, employees must have confidence that managers and supervisors support them and are keeping them informed about changes and developments.

Based on the survey conducted for this study, most of the team members have a good relationship amongst themselves. The management does not have direct contact daily with underground employees. Hence the results of the survey are showing that only half of the employees have a good relationship with the management, which might be the employees who have regular contact with the management. One out of every fifth employee is not happy with the management, and a quarter of employees are not sure of their relationship with management. The belief is that those are the employees who have never had contact or relationship with the management. Most probably if they could be given a chance to have face to face with their management, then there could be a possibility of them changing their perception.

A strong team is a foundation of high performing organisation, and for the team to perform to its optimal, it should abide by specific rules and characteristics of a high performing team. Such rules and characteristics include team members who are motivated to make changes, team members who understand the purpose of their team and the overall goal of the team to the entire organisation. It also includes transparent and effective communication amongst the team members, members who share and publicly communicate their thoughts and views in the team, team members who are committed to the team, who respect and trust their team members, team members who are accountable and take responsibilities for their roles as well as members who abide by the ground rules of the team and the organisation as a whole.

This is indicative of high results obtained for these particular characteristics from the survey as presented in Fig 4-28.

Generally, employees are satisfied with the shift schedule they are working, and that is why the employees are not thinking of quitting or staying away frequently from work. This means that employees are content with their job.

However, the negative issues about this shift schedule are that most of the employees do not attend to their social responsibilities which sometimes are not ideal. According to the analysis in Fig 4-23, employees have indicated that they did not get time to attend to their family and social responsibilities. The graph also supports this for family and social life whereby the employees have indicated that sometimes shift work cause problems with families, and sometimes families complain about shift work.

Using relative importance index (RII), to explore factors and their relative importance in negatively affecting labour productivity in the mining industry, the participants ranked material or tool, services and safety as the highest categories with factors affecting labour productivity negatively in the mining industry. Each category scored an RII above 70%.

Table 5-1: Highest-ranked variables and their significance

Variables	RII
Material	81
Safety	76
Services	75
Motivation	69
Time	68
Manpower	67
Leadership	65

5.3 CONCLUSIONS

Objective 1

- *To identify the relevance and the impact of "11-shift fortnight" working arrangement in a mine where employees need to travel long distances underground before*

reaching their respective workplaces to labour efficiency, utilisation, productivity, availability and the safety of the employees.

The “11-shift fortnight” schedule is based on employees working 8 hours per day and giving employees one day off one weekend and a two-day break every other second weekend. This schedule has the following impact on the employees of the organisations:

- In a mine where the workplaces are far away from a mine entrance, the allocated 8 hours a day of the 11-shift fortnight is not enough for the daily work that needs to be completed by employees. Hence most of the employees end up working long hours. The impact of working long hour results in

    - fatigue where most employees are continuously tired due to lack of rest, and therefore they end up using caffeine to boost their energy (See Figure 4-15 and Figure 4-22 on page 53 and 57 respectively).
    - employees frequently getting sick which leads to high labour unavailability (See Table 4-6 on page 87), employees not being able to spend enough time with their immediate families and relatives, which compromises family structures (see figure 4-23 on page 60); however, the study indicated that this does not necessarily end up with families separating or divorcing.
- Due to the actual hours that employees are working in this 11-shift fortnight, the mine does not comply with the basic employment conditions, section 9(1)(c) (See Figure 4-14 on page 53).
- In general, the outcome of the survey indicated that employees are satisfied with their employment conditions. However, they indicated the following challenges:
    - not satisfied with the bonus payment;
    - constrained relationship with the management of the organisation.

From the above information, objective one was met.

Objective 2

- *Exploring other factors and their relative importance is in negatively affecting labour productivity in the mining industry.*

The major factors contributing negatively to labour productivity as per the survey are (See Figure 4-38 on page 88 and Table 4-5 on page 84.

- Material or tools and services issues
  These are the critical resources needed by the employees to perform their daily task. Shortage or lack of these resources impacts the performance of the team and reduces the productivity for that particular day.

- Safety issues
  Section 23 of mine health and safety Act of 1996 give employees a right to leave or refuse to work in a dangerous workplace. Safety is a main priority in the mining industry, considering the history of accidents that happened before for an example, Lilly mine collapse accident. This means that if the place is not safe, no work will take place until such divisions identified have been rectified. This has an impact on the performance of the team because their performance is measured on their output. Shortage of material and services has also had an impact on the safety conditions of the workplaces, which may result in work stoppages.

5.4 RECOMMENDATIONS

Based on the research findings, recommendations are outlined as follows:

- Management needs to communicate the range of potential possibilities existing in mining to the young generation by conducting a series of presentations at higher institutions on career guidance in mining. There are notable opportunities for young people to enter the mining industry since numerous senior miners will be retiring very soon as most of the workforce is close to the retiring age of 60 years old (see Figure 4-2). Also, the industry needs to rebuild its skill base and build up a workforce

equipped of bringing the industry along the technology pathway to remain competitive.

- The mining industry is experiencing a tremendous technology change; therefore, it is unavoidable that its labour force needs to change. However, mining management needs to find ways to attract these young people by changing historical perceptions about the mining industry that it only belongs to the older generation. The mining industry is not vigorously looking to recruit talent on university campuses, so students/young generation do not consider working in mining because of the lack of exposure.

- Both parties, which are the management and employee representatives, need to find a roster that will give employees enough time to rest. About half of the employees are working long hours, and they are not happy with it. This is based on Figure 4-13 and Figure 4-14 under section 4.4. This has undesirable implications for the employees of the organisation. The consequences of working these long hours can be attributable to employees' personal life which includes health issues, lack of attending to their family and social responsibilities and causing problems within households.

- The issue with the hoisting operations at North Shaft can be resolved by installing the men conveyance system at the north shaft. In contrast, the issue with compressed air network can be resolved by increasing the pipe size of the compressed air and ventilation issues can be resolved by providing a dedicated return airway to meet the production targets of the mine at the scheduled times.

- The infrastructure design and arrangement at the mines seems to be an issue adding toward long-distance travelling underground, shortage of compressed air at the workplace and ineffectively ventilated workplace. This is because to mining activities have migrated deeper down into the northern part of the ore body of the mine lease area; the southern portion has been mined out. Access via the south shaft system takes a long time and effective face time is limited, and long working hours are required to maintain productivity levels of the underground teams. Personnel

transport down North Shaft could dramatically reduce the travelling time and improve the time spent in the working place. All in red are discussions.

- The bonus pays out dynamics explained in section 5.1 might be confusing to a general mine employee with limited knowledge of how the bonus is structured and what are the determining factors. Therefore, it is the responsibility of those who have been entrusted with the designing and reviewing of employee's bonuses, to ensure that the dynamics of the bonus payment are explained to all employees, and the effort has been made to ensure that they all understand.

- Based on the finding of this survey, the relationship between employees and management needs to be improved by having regular interactions between management and employees, such as employee liaison meetings and visible felt leadership initiatives. This would remedy/improve the relationship and most probably the perception that exists between both parties to change.

- The safety of employees is one of the most, if not the most, important concerns for the mining industry in South Africa. The survey has indicated that safety issues are affecting labour productivity and efficiency to a high degree. The recommendations made under the safety issues are not new. There is an urgent need for management to emphasise the safety aspect to employees continuously. The following are some of the actions that are to be emphasised in order to prevent or minimise accidents in the mining industry.

    1. Ensure compliance with safety and health standards. Make sure all are complying in every detail with every standard that applies to the operations and the workplace.

    2. Keep employees informed about hazards. Conduct regular risk assessments to identify potential risk and put remedial actions in place to eliminate hazards or minimise the risk where elimination of hazards is not possible.

    3. Take appropriate steps to minimize risks. This involves many issues, including:

- Well-conceived and implemented workplace safety and health programs
- Routine and thorough inspections and safety audits by the safety department and other stakeholders to ensure safety complaisance of the employees.
- Effective engineering, administrative, and work practice controls
- Frequent and effective employee training
- Appropriate personal protective equipment (PPE) to protect employees from hazards when controls are not enough.
- Routine workplace maintenance.

4. Train and encourage employees to work safely. Training is one of the most power accident-prevention tools. Train frequently to keep workers up to date on workplace and regulatory changes and to keep them aware, alert, and prepared to work safely.

5. The mine management must monitor performance and provide feedback. For all kinds of reasons, workers will decide to take risks or ignore warnings and instructions. Make sure supervisors monitor safety performance and provide positive or corrective feedback to maintain safe and healthy behaviour.

6. Pay attention to employees' suggestions and complaints. Move quickly to correct reported problems and consider employee’s suggestion in safety planning. Foot-dragging over hazard reported sends a bad message to employees. It can be concluded that management does not care about the safety of employees.

5.5 FUTURE RESEARCH

The cost and schedule to carry out these recommendations were not taken into consideration. Time constraints and costing will need to be investigated in detail to determine the feasibility of these recommendations.

An appropriate shift system needs to be investigated, during the shift system change, it is very important to involve workers, labour unions, and managers in the process of designing and introducing a new shift system.

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APPENDICES

APPENDIX A: QUESTIONNAIRE

Background	***Mark with X***
Sex	
Men	
Women	
Age group, years	
18–29	
30–39	
40–49	
50–59	
60+	
Marital status	
Married	
Single	
Separated/divorced/widowed	
If separated/ divorced, did this happen after working at the mine?	
Yes	
No	
Not Applicable	
Do you stay with your family (wife and family)	
Yes	
No	
Not Applicable	
Where do you originally come from?	
In Matjhabeng	
Outside Matjhabeng but in the Free State	
Outside Free State but in South Africa	
Outside South Africa	
Occupation: Please specify below	

SHIFT WORK QUESTIONNAIRE									
This survey is intended to help employees, health and safety representatives, union delegates and officers identify health and other effects of current shift arrangements in their workplace. It is intended to determine the impact of "eleven shift fortnight" schedule in a mine where workplaces are 2km and more away from the shaft.									
1. What is your work experience within the mine in years?									
0 to 2		2 to 5		6 to 10		11 to 15		15+	
2. How long have you worked shift work									
0 to 2		2 to 5		6 to 10		11 to 15		15+	
2. Why do you work shift work									
Job must be done		Better pay		Prefer working these hours		More time off			
Other – please specify									
YOUR ROSTER									
3. What shifts do you work? (tick all that apply)									
Morning shift only		Afternoon shift only		Night shift only		Rotating shift		Split shift	
4. What is the length of your shift									
<8 Hours		8 Hours		10 hours		12 Hours		14 Hours	
Other									
5. What are your total working hours a week? (average over 4 weeks)									
Less than 10		10-19		20-29		30-34			
35-39		40-44		45-49		50+			
6. Do your shift lengths (excluding overtime) vary?									
Yes		No							
7. Do your shifts times change from week to week?									
Yes		No							
8. Does your roster include breaks of less than 12 hours?									
Yes		No							
9. Are you called in for emergencies (callout)?									
Never		Sometimes		Frequently					

YOUR HOURS OF WORK					
UNDERGROUND TRAVELLING TO AND FROM WORKPLACE					
10. Are you concerned about your safety because of the times you have to travel?					
Never		Sometimes		Frequently	
11. Have you experienced any of the following symptoms as a result of your roster?					
Backaches		Loss of libido		Continual tiredness	
Menstrual problems		High Blood pressure		Digestive Disorder	
Panic/anxiety attacks		Feeling angry or irritable		Respiratory illness	
Feeling depressed		Sleep difficulties		Feeling stresses	
Headaches		Frequent Colds		Sprains and strains	
Other symptoms					
12. Have you used any of the following substances to cope with your shift work?					
Caffeine		Alcohol		Sleeping Pills		Other stimulants	
YOUR FAMILY AND SOCIAL LIFE					
13. Does shift work cause problems with your family and childcare responsibilities					
Never		Sometimes		Frequently		Not applicable	
14. Does your family complain about the shifts you work?					
Never		Sometimes		Frequently		Not applicable	
15. Can you swap shifts /rearrange roster to meet family and personal commitments?					
Never		Sometimes		Frequently	
16. Can you be contacted readily at work in case of family emergencies?					
Yes		No			
17. I would be willing to work longer day's part of the week in exchange for shorter days another part of the week.					
Never		Sometimes		Frequently	

Job satisfaction

Job satisfaction refers to the positive attitudes or emotional dispositions people may gain from work or through aspects of work (Lane: 2016).

Please answer the following questions by making a cross **(X)** the relevant answer (**yes, not sure or no** or for the case of question 8 **good, not sure or bad**). Only one answer may be chosen per question.

No	Question	Yes	Not sure	No
1	Are you happy with the general working conditions of your workplace:			
	a) Location of work			
	b) Daily starting time			
	c) Hours worked per week			
2	Are you being paid properly?			
	a) Salary (basic pay)			
	b) Benefits			
	c) Overtime worked			
	d) Bonus			
3	Do you think you deserve to be promoted from your current position?			
4	Do you get recognition for your job well done?			
5	Are you given an opportunity to use your skills?			
6	Are you given enough responsibility and freedom to do your job to the best of your ability?			
7	Is the job that you are doing the job of your dreams?			
8	How is your working relationship with the following team members?	Good	Not sure	Bad
	a) Co-workers			
	b) Supervisors			
	c) Management			

Team performance

A team is a dynamic system of interrelationships between individuals, linked to a common purpose.

Please answer the following questions by making a cross (X) the relevant answer (yes, not sure or no). Only one answer may be chosen per question.

No	Question	Yes	Not sure	No
1	As a team member, are you motivated to make changes?			
2	Do you understand the purpose of your team?			
3	Does your supervisor share safety and production information with the team members?			
4	Do you understand the importance of your team to the larger goal of the organisation?			
5	Are the team members able to openly express their ideas and opinions?			
6	Do you think all team members want to be part of this team?			
7	Do you trust and respect other team members?			
8	Are the team members held accountable for their responsibilities and assignments?			
8	Does the team have ground rules?			

Shift Satisfaction Questionnaire						
Indicate the degree of agreement to the following statements about fatigue.						
Strongly Disagree		1				
Disagree			2			
Neutral				3		
Agree					4	
Strongly agree						5
No		**Mark with X**				
1	Generally speaking, I am very satisfied with my shift schedule.	1	2	3	4	5
2	I frequently think of quitting because of my shift schedule.	1	2	3	4	5
3	I am generally satisfied with the number of hours I am working per day.	1	2	3	4	5
4	Most people in this shift are very satisfied with it.	1	2	3	4	5
5	I normally ask for a day off every week.	1	2	3	4	5
6	In this shift, I do not get time to attend my social responsibilities.	1	2	3	4	5

Fatigue questionnaire						
Indicate the degree of agreement to the following statements about fatigue.						
Never		1				
Rarely			2			
Sometimes				3		
Usually					4	
Always						5
No		**Mark with X**				
1	I have problems with tiredness.	1	2	3	4	5
2	I start things without difficulty but get weak as I continue with work.	1	2	3	4	5
3	I have difficulty concentrating.	1	2	3	4	5
4	I find it more difficult to find the correct word.	1	2	3	4	5
5	I normally need to rest more.	1	2	3	4	5
6	I normally lack energy.	1	2	3	4	5

7	I normally have problems thinking clearly.	1	2	3	4	5
8	I normally fall sleepy or drowsy.	1	2	3	4	5
9	I find myself having less strength in my muscles.	1	2	3	4	5
10	While speaking, I make slips of the tongue.	1	2	3	4	5
11	I have lost interest in things I used to do.	1	2	3	4	5
12	I normally have problems in starting things.	1	2	3	4	5
13	I normally feel weak.	1	2	3	4	5

Other factors that affect labour productivity and efficiency

Indicate the degree of agreement to the following statements about their effects on production.

Affects production with a little degree	1				
Affects production sometimes		2			
Affects production with an average degree			3		
Affects production with a large degree				4	
Affects production with a very large degree					5

No	Groups	Factors affecting labour productivity negatively	Degree of agreement				
1	Manpower issues	Majority of labour is old people	1	2	3	4	5
		Labour lack of experience	1	2	3	4	5
		Labour absenteeism	1	2	3	4	5
		Labour personal problems	1	2	3	4	5
		Labour dissatisfaction	1	2	3	4	5
2	Leadership issues	Misunderstanding between employees and supervisors and management	1	2	3	4	5
		Lack of periodic meeting with employees	1	2	3	4	5
		Lack of communication by management	1	2	3	4	5
		Supervisors absenteeism	1	2	3	4	5
		Micro-managing	1	2	3	4	5
3	Motivation issues	Lack of financial recognition (No or not enough Bonus)	1	2	3	4	5
		Lack of labour recognition (no awards)	1	2	3	4	5
		No means of transportation provided on the levels (no Man-carriage)	1	2	3	4	5
		Lack of development	1	2	3	4	5
		Payment delays	1	2	3	4	5

4	Time issues	Working overtime every day	1	2	3	4	5
		Working for 7 days a week without rest	1	2	3	4	5
		Increase the number of employees at the working place in order to work faster	1	2	3	4	5
		Long travelling distance underground (taking too long to get to the workplace).	1	2	3	4	5
		Misuse of time schedule	1	2	3	4	5
		Services departments are working different shift schedules with production (mining) department.	1	2	3	4	5
5	Materials/ Tools issues	Material shortage (explosives, support, etc.)	1	2	3	4	5
		Lack of material storage underground	1	2	3	4	5
		The unsuitability of material storage location (stores is too far from the working places).	1	2	3	4	5
		Tools and equipment shortage (Drilling, winches, locos etc.)	1	2	3	4	5
		Material and tools taking too long to arrive at the working places	1	2	3	4	5
6	Services	Shortage of compressed air	1	2	3	4	5
		Shortage of service water	1	2	3	4	5
		Shortage of drinking water	1	2	3	4	5
7	Safety	Poor ventilation	1	2	3	4	5
		Accidents	1	2	3	4	5
		Section 54 and 55	1	2	3	4	5

APPENDIX B: LETTER FROM EDITOR

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Sunday, 17 May 2020

To whom it may concern

Re: Confirmation of language edit, typography and technical precision

The MBA dissertation by **The impact of working "eleven shift fortnight" schedule and other factors on labour efficiency in a gold mine in South Africa** by **NA Mbobo** (29800498) was edited for language, typography and technical precision. The referencing and sources were checked and comply to the author guidelines specified by the targeted journal.

Final, last minute corrections remain the responsibility of the author.

Antoinette Bisschoff

BA Languages (UPE – now NMU); MBA (PU for CHE – now NWU); Translation and Linguistic Studies (NWU)

Officially approved language editor of the NWU since 1998
Member of SA Translators Institute (no. 100181)

Precision ... to the last letter