

Mining **Future Skills**



MINING QUALIFICATIONS AUTHORITY

FINAL REPORT

FINAL REPORT

FOR

**STUDY AIMED AT INVESTIGATING THE STATE OF ARTISAN SUPPLY
AND WAYS OF ENHANCING THEIR COMPETENCIES IN THE MINING
AND MINERALS SECTOR**

Prepared by: Wits Mining Institute

EXECUTIVE SUMMARY

Introduction and Background

Artisans play an integral role in the economy, driving operational efficiency, ensuring safety, and fostering innovation across a variety of industries. As vital contributors to economic growth and development, one of the key objectives of South Africa's National Development Plan is to produce 30,000 artisans annually by 2030. However, the country is currently producing only 20,000 artisans each year. Within the mining and minerals sector (MMS), the Mining Qualifications Authority (MQA), as the Sector Education and Training Authority (SETA) for the industry, contributes between 13% and 16% of the total annual artisan supply in South Africa.

Alarmingly, five out of ten hard-to-fill vacancies in the MMS are artisan-related, with the lack of relevant qualifications and experience being the primary factors that have been cited. This artisan shortage is compounded by rapid technological advancements within the sector, particularly in mechanisation and digital technologies, which require new and specialised skills. As a result, artisan development has become a critical priority for the MQA, which must ensure that a sufficiently skilled workforce is available to sustain and support the ongoing transformation and growth within the MMS.

Study Aim and Objectives

To address these challenges, the MQA has commissioned the Wits Mining Institute at the University of the Witwatersrand to conduct a comprehensive study to assess the current state of artisan supply and demand in the mining and minerals sector. The study aims to identify existing skills and training gaps while proposing solutions for improving skills development and enhancing competencies within the MMS.

Approach To the Study

The research employed a mixed-methods design, combining qualitative and quantitative approaches for data collection and analysis. Primary and secondary data were gathered through surveys, key informant interviews and literature reviews. Both the surveys and key informant interviews were conducted with artisans and employers. In the context of the study, employers were defined as mine personnel who are responsible for recruiting and training artisans (i.e., HRD, training facilitators and managers etc.) and those that directly work with artisans (i.e., Engineers, Foreman etc.). A total of 297 surveys were completed by artisans, while 177 surveys were completed by employers. Data analysis was conducted using both quantitative and qualitative methods, in particular, statistical and thematic analyses.

Key Findings and Insights

The findings from the study align closely with existing literature, reinforcing established trends and providing valuable insights into the artisan workforce in the MMS. A key finding is the strong alignment between current competencies and trade-specific roles in demand on both the supply and demand sides of the sector, particularly for Boilermakers, Electricians, Diesel Mechanics, and Fitters. These trades continue to be integral to the operational success of the MMS, with a clear demand for skilled artisans in these areas. The majority of employers indicated that the skill level of newly qualified artisans is "fair," which aligns with artisans' own perceptions that the training they receive prior to obtaining their trade certificates is adequate. This consensus underscores the importance of existing training programmes, which are generally viewed as sufficient to prepare artisans for entry into the workforce.

While this is the case, there is still room for improvement. To address the skills gap and further enhance workforce capability, there is a need for upskilling initiatives that focuses on strengthening the competencies related to core trade responsibilities, ensuring that artisans are equipped with the necessary skills to perform their duties effectively. To meet the sector's evolving demands, especially those influenced by technological advancements and industry-specific innovations, it is crucial to maintain an emphasis on specialised training where high proficiency is critical.

Furthermore, a significant number of artisans have expressed the need for project management and soft skills, such as communication, leadership, problem-solving and critical thinking, particularly for supervisory roles. This reflects their ambition to grow and prepare for future management opportunities. By strategically tailoring upskilling efforts to encompass core technical competencies, specialised expertise, and essential soft skills, the MMS can cultivate a well-rounded, capable, and adaptable artisan workforce. This approach will support the sector's continuous growth and also drive meaningful transformation.

Key Conclusions and Recommendations

Current artisan development programmes provide a foundation but fall short in addressing advanced sector-specific skills. The programmes are not sufficiently aligned with technological advancements and workplace readiness requirements, limiting their ability to meet the evolving demands of the MMS. There remains a significant shortage of artisans in critical trades such as Diesel Mechanics, Electricians, and Millwrights. While technical training is prioritised, soft skills such as problem-solving and critical thinking are often neglected. Furthermore, it was found that although artisan training generally aligns with policies such as the Skills Development Act, Mining Charter and NDP 2030, there are still gaps in implementation and impact.

The phasing out of N1, N2, and N3 along with the adoption of dual training programmes, offers an ideal opportunity to integrate technology and soft skills into the curriculum without the need for a complete curriculum redesign. Employers report that artisan graduates are underprepared for the real-world challenges citing for an example, a gap in practical experience. Countries such as Germany and Australia, despite having their own challenges, have shown the effectiveness of dual training systems and strong government-industry collaboration. To address the aging workforce and low participation from high school leavers, robust marketing campaigns targeting youth and women could be key in building a future-ready artisan workforce. However, this would require significant investment at school level by introducing Mathematics and Science tutorials especially in rural communities. The specific recommendations are elaborated below.

Recommendation 1: Implement a “Learners at risk programmes” for learnerships and apprenticeships

Efforts to address the shortage of skilled artisans must prioritise improving the throughput rates of learners in learnership and apprenticeship programmes. To achieve this, a proactive approach is necessary to identify and mitigate the barriers hindering programme completion. It is recommended that the MQA develop a system that will enable it to actively track and identify learners who have exceeded the expected duration of their training or those currently at risk of non-completion. This system can be supported by targeted research aimed at investigating and understanding the underlying reasons behind delayed completion times and or dropouts. Research-based solutions would ultimately guide the development of tailored interventions.

Once these learners’ challenges are identified, the MQA should take immediate action to resolve challenges within its control, such as improving support structures, aligning theoretical training with practical demands and enhancing workplace readiness initiatives. These interventions must be implemented promptly to support current learners effectively. Additionally, the insights gained should inform the creation of a robust framework to prevent similar issues from recurring with future cohorts. By addressing these barriers, the MQA can ensure a steady pipeline of skilled artisans, enhancing the workforce’s ability to meet industry demands and contribute to the sustainable growth of the mining and minerals sector.

Activity	Commission a research study to understand the reasons for low throughput rates among learners
When	This research study can be completed within a year (2025)

Recommendation 1: Establish collaborative workshops to bridge the technological skills and soft skills gap amongst artisans

To bridge the gap in technological skills among artisans, the MQA should establish consultative workshops and forums with key stakeholders, including TVET colleges, Original Equipment Manufacturers (OEMs), mining companies and other relevant entities. OEMs, with

their expertise in cutting-edge technological advancements would play a crucial role in informing the addition of technology related material in existing curriculum, thereby ensuring alignment between artisan training programmes with the latest and evolving industry developments including addressing knowledge gaps associated with the introduction of technology in the MMS. These collaborative platforms would facilitate meaningful dialogue and lay the groundwork for forming an advisory board tasked with evaluating and enhancing TVET courses.

The phasing out of N1, N2, and N3 presents an ideal opportunity to incorporate Fourth Industrial Revolution (4IR) components into the curriculum. Rather than overhauling the curriculum, the advisory board could focus on integrating 4IR technologies within the existing framework. Leveraging insights from these workshops, the board could guide the inclusion of advanced technological concepts, ensuring training programmes reflect the industry's evolving needs. Furthermore, these forums would define the specific technological and digital skills required for various trades in the MMS thereby, supporting the development of foundational training modules in technological applications and digital tools.

In addition to technical expertise, artisan training should include soft skills such as leadership, communication and teamwork. While these skills may not be inherent in all learners, they can be cultivated through activities such as group work, presentations and collaborative problem-solving tasks. This holistic approach to training will equip artisans not only with the technical proficiency needed to thrive in a technologically advanced sector but also with the interpersonal skills necessary for career growth and workplace adaptability. Through these targeted efforts, the MQA can ensure that artisan training programmes are forward-thinking, adaptable and aligned with industry advancements by fostering a skilled, versatile, and future-ready workforce capable of driving sustainable growth in the MMS.

Activity	Facilitate workshops between OEMs, TVET colleges and relevant stakeholders to identify opportunities within the existing curriculum to include 4IR technologies.
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When	The workshops may be implemented in 2026 to allow sufficient time for planning, organising and engaging relevant stakeholders effectively.
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Recommendation 3: Strengthen foundational skills by reintroducing Mathematics and Science tutorials in High Schools.

A critical component of promoting artisan careers is addressing the foundational skill gaps that hinder learners' progression in training programmes. One of the key activities in this regard is the reintroduction of Mathematics and Science tutorials specifically designed to strengthen the essential skills required for artisan careers. This initiative recognises the challenges faced by TVET colleges, which are tasked with accommodating a large number of learners, many of whom have achieved low marks or even failed crucial subjects such as Mathematics and Science that are foundational for artisan training. To effectively implement this intervention, the MQA could collaborate with established Mathematics and Science tutorial providers, particularly those operating in rural and under-resourced communities. These partnerships would leverage the expertise and infrastructure of existing organisations to deliver high-quality tutorials.

The MQA could negotiate service agreements with these companies, securing their services at competitive rates to make the initiative cost-effective and sustainable. By investing in foundational education through targeted tutorials, the MQA can better prepare learners for the academic and technical rigors of artisan programmes. This approach would not only enhance completion rates but also contribute to building a more capable and confident artisan workforce, addressing skills shortages and supporting the mining and minerals sector's growth.

Activity	Fund existing and established tutorial companies, especially in rural communities, to provide Mathematics and Science tutorials.
When	Recognizing the financial barrier but also the significance of this initiative, the tutorials can be started within 1 to 2 years.

Recommendation 4: Develop a robust Artisan marketing campaign similar to the 2014-2024 decade of the artisan DHET campaign.

The success of Recommendation 3 which addresses foundational skill gaps may, inadvertently result in an increased number of learners opting for university degrees, potentially overshadowing artisan career pathways. To mitigate this unintended consequence, it is vital to tutor critical subjects such as Mathematics and Science while simultaneously improving perceptions around artisan careers. This dual approach will help attract young learners to artisan professions by showcasing their value and opportunities. To achieve this, the MQA should robustly market artisan pathways to Grade 10, 11, and 12 learners through career guidance events especially at the local municipal level. This initiative should aim to demystify artisan careers and highlight their critical role in the MMS and the South African economy.

The MQA can leverage its own graduates as ambassadors to plough back into their communities. These graduates can serve as relatable role models showcasing the tangible benefits of pursuing artisan pathways. The other advantage is that incorporating practicing artisan professionals in these outreach events will provide real-world insights, inspire learners and effectively promote the profession. Engaging learners through personal stories of success and career growth can shift the narrative, transforming perceptions of artisan careers from physically demanding jobs to dynamic opportunities offering technological engagement, stability and long-term growth. Additionally, the MQA can foster inclusivity, address the underrepresentation of key demographic groups and build a stronger pipeline of skilled artisans. Ultimately, these efforts will contribute to the sustainability and transformation of the MMS while ensuring the development of a capable and a diversified workforce.

Activity	The MQA should support provincial and municipal career guidance events by providing financial assistance and the attendance of qualified artisans to these events. Additionally, it should fund the creation of posters on various artisan careers for display in school libraries and classrooms.
When	Considering budgetary constraints, this can be initiated in 2025.

Recommendation 5: Develop mentorship, life and career coaching to learners on MQA funded learnerships.

Many MQA funded learners in artisan programmes face unemployment after obtaining their trade certificates, unlike those in company-sponsored apprenticeships, who benefit from higher employment prospects and a more optimistic career outlook due to the job security and tailored attention provided during their training. To bridge this gap and improve career prospects, the MQA can implement group life and career coaching programmes as part of its support structure. These programmes would focus on guiding learners in goal setting, self-awareness, and the effective use of their strengths and weaknesses to advance their careers. Introducing coaching at an introductory level for new learners and offering more in-depth sessions to final-year learners preparing to exit the programme would create a comprehensive support system.

By fostering internal motivation and encouraging learners to identify alternative career opportunities within and beyond their chosen trades, the coaching programmes can equip them with critical tools for navigating the job market and pursuing sustainable career growth. This dual approach of combining practical training with personal and professional development would significantly enhance MQA-funded learners' readiness for the workforce and inspire a more positive outlook on their futures.

Activity	Leverage and extend the existing workplace coaches programme to group life and career coaching programmes.
When	With an existing budget for workplace coaches, the programme can commence immediately.

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LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviation/acronym	Description
APP	Annual Performance Plan
ARPL	Artisan Recognition of Prior Learning
CET	Community Education and Training
CLAS	Cement, Lime, Aggregates and Sand
CoS	Centre of Specialisation
DHET	Department of Higher Education and Training
DMR	Department of Mineral Resources
DMRE	Department of Mineral Resources and Energy
FDI	Foreign Direct Investment
FET	Further Education and Training
GDP	Gross Domestic Product
GET	General Education and Training
HRDC	Human Resource Development Council
HTV	Hard-to-Fill Vacancies
ILO	International Labour Organisation
LMI	Labour Market Intelligence
MerSETA	Manufacturing, Engineering and Related Services Sector Education and Training Authority
MMS	Mining and Minerals Sector
MQA	Mining Qualification Authority
NADSC	National Artisan Development Support Centre
NAMB	National Artisan Moderation Body
NCV	National Certificate Vocational
NDP	National Development Plan
NQF	National Qualification Framework
NSA	National Skills Authority

NSDP	National Skills Development Plan
NSF	National Skills Fund
OECD	Organisation for Economic Co-operation and Development
OQF	Occupational Qualifications Framework
PGMs	Platinum Group Metals
PIVOTAL	Professional, Vocational, Technical, and Academic Learning
QTCO	Quality Council for Trades and Occupations
RPL	Recognition of Prior Learning
SAQA	South African Qualification Authority
SARS	South African Revenue Service
SETA	Sector Education and Training Authority
SSP	Sector Skills Plan
WMI	Wits Mining Institute
YES	Youth Employment Service

1. INTRODUCTION AND BACKGROUND TO THE STUDY

1.1. Introduction

The Mining Qualifications Authority (MQA) is a Sector Education and Training Authority (SETA) for the mining and minerals sector (MMS) in South Africa. It was established in terms of the Mine Health and Safety Act No. 29 of 1996, and it is a recognised SETA in terms of the Skills Development Act No. 97 of 1998 as amended¹. The MQA’s vision is to lead skills development and training in the MMS so as to build a “*competent, health and safety oriented mining and minerals workforce*”. This is to be achieved through several programmes that are embedded within its six strategic objectives which encompass the following:

Box 1: MQA’s strategic objectives

- Promote efficient and effective governance and administration.
- Improve skills development planning and decision-making through research.
- Promote work-based skills development to support transformation in the mining and minerals sector.
- Facilitate access to occupationally directed learning programmes for the unemployed.
- Support mine community training initiatives to access economic opportunities.
- Ensure the delivery of quality learning programmes in the mining and minerals sector.

In the 2024/25 Sector Skills Plan (SSP), the MQA identified several strategic priorities, one of which alludes to the need to “*focus on increasing support for core mining-related skills and hard-to-fill occupations in terms of skills development in the MMS*” (MQA, 2023:50). Despite the implementation of skills development and training programmes in MMS, there is a shortage of skills needed to support mining operations, and this poses significant challenges that affect the sector’s performance and contribution to the country’s economy. Several occupations have been classified as hard-to-fill, including Diesel Mechanic and Millwright, both of which fall under artisan trades.

¹ Source: <https://mqa.org.za/company-overview/>. [Accessed: 27 November 2024].

To this end, artisan development is a critical priority for MQA to ensure the availability of a skilled base necessary to support and sustain the MMS. There are several issues affecting artisan supply and demand in the MMS and as such, the MQA has commissioned a study that aimed to provide an understanding of the state of artisan supply and demand in the MMS. This study was initiated to identify skills and training gaps so as to make proposals on skills development and training needed to enhance competencies in the MMS. This study was undertaken by the Wits Mining Institute at the University of the Witwatersrand.

1.2. Background and context

The National Development Plan (NDP) aims to eliminate poverty and inequality by 2030. To achieve this, a number of priorities areas have been identified, and this is against the challenges facing the country. Chapter 9 of the NDP highlights the need to improve education, training and innovation. One of the critical components of this pillar is the need to increase the number of qualified artisans entering the labour market (National Planning Commission, 2012). According to the Department of Higher Education and Training (DHET) (2022), artisan development has undergone several changes over the past decades, and these have resulted in a decline in the number of artisans available to meet the needs of the economy.

According to the Minister (2023), a 36% decline in the number of learners who entered the artisan learning programme was recorded in the 2020/21 financial year which is concerning (Lushaba, 2023). In light of these challenges, the government declared the year 2014-2024 as the *“Decade of the Artisan”* to promote artisanship, particularly amongst the young people. This is in support of the target set by the NDP to produce 30,000 artisans per year (National Planning Commission, 2012).

Artisans play a crucial role in the economy and are part of the critical workforce in several industries. In the MMS, the importance of artisan skills has been highlighted by various key stakeholders including the DHET (Mining Safety, 2023), the DMRE (Shabangu, 2012), the MQA (Mining Qualifications Authority, 2020), MCSA (Minerals Council South Africa, 2019), and the trade unions (Matlhabe, 2024). These stakeholders, through various platforms, have consistently emphasised the critical role that artisans play in maintaining operational

efficiency, ensuring safety, and driving innovation within the MMS (Department of Higher Education and Training, 2012; Department of Higher Education and Training, 2013). The importance of artisan skills in the MMS is summarised as follows (Mining Qualifications Authority, 2019):

- Artisans are critical in ensuring that machinery and equipment function efficiently, reducing downtime and keeping the production process running smoothly.
- Mining environments are hazardous, and artisans ensure that systems are maintained to meet safety regulations.
- By maintaining and repairing equipment, artisans help mines save costs on machinery. Preventative maintenance and timely repairs reduce the need for expensive replacements and avoid production losses due to equipment failure.
- As the mining sector adopts new technologies such as automation and remote monitoring, artisans like instrumentation mechanics and millwrights are essential for implementing and maintaining these advanced systems, allowing the MMS to adapt and thrive in a technologically evolving landscape.

1.3. Problem statement

Despite various efforts implemented to meet the objective of the NDP to produce 30 000 artisans annually by 2030, the country has been producing only 20,000 artisans per year. Of these, the MQA reported that around 1 522 candidates enrolled in artisanal learning programmes during the financial year 2022/2023 (MQA, 2023). Five out of ten hard-to-fill vacancies in the MMS are artisan-related, with the lack of relevant qualifications and experience cited as the primary issues (MQA, 2024). This shortage is exacerbated by the sector's technological advancements, particularly in areas such as mechanisation and digital technologies, which demand new skills (Mining Qualifications Authority, 2018).

The skills gap in the MMS is driven by several factors, including low throughput rates in artisan training programmes, misalignment between training curricula and industry needs, and an ageing workforce (Mining Qualifications Authority, 2018). According to the Department of Higher Education and Training (2022), the average age of artisans in the country is 55 years. There is therefore an urgent need to increase the number of artisans because a high

percentage of the current workforce will be retiring (Department of Higher Education, 2022). The gaps in the supply of artisans can also be linked to Further Education and Training (FET) colleges which are also struggling to produce graduates with the specific skills required by a rapidly mechanising mining industry.

Many current training programmes still focus on outdated competencies, leaving newly qualified artisans unprepared for the technological demands of modern mining. This mismatch between artisan skills and industry needs has resulted in high unemployment among artisans, while employers continue to face a severe shortage of skilled labour (Moodley, 2013). In light of these challenges, there is a need to assess the artisan training value chain to identify areas that need attention to ensure alignment between artisan supply and demand taking into account the evolving needs of the MMS. The findings from this research will be critical in shaping policies and strategies to modernise artisan training, increase output, and ensure that the MMS has a workforce capable of meeting its current requirements and future technological and operational demands.

1.4. Aim and objectives

The aim of the study is to investigate the state of artisan supply and ways of enhancing their competencies in the MMS. The objectives of the study are to:

- Assess the effectiveness of the existing artisan development programmes in enhancing the skills and capabilities of artisans in the MMS.
- Identify the interventions aimed at addressing artisans demand in the MMS.
- Discuss the specific skills and training components that are typically included in artisan development programmes in the MMS.
- Explore the employers' perceptions on the employability of artisans in the MMS.
- Determine whether the existing artisan development programmes are aligned with sectoral, and national policies in the MMS.
- Stipulate the international (global and continental) best practices from the mining countries.
- Develop innovative strategies that could be implemented to enhance the competencies of the current cohort of artisans.

1.5. Significance of the study

This study holds significance given the important role of artisans in the MMS. The study will contribute towards closing the knowledge gaps and provide understanding on the alignment (i.e., or misalignment) between available artisan skills and industry demands. This is particularly important in a context where the MMS is evolving to respond to technological advancements that comes with different sets of skills requirements. By examining the artisan skills ecosystem, the study will provide valuable insights to mining companies, training institutions, and policymakers putting them in a good position to improve workforce planning, curriculum development, and skills development strategies. In addition to industry benefits, the study feeds directly into one key intervention area of the NDP which recognises the important of artisans in supporting economic activities and subsequent growth in the country.

More so, given the country's high unemployment rate, understanding artisan skills development provides meaningful employment pathways, especially for historically disadvantaged communities. Broadly, the findings of the study are expected to contribute to NDP objectives and Mining Charter requirements, while providing empirical evidence to guide TVET college programmes, SETA strategies, and apprenticeship frameworks. This research thus serves both practical industry needs and broader societal goals, making it particularly relevant for sector development and transformation.

1.6. Structure of the report

The report is structured into six chapters that are elaborated below:

Chapter 1 provides introduction and background to the study. This is supported by the problem statement as well as aim and objectives of the study. The significance of the study is also included in the chapter.

Chapter 2 presents the literature and policy review. In the chapter, an overview of the MMS with its performance and challenges are presented. The chapter also discusses artisan skills in the MMS with a focus on skills supply, demand and artisan skills development support. International case studies are included in the chapter to draw lessons that can be considered in the South African context.

Chapter 3 discusses the research methodology that was employed in the study. The chapter also outlines data collection and analysis methods as well as ethical requirements and challenges and limitations of the study.

Chapter 4 presents the results, and these are analysed to draw key findings in line with the objectives of the study.

Chapter 5 provides an overall discussion of the key findings, and proposes initial recommendations based on aspects that are emanating from the study.

Chapter 6 concludes the study and proposes recommendations aimed at addressing enhancing the impact of MQA's artisan training programme.

2. LITERATURE AND POLICY REVIEW

2.1. Introduction

This chapter presents the literature and policy review. The chapter provides an overview of the mining and mineral sector in South Africa highlighting the landscape, mineral endowment, contribution to the country's economy and the key challenges affecting the performance of the sector. The chapter also provides insights into artisan skills in the MMS covering both supply and demand as well as skills development and training programmes. International case studies are also included in the chapter to provide learnings that could apply to the South African case.

2.2. Overview of the mining and mineral sector in South Africa

South Africa is amongst the leading mineral producers in the world. Its vast mineral resources cover precious minerals, energy minerals, non-ferrous metals and minerals, ferrous metals and minerals, and industrial minerals (Yager. 2019). According to the Department of Mineral Resources (DMR) (2019), the country has mineral reserves to support the mining sector for another 30 years. Some of the strategic minerals in the country are platinum group metals (PGMs), chrome, manganese, iron ore, vanadium, gold and others (i.e., see Beneficiation strategy, 2011). According to Minerals Council South Africa (2022), South Africa is ranked first in terms of reserves of PGMs, manganese and chrome which account for 91.3%, 40% and 35% of the world's total reserves respectively.

Mining in the country takes place in all nine provinces, however, the footprint of the mining and mineral sector depends on the availability of minerals in various regions. The four major mining provinces are North West, Limpopo, Mpumalanga and Northern Cape provinces. According to Minerals Council South Africa (2023), the mining sector contributed between 20% and 30% to the Gross Domestic Product (GDP) of these provinces. In addition to both provincial and national GDP, mining contributes to foreign direct investment (FDI), state revenue through taxes and royalties, infrastructure development, employment, and socio-economic development as seen in mining communities.

In 2023, the sector contributed 6.3% to the country’s GDP and this equated to R444.2 billion (Minerals Council South Africa, 2023). Figure 1 shows total employment in the sector and the contribution of the major mineral commodities. The sector employed 479,228 people in 2023. As seen on the figure, total employment declined between 2012 and 2016. It became relatively flat between 2016 and 2020. An increase in jobs created by the sector can be seen from 2020 with total employment increasing from 452 860 to 479 228 in 2023. This is equivalent to a 6% increase. Total employment differs across mineral commodities, and from the figure, it is seen that the PGM subsector is the largest employer and accounts for about 38% to the total direct jobs in the MMS. It is followed by coal and gold subsectors constituting 20% and 19% to the total employment respectively. The other subsectors, namely, iron ore, chrome, diamonds and manganese employed 23 762, 21 842, 14 856 and 11 503 people in 2023 respectively.

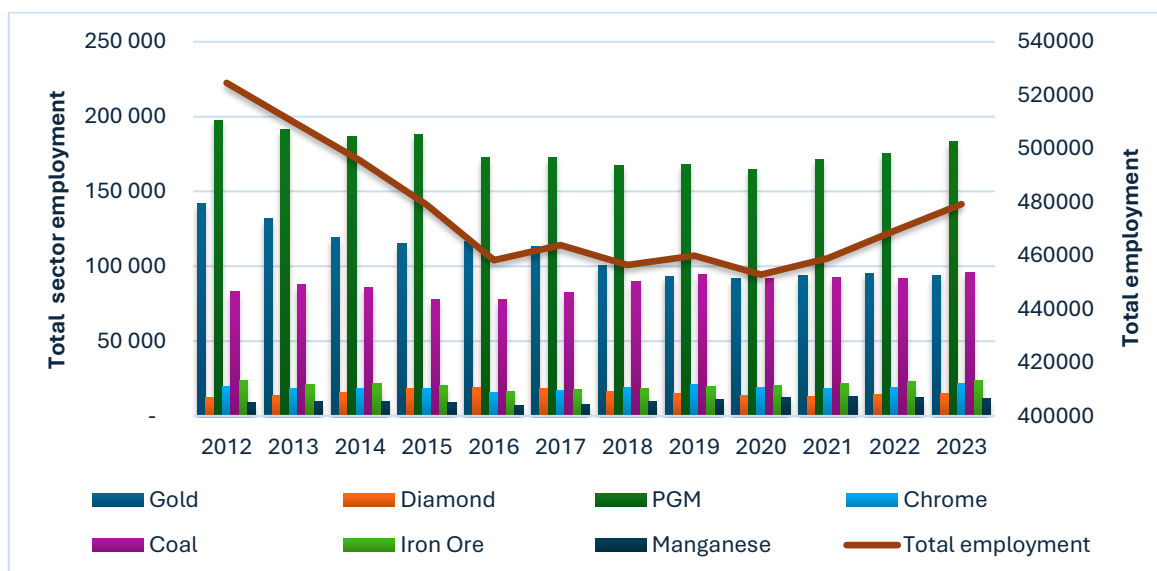


Figure 1: Total employment in the mining sector and in selected mineral commodities (Minerals Council South Africa, 2022, 2023)

In addition to employment, the MMS contributes significantly to state revenue through taxes and royalties. In 2023, a total of R25.3 billion and R 85.5 billion was paid to government as royalties and company tax (Minerals Council South Africa, 2023). The other benefits of mining are tied to its responsibilities towards transformation and socio-economic development targeting employees and communities. These include the Skills Levy which is 1 % of the payroll (Mineral Council South Africa, 2020). According to Minerals Council South Africa (2022), the

MMS has contributed more than R6 billion to skills development between 2016 and 2020. Overall, the MMS contributes significantly to several components of the NDP.

While this is the case, there are growing concerns about the performance of the MMS and its prospects. The MMS has been affected by several challenges, and these include commodity price fluctuations, logistical constraints (i.e., energy, water, transport), technical challenges (i.e., low grade deposits, deepening orebodies, cost of mining), legal and regulatory issues, social license to operate, environmental concerns, illegal mining and skills shortages (South African Academy of Engineering, 2016).

The need for skills remains at the centre for interventions that are needed to unlock the mining sector's potential for sustained contribution to the country's development objectives. Some of the key issues surrounding skills shortages in MMS are lack of technical skills as necessitated by the integration of technology within mining operations and digital skills that are needed to take advantage of automation and digitalisation in the MMS. There is also a lack of skilled personnel, in particular artisans who form a critical part of the day-to-day running of mining operations. In particular, there is shortage of Diesel Mechanics in the MMS, and this has been the case since 2018 (Department of Higher Education and Training, 2022). From the MQA's 2024/25 sector skills plan, Diesel Mechanic and Millwright form part of the hard-to-fill occupations.

In the context of the study, hard-to-fill vacancies (HTV) encompass *“occupations in which employers experience difficulty to recruit and retain staff due to a shortage of qualified and experienced people. These occupations are in demand (for various reasons) and are often defined as those occupations that take longer than 6 months to find a suitable candidate or remain unfilled for a long period”* (Department of Higher Education and Training, 2022). The MQA (2024) noted that the major reason resulting in HTVs is lack of work experience and relevant qualifications. All these factors need to be understood to come up with ways of addressing the skills shortages in MMS.

2.3. Artisan skills in the mining sector

2.3.1. Definitions

The Skills Development Amendment Act 37 of 2008 defines an "artisan" as a person certified as competent to perform a listed trade in accordance with this Act. A "trade" refers to an occupation for which an artisan qualification is required under Section 26B of the Act. This section empowers the Minister to publish a list of occupations classified as trades that require an artisan qualification (Republic of South Africa, 2008).

A broader definition of a "trade" describes it as an occupation in which a qualified individual applies advanced practical skills, supported by theoretical knowledge, to manufacture, service, install, or maintain equipment in an engineering or technical environment. Artisans use tools, troubleshoot machinery, and adhere to health, safety, and environmental regulations. These roles typically require at least three years of cumulative learning, which combines formal education, practical experience, and workplace training (Department of Higher Education and Training, 2012). The pathways to becoming an artisan are detailed in subsequent sections.

The MQA classifies artisan trades under the craft and related trades workers occupational category. Craft and related trades workers apply specialised knowledge and skills in various industries, such as mining and construction. They shape metals, erect structures, and make, fit, maintain, and repair machinery, equipment, and tools. They also engage in activities like printing or producing and processing foodstuffs, textiles, and various articles made from wood, metal, and other materials. This work is primarily manual and is supported by hand-powered and mechanical tools that reduce physical effort and time while also improving product quality. Workers in this category must have a thorough understanding of the entire production or assembly process, including the materials and tools used, as well as the purpose of the final product (Department of Public Service and Administration, 2024).

The occupations in the craft and related trades fall within the Major Group 6: *Skilled Agricultural, Forestry, Fishery, Craft, and Related Trades Workers* in terms of the Organising Framework for Occupations (OFO) Version 2021 (Department of Higher Education and Training, 2021). Artisan occupations which are prevalent in the MMS fall within the OFO sub-

groups: *Metal, Machinery and Related Trades Workers (OFO Code 65)* and *Electrical and Electronics Trades Workers (OFO code 67)* (Department of Higher Education and Training, 2021).

The requisite skills level for these trades is mostly at the 2nd skill level. Skill level indicates the complexity and range of tasks and duties performed in an occupation. The 2nd skill level encompasses secondary education. A period of on-the-job training and experience may be necessary, sometimes formalised in learnerships or apprenticeships. This period may supplement the formal training or, in some cases, replace it partially or wholly. In terms of the national qualifications framework (NQF), this skill level covers education from the general education and training (GET) band up to the further education and training (FET) band (i.e. schooling up to Grade 12, along with technical education at NQF levels 2-4) (Department of Public Service and Administration, 2024).

2.3.2. Artisan trades in the MMS

Table 1 outlines the trades registered on the NQF for the MMS, representing key artisan occupation categories in the MMS.

Table 1: Artisan trades in the MMS

Trade	Description
Diesel Mechanic (OFO Code: 653306)	Repairs and maintains the diesel engines that power transportation equipment, including heavy trucks, cranes, and bulldozers. Duties involve diagnosing engine issues, disassembling engines when necessary, replacing or repairing defective parts, and addressing mechanical and electrical faults in the machinery.
Electricians (OFO Code: 671101)	Electricians are responsible for installing, maintaining, and repairing electrical systems, wiring, and equipment. Their tasks include assembling, testing, and maintaining electrical systems using hand and power tools, connecting wires to circuit breakers and transformers, and inspecting systems for hazards or defects. They ensure compliance with safety codes and provide advice on

Trade	Description
	potential equipment hazards. Electricians also test systems using tools like ohmmeters and voltmeters, plan installations based on blueprints and job specifications and maintain their electrician's license to meet regulatory requirements.
Fitter and Turner (Including Machining) (OFO Code: 652302)	Fitters and turners manufacture, construct, assemble, and fit components for machinery, vehicles, installations, and other apparatus. They are also responsible for maintenance and repair tasks. Their work involves selecting and marking-off the necessary materials according to precise measurements found on blueprints, drawings, or models. They shape rough pieces of metal into their final forms using power-operated tools such as milling, drilling, and planing machines. Afterward, they fit the parts together to complete the required machine or article and inspect and test the final assembly to ensure a proper fit.
Instrumentation Mechanician (OFO Code: 672105)	Instrumentation Mechanicians manufactures and repairs instruments and recalibrates old instruments. The instrument mechanician plays a vital role in ensuring that automatic processes and plant systems operate correctly and efficiently. The control of nearly all processes depends on instruments that may be electrical, mechanical or hydraulic, which are responsible for measuring pressure, temperature, position, level, mass or flow of solids, fluids and gases.
Plater (Boilermaker and Welder) (OFO Code: 651302)	They construct and repair steel, plate, and piping structures, including boilers for steam engines and mine headgears. The plater is also responsible for cleaning and inspecting boilers to ensure they operate effectively.
Millwright (OFO Code: 671202)	Their responsibilities encompasses both mechanical and electrical tasks. This includes dismantling, diagnosing faults, and repairing equipment such as electric motors. A millwright will disassemble and test these motors, checking the wiring and

Trade	Description
	assessing power output and consumption. Additionally, millwrights are responsible for the maintenance, reconstruction, and installation of heavy machinery, electrically driven machines, and electronic control systems.
Rigger Ropesman (OFO Code: 651501)	They work with cables and ropes in hoisting equipment, scaffolding, and platforms. Their tasks include erecting hoisting apparatus, assembling, installing, and maintaining steel cables used with pulleys, lifts, or cranes. On-site, they estimate the weight of objects, determine the best method to secure and move them, arrange the necessary equipment, and provide instructions to the hoist or crane operator. During the lift, they ensure there are no knots or tangles.

(Mining Qualifications Authority, 2019)

2.3.3. Certification process/pathways

There are two main routes for artisan certification: the Formal Apprenticeship or Learnership Programme and the Recognition of Prior Learning (RPL) Pathway. Each route is designed to accommodate individuals from different educational and experiential backgrounds, offering multiple opportunities to obtain certification through trade testing. The pathways to becoming an artisan, as outlined in the Trade Test Regulations of 2014 under the Skills Development Act, involve the following steps (Department of Higher Education and Training, 2015):

- **Application for Trade Test:** Individuals must apply to an accredited trade test centre to undergo a trade test for a listed trade. Applicants must provide proof of completing the required components of the curriculum for the artisan qualification, or alternatively, they may submit a portfolio of evidence if they have undergone a Recognition of Prior Learning (RPL) process.
- **Pre-Trade Test Evaluation:** If an applicant completed their artisan training more than three years prior to applying for a trade test, they must undergo a pre-trade test evaluation to ensure they are ready to be tested.

- **Eligibility and Entrance Requirements:** The minimum qualifications to qualify for a trade test include relevant technical certifications, such as a Nated Level 2 (N2) Certificate, National Certificate Vocational (NCV) at NQF level 3, or completion of structured workplace learning (learnership, occupational certificate or apprenticeship).
-
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- Table 2 outlines the entrance requirements to be eligible for a trade test, specifying the minimum educational and/or work experience.
- **Recognition of Prior Learning (RPL):** Applicants who have relevant work experience but have not completed a formal learning programme can gain access to the trade test through an RPL process. This involves presenting a portfolio of evidence and passing a knowledge assessment.
- **Trade Test Attempts:** Learners on an official learning programme are allowed up to three attempts at the trade test. If not successful within these attempts, they are referred back for additional training or RPL.
- **Certification:** Successful learners will be awarded a National Trade Certificate, issued after the verification of results by the National Artisan Moderation Body (NAMB).

Table 2: Entrance requirements options for trade tests

Requirements	Minimum Work Experience	Additional Requirements
Formal Qualification Pathway		

Requirements	Minimum Work Experience	Additional Requirements
N2 Certificate with relevant subjects - Maths, Engineering Science, and a trade-specific subject. - Completion of all off-the-job practical training and workplace learning (minimum of 12 months), or	12 months	None
Technical Trade Theory Programmes (equivalent to NQF 3) - SETA/QCTO-approved programmes. - Completion of all off-the-job practical training and workplace learning (minimum of 12 months), or	12 months	None
Relevant Engineering NCV Certificate (NQF 3) - Completion of all off-the-job practical training and workplace learning (minimum of 12 months), or	12 months	None
Technical Grade 11 (Maths, Science, Language, Trade) - Completion of all off-the-job practical training and workplace learning (minimum of 12 months), or	12 months	None
Relevant N6 Certificate or National Technical Diploma - 18 months of relevant work experience.	18 months	None
Recognition of Prior Learning (RPL) Pathway		

Requirements	Minimum Work Experience	Additional Requirements
N2 Certificate with 3 years relevant work experience - Completion of relevant trade theory subjects and a minimum of 3 years relevant work experience, or	3 years	Applicants must pass a written knowledge assessment with at least 50% as part of the RPL toolkit approved by the National Artisan Moderation Body (NAMB).
Technical Trade Theory Programmes (equivalent to NQF 3) - Completion of relevant programmes and a minimum of 3 years relevant work experience, or	3 years	Applicants must pass a written knowledge assessment with at least 50% as part of the RPL toolkit approved by the National Artisan Moderation Body (NAMB).
Relevant Engineering NCV (NQF 3) - Minimum of 3 years relevant work experience, or	3 years	Applicants must pass a written knowledge assessment with at least 50% as part of the RPL toolkit approved by the National Artisan Moderation Body (NAMB).
Relevant Engineering NC(V) 4 - Completion of all work experience modules and a minimum of 18 months relevant work experience, or	18 months	Applicants must pass a written knowledge assessment with at least 50% as part of the RPL toolkit approved by the National

Requirements	Minimum Work Experience	Additional Requirements
		Artisan Moderation Body (NAMB).
Technical Grade 12 (Maths, Science, Trade Theory) - Minimum of 3 years relevant work experience, or	3 years	Applicants must pass a written knowledge assessment with at least 50% as part of the RPL toolkit approved by the National Artisan Moderation Body (NAMB).
Grade 9 with 4 years relevant work experience - A candidate with only Grade 9 can qualify through RPL if they have at least 4 years of relevant work experience, or	4 years	Applicants must pass a written knowledge assessment with at least 50% as part of the RPL toolkit approved by the National Artisan Moderation Body (NAMB).
Relevant N6 Certificate or National Technical Diploma - 18 months relevant work experience.	18 months	Applicants must pass a written knowledge assessment with at least 50% as part of the RPL toolkit approved by the National Artisan Moderation Body (NAMB).

(Department of Higher Education and Training, 2015)

2.3.4. Education and training programmes

The MQA, the Quality Council for Trades and Occupations (QCTO) and Technical and Vocational Education and Training (TVET) colleges have developed various learning programmes to promote artisan skills development. These include:

- **Apprenticeship programmes** combine theoretical modules, hands-on skills modules in an accredited training workshop, and practical workplace experience (EBMTC Artisan Academy, 2024). Entry requirements typically include an N2, NCV3, or NCV4 qualification in a specific trade. These programmes are tailored to traditional trades and generally take three years to complete, resulting in an occupational qualification for a registered trade, typically at NQF level 4 or below. During the training period, learners must be contracted to an employer. While employment after completion is not guaranteed, apprentices often have a strong chance of being hired by their training employer due to the relevant trade-specific experience they gain.
- **Learnership programmes** are similar to those of an apprenticeship, but learnerships usually take 12 to 18 months to complete. Learners may finish the programme with an occupational qualification or partial qualification across various NQF levels. A learnership requires a contract of employment involving the learner, employer, and a training provider, but there is no employment guarantee. However, learnerships equip learners with versatile skills applicable across different sectors, enhancing employability in a broader range of roles.
- Alternatively, learners may choose to enrol at a **TVET college**, completing levels N1 through N6. In this path, learners are not contracted to any specific employer. After achieving an N2, NCV3, or NC4, they can sit for a trade test at an accredited trade centre subject to meeting other workplace training requirements.
- The **Artisan Recognition of Prior Learning (ARPL)** route allows workers who have gained practical experience under qualified artisans to become certified artisans.

Table 3 and Table 4 present a comprehensive overview of the registered artisan learnerships with the MQA for the MMS, as well as relevant artisanal occupational qualifications registered with the QCTO.

Table 3: MQA artisan learnerships

Learnerships (National Certificates)	NQF Levels	Mining Types
Instrumentation Mechanician	Level 4	General
Rigging Ropesman	Level 3	Generalist, Open Cast
Diesel Mechanic	Level 3, Level 4	Underground Diamonds, Coal, Metalliferous, Surface Diamonds, Open Cast
Plater Welder	Level 3	Underground Diamonds, Coal, Metalliferous, Open Cast Diamonds, Open Cast
Plater Boilermaker	Level 3	Opencast, Coal, Metalliferous, Diamond Opencast
Fitting (Including Machining)	Level 3	Underground Diamonds, Underground Coal, Surface Coal, Hardrock Metalliferous, Surface Diamonds, Open Cast
Millwright	Level 4	Diamond, Coal, Metalliferous, Open Cast
Fitting and Turning	Level 3	Underground Diamonds, Underground Coal, Open Cast Coal, Metalliferous, Surface Diamonds, Open Cast
Electrical	Level 4	Underground Diamonds, Underground Coal, Surface Coal, Open Cast, Metalliferous, Surface Diamonds

(Mining Qualifications Authority, 2021)

Table 4: MMS-related QCTO qualifications

SAQA ID	Qualification Title	NQF Level
93626	Boilermaker	NQF Level 4
102760	Diesel Electrical Fitter	NQF Level 4
98822	Diesel Fitter	NQF Level 4
117237	Diesel Mechanic	NQF Level 4
97592	Diesel Mechanic	NQF Level 4
91761	Electrician	NQF Level 4
94020	Fitter and Turner	NQF Level 4
97582	Heavy Equipment Mechanic	NQF Level 4
94701	Instrument Mechanician	NQF Level 5
94021	Mechanical Fitter	NQF Level 4
93625	Metal Machinist	NQF Level 4
97585	Millwright	NQF Level 4
99255	Pipe fitter	NQF Level 4
102856	Rigger	NQF Level 4
117042	Transportation Electrician (Automotive Electrician)	NQF Level 4
94100	Welder	NQF Level 4

(Quality Council for Trades and Occupations, 2024)

2.4. Artisan skills supply

2.4.1. Number of artisans in MMS

As of 2023, the MMS had 48 337 employees in the artisan trades category, representing 9.4% of the total workforce (Mining Qualification Authority, 2023). Figure 2 shows employment of artisans in MMS between 2004 and 2023. This trend was created by collating data from the Sector Skills Plans (SSPs) of the MQA and their respective updates along with relevant information from the Annual Performance Plans (APPs) of the MQA. From the figure, gaps in data collection for 2005 to 2008, 2010 and 2020 can be seen. These data gaps do not impact

the analysis, as the focus is on a broader trend over time. By examining surrounding years, general pattern and direction can still be understood, ensuring that the missing data does not obscure the overall trend.

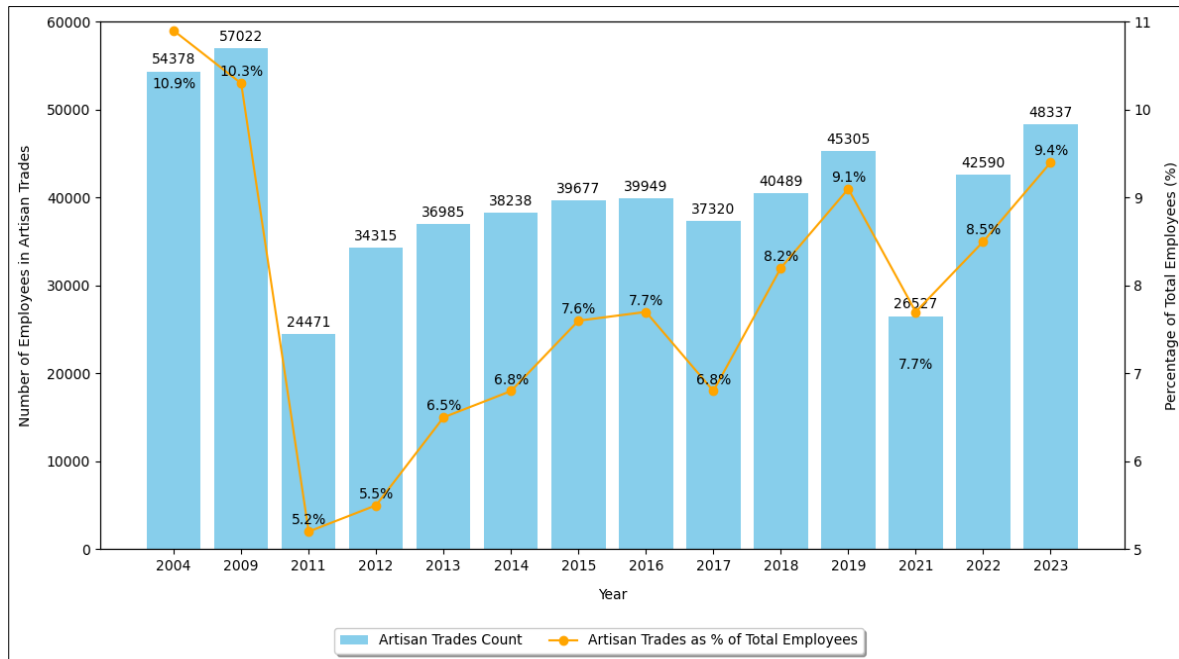


Figure 2: Number of artisans in the MMS 2004 – 2023

(Mining Qualifications Authority, 2004, 2009, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2021, 2023, 2023)

Artisan trades initially accounted for 10.9% of the workforce in 2004, with 54 378 employees, reaching a peak in 2009 with 57 022 employees (i.e., this is equivalent to a 10.3% increase). From 2009 to 2011, there was a significant drop in the number of artisans working in MMS. This changed from 2011 to 2016, where a gradual increase in both the number of employees and their percentage, rising from 24 471 employees (5.2%) in 2011 to 39 949 employees (7.7%) in 2016. However, this was followed by two brief declines: first, between 2016 and 2017, when the number of employees dropped to 37 320, and again between 2019 and 2021, with employee numbers falling from 45 305 to 26 517 (7.7% of the workforce).

Despite these declines, there were notable recoveries during the study period. From 2011 to 2012, artisans increased from 24 471 to 34 315, and from 2017 to 2018, the number of artisan trades employees rose again to 40 489, indicating a steady rebound. After the significant drop

in 2021, the number of employees recovered once more in 2022 and 2023, reaching 42 590 and 48 337 employees respectively, accounting for 9.5% of the workforce in 2023. These fluctuations suggested a cyclical trend in the employment of artisans, with artisan trades maintaining a 5 – 10% significant share of the total workforce in the MMS.

Figure 3 illustrates the gender distribution in artisan as a percentage of the total workforce from 2004 to 2021 (i.e., again, data gaps should be noted). It was also created by collating data from the SSPs of the MQA, their updates, and the Annual Performance Plans of the MQA, ensuring a comprehensive view of gender distribution trends over the years. It highlights the dominance of male employees in the sector throughout the period, with males consistently making up the vast majority of the workforce.

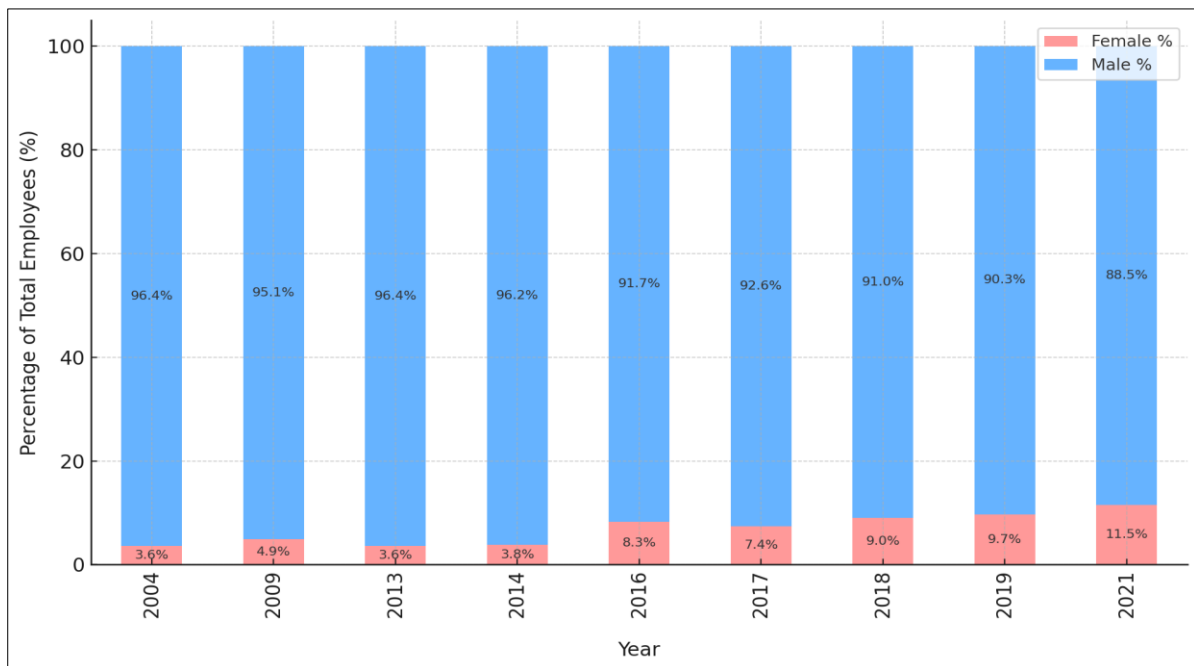


Figure 3: Gender distribution of artisans in MMS 2004 – 2021

(Mining Qualifications Authority, 2004, 2009, 2013, 2014, 2016, 2017, 2018, 2019, 2021)

In 2004, males accounted for 96.4% of the artisan trades workforce, and by 2009, their representation was still high at 95.1%. However, from 2016 onwards, there had been a noticeable increase in female participation. Female representation grew from 8.3% in 2016 to 9.7% in 2019, reaching a peak of 11.5% by 2021. This upward trend in female representation reflected ongoing efforts to improve gender diversity in the MMS. Despite this

progress, males still constituted the overwhelming majority, close to 90% of the workforce, suggesting that while strides are being made toward inclusivity, there remains significant room for further gender balance in the sector and the job category.

Figure 4 illustrates the contribution of various population groups to the artisan trades workforce between 2004 and 2021, showing the evolving representation of Africans, Coloureds, Indians, and Whites as a percentage of the total workforce. African representation had steadily increased, rising from 51.6% in 2004 to 71.9% in 2021, indicating a growing dominance of this group in artisan trades. Meanwhile, White representation had consistently declined, dropping from 41.8% in 2004 to 23.1% in 2021, showing a reduced presence. The Coloured population experienced fluctuations, peaking at 8.6% in 2016, but gradually decreasing to 4.4% by 2021. Indian representation remained relatively small and stable, contributing between 0.4% and 0.8% over the years.

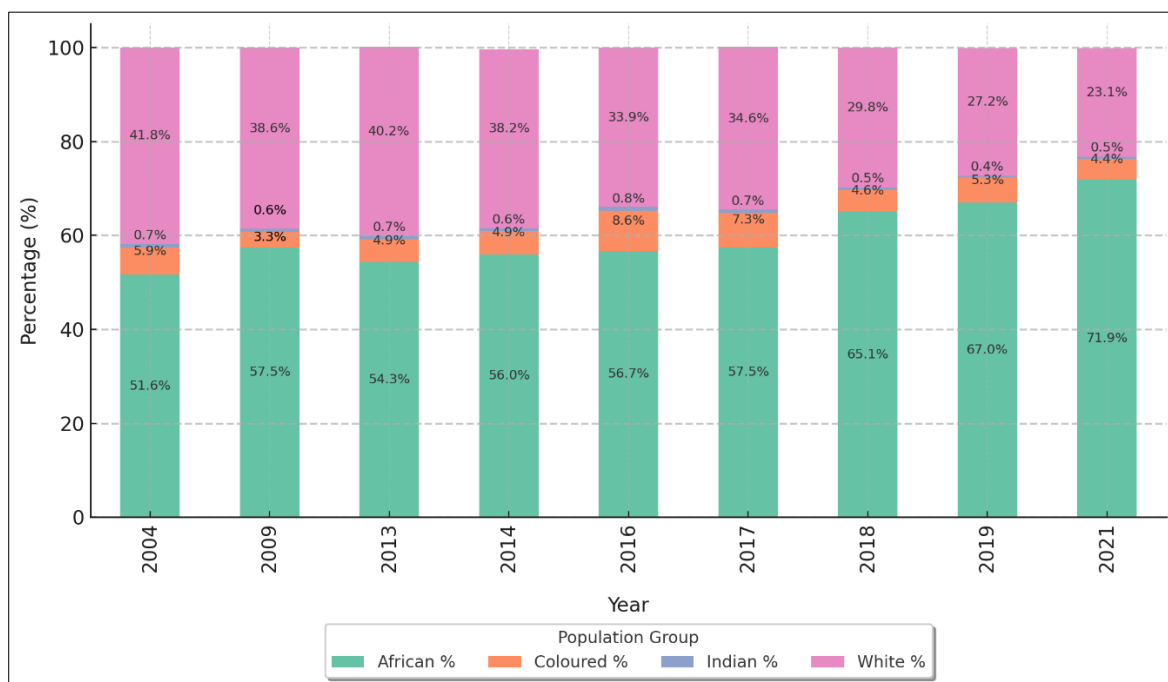


Figure 4: Population group distribution of artisans in MMS 2004 – 2021

(Mining Qualifications Authority, 2004, 2009, 2013, 2014, 2016, 2017, 2018, 2019, 2021)

2.4.2. MQA's supply of artisans

The MQA is responsible for skills development in the MMS, and through its programmes, it has contributed significantly to the supply of artisans in the MMS. Figure 6 illustrates the artisan supply in the MMS between 2011 and 2020. The figure compares the number of artisans produced by the MQA against the total number of artisans produced annually in the country. As seen on the figure, the contribution of MQA to artisan supply has fluctuated over the years, starting with 2 230 artisans in 2011, peaking at 3 526 in 2013, and stabilising between 2014 and 2020. In contrast, the total artisan supply shows significant variability, reaching a peak of 24 050 artisans in 2018 but declining to 15 106 in 2019.

The MQA's contribution, as a percentage of the total supply, ranged from 7% in 2018 to 20% in 2013, with more recent years showing a steady contribution of 13 to 16%. In total, MQA produced 20 682 artisans during the study period. This compares to 64 563 artisans produced by MerSETA (i.e., Manufacturing, Engineering and Related Services Sector of Education and Training Authority) making the MQA the second largest producer of artisans in the country (Department of Higher Education and Training, 2022)

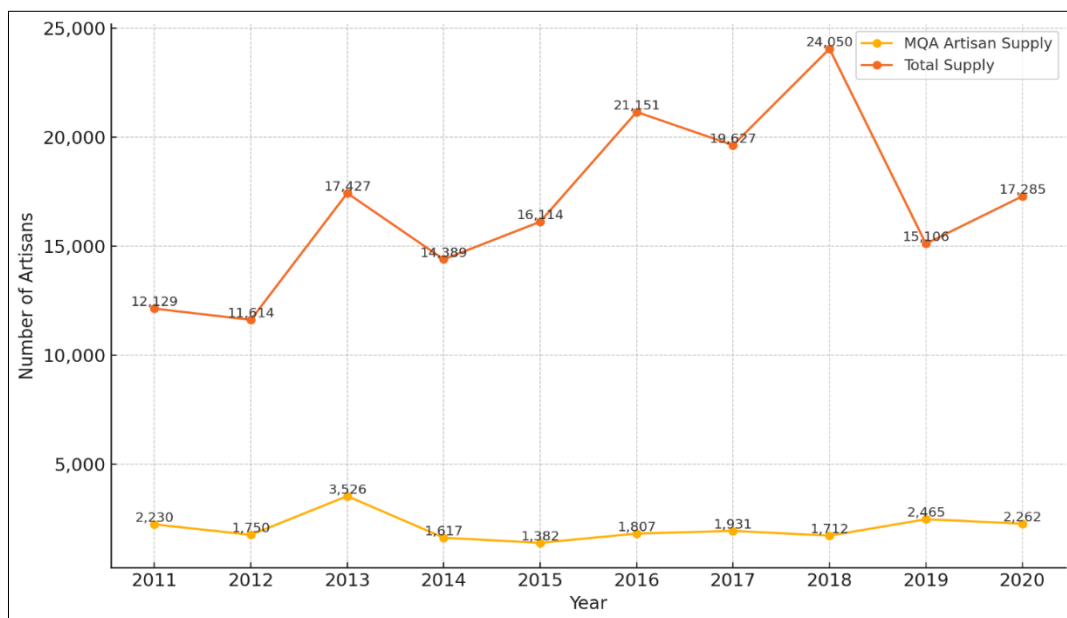


Figure 5: Artisan supply in the MMS, 2011 -2020

(Mining Qualifications Authority, 2011 - 2020)

Figure 6 focuses on the distribution of artisans across key trades. The most notable observation is the high supply of electricians, with 5 384 artisans trained during this time, making Electricians the largest group of artisans produced by the MQA. Following closely are Mechanical Fitters and Diesel Mechanics, with 2 549 and 2 519 artisans supplied, respectively. These numbers reflect a strong focus on providing skilled labour for mechanical and maintenance-related trades in the mining sector.

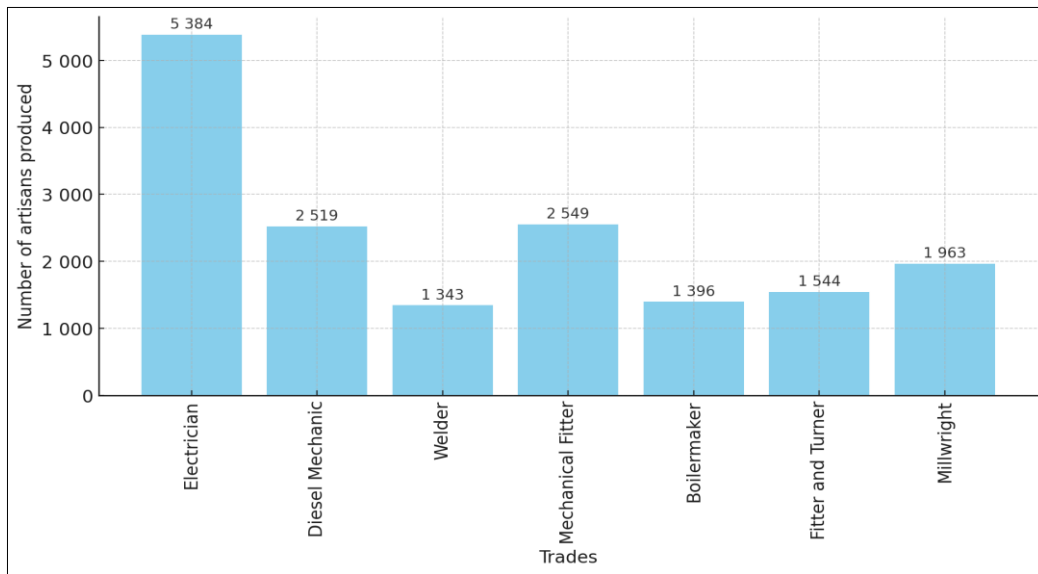


Figure 6: Supply of Artisan Trades by Category: 2011–2020

(Department of Higher Education and Training, 2022)

On the lower end, Welders and Boilermakers saw fewer artisans produced, with 1 343 and 1 396 artisans, respectively. Additionally, Fitters and Turners (1 544 artisans) and Millwrights (1 963 artisans) are also critical trades, but their supply remains moderate compared to Electricians and Mechanical trades.

2.4.3. Challenges with artisan skills supply

Developing a robust supply of artisans across various trades is complex and comes with several challenges. To this end, the MQA has identified the challenges in meeting the artisan supply needs within the MMS (MQA Annual Reports, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022). The key challenges are highlighted below:

- **Negative perceptions of artisan trades**

Historically, artisanship was a respected and highly valued skill in the workplace (Johnston, 2007). However, in post-apartheid South Africa, the perception of artisan careers shifted, with many viewing them as less prestigious compared to university-based qualifications. Following the transition to democracy, many African parents came to regard a university degree as the more desirable path to success, creating a bias that positions higher education above vocational careers. This perception has influenced younger generations to perceive artisan roles as a fallback for those who are either academically challenged or lack ambition. Consequently, artisan careers lack the social prestige they once held, which deters many from entering the field despite the high demand and critical economic need for skilled artisans. To this end, the *decade of the artisan campaign* was developed with the aim of demystifying artisanship in the country.

- **Lack of awareness of artisan career opportunities**

The negative perception surrounding artisan careers has led to artisanship being overlooked as a first choice by high school learners, who often prioritise university-bound careers instead. Consequently, learners spend little to no time researching artisan career options, focusing instead on professions that lead them to tertiary institutions. Furthermore, career days organised for high school students have traditionally lacked representation of artisan careers, resulting in low awareness of the opportunities available in these trades. This gap in exposure has created challenges for the MMS sector in attracting young talent to artisan trades, despite the critical demand for skilled artisans.

- **High cost of artisan training programmes**

The Government Technical Advisory Centre (GTAC) estimated in 2021 that training a single artisan costs approximately R352,000, encompassing theoretical instruction at TVET colleges, practical training, and workplace-based training with stipends. Although these expenses can be offset by government support such as National Student Financial Aid Scheme (NSFAS) and SETA funding, the high costs pose challenges for small enterprises, which often lack sufficient resources to train artisans at scale. The MQA allocates funding between R50,000 and R206,290 per learner for artisan training programmes linked to mining companies. However,

this amount is insufficient to cover full training costs, as companies are still responsible for maintaining training equipment and facilities, further increasing the associated costs.

- **Economic constraints leading to limited workplace-based opportunities**

Economic conditions play a crucial role in artisan training and development, particularly in the MMS. During economic downturns, reduced profitability within the MMS decreased the sector's capacity to support learner artisans, leading to fewer workplace-based learning opportunities. This continues to affect artisan training and throughput.

- **Lack of training officers and lecturers**

Artisan training in the MMS relies on experienced artisans who mentor learner artisans for workplace skills. However, an ageing workforce in the MMS mean that many of the q experienced training officers are retiring, leaving a skills gap that undermines efforts to maintain a steady pipeline of qualified and skilled artisans. This trend also affects TVET colleges, where lecturers often lack practical industry experience in the subjects they teach. The combined impact of retiring trainers in the MMS and insufficiently experienced educators in TVET institutions further constrains the MMS sector's ability to develop the skilled artisan workforce it requires.

- **Technological advances and skills mismatch**

The Fourth Industrial Revolution (4IR) brings transformative technologies that optimise productivity and enhance safety in the MMS. It is therefore important for artisan training programmes to incorporate these technological skills to ensure that learners are workforce-ready upon employment. In addition, learners must develop the agility to adapt swiftly to evolving technologies. Therefore, exposure to advanced technological equipment and automated processes during training is essential to prepare artisans capable of meeting the MMS sector's modern demands. Many older training officers, though experienced, lack familiarity with these new technologies, while younger training officers and TVET lecturers often lack sufficient hands-on expertise in the field. This skills gap complicates efforts to equip learners with the competencies required to succeed in the modern MMS environment.

2.5. Artisan skills demand

2.5.1. Skills requirements for artisans in the MMS

In addition to the relevant trade's technical skills, there are generic skills requirements for artisans in the South African MMS. These include (Mining Qualifications Authority, 2006-2025):

- **Mathematics and Science:** Foundational knowledge in mathematics and science is critical for artisans, especially in trades such as Electricians, Millwrights, and Mechanics. This is because many of the tasks that artisans perform, such as calculating measurements, understanding electrical currents, or troubleshooting mechanical issues, require these core competencies. To this end, these subjects are prerequisites for most artisan training programmes.
- **Sector Specific Skills:** These refer to the specialised skills and understanding that is directly relevant to the MMS. This is crucial in the sector due to its highly technical and unique nature, as well as the constantly evolving technologies and processes. Employees need a strong foundation in sector-specific knowledge to adapt to these changes and maintain competitiveness.
- **Technology:** The mining sector is increasingly adopting mechanisation and automation, which means artisans must be adept at using and adapting to new technologies. The MQA's SSPs therefore emphasise the need for artisans to be familiar with modern tools and systems, such as computer-aided equipment and digital monitoring technologies, as part of their skill set to stay competitive.
- **Problem-solving and critical thinking:** Artisans in the mining sector face complex, on-site issues that often require quick thinking and independent judgment. This skill is vital for troubleshooting equipment failures, managing breakdowns, and ensuring continuous operations. Problem-solving skills are a key requirement to ensure that artisanal work is done successfully.
- **Work-readiness:** Artisans must be able to work both independently and as part of a team, particularly in high-risk environments like mining operations. As such, there is a

need for soft skills, including the ability to follow instructions, meet deadlines, and adhere to safety protocols. Furthermore, work-readiness has been reported as crucial for the smooth transition from training to full-time roles in the industry.

- **People and Communication Skills:** Artisans regularly collaborate with colleagues, supervisors, and other stakeholders. Effective communication is therefore essential, particularly in coordinating tasks, reporting issues, and adhering to health and safety protocols. Communication skills are also increasingly important as artisans move into leadership positions.
- **Leadership and Managerial Skills:** As artisans advance in their careers, they may take on supervisory or managerial roles, which require leadership capabilities. These roles often involve overseeing teams, managing workflows, and ensuring compliance with safety regulations.
- **Environmental Sustainability:** Artisans in the mining sector must be aware of the environmental impacts of their work and adhere to sustainable practices. With global shifts toward greener mining practices, training programmes are increasingly incorporating modules on environmental responsibility to ensure artisans contribute to sustainable development goals.

2.5.2. Current demand for artisans in the MMS

Figure 7 displays the total artisan demand in the MMS from 2013 to 2018, based on number of vacancies recorded in the SSPs (Mining Qualifications Authority, 2013, 2015, 2016, 2017, 2018). Significant fluctuations in workforce can be observed during this period. In 2013, the demand for artisans was at its peak, with 1 176 artisans required, indicating high sector activity or workforce needs at that time. By 2015, the demand had decreased to 1 015 artisans, reflecting a reduction of about 13.7% from 2013. It is important to note that no data was reported for 2014, leaving a gap in the trend for that year.

In 2016, demand fell sharply to 568 artisans, marking the lowest point on the graph, with almost a 50% decrease from 2015. This decline in artisan vacancies coincides with the mining downcycle between the years 2014 and 2016 (Neil & Terazono, 2021), as well as a five-month-long strike in the platinum sector in 2014 (Mining Qualifications Authority, 2014). More so,

total employment in MMS had dropped from 510 099 in 2013 to 458 291 in 2016 (i.e., See figure 1).

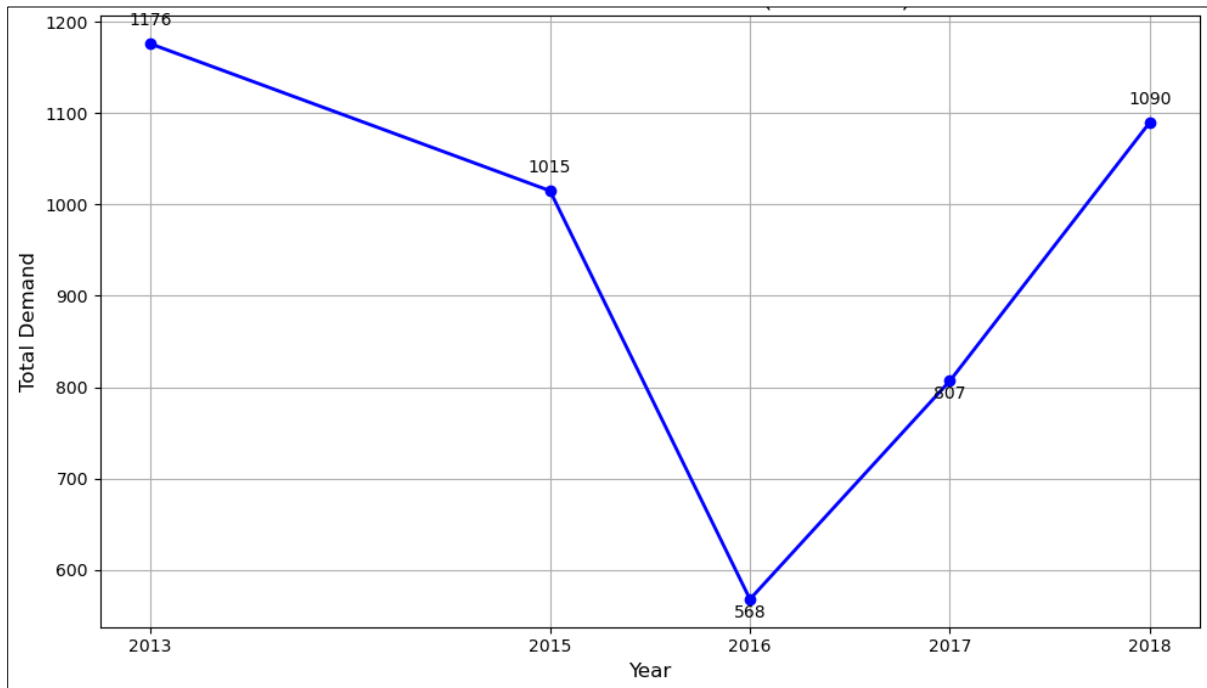


Figure 7: Artisan demand (vacancies) in the MMS

(Mining Qualifications Authority, 2013, 2015, 2016, 2017, 2018)

In addition to reporting on vacancies to assess demand, the Mining Qualifications Authority also evaluates hard-to-fill vacancies (HTFVs). By identifying HTFVs, the MMS can strategically develop the human capital necessary to address the challenges faced by the sector so that it remains competitive in the global economy (Mining Qualifications Authority, 2006-2025)

Another way to assess demand in a sector is to evaluate the number of unemployed individuals in a particular occupation. Figure 8 shows the number of reported unemployed artisans in the MMS, based on data from a study conducted by Mzabalazo Advisory Services (2022). The study was commissioned by the Department of Higher Education and Training (DHET) through the Labour Market Intelligence (LMI) research programme. The aim of the study was to investigate the supply and demand of artisans in South Africa. As can be seen on the figure, there was a steady increase in the number of unemployed artisans between 2012 and 2016. This was followed by a significant drop in the number of unemployed artisans from 290 in 2016 to 1 in 2020.

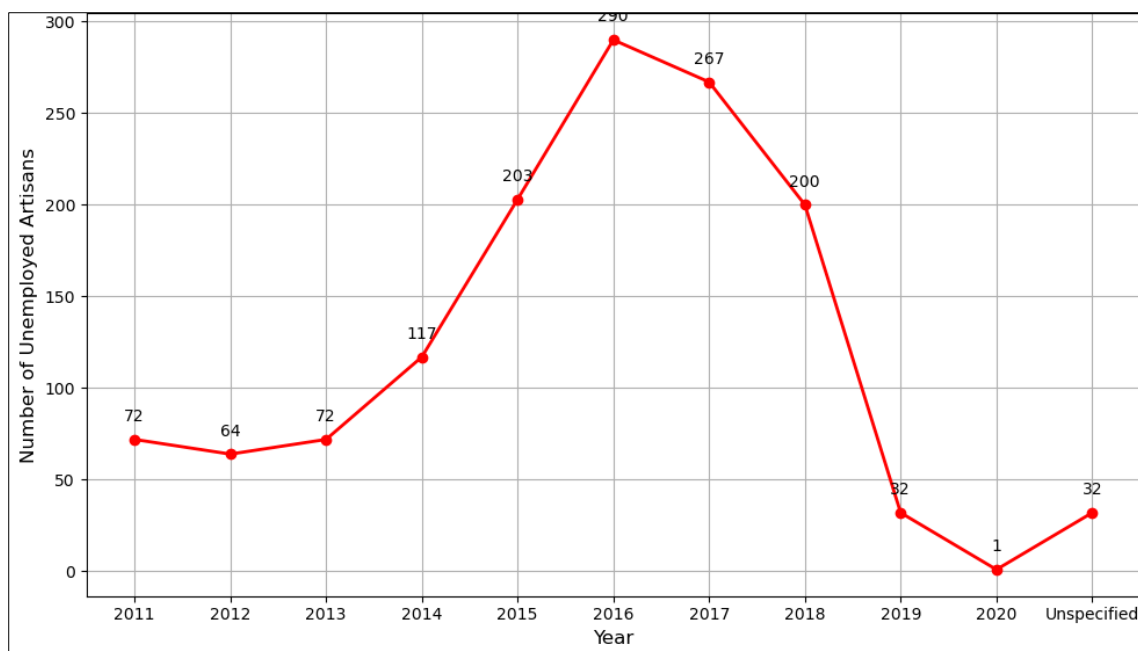


Figure 8: Number of unemployed artisans

(Mzabalazo Advisory Services, 2022)

2.5.3. Factors affecting the employability of artisans in MMS

Stakeholder feedback on the demand for artisans in the MMS as reported in the MQA Sector Skills Plans and Updates from 2013 – 2021 highlights several key challenges. One of the most prominent issues is the shortage of artisans with specific sector-related skills, particularly those familiar with updated technologies and specialised machinery used in modern mining operations. This lack of sector-specific expertise is compounded by the inadequacy of current qualifications, which are often seen as not sufficiently aligned with the needs of the MMS. As a result, there is a growing demand for additional specialised training interventions that are better tailored to these unique requirements.

Figure 9 visualises the stakeholder responses from the years 2013 – 2021 regarding issues about the employability of artisans in the MMS. These is a widespread concern about the lack of work readiness among graduates entering the workforce. Employers have noted that many artisans lack relevant experience, and there is a gap in their practical knowledge, especially regarding the use of specific machinery in mining.

2.6. Artisan skills development support

2.6.1. Policy and legislation

South Africa has developed a robust framework of policies and legislation to promote and support artisan development. Below is a discussion of the key pieces of legislation and policies that underpin artisan development in South Africa:

- **Skills Development Act, 1998 (Act No. 97 of 1998) and respective amendments:** The Skills Development Act is one of the foundational laws governing artisan development in South Africa. The Act was created to develop the skills of the South African workforce, including artisans, and to encourage employers to invest in education and training programmes. The Skills Development Act also established the National Skills Authority (NSA) and the National Skills Fund (NSF), which provide oversight and funding for skills development initiatives, including artisan training. The QCTO is established under this Act, and it is responsible for designing and maintaining occupational qualifications, including those for artisans. The QCTO ensures that these qualifications meet industry needs and are standardised across the country. The main objectives of the Act are:
 - To promote a culture of lifelong learning.
 - To improve productivity and competitiveness in the workplace by developing employee skills.
 - To encourage employers to use workplace-based training programmes such as apprenticeships and learnerships.
 - To establish Sector Education and Training Authorities (SETAs) to facilitate and fund training.
- **Skills Development Levies Act, 1999 (Act No. 9 of 1999):** The Skills Development Levies Act complements the Skills Development Act by establishing a levy-grant system to fund skills development initiatives. Under this Act, employers are required to pay a skills development levy (usually 1% of their payroll), which is collected by the South African Revenue Service (SARS) and distributed to SETAs. This system provides funding for various training programmes, including apprenticeships and learnerships

for artisans. Employers can reclaim part of the levy by participating in approved training programmes, thereby encouraging investment in artisan development.

- **National Qualifications Framework Act, 2008 (Act No. 67 of 2008):** NQF Act provides a framework for the development, recognition, and certification of qualifications in South Africa. The Act established the South African Qualification Authority (SAQA), which is responsible for overseeing the implementation of the NQF. The NQF categorises qualifications by level and ensures that artisan training programmes align with national standards, from foundational education to technical qualifications, for example, trade certificates.
- **Continuing Education and Training Act, 2006 (Act No. 16 of 2006):** It provides a regulatory framework for the governance, funding, and management of TVET colleges. It also supports the alignment of TVET institutions with national skills development priorities, including the training of artisans to meet the needs of various sectors such as engineering, manufacturing, and construction. TVET colleges work closely with SETAs and employers to ensure that training programmes are relevant and aligned with industry requirements. The curriculum, which includes practical work, is essential for preparing artisans for trade tests and certification.
- **National Development Plan (NDP) – Vision 2030:** Adopted in 2012, is South Africa’s long-term socio-economic development roadmap. The NDP emphasises the importance of artisan development as part of a broader strategy to address skills shortages in key economic sectors, including manufacturing, construction, and mining. The NDP acknowledges the importance of artisans in supporting industrialisation and economic growth, making artisan development as a critical component of South Africa’s future prosperity (National Planning Commission, 2012). The NDP sets a target of producing 30,000 qualified artisans per year by 2030, with a focus on:
 - Expanding access to education and training opportunities for artisans.
 - Improving the quality of TVET colleges and their programmes.
 - Encouraging partnerships between educational institutions and industries to create more apprenticeship opportunities.
 - Enhancing the role of SETAs in coordinating and funding artisan training.

- **National Skills Development Strategy (NSDS):** Provides a framework for skills development in South Africa, with a specific focus on increasing the supply of qualified artisans. The NSDS III (2011–2020) prioritised artisan training, setting targets which are to be implemented by SETAs and its aims are to:
 - Increase access to occupationally directed programmes, including apprenticeships, learnerships, and internships.
 - Support workplace-based learning, ensuring that artisans gain practical experience.
 - Improve the quality of artisan training programmes and ensure that they are aligned with industry needs.
 - Strengthen partnerships between educational institutions (TVETs), industry, and government to ensure that artisan skills are adequately developed.
- **Occupational Qualifications Framework (OQF):** Managed by the QCTO, it supports the development of qualifications that are directly related to specific trades and occupations. The OQF ensures that qualifications, particularly for artisans, are designed to meet occupational standards and employer needs. The OQF is aligned with the broader National Qualifications Framework (NQF) and ensures that artisan qualifications remain relevant and up to date with technological and industry changes (Government gazette, 2013).
- **Mining Charter 2018:** The Mining Charter is a key policy framework for the mining sector, outlining requirements for mining companies to invest in skills development, including training of artisans. The Charter mandates that a percentage of mining companies' expenditure be allocated to skills development, ensuring that the mining sector contributes to the development of skilled artisans who can meet the sector's unique demands (Government gazette, 2018).

2.6.2. Institutional arrangements

In addition to legal and supporting frameworks, artisan development in the country is also supported by a comprehensive system of institutional arrangements. These institutions play various roles in implementing, managing, coordinating, and overseeing artisan training,

certification, and quality assurance. An overview of the key institutions and their roles in artisan development at the national level and within the MMS is presented.

National Level

The following institutions are essential for artisan development at a national level:

- **Department of Higher Education and Training (DHET):** The DHET is responsible for overseeing skills development and vocational training in the country, including artisan training programmes. The role of DHET is to ensure that artisan development aligns with the country's broader skills development strategy. The department also administers the Skills Development Act, coordinates artisan-related education and training across various sectors and ensures that training providers adhere to national standards.
- **National Artisan Development Support Centre (NADSC):** The NADSC provides centralised support for artisan development initiatives across the country. It operates a system for managing the registration of learners for apprenticeships and trade tests, helping streamline the artisan development process. The NADSC offers assistance to learners, training providers, and employers by ensuring access to accurate information and resources for artisan training, making the overall process more efficient and organised.
- **Quality Council for Trades and Occupations (QCTO):** The QCTO is responsible for developing and managing South Africa's occupational qualifications system, including the certification of artisans. It ensures that artisan qualifications align with national occupational needs and standards. Additionally, the QCTO plays a key role in ensuring quality assurance by overseeing the training, testing, and certification processes to maintain a high standard of artisan training throughout the country.
- **National Artisan Moderation Body (NAMB):** Operating under the QCTO, NAMB focuses on moderating trade tests and ensuring that the certification process for artisans is standardised. NAMB guarantees that artisan trade tests are consistently applied across accredited testing centres, ensuring uniform evaluation of skills. It also verifies the accreditation of trade testing centres to ensure compliance with national regulations and quality standards.

- **South African Qualifications Authority (SAQA):** SAQA oversees the National Qualifications Framework (NQF) and ensures that artisan qualifications are recognised and properly registered. It collaborates with the QCTO to develop artisan qualifications that align with national standards and occupational requirements, ensuring that the qualifications meet the needs of South Africa's economy.
- **Human Resource Development Council (HRDC):** The HRDC plays a strategic role in overseeing and coordinating artisan development within the broader framework of human resource development in the country. It ensures that artisan development aligns with national economic objectives and advises the government on relevant policies. The HRDC facilitates collaboration between various stakeholders, including the DHET, SETAs, QCTO, industry bodies, and training institutions, to ensure a cohesive approach to artisan skills development. It also monitors and evaluates the implementation of artisan-related initiatives to ensure that national targets are met.

Mining and Minerals Sector specific

The following institutions are essential for artisan development at a sector level:

- **Mining Qualifications Authority (MQA):** The MQA is the primary authority responsible for skills development in the MMS. It ensures that artisans in mining-related occupations receive proper training, development, and certification through programmes such as learnerships, apprenticeships, and trade tests. The MQA funds these programmes so as to align artisan development with the specific needs of the mining industry. Additionally, the MQA plays a crucial role in maintaining the quality of artisan training and certification in the mining sector.
- **Department of Mineral Resources and Energy (DMRE):** The DMRE regulates the mining and energy sectors in South Africa and ensures that mining companies comply with regulations, including those related to artisan training and skills development. The department is integral in promoting artisan development through the enforcement of sectoral regulations, such as those outlined in the Mining Charter. By ensuring compliance, the DMRE contributes to building a skilled workforce within the mining sector.

- **Technical and Vocational Education and Training (TVET) Colleges:** TVET colleges provide technical and vocational education, including artisan training programmes aligned with the specific needs of the mining industry. These institutions offer both theoretical education and practical training for learners pursuing artisan qualifications. By aligning their curricula with industry demands, TVET colleges play a key role in preparing artisans for the workforce in the mining sector.
- **Mining Companies and Training Providers:** Mining companies, as part of their compliance with sectoral skills development obligations, often provide in-house training or partner with accredited training providers to develop artisans. Some mining companies offer workplace-based training, mentorship, and practical exposure for learners, while some operate accredited trade test centres to certify artisans. This ensures that the MMS produces artisans with the specific skills needed for their operations.

2.6.3. Artisan skills initiatives and interventions

Several initiatives have been implemented to support artisan training and development, and these include bursaries, recognition of prior learning, artisan aides and others.

- **Career Guidance and Maths and Science Support**

Career guidance initiatives are designed to enhance awareness among young people interested in careers within the MMS. These targeted interventions are critical in drawing new talent into artisan trades by educating students about requisite skills, career progression routes, and the benefits associated with pursuing a career in the MMS. The MQA supports, on average, over 70 career guidance events annually across the country. A central focus is placed on strengthening mathematics and science education, given the foundational role these subjects play in technical careers, including artisan trades. Improved proficiency in mathematics and science equips students with essential skills, increasing their potential for success in advanced technical training.

Research has shown that supplementary mathematics and science instruction enhances academic performance, supporting successful university admissions and career readiness

(Horak and Fricke, 2004; McCarthy and Oliphant, 2013; Priulla et al., 2023). Accordingly, each year, between 1 000 and 1 200 Grade 10 to 12 learners from historically disadvantaged backgrounds in rural, mining communities are provided with additional mathematics and science classes. Improving mathematics and science outcomes, along with raising the quality of Grade 12 pass rates, expands the pool of technically inclined learners ready to pursue careers in the MMS.

- **Bursaries**

Bursaries play a vital role in promoting and expanding access to higher education in the country, especially given the legacy of apartheid, which restricted educational and economic opportunities for many (Kaye, 2020). They help bridge historical inequalities by supporting students mainly from historically underrepresented and disadvantaged communities and thus compensate for financial disadvantage ensuring participation in higher education (de Villiers, 2023). It is on this premise that the MQA provides financial support to disadvantaged and qualifying students (MQA, 2018). From 2018, the awarding of bursaries was also extended to employed graduates in the MMS to ensure continuous learning and improvement. Figure 10 shows the total number of bursaries awarded by MQA between 2010/11 and 2022/23, against the number of learners that completed their studies.

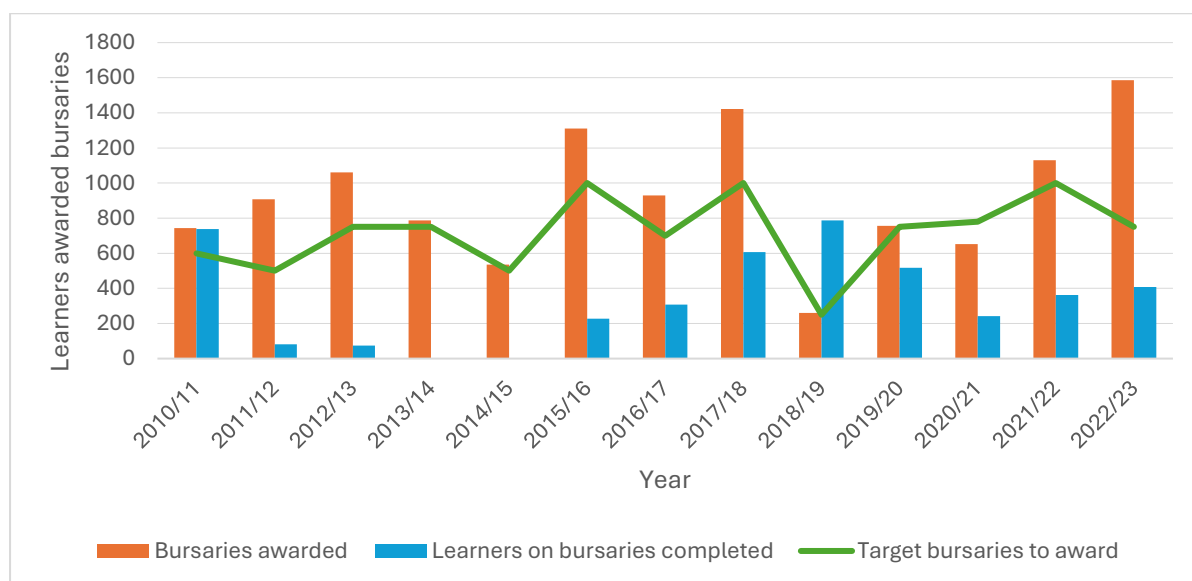


Figure 10: Bursaries awarded under the MQA bursary scheme between 2011 and 2022

(Mining Qualifications Authority, 2011-2023)

A total of 12 076 bursaries against a set target of 9 540 were awarded. The MQA exceeded its target by 26.5% during the period, indicating strong performance in funding learners' access to higher education. While this is the case, the completion rate among MQA bursary recipients remains lower. This has been attributed to several factors, in particular, the non-financial challenges that learners continue to face (Kaye, 2020 and Harrison et al, 2018).

- **Artisan Development Programmes/Projects**

As alluded above, a learner can qualify as an artisan through the Recognition of Prior Learning (RPL) for artisan aides, and the formal pathway. The MQA supports learners in all the routes to qualify as artisans.

Recognition of Prior Learning (RPL) programme for artisan aides: The RPL programme for artisan aides is a strategic initiative aimed at formally acknowledging the skills and practical experience that artisan aides have acquired through years of work in the MMS. Many artisan aides, who assist qualified artisans in various technical tasks, have accumulated significant on-the-job knowledge but often lack formal qualifications. The RPL programme therefore offers these workers an opportunity to have their skills assessed and recognised, allowing them to transition from informal roles to certified artisans.

This programme is particularly important for artisan development as it enables the MMS to tap into an existing pool of experienced workers. By providing artisan aides with a formal qualification based on their prior learning and experience, the RPL programme helps to expand the number of qualified artisans in the workforce without requiring them to undergo the lengthy, full-scale training programmes. This process accelerates the availability of skilled artisans and helps to meet the growing demand for these critical roles in the mining industry.

In addition to benefitting individual workers, the RPL programme supports career progression, offering artisan aides the opportunity to advance to fully qualified artisan positions. This not only enhances their employability but also provides them with better remuneration and career stability. For the MMS, the RPL programme ensures a continuous supply of skilled workers who are formally recognised for their abilities, contributing to improved productivity, safety, and efficiency in the workplace. Between 2011/12 and 2022/23, a total of 1 678 RPL artisan aides were upskilled to qualified artisans.

Work Placement for TVET NCV Graduates: The work placement programme is designed to bridge the gap between theoretical learning and practical application for TVET National Certificate Vocational (NCV) Level 4 learners. Despite the inclusion of practical components in the NCV curriculum, many graduates complete the programme without sufficient hands-on experience required for artisan roles. Thus, by strategically placing these learners with host employers, the programme enables them to gain on-the-job experience within the MMS. This direct exposure to the daily technical requirements of artisan roles equips learners with the practical skills and industry knowledge essential to meet sector demands. Figure 11 and Figure 12 illustrate the number of students enrolled in the NCV work placement programme and those who successfully qualified, measured against MQA targets.

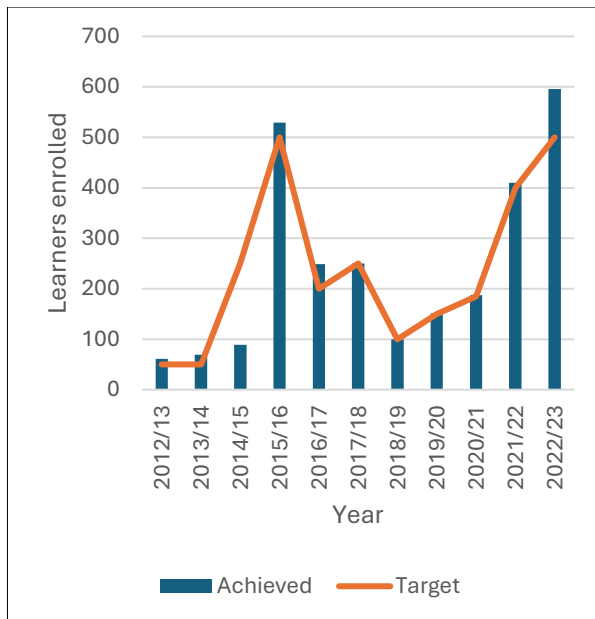


Figure 11: NCV4 TVET learners entering a work placement programme at a host employer against the targets

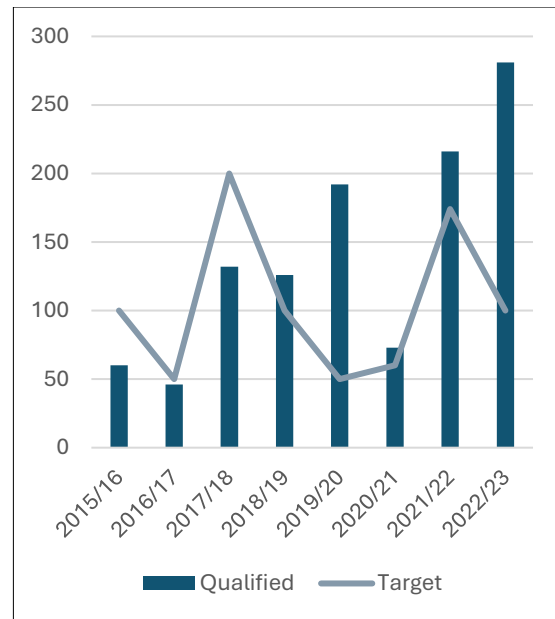


Figure 12: NCV4 TVET learners qualifying as artisans post the work placement programme

(Mining Qualifications Authority, 2013-2023)

In the period 2010/11 and 2022/23, the work placement programme facilitated placements for 2 738 learners with host companies, of whom 1 208 successfully completed the programme and qualified as artisans. The programme’s effectiveness in registering learners relies on employer demand and their willingness to accept NCV learners, hence the fluctuations. Over time, the programme has consistently exceeded its artisan qualification targets, underscoring MQA’s impact on professional development for aspiring artisans.

Formal Artisan Training Programmes: The artisan training programme represents the primary formal pathway for learners aiming to qualify as artisans after completing Nated levels (N2 – N6) or NCV4 qualification at a TVET college. This programme is the most contributor to artisan certification compared to other pathways, indicating its centrality to workforce development in the sector. Figure 13 illustrates the annual registration and qualification trends of learners in artisan training programmes from 2012/13 to 2022/23, highlighting shifts in enrolments over this period.

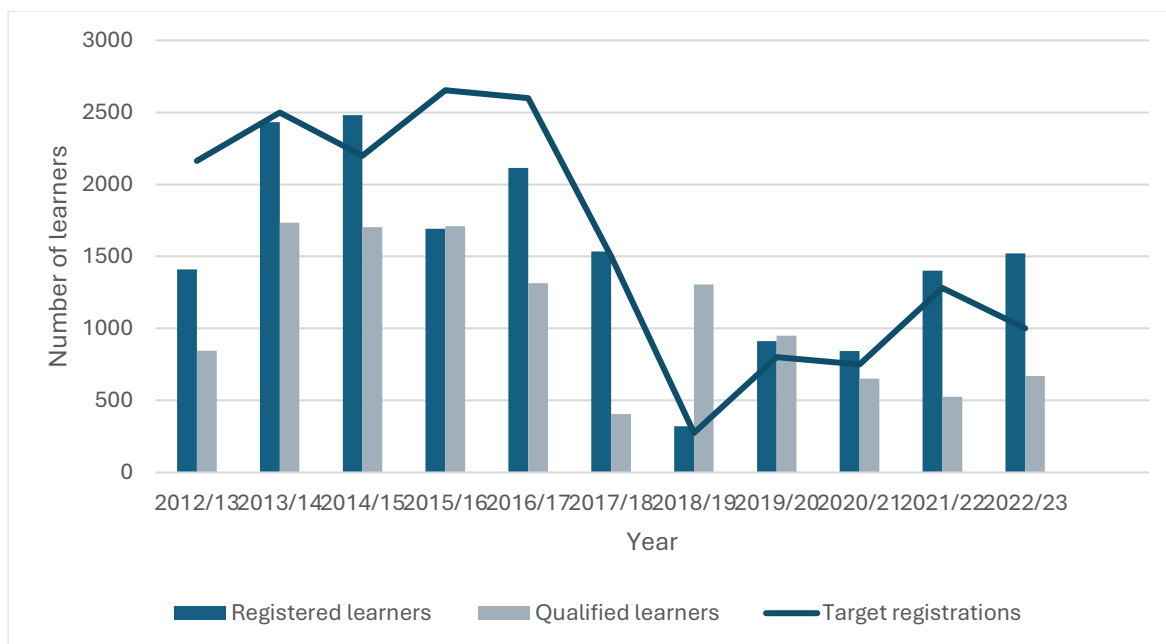


Figure 13: Artisan learners registered on training programmes between 2012 and 2022

(Mining Qualifications Authority, 2013-2023)

Enrolment in artisan training programmes saw a significant rise from 1 411 in 2012/13 to 2 482 in 2014/15 due to high activity in the sector, followed by a decline in 2015/16, a slight recovery in 2016/17, and a continued downward trend, reaching a low of 320 in 2018/19. This is attributed to the general mining down cycle and the after-effects of the five-month long strike in the platinum sector (Neil and Rerazano, 2021) which limited the placement and appetite of learners in the MMS. Enrolments began to increase again from 2019/20 onwards. Although increasing, the lower enrolments between 2019/20 and 2022/23 can largely be attributed to low economic activity due to the impacts of the Covid-19 pandemic. However, as economic conditions improve and mining companies experience stronger performance, a corresponding increase in artisan programme enrolments is observed. This upward trend may suggest renewed appetite from mining companies in supporting learners in artisan training programmes.

Figure 14 shows the number of learners who qualified as artisans under the MQA programmes between 2012/13 and 2022/23. The majority of artisans qualified through the formal artisan training programme followed by the RPL Artisan Aides programme and then the NCV work placement programme. As can be seen in the figure, the total number of learner

registrations is significantly higher than those qualifying and/or completing the programmes (Note: there is a duration of three to four years to completion after enrolment).

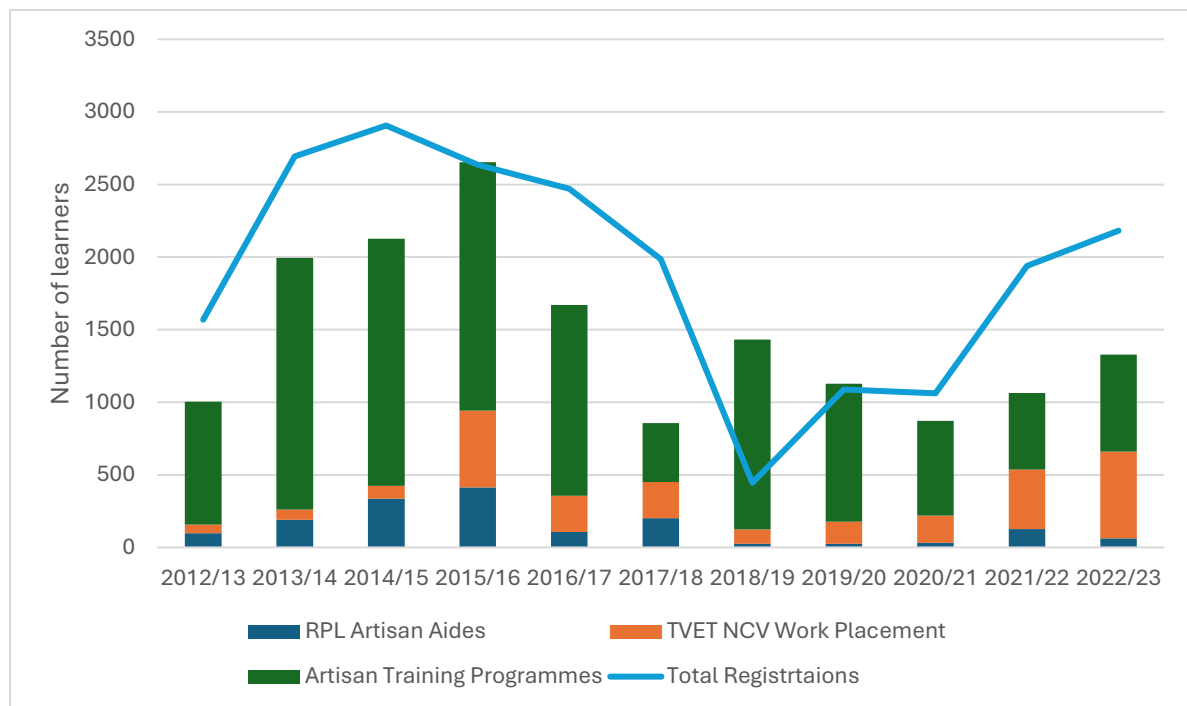


Figure 14: Qualified artisans in the mining and mineral sector between 2012/13 and 2022/23 (Mining Qualifications Authority, 2013-2023)

For the period under study, the throughput rate stood at 76.9%. However, the Government Technical Advisory Centre (GTAC) (2021) reported a throughput rate of 56%. This may be largely due to dropouts driven by factors outside the learning environment, such as socio-economic pressures and mental health issues.

Artisan Aides Certification: In the MMS, many individuals begin their careers as artisan aides, often working for years without formal recognition of their skills. To address this, the MQA developed the Artisan Aides Programme, which aims to acknowledge the skills and experience of entry-level workers (e.g., artisan assistants) by helping them attain the National Engineering Certificate at NQF Level 2. This certification, awarded through the RPL process, validates their existing competencies and serves as a stepping stone for those seeking formal training and qualification as artisans. However, completion of the programme does not

directly qualify participants as artisans; it instead enables them to pursue formal routes, such as apprenticeships or accredited training programmes, to achieve full artisan certification. Unemployed learners are also eligible to join the programme but must approach a mining company through which funding will be provided. Since the programme's inception, 1 566 Artisan Aides have been certified.

- **TVET lecturer support**

Research has shown that lecturer's competencies influence students' academic performance. Recognising the significance of lectures in developing artisan skills, the MQA has developed the TVET Lecturer Support programme that aims to enhance the skills and knowledge of educators responsible for training future artisans in the MMS. In addition to providing workplace exposure, where lecturers gain direct industry experience, the programme offers several other forms of support to improve the quality of teaching and learning at TVET colleges. These include bursaries for lecturers to pursue further studies, allowing them to deepen their understanding of subjects relevant to their fields and stay updated with advancements in the MMS. This academic support equips lecturers with the theoretical foundation necessary to improve their teaching quality. Through this initiative, lecturers participate in industry's specialised skills programmes, giving them hands-on experience with the latest technologies and practices in the mining sector. This practical exposure enables them to translate industry-relevant skills into their teaching.

The programme also funds assessor and moderator training. This helps improve their ability to evaluate student performance accurately and ensure the consistency and quality of assessments within the artisan training programmes. Collectively, these initiatives contribute towards strengthening the overall capacity of TVET lecturers, ensuring that students receive a high standard of education aligned with the current needs of the MMS.

- **Centres of Specialisation (CoS)**

The Centres of Specialisation (CoS) programme is a key initiative aimed at addressing the critical shortage of skilled artisans in the MMS by offering high-quality, industry-relevant training. The programme focuses on specific trades that are in high demand within the sector, such as millwrights, electricians, and fitters, ensuring that learners are trained in areas that align directly with the needs of the mining industry.

Centres of Specialisation are typically hosted by selected TVET colleges that are equipped with advanced training infrastructure and resources, ensuring that learners receive top-tier instruction. These centres work in close collaboration with industry stakeholders to ensure that the curriculum is tailored to the actual demands of the workplace, blending theoretical learning with practical, hands-on experience. This alignment ensures that graduates from CoS programmes are work-ready and equipped with the skills that are immediately applicable in the sector.

The CoS programme also facilitates partnerships between TVET colleges and industry employers, providing learners with the opportunity to undertake apprenticeships or practical placements during their training. This practical exposure is invaluable as it allows learners to apply their theoretical knowledge in real-world settings, gaining experience that enhances their employability upon graduation. Ultimately, the Centres of Specialisation play a pivotal role in developing a steady pipeline of highly skilled artisans, directly addressing the skills gaps within the MMS and contributing to the sector's growth and sustainability.

- **Marketing strategies/Awareness campaigns**

Recognising the negative perception on vocational institutions and the need to develop 30 000 qualified and skilled artisans by 2030, the DHET has launched a campaign called *“The Decade of the Artisan”* with the theme *“It’s cool to be a 21st century artisan”* which seeks to promote artisanship as a career of choice for the country’s youth within the post-school education and training system as well as highlight skills development opportunities for artisans. This initiative has set the target of attracting 60% high school leavers to trade qualifications in order to meet the country’s skills demand for scarce skills (Bulbilia, 2023).

- **Youth Employment Service (YES) Programme**

The Youth Employment Service (YES) programme is a South African initiative aimed at tackling youth unemployment by creating job opportunities and providing work experience for young people between the ages of 18 and 35. YES focuses on improving the employability of South African youth by placing them in structured, one-year work experiences across various sectors that align with South Africa's economic sectors, including the MMS. This is a collaborative effort between government, business, and labour, and as such mining companies and training centres have taken part in the programme by training artisans.

2.7. Case studies and international experiences

This section examines approaches toward artisan skills development and training in four case study countries: Chile, Australia, Germany and Canada. The discussion provides insights on history of the programmes, design and structure as well as stakeholder participation in the programmes. The recent adoption of the Dual System Pilot Project by South Africa is also discussed.

2.7.1. Chile

Chile's apprenticeship programme, formerly known as the "Aprendices" programme and now called "Training in the Workplace", is a dual training system aimed at improving the employability of young people with low employment prospects (Rojas et al., 2020). The programme is implemented by the National Training and Employment Service (SENCE), and it combines theoretical instruction with practical on-the-job experience that takes place in companies (OECD, 2018). It targets youth between the ages of 15 and 25 (or up to 26 for those with disabilities) and requires participants to have a learning contract with an employer. The following are key features of the programme (OECD, 2018; Rojas et al., 2020)

- **Training Structure:** Combines on-the-job training with classroom-based learning provided by Organismos Técnicos de Capacitación (OTECs), which administer apprenticeships nationally. OTEC means Technical Training Organisation, and it is an institution authorised to provide vocational training in Chile by their National Training and Employment Service.

- **Compensation:** Apprentices receive at least the minimum wage during training (i.e., up to a maximum of two wages) ensuring financial support during their training period.
 - **Certification:** On completing the programme, a certificate is awarded. Even though it is recognised by SENCE, it currently lacks coordination with formal vocational education and ChileValora (the national certification organisation). As a result, there is no link to the formal education system or guarantee progression to further formal education.
 - **Regulation and Quality Assurance:** The programme is overseen by SENCE under the Ministry of Labor and Social Security. Chile Valora, the national labour skills certification system, plays a role in certifying competencies regardless of how they were acquired. Additionally, training providers (OTECs) and company trainers must be registered and approved by SENCE.
 - **Participation Rates:** The apprenticeship programme is underutilised, with only 1 286 participants in 2016, representing 0.9% of the target population.
 - **Outcomes:** Evaluations indicate positive effects on employment prospects, with 40% of participants staying with the same firm and 20% finding jobs related to their training.
- Financing:** The government finances 50% of the minimum wage for apprentices, with employers covering the remainder. Employers also receive a grant for training costs per apprentice.

2.7.2. Australia

At its core, the Australian apprenticeship system is a formal vocational training programme that combines on-the-job and off-the-job training. The system encompasses both traditional apprenticeships, typically lasting three to four years in trades and crafts, and shorter traineeships, generally lasting around one year in service sector and newer occupations. Apprentices and trainees are employed and paid by their employers, working under the guidance of experienced mentors while also undertaking training with Registered Training Organisations (RTOs). The programme targets both young people and adults. Some of the key features of the system are as follows (Smit, 2021)

- **Training Duration:** Apprenticeships range from one to four years, with traditional apprenticeships typically lasting three to four years and traineeships generally one year.
- **Certification:** Upon completion, apprentices attain a qualification under the Australian Qualifications Framework.
- **Regulation:** The system is overseen by both national (Commonwealth) and State/Territory governments, with involvement from social partners.
- **Integration:** Apprentices have employee status and are paid as such, with training taking place both on and off the job.
- **Scope:** The system covers a large range of occupations, including traditional trades and newer service sector roles such as information technology.
- **Intermediaries:** Specialist organisations like Group Training Organizations (GTOs) and Australian Apprenticeship Support Network providers (AASNs) play important roles in supporting and administering apprenticeships.
- **Training Providers:** Off-the-job training is usually conducted in adult Vocational Education and Training (VET) providers, including both public (TAFE) and private institutions.
- **Assessments:** These are based on national competency standards developed by industry committees, with Registered Training Organisations (RTOs) responsible for all assessment.
- **Completion Rates:** While the system has relatively low completion rates (around 45% for young apprentices in traditional trades), those who complete often progress to secure permanent employment.

2.7.3. Germany

The German apprenticeship system is known for its structured dual system where theoretical classroom instruction is combined with practical on-the-job training. The programme integrates classroom learning at vocational schools with hands-on work experience in real businesses, creating a comprehensive training approach. Apprentices usually divide their time during the week between attending vocational school for general education and theoretical learning and working under the guidance of experienced mentors in companies to acquire

hands-on skills. The federal government is responsible for vocational training in companies, while the federal states (Länder) are responsible for vocational schools. This institutionalised cooperation is based on a principle of consensus among the Federal Government, the Federal States, and social partners. The programme targets mostly young people who become eligible after completing their compulsory education, at around 15 or 16 years of age. The following are key features of the programmes (Oh, 2024; Federal Ministry of Education and Research. (n.d); Federal Foreign Office (n.d)):

- **Training Duration:** Apprenticeships typically last between two to three and a half years, varying based on the complexity of the profession.
- **Participation Rates:** The dual system accounts for about 66.5% of learners in the vocational education and training (VET) system as of 2020, with approximately 1 288 962 apprentices registered nationwide.
- **Certification:** Upon completion, apprentices receive a nationally recognised certificate in their vocational field, which is highly valued in the job market.
- **Regulation:** The system is regulated by the government in collaboration with industry representatives, ensuring that training standards remain high and are aligned with industry needs. The Vocational Training Act (BBiG), first adopted in 1969 and amended in 2005 and 2020, regulates vocational training.
- **Integration:** Apprentices are considered part-time employees of the companies that they train with, often receiving a stipend and other benefits. Private companies bear two-thirds of the total costs of vocational training, viewing it as the best way to meet their need for skilled staff.

2.7.4. Canada

The Canadian apprenticeship system is designed to develop skilled workers across various trades, and this is done through a combination of on-the-job training and classroom instruction. Due to Canada's federal structure, apprenticeship programmes are primarily administered at the provincial and territorial level, resulting in 13 distinct systems with some commonalities. The Interprovincial Standards Red Seal Programme provides a national standard, allowing for the recognition of trade qualifications across provinces and territories.

Apprentices typically secure employment with an employer who acts as a sponsor and provides workplace training, supplemented by periods of technical training at colleges or training centres. Apprenticeship in Canada has largely been an adult programme, with a median age between 27 and 30 years old. However, there are initiatives in place to encourage younger individuals, including high school students to enter apprenticeship programmes directly from secondary education. Below are some of the key features of the programme (ILO, 2013)

- **Governance and Structure:** Apprenticeship programmes are administered by the provinces and territories, leading to variations in requirements and regulations across Canada. The federal government promotes apprenticeship at the national level and maintains inter-provincial standards through the Red Seal Programme.
- **Training Duration:** Apprenticeships typically last from two to five years or more, depending on the trade and the accumulation of required on-the-job hours and technical training.
- **Training Structure:** Apprenticeships combine 80% hands-on work experience under qualified journey persons (i.e., with a sponsoring employer) and 20% technical training. This classroom instruction occurs in 4 - 10 week annual blocks at colleges, union centres, private facilities, or online.
- **Certification:** In most provinces and territories, the Interprovincial Red Seal Examination serves as the final assessment for trades designated under the Red Seal Programme. The certificates bearing the Red Seal endorsement are highly valued and facilitate labour mobility across provinces.
- **Regulation and Quality Assurance:** Provincial/territorial apprenticeship authorities oversee the programme standards and certification, designating trades as either compulsory (certification required) or voluntary. They also offer Prior Learning Assessment and Recognition (PLAR) to acknowledge existing skills and training.
- **Financial Support:** The federal government and provinces offer various grants and incentives to support apprentices and employers, including Employment Insurance benefits, Apprenticeship Incentive and Completion Grants, and Tax credits and training subsidies for employers.

- **Participation and Diversity:** Women comprise around 13% of all apprentices, with higher representation in trades like food and service. Efforts are being made to increase participation among underrepresented groups, including women, indigenous peoples, and immigrants.

2.7.5. Discussions

Apprenticeship systems can be categorised based on their focus and size relative to the labour force. A system is considered "large" if the apprentice-to-labour force ratio exceeds 1.5%, while a ratio of 1.5% or lower is considered "small." Countries like Germany and Australia have some of the largest apprenticeship systems, with over 3.7% of their labour force engaged in these programmes. On the other hand, countries such as the United States have smaller systems, with only 0.3% participation (ILO, 2013). South Africa currently also falls into the "small" category, with an apprentice-to-labour force ratio of 0.4%. Approximately 68,000 artisans and learners are enrolled in apprenticeship programmes, out of a total working population of about 16.6 million (Stats SA, 2023; DHET, 2023).

Comparing apprenticeship participation from a decade ago to 2023 reveals both stability in some countries and shifts in other countries. Germany and Australia's dominance in training artisans remains in 2023, with Australia still maintaining 3.7% of its workforce, while Germany dropping slightly to about 3.5%; however, the number of participants is estimated around 1.6 million apprentices (Federal Employment Agency, 2024; Johnson, 2023). The United Kingdom (UK) has seen growth from having relatively smaller participation (with about 530,000 apprentices in 2014) to 752 000 apprentices in 2023. This represents 2.7% of the workforce (Department for Education, 2023). Meanwhile, the United States, which had only 0.3% apprenticeship participation in 2013, has also seen improvements, reaching 0.4% of the workforce with around 600 000 apprentices in 2023 (Johnson, 2023). The overall trend shows efforts to modernise and expand apprenticeships, particularly in non-traditional sectors.

The ability to expand apprenticeship systems to include new occupations varies significantly across countries, affecting the supply of skilled labour in emerging industries. In the UK, for example, strong political commitment has facilitated the rapid development of new apprenticeship frameworks. In other countries, more incremental approaches have been

adopted, often led by social partners. While this is the case, several challenges have been noted including the complex and lengthy agreements on occupational designations which hinder progress, as seen in Canada, where regional disparities complicate the establishment of a consistent national system (ILO, 2013).

As highlighted by ILO (2013), support during the life cycle of an apprentice can play a crucial role in enhancing completion rates and skill development. As such, the most common model among the selected countries is the dual training system model where external training providers supplement employer-led training. This approach not only broadens apprentices' skills and provides peer support but also incorporates additional mentorship structures. France, for example, utilises a “pedagogical-referent tutor”, serving as a quasi-case manager for apprentices, while Australia and UK often implement “case manager” models through Group Training Organisations and Apprenticeship Training Agencies, respectively (ILO, 2013). The other models seen in some countries include apprentice masters in large companies or committees of employers and chambers. These support structures have been established to support apprentices, who are mostly young, and need assistance in adapting to working life into their chosen occupations.

Empirical evidence on the rate of return of large-scale adoption of apprentice system in relations to economy are limited, but several studies has revealed several key points. First, it has been found that replacing vocational education with general training does not necessarily improve labour market outcomes, suggesting that observed differences are due to selection effects. Second, there is a trade-off between early career gains and later disadvantages for vocational education students compared to those in general education, with the net effect varying by country and programme.

Third, outcomes differ significantly based on gender, occupation, and skill level, highlighting the need for nuanced analysis. Finally, the findings are highly context-specific, limiting their applicability across different countries (Muehlemann & Wolter 2020). In their 2021 study, Samoliuk, Bilan and Mishchuk found a positive relationship between vocational training costs and GDP per capita for the large-scale adopting countries. In Switzerland, it was realised that the financial burden on the government will quadruple for school-based programmes compared to firm-based apprenticeships.

Challenges in Apprenticeship Systems Across Countries

Countries face several common challenges in their apprenticeship systems, albeit with different regional contexts and nuances. In Australia, key issues include encouraging higher completion rates, attracting high-quality applicants in booming industries, and harmonising apprenticeship arrangements across states. Improving curriculum quality and ensuring “value for money” from government investment also remain areas of concern. In Canada, despite progress in recruitment and retention, long-standing issues such as gender segregation and unequal quality perceptions persist. Efforts to address these issues, including publicly funded schemes and incentives, have yielded limited results. Germany faces bureaucratic challenges, including difficulties in increasing permeability between academic and vocational education, and shortages of suitable candidates in certain regions. Meanwhile, Chile’s apprenticeship system is in its nascent stages, with efforts focused more on building foundational support and infrastructure for future expansion (ILO, 2013).

Updates on Apprenticeship Developments Across Countries

The apprenticeship systems in Australia, Germany, and Canada have undergone various changes and improvements, yet each faces unique challenges and opportunities. In Australia, the MMS has experienced significant growth in apprenticeship participation. In 2022, apprenticeships in the mining sector increased by 19%, with notable increases among women (26%) and Aboriginal and Torres Strait Islander individuals (14%) (Constable, 2023). These gains are a result of collaborative industry initiatives aimed at creating tailored work readiness, apprenticeship, traineeship, cadetship, and recruitment pathways. Despite the successes, proposed policy changes, such as “Same Job, Same Pay”, have been highlighted as impeding the future growth of artisanship by requiring equal pay for inexperienced apprentices, which could discourage their employment (Constable, 2023).

Germany continues to have an apprenticeship market with ample opportunities; however, challenges persist in matching candidates to positions, particularly in physically demanding trades such as metalwork, construction, and warehousing. Many high school graduates are opting for less physically intensive careers, leading to shortages in skilled trades. Programmes like the Ahr Valley initiative are helping bridge the skilled labour gap by combining volunteering with practical trade experience, providing innovative pathways to attract young

people to trade careers. Such regional programmes have proven effective in addressing labour shortages in certain regions (Wrede, 2023; Federal Employment Agency, 2023).

Canada has seen progress in recruiting and retaining apprentices, but long-standing issues of gender segregation and disparities in labour market outcomes remain. Women continue to be underrepresented and are more likely to enter lower-paying trades, while male-dominated trades, such as heavy-duty roles, have the highest median earnings (Finnie, 2021). Notably, in the first few years after certification, junior persons in many trades earn more on average than bachelor's degree graduates, which demonstrates the value of skilled trades. Despite these positive indicators, there is a need for better data on labour market outcomes for trade certificate holders compared to post-secondary graduates, which could help inform targeted interventions and support improvements in the apprenticeship system (Finnie, 2021).

Overall, the updates on apprenticeship systems across these countries reveal both progress and persistent challenges. Australia has achieved notable gains in diversity within its mining apprenticeships but faces potential policy obstacles. Germany struggles with attracting candidates to physically demanding trades, although regional initiatives show promise in addressing these shortages. Meanwhile, Canada continues to face gender-related disparities in the trades, underscoring the need for ongoing policy improvements and better labour market information. Despite these challenges, all three countries exhibit a commitment to fostering apprenticeship growth and workforce development. In countries such as Chile, the formal apprenticeship system is still in its early stages, and thus expansion has not yet become a primary focus (Rojas, et. al, 2020).

2.7.6. Case Study of recent dual system pilot project in South Africa

The Dual System Pilot Project (DSPP), supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in collaboration with the Department of Higher Education and Training, represents a milestone effort in transforming occupational training in South Africa. The project aimed to modernise vocational education by implementing dual training approaches, focusing on practical, workplace-based training combined with theoretical instruction at Technical and Vocational Education and Training colleges. This section summarises the context, lessons learnt, processes, and outcomes as documented in the report.

Context and objectives

The DSPP, launched as a pilot measure, sought to address critical issues in the South African labour market, including the shortage of qualified artisans, the declining quality of apprenticeship training, and the systemic weaknesses in training. It was part of the broader Skills Development for a Green Economy II (SD4GE II) programme, implemented over four years, from April 2018 to May 2022. The programme was designed to enhance collaboration between vocational training institutions and the private sector, focusing on employment-oriented training.

The project also leveraged lessons learnt from previous global and local pilot projects, promoting a dual system characterised by two distinct learning avenues—theoretical knowledge at TVET colleges and practical, structured training in companies. The goal was to build a pool of skilled artisans capable of meeting 21st-century workplace requirements, particularly in the electrical and plumbing trades.

Core processes and lessons learnt

The DSPP identified and implemented five core processes as foundational to the successful implementation of the dual training:

1. **Recruitment of Apprentices:** The recruitment of suitable candidates was a critical step in the programme. Employers and TVET colleges collaborated to select apprentices based on foundational learning competence (FLC) assessments and practical suitability. Lessons learnt included the importance of refining selection criteria to emphasise passion and work ethic, as some apprentices lacked the commitment needed for success.
2. **Cooperation of Companies for Learning at the Workplace:** The involvement of companies played a significant role in ensuring practical exposure. The cooperation between TVET colleges, lead employers, host employers, and direct employers was crucial in terms of addressing institutional challenges. Regular interaction between stakeholders helped align theoretical training with workplace requirements.
3. **Quality Assurance in TVET Colleges and the Workplace:** The quality assurance process aimed to improve training standards and outcomes by developing a 7-step quality assurance model and introducing the Work-Based Learning and Development (WBLD)

Practitioner Programme was implemented. Several lessons were drawn including the need for stronger involvement from stakeholders and better time allocation for training practitioners.

4. **Examination and Assessment of Dual Training Approaches:** Developing formative assessments for multiple trades was another core process. The integration of theoretical and practical elements was important in preparing apprentices for the workplace ensuring that training is aligned to industry requirements. Amongst the lessons drawn was the need to secure industry experts and the need for enhanced facilitator support.
5. **Alignment of Curricula to 21st-Century Requirements:** The curriculum review process included online workshops and employer surveys to assess industry needs and modernise training content. However, limited participation from stakeholders during workshops and surveys revealed the need for better engagement strategies.

Key outcomes and insights

The success of the DSPP in South Africa can be attributed to several key factors. The customisation of the five core processes to meet the unique needs of the South African context ensured that the programme was highly relevant and impactful. Moreover, the involvement of international organisations, such as the International Labour Organisation and the German Federal Institute for Vocational Education and Training (BIBB), provided vital expertise and guidance. This significantly enhanced the quality and credibility of the training for the 240 electrician and plumber apprentices who underwent a 3-year dual occupational programme across 70 training companies and 5 TVET colleges. Additionally, the strong collaboration between local stakeholders, including TVET colleges, employers, and industry bodies, fostered a supportive ecosystem that was crucial to the success of the dual occupational training system.

Key insights emphasised the importance of stakeholder cooperation, refinement of selection processes, and quality assurance measures to improve training effectiveness. The importance of establishing formal channels of communication and defined roles for stakeholders was also stressed as essential for future implementation of artisan training projects. Cooperation between TVET colleges and employers, refinement of recruitment processes, and a structured

approach to quality assurance were foundational in terms of transforming vocational training. As South Africa aims to bridge the skills gap, initiatives like the DSPP can serve as a blueprint for fostering a more productive, employment-ready workforce.

2.8. Summary and conclusion

The review of artisan skills supply and demand within South Africa's MMS highlights the critical role artisans play in sustaining the sector's productivity, safety, and technological advancement. The study reveals several key challenges facing the sector, including a persistent shortage of artisans in crucial trades such as diesel mechanics, millwrights, and electricians. These shortages are exacerbated by factors such as a lack of work-readiness among graduates, outdated training curricula, and geographical barriers that make it difficult to attract and retain skilled labour in remote mining regions.

The skills gap between the qualifications of many artisans and the specific, advanced competencies required by the MMS remains a concern. This gap is driven by technological changes, including automation and mechanisation, which have increased the demand for artisans proficient in digital tools, remote monitoring systems, and automated machinery. Furthermore, soft skills such as problem-solving, critical thinking, and communication are increasingly valued, yet are often lacking in the workforce, making artisans less adaptable to the rapidly evolving sector.

The artisan training ecosystem, including TVET colleges, learnerships, and apprenticeship programmes, play a pivotal role in artisan development. However, the current system faces challenges related to the quality of education, particularly in TVET institutions, where the qualifications and experience of lecturers have been cited as a concern. Efforts to improve TVET lecturer support, alongside initiatives such as the Centres of Specialisation, are essential for elevating the quality of artisan training and aligning it with industry needs.

Policy frameworks such as the Skills Development Act, National Development Plan 2030, and the Mining Charter have laid the groundwork for artisan development, but further alignment between policy objectives and industry requirements is necessary. The Recognition of Prior Learning pathway has emerged as a key strategy for addressing skills shortages by formalising the competencies of experienced workers who lack formal qualifications. Moreover, national

initiatives like the Youth Employment Service programme and marketing strategies targeting youth are key in increasing the number of young people who take interest in artisan trade as a career. This is critical given the need to address the issues brought by aging artisan workforce and the underrepresentation of women in the artisans working in the MMS in the country.

International case studies, particularly from Germany and Australia, demonstrate the potential benefits of a well-structured apprenticeship system that integrates on-the-job learning with formal education. These models emphasise the importance of collaboration between government, industry, and educational institutions to ensure the alignment of training programmes with the needs of the sector. The case studies also highlight the importance of artisan qualifications that are recognised nationally and across industries. For South Africa, the challenge lies in adapting these models to local conditions, particularly the need for expanded access to apprenticeship opportunities and establishing more targeted industry partnerships.

As such, addressing the skills shortages in the MMS will require a multi-faceted approach that includes improving the quality and relevance of artisan training, expanding pathways for certification, and fostering stronger collaboration between industry and education providers. By focusing on these areas, South Africa can not only meet the current demand for artisans but also ensure that the workforce is prepared to navigate the future challenges posed by technological advancements and global economic trends. The success of these efforts is crucial, not only for the sustainability of the mining sector but also for its broader contribution to national economic growth, employment, and social development goals. As a starting point, it is important to reconcile artisan training and supply with industry needs and demand to ensure that there is a clear line of key aspects that need to be addressed.

3. APPROACH TO THE STUDY

3.1. Introduction

Research methodology is a systematic approach that is employed to address research problems. This is done through collection, analysis, interpretation, and presentation of data. The selection of an appropriate methodology is informed by the objectives of the study ensuring that accurate data is collected, analysed and used to respond to aspects being investigated in a particular study. This chapter presents the methodology that was followed in the study. The components discussed in the chapter include research design, data collection and analysis methods, research reliability and validity, ethical requirements as well as study limitations.

3.2. Theoretical and conceptual frameworks for the study

Skills mismatch theory has gained focus in labour economics and policy formulation and according to McGuinness et al (2018), the theory is positioned to explain the inefficiencies within the labour market. Specifically, the theory is concerned with the discrepancy between the skills that workers have and those required by employers (International Labour Organisation, 2022). Pellizzari and Fichen (2017) highlighted that skills mismatch can be constructed by comparing skills and/or qualifications of an employed worker with the skill and/or qualifications requirements of the job.

In doing so, a “good match” is established when the skills/qualifications of the employee are compatible with the job requirements (Pellizzari and Fichen, 2017). According to the Department of Higher Education and Training (2022a:17), skills mismatch “*occurs where the skills supplied by an individual do not match the demand exactly but are sufficiently close for employers to hire the worker*”. Skills mismatch results from either the inadequacy of employees’ skills when assessed against the requirements of the job or when the employee has skills that exceed the job requirements.

A skills mismatch can be interpreted through several lenses. For example, over-skilling and under-skilling where the former describes a situation where the worker possesses more skills than what their job requires. Under-skilling, on the other hand, denotes a situation where the current skills of the worker do not meet the demands of the job (McGuinness et al, 2018). The

International Labour Organisation (2022) also made references to skills obsolescence where skills become obsolete. As highlighted by McGuinness et al (2018), skills obsolescence can be linked to ageing which reduces certain manual skills (i.e., this is referred to as physical obsolescence), technological advancement rendering some skills redundant (i.e., economic obsolescence), and/or complete underutilisation of skills (i.e., skills atrophy). According to the Department of Higher Education and Training (2022a), skills mismatch can be classified as either a skills gap, qualification mismatch or field-of-study mismatch.

Horizontal mismatch is another measure of skills mismatch, and this is defined as the *“extent to which workers are employed in occupations that are unrelated to their principal field of study”* (McGuinness et al, 2018:990). Skills gap is another commonly used measure which is situated within a context where workers lack the necessary skills to deliver the job demands. Within this situation, employers would submit that the current workforce do not have certain skills needed to effectively deliver their work responsibilities (Sutcliffe and Bannister, 2020). Skills mismatch can also be explained in terms of skills shortages, which is equated to the lack of qualified individuals in the labour market. As explained by McGuinness et al (2018:991) skills shortages encompass *“unfilled or hard-to-fill vacancies that have arisen as a consequence of a lack of qualified candidates for posts”*.

According to Cappelli (2015), the skills mismatch theory provides a framework for identifying areas where there are disparities between labour supply and demand. This is critical for policymakers in ensuring that interventions that are implemented are targeted at the points of diversion within the labour market. Another advantage of the skills mismatch theory is that it can underpin workforce development particularly in cases where reskilling and upskilling is required to enable the workforce to meet the evolving job requirements (Organisation for Economic Co-operation and Development, 2016). According to Acemoglu and Restrepo (2020), the theory can also be used to explain structural unemployment affecting countries.

Figure 15 presents a framework developed by the Department of Higher Education and Training which can be used to establish skills mismatch. The framework highlights the importance of understanding the broader context which has a bearing on skills supply and demand in the various economic sectors. In particular, it is important to understand the factors affecting skills supply and demand. According to the Department of Higher Education

and Training (2022a), there are a number of factors that can affect the supply of and demand for skills either directly or indirectly and these can encompass current events, for example Covid-19 pandemic or long-term trends, such as globalisation and climate change which necessitate changes within particular sector.

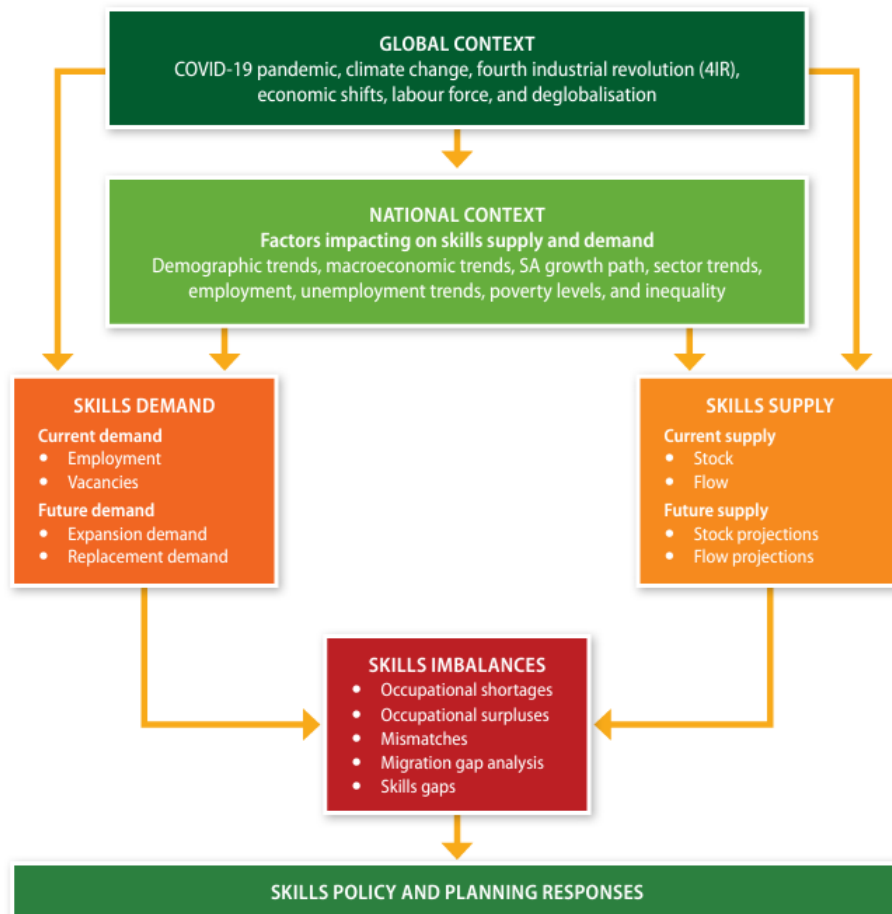


Figure 15: Framework for analysis of skills supply, demand and mismatches

(Source: Department of Higher Education and Training, 2022a)

Skills supply is described as skills “possessed by individuals who are either working (the employed) or willing, able and available to work (the unemployed)” (Department of Higher Education and Training, 2022a:16). Essentially, skills supply encompasses the skills that labour force has (Department of Higher Education and Training, 2022a). There are several factors that influence skills supply including demographic, economic, educational, and technological factors that determine the volume and quality of workforce capabilities.

Skills demand, on the other hand, is defined as “human resources and competencies required by employers at prevailing wages rates to meet their operational needs at a given point in time” (Department of Higher Education and Training, 2022a:16). Skills demand is also influenced by a myriad of factors which can be linked to technological, economic, structural, and strategic factors and these continue to affect the labour market's requirements. Reconciling supply and demand of skills is important in that it allows for identification of gaps between available workforce capabilities and employer needs. This analysis enables policymakers, educational institutions, industry and other key stakeholders to develop targeted interventions aimed at addressing skills mismatches. The Department of Higher Education and Training (2022a), noted that, in a situation where there is alignment between skills supply and demand, no changes or interventions will be required in the education and training system. Misalignment in skills supply and demand marks a skills mismatch in the labour market which will need to be addressed through targeted interventions.

In this study, the skills mismatch theory is employed to identify and analyse the skills gaps of artisans in relation to the demands of the MMS. This theoretical framework provides a foundation through which the bottlenecks resulting in skills mismatches can be identified. By examining the mismatches, the research aims to provide targeted recommendations directed towards increasing the alignment between artisan supply and demand in the MMS, thereby addressing both the skills shortages and the rising unemployment rate amongst qualifying artisans.

3.3. Research design

The study employed a mixed methods research design. A mixed methods research design involves the use of qualitative and quantitative methods of data collection and analysis. This design is selected because it enables the researcher to gain increased understanding of a topic under investigation because of the use of different sources of data (Dawadi et al, 2021). One of its benefits is that it allows for the use the different methods which complement each other. Creswell et al (2011) indicated that the use of several research methods fosters interdisciplinary collaboration leading to results that are comprehensive and convincing.

The mixed methods approach also allows for triangulation of data thereby increasing the reliability of the results emanating from the study (Dunning et al, 2008). The shortcomings of the mixed-method approach include potential conflict in the theoretical underpinnings of the methods used. As such, it is important that the selection of data collection and analysis methods are guided by research questions to ensure that the methods used are those that can best address the research objectives. The two components of the methodology are elaborated below:

- **Quantitative methods** involve the collection and analysis of numeric data to describe, understand, explain, predict, and control variables and phenomena being studied. Creswell (2009) noted that quantitative methods are used to examine relationships between variables, such as dependents, independent and extraneous. There are several methods falling under this category and in the study, survey methods were used to collect the data for the study.
- **Qualitative methods** focus on human experiences to provide holistic and in-depth understanding of issues being investigated (Vishnevsky and Beanlands, 2004). Several techniques can be used to collect data and for this study, key informant interviews (KIIs) were used. Key informants are study participants that have expert knowledge, expertise and/or unique access to information about a community or a topic under investigation (Lokot, 2021).

3.4. Data collection methods

There were two phases to the data collection, and this are depicted on Figure 16. Primary and secondary data were collected through three methods, namely, literature and document review, rapid surveys and key informant interviews. The different methods are elaborated below.

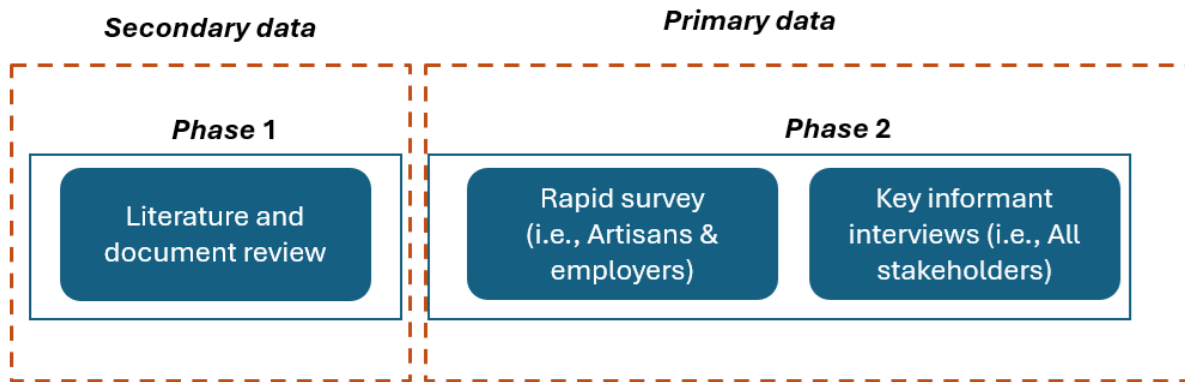


Figure 16: Data collection framework

- **Literature and document review** – Desktop research was conducted to obtain relevant literature for the study. Different sources of data were used and these included peer reviewed papers, reports, online material, as well as grey literature. The key documents that were used in the study include MQA’s sector skills plans, annual reports, reports published by the Department of Higher Education and Training (DHET) and other relevant literature.
- **Rapid survey** – Two surveys were created to serve as data collection instruments for the study. The first survey was administered to artisans working in MMS. The survey was used to obtain the insights of artisans on skills and competencies, as well as artisan training and skills development programmes implemented in the sector. The second survey was administered to employers. In the context of the study, employers are mine personnel who are responsible for recruiting and training artisans and these include Human Resource Development (HRD) personnel, training managers and facilitators, etc.). Employers also included mine personnel who is working directly with artisans (i.e., Engineers, Foreman, and others). This survey was used to solicit the perspectives of employers on the employability of artisans as well as skills needs of the MMS.

Both surveys were created online using Microsoft Forms. The surveys were distributed using various channels to ensure a broad reach among artisans and employers. These included sharing the surveys through WhatsApp groups, cold calling qualified artisans found in the MQA database, sending emails to artisans and training officials and conducting visits to mine training centres in the North West and Northern Cape provinces.

Voluntary and snowballing sampling methods were employed in the study. With voluntary sampling, eligible participants volunteer to take part in the study. The process of implementing the sampling method starts with the research information being sent to the potential participants prior to the study. The participant will then use this information to decide if they will take part in the research or not (Murairwa, 2015). Snowballing sampling, on the other hand, is a sampling technique where the researcher would ask participants to assist in identifying other potential participants (Naderifar et al, 2017). This method is best placed to support data collection where it may be difficult to access target participants. Both sampling methods were selected because they are efficient and cost effective and enable the use of existing networks to access study participants.

Sample size determination is an important step in research design to ensure the adequacy of data collection which would translate into the credibility of the results emanating from the study. Several methods have been developed that allows sample size determination based on a set of judgements (i.e., in the case of non-probability sampling methods). According to Ward (2022) a minimum sample size of 100 is usually considered sufficient to allow for meaningful analysis. There are about 45,000 artisans working in the MMS, and using the sample size formula for finite populations, the sample size for the artisan survey was estimated at 174 (i.e., this is rounded to 200).

The MQA reported that there were 2 352 registered levy paying employers in the MMS as of June 2023. Taking this as the total number of number of employers, the sample size for the survey targeting employers was estimated at 93 (i.e., this is rounded to 100).

Table 5 shows the target and achieved sample size for both the artisan and employer surveys, and this is presented according to the subsectors in MMS. The targeted samples were calculated based on percentage shared of employees in the different subsectors. As noted, the target sample size for the artisan survey was 200 and this was exceeded with 297 surveys being completed. This equated to 148.5% achievement rate. The target sample size for the employer survey was 100 and this was also exceeded with 177 surveys completed. This translated to 177% achievement rate. From the employer survey, planned representation was achieved across the different subsectors. In the artisan surveys, the target sample was not

attained in four subsectors, however the number of participants is sufficient for meaningful analysis.

Table 5: Target and achieved sample size for the artisan and employer surveys

Subsector	Target		Achieved	
	Artisans	Employers	Artisans	Employers
PGM Mining	71	35	101	39
Gold Mining	37	18	32	26
Coal Mining	37	18	29	27
Diamond Mining	6	3	7	3
Other Mining	31	15	98	40
Diamond Processing	1	0	0	3
CLAS	5	2	2	6
Jewellery Manufacturing	1	0	11	8
Services Incidental to Mining	13	6	17	25
TOTAL	200	100	297	177

- **Key informant interviews** – To complement the two surveys, interviews were conducted with artisans and employers. Voluntary sampling technique was used where, after completing the survey, the participants were asked if they were interested in participating further in the study as key informants. Those who agreed, were contacted to take part in the interview. Three standard questions were posed to both the artisans and employers. These are, (1) What are the factors affecting artisan skills supply in MMS? (2) What are the factors affecting the employability of artisans in MMS? And (3) What key interventions are needed to address artisan skills gaps in

MMS? A total of 50 responses were obtained from artisans and 14 responses from employers. Additional interviews were also conducted to obtain in-depth insights from both artisans and employers. The interviews were conducted either telephonically or on Microsoft Teams. A total of 13 interviews were conducted with Artisans, and 3 interviews with employers.

3.5. Data analysis methods

The following methods were used to analyse the data was collected:

- Surveys – the data collected from both surveys was analysed using Microsoft Excel to establish frequencies and percentages which were translated into trends offering insights on the various components of the study.
- Key informant interviews – The data collected from interviews was analysed using thematic analysis. This is a qualitative analysis method used to identify and extract recurring patterns or themes in the data. These themes were then interpreted in accordance with the objectives of the study (Clarke and Braun, 2016).

3.6. Research reliability and validity

Research reliability and validity are important measures in research that ensure the quality and trustworthiness of the research and findings being presented. There are various methods that can be used to establish validity and reliability of quantitative and qualitative research. In this study, reliability and validity was established through the use the triangulation method. There are different triangulation methods – data triangulation (i.e., the use of multiple data), investigator triangulation (i.e., involves multiple researchers collecting and analysing the data), theory triangulation (i.e., application of multiple theories to test the findings) and methodological triangulation (i.e., the use of different approaches to collect and analyse data) (UNAIDS, n.d; Heale and Forbes, 2013). This research study used multiple sources of data (i.e., secondary and primary data) as well as different investigators to collect, analyse and cross check the data.

3.7. Ethical considerations

The study was conducted in line with the University's research requirements. During the research, ethical requirements were followed particularly in terms of:

- **Informed consent** – consent was sought from the participants before they took part in both the surveys and key informant interviews. Both written and verbal consent were obtained. In the case of surveys, the participants were required to complete a compulsory question. This was a yes or no question to the statement “*I agree to participate in the study. My participation in this research study is voluntary*”. Verbal consent was requested before the key informant interview took place. This is because these were done telephonically. Only one interview was done face-to-face, and in this case, written consent was obtained.
- **Anonymity** – This could not be guaranteed during data collection because of the sampling technique and data collection method that was used. This is the case where data was collected in a communal venue. While this is the case, anonymity is maintained in the final report. The results are presented in a generalised manner and at an aggregated level.
- **Confidentiality** – This was maintained during data collection. The information that was collected was not disclosed to anyone outside of the project team.

3.8. Study limitations and challenges

At the start the project, it was planned that key informant interviews will be conducted with key stakeholders involved in artisan training value chain and these include artisans, MQA, National Artisan Moderation Body, Department and Higher Education and Training, Quality Council for Trades and Occupations, Technical and Vocational Education and Training Colleges, Training Providers, Mining Companies, Engineering Contractors, INDLELA, and other SETAs (i.e., MerSETA, CHIETA, TETA, AgriSETA and others). These planned interviews were not achieved because of time that was available for data collection which was not sufficient to complete the data collection as was planned. The absence of key informant interviews represents a critical gap in adequately understanding the artisan skills landscape in MMS. Whilst this is the case, the study provides insights into the core issues in terms of the disconnect between employers and employees. These insights are valuable in terms of informing future research and policy recommendations aimed at bridging the skills gap and improving the alignment between artisan training and industry demands.

3.9. Summary and conclusion

The objective of the chapter was to discuss the research methodology that was used to carry out the research. The study used a mixed-methods approach to collect and analyse data. Data was collected through literature and document review, surveys and key informant interviews. A combination of quantitative and qualitative data analysis methods was used to consolidate the results in line with the objectives of the study. The chapter also highlighted ethical considerations that were taken into account as well as study limitations and challenges that were encountered. In the next chapter, the results are presented, and these are drawn from the surveys as well as interviews conducted with artisans and employers.

4. ANALYSIS AND INTERPRETATION OF RESULTS

4.1. Introduction

To assess the current status of artisan supply and demand in the MMS, this study examined and analysed various aspects of artisanship and the training processes that artisans undergo. The objective was to generate insights that address the research questions and contribute to understanding the dynamics that affect artisan supply and demand within the MMS. This chapter presents the findings through a structured analysis and comprehensive interpretation of the collected data, providing a foundation for informed decision-making in addressing the challenges in the demand and supply of artisans.

4.2. Quantitative and qualitative interpretation of results

4.2.1. *Artisan survey results analysis*

The demographic profile of the artisan in the MMS

Section 1 and section 2 of the survey focused on gathering background information and the work experience of the artisans participating in the study. The purpose of this section was to provide a foundational understanding of the respondents' profiles, including their demographic details, gender, and employment status. The information collected served as a critical context for interpreting the subsequent data and understanding the profile of artisans within the MMS. The survey findings aligned with existing literature confirmed that artisanship in the MMS is male dominated, with 73.1% of respondents identifying as male, 26.6% as female, and 0.3% as non-binary, as illustrated in Figure 17.

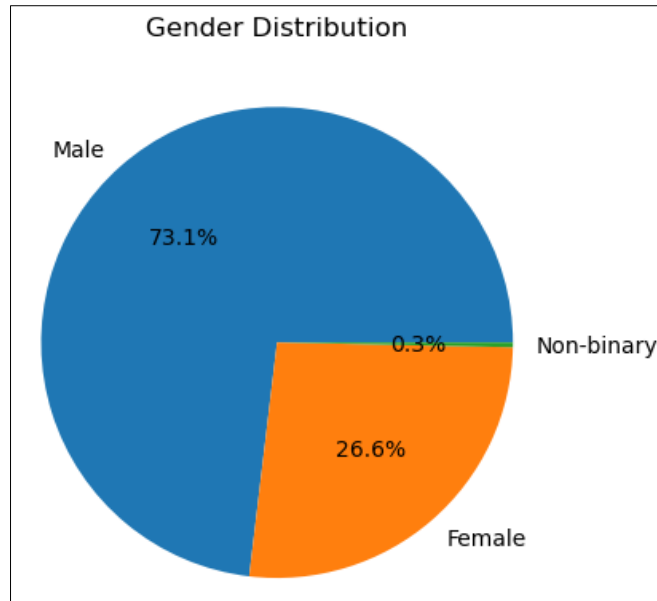


Figure 17: Gender distribution of artisans in the MMS

The 26.6% female representation reflects notable progress toward gender diversity, especially when compared to the reported 11.5% female artisans between 2004 and 2021. Although non-binary representation accounted for a small proportion (0.3%), its presence in the responses highlights the emerging need to recognise gender diversity in the MMS. This further emphasises the need for more inclusive reporting frameworks in the sector, moving beyond binary gender definitions to better reflect the evolving workforce demographics.

Figure 18 illustrates the age distribution of artisans in the MMS. The majority of respondents (54.2%) fall within the 26–35 years age group, followed by 33.7% in the 36–45 years age group. Combined, these two categories account for nearly 88% of the workforce, highlighting a strong presence of mid-career artisans within the sector.

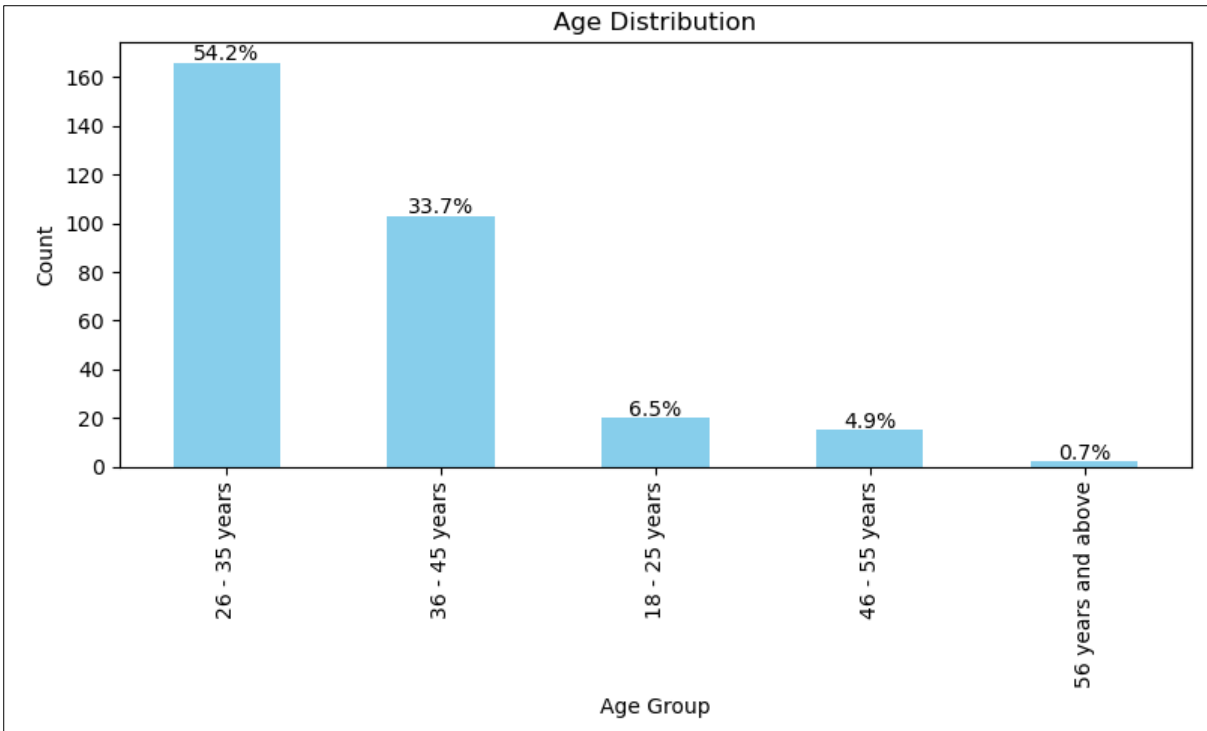


Figure 18: Age distribution of artisans in the MMS

The remaining age groups reflect significant disparities. Artisans aged 18–25 years account for only 6.5%, indicating a limited number of young people pursuing artisan careers. This may be attributed to factors such as negative perceptions of artisan roles and a lack of career awareness, as noted in literature. Meanwhile, the 46–55 years age group accounts for 4.9%, and artisans aged 56 years and older represent just 0.7% of the respondents. The minimal representation in the latter group raises concerns about the lack of skilled artisans for knowledge transfer, potentially exacerbated by early retirements or historical trends from the early 1990s. As highlighted in subsection 2.4.3, following the transition to democracy, many African parents perceived a university degree as the more desirable path to success, creating a bias that positions higher education above vocational careers resulting in few enrolments in vocational careers. To address these workforce imbalances, it is crucial to implement strategies that retain experienced professionals and facilitate effective knowledge transfer from older to younger artisans.

In terms of racial representations, an overwhelming majority (86.5%) of the artisans who participated in the survey are Black, with 6.9% identifying as White, 6.3% as Coloured, and a very low 0.3% representation of Indian artisans, as illustrated in Figure 19.

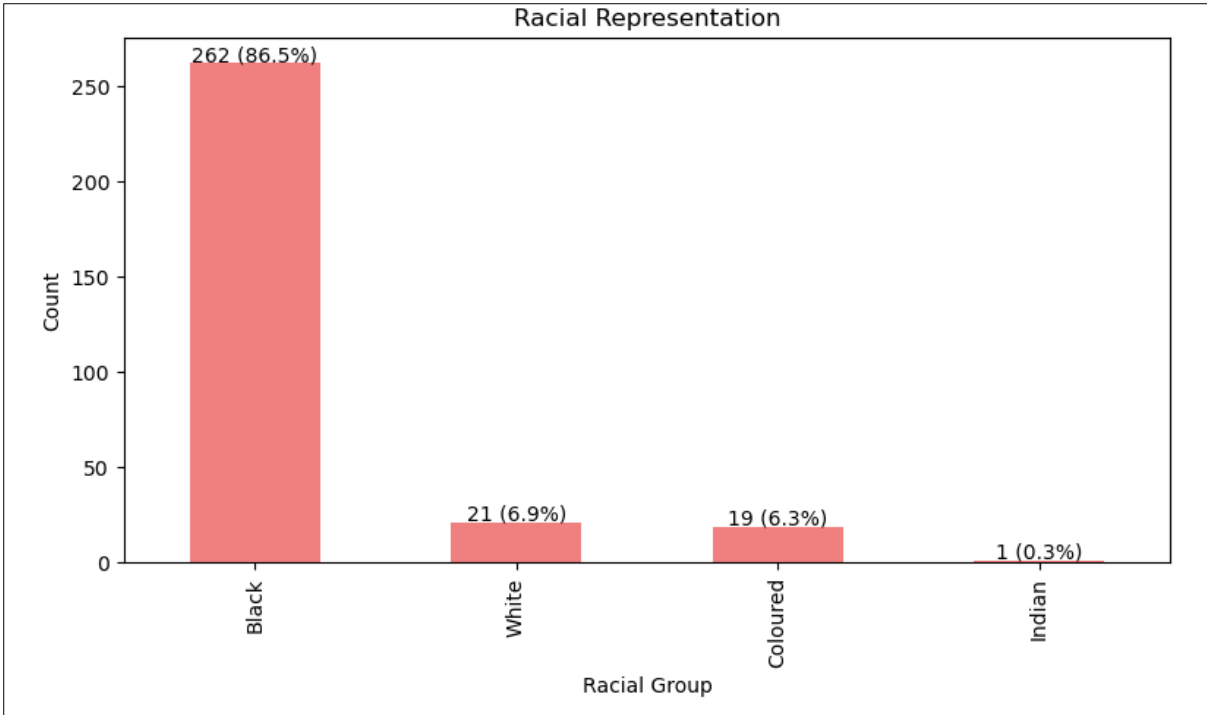


Figure 19: Racial representation of artisans in the MMS

These findings align with South Africa’s national racial demographics (Statistics SA, 2023) and reflect progress toward achieving greater equity in the mining sector. The increased number of Blacks likely results from targeted transformation policies, including employment equity and affirmative action measures designed to address historical imbalances. This highlights significant strides in aligning the racial composition of the MMS workforce with transformation goals.

The survey results show that 99% of respondents are of South African nationality, with the remaining 1% identifying as Zimbabwean and Mozambican nationals. This distribution underscores the focus of the MQA on prioritising South African citizens for artisan training programmes. More so, the large representation of South African artisans highlights the alignment of training initiatives with national goals of skills development.

In addition to gathering demographic information, artisans were asked questions to gain insights into their profiles, specifically regarding the trades they are qualified in. Figure 20 shows a Pareto analysis of the distribution of artisans by trade. The Pareto chart demonstrates the significant dominance of Electricians, contributing 30.8% to the workforce.

This aligns closely with the literature review, where Electricians account for 32.2% (see *Figure 6*). The close alignment between literature and survey results falls within a $\pm 5\%$ margin, showcasing the consistency of artisan production representation thus solidifying their role as the most critical trade.

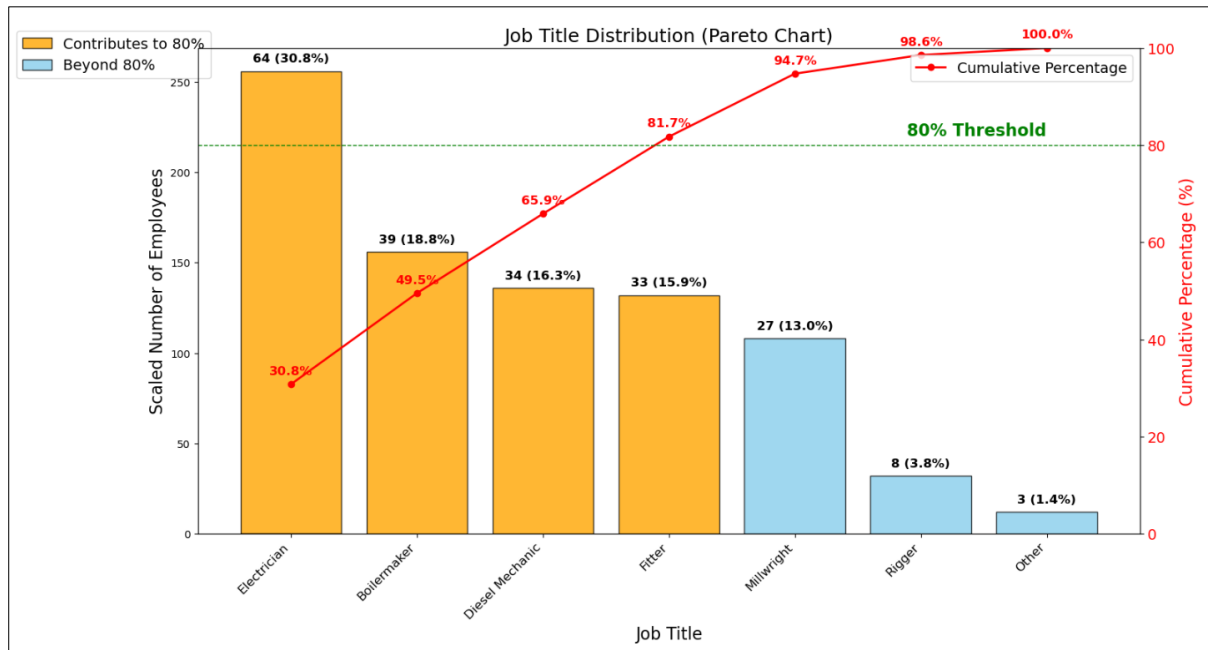


Figure 20: Distribution of artisans by trade

Together, Electricians, Boilermakers, Diesel Mechanics, and Fitters account for 81.7% of the workforce in the survey. This emphasises their role as the backbone of the artisan labour pool and highlights the need for sustained focus on these key trades. Trades like Millwrights and Riggers contribute less significantly to the workforce. While this is the case, as specialised fields, they remain essential to the mining sector. The "Other" category makes up only 1.4%, underscoring its limited contribution.

Artisans' trade training and qualifications in the MMS

Section 3 of the survey was aimed at understanding the training that artisans received prior to qualifying as artisans, and their academic qualifications. In doing so, the section further provides insights into the training effectiveness, artisans' preparedness for trade assessments, and the challenges encountered during the training process. Literature highlights that just over 50% of learners complete artisan training programmes. Analysing

artisans' experiences, along with their views on the difficulty of trade assessments is essential for identifying barriers to completion and guiding improvements in training programmes. These insights are crucial for enhancing success rates and ensuring artisans are adequately equipped to meet industry demands.

Figure 21 shows that the largest group of respondents (153 individuals) obtained their trade certificate between 1 and 5 years ago. A notable portion (62 respondents) reported obtaining their trade certificate less than a year ago, highlighting ongoing certification activity. About 50 respondents obtained their trade certificate more than 10 years ago, representing experienced artisans in the workforce, and 30 respondents obtained their certificate between 6 and 10 years ago, forming a smaller group of mid-career professionals.

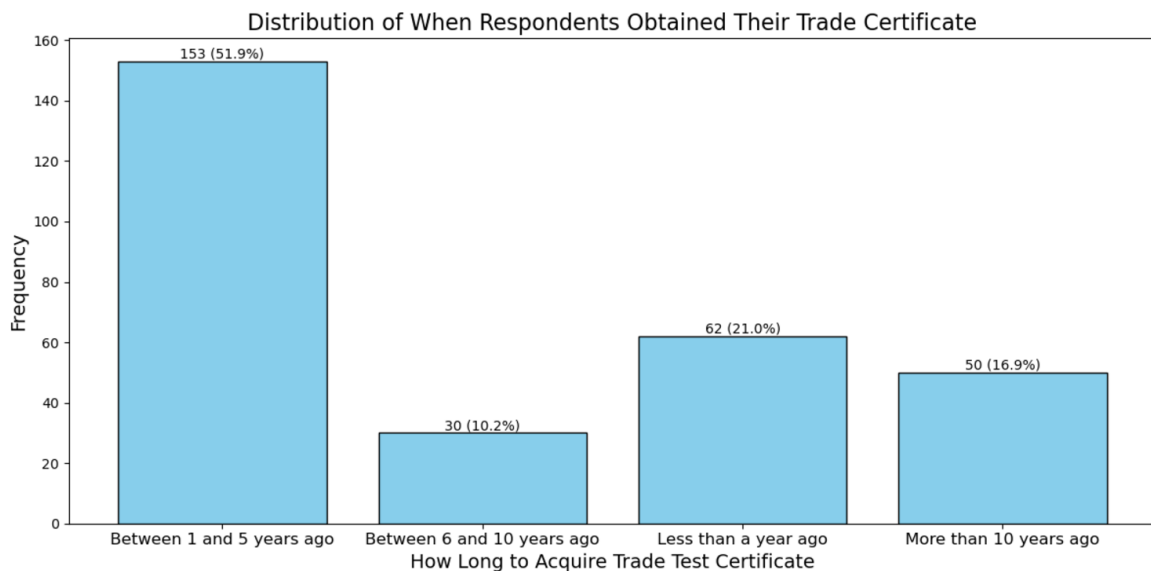


Figure 21: Year of trade certificate acquisition

The high proportion of certifications in the last 5 years suggests an increase in artisan training and qualification efforts. While the presence of certifications across all time ranges shows an increase in flow of artisans into the workforce, balancing between experienced workers and new entrants is important. This aligns with industry demands for skilled labour and possibly reflects government (DHET and SETAs) and/or institutional programmes and efforts to boost artisan supply.

Figure 22 shows that several respondents have qualifications combining Grade 12/Matric/NCV Level 4 with a trade certificate or N4, N5, or N6 certificates with a trade certificate. This distribution suggests that mid-level qualifications, such as Grade 12/Matric, Artisanal Trade Certificates, and N4, N5, or N6 Certificates, dominate the artisan workforce. The minimal representation of higher academic qualifications underscores the practical, vocational focus of the workforce, potentially indicating that learners typically complete their studies at Grade 12/Matric/NCV Level and proceed directly to trade assessments without further academic progression. Further, Figure 23 shows that many respondents completed Nated levels, mainly N3 and N4.

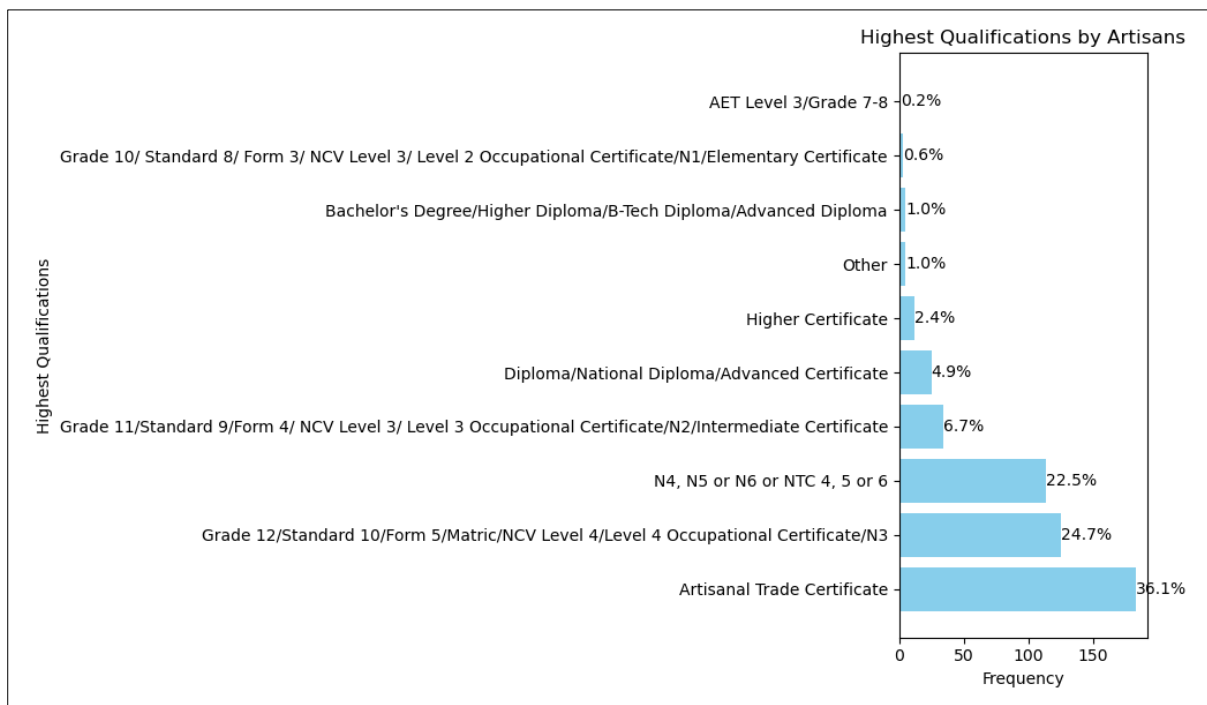


Figure 22: Highest level of qualification among respondents

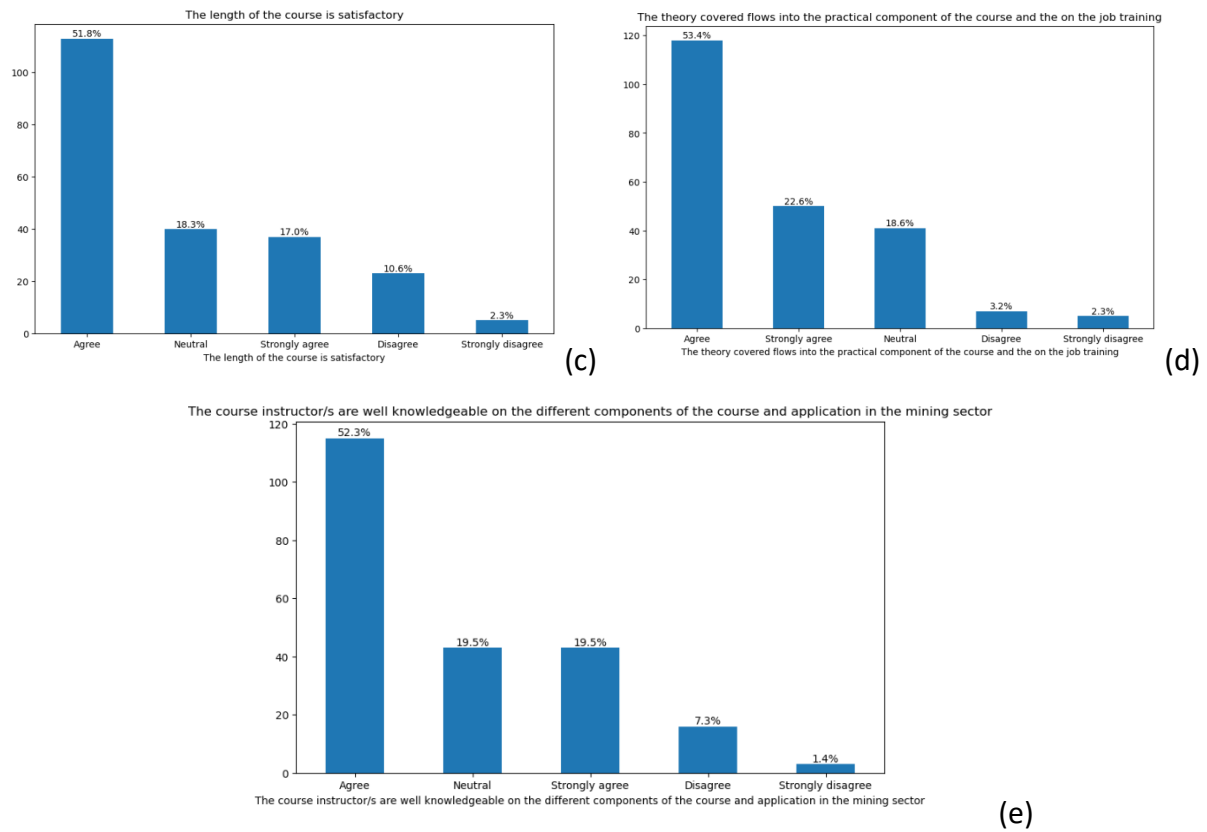


Figure 24: Assessment of theoretical knowledge provided by TVET colleges

As seen on the figure, there was high agreement on the alignment of course content with industry needs and the adequacy of course coverage. The respondents generally expressed satisfaction with the course length, although some offered neutral or negative feedback. Instructor expertise received strongly positive ratings, reflecting confidence in their knowledgeability. Additionally, the integration of theoretical and practical training was highly valued, with respondents emphasising the practical applicability of the theoretical content.

The majority of artisans (156 respondents) perceive the trade test as neither difficult nor easy, indicating a balanced level of challenge. However, 78 respondents rated the test as “Difficult,” while 48 found it “Easy.” Smaller groups rated the test as “Very Difficult” (14) and “Very Easy” (13).

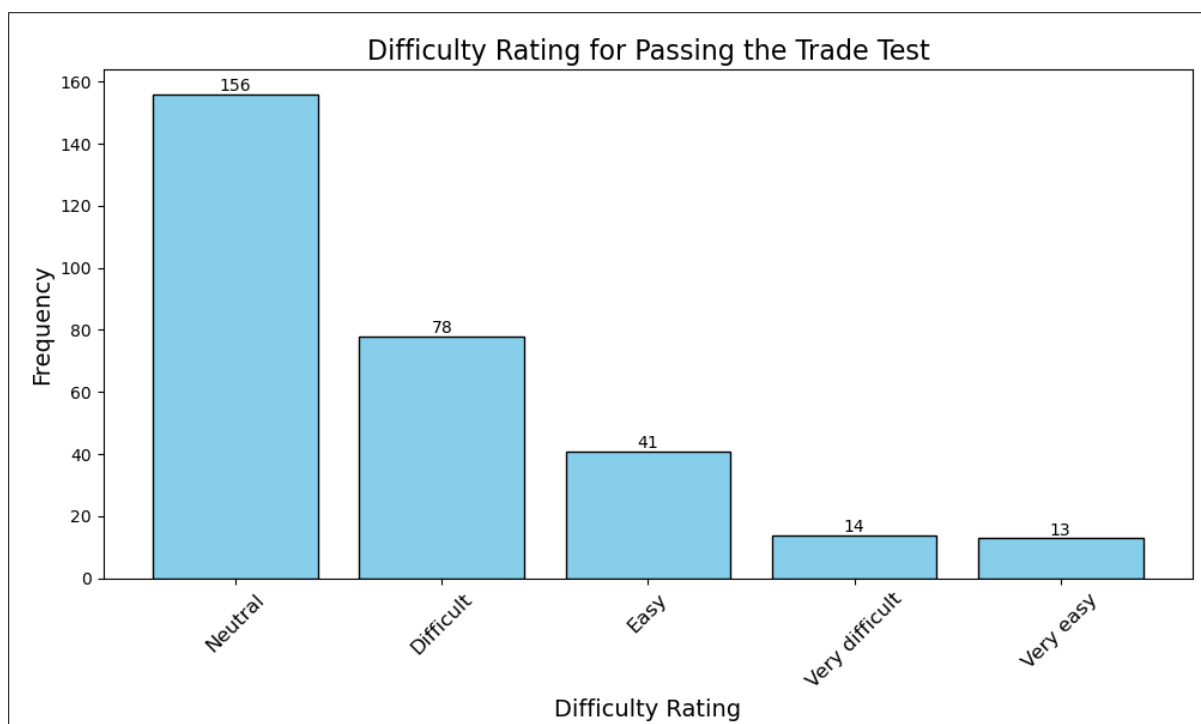


Figure 25: Difficulty rating for passing the trade test

The neutral perception of the trade test's difficulty could encourage young learners to pursue artisanship. This is because human decisions are strongly influenced by the perceptions and opinions of others, even in seemingly straightforward contexts (Mojzisch & Krug, 2008).

Figure 26 shows that apprenticeship programmes are the most prevalent pathway for artisan training, accounting for 52.2% of respondents. Learnerships follow at 37.2%, reflecting their significant contribution to artisan development. Furthermore, 6.6% of respondents received training through Company Training Programs, emphasising the role of in-house initiatives in supporting existing artisan training and development. A smaller proportion (3.3%) of respondents relied on Technical Colleges as their primary training source, suggesting that formal academic settings, often complemented by practical exposure elsewhere, play a less prominent role. Finally, 0.7% of responses fell under the "Other" category, indicating minimal reliance on alternative or unspecified training pathways. This distribution underscores the importance of workplace-integrated training approaches in artisan development and workforce readiness.

Figure 27: Artisan training centres where students obtained trade certificates

Additionally, artisans may prefer apprenticeships due to the high likelihood of securing employment upon completing the programme. Further, training academies such as Zurel Bros SA and Thorn Castle emerge as the predominant non-mining training providers.

The duration of artisan training programmes varies depending on the type of programme that a learner undertakes. Typically, obtaining a trade certificate should take between 12 months and 4 years (refer to section 2.3.4). This is reflected in the results shown in Figure 28, where 57.6% of artisans reported taking between three (3) and four (4) years to qualify, while 39.4% completed their training in one (1) to two (2) years.

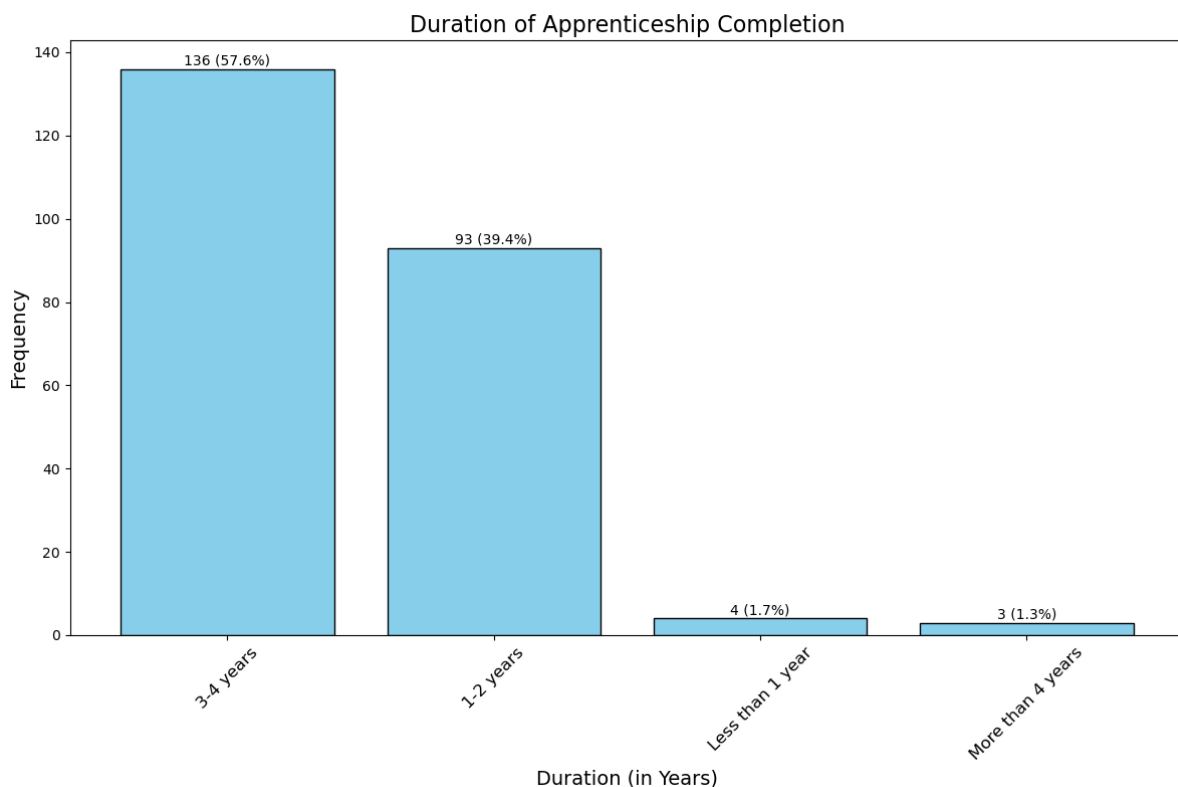


Figure 28: Time taken to obtain a trade certificate

A smaller group (1.7%) obtained their trade certificates in less than one year, likely due to prior relevant work experience that enabled them to write the trade test within a short space of time. This suggests opportunities for RPL to fast-track certification and address the

immediate skills gap in the industry. A significant minority (1.3%) of respondents took more than 4 years to complete their apprenticeship. This extended duration may indicate interruption in training and failure to pass the test at first attempt.

Artisans' skills and competencies in the MMS

This section analyses the responses from Sections 4 and 5 of the survey, focusing on the essential technical skills and competencies required of artisans in the MMS and their proficiency levels. Section 4 of the survey evaluated artisans' technical capabilities, while Section 5 explored job requirements and workplace challenges. Challenges encountered on the job may stem from skill gaps not addressed during initial training at TVET colleges or workplace training centres. To mitigate these gaps, the survey examines on-the-job training undertaken by artisans to meet industry standards and identifies areas requiring further improvement to enhance their alignment with industry demands.

The majority of respondents (84.6%) indicated that they feel their initial training provided adequate preparation for their current roles as artisans (see Figure 29).

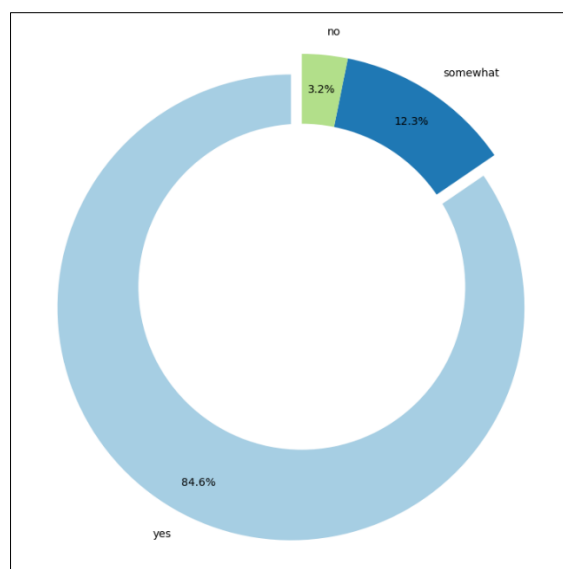


Figure 29: Effectiveness of initial training programmes in preparing artisans for their current roles

This suggests a high level of satisfaction with the existing training programmes. This was confirmed during key informant interviews with artisans who confirmed their satisfaction and adequacy of the initial training received.

“The training center gave me a lot of experience. We had training officers who were hands-on with us, when we asked, they were elaborating...we got everything we needed at the training centers”

(Boilermaker Artisan, 12.12.2024)

“By the time I was in training, I knew the truck, I knew how to change pipes, I knew hydraulics, I knew electrical side, I knew mechanical side...”

(Millwright Artisan, 13.12.2024)

A smaller portion (12.3%) answered "Somewhat," indicating that while their initial training provided some foundation, they still required additional learning or upskilling on the job. This was noted during the interview.

“I can say 50/50 they did prepare me well because they gave me the basics of the trade.”

(Diesel Mechanic, 13.12.2024)

A very small minority (3.2%) answered "No," suggesting their initial training did not adequately equip them for their current roles. The high percentage of "Yes" responses suggests that current artisan training programmes are effectively preparing individuals for their roles in the MMS. However, the "Somewhat" and "No" responses highlight potential areas for improvement in training programmes. Figure 30 highlights training areas lacking in artisan development that may have been the reason for “No” and “Somewhat” responses in Figure 29.

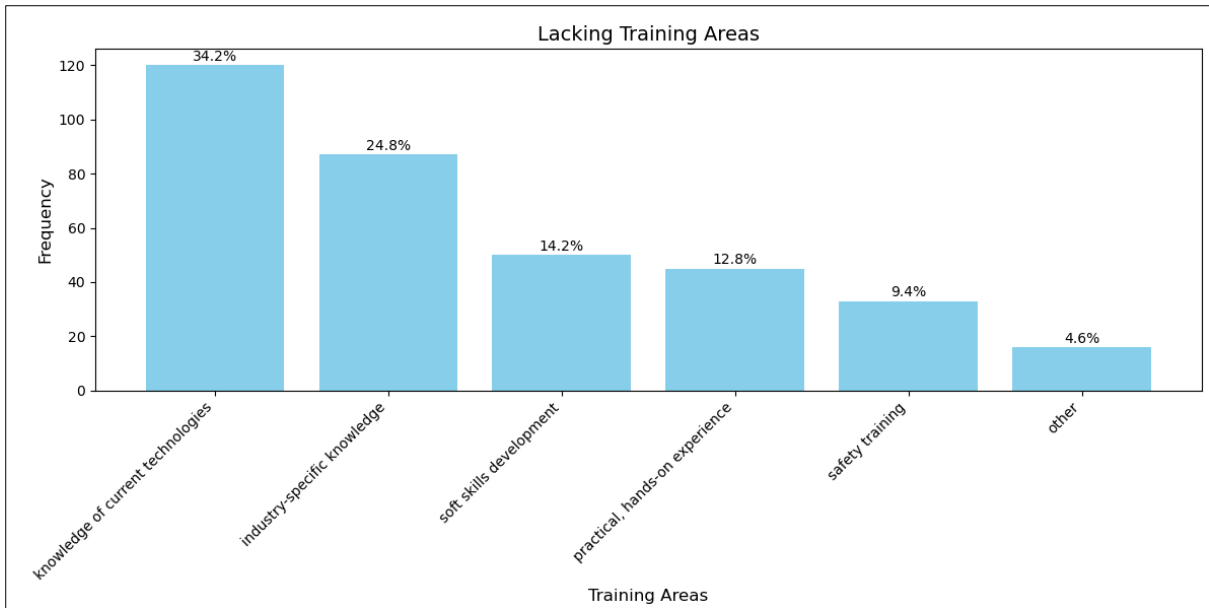


Figure 30: Lacking artisan training areas

Knowledge of current technologies was the most frequently cited skill deemed to be lacking amongst artisans (34.2%), highlighting the need for artisans to stay updated with the latest advancements in the mining sector. It is followed by industry-specific knowledge (24.8%) which may indicate a potential gap in training programmes regarding specialised knowledge and practices relevant to the MMS. Even with strong initial training, the evolving nature of the MMS with the incorporation of the Fourth Industrial Revolution (4IR) technologies (New technology) such as automation, artificial intelligence (AI), Internet of Things (IoT), and big data analytics introduces a new knowledge area that further adds to the skills requirements.

During the key informant interviews, artisans identified several gaps in training. For example, a diesel mechanic artisan noted that engine training provided at mine training centres does not always align with on-site requirements, as the engines used for training often differ from those used in the industry. Similarly, an electrician highlighted that training on Supervisory Control and Data Acquisition (SCADA) systems, VSDs and Programmable Logic Controllers (PLCs) do not accurately reflect real-world applications. This misalignment may be due to the faster adoption of new technologies in mining operations compared to training centres, leading to a gap between training content and industry practices.

In addition to the technical skill gaps, some artisans highlighted a lack of training in soft skills which were deemed essential in terms of navigating workplace relationships in the MMS. Furthermore, they identified the need for an introductory course on relevant Acts and Regulations to ensure compliance and a better understanding of legal requirements in the sector.

Figure 31 shows the distribution of primary technical skills among artisans, segmented by job title. Each bar represents a technical skill, and the coloured segments within the bar represent the job titles contributing to that skill. Additionally, the total frequency of each skill is annotated at the end of each bar.

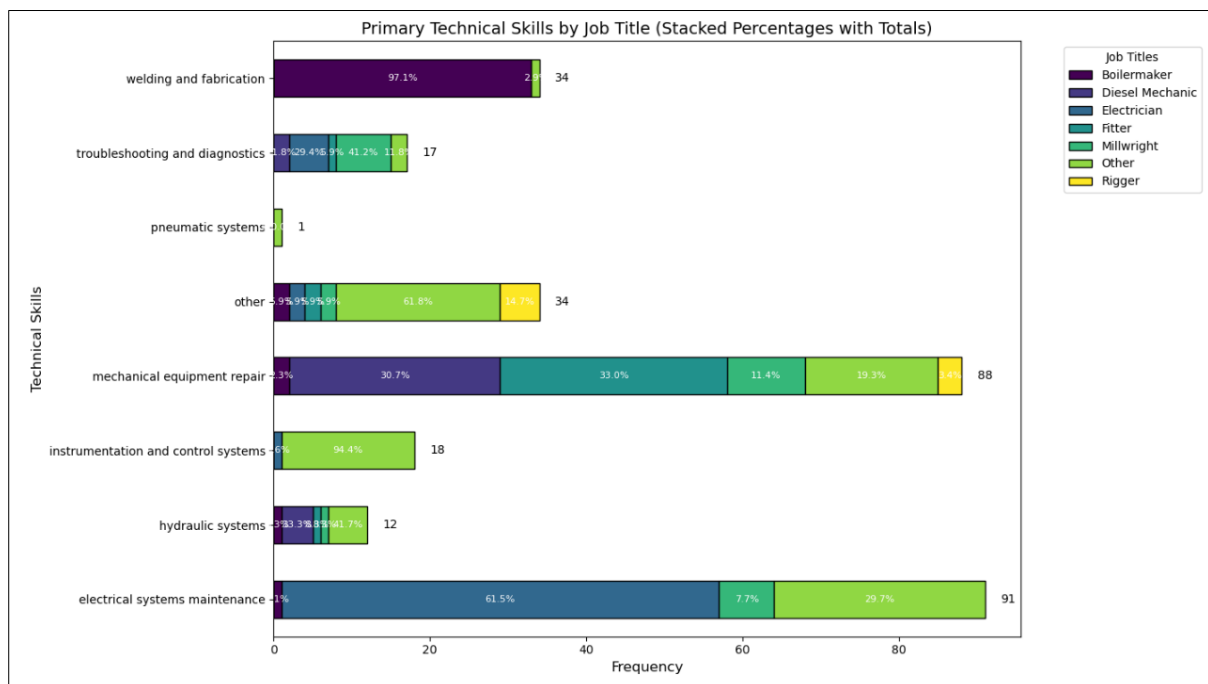


Figure 31: Technical skills by job title

Electrical Systems Maintenance has the highest total frequency (91), with electricians contributing 61.5%. Welding and fabrication are almost exclusively dominated by Boilermakers (97.1%). Skills like troubleshooting and diagnostics have a more even distribution across multiple job titles, reflecting shared responsibilities. While pneumatic systems have the lowest total frequency (1), it is primarily contributed by Millwrights (61.8%). This alignment of the technical skills and job function confirms, partly, the adequacy of initial

training received by artisans. It is acknowledged that the skills could have also been acquired from other training programmes in the course of employment. The most relevant skills identified in the "other" category is planning, rigging and lifting, troubleshooting and diagnostics, mechanical equipment installation and construction, and pipeline and conveyor belt construction. These skills highlight additional expertise areas that play a critical role in the MMS. Further exploration could identify opportunities for skill development and training.

Figure 32 provides insights into the proficiency levels of various trades across five key technical skills, showcasing trade-specific strengths and gaps in the MMS workforce.

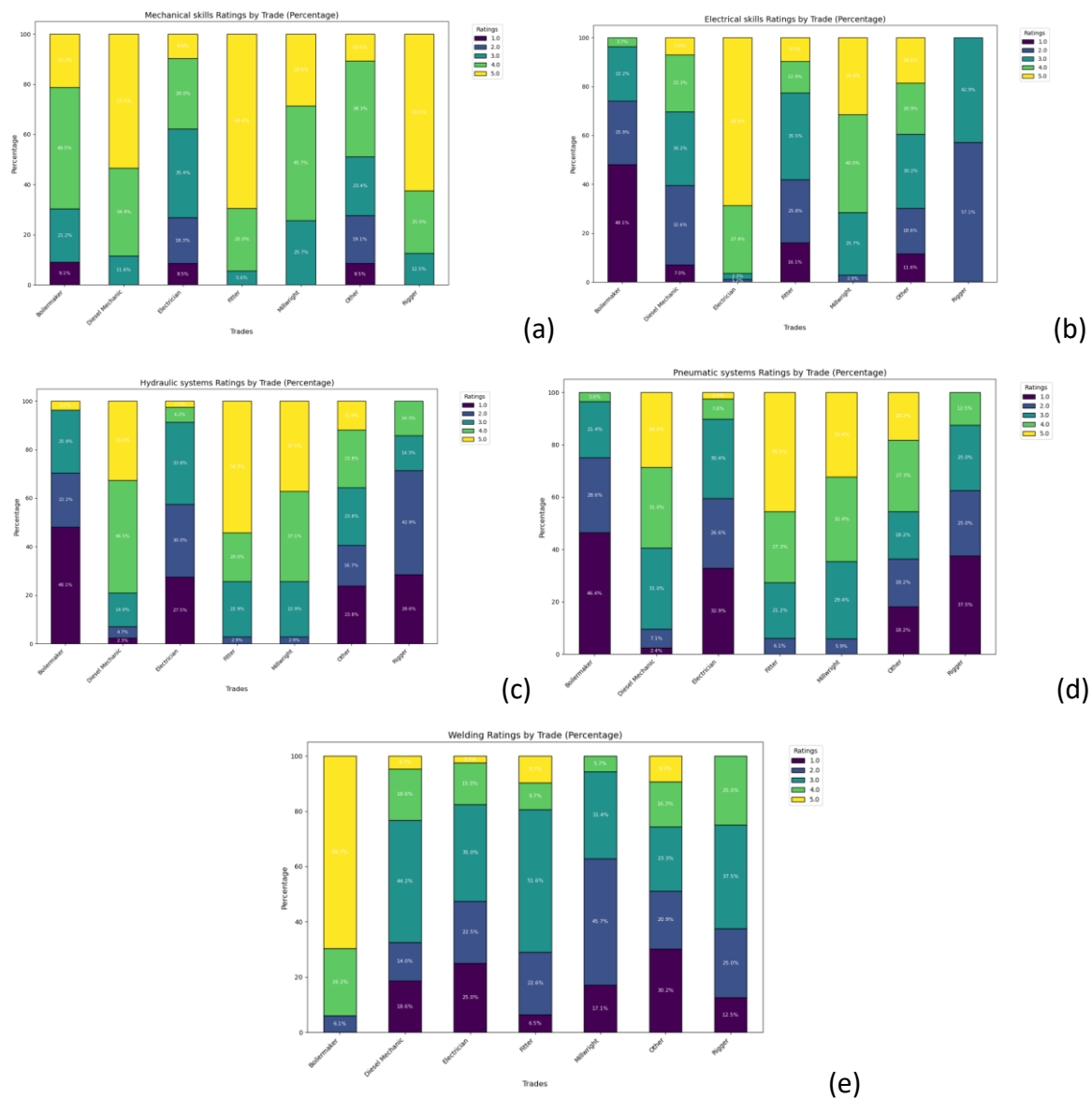


Figure 32: Skills proficiency ratings for various trades in the MMS

- **Mechanical Skills:** Diesel Mechanics and Fitters excel, with a majority receiving high ratings (4 and 5), while Boilermakers, whose core focus lies elsewhere, score lower.
- **Electrical Skills:** Electricians dominate high proficiency ratings, as expected. Conversely, Boilermakers and Riggers display lower ratings, reflecting minimal engagement with electrical tasks, negating a need for further training.
- **Hydraulic Systems:** Diesel Mechanics and Millwrights exhibit strong expertise, while Boilermakers and Riggers receive lower scores due to limited application in their trades.
- **Pneumatic Systems:** Diesel Mechanics and Fitters lead in this area, with high proficiency ratings, while Boilermakers, with minimal involvement, score lower.
- **Welding:** Boilermakers demonstrate exceptional proficiency, with the majority rated 5, reinforcing welding as their core competency. Other trades, such as Electricians and Riggers, show expectedly lower ratings to welding due to limited reliance on this skill.

It is important to note that Diesel Mechanics consistently rank among the top for all skills, showcasing their versatile technical expertise and hence their increased demand. Millwrights are also high performers, particularly in specialised areas like hydraulic and pneumatic systems. Boilermakers and Riggers frequently appear in the bottom rankings, suggesting targeted upskilling opportunities in mechanical, electrical, and fluid power systems.

Although artisans' proficiency and skills are aligned with their respective trades, many respondents (61.5%) reported to have observed changes in the skills requirements in the MMS. As a result, respondents were also asked to select new skills that they have had to learn on the job that were not covered in their initial training (theoretical and practical). Figure 33 presents their responses.

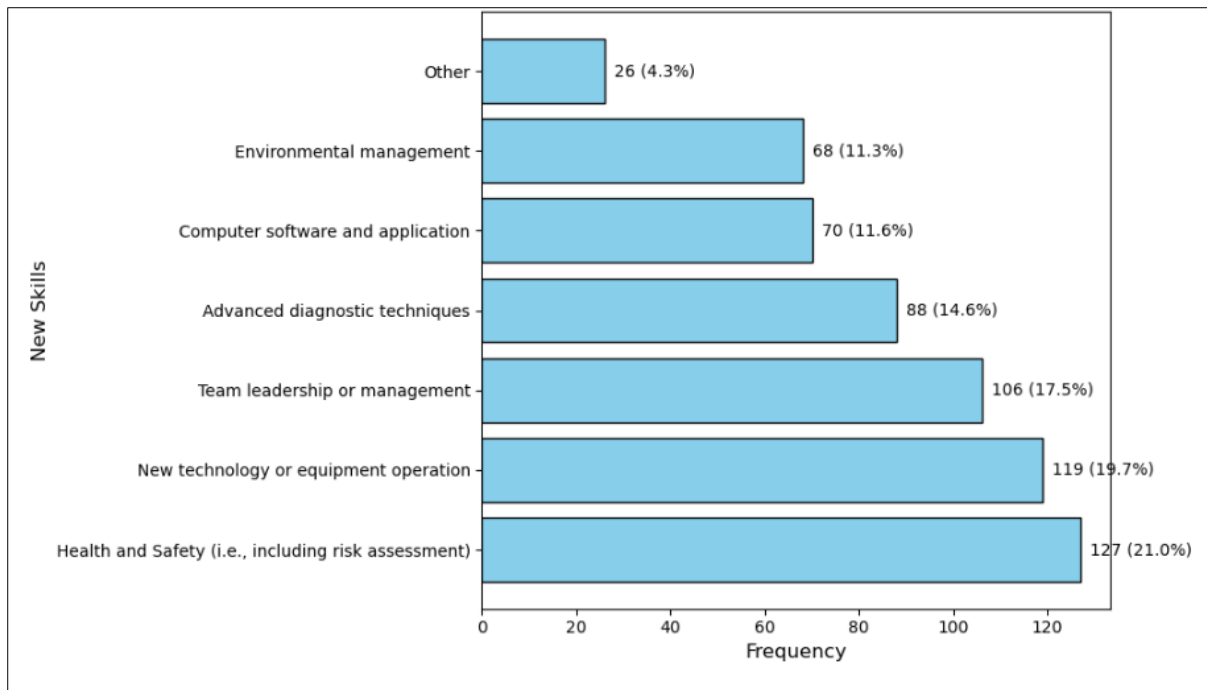


Figure 33: New skills learned on the job that were not part of the initial training

Health and Safety (i.e. including risk assessment) is the most frequently learned new skill (21% of respondents), indicating a strong emphasis on workplace safety and a possible need for more comprehensive safety training in initial programmes. New technology or equipment operation is the second most frequent (19.7%), suggesting the mining sector is experiencing technological advancements that require artisans to adapt and upskill continuously.

A significant number of artisans (17.5%) have had to learn leadership or team management on the job, implying potential career progression opportunities for artisans and a need for leadership development. Computer software and application (11.6%) and Advanced diagnostic techniques (14.6%) are also notable, highlighting the increasing importance of digital literacy and specialised technical skills in the mining sector. Environmental management is among the skills artisans less frequently learnt on the job (11.3%). This highlights a potential deficiency in initial training programmes regarding environmental awareness and sustainable practices within the mining sector. Skills identified under “Other” represent the smallest category (4.3%), indicating that the provided options capture the majority of new skills acquired on the job.

Figure 34 provides insights into the distribution of skills and competencies artisans feel are lacking and require improvement, categorised by job title. The heatmap represents the percentage of responses for a particular skill, with contributions from various job titles displayed as percentages.

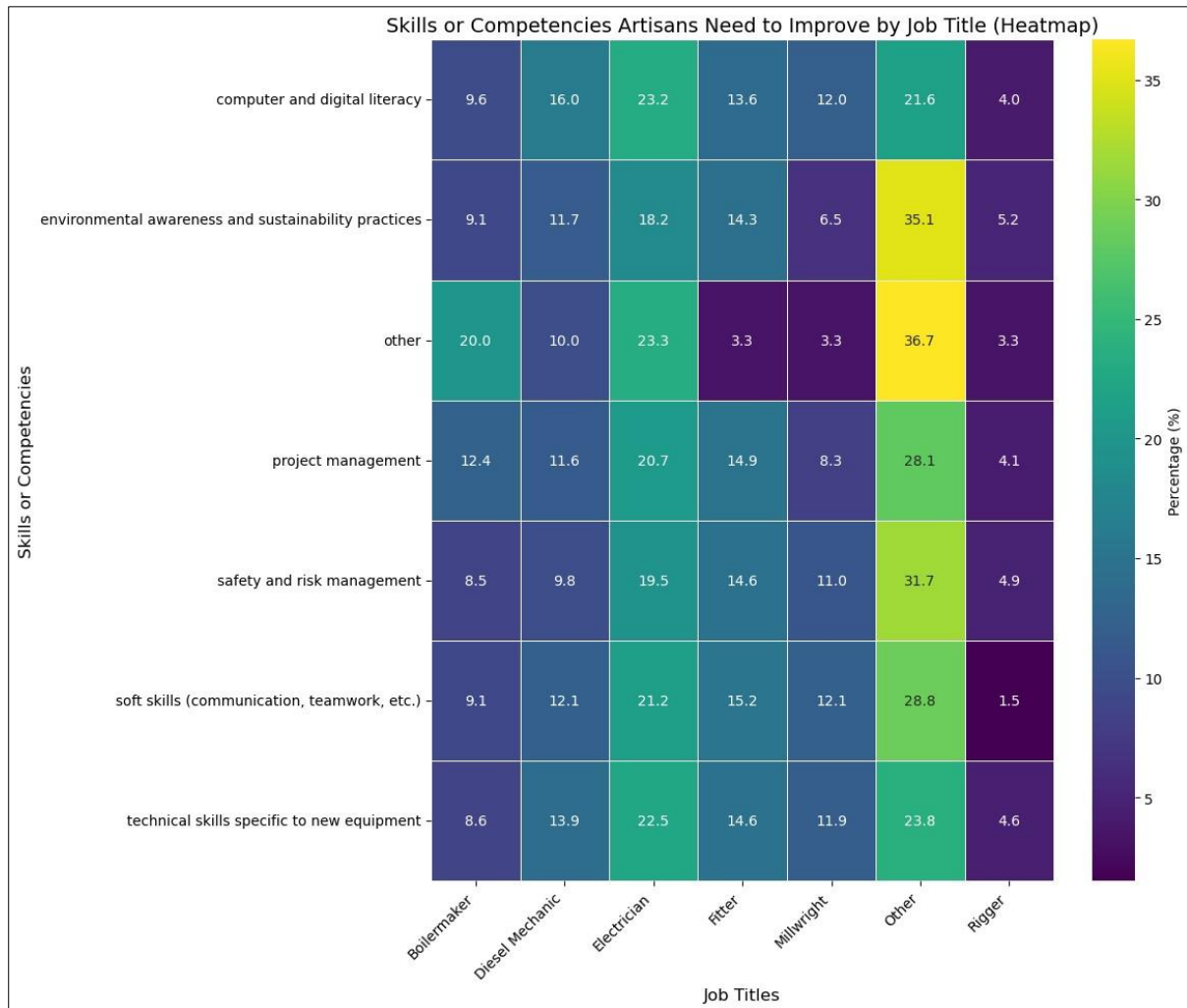


Figure 34: Skills or competencies artisans need to improve by job title

The dominant skills artisans identified for improvement across trades include technical skills specific to new equipment, project management and computer and digital literacy. Significant contributions are from Electricians, Fitters, Millwright and Diesel Mechanics reflecting the sector’s reliance on advanced technologies requiring continuous upskilling. Project management was also emphasised underlining the need for effective planning and

coordination skills. Safety and risk management remains a critical area. Environmental awareness and sustainability practices were also mentioned, highlighting a gap in addressing sustainability within training programmes. Similarly, soft skills, including communication and teamwork, though underrepresented, were noted and suggests a growing recognition of their importance for collaboration and leadership in the mining sector.

A common area for development identified by key informants is the lack of fault-finding and troubleshooting skills among artisans. Troubleshooting is regarded as a critical competency required for effective problem-solving in the field. Additionally, key informants highlighted the need for improved knowledge and adherence to Safety, Health, and Environmental (SHE) standards, emphasising their importance in ensuring compliance and maintaining safe working conditions in the mining sector. The following was highlighted by a respondent who is employed as Boilermaker.

“The only thing that lacks are environmental awareness because there is a lot of environmental issues that we need to take precaution of” (Boilermaker, 13.12.2024)

Artisan development programmes

The last section of the survey (section 6) turned the attention to artisan programmes focusing on the training offered, its duration, and overall effectiveness. It gathered feedback on the specific training programmes offered and their typical duration. The survey also assessed the effectiveness and impact of these training programmes. Additionally, the study aimed to gather insights on whether there were sufficient opportunities for ongoing learning to keep pace with evolving developments in the MMS. It also posed questions speaking to ways in which the current programmes can be improved.

The survey results demonstrated that employers play a significant role in artisans' upskilling by offering comprehensive development programmes. A combined 67.1% of respondents reported receiving training and development from their current or previous employers, underscoring the critical role of workplace-driven initiatives in artisan growth. Additionally, 18.6% received training from industry bodies such as the Mining Qualifications Authority.

Private service providers accounted for 12.0% of training, indicating a smaller but considerable contribution from independent institutions, often in collaboration with mining companies.

Figure 35 outlines the key components of these artisan development programmes. Technical skills training ranked highest at 20.7%, highlighting its foundational role in equipping artisans with the expertise needed for their roles. Safety and health training followed at 17.3%, reflecting its critical importance in ensuring compliance with safety regulations and maintaining a secure work environment in the mining and minerals sector. Practical, Hands-on Experience was reported by 16.9% of respondents, demonstrating the value of experiential learning in reinforcing technical and operational competencies. Leadership and management skills training, cited by 13.1% of respondents, suggests a focus on preparing artisans for supervisory or leadership roles within the industry.

Training on new technology and equipment was noted by 11.2%, indicating a growing but still underrepresented need for programmes that address emerging technologies and machinery relevant to modern mining practices. Similarly, soft skills development, reported by 11.1% of respondents, highlights the significance of interpersonal and communication skills in fostering effective collaboration in the workplace. Lastly, environmental awareness and sustainability practices were included in 9.0% of the programmes, reflecting a rising emphasis on environmental stewardship and sustainable practices as integral components of artisan training. These findings underscore the multifaceted approach required to develop artisans capable of thriving in a dynamic and technologically evolving mining environment.

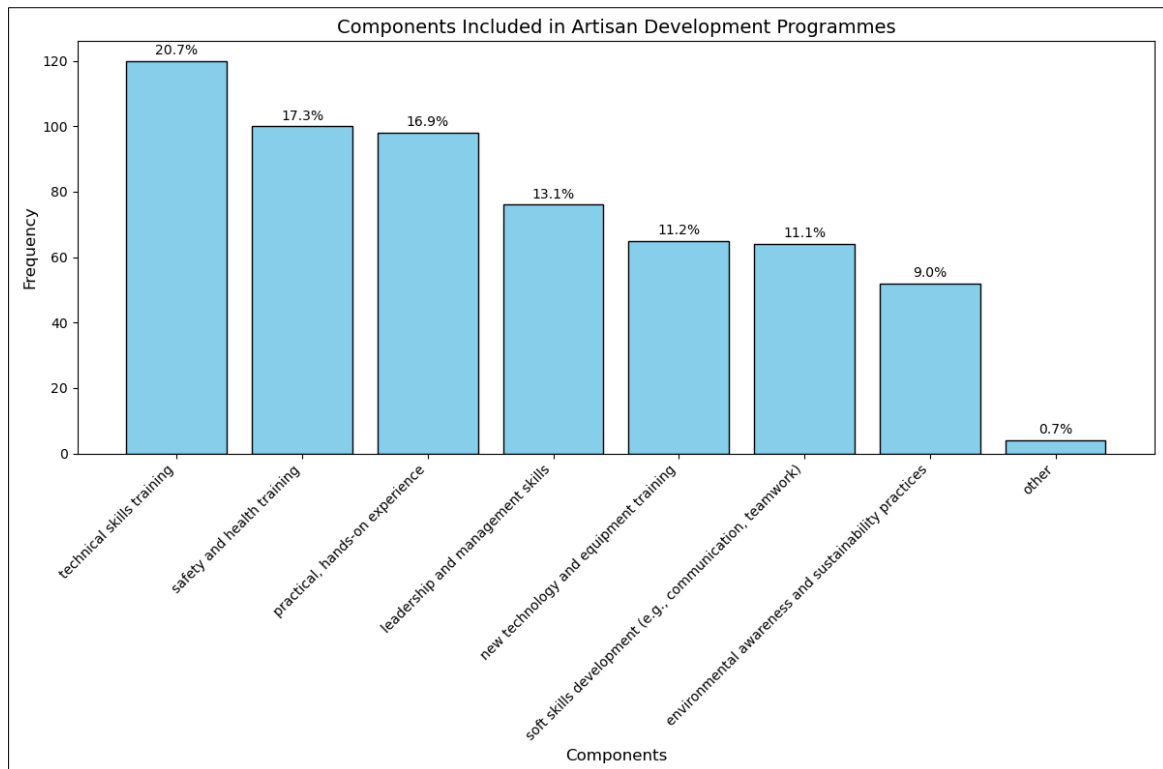


Figure 35: Components included in the artisan development programmes

Respondents generally perceived the overall artisan development programmes as effective in enhancing their skills and competencies. However, they identified certain critical components that were either missing or inadequately addressed in the training programmes, as illustrated in Figure 36. These gaps highlight areas requiring improvement to ensure a more comprehensive approach to artisan training. Incorporating these missing elements into the development programmes would foster a well-rounded cohort of skilled artisans, better equipped to meet the dynamic demands of the MMS and adapt to evolving industry technologies and practices.

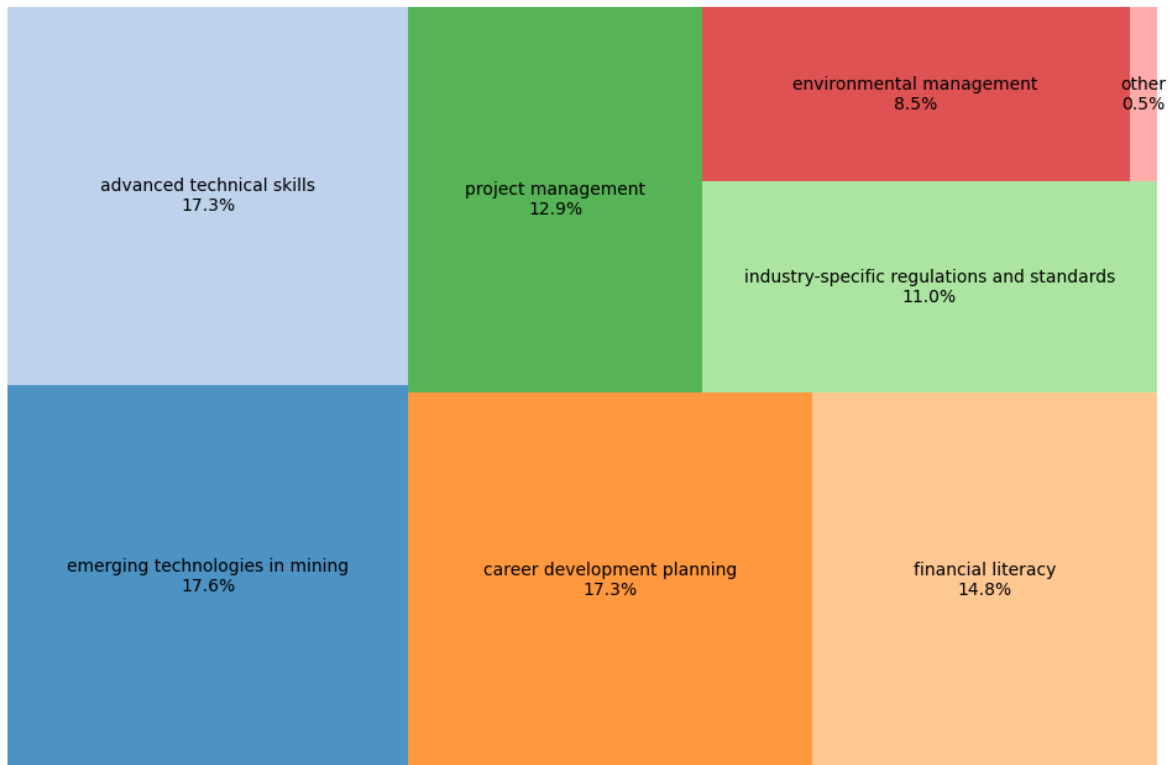


Figure 36: Missing or inadequately covered skills in artisan development programmes

Artisans' perspectives on factors affecting the supply of artisans in the mining sector

Participants highlighted artisanship awareness, maths and science performance of learners in high school and failure rate at college to be affecting the supply of artisans in the mining sector. The key informant interviews identified three main pathways through which individuals become aware of artisanship careers: attending technical high schools, participating in career guidance programmes, and discovering artisanship through alternative routes. Learners from technical high schools are introduced to the field as part of their curriculum, while career guidance programmes, though not widely available, provide exposure to some students. Less than 20% of the interviewed artisans had attended career guidance sessions that included discussions on artisanship.

Many learners from non-technical schools initially aspire to become engineers but, due to not meeting university entry requirements, explore alternative study options such as technical colleges, where they discover artisanship. Others enter the field out of necessity due to job availability rather than as a career choice. This were highlighted during the interviews.

I actually wanted to be a teacher, that was my first choice.”

Diesel Mechanic (13.12.2024)

“I think we don’t know have knowledge from high school. For example, I didn’t know much. We went for career exhibition, but there was nothing that was spoken about artisan careers.”

Boilermaker (13.12.2024)

“We went to a career guidance. In high school, I wanted to become an electrical engineer, but according to the points at university, I saw I couldn’t qualify so I opted for college.”

Millwright (13.12.2024)

Participants also highlighted the avoidance of Physical Science and Pure Mathematics by high school learners as a possible bottleneck to the supply of artisans as these are essential subjects to pursue a career in artisanship. This was noted by one respondent.

“Our younger generation, they don’t necessarily want to study math and science. They think it is difficult”. Specialist Process Artisan (12.12.2024)

Another issue raised was the high failure rates at college, particularly in technical drawing. Learners from non-technical schools often struggle with this subject, as they have not been exposed to it early in their education. In contrast, students from technical schools perform better since they are introduced to technical drawing as part of their curriculum, giving them a foundational advantage.

Artisans' perspectives on factors affecting the employability of artisans in the mining sector

Artisans identified several factors that are impacting their employability in the MMS. The majority of the respondents highlighted the lack of work experience among newly certified artisans. Apprenticeships and learnerships in the mining sector typically span three years, aligning with the period required for artisan trainees to complete their trade certificates.

However, most mining companies require three to five years of post-certification work experience for employment as artisans. This gap creates a barrier to entry, rendering newly certified artisans unemployable due to insufficient industry experience. The unemployment of inexperienced artisans is further exacerbated by the downscaling of many mining companies who retrench experienced artisans, increasing competition in the job market. As a result, when employment opportunities arise, mining companies tend to prioritise experienced artisans over newly qualified ones.

Furthermore, it was indicated that employment opportunities are often contingent upon obtaining specific professional certifications, which many newly certified artisans lack. While acquiring these certifications is not inherently challenging, the high costs, which exceeds R5,000, pose a significant barrier. Many artisans are unable to afford these costs, and this limits their employability in the mining sector.

4.2.2. Employer survey results analysis

The employer survey was designed to gather key insights into their perceptions of artisan skill levels, the demand for artisans, interventions to address skill gaps, and the MQA's role in addressing training and skills development challenges within the MMS.

Background information and employer profile

The first section of the survey focused on obtaining background information. The respondents of the employers' survey consisted of 13.5% Training Managers, 7.9% Human Resource Development (HRD) Managers, 4% Engineers, 1% Mine Managers and the remaining majority (74.6%) consisted of a diverse range of professions. The top 10 positions within "Other" included several supervisory and managerial roles (e.g., supervisor, contracts manager, foreman), and positions related to HRD and training (e.g., HOD admin, skills development facilitator/recruiter, HRD coordinator). About 76.5% (101) of respondents indicated they are responsible for recruiting and training artisans, while 23.5% (31) stated they are not responsible for recruiting or training artisans. However, while not directly involved, these individuals interface with artisans. About 72.7% (96) respondents stated they work directly with artisans.

Artisan demand

Section 2 of the employer survey explored the demand for artisans across various subsectors within the MMS. The respondents were asked to identify the three artisan roles that are most in demand within their companies. The analysis of this data was aggregated according to company size and the specific commodities associated with each organisation. The findings are presented in Figure 37 and Table 6, respectively, providing a detailed overview of artisan demand within the MMS.

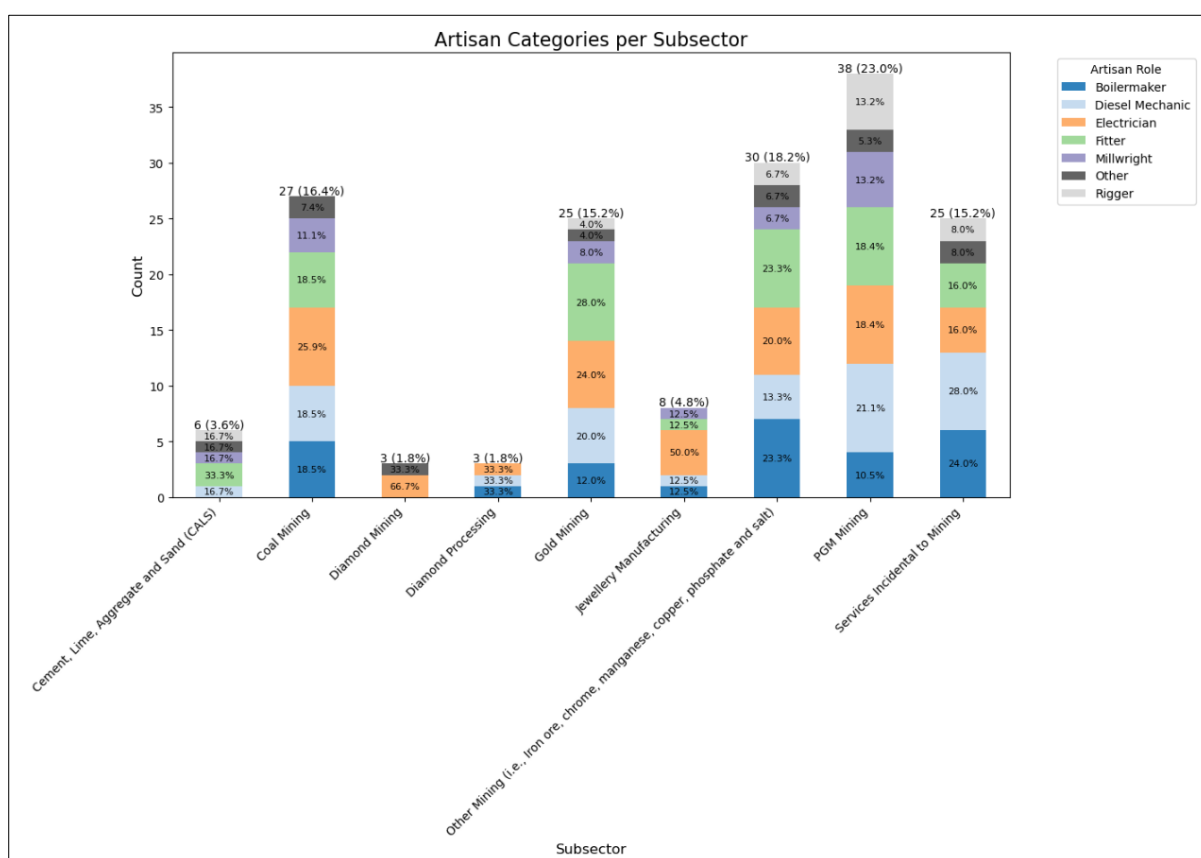


Figure 37: Artisan roles most in demand in companies

Table 6: Artisan roles in demand based on company size

Company size	Top 3 Artisan roles
Between 50 and 149 employees	[Electrician, Boilermaker, Diesel mechanic]

Less than 50 employees	[Electrician, Fitter Boilermaker,]
More than 150 employees	[Electrician, Fitter, Diesel mechanic]

The results show that artisan roles most in demand vary significantly across subsectors, highlighting the specialised skills required in different areas of the mining industry. The PGM is the largest employer (23%) of various types of artisans followed by other mining (Iron ore, chrome, manganese, copper, phosphate and salt) (18.2%), coal mining (16.4%), gold mining and services incidental to mining both at 15.2%. It is evident from Figure 37 that electricians are sought after across all subsectors and company sizes (see Table 1), underscoring their crucial role in maintaining electrical systems across the MMS. Diesel Mechanics, Boilermakers, and Fitters are also in high demand, particularly in subsectors with heavy machinery and complex infrastructure. Some subsectors have unique needs, such as PGM's demand for Millwrights and Riggers.

There is a general expectation of moderate growth in the demand for skilled artisans in the coming 5 years by companies. Figure 38 shows the projected number of artisans required by companies in the MMS.

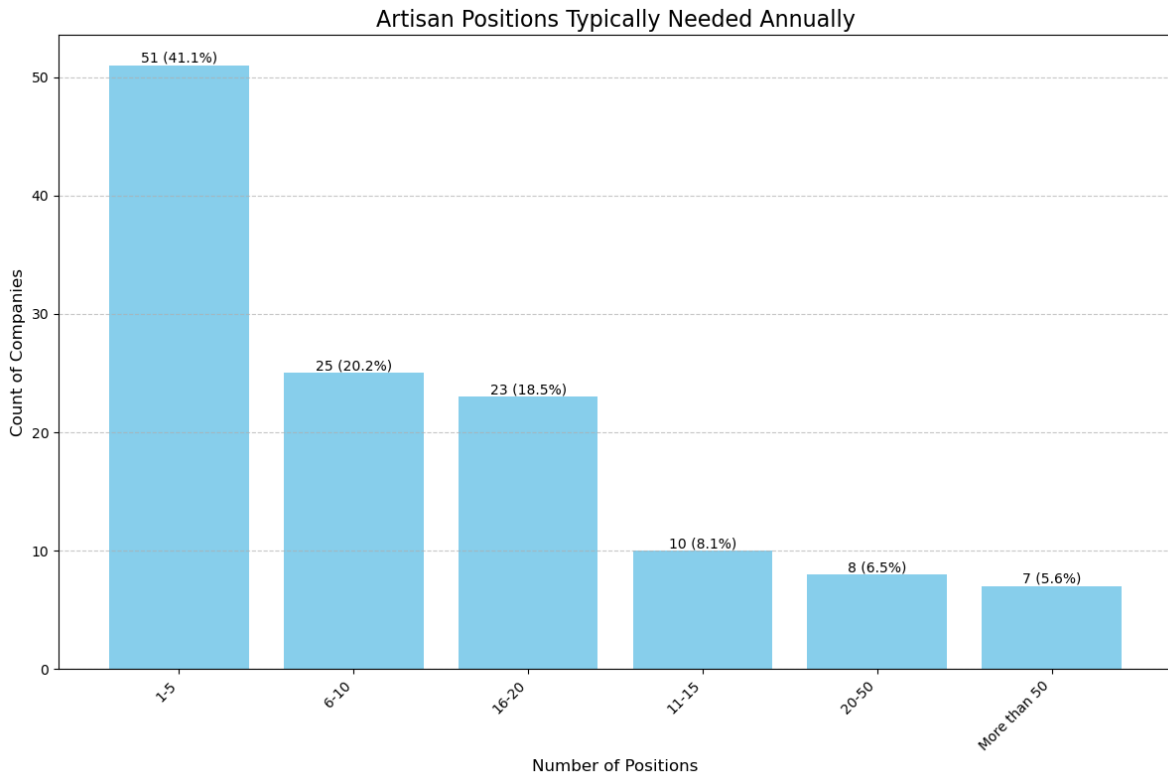


Figure 38: Projected number of artisans required by companies in the MMS

Over 40% of the companies anticipate a demand for 1 to 5 artisans, followed by 20% for between 6 and 10 artisans, 18.5% for 11 to 15 artisans, 8% for 16 to 20, 6.5% for 20 to 50 and finally, about 6% of companies in the MMs anticipate needing more than 50 artisans. The different subsectors have varying needs for artisan positions, and this is illustrated by the heatmap shown in Figure 39.

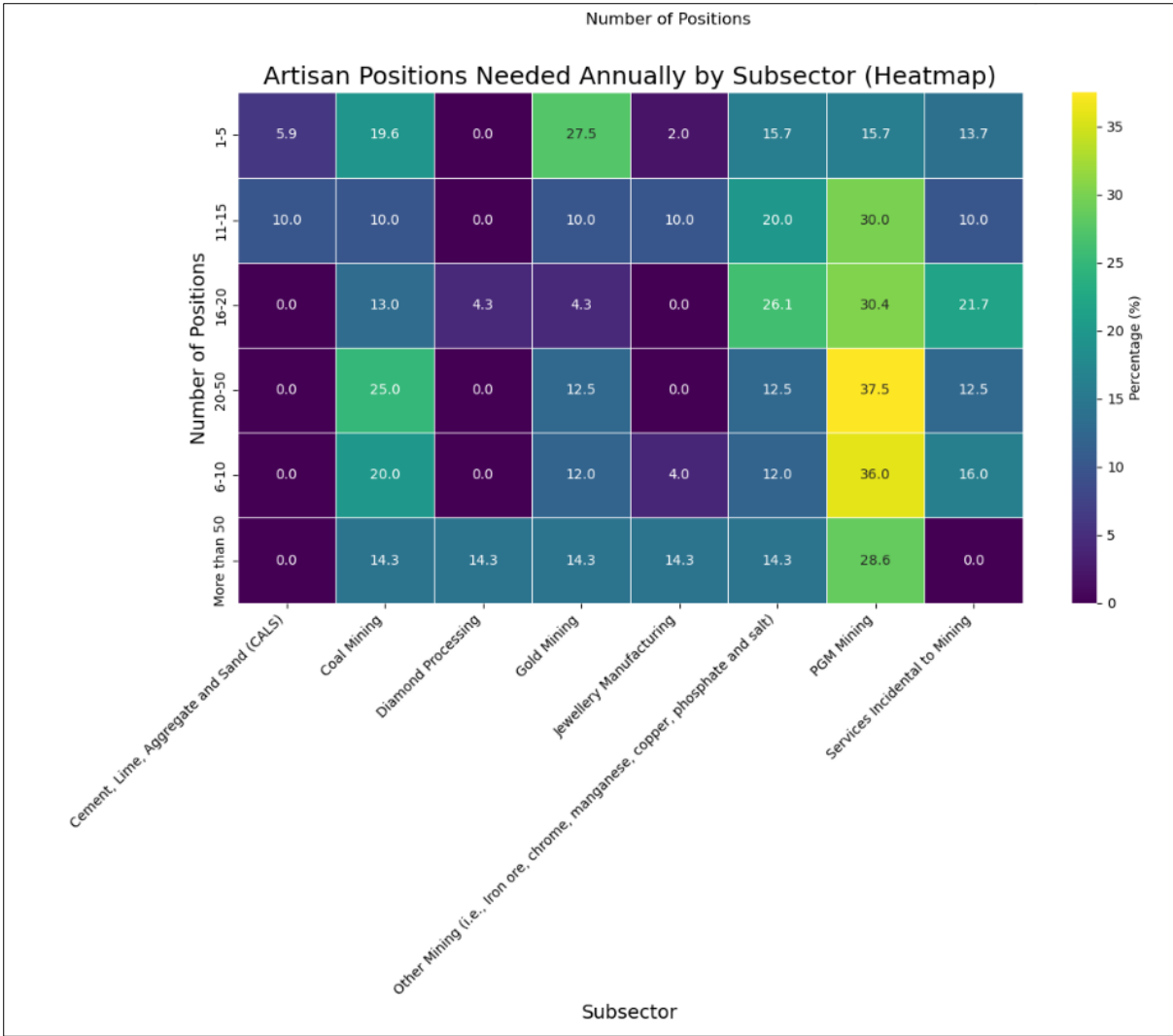


Figure 39: Projection of artisan demand by subsector

The PGM subsector is expected to have a higher demand for artisans across different position ranges with a slightly lower demand of between 1 and 5 artisans. Coal mining follows with the second highest demand for artisans across most position ranges, with Other Mining also exhibiting a notable demand for artisans, especially in the 15-20 positions range. Gold Mining, on the other hand shows a moderate demand for artisans, with a concentration in the 1-5 and more than 50 positions categories. Subsectors like Cement, Lime, Aggregate and Sand (CALs), Diamond Mining, Diamond Processing, and Jewellery Manufacturing generally have lower artisan position needs, primarily concentrated in the 1-5 positions range. The majority (47%) of respondents indicated that they expect a slight increase in the demand for artisans.

Artisan skills assessment

Section 3 of the survey examined employers' assessments of the skills possessed by entry-level artisans upon their initial employment in the MMS. The top three factors influencing hiring decisions were practical experience (27%), technical skills (27%), and educational qualifications (20%). Industry-specific certifications (14%) and soft skills (11%) were also noted as important considerations.

Over half of the employers rated the skill level of new artisans as "Fair," indicating a baseline level of competency but highlighting a substantial need for improvement to meet industry needs. These findings emphasise the importance of bridging skill gaps to enhance the readiness and effectiveness of entry-level artisans in the MMS.

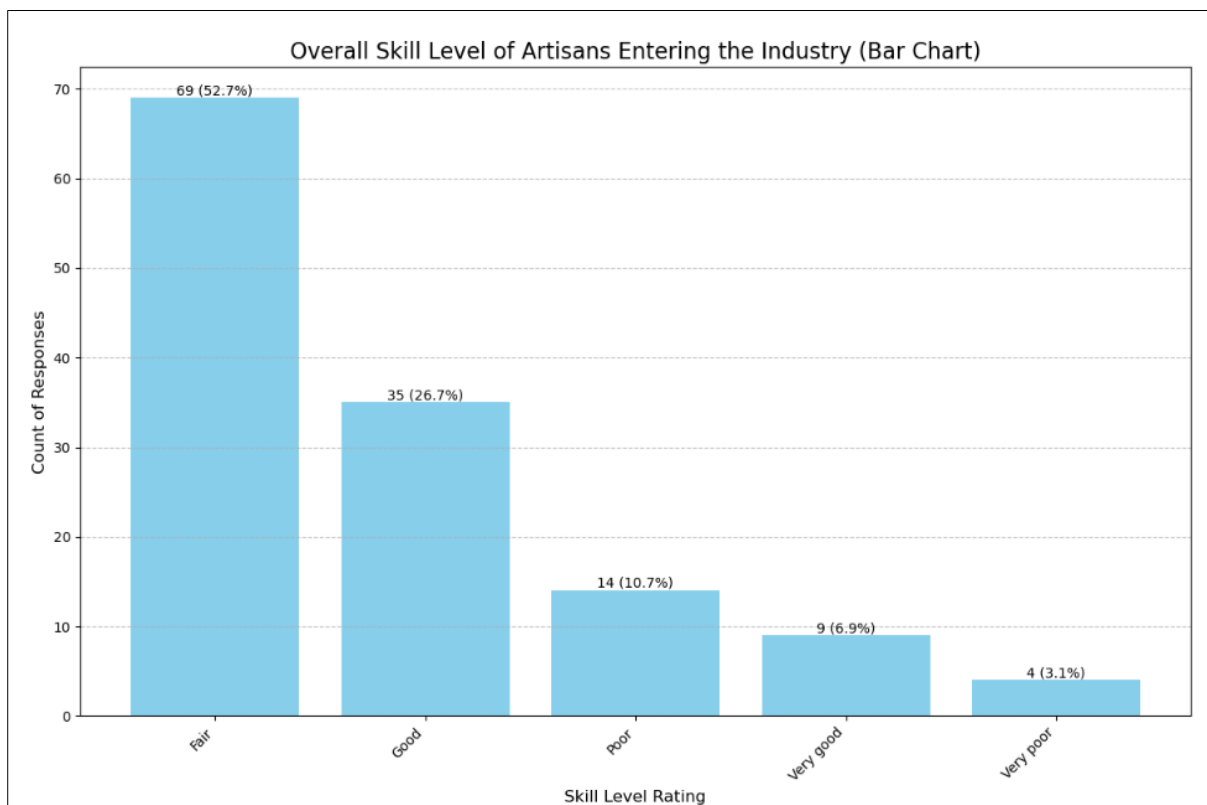


Figure 40: Employers' perception/assessment of artisans' skills when entering the MMS

Over a quarter, viewed the skill level as "Good," indicating overall competence but acknowledging a need for further development. A notable portion of employers expressed dissatisfaction with the readiness of new artisans, rating their skills as "Poor" or "Very Poor." Only a small minority believe new artisans possess a "Very Good" skill level. These findings

raise concerns about a potential skills gap in the industry. While many new artisans demonstrate basic competency, the low percentage of "Very Good" ratings and the notable proportion of "Poor/Very Poor" ratings suggest a need for enhanced training and development initiatives.

According to the employers, artisans lack both technical skills and soft skills. These skills gaps affect the performance of the MMS as they result in several bottlenecks such as reduced productivity and efficiency, challenges in maintaining quality standards, increased risk of workplace accidents, difficulty in meeting industry demands and others. Trouble shooting and problem solving, equipment specific knowledge and computer and digital skills combined, accounted for 70% of the technical skills employers' regard as lacking amongst artisans (see Figure 41).

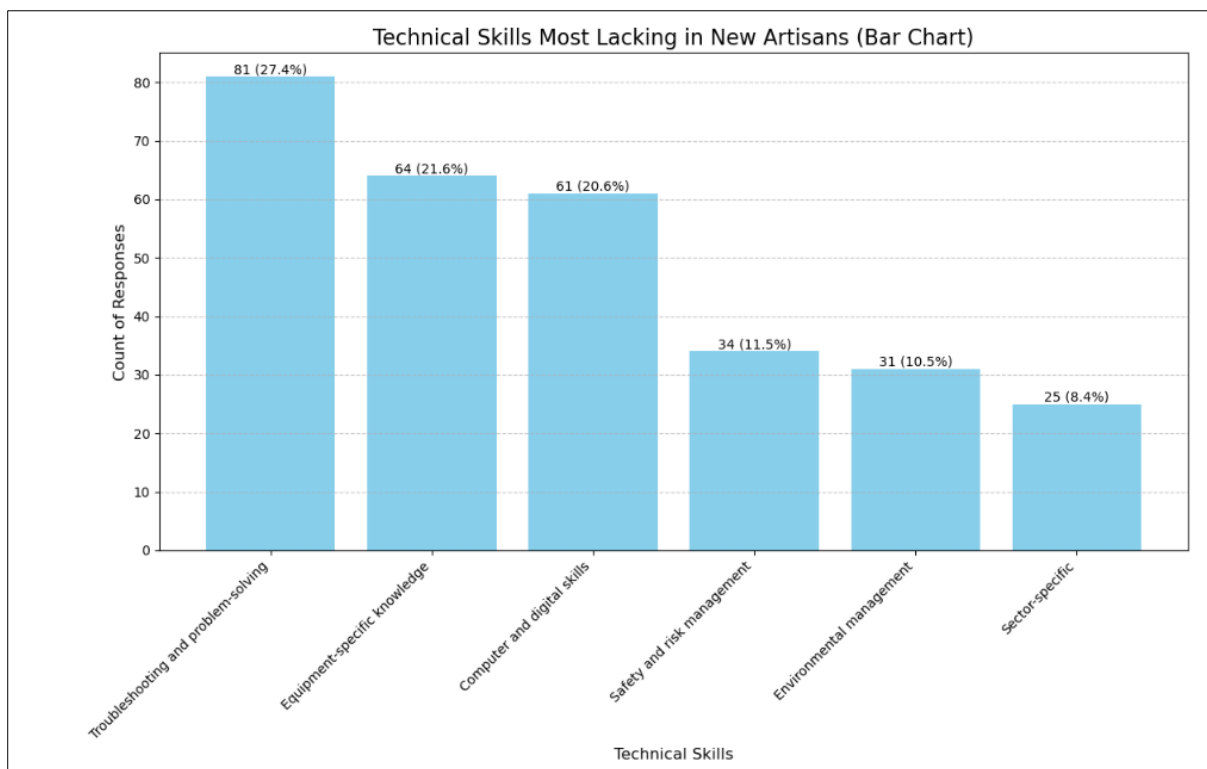


Figure 41: Technical skills most lacking in artisans

From the survey, 11.5% of employers identified a lack of safety and risk management skills, followed by environmental management skills at 10.5% as skills lacking amongst artisans

entering the MMS. Additionally, 8% of employers highlighted a deficiency in sector-specific skills. The findings suggest an urgent need for training programmes that extend beyond basic technical competencies. Figure 42 highlights that problem-solving skills remain the most lacking competency among artisans, as well as communication skills at 19% and leadership skills at 18%.

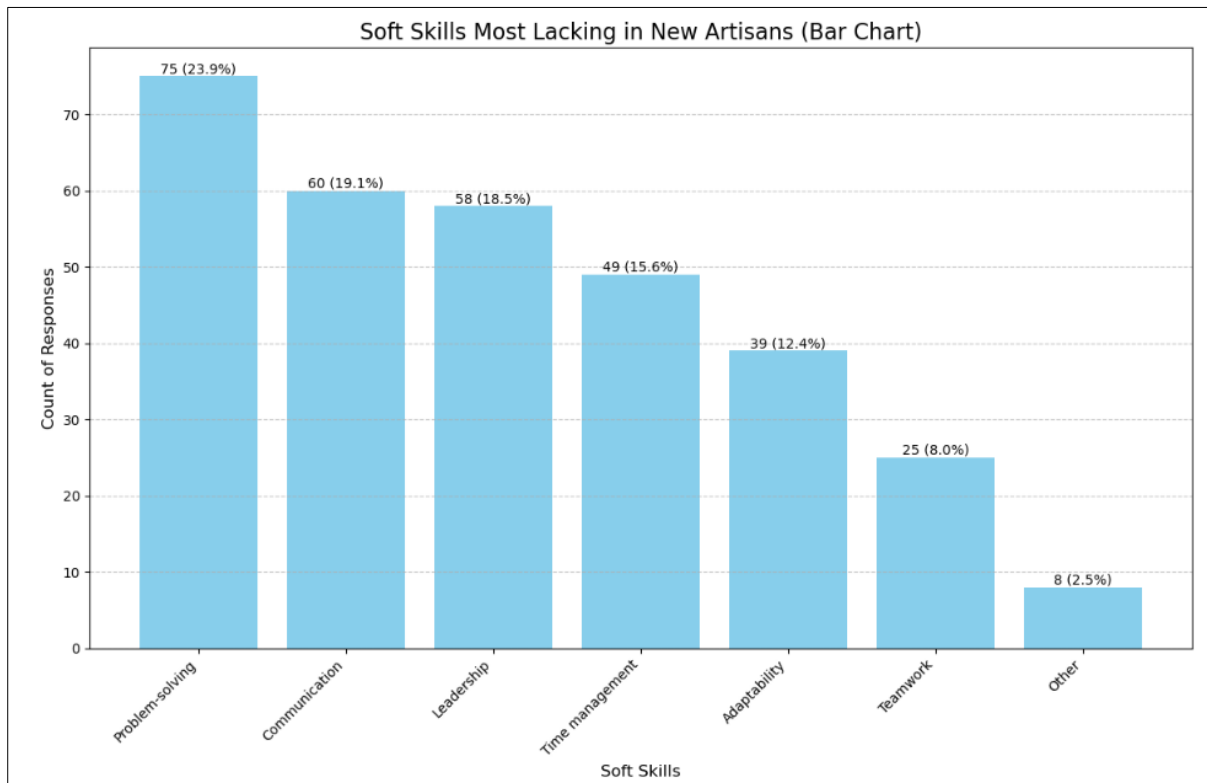


Figure 42: Soft skills most lacking in artisans

In recognising these skills challenges, several programmes have been implemented with the objective of increasing the job readiness of entry level artisans so as to integrate them in the workplace. Some of these programmes have been spearheaded by employers. Figure 43 shows the duration of training programmes offered to entry level artisans. The training duration varies from a month to more than twelve months. Artisans entering the workforce are equipped with a blend of problem-solving skills, equipment-specific expertise, digital literacy, safety awareness, and environmental consciousness. These competencies are

essential for thriving in the modern industry and supporting the MMS in its pursuit of zero harm.

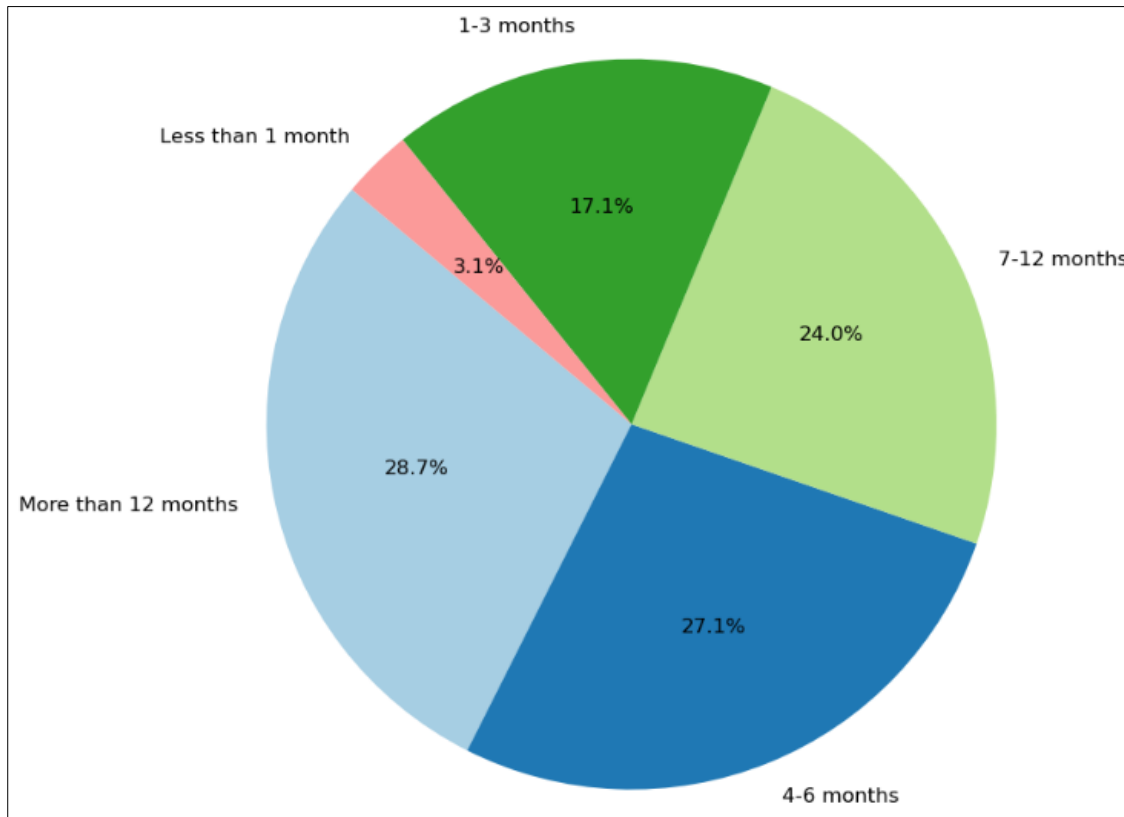


Figure 43: Additional training for new artisans

Employability of artisans

The lack of skills highlighted in the preceding sections have a direct influence on the employability of artisans according to employers. Besides the trade certificate, there are several factors that influence employer's hiring decisions. Based on Figure 44, practical experience and technical skills were rated high accounting for nearly 54% of responses. This clearly indicates employers prioritise artisans with hands-on experience and strong technical capabilities, highlighting the value of real-world application and competency. Educational qualifications rank third at 19.6%, showing that formal education remains a significant factor in hiring decisions. This suggests employers value the knowledge gained through education but place greater emphasis on an artisan's ability to apply that knowledge effectively.

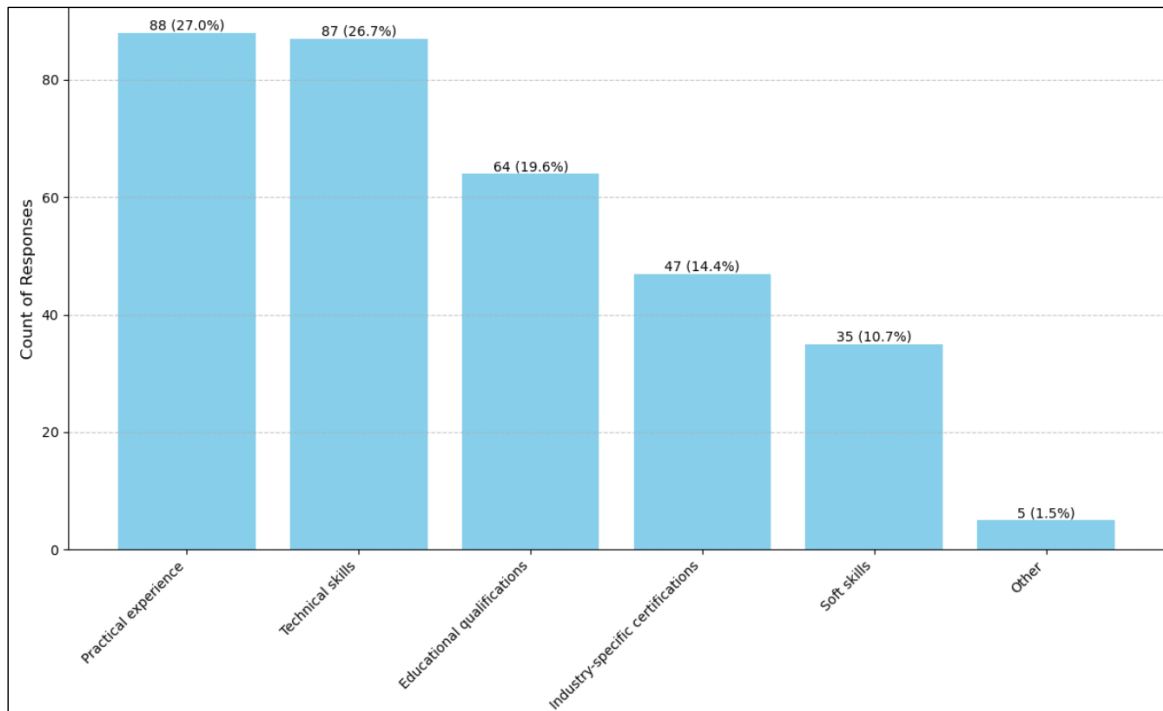


Figure 44: Factors influencing artisan hiring decisions

Given that apprenticeships and learnership programmes serve as primary pipelines for a mining company’s artisan workforce, learners must demonstrate their competency to be considered for these opportunities. One of the key selection criteria includes passing psychometric evaluations, which assess various cognitive and behavioural attributes. These evaluations measure a learner’s aptitude in deductive reasoning, inductive reasoning, and numerical reasoning, along with a personality assessment. The results help mining companies identify candidates with the critical thinking skills, problem-solving abilities, and behavioural traits necessary for success in the artisanal field. During the interviews, it was highlighted that the number of learners that pass these psychometric tests are few. This was submitted by one respondent.

“A person must have math and science above 45%. We had also learners from grade 12 who did math and science, and there were around 70 of them. But within 70 of those who had math and science, its only 18 of them who passed above 45%. Now they have to come through our psychometric assessment, only 4 of the 18 passed.”

Employer (14.12.2024)

Specialised expertise is also valued because industry-specific certifications hold a considerable weight at 14.4%. These certifications validate an artisan's expertise and knowledge in specific areas, making them an important consideration for employers seeking qualified professionals. Considering artisans' career progression to managerial positions later in their careers, soft skills, although less emphasised than technical aspects, are acknowledged by 10.7% of respondents to be essential in hiring decisions. The following were highlighted during the interviews.

There is a gap, especially with the soft skills like writing reports. If someone is required to write a job request, they are unable to articulate exactly what they require."

Employer (09.01.2025)

"They also need courses, like you teach them about people, like diversity, things like that, so that they know how to deal with people. Because remember, as an artisan, you only work with equipment and stuff like that. And now when you start to step into maybe a higher level than you need now to also lead people and to deal with people and their issues and all that. And now you find out that most of the artisans, they don't have that humane part in them for them is like it's all about job and they don't have the empathy. It's more of I hear what you're saying. But I want this job to be address some."

Employer (09.01.2025)

These highlights the growing recognition that interpersonal and professional skills, such as communication, teamwork, and problem-solving, are essential for success in the modern workplace. The "other" category is the lowest at 1.5%. In this category factors such as equity ratios, geographic preferences, attitude and work ethic. This insight was provided by one respondent.

"The only issue we encounter is a mindset change. Most of our artisans don't take care of their work. When they get to the mine, they start to relax. It's no longer about the quality that we taught them, that you must push for quality. For them it's I need my pay."

4.3. Summary and conclusion

The survey findings provide a comprehensive understanding of the artisan workforce in the MMS, highlighting key trends, progress, and areas for improvement. While male continue to dominate the percentage of artisans in the MMS, there was good representation from female artisan suggesting that an overall increase in gender diversity within the sector. More so, there was large participation from Black artisans, and this can be equated to the inroads made by policies and legislation and supporting programmes aimed at transforming the profile of artisans in the MMS. While noticeable strides have been made in working towards the NDP's targets, there are challenges that remain. Training pathways, predominantly apprenticeships and learnerships are vital for equipping artisans with practical skills, although barriers to programme completion and variability in training duration remain a concern.

The survey also highlighted the evolving skills landscape in the MMS, driven by Fourth Industrial Revolution (4IR) technologies and industry advancements. While most artisans feel adequately prepared by their initial training, gaps in areas like new technology, advanced diagnostics, and digital literacy remain. Employer-driven training programmes reported by most respondents are crucial for upskilling and addressing these deficiencies. However, training in emerging areas such as sustainability and soft skills remains underrepresented.

The issue of artisanship not being a first-choice career for many learners remains a critical challenge. There is a lack of awareness regarding career opportunities within this field, which hinders the sector from attracting sufficient talent. Moreover, the perception that subjects like mathematics and science are difficult discourages learners from pursuing these crucial subjects, further limiting the pool of candidates for artisanal careers. Furthermore, barriers to entry are heightened by the retrenchment of experienced artisans, who are often preferred by mining companies over newly certified artisans due to their lack of post-certification work experience. This trend leaves many qualified artisans struggling to find employment, exacerbating the skills gap in the sector.

5. KEY FINDINGS AND INSIGHTS

The results align closely with existing literature, reinforcing established trends while providing deeper insights into the state of the artisan workforce within the MMS. The South African apprentice-to-labour force ratio is considered small at 0.4% in comparison to international standards where a ratio of 1.5% is considered large. While this is the case, the results reveal a positive shift in gender representation, with female artisans possibly accounting a growing percentage. This progress highlights the impact of diversity-focused initiatives aimed at promoting gender equality. Additionally, the survey confirms that mid-career artisans (ages 26–45) remain the dominant demographic, mirroring previous studies, while younger artisans (18–25) continue to be underrepresented.

This underrepresentation is attributed to limited career awareness and the societal perceptions that shape career choices. The rising representation of Black artisans underscores the success of transformation policies and aligns with the national demographics of South Africa, reinforcing the importance of equity-driven interventions. Furthermore, the dominance of key trades such as Electricians, Boilermakers, Diesel Mechanics, and Fitters remains consistent thereby affirming their critical role in the workforce.

It was also found that there is significant reliance on workplace-integrated training programmes, with apprenticeships and learnerships identified as the primary pathways to qualification. These findings align with industry demands for practical, job-ready skills and hence demonstrate companies' preference for tailored in-house training. The majority of respondents completed their training within 3–4 years, reflecting the typical duration for these programmes, while some (experienced candidates already working in the MMS) expedited their certification by a year possibly through the RPL programme. The results further reveal a neutral perception of trade test difficulty and a balanced representation of newly qualified and experienced artisans, suggesting a steady flow of skilled workers into the MMS.

Despite respondents generally expressing satisfaction with their training citing well-aligned content, industry relevance, and high-quality instructors, challenges persist, particularly regarding low programme completion rates. While artisan programme enrolments in South Africa are high, with the MQA consistently meeting its targets, the completion rate remains a critical issue. This challenge is not unique to South Africa; countries like Australia also face similar hurdles, with apprenticeship completion rates averaging approximately 45%.

To address this, Australia has introduced programmes aimed at encouraging higher completion rates and attracting high-quality applicants in growing industries. These initiatives have achieved considerable success, resulting in significant increases in both apprenticeship participation and completion. Central to this success has been the adoption of collaborative industry-driven approaches, including tailored work readiness programmes to prepare candidates for the demands of their trades, structured apprenticeships and traineeships offering practical, hands-on learning experiences, and innovative cadetships and recruitment pathways to provide diverse entry points into the workforce. South Africa could benefit from adopting similar strategies to strengthen its artisan training framework.

Notably, gaps in training were identified, including insufficient knowledge of new technologies and industry-specific expertise which emphasises the necessity for aligning training programmes with the advancements brought about by the Fourth Industrial Revolution (4IR). The survey also revealed that artisans' proficiency aligns well with their trade-specific tasks, with Diesel Mechanics excelling in mechanical, hydraulic, and pneumatic systems, and Boilermakers demonstrating strong welding skills. However, opportunities for upskilling were identified for all trades in emerging areas such as project management, digital literacy, and new technologies. As technological advancements continue to reshape the industry, addressing these gaps through targeted training and upskilling initiatives is crucial. This will enhance artisans' readiness to meet industry demands, improve workplace safety, and support their career growth within the sector.

The results highlighted that workplace-driven initiatives are pivotal, with most of the respondents reporting that their employers provide training. A considerable percentage also

received industry-specific training from bodies like the MQA, while a sizeable percentage received training from private service providers. Training components primarily focused on technical skills safety and health, practical hands-on experience, and leadership and management skills. However, emerging areas such as new technology and environmental awareness were underrepresented, though these are gaining importance in response to industry shifts.

6. CONCLUSIONS

While progress is evident, several challenges persist that threaten the long-term sustainability of the workforce. The limited number of young artisans, combined with the declining numbers of older and experienced workers, presents a significant challenge for knowledge transfer and raises concerns about the future stability of the sector. This generational gap not only threatens the retention of critical institutional knowledge but also highlights the urgency of attracting and retaining young talent. Furthermore, the underrepresentation of specialised trades, such as Millwrights, underscores the need for focused training initiatives to address these critical skills shortages. Addressing these gaps is crucial for cultivating a skilled, diverse, and balanced workforce that not only supports the ongoing transformation within the MMS but also aligns with broader national goals of equity, inclusion, and sustainable growth.

Despite the issues and shortfalls highlighted with artisan supply and demand skills, there is evidence to suggest that South Africa has made considerable efforts in addressing these issues. The Dual Pilot programme: supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and in collaboration with the DHET was introduced after years of trialling in an effort to transform occupational training and modernise vocational education in the country. The success of the programme has resulted in the addition of Centres of Specialisation programmes at several TVET colleges in collaboration with the industry, that focuses on specific trades that are in high demand such as Millwrights, Electricians, and Fitters.

It is important to note that the issues on low completion rates are not only a South African phenomenon, but Australia also experiences similar issues and have introduced programmes that encourage higher completion rates, attracting high-quality applicants in booming industries which resulted in significant growth in apprenticeship participation. These gains are a result of collaborative industry initiatives aimed at creating tailored work readiness, apprenticeship, traineeship, cadetship, and recruitment pathways. In Germany, many high school graduates are opting for less physically intensive careers, leading to shortages in skilled trades. Combining volunteering with practical trade experience, providing innovative pathways to attract young people to trade careers. Such regional programmes have proven effective in addressing labour shortages in certain regions.

To fully meet the demands of a technologically advanced and environmentally conscious MMS, it is essential to continuously review training and associated underlying deficiencies to implement interventions that ensure ongoing improvement. Expanding the breadth and depth of artisan training will better equip the workforce to navigate the challenges and opportunities of a rapidly evolving industry. Additionally, understanding and addressing the root causes of low completion rates in artisan programmes is crucial. By identifying and resolving these issues, South Africa can unlock the full potential of its current and future artisan workforce, fostering a positive economic impact. This effort will not only strengthen the sector but also contribute significantly to reducing the country's high unemployment rates, supporting broader economic growth and transformation.

7. RECOMMENDATIONS

The purpose of this section is to provide actionable recommendations aimed at addressing challenges affecting artisan supply and demand in the MMS. These recommendations are based on the key insights and conclusions derived from the preliminary results and analysis. To ensure effectiveness, the recommendations are structured according to the SMART criteria (Specific, Measurable, Achievable, Relevant, and Time-bound), promoting clarity and accountability in their implementation.

Recommendation 6.1: Implement a “Learners at risk programmes” for learnerships and apprenticeships

Efforts to address the shortage of skilled artisans must prioritise improving the throughput rates of learners in learnership and apprenticeship programmes. To achieve this, a proactive approach is necessary to identify and mitigate the barriers hindering programme completion. It is recommended that the MQA develop a system that will enable it to actively track and identify learners who have exceeded the expected duration of their training or those currently at risk of non-completion. This system can be supported by targeted research aimed at investigating and understanding the underlying reasons behind delayed completion times and or dropouts. Research-based solutions would ultimately guide the development of tailored interventions.

Once these learners’ challenges are identified, the MQA should take immediate action to resolve challenges within its control, such as improving support structures, aligning theoretical training with practical demands and enhancing workplace readiness initiatives. These interventions must be implemented promptly to support current learners effectively. Additionally, the insights gained should inform the creation of a robust framework to prevent similar issues from recurring with future cohorts. By addressing these barriers, the MQA can ensure a steady pipeline of skilled artisans, enhancing the workforce’s ability to meet industry demands and contribute to the sustainable growth of the mining and minerals sector.

Activity	Commission a research study to understand the reasons for low throughput rates among learners
When	This research study can be completed within a year (2025)

Recommendation 6.2: Establish collaborative workshops to bridge the technological skills and soft skills gap amongst artisans

To bridge the gap in technological skills among artisans, the MQA should establish consultative workshops and forums with key stakeholders, including TVET colleges, Original Equipment Manufacturers (OEMs), mining companies and other relevant entities. OEMs, with their expertise in cutting-edge technological advancements would play a crucial role in informing the addition of technology related material in existing curriculum, thereby ensuring alignment between artisan training programmes with the latest and evolving industry developments including addressing knowledge gaps associated with the introduction of technology in the MMS. These collaborative platforms would facilitate meaningful dialogue and lay the groundwork for forming an advisory board tasked with evaluating and enhancing TVET courses.

The phasing out of N1, N2, and N3 presents an ideal opportunity to incorporate Fourth Industrial Revolution (4IR) components into the curriculum. Rather than overhauling the curriculum, the advisory board could focus on integrating 4IR technologies within the existing framework. Leveraging insights from these workshops, the board could guide the inclusion of advanced technological concepts, ensuring training programmes reflect the industry's evolving needs. Furthermore, these forums would define the specific technological and digital skills required for various trades in the MMS thereby, supporting the development of foundational training modules in technological applications and digital tools.

In addition to technical expertise, artisan training should include soft skills such as leadership, communication and teamwork. While these skills may not be inherent in all learners, they can be cultivated through activities such as group work, presentations and collaborative problem-solving tasks. This holistic approach to training will equip artisans not only with the technical

proficiency needed to thrive in a technologically advanced sector but also with the interpersonal skills necessary for career growth and workplace adaptability. Through these targeted efforts, the MQA can ensure that artisan training programmes are forward-thinking, adaptable and aligned with industry advancements by fostering a skilled, versatile, and future-ready workforce capable of driving sustainable growth in the MMS.

Activity	Facilitate workshops between OEMs, TVET colleges and relevant stakeholders to identify opportunities within the existing curriculum to include 4IR technologies.
When	The workshops may be implemented in 2026 to allow sufficient time for planning, organising and engaging relevant stakeholders effectively.

Recommendation 6.3: Strengthen foundational skills by reintroducing Mathematics and Science tutorials in High Schools.

A critical component of promoting artisan careers is addressing the foundational skill gaps that hinder learners' progression in training programmes. One of the key activities in this regard is the reintroduction of Mathematics and Science tutorials specifically designed to strengthen the essential skills required for artisan careers. This initiative recognises the challenges faced by TVET colleges, which are tasked with accommodating a large number of learners, many of whom have achieved low marks or even failed crucial subjects such as Mathematics and Science that are foundational for artisan training. To effectively implement this intervention, the MQA could collaborate with established Mathematics and Science tutorial providers, particularly those operating in rural and under-resourced communities.

These partnerships would leverage the expertise and infrastructure of existing organisations to deliver high-quality tutorials. The MQA could negotiate service agreements with these companies, securing their services at competitive rates to make the initiative cost-effective and sustainable. By investing in foundational education through targeted tutorials, the MQA can better prepare learners for the academic and technical rigors of artisan programmes. This approach would not only enhance completion rates but also contribute to building a more

capable and confident artisan workforce, addressing skills shortages and supporting the mining and minerals sector's growth.

Activity	Fund existing and established tutorial companies, especially in rural communities, to provide Mathematics and Science tutorials.
When	Recognizing the financial barrier but also the significance of this initiative, the tutorials can be started within 1 to 2 years.

Recommendation 6.4: Develop a robust Artisan marketing campaign similar to the 2014-2024 decade of the artisan DHET campaign.

The success of Recommendation 3 which addresses foundational skill gaps may, inadvertently result in an increased number of learners opting for university degrees, potentially overshadowing artisan career pathways. To mitigate this unintended consequence, it is vital to tutor critical subjects such as Mathematics and Science while simultaneously improving perceptions around artisan careers. This dual approach will help attract young learners to artisan professions by showcasing their value and opportunities. To achieve this, the MQA should robustly market artisan pathways to Grade 10, 11, and 12 learners through career guidance events especially at the local municipal level. This initiative should aim to demystify artisan careers and highlight their critical role in the MMS and the South African economy.

The MQA can leverage its own graduates as ambassadors to plough back into their communities. These graduates can serve as relatable role models showcasing the tangible benefits of pursuing artisan pathways. The other advantage is that incorporating practicing artisan professionals in these outreach events will provide real-world insights, inspire learners and effectively promote the profession. Engaging learners through personal stories of success and career growth can shift the narrative, transforming perceptions of artisan careers from physically demanding jobs to dynamic opportunities offering technological engagement, stability and long-term growth. Additionally, the MQA can foster inclusivity, address the underrepresentation of key demographic groups and build a stronger pipeline of skilled

artisans. Ultimately, these efforts will contribute to the sustainability and transformation of the MMS while ensuring the development of a capable and a diversified workforce.

Activity	The MQA should support provincial and municipal career guidance events by providing financial assistance and the attendance of qualified artisans to these events. Additionally, it should fund the creation of posters on various artisan careers for display in school libraries and classrooms.
When	Considering budgetary constraints, this can be initiated in 2025.

Recommendation 6.5: Develop mentorship, life and career coaching to learners on MQA funded learnerships.

Many MQA funded learners in artisan programmes face unemployment after obtaining their trade certificates, unlike those in company-sponsored apprenticeships, who benefit from higher employment prospects and a more optimistic career outlook due to the job security and tailored attention provided during their training. To bridge this gap and improve career prospects, the MQA can implement group life and career coaching programmes as part of its support structure. These programmes would focus on guiding learners in goal setting, self-awareness, and the effective use of their strengths and weaknesses to advance their careers. Introducing coaching at an introductory level for new learners and offering more in-depth sessions to final-year learners preparing to exit the programme would create a comprehensive support system.

By fostering internal motivation and encouraging learners to identify alternative career opportunities within and beyond their chosen trades, the coaching programmes can equip them with critical tools for navigating the job market and pursuing sustainable career growth. This dual approach of combining practical training with personal and professional development would significantly enhance MQA-funded learners' readiness for the workforce and inspire a more positive outlook on their futures.

Activity	Leverage and extend the existing workplace coaches programme to group life and career coaching programmes.
When	With an existing budget for workplace coaches, the programme can commence immediately.

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