Private Sector Federation
(PSF- Rwanda)

SECTOR SPECIFIC SKILLS NEEDS ASSESSMENT
MINING

DRAFT REPORT

March, 2022

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LIST OF ABBREVIATIONS AND ACRONYMS

CB		Capacity Building
EAC		East African Community
EDPRS		Economic Development and Poverty Reduction Strategy
ESSP		Education Sector Strategy Plan
FDI		Foreign Direct Investment
FIR		Fourth Industrial Revolution
FSS		Financial Sector Strategy
GDP		Gross Domestic Product
GoR		Government of Rwanda
HLIS		Higher Learning Institutions
IBES		Integrated Business Enterprise Survey
IPRC		Integrated Polytechnic Regional Center
ISCED		International Standard Classification for Education
ITSCi		International Tin Supply Chain Initiative
KCB		Kenya Commercial Bank
LMIS		Labour Market Information System
MIFOTRA		Ministry of Public Service and Labour
MIFOTRA		Ministry of Public Service and Labor
MINECOFIN		Ministry of Finance and Economic Planning
MINEDUC		Ministry of Education
MINIRENA		Ministry of Natural resources
NFIS		National Financial Inclusion Strategy
NISR		National Institute of Statistics of Rwanda
NSDEPS		National Skills Development and Employment Promotion Strategy
NST		National Strategy for Transformation
NST1		National Strategy for Transformation
RBA		Rwanda Bankers Association
RDB		Rwanda Development Board
RDB		Rwanda Development Board
REB		Rwanda Education Board
RLFS		Rwanda Labour Force Survey
RMA		Rwanda Mining Association
RMPGB		Rwanda Mines, Petroleum and Gas Board
SACCOs		Savings and Credit Cooperatives
SIDECO		
SMMEs		Medium and Micro-sized Enterprises
TTC		Teacher Training School
UR		University of Rwanda

EXECUTIVE SUMMARY

This sector skills assessment report provides information on the current performance of the mining sector, its workforce, and the demand and supply, shortages, gaps, and required skills for the sector's expected performance. In the process of assessment, key skills issues have been identified, including the extent of skills mismatch, the drivers of change and their skills implications, and the future skills needs of the education sector. It also identifies areas to be prioritised for action in the short, medium, and long term.

The main goal was to identify the skills required by the sector and to assess the potential gap between the skills available in the workforce and those required by the sector, which resulted in relevant recommendations for updating education and training provision.

A variety of resources were reviewed, coupled with consultations with stakeholders in the Rwandan mining sector, visits to mining sites, survey questionnaires for employers, and interviews with key informants in both the public and private sectors, providing data and the basis for recommendations made in this report. In addition, the report is divided into five chapters.

The mining sector in Rwanda is growing at a rapid rate and has great potential to support economic growth, earn foreign currency, and contribute to poverty reduction. The Government of Rwanda (GoR) has created an enabling environment for regulation and growth of the sector, including the creation of the RMB, which helps the private sector earn capital through foreign investments. However, the mining sector is dominated by artisanal and small-scale mineral production, processing, and trading along the sector's value chain. These players have minimal skills and the requisite competencies to meaningfully contribute to the development of the sector towards the NSTI targets.

The mining skills needs assessment revealed that the sector is lacking and/or limited from the supply institutions in Rwanda includes the following:

- Graduates with university qualifications are perceived to be not work-ready as they lack sector- and machine-specific knowledge and skills, which can be caused by inadequate practical training at college,
- The technical skills shortage highlighter in engineers, artisan development, practical training and workplace experience, and management skills.

The skills assessment indicates reasons for skills gaps, including: lack of experience in recently recruited staff, lack of staff motivation, failure to train and develop staff, and the failure to keep staff up-to-date with changes in their subject areas.

The skills assessment indicated that there was a gap between what was being taught at the university in terms of both technical content and the competencies needed by the world of work. From the findings of this study and the conclusions made, the following recommendations were made:

- Participate in curriculum development and internship program design to strengthen the skills gaps in order to respond on the labor market's demand
- Update the curriculum development on technological trend regarding mining skills;
- Design exchange and internship programs as well as industrial attachment based on skills required across all sectors in and out of country
- Put in place an interaction platform led by the PSF between companies on the one hand and university educational institutions, IPRCs and TVETs on the other hand to allows permanent collaboration in order to rethink on teaching systems that meet business expectations;
- Provide education at various different levels to create new generations of skilled personnel ready for the world of work (STEM education provided from primary to Post Graduate level)
- Develop cooperation (training and exchange programs) with regional geology and mineral institutions and joint projects/studies with experienced geology and mineral agencies to acquire advanced skills and best practices;

CHAPTER ONE: INTRODUCTION

1.1Background and Context

Rwanda was in the midst of an economic boom, with real Gross Domestic Product (GDP) growth of 9.4% in 2019, fuelled mostly by massive public investments for the implementation of the National Strategy of Transformation. International trade in products and services has been severely interrupted, with substantial consequences for the world economy. The services industry, which accounts for more than half of Rwanda's GDP, has been impacted hard by disruptions in international trade and travel. Conservative estimates for 2020 have reduced economic growth by about 7 percentage points to between 2 and 3.5 percent signalling the acute impact already on Rwanda. Government newly formulated Economic Recovery Plan to build back better and greener, in consistency with the country's NST1 and agendas 2030 and 2063 and the overall macro-economic framework[1].

Due to the significant role of private sector on economic development in Rwanda, the Economic Recovery Fund (ERF) was established by the Government of Rwanda to support the recovery of private sectors so that they can survive, resume operations and safeguard employment, thereby cushioning the economic effects of the pandemic. National Bank of Rwanda was appointed as the Fund Manager[2].

Mining in Rwanda commenced in the early part of the 1900's and the focus has mainly been on cassiterite, coltan and wolfram. These minerals, after beneficiation, renders tin, tantalum and tungsten respectively – the so-called 3T metals. Given this long history, the Government of Rwanda has placed much emphasis on the role and contribution of the mining sector to assist in the economic development of the country. The sector has thus been steadily privatised and transformed over the past two decades from a publicly run one into an exclusively privately driven industry. New legislation has also been introduced in 2018 to assist in the modernisation of the sector. This legislation is supported by policy aimed at promoting increased professionalism within the industry, notably among the artisanal small miners, as well as the introduction of local beneficiation[3].

In 2018 mining has contributed 2.4% to GDP with total export earnings from mining of about US$346 million. The aim is to accelerate the mining sector's contribution to export to US$1.5 billion by 2024. It is anticipated that this can be accomplished by, among others, doubling the exports from the 3T'sfrom US$142 million in 2018 to about US$300 million and to advance the export earnings from other minerals such as gold. Due to the development of other minerals and metals, the proportionate share of the 3T's contribution to mining exports has declined from about 100% in 2014 to 41% in 2018. In addition to its contribution to GDP and exports, the mining sector is a large employer. The mining sector employs about 54,000 people, or about 2% of the total number of people employed. The majority (about 97%) are informally employed with only about 1,200 formally employed. By

[1] *UN,* The socio-economic impact of covid-19 in Rwanda *2020.*

[2] *BNR,* Economic Recovery Fund (ERF) *2021.*

[3] *NISR,* Rwanda Natural Capital Accounts - Minerals resource flows 2019.

far the most people participating in mining are therefore doing so on a part time basis to augment their income in addition to being employed elsewhere, mainly in agriculture. They embark on mining activities as contract workers when it is not planting or harvesting season[4].

The National Strategy for Transformation (NST1) in Rwanda pointed out that among the key sectors of focus to increase demand mining is included. The mining sector is projected to achieve 23.0% average growth per year from 2017 to 2024 with plans to modernize and expand the sector. The Social transformation pillar focuses on developing Rwandans into a capable and skilled people with quality standards of living and a stable and secure society. The underlying objectives include[5]:

a. Develop a competitive and Capable Rwandan Population
b. Ensure Quality of education for all aiming at building a knowledge-based economy

The Economic pillar emphasizes accelerating Inclusive Economic Development founded on the Private Sector, knowledge, and Rwanda's Natural Resources.[6] The two pillars are designed to exploit opportunities in various sectors including mining; to ultimately create decent jobs for economic development and poverty reduction. One of the key strategic interventions entails developing and supporting priority sub-sectors with high potential for growth and employment including; which essentially involves value addition and processing of mining products.[7]

1.2 Rationale

Rwanda recognizes that a skilled workforce is critical to the transformation of the economy. The GoR's agenda of moving from low productivity-based agriculture to a more industrial and diversified economy requires developing a workforce with relevant skills. However, mining as the second sector revenue earner is lacking skilled workers to strengthen the sector.

The 2012 Skills Audit that focused on taking stock of available skills and projecting required specialized skills indicated that there were severe shortages of technician and professional levels skills in the mining sector.[8] This finding was corroborated by a parallel Manpower Survey jointly conducted by the National Institute of Statistics of Rwanda and the Ministry of Public Service and Labor (MIFOTRA), followed by a Labor Force Survey four years later.

All these studies showed that there was a general dearth of skilled mine engineers, geologists, and metallurgists in Rwanda, implying that companies were compelled to import skilled staff. Presently, the skills gaps are being addressed with efforts to train young Rwandans as miners.

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[4] *NISR,* Rwanda Natural Capital Accounts - Minerals resource flows 2019.
[5] *Ministry of Economic Development and Finance, NST1_7YGP, 2017-2024*
[6] *Ibid*
[7] *Ibid*
[8] *RDB, Skills Audit in priority sectors 2012.*

Several initiatives have been intended such as establishment of TTS Rutongo for short courses training for artisans in mining, IPRC Kigali for advanced Diploma courses for Technicians, and Bachelor's Degree courses for the full Engineers in Mining and Geology in UR as wells as sending Rwandans abroad to specialize in mining.

In addition, RDB to attract more investment has to ensure that the country has the quantity and quality skills to support the infant and growing industries. All the stated reasons prove that there is a need of conducting skills assessment in Mining sector.

1.3 Objectives and Scope of the Assignment

The overall objective of the study is to assess the skills requirements of the Mining Sector in Rwanda over the period 2020-2030, and to formulate recommendations to ensure that the future skills requirements of the sector can be addressed out to the end of NST1. Specifically, the objectives of the study are many folds:

- Assessing the global drivers of change impacting on the Mining Sector and the relevant consequences for future skills needs;
- Providing economic assessment and profile of the Mining Sector, particularly with regard to current employment and human capital characteristics;
- Assessing skills along the Mining Sector sub-sectors and document the current status (*skills gaps* against the *skills needs*);
- Identifying the skills supply and analysing the mismatch between demand and supply in the sector;
- Forecasting the skills for the Mining Sector up to 2030 based on mid and long-term national development and specific targets to deliver on;
- Developing profiles of the future skills requirements of the key occupations within manufacturing
- Proposing appropriate recommendations and policy actions that shall clearly outline how skills demand and supply will be matched with clear and smart targets in the sector.

The SSA report builds on an extensive existing literature, complementing it with online survey and on-site consultations and an updated statistical analysis of the National Institute of Statistics of Rwanda (NISR) and relevant stakeholders in Mining Sector.

1.4 Methodological Approach

To conduct mining sector skills needs assessment, different methods and approaches were used.

1.4.1 Approach

1.4.1.1 Assessment Process

The achievements and challenges of the PSF since its creation in 1999 to facilitate and complement mining sector by enhancing the Rwandan economy's growth aspirations through the private sector were evaluated and assessed. Here, we compare the achievements in research and advocacy, governance and membership management, capability development, and support services. As such, we specifically review the PSF and its members' strategic skills needs documents. The challenges were revealed based on desk review and individual interviews with the PSF leadership, staff, and its members in the mining sector. Furthermore, the identified achievements and challenges helped identify the demand and supply skills requiring effort among the future priority skills areas for the mining sector.

1.4.1.2 Formulation of the Skills Assessment

This process involved reviewing different documents informing the specific sectoral skills needs assessment. Accordingly, policy and strategic documents outlining the mining sector development goals at the international and national levels were reviewed. Furthermore, international conventions, good practices frameworks for workforce development on how companies have successfully addressed their skill gaps, and national frameworks relevant to mining sector were thoroughly researched to inspire the current skills needs assessment.

1.4.1.3 Participative Approach

In assessing the required skills of the mining sector in Rwanda, PSF and its stakeholders (institutions providing mining activities in Rwanda) were informed by a participatory approach. Therefore, it involved participation and consultations by senior management, staff, other relevant stakeholders, and some key PSF senior personnel. The survey covered the identified categories or a representative sample of the mining sector and its subsectors, including Mineral Marketing (Trade), Mining and Quarrying (Extraction), Exploration and Mineral processing & Value. In addition, the interviews of the key informants were officials in mining regulatory institutions, miners, company leaders; skills supply Institutions (University, IPRC, and TTS), Rwanda Mining Association leaders, and some experienced persons in the mining sector.

Table 1: Mining Subsectors

SUB-SECTOR	COMPANIES
Mineral Marketing (Trade)	8
Mining and Quarrying (Extraction)	11
Exploration	13
Mineral processing & Value	14

1.4.2 Process

1.4.2.1 Desk Review and Research

Mining Sector Specific Skill Needs Assessment was based on literature review of various relevant documents to capture a wide range of information. The fieldwork was conducted across all provinces from March to May and consists of on-to-one and group discussions. This has brought different point of views and opinions from different stakeholders on how skills in mining sector can be strengthened for better improvement of private sector by reinforcing the required capacities.

To enable observation, desk research was carried out in documentation produced by: MINERENA, MIFOTRA, RDB, Rwanda Mining, Petroleum and Gas Board, Rwanda Mining Association. This implies that the secondary data were collected from a variety of published literature and reports, policies, strategies, legal frameworks of various institutions;

Illustratively, reference was made to several key policy documents, which include but not limited to:

- IPRC Kigali Strategic Plan 2014/15-2018/19
- Rwanda Mining Policy of 13th January, 2010
- World Bank. (2014). Mining and its contribution to National development. Rwanda Economic updates.
- Business and technical management of small-scale mineral producers in Rwanda, 2015, RNRA, (Capacity assessment Report & Training and skills transfer recommendations
- Skills area and numbers of priority skills required across Rwanda, 2013, MIFOTRA. Five-year program for priority skills development to deliver, EDPRS II (2013-2018)
- Mining Policy Framework Assessment in Rwanda, 2017, IGF
- Sustainable development mining in Rwanda, 2019, DFID.
- The mining Sector in Rwanda, 2018, Rwanda Mining Association
- National tracer survey for TVET and higher education graduates and employer satisfaction, 2019, MINEDUC, Final Report.
- Mining & Metals in a Sustainable World 2050, 2016, World Economic Forum, Industry Agenda.
- The future of Mining in Africa, 2018, Deloitte. Navigating a Revolution.

1.4.2.2 Key Informant Interview

In addition, this assessment was resorted to face to face or calls phone interviews with Key Informants using an interview guide. With this method, key informants were identified in close collaboration with the client (PSF) from relevant stakeholders and/or members about its functioning and mandate. Anticipatively, the stakeholders were contacted (*listed in annex_1*) for a conversation aimed at helping the consultant team to gather relevant information about the subject under study. In developing this assessment report, different

views were collected from different institutions. Participants in the interviews were purposively selected.

In this framework, Collection of primary data to complement and actualize secondary data were collected through interviews with key informants (officials in mining regulatory institutions, miners, company leaders, and some experienced persons…) in the mining industry in Rwanda.

- **Response Rate**

It was initially planned to conduct consultations with 30 Institutions from the six identified categories of stakeholders in mining sector (Mineral marketing, Mining and quarrying, Exploration, Mineral processing & Value, Regulatory and Supervisory bodies, and Capacity building supply institutions) As shown from *table_1* below, out of 30 expected institutions, 27 were covered, making a responsive rate of 90%, largely sufficient and representative to make significant analysis.

Table 2: Response rate as per category of key informant Interviews

Category of key informant	Expected companies	Companies consulted	Response Rate (%)
Mineral Marketing (Trade)	5	5	100%
Mining and Quarrying (Extraction)	8	6	75%
Exploration	5	4	80%
Mineral processing & Value	6	6	100%
Regulators and supervision bodies	3	3	100%
Capacity building supply institutions	3	3	100
TOTAL	30	27	90%

Source: Customized from primary data collection, 2020

In addition, the interview process targeted individual as key informants from identified stakeholder's above institutions, to provide information through interviews.

1.4.2.3 Data Collection

To conduct Mining Sector Specific Skill needs Assessment for Rwanda's private sector, a combination of following methodological approaches both quantitative and qualitative were used. This assessment was conducted to determine the existing skills against the required skills and determine current skills gap, as well as suggesting skills projection in next ten years.

Qualitative information was collected via interviews with officials in mining regulatory institutions, miners, company leaders, and some experienced persons in a representative sample of mining activities, institutions of learning, and regulatory or supervisory bodies. (*See Annex_1 for a list*).

A quantitative survey of key informants was carried out through Monkey survey, comprising a questionnaire covering companies' profiles, skills, job specifications, qualifications and experience.

In terms of sampling, stratified random sampling was used to maximize information accuracy. This consists of dividing the sample population into smaller groups, or strata, based on shared characteristics. A random sample is selected from each stratum based on the percentage that each subgroup represents in the population. Stratified random samples are generally more accurate in representing the population.

The survey data was then processed and analyzed to form the basis of the current report, which highlights the key findings and recommendations for developing skills in Rwanda's mining sector.

1.5 Report Outline

A variety of resources were reviewed coupled with consultations with stakeholders in the Rwandan mining sector, visits to mining sites, survey questionnaire for employers, and interviews with key informants, in both the public and private sectors, provided data and the basis for recommendations made this report. The report is divided into 6 Chapters:

- **Chapter One** provides the general introduction which is composed by brief economic performance, briefly the significance of the mining industry for Rwanda's economy, the rationale for the study, objectives and scope of the study, the methodological approach and profile of your respondents.
- Chapter Two shows the sector's profile in terms of its importance and performance on the global perspective, Africa, regional, and finally Rwandan context. It contains also the labor market in the mining sector and its share of the employment as a percentage of the total employment.
- Chapter Three presents the drivers of change and their skills implications
- Chapter Four. Present the skills status in mining sector in terms of current skills demand, current skills supply, specific future economic implication, skills gap by 2030 and projected skills demand 2020-2030.
- Chapter 5. Summarizes the sector skills response to address the identified skills gap, sector skills benchmarking, and lessons to Rwanda's mining sector.
- Chapter 6 presents conclusion and recommendations by referring to the objectives and related policy interventions.

CHAPTER TWO: MINING SECTOR PROFILE IN RWANDA

2.1. Introduction

Many low and middle-income mineral-rich countries have experienced strong growth for a decade or longer, propelled by a rapid expansion of their mineral exports and a rise in prices of these commodities. This sustained strong economic performance goes against the accepted wisdom that even though the mining sector, like other extractive industries, can generate foreign exchange and fiscal revenues, it contributes little to sustained economic growth and, by extension, human development. Through the presentation of trends and patterns of various indicators, it was revealed that in addition to economic growth, countries rich in minerals other than oil have experienced significant improvements in their human development index (HDI) scores that are on average better than those experienced by countries without minerals mining[9].

The mining sector is considered as one of Rwanda's key sectors from an economic development perspective. Its contribution to GDP is provided in Table 2 and Figure 2 with the overall structure of the economy provided. In current prices mining has increased its share in the economy from about 0.2% in 1999 to 2.5% in 2018, with a peak in 2014 of 2.7%.

Table 3: Mining's contribution to the Rwandan economy

Year	GDP at current 2014 prices (million US$)	Mining GDP at current 2014 prices (million US$)	Mining GDP as % of GDP (%)	Exchange rate (RwF: US$)
1999	1,817	3	0.2%	334
2000	1,733	3	0.1%	390
2001	1,675	14	0.8%	443
2002	1,678	4	0.3%	475
2003	1,846	6	0.3%	538
2004	2,097	14	0.7%	575
2005	2,585	18	0.7%	557
2006	3,192	42	1.3%	552
2007	3,876	79	2.0%	547
2008	4,923	93	1.9%	547
2009	5,452	58	1.1%	568
2010	5,851	77	1.3%	583
2011	6,650	170	2.6%	600
2012	7,433	158	2.1%	614
2013	7,618	192	2.5%	647
2014	8,003	215	2.7%	683
2015	8,289	183	2.2%	720
2016	8,478	174	2.1%	787

[9] *World Bank, The Contribution of the Mining Sector to Socioeconomic and Human Development. Extractive industries for development series; no. 30. 2014*

2017	9,135	219	2.4%	832
2018	9,511	237	2.5%	861

Source: NISR (2019a)

As can be seen in Figure 2 below, agriculture, contributing 29% to the GDP is the largest sector in the economy, followed by the trade and transport sector (11.8%), construction (6.2%) and manufacturing (5.9%). Mining and quarrying, although important from a strategic perspective, is therefore one of the smaller sectors from a GDP perspective.

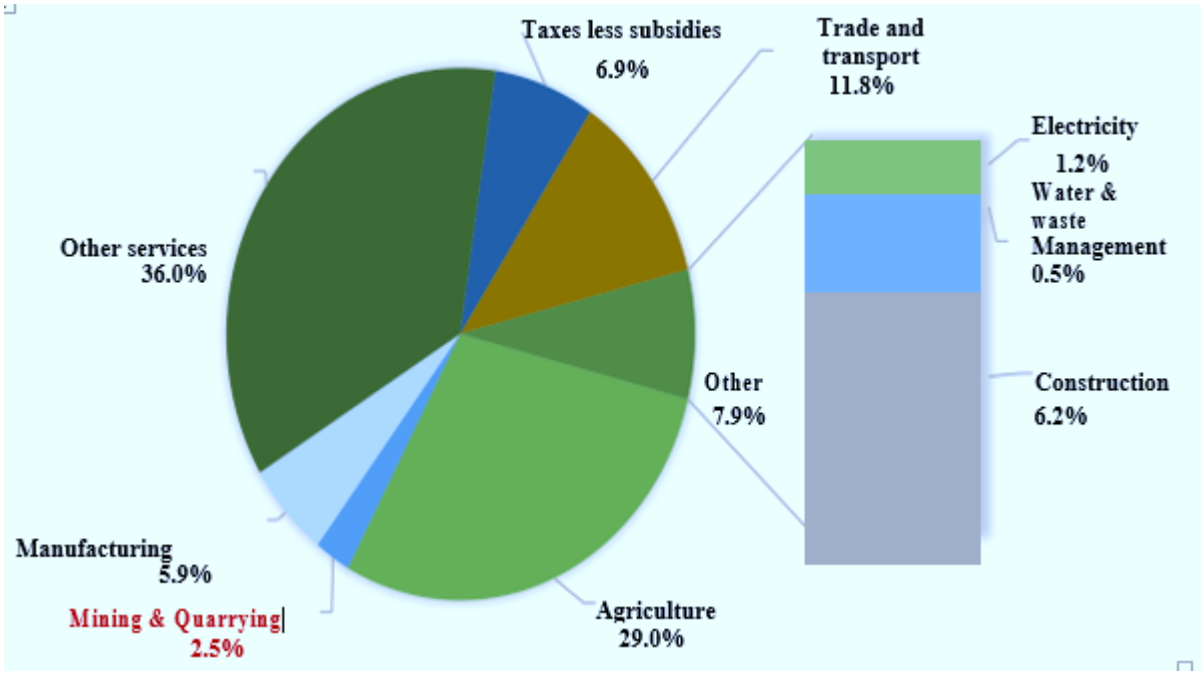


Figure 1: Composition of GPD

2.2 Mining Sector Profile

African economies are heavily dependent on the extractives sector, which comprised 28% of the continent's combined gross domestic product in 2012, 77% of total exports and 42% of all government revenues. Studies by the International Mining and Minerals Council (ICMM) show that for every US$1 generated by mining, at least an additional US$3 is generated elsewhere in the local economy, and that for every direct mining employee, as many as 15% more jobs are created elsewhere in that economy[10].

During the commodity boom, there was considerable optimism that African economies were changing and that they were no longer dependent on raw material exports. However, the commodity price downturn has illustrated the continent's continued dependency on this

[10] *GREAT Insights, mining for development in Africa and the developing world,* ECDPM, *2017*

sector and its vulnerability to variations in external demand, especially from China which, since 1990, has grown its share of worldwide metals consumption sevenfold to over 40%[11].

In this new, highly competitive yet austere environment, governance and policy attractiveness will become increasingly important differentiators in the performance of African countries. Just as important will be the state of health of regulatory and administrative processes needed to ensure strong and diversified growth. These factors, too, will be vital determinants for attracting investment and growth in mining projects. Indeed, as the World Bank has noted, after geological factors, governments are the single largest determinant of where mining investments flow globally[12].

2.2.1 The Subsectors in Mining Industry

The mining sector in Rwanda has 4 principal activities. Extraction of stones is the largest in the sector constituting 61% of establishments followed by mining of metal ores constituting 19.5% and mining support service activities constituting 9.8%. Other activities include retailing of mining products (7.3%) and quarrying (2.4%)[13]. Mining Sector in Rwanda has four core activities namely: Exploration, Mining and quarrying

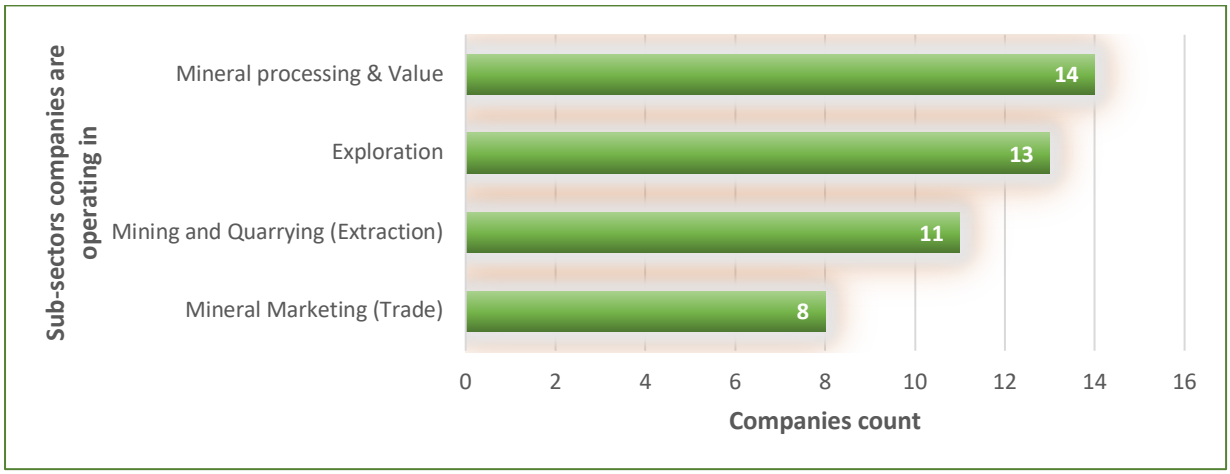


Figure 2: Subsectors in Mining sector

2.3 Mining Sector Occupational Profile

Recent statistics shows that mining sector has performed in terms of earnings and has a positive prospective to contribute to the national economic growth and overall development in general. There is a great potential of employment creation and poverty reduction. This can be seen by observing the size of the sector and the number of employees it hosts especially at informal level.

[11] *GREAT Insights, mining for development in Africa and the developing world,* ECDPM*, 2017*
[12] *World Bank, The Contribution of the Mining Sector to Socioeconomic and Human Development. Extractive industries for development series, 2017*
[13] http://www.lmis.gov.rw/index.php?id=115

Table 4: Employment in the mining sector

		Total	Male	Female	Urban	Rural
Employed population	2017	2,959,965			814394	2,145,571
	2018	3,096,278	1,719,527	1,376,751	773,971	2,322,307
Mining and quarrying (2017)		54,618	49,756	4,862	2,749	51,869
	2017 % of tot	1.8%	2.9%	0.4 %	0.3%	2.4%
	Formal Employment	1,249	1.249	0	n.a.	n.a.
	Informal Employment	53,369	48,507	4,862	n.a.	n.a.
Mining and Quarrying (2018)		55,768	53,387	2,381	647	55,121
	2018 % of tot	1.8%	3.1%	0.2%	0.1%	2.5%

Source: NISR (2018a, 2018b – based on the Labour Force Survey)

As indicated in the Table 3, in 2018 mining has contributed 2.5% to GDP with total export earnings from mining of about US$346 million. The aim is to accelerate the mining sector's contribution to export to US$1.5 billion by 2024. It is anticipated that this can be accomplished by, among others, doubling the exports from the 3T's from US$142 million in 2018 to about US$300 million and to advance the export earnings from other minerals such as gold. Due to the development of other minerals and metals, the proportionate share of the 3T's contribution to mining exports has declined from about 100% in 2014 to 41% in 2018.

In addition to its contribution to GDP and exports, the mining sector is a large employer. The mining sector employs about 54,000 people, or about 2% of the total number of people employed. The majority (about 97%) are informally employed with only about 1,200 formally employed. By far the most people participating in mining are therefore doing so on a part time basis to augment their income in addition to being employed elsewhere, mainly in agriculture. They embark on mining activities as contract workers when it is not planting or harvesting season.

This percentage of people employed in mining sector in Rwanda is small compared to the mining employment rate in Kenya which is 14.4% of the total population in 2017.

CHAPTER THREE: DRIVERS OF CHANGE AND THEIR SKILLS IMPLICATION

3.1. Introduction

There are numerous factors that impact on skills development in the Mining sector. These factors are analyzed based on the economic, social, technological, environment and legislative aspects. The relationship between the drivers is critical to determining their impact on the Mining sector. Their interdependencies mean that they may mitigate or reinforce each other's impact, and it is therefore important to recognize these dynamics when analyzing trends that impact on skills in the sector.

The drivers of change in this Sector Skills Assessment were based on extensive desktop research and stakeholder meetings. Some of the change drivers are non-sector specific, meaning they are not directly related to the sector but exert change in the broader environment in which the sector operates. The change drivers discussed here nevertheless have direct implications for skills development in the Mining Sector.

3.2. Drivers of change and their skills implication

3.2.1 Technology

Technological change remains at the forefront of the sector's ability to become as efficient, effective and economical as possible to maximize on productivity and profit margins. The impact of new technologies and innovations transforms the mining and metals processes and operations. In addition, the type, level and mix of skills required to streamline mining operations presents a challenge to the sector as a result of increased technological change. The implication to Mining in terms of skills is that learner ships must engage new mining technologies, new tools, systems and processes. Mining enterprises must start developing the technologies to operate in a clean, affordable and safe environment in frontiers previously considered inaccessible. There is an intensified rate of technological change and mechanization in the Mining sector or and this has affected numerous occupations including but not limited to rock drill operator, blaster, and drill rig operator. The employer response to technological change has been in the form of mining production and investment shifting towards newer, better performing export sectors.

3.2.2 Foreign direct investment and technological change

FDI is a controlling ownership in a business enterprise in one country by an entity, mostly multinational companies (MNCs) based in another country. FDI has a high economic impact on the Mining sector as the sector is highly capital intensive and has significant foreign investments. FDI will generate employment since new entrants/ investors will need to hire staff. FDI creates better mining infrastructure, which helps to support overall sector and economic growth. Increased economic activity brings with it more employment opportunities.

3.2.3 Small enterprise development

Enterprise development supports the notion that Small, Medium and Micro-Sized Enterprises (SMMEs) should build sustainable business models given that the gestation period for success in the Mining sector is long. Enterprise development creates employment growth opportunities. Most workers employed by unorganized businesses do not receive healthcare, education opportunities and minimum wages. There is also increasing casualization of labour. The SMEs need to be taken into account through calls for the grant allocation. Training and support to the SMEs could be in the form of design learning programs for SMEs, voucher training schemes, toolkits, on-the-job training, industry clusters, mentoring and coaching. In addition, the PSF and RMB will assist SMEs with research and development of appropriate technologies, and by providing training and support so that development is sustainable.

3.2.4 Employment Equity

Employment equity is another high priority change driver. The Mining Sector is still faced with specific challenges that need more focused attention. As highlighted in the labour market profile, women in particular is underrepresented in the Mining sector management. The Mining sector facing the issue of gender inequality where only 6% are women who are employed and are mostly unskilled. The skills planning implication for Mining sector needs to focus on the development of women for all positions in the sector. Skills development must also include measures to address the representation of women in senior management positions in particular.

3.2.5 Mineral beneficiation[14]

Mineral beneficiation is premised on the proposition that opportunities exist along the mining value chain from extraction, processing to shipping and beneficiation of minerals such as Columbium (Niobium) and Tantalum, Gold, Cassiterite (tin ore), Coltan, Sapphire, Pozzolanic, and Wolfram are some of the potential investment areas in the sector.

Mineral beneficiation need to be planned to transform the industry from being largely resource-based to knowledge-based. There is therefore need to train in new skills in line with this transformation. For example, in jewelry manufacturing sub sector requires specific skills for beneficiation. The critical skills identified in line with mineral beneficiation includes jewelry designer and evaluator; diamond and gemstone cutter; gemologist; gemstone setter; goldsmith; jewelry processing and finishing machine operator.

3.2.6 Environmental Sustainability

The industry is becoming more conscious of protecting the environment to ensure its sustainability. Increased enforcement of legislation and consumer pressure is driving the demand for eco-compliance, so that the industry is able to show that it is environmentally friendly in business processes. Skilled workers are required in energy efficiency and sourcing

[14] Beneficiation refers to the transformation of a mineral (or a combination of minerals) to a higher value product, which can either be consumed locally or exported. The term is used interchangeably with "value-addition"

of ‘green’ products and services and managing ‘green’ supply chains. There is therefore a business and ethical case for ensuring that an environmentally friendly Mining sector is realized. In addition, mining companies also need to assess the impact of adverse weather patterns on their operations (excessive or below-average rain, heat, fog and dust impacting on operations) and then communities in which they operate.

The implications for the Mining sector include: developing greening skills programs, learnerships and apprenticeships, toolkits for businesses to go ‘green’, code of conduct for sustainable practices; green projects promoting ‘green’ occupations and jobs awareness campaigns. There is great need for people to be skilled in energy efficiency.

3.2.7 Occupational Health and Safety

Mining is a hazardous activity and has generic risks that impact the health and safety of employees. Therefore, mining companies, government and unions should continue to place importance on employee safety since continued fatalities, injuries and occupational diseases jeopardize a company’s license to operate. However, there has been a decrease in mining injuries and fatalities.

CHAPTER FOUR: SKILLS STATUS IN RWANDAN MINING SECTOR

4.1Introduction

The skills assessment results presented in this section provides the profiles of skills available, skills required, skills gap and shortages in the Mining Sector in Rwandan private sector. This is done following the value chain framework

4.1.1 Existing Skills in Mining sector /Current status

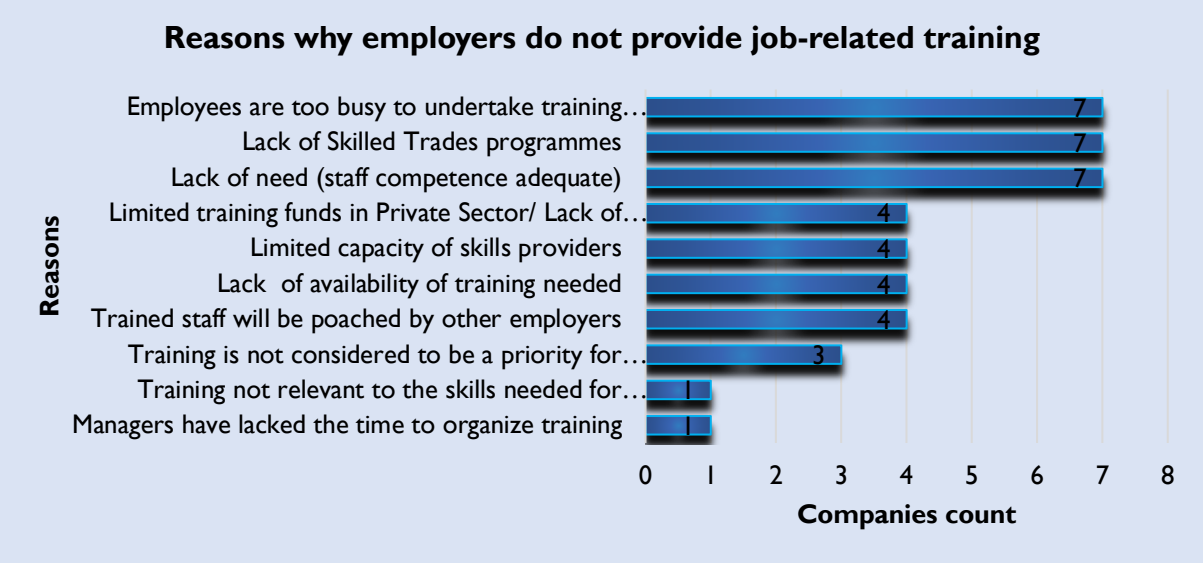
- Basin Analysis
- Environment, Geology, Rock and Natural resources
- Forest and Green Environment
- Hydrology and Water Resources
- Land Administration
- Land Administration and Valuation
- Land Surveying
- Machine Operators, Excavator, Bulldozer and
- Mining Surveying
- Ore dressing Engineering
- Photogrammetry
- Rock Mechanics and Engineering
- Sedimentology
- Water Resources and Sanitation

4.2 Current Skills Demand and Their Specific Future Economic Implication

4.2.1 Current Skills Demand

Despite the high incidence of training across the Mining sector in comparison to other areas of the economy there are still a significant proportion of employers (14 per cent) who report that they do not provide training.

Table 4 shows that the main reasons given by employers for not providing training in Mining sector and the economy overall. In the Mining sector, 11 respondents' companies cited "Limited training funds. A further 4 respondents' companies reported that there is Limited time for Training, Limited time for Training and lack of appropriate courses. Finally, 3 respondent's companies of mining sector state that is frequent mobility of Labour force.



4.2.2 Future Skills demand

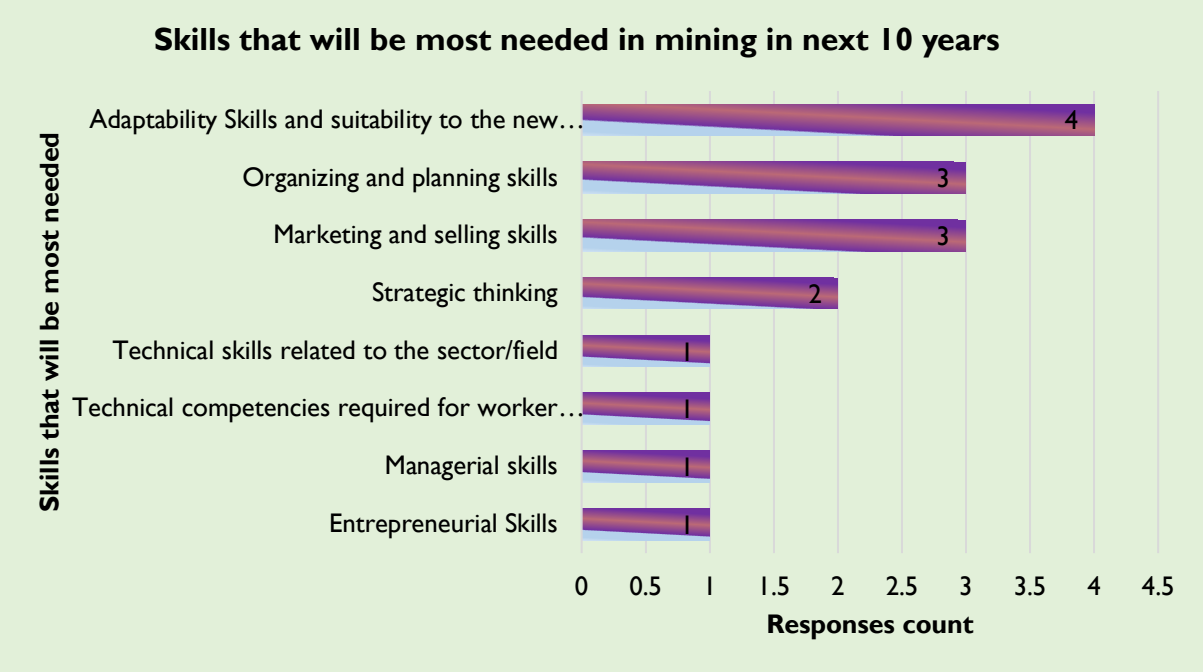


Figure 3: Reasons why employers do not provide job-related training

Figure 4: Measures taken by employers to overcome the problem of finding skilled staff

Employers adopt different approaches to overcome the problem of finding skilled staff. Table 6 shows the measures taken by employers within the Mining sector. Most employers in the sector tend to focus on improving career progression by either increasing/expanding trainee programmes or introduce further. This is broadly consistent with the whole economy average.

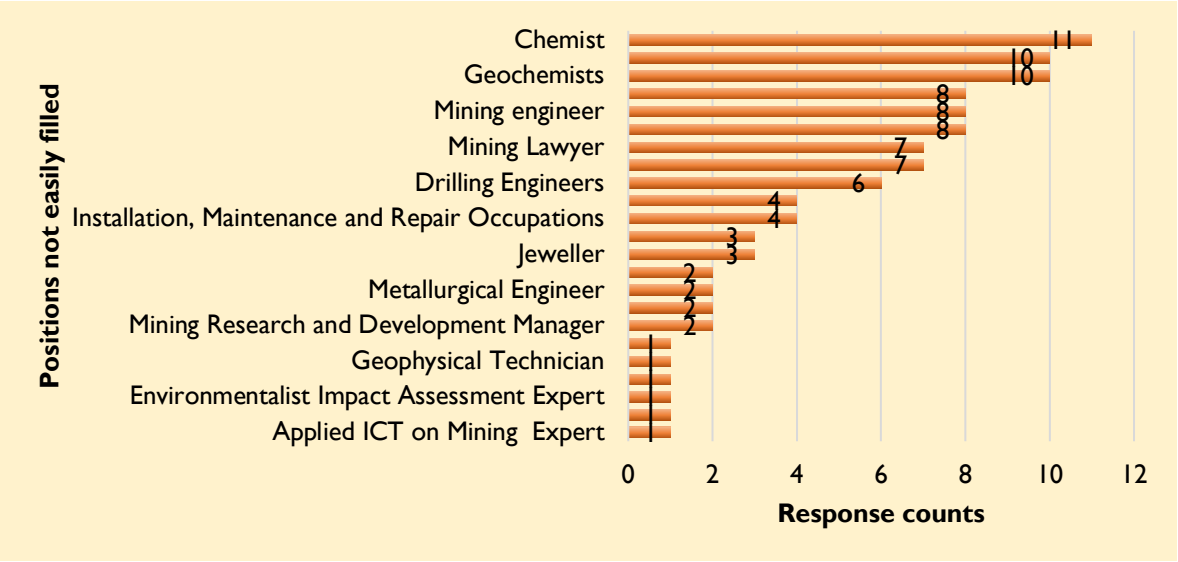


Figure 5: Positions not easily filled from Rwanda labour market

4.3 Current skills supply and their specific future economic implication

4.3.2 Current Skills Supply

According to Rwanda vision 2030, Investment in Human capital mainly in capacity building from a low base is one of the key Success factors in Development progress15. To tackle the problem of the shortage in Human capital, the Government of Rwanda in collaboration with the stakeholders in mining have established different ways to close gaps through learning institutions, short courses, mentorship or industrial attachment. In the

[15] GoR, Vision 2030,

long-term Rwanda have developed a degree programs in University and technical training programs at certain Universities and technical schools.

4.3.2.1 University of Rwanda / College of Science and Technology/ School of Mining and Geology

The School of Mining and Geology have been established in 2016 with the aim of supplying the mining industry with required skills to strengthen the nascent mining industry.

The School of Mining and Geology have produced the first intake of fifty graduates in Mining and Geology in 2019.

A Tracer Study of Graduates from Higher Learning Institutes and Employers' Satisfaction of Graduates' Competencies[16] was conducted to assess graduates' competences, relevance of higher education, and employers' satisfaction with graduates, found that Higher Education Institutions had inadequate facilities, limited research capacity, and had weak links with industry or access to internships opportunities. Whilst 80% of employers were satisfied with university graduates' skills, issues were raised regarding levels of practical skills and general knowledge. Further analysis of data revealed that more emphasis was placed on theoretical skills than on practical skills. This implies that the fresh graduates learn from the experienced technicians from TVEs.

Table 5: Tertiary graduates in 2018/2019 by field of education

S/N	**Field of Education**	**Number of Graduates**			
		Male	Female	Total	% by field
1	Business, Administration and Law	11,481	14,227	25,708	29.82%
2	Engineering, Manufacturing, and construction	11,423	2,797	14,220	16.50%
3	Education	6,402	4,473	10,875	12.62%
4	Services	2,308	3,029	5,337	6.19%
5	Health and Welfare	3,477	3,249	6,726	7.80%
6	Information and Communication Technologies	5,888	3,539	9,427	10.94%
7	Social Sciences, journalism, and information	3,151	3,107	6,258	7.26%
8	Natural Sciences, Mathematics and Statistics	2,461	1314	3,775	4.38%
9	Agriculture, Forestry, fisheries and veterinary	1,909	998	2,907	3.37%
10	Arts and humanities	590	383	973	1.13%
	Total	49,090	37,116	86,206	100%

As indicated by the *table 5*, the courses offered by tertiary institutions have been grouped to ten (10) major groups based on International Standard Classification for Education (ISCED). Rwanda has 40 institutions of higher learning of which 37 are private and 3 public[17]. The table above shows that Business, Administration and Law have the most graduates (29.82%).

[16] *Higher Education Council, 2020*
[17] MINEDUC, 2019 Education statistics

It can therefore be concluded that the problem of human resources skills in the Mining sector is not due to a low number of graduates in the higher education system.

According to the interview conducted during the field work revealed that graduates lacking practical skills to complement the theories, that means education often trains generalists with more theories than practical skills in most cases.

4.3.2.2 IPRC Kigali/ Mining and Geology

Integrated Polytechnic Regional Center Kigali's (IPRC) has a 3 years training program for mine technicians began in 2012. The IPRC is part of a national Technical and Vocational Education and Training (TVET) network under the auspices of the Workforce Development Authority. The first intake has graduated in September 2015 with 30 graduates in Mining Engineering. IPRC's program focuses on medium-scale mine practice. From 2015 -2019, 310 students have graduates.

4.3.2.3 TTS Rutongo

TTS Rutongo have been established in 2010 on the recommendation of Mining sector with the aim of tackling shortage of skills challenges for technicians in mining. Training in mining sector helped industry itself to obtain skilled and competent manpower.

4.3.2.4 Education, Training programs and Graduate

In Rwanda TSS offers a course in basic Mining as an option. This part of a certificate course for the secondary schools' students. IPRC Kigali visited during the assessment period offers certificate courses on Geology & Geophysics, Mining Engineering, Mineral Processing and Safety and Environment Management at Advanced Diploma. The University of Rwanda is the only University in Rwanda which offer the course of mining and geology within the country through the College of Science and technology/ School of mining and geology at bachelor's degree.

Table 6 below indicates the types of courses offered by various training institutions and level of training of such programs. Rwanda training institutions focuses more on graduates (managers and professionals) in mining. The annual out of graduates put is about 310 (bachelor degrees and diploma certificates holders).

Table 6: Mining courses by institution, level and graduates

Type of institution	Courses	Level of programme	Graduates				Total
			2016	2017	2018	2019	
UR	Mining and &Geology	Bachelor's Degree			-	50	**50**
IPRC	Mining Engineering	Advanced Diploma	30	47	55	178	**310**

Source: Table adapted from data collected from field

As indicated in the above *table_6*, the School of Mining and Geology in the College of Science and Technology, was started by the University of Rwanda at the beginning of academic year 2015/2016 with the aim of supporting the mining industry, and it is expected to become a centre of excellence for mining and geological studies in the region. According to information gathered from the school, the first intake in Geology and Mines graduated in 2019 with 50 graduates. According to the market demand and Rwanda Mining, Petrol and Gas Board requirements for mining companies, 50 graduates is not sufficient for both the public and private sectors to close the gaps. The 2012 skills survey indicates that the mining sector in Rwanda has a total gap of 2,721 labour units in the short term. Out of these skills gaps, 89.9% are skilled mining artisans, 4.1% are managers, 2.8% are technicians, 1.4% are liberals, and 1.8% are scientists. It has been revealed that not all graduates are employed. That means there is a need to regulate mining jobs in order to absorb skilled employees instead of employing the less skilled and experienced. For the IPRC Kigali, the first cohort graduated in the academic year 2016/2017 with 30 graduates in mining engineering, followed by 47 and 55 graduates in 2017/2018 and 2018/2019, respectively.

- **Trainings organized by mining partners (MINIRENA, RMB, RMA)**

For training, every company have their own capacity development policy, some have opted to hire the Expert in mining for in house training and mentorship which is cost effective instead of sending the workers abroad and other nothing is done for capacity building for their employees.

As illustrated in the figure_ below, the following recommendations have been observed by the training providers.

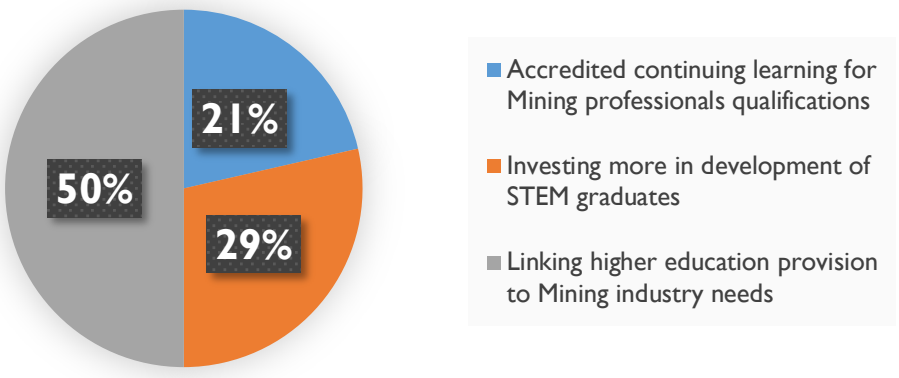


Figure 6: Companies recommendations to training providers

While 50% of mining companies respondents said that there is needs of linking HLI provision to mining industry needs in terms of skills, 29% recommended that investment should be focused on development of STEM graduates. 15% required that accredited learning for mining professionals' qualification be given a high stake of emphasis.

- **Employability of graduates**

Graduates who complete with artisan qualifications are perceived to be not work-ready as they lack sector- and machine-specific knowledge and skills, which can be caused by inadequate practical training at college, as well as workplace experience which is too generic in nature. The responsibility then becomes the employers to undertake further training for them, which is an increased cost to company and in Rwanda many companies are not willing to incurred skills training costs. Work-integrated learning programmes aims to address this issue.

Graduates of non-mining related engineering qualifications usually lack mining sector related experience. Companies generally prefer to recruit Engineers with some sector-related experience. There is a need of internship programs for Engineering graduates aims to address this issue.

4.4 Skills Gaps, Anticipated Skills Demand, and their Policy Interventions by 2030

4.4.1 Skills gaps

The shortage of qualified graduates to enter the Mining industry of experienced mining professionals is a serious constraint to Mining sector efficiency and growth. As much as the Degree is the foundation for entering Mining industry still the latter is lacking some fundamental areas that constitutes the knowledge package that can qualify the workers to be professional who muster the performance for search industry productivity.

The primary skills gap which have emerged through Mining sector are generally those skills which are core to a company's operations. Some skills are often found to be important skills in a number of occupations, rather than just one, and can sometimes be referred to as "top-up" skills. Below is a list of these skills gaps:

4.4.1.1 Engineers

In mining sector, the numbers of qualified Engineers are limited due to their scarcity which implies a high competition between companies.

4.4.1.2 Artisan development

Skills Assessment indicates that artisans are not scarce in the Mining sector. Anecdotal evidence, however, suggests that artisans with sector-specific skills are for the most part quite scarce, and, in particular, suitable female candidates.

4.4.1.3 Practical training and workplace experience

Learners are often not perceived to be work-ready upon graduating, owing in part to a lack

of adequate practical training during their studies, and inadequate workplace learning. Private sector in collaboration with the skills providers to work hand in hand

4.4.1.4 Certificates of Competence

Certain occupations within the Mining sector can only operate upon issuance of a technical certificate, which confirms the employee has the criteria required to perform the job.

4.4.1.5 Management Skills

Technical people, often Engineers, are promoted to managerial positions as there is a need for Managers to have a strong technical understanding of the operations they are managing. However, these skills are often lacking as they are not developed during the person's early education and career. The RMB in collaboration of Private sector need to have a Management Development Programme in place which aims to address this challenge.

4.3.2 Anticipated Skills Demand and their Policy Interventions by 2030

4.3.2.1 Required Skills

According to the mining stakeholders visited during the assessment revealed that the following are the core skills needed in the Mining sector in Rwanda:

- Geological Engineer
- Geophysicists
- Geochemists
- Geologist
- Chemist
- Metallurgists
- Mining Lawyer
- Mining engineer
- Mineral Auditor
- Mechanical Engineer
- Mineral Economist
- Drilling Engineers
- Environmentalist Impact Assessment specialist
- Applied ICT on Mining Specialist
- Shot firers and Blasters
- Geo-statistician
- Jeweller
- Metallurgical Control Analyst
- Metallurgical Engineer
- Process Engineer
- Prospector
- Quality Control Engineer
- Surveyor

- Installation, Maintenance and repair occupation
- Mining Research and Development Manager
- Commercial Production manager
- Geological Technician
- Geophysical Technician
- Geological and mineral technology technicians.

In addition to the skills listed above revealed as skills required by different companies visited during the field work, the Ministry of Labour have also identified the required skills in Natural resources and environment to deliver on EDPR.

Table 6: Mining Sector and Sustainable Development Goals (SDGs, 2030)

Sustainable Development Goals (2030)	**How Mining Sector should contribute to Sustainable development Goals (2030)**	**Recommended areas for improvement**
Mining and Poverty Eradication (SDG1)	♦ Paying taxes and royalties; ♦ Employment creation; ♦ Preserve land access; ♦ Leverage local procurement	♦ Facilitate equitable access to employment opportunities; ♦ Offer training and apprenticeship programs; ♦ Develop local supplier capacity; ♦ Strengthen local value chains; ♦ Begin land access planning early in projects ♦ Collaborative to leverage resources for poverty alleviation; ♦ Fully restore resettled communities
Mining and Zero Hunger (SDG2)	♦ Explore synergies with agriculture; ♦ Keep farmland pollution-free.	♦ Manage water resources transiently; ♦ Minimize land take; ♦ Share infrastructure benefits with agricultural community; ♦ Conduct baseline and ongoing geochemical surveys; ♦ Monitor water quality and soil fertility regularly; ♦ Strengthen watershed management; ♦ Partner with the agriculture sector; ♦ Support programs to reduce childhood malnutrition and hunger.
Mining, Good Health and Well-being (SDG3)	♦ Promote workplace health; ♦ Offer and encourage preventive care; ♦ Combat Tuberculosis and HIV/AIDS; ♦ Increase mental health awareness.	♦ Establish rigorous workplace health and safety monitoring and reporting; ♦ Focus on road safety; ♦ Provide health canteen food options and good hygiene protocols; ♦ Prevent toxic emissions to the environment; ♦ Run HIV/AIDS education, prevention and counselling programs; ♦ Regularly test for drug and alcohol use and abuse; ♦ Support community health programs; ♦ Participate in response to and recovery from epidemics; ♦ Train community health workers;

Mining and Quality Education (SDG4)	♦ Assess and upgrade the local skills base; ♦ Train and educate the workforce.	♦ Routinize skills baseline assessment and gap analyses; ♦ Sponsor apprenticeships, scholarships and graduate programs; ♦ Train workforce in technical and management skills; ♦ Ensure training opportunities are made available to employees at all levels and across all backgrounds; ♦ Collaborate with universities to design curricula; ♦ Participate in classrooms and workshops; ♦ Train for sustainable livelihood opportunities beyond mining.
Mining and Gender Equality (SDG5)	♦ Offer equal opportunities for women; ♦ Practice gender inclusion across the business and project life-cycle.	♦ Recruit more women; ♦ Pay women and Men equally; ♦ Promote more women to visible leadership positions; ♦ Adopt, where possible, flexible schedules for accommodating children; ♦ Provide gender-sensitive career development planning; ♦ Include men and women in negotiation; ♦ Make social investments gender-inclusive; ♦ Offer educational scholarships for women; ♦ Remain vigilant against gender-based violence; ♦ Establish gender-sensitive grievance mechanisms; ♦ Provide women's health monitoring.
Mining, Clean water and Sanitation (SDG6)	♦ Conserve and recycle water; ♦ Monitor water quality; ♦ Manage water holistically.	♦ Recycle and or recover metals from wastewater; ♦ Reduce water consumption; ♦ Use alternative water sources (Seawater); ♦ Monitor water source both near and downstream; ♦ Involve the community in monitoring and share water data openly; ♦ Align with government water management policies; ♦ Support portable water and sanitation planning and infrastructure; ♦ Share benefits of water infrastructure; ♦ Support local capacity-building in water and sanitation management.
Mining and affordable, Clean Energy (SDG7)	♦ Improve energy efficiency; ♦ Incorporate renewable energy.	♦ Undertake energy audits; ♦ Improve energy infrastructure maintenance; ♦ Reduce energy demand onsite; ♦ Deploy off-grid wind, solar, or geothermal power; ♦ Diversify power sources; ♦ Support local energy initiatives; ♦ Integrate into rural electrification schemes;

		♦ Share benefits of energy infrastructures.
Mining, Decent work, and Economic Growth (SDG8)	♦ Communicate opportunities and limits of mining; ♦ Drive economic growth with local procurement.	♦ Provide decent work; ♦ Clearly communicate the capital-intensive nature of mining; ♦ Diversify local economies; ♦ Train local suppliers how to meet corporate supply requirements; ♦ Establish business incubations; ♦ Collaborate to end child labor.
Mining, industry, innovation, and Infrastructure (SDG9)	♦ Support local procurement; ♦ Share infrastructure.	♦ Upgrade expertise of local suppliers; ♦ Improve quality of locally produced goods; ♦ Provide support to local suppliers to service the mine; ♦ Explore co-funding arrangements with government; ♦ Share road, power, water, ICT infrastructure; ♦ Use business profile to create horizontal linkages; ♦ Promote domestic research and development initiatives.
Mining and Reduced inequalities (SDG10)	♦ Anticipate inequality related risks; ♦ Champion inclusivity.	♦ Be sensitive to local wage disparities ♦ Establish baseline welfare statistics before mining; ♦ Train, recruit and employ marginalized populations include excluded groups in local procurement and supply chains; ♦ Work with local partners to target social investments to marginalized populations; ♦ Encourage participatory budgeting in local communities, especially of mining revenues.
Mining and Sustainable cities, communities (SDG11)	♦ Mine unconventional deposits; ♦ Plan land use carefully.	♦ Pair metals recycling and waste energy reclamation; ♦ Plan land use with the life-of-mine in mind; ♦ Develop cultural heritage management plans.
Mining and Responsible Consumption, Production (SDG12)	♦ Minimize resource use and waste; ♦ Incorporate life cycle thinking.	♦ Minimize use of water, energy, land, chemicals; ♦ Minimize production of waste, emissions; ♦ Analyze mineral and chemical products across sourcing, transport, storage, use, production; - Extend responsible sourcing to suppliers - Collaborate inter-and intra-industry to develop and report against materials management codes ♦ -Engage consumers about mining and connect the consumer with raw materials.
Mining and Climate Action (SDG13)	♦ Reduce emissions; ♦ Build climate change resilience; ♦ Recognize climate change in planning and investment.	♦ Improve energy efficiency; ♦ Use renewable energy; ♦ Use low-emissions fuels; ♦ Measure and report direct, indirect, and product-related emissions. ♦ Plan for climate change impacts on mines

		and communities; ♦ Model climate related environmental impacts; - Use of climate projections in design and placement of operations and infrastructure ♦ Participate in climate related research and development; ♦ Engage in intra and cross-industry climate dialogues.
Mining and Life Below Water (SDG14)	♦ Incorporate life under water into impact assessments; ♦ Approach seafloor mining cautiously.	♦ Properly dispose of waste; ♦ Assess social and environmental impacts on fishing and marine-base livelihoods; ♦ Protect marine life; ♦ Minimize habitat disturbance; ♦ Conduct sensitivity analyses in understanding short and long-term impacts.
Mining and Life on Land (SDG15)	♦ Achieve net positive or no net loss impact; ♦ Preserve ecosystem services.	♦ Apply mitigation hierarchy to minimize impact; ♦ Avoid impacts to critical habitat; ♦ Offset biodiversity impacts; ♦ Recognize dynamic nature of habitats; ♦ Conduct comprehensive baseline and follow-up environmental impact assessments; ♦ Support projects that link communities and biodiversity; ♦ Encourage and participate in landscape level planning; ♦ Collaborate in research initiates.
Mining, Peace, Justice and Strong Institutions (SDG16)	♦ Prevent and pre-empt conflict; ♦ Respect indigenous rights.	♦ Listen and respond early to stakeholder concerns; ♦ Establish formal and accessible complaint and grievance mechanisms; ♦ Implement human rights impact assessments; ♦ Extent high standards to security contractors; ♦ Facilitate peaceful working environment and good community relationship; ♦ Promote the rule of law.
Mining and Partnerships for the Goals (SDG17)	♦ Mobilize financial resources and technology; ♦ Share geo-data.	♦ Make data on payments to governments transparent; ♦ Engage in public private partnerships; ♦ Transfer unused exploration data over to national authorities; ♦ Improve national knowledge of mineral wealth; ♦ Dialog actively with governments, civil society and development partners; ♦ Strength coordination between initiatives.

Table 7: Desired skills in natural resources and environment

Area	PHD	Masters	Bachelors	Technicians	Artisans	Total
Mining Economists		5	5			
Mining and Metallurgy Engineers		20	80	2512	4986	7598
Petrographer		7	15			22
Basin Analyst		3				3
Blasting Engineering		3	5	50		58
Environment, Geology, Rock and Natura resources	5					5
Forest and Green Environment		10				10
Geologists		10				10
Geochemists		10		10		20
Geomapping and Cartography		8				8
Geophysics		5	20			25
Hydrology and Water Resources		5	30			35
Land Administration		4				4
Land Administration and Valuation		47				47
Land Surveying		10		100		110
Machine operating and Excavator, Bulldc			10	60		70
Mining surveying		10				10
Mineral processing		4	30			34
Ore Dressing Engineering		10	15			25
Petroleum Engineering		10	15			25
Petroleum Geochemists and Geophysic		15				15
Photogrammetry		4				4
Rock Mechanics and Engineering		5		60		65
Sedimentology		5	5			10
Tectonics		5	20			25
Water Resources and Sanitation		5	30			35
Wood Technicians				400		400
Total		220	280	3192	4986	8683

Source: Rwanda Skills Development 2013-2018. Five-year program for priority skills development to deliver EDPRS II (2013 - 2018)

As indicates in the table 6, the natural resources and environment needs 8,683 labor units, which are the required skills in 5 years in Rwanda. Since the mining sector streamlined the required skills also have increased proportionally.

4.3.2.2 Mining sector skills gaps & skills required across value chain

- ***Mining Exploration and skills required***

Exploration stages of developing any mining project involve mainly drilling activities and resource modeling in order to be able to definitively state the size and grade of the resources in the ground. This stage requires different skills.

Table 8: Mining exploration skills required

Sector occupations	Skills gaps	Skills required
Geologist	• Lack of skills to develop research proposals and disseminate the research results	• Drilling techniques • Ability to identify and assess the location, quantity and quality of mineral deposits • Ability to Plan geology projects and field sampling events • Ability to understand basic engineering principles. • Ability to use geology software (e.g. ArcGIS, Rock ware) and other data and modelling tools • Capacity to coordinate research programs • Capacity to measure and test fossils, rocks, soil, ores and other material with the proper instruments (e.g. X-rays) • Ability to handle and analyse data and 3D models
Geophysicist	• Inadequate capacity to analyse the age, nature and components of rock, minerals, soil and other environmental samples handle • Inadequate capacity to undertake long-range theoretical and applied research • Lack of competency for developing research proposals • Inability to conduct geophysical research or field mapping/work based on developed proposals • Lack of Competency to undertake Geophysical data/information analysis, processing and report writing • Limited application of ICT in geophysical projects • Untested Team leadership • Untested Supervisory skills	• Ability to analyse the age, nature and components of rock, minerals, soil and other environmental samples handle • Capacity to analyse undertake long-range theoretical and applied research • Competency for developing research proposals • Ability to conduct geophysical research or field mapping/work based on developed proposals • Competency to undertake Geophysical data/information analysis, processing and report writing • Application of ICT in geophysical projects • Team leadership • Supervisory skills
Geochemist	• Inadequate capacity to conducting sample tests and checks, including gas chromatography, carbon and isotope data, viscosity and solvent extraction • Lack of competency for developing research using specialized equipment including mass	• Capacity to handle Geochemical projects • Competency for developing research proposals • Ability to conduct geochemical research or field mapping/work based on developed proposals

	spectrometers, microscopes and electron microprobes; • Lack of Competency to undertake Geochemical data/information analysis, processing and report writing	• Competency to undertake Geochemical data/information analysis, processing and report writing
Chemist	• Limited competency to develop research proposals for investigating the chemistry of rocks and minerals • Limited capacity for conducting experiments, tests and analyses to investigate chemical composition of rocks and minerals • Lack of ability to develop procedures for environmental control, quality control and various other procedures for mineral processing • Lack of ability to conduct programs of rock sample and data collection and analysis to identify and quantify environmental toxicants • Inadequate capacity of supervisory skills for in interdisciplinary research and development projects involving geo-scientists • Limited ability to work with micro to produce macro substances • Lack of Competency for preparation and dissemination of Scientific papers and reports	• Competency to develop research proposals for investigating rocks and minerals • Conducting experiments, tests and analyses to investigate chemical composition of rocks and minerals • Ability to develop procedures for environmental control, quality control and various other procedures for mineral processing • Ability to conduct programs of rock sample and data collection and analysis to identify and quantify environmental toxicants • Capacity of supervisory skills for in interdisciplinary research and development projects involving geo-scientists • Ability to work with micro to produce macro substances • Competency for preparation and dissemination of Scientific papers and reports
Mining lawyer	• Lack of financial negotiation skills in mining sector •	• Ability to negotiate and draft mine acquisition agreements • Ability to negotiated and draft joint venture and royalty interest agreements
Research and Development Manager	• Lack of ability to conduct a geological research and develop a research proposal	• Ability to conduct a mining et geological research and develop a research proposal
Mineral Economist	• Limited capacity to develop research proposals • Lack of ability to manage financing capital and investments of mining sites, plants, smelters and refiners • Lack of ability to manage economic feasibility and cash flow, extraction, processing and trading of minerals and mineral products • Inadequate decision making on optimal investment and technology acquisition • Lack of capacity to handle local, regional and international trading of minerals • Lack of collaboration and linkages for optimal exploitation of available minerals • Inadequate ability to plan, organize and	• Capacity to develop research proposals • Ability to manage financing capital and investments of mining sites, plants, smelters and refiners • Ability to manage economic feasibility and cash flow, extraction, processing and trading of minerals and mineral products • Decision making on optimal investment and technology acquisition • Capacity to handle local, regional and international trading of minerals • Collaboration and linkages for optimal exploitation of available minerals • Ability to plan, organize and execute programs for processing minerals and mineral products

	execute programs for processing minerals and mineral products • Lack of knowledge in benchmarking for best practice in handling exports of minerals and mineral products	• Ability to undertake research through well informed research outputs • Benchmarking for best practice in handling exports of minerals and mineral products • Capacity for inter-department supervisory have developed the skills and knowledge to understand the theoretical fundamentals of mineral economics and be able to apply them to practical mining applications work
Geo-Technical (Engineering Geologist)	• Inadequate ability to develop research proposals • Inadequate ability to undertake research • Lack of ability to undertake Geotechnical surveys • Lack of comprehension of rock and allied materials strength analysis • Lack of knowledge in geotechnical data processing, analysis and reporting • Lack of competency for inter-disciplinary collaboration and linkages	• Ability to develop research proposals • Ability to undertake research • Ability to undertake Geotechnical surveys • Comprehension of rock and allied materials strength analysis • Geotechnical data processing, analysis and reporting • Competency for inter-disciplinary collaboration and linkages
Geologist-Seismologist	• Lack of capacity to develop research proposals • Lack of ability to undertake research • Inadequate monitoring end evaluating earthquakes and related geo-phenomena • Inadequate competence for report writing	• Capacity to develop research proposals • Ability to undertake research • Monitoring end evaluating earthquakes and related geo-phenomena • Competence for report writing

► *Mining Exploitation and Quarrying*

Table 9: Mining exploitation and quarrying skills required

Sector occupations	Skills Gaps	Skills Required
Mining Engineers	• Lack of competency in developing research proposals • Inadequate capacity for conducting research • Limited ability to plan the extraction of minerals and building materials • Inadequate knowledge in Efficient mining and extraction of minerals and rock materials • Limited knowledge on mine plants and mine structures/design • Limited ability to manage drilling • Limited ability to manage storage, treatment and transportation of minerals • Limited knowledge on mine safety standards and procedures • Lack of Inter-disciplinary liaison • Limited ICT for work	• Competency in developing research proposals • Capacity for conducting research • Ability to plan the extraction of minerals and building materials • Efficient mining and extraction of minerals and rock materials • Knowledge on mine plants and mine structures/design • Ability to manage drilling • Ability to manage storage, treatment and transportation of minerals • Mine safety standards and procedures • Inter-disciplinary liaison • ICT for work
Drilling engineer	• Lack of knowledge in developing research proposals	• Ability to develop research proposals • Conducting research

	• Lack of research • Inadequate ability to locate sites and supervise and undertake drilling to help in the extraction of minerals • Inadequate knowledge in planning, organizing and executing efficient drilling • Inadequate knowledge in determining types of machinery to be used, planning drilling layout and directing support mechanisms for drilling • Inadequate capacity for planning and directing storage of materials that aid in drilling • Inadequate capacity for establishing safety standards and First Aid • Inadequate knowledge for examining and applying most efficient and effective drilling techniques • Lack of knowledge in maintaining inter-disciplinary technical liaison • Inadequate ICT for work	• Ability to locate sites and supervise and undertake drilling to help in the extraction of minerals • Knowledge in planning, organizing and executing efficient drilling • Determining types of machinery to be used, planning drilling layout and directing support mechanisms for drilling • Planning and directing storage of materials that aid in drilling • Establishing safety standards and First Aid • Examining and applying most efficient and effective drilling techniques • Maintaining inter-disciplinary technical liaison • ICT for work
Mining Supervisors	• Inadequate ability to supervise and coordinate activities of workers • Inadequate competency for establishing methods to meet work schedules • Inadequate knowledge in decision making in recommending measures to mining managers to improve productivity • Inadequate knowledge in resolving operational problems and coordinate activities • Inadequate capacity to provide reports and other information to mining managers •	• Ability to supervise and coordinate activities of workers • Competency for establishing methods to meet work schedules • Decision making in recommending measures to mining managers to improve productivity • Ability to work with other employees • Ability to resolve operational problems and coordinate activities • Capacity to provide reports and other information to mining managers • Determining staffing and material needs for the Mine or Quarry
Mine safety Inspector	• Inadequate ability to liaise with managers in production quotas • Inadequate ability to evaluate efficiency of mine production sites • Inadequate ability to control operation of mine and quarry plants • Inadequate knowledge in managing use and maintenance of plants and equipment • Low capacity in planning, organizing and executing mine programs • Low capacity to oversee the acquisition and installation of new plant and equipment • Inadequate knowledge in production records and reports control • Inadequate coordination of occupation health and safety (OHS) • Inadequate capacity to administer Policies and regulations of the mines • Ability to supervise staff	• Ability to liaise with managers in production quotas • Ability to evaluate efficiency of mine production sites • Ability to control operation of mine and quarry plants • Managing use and maintenance of plants and equipment • Ability to plan, organize and execute mine programs • Capacity to oversee the acquisition and installation of new plant and equipment • Production records and reports control • Coordinating occupation health and safety (OHS) • Policies and regulations of the mines • Ability to supervise staff

ICT Service *Managers*	• Low capacity for formulating and directing ICT Strategies, policies and plans • ICT operations for Mining sector • Inadequate knowledge in security of Mining ICT systems • Inadequate knowledge in evaluating and recommending Mines' technology • Skills development for ICT staff for mining sector •	• Ability to liaise with ICT users • Capacity for formulating and directing ICT Strategies, policies and plans • ICT operations • Security of Mining ICT systems • Assigning, reviewing, managing and leading the work of systems analysts, programmers, and other computer related workers • Evaluating and recommending Mines' technology • Ability to manage programs • Skills development for ICT staff • Ability to represent the mining sector at ICT forums.
Blasters and firers	• Inadequate ability to enforce workplace safety • Inadequate ability for safe use of explosives • Low capacity to plan and execute blasting • Inadequate knowledge in supervising Blasters and Firers • Low capacity to comply with laws and regulations	• Capacity to plan and execute blasting • Supervising Blasters and Firers • Ability to enforce workplace safety • Ability for safe use of explosives • Capacity to comply with laws and regulations •

► *Mineral Processing & Value Addition*

Table 10: Mineral processing & value addition skills required

Sector occupations	Skills Gaps	Skills Required
Metallurgist	• Low capacity for developing research proposals • Inadequate knowledge in conducting research, developing methods of extracting metals from their ores and advising on their application • Inadequate ability to plan the extraction of coal, metallic ores, non-metallic minerals and building materials • Inadequate capacity to determine most suitable methods of efficient mining and extraction and types of machinery to be used • Inadequate knowledge in determining drilling site and devising methods of controlling the flow of water, oil or gas from wells • Inadequate knowledge in planning and directing storage, initial treatment and transportation of water, oil or gas • Low knowledge in establishing safety	• Developing research proposals • Conducting research, developing methods of extracting metals from their ores and advising on their application • Ability to plan the extraction of coal, metallic ores, non-metallic minerals and building materials • Capacity to determine most suitable methods of efficient mining and extraction and types of machinery to be used • Knowledge in determining drilling site and devising methods of controlling the flow of water, oil or gas from wells • Planning and directing storage, initial treatment and transportation of water, oil or gas • Establishing safety standards, procedures and quality • Investigating properties of metals and alloys, and developing new alloys • Supervising technical aspects of metal and

	standards, procedures and quality • Inadequate knowledge in investigating properties of metals and alloys, and developing new alloys	alloy manufacture and processing
Mining and Mineral processing plant operators	• Lack of ability to set up, operate and monitor a variety of mining and mineral processing plant and machinery • Lack of ability to operate washing, separating, extracting and combining equipment to remove waste and recover minerals • Lack of ability to operate plant and machinery to make cement, concrete, rock, and precast concrete and rock products • Lack of capacity for monitoring the performance of plant and machinery, detecting malfunctions and taking corrective action • Lack of knowledge of performing plant and machinery maintenance, repairs and cleaning; and maintaining production records.	• Ability to set up, operate and monitor a variety of mining and mineral processing plant and machinery • Ability to operate washing, separating, extracting and combining equipment to remove waste and recover minerals • Ability to operate plant and machinery to make cement, concrete, rock, and precast concrete and rock products • Capacity for monitoring the performance of plant and machinery, detecting malfunctions and taking corrective action • Knowledge of performing plant and machinery maintenance, repairs and cleaning; and maintaining production records.
Jeweller	• Lack of ability to determine objectives and constraints of Jewel design • Lack of ability to formulate design concepts for Jewels • Lack of capacity to harmonize gemstone considerations with technical, functional and production requirements • Lack of ability to preparing sketches, diagrams, illustrations, plans, samples and models to communicate design concepts • Lack of competency for negotiating design solutions with clients, management, and sales and manufacturing staff • Lack of ability to Select, specify and recommend gemstone functions, materials, production methods and finishes for manufacture • Lack of ability to prepare and commission prototypes and samples • Lack of capacity to supervise the preparation of designs and development plans of gemstones, their patterns, programs and tooling, and the manufacturing process	• Ability to determine objectives and constraints of Jewel design • Ability to formulate design concepts for Jewels • Computer design skills to produce designs • Capacity to harmonize gemstone considerations with technical, functional and production requirements • Ability to prepare sketches, diagrams, illustrations, plans, samples and models to communicate design concepts • Competency for negotiating design solutions with clients, management, and sales and manufacturing staff • Ability to Select, specify and recommend gemstone functions, materials, production methods and finishes for manufacture • Ability to prepare and commission prototypes and samples • Capacity to supervise the preparation of designs and development plans of gemstones, their patterns, programs and tooling, and the manufacturing process

- ***Mineral Marketing***

Table 11: Mineral marketing skills required

Sector occupations	Skills Gaps	Skills Required
Mineral Auditor	• Lack of skills in mineral auditing • Lack of skills in mineral sales and marketing	• Ability in mineral auditing • Mineral Sales and Marketing • Mineral Sales & Promotion/Branding • International trade in Minerals • Customer service • International languages e.g. English, Chinese • Communication and Business Language.
Marketing Analyst	• Ability to drive a hard bargain • Ability to absorb and interpret data • Understanding of consumer behaviour • Lack of communication skills	• Negotiation skills • Communication skills • Capacity to analyze big data
Mineral Branding	• Lack of marketing and branding skills • Lack of writing Business plan and packaging skills	• Skills in market branding (online marketing …) • Skills in writing Business plan and packaging

Source: *All above tables_ 6,7,8,9,10,11 adapted from information gathered from field*

The mining sector also offers significant off-farm employment opportunities with a low qualification threshold for unskilled miners. It is probable that Rwanda's mining sector will continue to serve as major motor for economic development in the coming years, provided that current efforts both to formalize and build sectorial technical capacity (especially with regard to mine management, productivity and recoverability) are augmented.

A part from the skills listed above as in shortage, mining leaders, professionals, technicians and artisans lack also some soft Skills as illustrated in *Figure_7*.

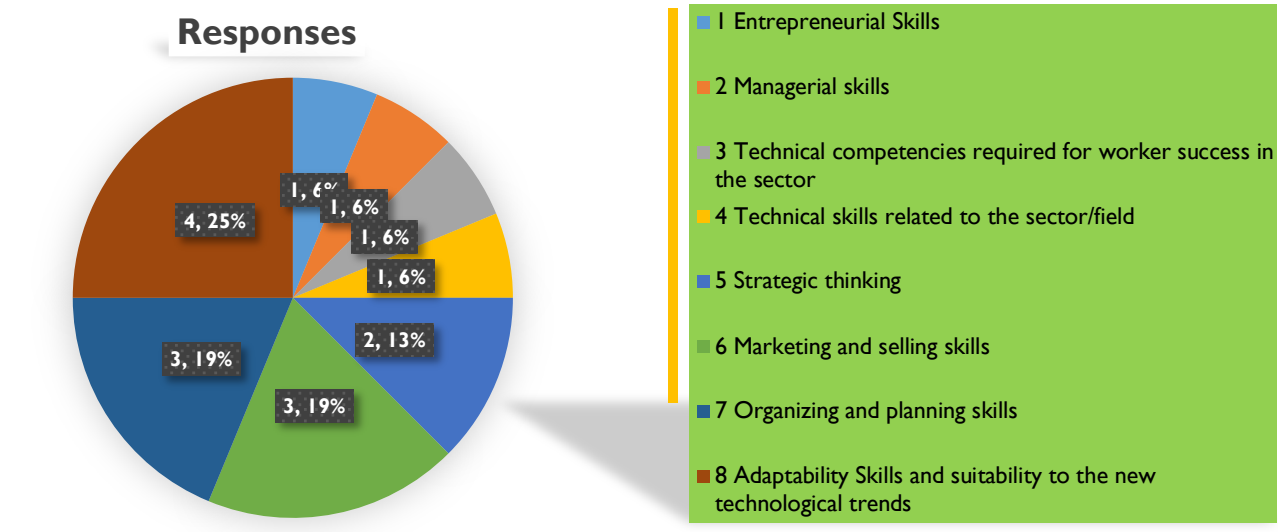


Figure 7: Future soft skills needed in Mining Sector

4.5 Main barriers to the closing skills gaps

This section describes the main barriers to close the skills gaps mentioned in the chapter four.

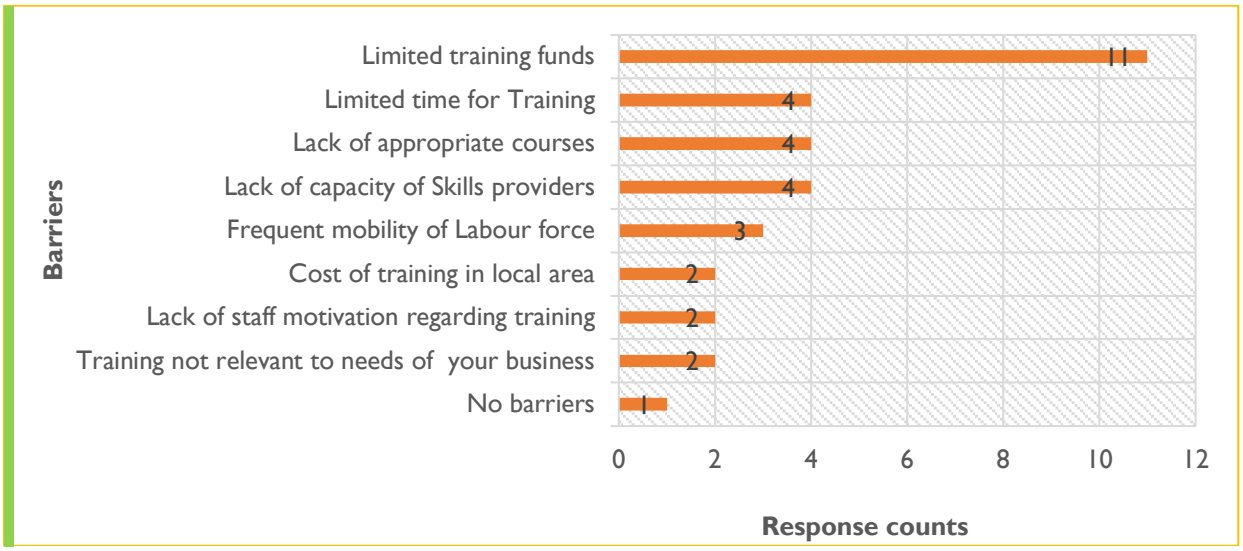


Figure 8: Main Barriers to the closing skills gaps

Therefore, employers stated that the main barriers to address skills shortages on their businesses included:

- Employers located in rural areas need to incentives skilled people to relocate from other parts of the country, with additional incentives to retain them, which is a high cost to company.
- When skills in the country are absolutely scarce, the cost of importing skills is very high, and involves a lengthy procedure to prove scarcity.

- The lack of management skills can cause tension between employees within companies, and a lack of planning ability within the management skill can disrupt operations and jeopardize productivity.
- The lack of high-quality Math and Science levels in learners make training more challenging to employers, as many of the Mining sector -related occupations require these subjects as a foundation to do the jobs well.

According to the table 14, beneficiaries of this training include 23 males and 7 females. After this first intake of 30 trainees who started in August 2014, Wolfram mining and processing limited have recruited the 1st intake.

CHAPTER FIVE: SECTOR SKILLS RESPONSE TO ADDRESS THE IDENTIFIED SKILLS GAP

5.1 Introduction

As previously discussed, there are many skills that are important to mining sector that can be identified. Building a competitive mining industry and future skills for key occupations are crucial to progress towards this assessment and meet the needs of the future labour market. This section focuses on how these skills can be fostered and developed through sector skills response to address the skills gaps identified by projecting and forecasting to 2030.

5.2 Proposed Ways to Bridge the Skills Gap

In order for the Mining sector to have enough capacity there is need to fast track capacity building and skills upgrading for the existing professionals (geoscientists...) technicians and artisans. Following ways can lead to best approach to bridge the skills gaps in a sector including:

- Hire, recruit needed skills;
- Develop skills and competencies internally by training existing staff where skills will be needed in the long term for sustainability;
- Acquire skill/competency through contracting, consultant, exchange program.

Moreover, the skills assessment conducted revealed that more emphasize should be put on hiring mentors for know-how transfer for the existing employees. According to the respondent's suggestion on ways to close gaps 13 companies to hire a mentor for know-how transfer, 10 companies to develop new methods and processes of apprenticeship, 10 to increase provision of training and on job training.

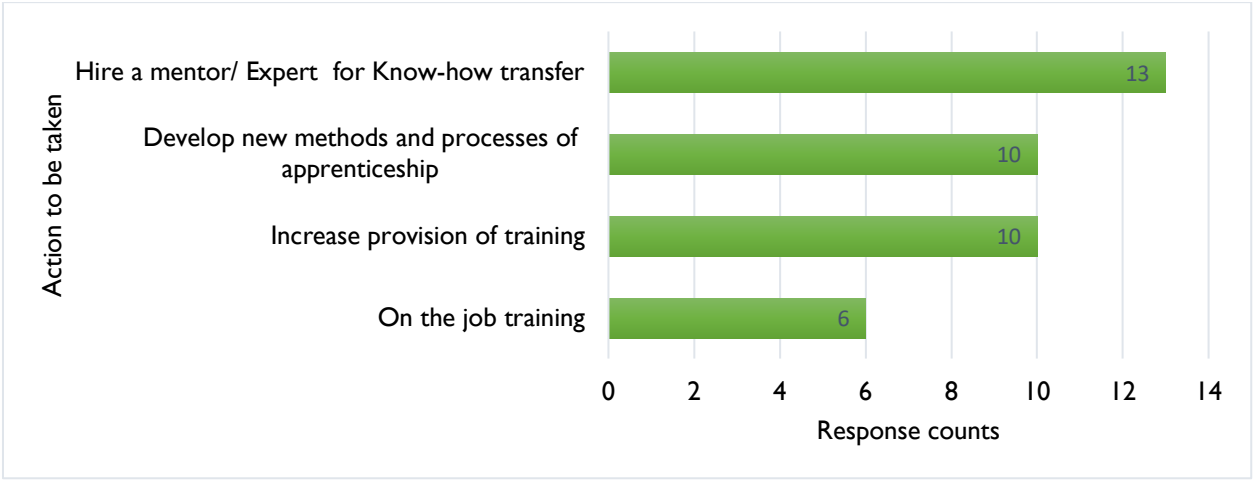


Figure 9: Ways for closing skills gaps in Mining sector

The figure_10 below illustrates the skills that should be acquired to implement company's business strategies.

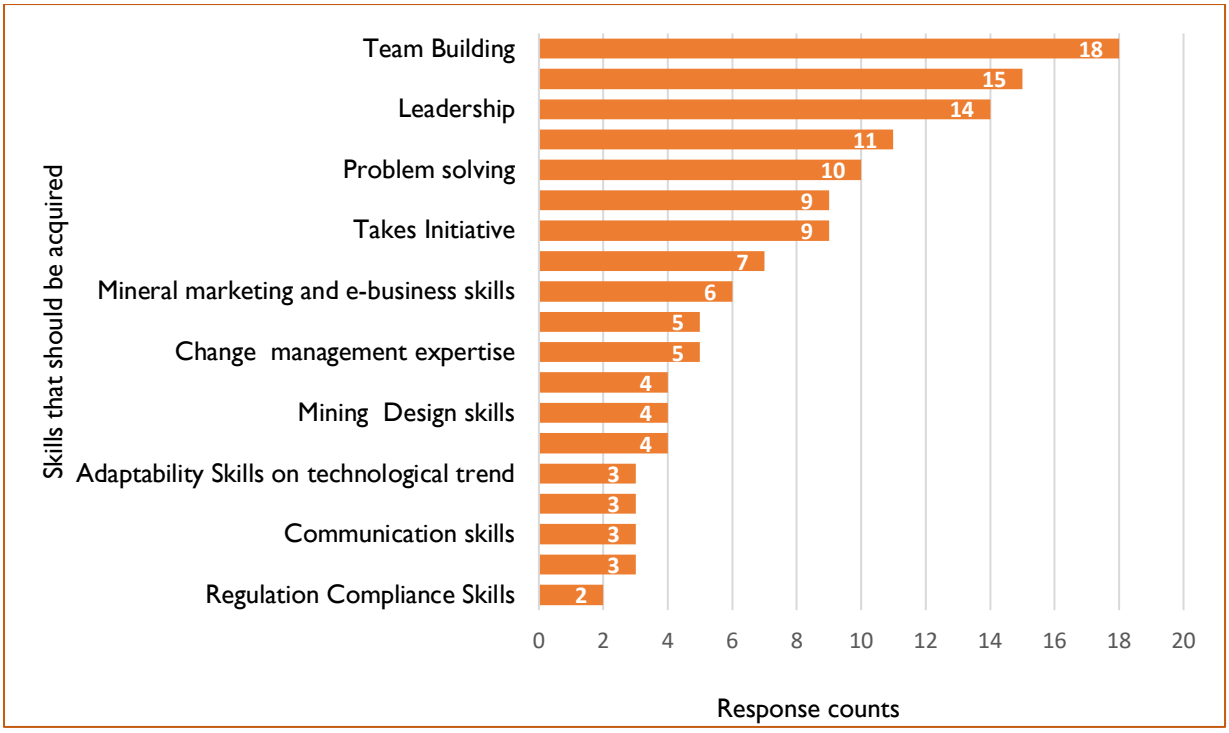


Figure 10: Skills that should be acquired to implement company's business strategies

CHAPTER SIX: CONCLUSION AND RECOMMENDATIONS

6.1Conclusion

The mining industry, one of Rwanda's most critical sectors anticipated to drive growth in the short to medium term, does not possess sufficient skills to propel the economy to the required levels, according to the assessment findings. It has been noted that the pervasive skills and knowledge gaps foster an operative level inadequate to take the industry to expected higher levels of job creation, valued added goods, and stimulation of economy through linkages, driving growth and exports and higher tax revenue among others.

The mining sector skills assessment indicate that all produced graduates in mining engineering can't be absorbed by mining establishment due to the mindset of mining owners/leaders; some of them still requires low skilled staff with experiences (artisans and other support staff). Some companies recruit qualified staff not for strengthening of the company but for inspection reasons, reason why there is needs of:

- Jobs regulations;
- Training of mining leaders;
- Contribution of companies in training of their own employees;
- Involvement of private sector in curriculum development to express their needs;
- Employees to acquire soft skills;
- Privatization also led to an influx of international companies investing in mining projects and forming joint ventures with local investors will provides the opportunity to gain new insights and expertise.

6.2 Recommendations

N⁰	Stakeholders	Stakeholders responsibilities and areas of collaboration	Time frame
1	**MINEDUC, MINIRENA, Skills providers institutions**	• Provide continuous professional development to the Engineers, curriculum developers to enhance current skills levels, as well as develop the multi-tasking and flexibility that may be skills needed for the future. • Increase quality and relevance of programs offered at school by providing relevant skills, internship and placement opportunities in industry;	Short and Long term
2	**Ministry of Public Service and Labour (MIFOTRA)**	• Reinforce observations of skillset required for all occupation categories	Short term
3	**PSF**	• Engage and coordinate all stakeholders in	Short and Long

N⁰	Stakeholders	Stakeholders responsibilities and areas of collaboration	Time frame
		implementation of skills development programs	term
4	**MINEDUC,MINIRENA Skills providers**[18]	• Participate in curriculum development and internship program design to strengthen the skills gaps in order to respond on the labor market's demand	Short and Long term
5	**REB**	• Schools managers should be trained in School management and curriculum interpretation • REB to update the curriculum development on technological trend regarding mining skills;	Short and Long term
6	**RDB**	• Design exchange and internship programs as well as industrial attachment based on skills required across all sectors in and out of country	Short and Long term
7	**Academic Institutions/ Skills providers(TVET, IPRCs, Universities)**	• Put in place an interaction platform led by the PSF between companies on the one hand and university educational institutions, IPRCs and TVETs on the other hand to allows permanent collaboration in order to rethink on teaching systems that meet business expectations; • Provide education at various different levels to create new generations of skilled personnel ready for the world of work (STEM education provided from primary to Post Graduate level)	Short and Long term
	MINIRENA, RMB, RMA	• Develop cooperation (training and exchange programs) with regional geology and mineral institutions and joint projects/studies with experienced geology and mineral agencies to acquire advanced skills and best practices; •	Short, medium term

[18] Private Sector/ Chambers to collaborate in curriculum development

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ANNEXES

Annex: List of Key informants interview

1	**HIGIRO JEAN PAUL**	**APT**
2	KAYIHURA FABRICE	LUNA SMELTER LTD
3	KALIMA JEAN MALIC	WOLFRAM MINING AND PROCESSING
4	MUTESI JANET	RAP
5	RUKUNDO RICHARD	FURNITURE BUSINESS AND TECHNOLOGY
6	RUHIGIRA BIDA	FECOMIRWA
7	TWAGIRAYEZU FIDELE	
8	KAVARUGANDA JULIEN	NEW BUGARAMA MINING
9	MULINDAHABI	SONGA MINERALS
10	NYIRINKWAYA PASCAL	NEPA SHAROM
11	MUYANGO Innocent	MUYANGO Innocent
12	BIZIMANA JEAN BOSCO	RWANDA YOUNG MINERS
13	NIYIGENA INNOCENT	NIYIGENA MINING COMPANY
14	NDINDABAHIZI Aloys	AFRICOM INTERNATIONAL
15	MUSABYIMANA ANDRE	BMTC LTD
16	HAKIZINSHUTI JONAS	MEGOCROS
17	HARELIMANA JONAS	ETS HAJOS
18	HARELIMANA JONAS	MISERCORD TRADING
19	MUTESI JANET	RAP
20	NGABO	ALDANGO
21	Eng. UWIRINGIYIMANA Justin	NMC
22	Frank	Rwanda Mining Association (RMA)