Operation Phakisa skills development roadmap for the Offshore Oil and Gas industry in South Africa

Offshore Oil and Gas Skills Working Group

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Glossary of terms

AEON	Africa Earth Observatory Network
CoE	Centre of Excellence
COP	Community of Practice
CoS	Centre of Specialisation
CPUT	Cape Peninsula University of Technology
DHET	Department of Higher Education and Training
DST	Department of Science and Technology
ECSA	Engineering Council of South Africa
E-HCD&KG	The Energy Human Capital Development& Knowledge Management Generation Programme
EIA	(US) Energy Information Administration
ESCG	Energy Security Challenge
ESSRI	Earth Stewardship Research Institute
HCD	Human Capacity Development
HSE	Health Safety and the Environment
IADC	International Association of Drilling Contractors
IRATA	Industrial Rope Access Trade Association
IRP	Integrated Resource Plan on Electricity
MOGA	Marine Oil and Gas Academy
MPRDA	Mineral and Petroleum Resources Development Act
NQF	National Qualifications Framework
NRF	National Research Foundation
NMMU	Nelson Mandela Metropolitan University of Technology
OCTG	Oil Country Tubular Goods
OPASA	Offshore Petroleum Association of South Africa
OPITO	Oil Producers International Training Organisation
PASA	Petroleum Agency of South Africa
PetroSA	The Petroleum Oil and Gas Company of South Africa
PTP	Petrotechnical Professional
RD&I	Research Development and Innovation
R&D	Research and Development
ROV	Remotely Operated Vehicle
SAPIA	South African Petroleum
SAMSA	South African Maritime Safety Authority
SAOGA	South African Oil and Gas Alliance
SETA	Sectoral Education and Training Authority
SIP	Strategic Integrated Projects
SPE	Society of Petroleum Engineers
Tcf	Trillion cubic feet
TVET	Technical and Vocational Education and Training
TYIP	Ten-Year Innovation Plan
UWC	University of the Western Cape

1. Background

1.1 A brief description of Operation Phakisa

In August 2013, President Jacob Zuma undertook a State Visit to Malaysia. He was introduced to the Big Fast Results Methodology through which the Malaysian government achieved significant government and economic transformation within a very short time. Using this approach, they addressed national key priority areas such as poverty, crime and unemployment.

With the support of the Malaysian government, the Big Fast Results approach was adapted to the South African context. To highlight the urgency of delivery the approach was renamed to Operation Phakisa ("phakisa" meaning "hurry up" in Sesotho).

Operation Phakisa is a results-driven approach, involving setting clear plans and targets, on-going monitoring of progress and making these results public. The methodology consists of eight sequential steps. It focusses on bringing key stakeholders from the public and private sectors, academia as well as civil society organisations together to collaborate in:

- detailed problem analysis;
- priority setting;
- intervention planning; and
- delivery.

The results of the labs are detailed (3 foot) plans with ambitious targets as well as public commitment on the implementation of the plans by all stakeholders. The implementation of the plans are rigorously monitored and reported on. Implementation challenges are actively managed for effective and efficient resolution. Operation Phakisa is currently being implemented in four sectors, namely, the ocean economy, health, mining and education.

Against the background of expected increase in future demand for energy, it is appropriate that Operation Phakisa focuses on the Offshore Oil and Gas sector as an important subsector of the Oceans economy. In sync with the above methodology this study seeks to develop a skills roadmap for offshore exploration through the work of the Operation Phakisa Offshore Oil and Gas Skills Working Group. In line with the Operation Phakisa 3 foot plan the roadmap is addressing such issues as; strategy, research, training capacity development (CoEs and CoCs), implementation and evaluation.

A number of interviews with key stakeholders and experts provided additional information and contexts which fed into the skills roadmap. An industry workshop was held to provide key stakeholders an opportunity to engage with the skills roadmap and to share the document with their constituencies for comment. The working group resolved for this roadmap to be reviewed on a regular basis, due to the dynamic nature of the offshore oil and gas industry. The working group decided to use the Strategic Integrated Project (SIP) methodology for gathering skills information on Offshore Oil and Gas exploration projects.

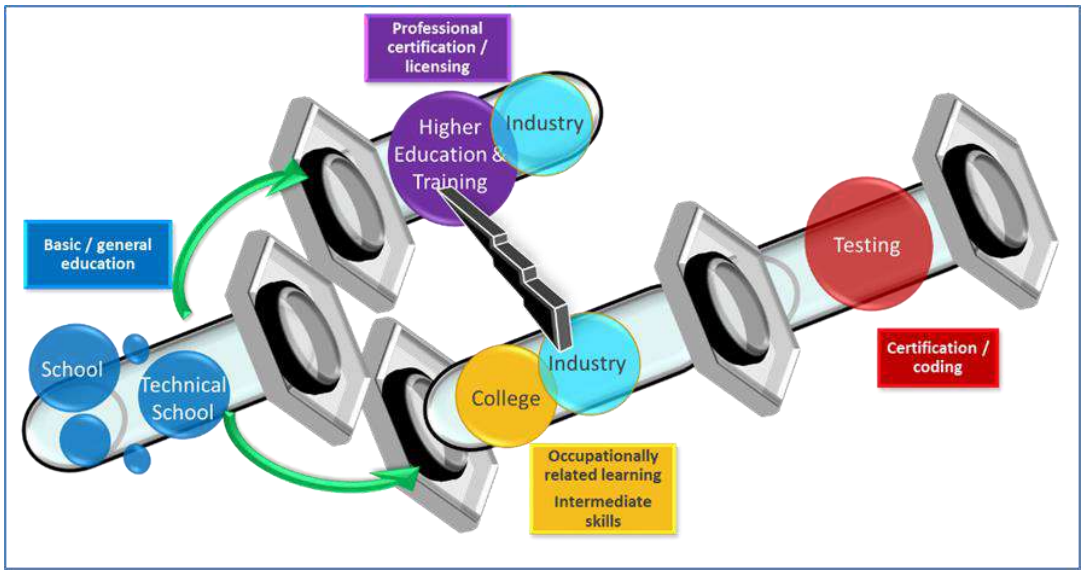
A methodology was developed to generate the list of occupations in demand nationally and to propose actions to address the scarcity identified. This methodology will be used to help quantify the skills needed for offshore oil and gas exploration and intervention strategies. A graphic depiction of the 21 Step Operating procedures is attached. See **Annexure A**. A SIP spreadsheet generated for projects shows a high percentage of overlap with the offshore Oil and gas exploration sector, with particular reference to artisanship and energy. See **Annexure B and C** for typical SIP information on Offshore Oil and Gas Exploration and Energy respectively. The idea is to aggregate the crosscutting skills and artisanal skills in particular, to inform a holistic approach in this regard.

1.2 Purpose of the skills roadmap

The purpose of the strategic skills road map is to provide an indication of the way forward for the developing of skills to meet the anticipated demand for skills by the offshore oil and gas industry in South Africa

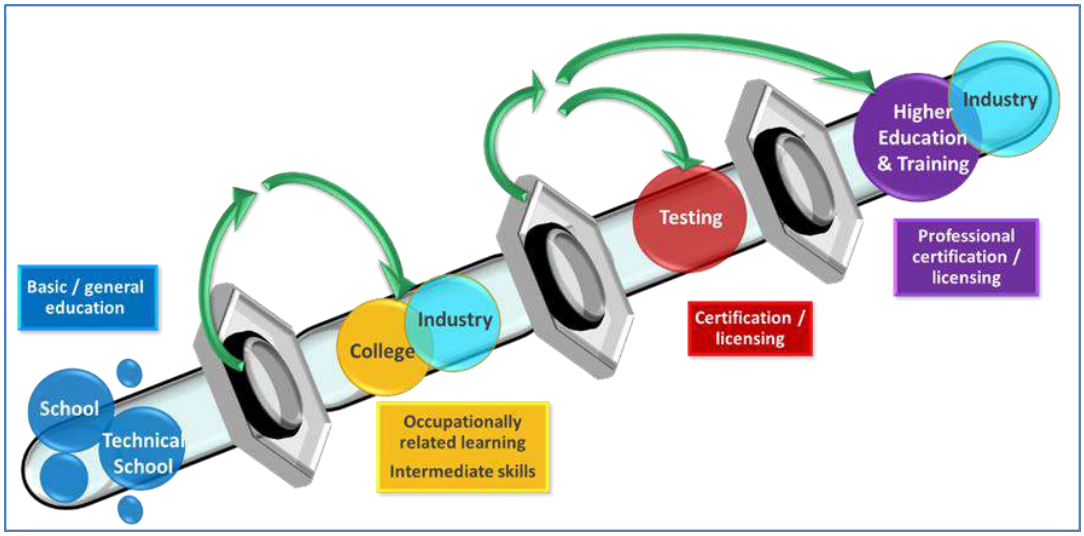
It is understood that the roadmap will provide a basis for further discussion and that the roadmap provides direction as well as a flexible basis, which is required taking into account that South Africa does not have a significant local offshore exploration industry. The roadmap signifies the beginning of the journey.

Figure 1 – A graphic depiction of some of the skills development challenges facing the Oil and Gas industry



Source: Fiona Cameron Brown, 2014

Figure 2 – A preferred skills development pipeline scenario



Source: Fiona Cameron Brown, 2014

1.3 Guiding principles with respect to the skills roadmap

As the local offshore oil and gas industry is in its infancy, it is important that clear guiding principles are agreed upon to ensure that the work done on the road map remains current and subject to review. The following principles are accepted in the development of the roadmap:

- A consultative approach is important to enhance 'buy in' at implementation.
- A developmental approach is important, given the infancy of the industry in South Africa. The roadmap is seen as reference point that is open to change, based on the status of skills demand in the region.
- A systemic approach – although the roadmap is sharply focused on skills for the offshore oil and gas industry, openness is valued to actively articulate with the skills ecosystem in a systemic manner.
- It is accepted that developing the roadmap is a process. Although the roadmap provides a clear indication of the way forward, it is not a finite product.

- A sharp industry focus is maintained, as it is understood that industry represents important employer views and considerations.
- Global benchmarking is of paramount importance due to the global nature of the industry.
- A commitment to optimise the value-add of "South Africa Inc." by consolidating and enhancing available resources.
- Partnerships are important for success, where partners like; Government, State owned enterprises, PetroSA, SAIMI, PASA, SAPIA, OPASA, SAMSA, SAOGA, Industry, the Council for Geosciences, Professional Bodies, relevant Research entities, Training Institutions are actively engaged to optimise skills development.

1.4 Industry objectives of an Oil & Gas Capacity Building Programme and the Skills Roadmap

At an oil and gas exploration industry workshop held at the Mount Nelson in Cape Town in 2014 the following objectives for a skills roadmap were articulated:

- Building a human capital pipeline of highly skilled engineers and scientists (up to PhD level) and innovation practitioners through research chairs and collaborative RD&I initiatives;
- Developing globally benchmarked operators, artisans and technicians for drilling operations locally and in the region;
- Contributing to the development and strengthening of research and technology platforms towards an enhanced South African research publication output and patent production;
- Facilitating R&D value from state-owned enterprises and industry partners through provision of skilled graduates; and
- Contributing to the achievement of some of the identified Energy Security grand challenge outcomes for 2018, e.g. the required knowledge base and increased local content.

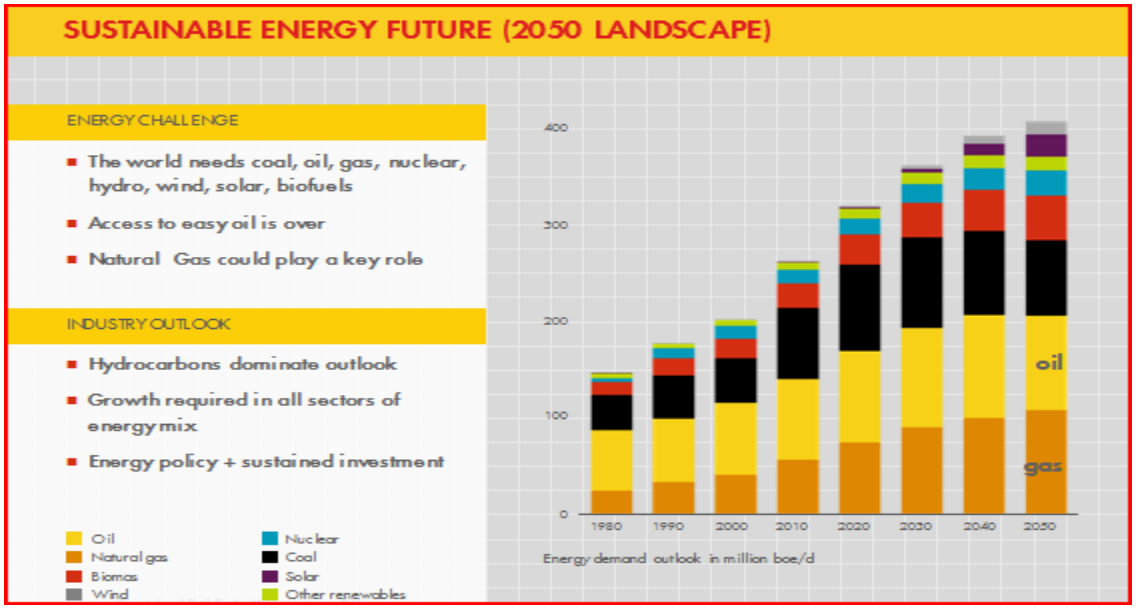
As the SIP initiative is currently in the process of renewing contractual arrangements with respect to IT service provision it was decided to gather the required information with the view of applying this methodology with greater rigor with respect to offshore oil and gas exploration in future.

1.5 An increased demand for energy a key driver for increasing skills development supply

In a document developed by the NRF and industry*, the increased demand for energy is aptly outlined as seen in the paragraphs and the graphic below. The increased demand for energy should drive skills development to support the production of energy and the maintaining of energy infrastructure, of which offshore exploration is a part.

By the middle of this century the global demand for energy will have doubled compared to the beginning of the century. Increasing population growth, urbanisation, increase in motorised vehicles and higher living standards are likely to increase the total energy demand from 200 million barrels of oil equivalent per day in 2000 to approx. 400 million barrels of oil equivalent per day in 2050 (Shell Scenarios, International Energy Agency). In order to meet the future energy demands the world needs to expand all of its energy resources. Despite the increasing supply in renewable energy the demand for fossil fuels (coal, oil and gas) is likely to grow by 70% until 2050 and oil and gas will still form the base of 50% of the world's energy.

Figure 3 – Global Energy Demand Forecast



Source: Sassman N, 2014

The Energy Security Grand Challenge (ESGC), as described in the Ten-Year Innovation Plan (TYIP) for South Africa of the Department of Science and Technology (DST), lists energy security, environmental protection and access to affordable, safe, clean and reliable energy as the three principal global energy challenges. In South Africa the Department of Energy's Integrated Resource Plan estimates in a base case scenario that electricity demand in the country will double between 2010 and 2030 (Electricity Regulations on the Integrated Resource Plan 2010-2030). At present more than 85% of South Africa's primary energy needs are met by the use of coal, crude oil or gas. Similarly a high percentage of electricity generation is based on coal. South Africa produced about 930 000 tonnes of natural gas and 104 860 tonnes of associated condensate in 2013. The entire gas and condensate output is dedicated to PetroSA's liquid-fuel synthesis plant, and accounts for about 1,5 percent of total primary energy supply (Department of Energy). In 2012 South Africa imported 140 Million barrels of oil to be refined into oil products in its 5 refineries (South African Foreign Policy Initiative, 2014). Of the consumed oil approximately 35% is locally produced in South Africa (World Factbook 2009). Compared to coal, oil and gas therefore still play a relatively minor role in South Africa's energy mix.

In order to meet the future energy needs,the Department of Energy's Policy-Adjusted Integrated Resource Plan on Electricity (IRP2010) indicates that, 42% of all the new electricity generating capacity in the country will come from renewable sources (including wind, solar, hydro) over the next 20 years and 23% of electricity will be generated by nuclear power stations. Various factors will have to be considered in the selection of technologies to be used in meeting the

country's energy needs while taking cognisance of Government strategies and policies such as those referred to above. Such parameters include the following: the maturity of the technology from a routine, reliable and economic production point of view; the national skills and technology base to support the introduction and use of new energy technologies; the cost to develop, implement and operate generating capacity based on different energy technologies; international comparisons and experience; cost and affordability from both a construction and operation point of view (viewed over its entire life-cycle); and the potential for reduction of greenhouse gas emissions.

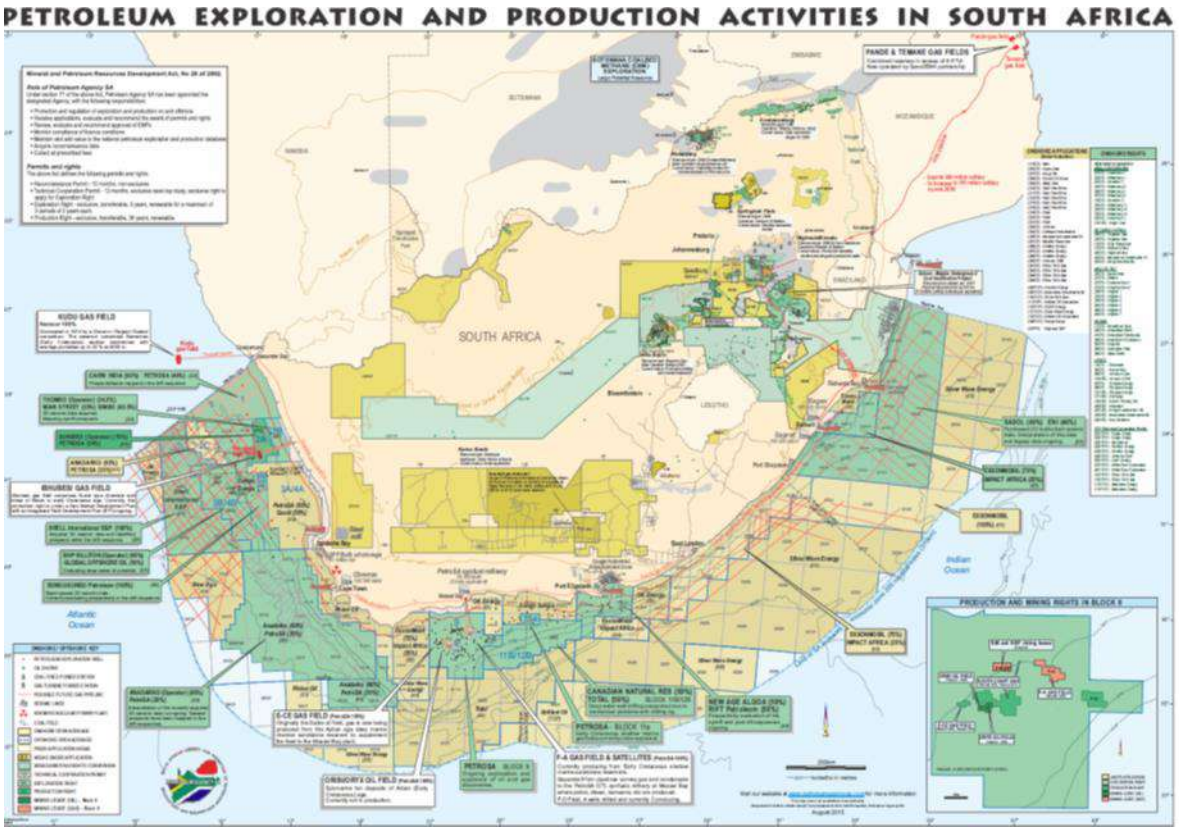
However, existing and future energy demands cannot be met by nuclear and renewable energy alone. Fossil fuels such as coal oil and gas will remain an important part of South Africa's energy mix for at least another half decade. Oil is needed for producing products such as gasoline, diesel, jet fuel, kerosene, lubricants, chemicals and many other materials dependant on oil products. For power generation, gas can be seen as a more attractive energy solution than coal as gas-fired power stations are 30% more energy efficient, emit half the CO_2, less than a third of nitrogen oxides and only one percent of sulphur oxides (US Environmental Protection Agency 2000). On a total cost basis (capital, fuel, operation) gas-fired power stations based on a combined cycle gas turbine are also cheaper to build and operate than coal-fired power stations (UK Department of Energy and Climate Change/Mott MacDonald June 2010).

Given the increased interest and exploration activity in on- and off-shore Oil and Gas, South Africa has the potential to meet its future domestic oil and gas demand and to become an oil and gas exporting nation. The significant oil and gas finds in Sub-Saharan Africa in the past decade (Ghana, Angola, Namibia Uganda, Kenya, Tanzania & Mozambique) have significantly raised the level of exploration activities in East, West and Southern Africa by all players in the industry: independent-, major - and national oil companies. The drilling activities in Kenya, Uganda, Tanzania and Mozambique in 2012 account for nearly half of conventional oil and gas resources found worldwide that year. These oil and gas finds will transform these Eastern African economies and, if used responsibly, billions of dollars of new government revenues will support investments in infrastructure and social services (Brookings Institution 2014). The Petroleum Agency of South Africa (PASA) has currently issued exploration licenses to many local and international oil and gas companies (see map and table below).

1.6 Offshore Oil and gas exploration in South Africa

According to the most recent petroleum exploration and production overview from PASA, there are 30 offshore ventures registered in South Africa. Three of them are at a production or development stages, whereas the remainder of the ventures are at an early exploration phase. Based on industry estimation (from Shell and SAOGA 2013), a base case scenario was developed for the South African oil and gas exploration portfolio. It was assumed that 21 out of 31 ventures would commence exploration activities. Sixteen ventures would be stopped after exploration and appraisal activities and only 5 ventures would continue with a pilot phase and enter full development for oil and gas production. This scenario assumes a likelihood of 16% that a venture will be successful. If 5 exploration ventures were to be successfully developed in the coming 10-15 years, it would significantly increase the oil and gas resource base of South Africa. Significant job creation will only come into effect when the production phases of the respective drilling projects commence, but as technical and engineering skills take years to develop, we cannot afford to delay skills development. The most recent Petroleum exploration map indicates a measurable increase of onshore drilling license applications with PASA. Offshore licenses have not changed dramatically.

Figure 4 – South Africa Petroleum Exploration & Production (PASA, August 2015)



Source: PASA

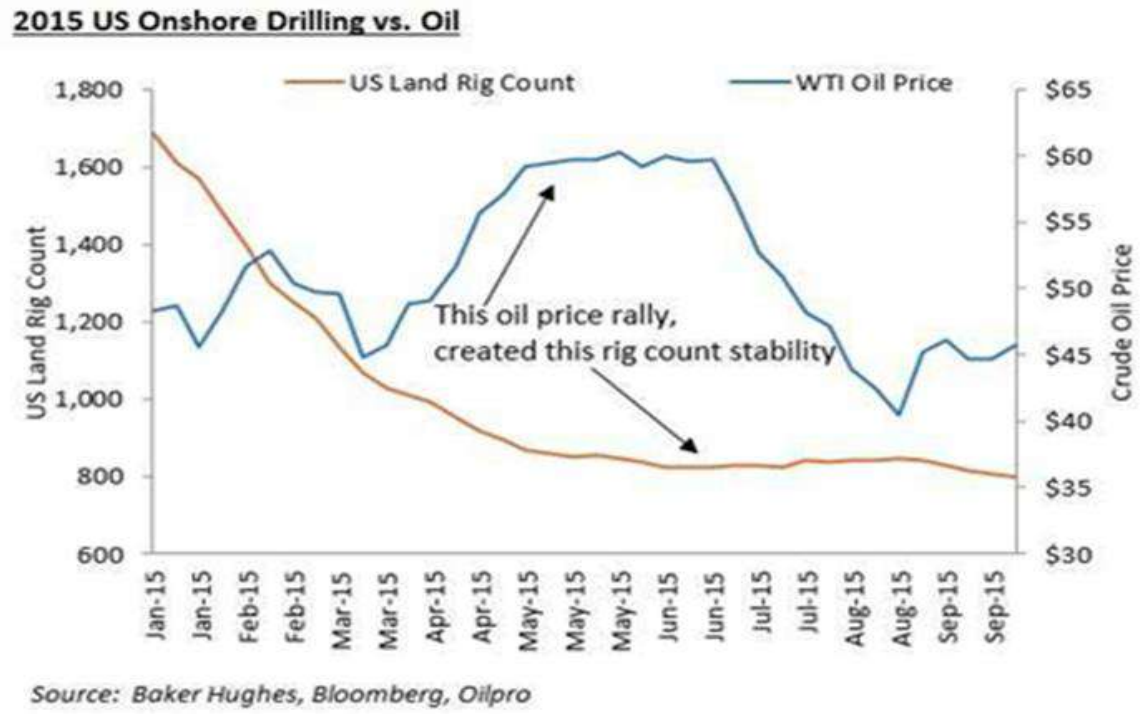
Table 1 – South Africa Offshore Venture Overview – Base Case (Dec 2013)

South Africa Offshore Petroleum Exploration & Production									5 Y					10 Y					15 Y
		Venture	Block/Acerage Nr.	Stage	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
1		Cairn/PetroSA	1	Exploration	Exploration			Appraisal											
2		Anadarko	2C	Under Application	Exploration														
3		Shell	Orange Basin DW	Exploration	Exploration				Appraisal				Pilot				Development		
4		BHP	Orange Basin DW	Exploration	Exploration														
5		Sasol/PetroSA	3A/4A	Under Application	Exploration						Appraisal								
6		Sungu-Sungu	Mid-Orange Basi	Exploration															
7		Thombo	2B	Exploration	Exploration				Appraisal				Pilot				Development		
8		Anadarko	5/6	Exploration															
9		Silverwave	3620A/B - SouthW	Under Application	Exploration														
10		Impact Africa	7	TCP	Exploration														
11		Total	3622	Under Application	Exploration														
12		PetroSA	9	Exploration	Exploration			Appraisal				Pilot				Development			
13		CNR/Total	11B/12B	Exploration	Exploration		Appraisal												
14		New Age	3314-3415	TCP															
15	Exploration	OK Energy	3414-3515	TCP															
16		OK Energy	3422A/B/D	TCP	Exploration														
17		OK Energy	3326/27	TCP															
18		Bayfield	3423A/B 3424A/B	Exploration	Exploration														
19		Rhino Oil	3418/9	TCP															
20		New Age Algoa/Rift Petroleur	3425	Exploration	Exploration														
21		Exxon/Impact Africa	2932A/C	Exploration	Exploration														
22		Exxon/Impact Africa	3130-3327D	Exploration	Exploration														
23		Exxon	South Durban/ 3	TCP	Exploration				Appraisal				Pilot				Development		
24		Impact Africa	2832C	TCP															
25		Impact Africa	3420-3520	Exploration	Exploration				Appraisal				Pilot				Development		
26		Impact Africa	3426	TCP	Exploration														
27		Silverwave	3718/9	TCP															
28		Silverwave	3630	TCP	Exploration														
29		Silverwave	3530-3624	TCP															
30		Silverwave	2734-3527	TCP															
31		Sasol	Durban	Exploration	Exploration														
32	Development	Forrest/Sunbird	2A	Production Right	Pilot				Development										
33		PetroSA	9	Production	Pilot	Development													
34		PetroSA	9	Production	Development														

Source: PASA, Shell & SAOGA

Since the above scenario analysis was done the petrol price dropped dramatically. This, combined with the uncertain legislative environment related to the MPRDA, has retarded the implementation of these drilling projects. This trend is not out of sync with global trends. The graph below shows the land rig count trend over the past months in the United States of America, indicating a sharp drop of onshore rig activity in the United States of America. Future demand for skills in the on and offshore exploration (The same staff often intermittently work onshore and offshore) industry.

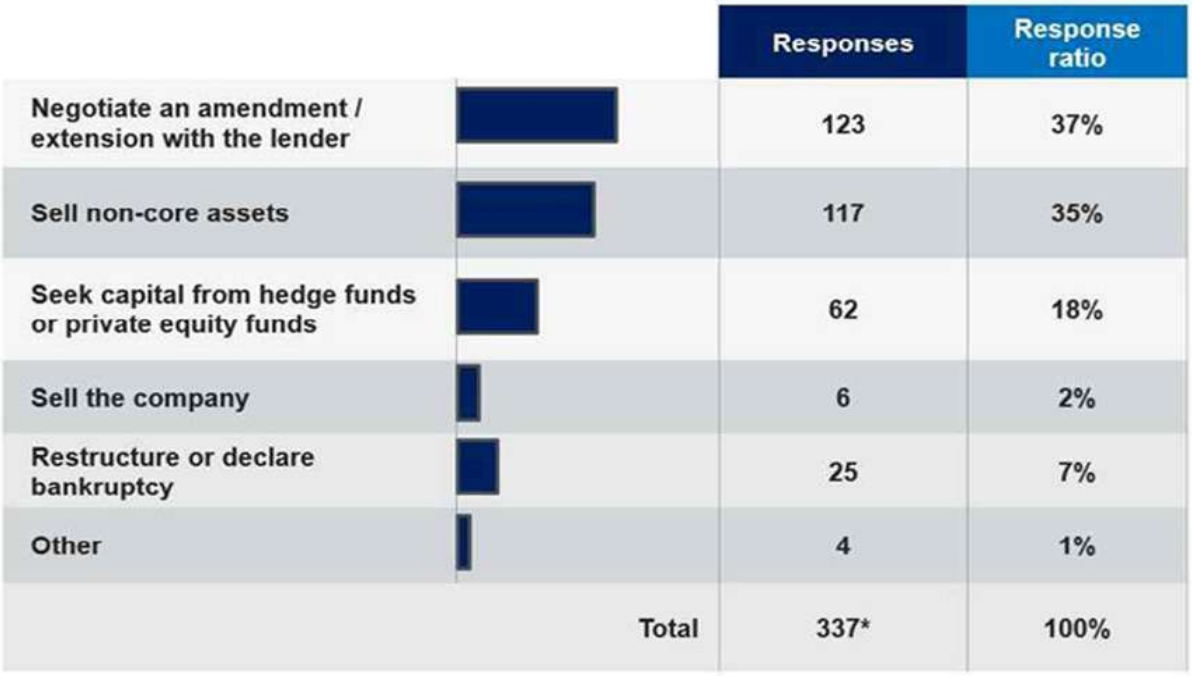
Figure 5 – US Onshore Drilling vs. Oil



Source: Baker Hughes, Bloomberg, Oilpro

The graph below shows the results of research done on how companies are experiencing the current low oil price challenge. The table highlights how companies are dealing with the low oil price scenario. This will undoubtedly have an impact on the demand for skills and should inform our approach to skills development in the South African context. It is clear that companies are focusing on greater efficiencies. Reducing of staff is a given against this background.

Table 2 – Response by companies to the low oil price



	Responses	Response ratio
Negotiate an amendment / extension with the lender	123	37%
Sell non-core assets	117	35%
Seek capital from hedge funds or private equity funds	62	18%
Sell the company	6	2%
Restructure or declare bankruptcy	25	7%
Other	4	1%
Total	337*	100%

*Although there were 182 respondents, up to two options could be selected.

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The table below gives a glimpse into the number of oil and gas jobs advertised by a major player in the oil and gas industry over the past months, regardless of the downturn currently being experienced in the industry. It is difficult to predict how long the down cycle will be, but it is clear that there will continue to be a steady demand for oil and gas skills worldwide.

Table 3 – Number of oil and gas jobs advertised by a major player in the industry

Date	New UK jobs	Worldwide jobs
06-Jun-15	787	4713
13-Jun-15	660	4683
20-Jun-15	616	5035
27-Jun-15	842	5291
04-Jul-15	976	5168
11-Jul-15	1029	5495
18-Jul-15	800	5736
25-Jul-15	836	5873
01-Aug-15	837	5825
08-Aug-15	947	5857
22-Aug-15	972	5722
29-Aug-15	1173	5567
24-Oct-15	492	4569
31-Oct-15	775	4586
07-Nov-15	840	4235
14-Nov-15	786	4383
21-Nov-15	814	4284

1.7 Challenges facing the Southern African region

The challenges for drilling in Africa, pointed out by Dave Geer (Africa and Asia Director of the International Association of Drilling Contractors (IADC), in his address at a SAOGA networking event on 1 October 2015, need to receive attention when planning for oil and gas related skills development for South Africa and the region;

- Language communication barriers;
- Capability and competence;
- Availability of labour;
- Suppliers; and
- Service Providers.

1.8 Skills development gaps/challenges highlighted at an HRDC maritime task team workshop on 13 June 2014

In a consultative workshop on oil and gas skills development, held at SAMSA in 2014 to inform the work of the HRDC Maritime Task Team, the following were raised.

- Skills development challenges were mainly linked to the socio-economic issues, i.e., the standard of basic education (especially Maths) and limited number of people with a matric qualification[1]; limited focus on school leavers which form part of the feeder system for the maritime sector; limited focus on the semi-skilled.
- The entry level for trades has been lowered to Grade 9 but exit requirements remain the same. This means that companies have to invest more in training a candidate to reach the trade testing level. Furthermore, some colleges and companies are ignoring the lowered entry-level requirements.
- Lack of bridging programmes for Recognition for Prior Learning (RPL) and it is sometimes difficult to get historical information about a person's experience for RPL.
- The NAMB representative also expressed concern that the new architecture of occupational qualifications is not "RPL-friendly" and said that he did not think that in future RPL for the trades would be possible.
- Lack of communication and information sharing amongst stakeholders.
- Lack of marketing about existence of programmes within the sector.
- There is no provision for part-qualifications in the current legislation – a number of companies employ people with part-qualifications. Actually, the legislation (NQF Act) provides for this, the point is that the qualifications, as registered, do not. This was the point made by the NAMB rep and should be seen in conjunction with the earlier comment in red, above.
- Access to funding; funding model of SETAs not flexible enough (see the note in red below).
- There is no monitoring for future development of new qualifications at Quality Council for Trades and Occupations (QCTO) level. Over-emphasis on full qualifications by DHET policy; little understanding of the value of part qualifications and just-in-time (JIT) that companies implement on an as needs basis and which does build capability. Also, these "part" qualifications are often mandatory e.g. OSH, etc.
- Limited Organising Framework for Occupations (OFO) offering for all trades at Technical & Vocational Education & Training (TVET) colleges and this has an impact on the possibility of partnerships between TVET colleges and private training institutions.
- Lack of infrastructure and limited Competency Based Modular Training (CBMT) training at TVET colleges.
- No absorption plan for trained candidates.

- There are gaps between industries with regard to specific qualifications / codes. This requires specialised training to fulfil maritime industry needs, e.g., a Fitter needs a further qualification to become a Marine Fitter.
- High cost of training; funding and facilities required.
- Poaching of trained staff by other companies.
- Mismatch between supply and demand for skills.
- Limited data on what is happening in the industry in respect of demand and supply of skills.
- Technical schools which form part of the feeder system are closing down, as a result learners have no practical exposure.
- Lack of articulation between various levels of qualifications, i.e, National Qualifications Framework (NQF), National Certificate Vocational (NCV).
- Placement of leaners with companies a challenge.
- Method used to draw up the Department of Higher Education and Training (DHET) scarce skills list is questionable.
- The cyclical nature of the Oil and Gas industry is a challenge (current demand for skills does not necessarily amount to future demand).

1.9 Risks and mitigation factors

The oil and gas industry identified the risk factors related to skills development in the table below at an industry workshop at the Mount Nelson in 2014.

Table 4 – Risks and mitigation factors identified at the Mount Nelson workshop

No.	Risk	Potential Impact	Mitigation Strategy
1.	Slow roll-out of IRP 2010 and the new build programme implementation	Delayed decision-making on and funding of Oil & Gas Capacity Building implementation; disillusionment of oil & gas RD&I community	Involve all role-players to facilitate decision making;
2.	Insufficient funding for Oil & Gas Capacity Building Programme implementation	Slow implementation of HCD programme to support new build and grow oil & gas sector	Optimise and exploit existing partnerships for efficient use of funds and access to new funding sources while motivating for increased funding
3.	Continued capacity challenges and fragmentation of oil & gas sector capabilities	Delayed HCD implementation	Align, utilise and expand existing RD&I capabilities and collaborative networks
4.	Lack of Skills Requirement Report detailing priority areas to be addressed	High impact on planning and impact on readiness of sector	Engage DoE and stakeholders in the energy sector on the relevant priority areas regards to outputs required.
5.	Lack of government or public support for Oil & Gas Capacity Building Programme	Delayed decision making on HCD funding and implementation	Engage decision makers and continuously communicate outputs of HCD activities and impact thereof in oil and gas sector

Oil and Gas companies generally were 'fat and sluggish' when oil prices were high. The downturn in the sector has forced the industry to trim off the 'fat'. Aggressive pursuit of shareholder value has forced companies to become more efficient. Inherent in this increased efficiency drive is an opportunity for growing South African exploration, development and production skills development. It is imperative that a South African skills roadmap seeks to address the above challenges.

1.10 Industry SWOT Analysis and Risk Management

Industry has done a high level analysis of the strengths, weaknesses, opportunities and threats with regards to the Oil & Gas HCD Programme and its implementation is presented in the following table from an unpublished document that was developed with support from the NSF.

Table 5 – SWOT Analysis

STRENGTHS	WEAKNESSES
• Excellent training infrastructure • Available and planned education programmes • Government support for human capital development • Support and impetus for planned energy new build (expansion) • Industry collaboration efforts	• Skills requirements versus skills development time • Ability of energy industry to absorb new graduates • Limited financial resources for skills development • Weak national coordination of skills development efforts • Resource challenges (human capacity, infrastructure and funding) • Minimal interest in oil & gas as a career as the sector is limiting • Implications for HCD of planned SA new build programme
OPPORTUNITIES	**THREATS**
• Economic spin-offs from a sector with quality skills base • Improved research base in academia and research institutes • Economic spin-offs from innovation and technology transfers • Planned SA new build programme • Government priorities on localisation and skills development • International RD&I collaboration and oil & gas business opportunities	• Attrition rate and graduates that opt for other industries • Industry not being able to retain skills • Increasing needs for developed skills in global oil & gas market • Lack of funding for programme, bursaries and scholarships • Resistance to transformation within the sector

Source: Sassman N, 2014

The next paragraphs provide an analysis of the table from the draft NSF study. Although the DST's TYIP lists ESGC as one of the Five Grand Challenges, the Plan acknowledges that to achieve sustainable progress in all these areas, South Africa must radically strengthen its human capital development and knowledge generation in this sector. A critical mass of skilled researchers is required to conduct the research that leads to innovations. In this regard, the importance of human capital development strategies and programmes cannot be overemphasized.

Several studies have indicated a shortage of engineering and technical skills across various sectors, which mean that the requisite human resources do not currently exist in South Africa to the extent required for the foreseen expansion in the energy sector and have to be developed from a relatively low base. A major effort is thus required to create or expand mechanisms for developing such local skills for both the entire energy programme as captured in the IRP 2010 and the Research, Development and Innovation (RD&I) component thereof. Given significant growth and further potential for Oil and Gas exploration successes in Southern Africa, the skill gap in the Oil and Gas industry is particularly pronounced in Southern Africa (Schlumberger Business Consulting 2012, Manpower 2012). The following section outlines current industry trends with regard to critical skills and zoom in on Southern and South Africa.

Due to the increasing growth and a retirement wave in the Oil and Gas industry there is a global critical shortage of key technical skills in the industry. Schlumberger Business Consulting conducted a HR Benchmark with key industry players: major international oil companies, independent oil companies and national oil companies and confirmed a critical gap for Petrotechnical Professionals (PTP) (Geoscientists & Petroleum Engineers). The study showed that by 2016 there will be a global shortage of 15 300 experienced PTPs in the industry and that there is a continuous demand for PTP graduate recruitment (10 000 per annum). The most significant recruitment challenges for PTPs are forecasted to be in North-America, MENA and in Sub-Sahara Africa. Sub-Saharan Africa alone will have an estimated supply shortage of 4 300 PTPs by 2020, excluding the growth projections for the region.

Because of the imbalance between PTP graduate supply and demand it is estimated that 70% of all local graduate PTP recruitment will not be achieved in Sub-Saharan Africa. The benchmark study further indicates that a shortage of PTPs strongly impacts the abilities of companies to explore and grow their oil and gas production, leads to project delays and consequently also to investment & production delays and increased risk-taking, which can negatively impact the safe delivery of ventures (Schlumberger Consulting 2012).

The global and regional trend of a shortage in PTPs is even more applicable to South Africa. Due to the limited history of Oil and Gas development in South Africa there has not been a major local demand for these skills and local operators have been forced to develop some of their local staff outside of South Africa and import contract workforce from abroad. The increase in exploration activity in South Africa is likely to lead to an increase in the development and production of oil and gas and will therefore also lead to an increasing demand in PTPs and other technical and non-technical skills.

The following section describes the overall human capacity and capabilities that are needed to deliver on the opportunity of growing South Africa's oil and gas in line with the base case scenario (5 new offshore ventures & 30 TCF gas developments in Karoo) outlined above.

2. The skills required for the Offshore oil and gas industry

2.1 Background

This section is almost entirely taken from the draft NSF document, as the relevance of the document is high with respect to this report, as document is based on active industry participation. The work group has however factored in current trends related to skills demand with respect to the present downturn in the oil and gas industry. This can be seen in the approach to a crosscutting skills focus and the recommendations at the end of this document that crystallised from recent engagements with industry. The timeline for implementing the exploration projects has been moved forward by an estimated two years. The speed at which government is able to signal legislative certainty to industry will also impact on the speed of Offshore Oil and Gas exploration project implementation.

The predictions for the oil and gas industry human capacity requirements are derived from industry workforce planning models for offshore ventures and onshore shale gas ventures. The estimated human capacity requirements for companies providing services to the offshore oil and gas industry are based on general industry experience that an offshore venture contracts twice as many services staff than deployed by the oil and gas operating company (Oil and Gas Industry Presentation, Nigeria). The assumption that oil and gas companies will contract 6 service staff for each of their own staff in an onshore shale gas venture is based on the labour intensity of these ventures. The following scenarios have been considered:

- **Base Case Scenario:** The overall estimated human capacity for the development of an oil and gas industry in line with the baseline scenario shows a need for 2 500 technical experts in 2020, 5 000 technical experts in 2025 and 15 000 technical experts in 2030. These figures are indicative estimates and depend on the speed with and the extent to which the industry develops in South Africa and how individual companies will choose to resource their venture. Especially in the early stage of an oil and gas venture, where the likelihood of success is unknown, international companies tend to draw on technical resources and services from their headquarters to de-risk a venture (exploration phase). The predicted number of technical experts for 2020 already assumed that 50% of the workforce will not be based in South Africa, as most ventures will still be in the exploration phase. As the certainty of success of a venture grows, local resourcing will increase. Once an investment decision is taken to develop a venture into an oil and gas producing asset (development phase) companies aim to maximise the employment of capable local resources to comply with local rules and regulations and to save costs through the reduction of expatriates.
- **Low Case Scenario:** If all exploration activities of new ventures fail, the demand for local technical resources will still be high during the exploration phase and require approximately 1 900 technical experts in 2020. However, in 2025 and 2030 that number will tail off to approximately 800 technical experts for operating the assets that are currently under development or already at production stage.

- **High Case Scenario:** If 8 offshore ventures will be fully developed and produce oil and gas and, if 50 trillion cubic feet of gas will be produced in the Karoo, the requirements for the number of technical experts start to increase drastically: 2020: 3 300 = 3300; 2025 = 17 000; and 2030 = 25 000 technical experts in the Oil and Gas and Services industry. Additional growth opportunities for a demand in human capacity exist if the recent oil and gas developments in other Southern and Eastern African countries are taking into account as well and if a part of the work force is to be educated in South Africa's leading university system.

Table 6 – Human Capacity & Capability estimations for the South Africa Oil and Gas industry in the base case scenario.

		2020	2025	2030	Assumptions
Offshore	Oil and Gas Human Capacity	700	1900	900	5 out of 31 ventures develop
	Services Human Capacity	1400	3800	1800	O&G x2
	Total Industry Job Creation	2100	5700	2700	
Onshore (Karoo)	Oil and Gas Human Capacity	100	700	1800	30 TCF shale gas development
	Services Human Capacity	600	4200	10800	O&G x6
	Total Industry Job Creation	700	4900	12600	
Total Staffing Oil and Gas	Total O&G Human Capacity	800	2600	2700	
	Subsurface Human Capacity	100	400	400	15%
	Engineering Capacity	600	1800	1900	70%
	Functional Capacity	100	400	400	15%
Total Services Staffing	Total Services Human Capacity	2000	8000	12600	
	Subsurface Capacity	300	1200	1890	15%
	Engineering Capacity	600	2400	3780	30%
	Vocational Capacity	1100	4400	6930	55%
Total OG & Services Staffing	Total Subsurface Capacity	400	1600	2290	
	Total Engineering Capacity	1200	4200	5680	
	Total Vocational Capacity	1100	4400	6930	
	Total Industry Technical Capacity	**2700**	**10200**	**14900**	
	Total Industry Human Capacity	2800	10600	15300	

It is important to note the synergies and overlaps with respect to skills in the nuclear, renewable energy and manufacturing industries, offshore and onshore oil and gas development phase, ship and rig repair, shipbuilding, maintenance projects and infrastructure development projects. Below is a presentation of Warwick Blyth indicating the South African supplier based offerings.

Figure 6 – South African supplier based offerings

The graphs below indicate an increased demand for and supply of oil. This means that South Africa can hardly ignore the developing of offshore exploration skills. The benefits to the South African economy, employment creation and the trade balance are obvious.

Figure 7 – World Liquid Fuels Consumption

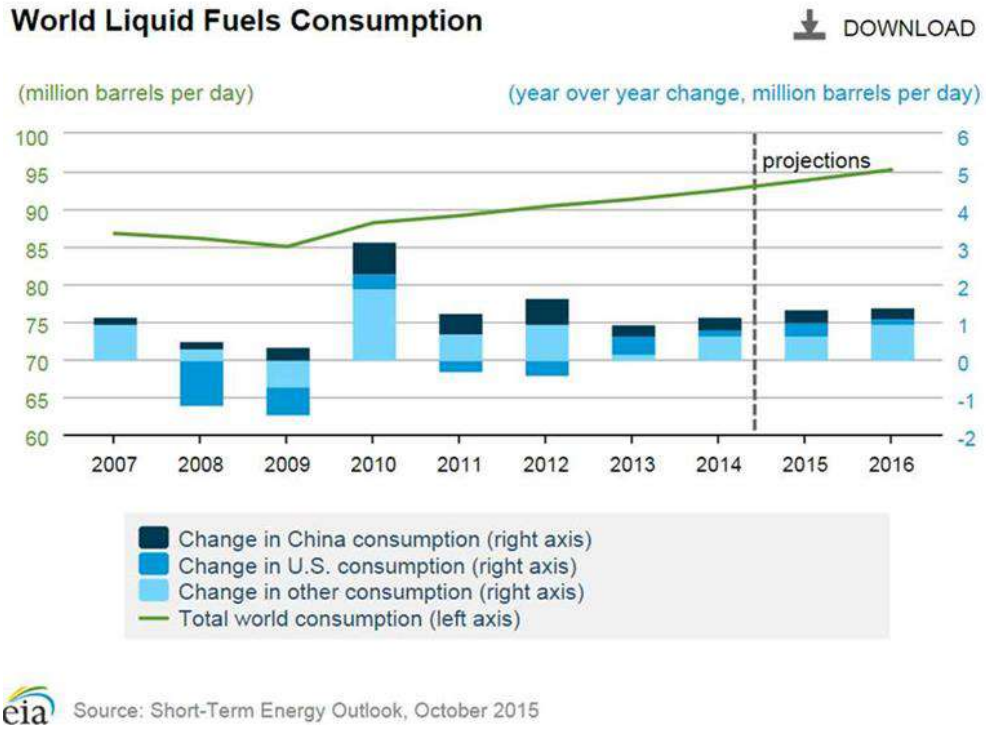
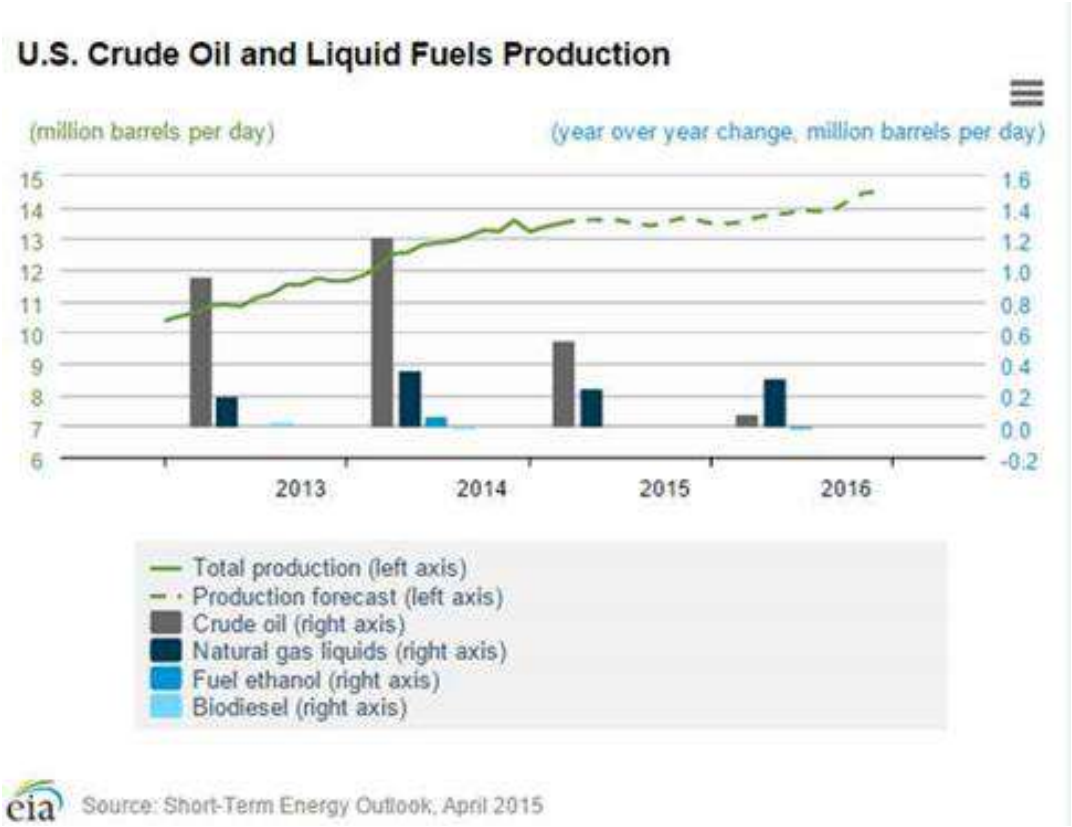


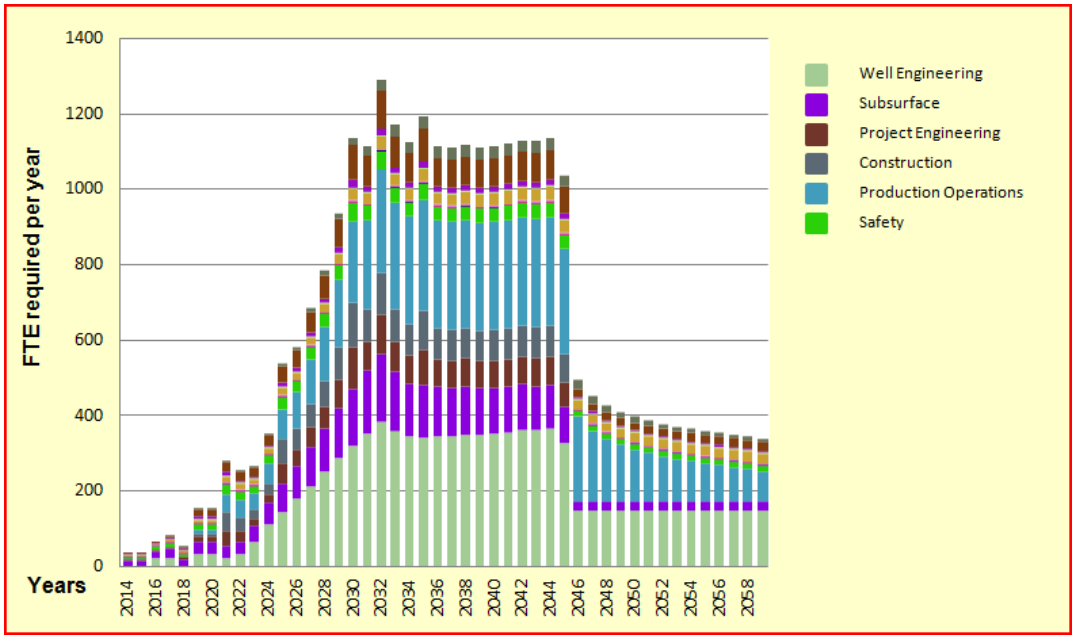
Figure 8 – US Crude Oil and Liquid Fuels Production



2.2 Human Capability

Sassman (2014) indicates the capabilities and skills deployed in oil and gas companies can be classified into technical and functional support staff. The graph below shows the estimated manpower requirements for an oil and gas company developing gas from shale. This is relevant as there is a significant overlap between the skills required for offshore and onshore exploration and production. From the manpower estimates it becomes quite clear that the dominant (There is an overlap between the skills needed for offshore and onshore oil and gas exploration. Consideration should be given for using onshore exploration drilling as a training ground for developing offshore drilling skills) resourcing requirements relate to technical skills, which consolidates: Subsurface specialists, Well Engineers, Project & Discipline (Construction) Engineers, Production Engineers and Safety specialists. Functional staff such as Finance, HR, Legal, Contracting and Procurement etc compromise approximately 15% of the total work force and are more easily recruited as most don't require technical training and/or a deep understanding of the core activities in the Upstream oil and gas business. Approximately 85-90% of all technical staff employed by an Oil and Gas Operator has a tertiary education degree (BSc, MsC or PhD).

Figure 9 – Modelling Staff Requirements for Unconventional Gas Development



Sassman N, 2014

Given the current low oil price levels, we will see a shift to the right in the above graph, as oil companies are generally delaying capital spend by postponing projects. This has a knock on influence on skills demand. This skills roadmap is taking this into consideration.

2.2.1 Subsurface Professionals

Sassman (2014) indicates that subsurface specialists are key in the exploration and development phase of a venture as they locate the hydrocarbons in the ground and propose and monitor the most efficient way of extracting the hydrocarbons. This skill set is unique to the Upstream Oil and Gas industry and requires professionals to have specialised degrees in mostly Petroleum Geosciences and Petroleum Engineering.[2] He further expands on the skills required below. There are several skill-pools in the Petroleum Geosciences disciplines that are employed in the Oil and Gas industry: Exploration Geoscientists, Geophysicists, Production Geologists and specialist geoscientists dealing with topics such as Geochemistry, Basin Modelling or Stratigraphy. Subsurface specialist teams also require non-core Petroleum related Geosciences skills such as Geomaticians and Hydrogeologists.

The main skill-pools for Petroleum Engineers are Petrophysics and Reservoir Engineering. Reservoir engineers analyse the hydrocarbon drainage during the development and production of oil and gas reservoirs and generate accurate reserves estimates. Petrophysicists measure and evaluate rock properties by acquiring well log measurements, rock samples that are retrieved from subsurface and seismic measurements to determine the hydrocarbon capacity of a reservoir.

Almost all subsurface professionals have a specialized Petroleum Geosciences or Petroleum Engineering university degree. Whereas oil and gas companies tend to recruit PhD and Masters students, services companies also hire subsurface specialists with a bachelor degree. Subsurface professionals will typically make up 5-15% of the required staffing in an oil and gas company depending on the venture phase (exploration through to development 10-15% and 5% during production).

2.2.2 Engineers

The majority of the capabilities required in an oil and gas company for developing a venture is related to engineering. At the peak of a venture development approximately 70% of all employed oil and gas company staff have an engineering degree background.

[2] The geosciences focus of other types of mineral resource (diamonds, metals, etc.) exploration and extraction focuses on hard rocks, whereas subsurface professionals in the oil and gas industry focus on the identification of sedimentary (soft) rocks and analyse their potential for hydrocarbon development. This means that Mining Geosciences skills cannot be deployed in the Upstream Oil and Gas industry.

2.2.3 Well Engineers

Well engineers are a critical skill in the oil and gas industry as they are responsible for the safe delivery of hydrocarbons from subsurface to the surface. A distinction is typically made between Well Engineers that design, drill and construct and opposed to Well Engineers that deal with the completion of and intervention on wells. Globally there are very few Well Engineering programmes at universities. Generally oil and gas companies tend to take on Engineering Graduates (e.g. Mechanical or Chemical Engineers) and then train them in-house to become Well Engineers. Offshore ventures typically have a lower requirement for Well Engineers (approx. 5% of staff), whilst onshore shale gas ventures require a larger number of Well Engineers (approx, 20%) due the significant amount of wells that need to be drilled. Well engineering and drilling in the Oil and Gas industry is distinct from mining or water drilling activities as the engineers often need to drill very deep wells, need to deal with high pressure, high temperatures and other hazards and need to prevent kickbacks, blow outs and contamination of ground/ocean water through hydrocarbons.

2.2.4 Project & Discipline Engineers

Once the existence of hydrocarbon resources has been proven in the subsurface the Project and Discipline Engineers take on the planning and development of the infrastructure for development of the hydrocarbons. At development phase of a venture, approximately 25% of the workforce in an oil and gas company is made up of project and discipline engineers. Most university engineering degrees such as civil, electrical, mechanical and chemical engineering are relevant to work in this field and workforce with work experience from other industries can be deployed in this area. Typical engineering work during the project delivery phase covers: Electrical, Rotating Equipment, Mechanical, Materials & Integrity, Utilities, Water, Energy & Heat Transfer, Pipelines & Flow Assurance Systems Quality, Integration & Project Support, Process Automation & Control Optimisation, Civil, Structures & Offshore as well as Instrument/Control Systems. For Offshore ventures engineering capabilities also extend to dealing with subsea, umbilicals, risers & flow-lines.

2.2.5 Production Engineers

Production Engineers manage the flow of hydrocarbons from the well, through the production facilities, to the final point of sale and the maintenance of the production infrastructure. Roles are split into the areas of production operation, production maintenance and reliability, production technology & chemistry and logistics. The general university profile for a Production Engineer is a Chemical, Petroleum or Mechanical Engineering degree. About one third of all production engineering related staff in an oil and gas company has a university degree. The other two-thirds follow a focused technical vocational training defined by set industry standards (such as OPITO). The majority of the production engineering staff will be deployed later in the venture life cycle (the development and production phase), when hydrocarbons are being produced.

2.2.6 Drilling Personnel

A typical offshore drilling operation will require the following personnel.

- Toolpusher;
- Barge Engineer/Assistant Barge Engineer;
- Drillers/Assistant Driller;
- Crane Operator;
- Welder;
- Chief Mechanic/Mechanic;
- Chief Electrician/Electrician;
- Medic;
- Materials man;
- HSE Advisor; and
- Deck Foreman.

2.2.7 Drilling Service company personnel

Drilling Service companies requires the following personnel:

- Drill Bit engineer;
- Measurement and Logging Drilling/Engineer/specialists;
- Directional Driller;
- Drilling Fluids Supervisor/Engineer and support staff;
- Mud Logging Operator;
- Sample Catcher;
- Wireline Geophysical Logging Engineer/Manager;
- Wireline Logging Operators/Chief Operators;
- Cased Hole Logging/Operator Engineer;
- Drilling Tools Manager and staff;
- Fishing Tools specialist;
- OCTG (Pipe supply, etc);
- Tubular Running Casing/production/Manager;
- Cementing Manager/Crew chief/Cementing/Pumping/Cementing operator;
- Well Testing Manager/Supervisor/operator;
- Slickline Supervisor/operator;
- Completions Operator/Supervisor/Manager;
- Remotely Operated Vehicle (ROV) Operator/ ROV Technician;
- Subsea wellheads specialist;
- Field Service Technician;
- Analyst; and
- General worker.

2.2.8 Support Services

- Logistics Manager;
- Health Safety and Environment Advisor;
- Legal Counsel / contract manager;
- Storeman;
- Procurements officer;
- Human Resources Manager; and
- Accountant

2.2.9 External Support

- Logistics / Trucking / Clearing Agent;
- Engineering shop personnel;

- Consumables suppliers;
- Accommodation services / agents;
- Vehicle leasing/rentals;
- Banking;
- Category manager – Food; and
- Cooks.

See **Annexure D** for descriptors of the drilling occupations prepared for OFO registration submission. The provision of drilling training is generally non-existent in South Africa currently. In addition to the above skills, a number of crosscutting artisanal skills are needed in the oil and gas development phase in particular. The work of the Manufacturing work group deals extensively with artisanal skills development.

2.1.10 Health and Safety

As a result of the importance of health and safety for the offshore oil and gas exploration industry and the need to respond to an incident involving an off-shore installation (vessel, or structure) which requires highly specialised technical personnel, this area requires special attention.

2.1.10.1 Offshore Safety and Survival

Of particular importance is Offshore Safety and Survival training, which is a requirement to work offshore. All offshore industries insist on Offshore Petroleum Industry Training Organisation (OPITO) accredited training. Funding for offshore safety and survival training often is problematic, as the Sector Education and Training Authority (SETA) funding generally does not provide for offshore safety and survival training. This can be a barrier for young people wanting to access positions offshore. Offshore personnel always have to be prepared for emergencies and undergo continuous refresher training.

2.1.10.2 Incident Management System (IMS) Training

One of the initiatives under the Oil and Gas Lab of Operation Phakisa (B1) involves the planning and implementation of several joint oil spill emergency response drills within the offshore oil and gas sector. The initiative is working towards the establishment of an "Incident Management System (IMS)" that will comprise of several government departments and industry working together to manage major emergency incidents.

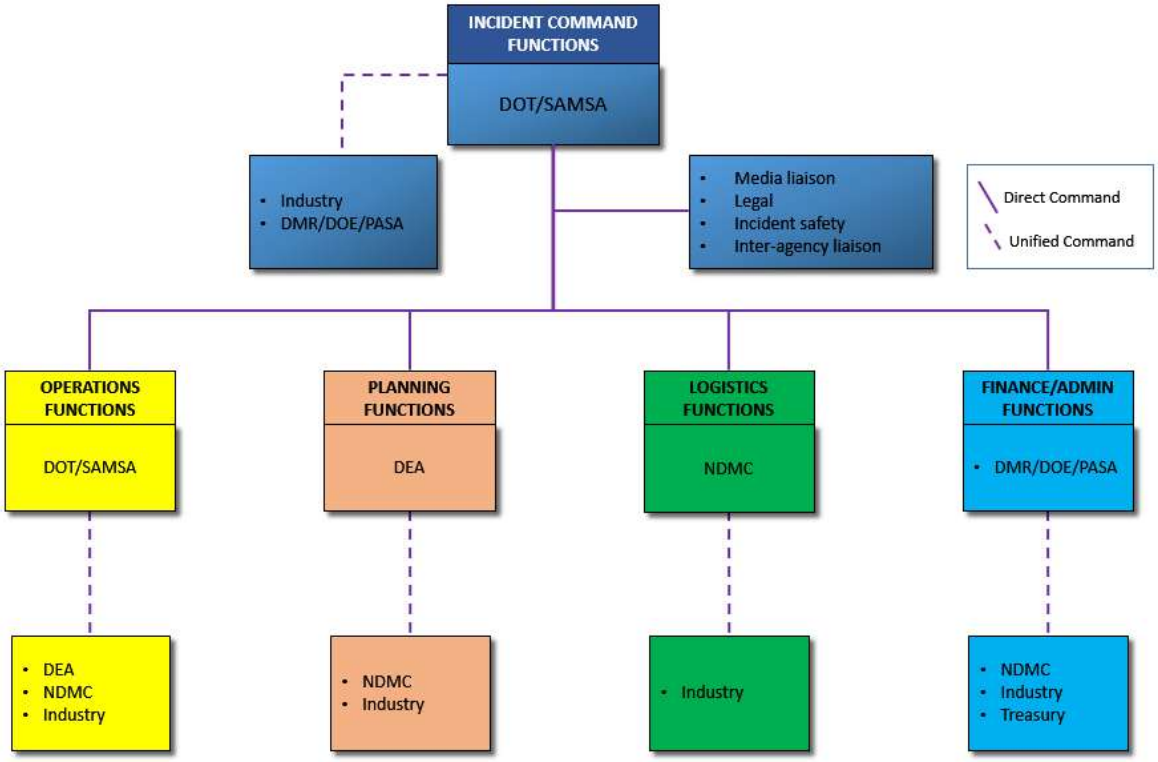
IMS training will be required for all staff that will be assigned to the IMS structure, as part of the preparations for the emergency drills and incident management operations. However this training is not readily available in South Africa since the IMS approach to emergency management is a relatively new concept to SA. A solution for the IMS training for SA will be required.

The International Maritime Organization (IMO) adopted the International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) Convention in 1990. This Convention is now ratified by the governments of many countries and is the primary international instrument for the implementation of effective national response systems and international cooperation mechanisms in cases of major oil spills. The OPRC Convention obliges governments to establish a programme of exercises for organisations involved in oil pollution response and the training of relevant personnel. It also calls on the IMO to develop a comprehensive training programme in co-operation with interested governments and industry. IMO's approach is to have the Model Courses available for use in developing countries, bearing in mind the necessity to take into account national and regional needs.

The Model Courses address oil spill planning, response and management. Some governments make direct reference to IMO Courses as part of their mandated training requirements. Others have developed more detailed training requirements or guidance within the framework of the IMO courses. For example, the United Kingdom (UK) government has detailed courses for both the offshore oil industry, ports and the shipping industry. Where applicable, these UK courses can be matched to the equivalent IMO level.

A solution for the SA environment will have to be sought in this regard.

Figure 10 – IMS training required for personnel in various functions under the incident management organisation



The key functions for the designated officers are indicated above and they will be supported by others within that function, implying that relevant training will be required for the primary and secondary personnel within each function.

The primary personnel are:

- Incident Commander;
- Operations Lead;
- Planning Lead;
- Logistics Lead; and
- Finance/Admin Lead

The secondary list will include, but not limited to:

- Asset/Facility Personnel;
- General Oil Spill Labourers;
- Liaison Officer;
- Legal Officer;
- Oil Spill Response Technicians;
- Public Information Officer;
- Qualified Individual;
- Response Support Personnel;
- Safety Officer;
- Source Control;
- Section Chief or Branch Director;
- Source Control Staff; and
- Spill Response Operators

SAIMI has been approached to assist with finding a solution in respect of the provision of IMS and related oil and gas training in SA. **Addendum E** provides guidelines on Incident Management Training requirements.

3. The current skills (local) that can be supplied to the industry

Whilst South African Universities and Universities of Technology are producing good quality engineering skills and TVET colleges supply artisan training of a fair quality in general, we need to improve in several areas of the skills pipeline to meet the skills demand in the oil and gas industry, in order to optimise the economic benefit from offshore oil and gas exploration and subsequent development work in the country and in the Southern African region.

3.1 The Department of Higher Education and Training (DHET)

The Department of Higher Education and Training (DHET) has responsibility for colleges and the universities as well as the training functions and institutions, such as the National Skills Authority, the Sector Education and Training Authorities (SETA's) and the National Qualifications Framework (NQF). As this is a new industry with excellent capacity building and economic development potential, government will have to play a more significant role in initiating and sustaining skills development and research capacity in the sector.

At an HRDC Maritime Task Team workshop held on 13 June 2014 in Cape Town the following current skills development initiatives related to the Oil and Gas industry were highlighted.

- The Artisan Development Programme (SAOGA) in the Western Cape – 203 students have been placed in different sectors of the economy.
- Train the Trainer Programme (SAOGA) - between 70-100 people have completed the programme.
- Work and Skills Schools Programme (DEDAT/SAOGA), work readiness programme over a 6-month period for those who have completed Matric.
- International Chartered and Shipbrokers (ICS) course – the Ships' Agency takes about 30-50 school students and enrols them on the ICS course which is currently not offered in SA.
- Tool, Dye and Mould Programme (Ships' Agency) with about 140 participants in the Western Cape.
- National Tooling Programme (DTI) with about 1000 participants.
- DTI to fund the Ship/Boat Building skills development programme (Future initiative).
- RPL pilot programme (DEDAT/SAOGA) with 45 participants in the Western Cape.
- Dual Artisan Programme (Merseta and Dormac) to support the ship repair industry – aim to produce 60 artisans over the 3-year pilot programme.
- Welding Training Programme (DCD Marine).
- APP Training Programme (Welders, Boilermakers).
- Marine Engineering introduced by NMMU.
- Work Readiness Programme (Northlink).
- Artisan training at various FET Colleges in the country.
- Training at NOV training centre – Port Elizabeth.
- Internationally accredited IRATA, Rope Access Training by 3 private Training Providers.
- University of the Western Cape, Honours degree in Geology, Geo-Sciences Masters' Degree.
- CPUT and Project Maritime - STCW Offshore Survival courses.
- Wits Petrochemical Engineering degree (soon to be implemented).
- Proposed CPUT Petroleum Engineering Degree.

It should be noted that this list does not include all the training initiatives. Also, new training programmes and initiatives have commenced since. To see a full complement of training provision to the marine, oil and gas industry in South Africa, kindly visit www.moga.saoga.org.za/courses.

3.2 Sectoral Education and Training Authorities (SETAs) Sector Skills Plans

SETA sector skills plans are developed on annual basis. The SETAs currently have a role to play in developing Offshore Oil and Gas skills. A challenge is that SETA's generally do skills planning based on current demand. As offshore oil and gas exploration will see growth in the future, we are in danger of ignoring this and lose out on developing the youth for opportunities to work in the industry. We will then have to import more skills. The Oil and gas industry straddles several SETAs. A greater measure of coordination of skills needs is required.

3.3 Technical Vocational Education and Training (TVET) Colleges

This band of education and training is also referred to as 'post-school', meaning that it refers to education and training that takes place after leaving school, even if only with a Grade 9 completed. TVET Colleges offer a very wide range of courses/programmes that have been developed to respond to the scarce skills needed by employers. Courses vary in duration from a short course of a few hours to formal diploma courses over three years. Colleges offer various types of courses and also cover subject areas that are important for the Upstream Oil and Gas industry, such as engineering, manufacturing and technology and construction. A number of the 50 plus TVET Colleges and private training providers are currently offering such training courses as Welding, Fabrication, Pipefitting and courses for Electricians and Mechanics.

3.4 Private Training Providers

There are several private training providers in the upstream oil and gas industry that support the competence development and competence assurance of petroleum professionals. A leading training service provider for example is PetroSkills, which is an industry alliance created by BP, Shell and Oil and Gas consultants international in 2001 to provide high quality, competency-based training that is critically important for all oil and gas companies, but not unique to any particular company. Most of the world's leading oil and gas operators and services companies are today part of this industry training alliance that allows members to more strategically leverage their investments in training, competency development and competency assurance. Alliance members contribute technical know-how and oversee and approval of PetroSkills courses and curricula. Private training institutions like Project Maritime, Offshore Africa Training Centre and Seadog are providing globally benchmarked courses.

3.5 Company Training

In general all Oil and Gas companies provide in-house training opportunities for their technical staff. The degree between in-house and external training depends on the size, scale and history of the oil and gas company. All major oil international companies such as Shell offer a full suite of training courses for all technical disciplines. At the start of the career in an oil and gas company, structured training programmes help Graduates fresh out of universities to be developed into independent and competence assured technical petroleum professionals. Each technical discipline offers further education and training courses that ensure that employees continue to develop in their field of expertise and that the most critical competencies are trained, tested and assured. Most of the learning in the industry is carried out as blended learning in a mixture of class room, virtual and on-the-job training. Annual training costs per technical employees can vary, depending on technical discipline, the seniority and role of an individual in the organisation.

3.6 eLearning/Blended Learning

Several eLearning training courses are available. South Africa is able to provided blended learning capability, using eLearning.

3.7 Basic Education – Primary & Secondary level

Basic education is the essential feed in the pipeline of skills development towards any programme in the energy sector which intends to deliver on IRP 2010. The level of basic education in the technical areas (maths, science, craft, woodwork,

metalwork, etc.) needs to be improved. One way of achieving this includes an increased support for all governmental and non-governmental initiatives aimed at strengthening the quality of education and increasing the number of matriculants (Grade 12) with strong foundations in mathematics and science.

3.8 University Education and Training and Research and development

The table below provides an overview of university level education for the Oil and Gas exploration industry in South Africa.

Table 7 – University level education for the Oil and Gas exploration industry in SA

University	Key areas of interest	Petroleum Geosciences Research	Petroleum Geosciences Teaching
University of Cape Town	Sedimentology & Geophysics	Yes (Dr Emese Bordy & Dr. Beth Kahle)	Yes, Petroleum Geosciences research Masters
University of Western Cape	Petroleum Geosciences	Yes, Petroleum Geosciences	Yes, taught Petroleum Geosciences Masters programme
Nelson Mandela Metropolitan University (Eastern Cape)	Geophysics (including Marine) Structural geology & Sedimentary geology **AEON – ESSRI**	Yes (Prof Moctar Doucouré, Prof Maarten de Wit & Prof Daniel Mikes)	Yes, individual students
University of KwaZulu-Natal	Coastal and marine geomorphology, sedimentology and stratigraphy Structural geology Archaean crustal evolution	Yes (Dr Andrew Green)	
University of the Witwatersrand	Geophysics http://www.africaarray.psu.edu/ Palaeontology http://www.wits.ac.za/geosciences/bpi/6569/home.html Dominant focus is on minerals exploration and mining industry	Yes (e.g., Prof Sue Webb)	Yes, individual students
University of Stellenbosch	Igneous petrology http://academic.sun.ac.za/earthSci/post_nomad.htm	Yes, Lecturer Sedimentology (vacant)	Yes, individual students

The general engineering output from South African universities is fairly low compared to other countries. In 2010 SA awarded 10.000 engineering degrees, which compromises 7% of the overall tertiary education degrees (half of the OECD average). Only 27% of the engineering students were black South Africans. Engineers are the main talent 'feedstock' for Oil and Gas companies to develop and produce hydrocarbons. CPUT is planning to implement a degree course in Petroleum Engineering. Universities of Technology are offering Mechanical, Electrical and Chemical Technician training at present.

It is imperative to have a comprehensive understanding of the oil and gas related landscape in South Africa in order to structure an appropriate HCD programme which would also offer placement opportunities for experiential learning. It is therefore imperative to capture the institutions in the South African National System of Innovation performing some measure of oil and gas related RD&I. These would include State Owned Enterprises such as Eskom, Mintek, PetroSA, the CSIR, various universities, and Science Councils such as the Council for Geosciences. Collectively these organisations have substantial infrastructure of relevance to an Oil & Gas HCD Programme, although equipment and facilities are in many cases outdated or not optimised for R&D at a level comparable to those of collaborators elsewhere in the world. These efforts are probably mostly quite fragmented from a national perspective and often of sub-critical capacity.

Oil and Gas R&D is performed both in-house by these organisations and also in collaboration with local and international organisations. In many cases such activities may be performed in conjunction with education and training activities, mainly at universities but often in close collaboration with industry organisations.

3.9 Research and Development

No Petroleum Engineering research or human capacity building programme currently exists at South African universities. PetroSA signed MoU with Schlumberger on Shale Gas Development Centre. There is a need for applied research/research and development to enable world class industry focused R&D projects.

3.9.1 Universities

(a) Research chairs

There is currently no research Chair for Offshore Exploration or Petroleum Engineering at South African Universities.

(b) Centres of Excellence

More work needs to be done to ensure appropriate Centres of Excellence are developed which responds dynamically to the Oil and Gas Exploration and Production industry.

(c) Communities of Practice (COP)

A COP actively focuses the attention of researchers across different institutions of higher learning on key focus areas. The offshore oil and gas sector will no doubt benefit from the establishing of a COP for Oil and Gas exploration and production. This should be motivated and supported at all levels, as it will articulate knowledge management initiatives and with the aggregating and focusing on relevant research and development in the Oil and Gas industry. The benefit for the oceans economy is obvious.

(d) Research programmes

Several Oil and Gas research programmes are in progress. Some are:

- Technical Evaluation & Socio-Economic Analysis of Shale Gas in the Eastern Cape, AEON-ESSRI/NMMU - Funding R16 million by Department of Economic Development, Environmental Affairs and Tourism (DEDEAT);
- Karoo Geosciences Research: Geological Society South Africa/Shell; and
- Karoo based skills research by SAOGA, funded by CHIETA

A proposed COP will help collate and optimise the relevant research being conducted in isolation presently. It is important that research has relevance to the challenges faced by industry and the country. Research and development should be included as indicated above, an important focus to enhance the economic value.

3.9.2 Relevant international strategies, initiatives and R&D linkages

It would be informative and valuable to compare similar strategies followed by countries and multinational programmes elsewhere in the world (e.g. UK). Various oil and gas sector role-players and universities have active collaborative programmes with counterparts elsewhere in the world. It is important that these be captured as they offer educational and training opportunities for concurrent cadres of students to be capacitated.

4. A Mechanism/s for knowledge generation

4.1 Rationale

A mechanism/s is needed for the building of efficient and effective knowledge generation and knowledge management capacity.

4.2 The Marine Oil and Gas Academy (MOGA) skills platform example

The virtual Marine, Oil & Gas Academy (MOGA) facilitates coordination of the various skills initiatives from industry, government and training by allowing participants to highlight their initiatives. MOGA largely serves as the skills development engine of SAOGA, consolidating the various skills development initiatives of the industry body. MOGA coordinates the relationship with the training providers, industry, colleges and universities and plays a facilitative role, but

it does not compete with the Academy partners as a training provider. MOGA is set up to serve as a hub for Marine, Oil & Gas knowledge, thought leadership and skills in Africa to:

- Facilitate the development of faculty knowledge pertaining to Maritime, Oil and Gas, at private and public educational institutions in South Africa and regionally in Africa, in line with industry requirements;
- Enable the development of Maritime, Oil & Gas skills in Africa through facilitating accreditation of training to international standards;
- Develop local capacity and knowledge to support local content programmes in African countries;
- Link international professional bodies to bodies in Africa or serve as the link for those bodies;
- Provide Marine, Oil and Gas career information to industry and the learning communities.

The Academy provides high level views of the career landscape within the following industry sectors:

- Ship & Rig Repair
- Oil & Gas
- Ship Building
- Marine

MOGA is a 'one stop shop' for industry players, prospective trainees/students, parents and schools to engage proactively on curriculum and training content related issues, course information, access to courses and career information. **See www.moga.saoga.org.za for more information on MOGA**

Figure 11 – Screenshot of the web-based skills platform

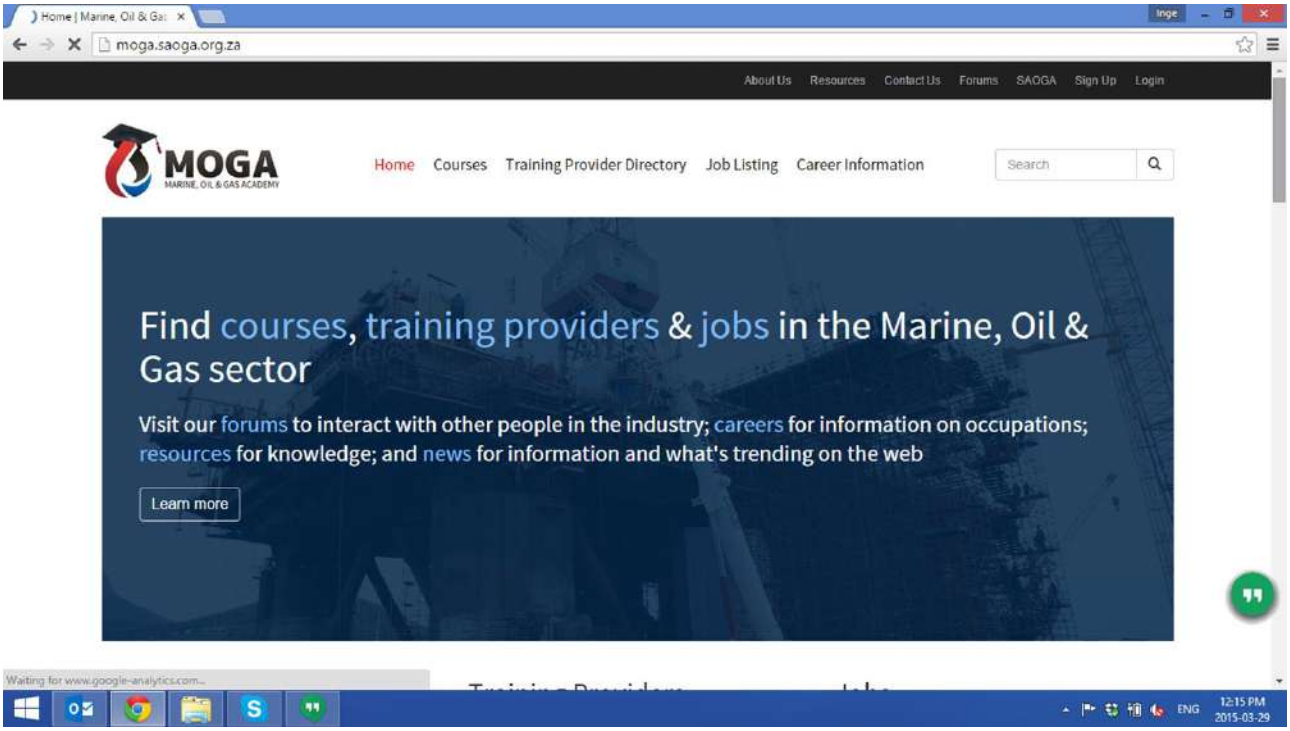
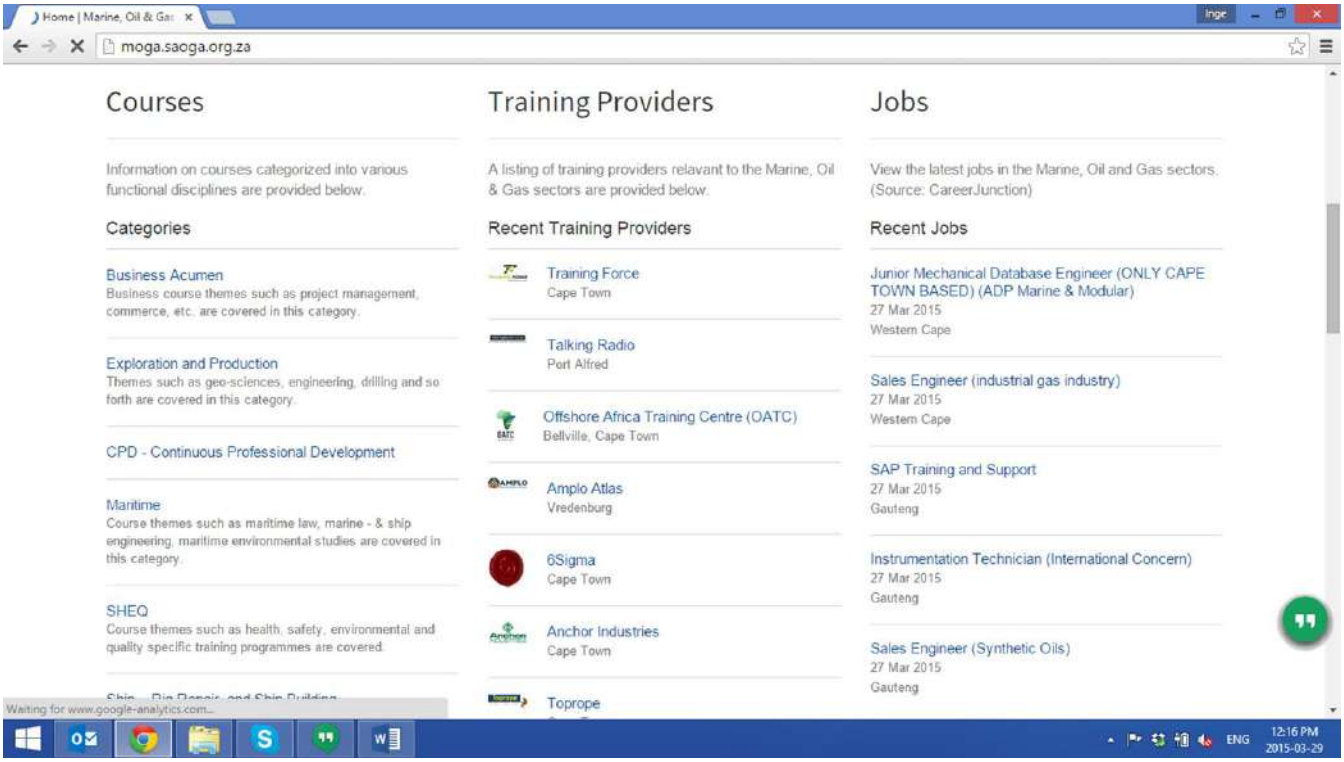


Figure 12 – Screenshot of the web-based skills platform



4.3 Enhancing the model to meet the needs of the sector more adequately (or a new model)

The lessons learnt from developing MOGA can assist to develop a MOGA 'on steroids', which links to or includes Research and Development and collaboration with the relevant professional bodies and accrediting entities. It is envisaged that this will be a dynamic and useful collaborative information management resource for the sector.

5. Professionalisation and Accreditation

To enhance skills development and professionalism in the region it is important for active professional body engagement.

5.1 Professional Bodies

The following are key professional bodies:

- The Engineering Council of South Africa (ECSA) is a recognised nationally focused professional;
- Body for engineers;
- Society of Petroleum Engineers (SPE) is a professional body with a global footprint;
- Geological Society of South Africa: One of Africa's oldest scientific societies, which were established in 1895 and have 2500 members today. It aims to promote the study of the earth sciences and to look after the interests of earth scientists by providing forums and events where geologists and members from related disciplines may meet and share ideas, discuss advances in the science, emerging technology, and new geological models and ideas.

It is noted that further work needs to be done in developing more focused professional body capacity in order to enhance continuing professional development, but as oil and gas exploration is a fledgling industry in South Africa it will take considerable time to develop a membership base which is a requirement for establishing professional bodies.

5.2 Accreditation entities

OPITO, IADC, IRATA, City & Guilds are examples of globally recognised accrediting entities relevant to the oil and gas industry. Local accrediting entities are; SAMSA and the SETA's. Several Private Training Providers provide training, but as oil and gas exploration is a fledgling industry in South Africa, developing, formalising and harmonising of curricula is needed to ensure that global standards are maintained. Harmonising of South African qualifications with respect to global standards and qualifications is of particular importance, without which it is hardly possible to promote international recognition of local training.

6. Key Messages

It is likely that the demand for technical upstream oil and gas professionals will rise in the future. The case scenario developed in 2014 envisioned a demand of 2500 technical professional in 5 years' time that grows to over 15,000 technical professionals in 15 years' time. Of these 15 000 professionals who would find employment with Oil and Gas operators and Oil and Gas services companies approximately 2,000 need to have a Petroleum Geosciences or Petroleum Engineering background, approximately 6,000 would need to be professional engineers and 7,000 would need technical artisans training. These numbers do not include the engineers and artisans that work in the construction and manufacturing environment supporting the Oil and Gas industry. Current indications are that this scenario will be delayed by 3 to 5 years due to the low oil price, an oversupply of oil and gas and uncertainties caused by an unclear legislative environment in South Africa with respect to oil and gas exploration rights.

The findings of the industry document remains largely unchanged; 'In order to support the development of Upstream Oil and Gas industry in South Africa local human capacity building initiatives need to be developed and supported by industry, government, tertiary institutions and other training providers. This would allow Oil and Gas operators and services companies to resource jobs locally in South Africa and to fill the majority of them with well trained and educated historically disadvantaged South Africans. What is apparent is that there is very limited capacity building regarding Petroleum Geosciences, no capacity building regarding Petroleum Engineering and the general university output of Engineering graduates is too low to sustain the development of a new industry on top of the other growth drivers of a developing nation that requires strong engineering support.

The recommendations of the NRF study remain valid; 'In Southern Africa the demand for Upstream Oil and Gas technical professionals is even more significant and urgent due to the recent discoveries and ongoing developments of oil and gas fields e.g. Mozambique, Angola, Namibia and East African countries such as Tanzania, Kenya and Uganda. Due to its leading university education system in the region South Africa could establish itself as a hub for research and human capacity building for the Upstream oil and gas industry in the region'.

Any expansion or exploration programme in the oil and gas sector must be premised on the fundamental approach that South Africa should derive the maximum benefit from the implementation of such a programme. It would clearly be impossible to gain such benefits without having the local skilled human resources available to fully participate in the

programme. These resources do not currently exist in South Africa to the extent required for the projected exploration and expansion in oil and gas and have to be developed from a relatively low base. A major effort is thus required to create or expand mechanisms for developing such local skills for both the entire oil and gas exploration and expansion programme and the RD&I component thereof. This should be done in synchronisation with the implementation of the relevant programmes. A minimum level of maturity and depth of knowledge is needed before the exploration and production come into its own.

Funding is needed to sustain current skills development initiatives and to develop new capacity for training and development and research and development. Direct support is required for postgraduate research projects, post-doctoral research fellowships, Centres of Excellence, specialised further education and training of current oil and gas energy, RD&I workers, skills exchange among oil and gas role-players and also with international partners, as well as similar mechanisms to be included in research and funding proposals from participating organisations. Funding of additional research and teaching positions at educational institutions should be considered, especially to change the age, gender and race profile of the industry. Emphasis should be placed on the scientific and engineering disciplines of direct interest to the implementation of the exploration/expansion programme for the oil and gas sector as presented in the IRP 2010.

Specific additional interventions may include the following:

- Support for the development of an Oil and Gas Human Capital Development & Knowledge Generation initiative.
- Close collaboration with other South African skills development role-players, including artisan development role-players;
- Develop specialisation training programmes at artisan, technician and engineering level to build on current skills offerings at South African institutions.
- Increased utilisation of internationally supported mechanisms such as fellowships, scientific visits and sandwich programmes which are available through international bilateral cooperation agreements between the South African Government, South African institutions and international governments, agencies and organisations;
- Use of human capital development opportunities presented by bilateral agreements at national or institutional level; and
- Development of stronger ties with relevant oil and gas international education networks.
- Engage with global e-learning providers to support local training and development.

Close collaboration should be maintained between all oil and gas role-players to ensure optimal alignment of university education programmes and R&D activities with the human capital development objectives of the Oil & Gas HCD Programme. Besides the essential education programmes to be continued or implemented at universities, experiential training at research and industry organisations should form a prominent part of the skills expansion initiative. The following also has to be considered:

- Given large numbers, short timeframe, multiple & new pathways are required;
- Need to do something radically different (increase input, throughput);
- Concurrent implementation;
- Benefits & trade off local vs. international;
- Accreditation of new skills (SAQA, SETAs);
- Export students to international universities/institutions;
- Import international lecturers/experts;
- EHCD&KG for O&G;
- THRIP;
- CoEs

- SARChI;
- Grants (aligned to research and HCD);
- Private Sector; and
- Secondary Education

At the HRDC Maritime skills task team workshop held in June 2014 the following interventions were proposed:

- A multi-year approach to SETA grants is needed.
- Grant regulations need to be reviewed.
- Industry needs to be more involved in influencing policy e.g. QCTO regulations etc.
- Future programme development needs to be in line with the new regulations.
- Trade test policies should be published.
- The New National Skills Development Strategy (coming in 2016) should accommodate the skills development challenges identified by the sector.
- The DHET scarce skills list process should look at industry instead of company level to get the full picture. Semi-skilled needs should also be accommodated.
- Individual assessments needed as part of the selection process into the industry.
- Access to SETA data to get proper analysis of scarce skills.
- In-service training required.
- Better relationships need to be built between industry and the training providers.
- Mentoring and coaching required.
- DHET reports should be publicly available.
- Co-funding between SETAs should be explored.

7. Skills Roadmap

The skills roadmap is developed on the basis of the information provided in the previous sections of this document. The roadmap seeks to provide a map for achieving the goal of meeting the anticipated demand for skills by the offshore oil and gas industry in South Africa.

7.1 Assumptions

It is assumed that the roadmap will provide a basis for further discussion and that it provides direction as well as a flexible basis, which is required taking into account that South Africa does not currently have a significant local offshore exploration industry. The roadmap will therefore be treated as a live document that will be reviewed on a regular basis.

The current cyclical downswing in the oil and gas sector is recognised. It is however assumed that we will not wait on the upswing to implement the skills roadmap. A proactive approach is assumed to ensure that we optimise the benefits of the upswing, in line with Operation Phakisa urgency, taking into account the increased time lag due to exploration projects being postponed as result of factors such as a drop in the oil price. It is suggested that the skills roadmap be treated as a live document that will keep track of dynamic developments in the sector.

Table 8 – Towards a simplified occupational learning framework

5	Executive Managers and researchers	Oil and Gas exploration and production skills	
Universities/Universities of Technology/Research and Development entities/Industry: Research and development			

Executive management Consulting Design Entrepreneurship			
4	Engineer	Oil and Gas exploration and production skills	Competence overseen by professional body/CHE
Universities/Universities of Technology/Industry: Bridging into engineering Management Project management Design			
3	Technician	Oil and Gas exploration and production skills	Competence overseen by professional body/QCTO
Universities of Technology/Universities/Industry: Bridging into technician level Entrepreneurial skills Introduction to project management Training and mentoring Supervisory skills Inspection skills Drafting Design			
2	Trade tested artisan level	Oil and Gas exploration and production skills	Competence overseen by professional body for artisans/QCTO
Industry/SOE's/TVET Colleges/Private colleges/Technical High Schools: Bridging into artisanship and work Computer literacy a requirement			
1	Associate Artisan/Operator level	Oil and Gas exploration and production skills	Competence overseen by industry and professional body for artisans/QCTO
Community Colleges/TVET Colleges/NPO's/Schools of Skills/Churches/Navy/Correctional facilities/Army/e-Learning initiatives/Labour/Industry/Municipalities/Libraries/SOE's (Every place a place of learning): Targeted Occupational Readiness Programmes with clearly defined exit levels and assessments defined by industry and the next entry levels Mathematics Science Computer literacy Life Skills Communication			

The following should be noted:

- Multiple entry and exit points clearly defined;
- No glass ceilings;
- Upright pyramid approach moving to the top levels is anticipated (Massification at the bottom);
- Articulates with, but does not replace the formal education system;
- Grow Oil and Gas exploration and production numbers over time, based on demand;
- Export Oil and Gas exploration skills initially (I*nternational benchmarking is critical);*
- Artisan Development and associate artisan development forms the basis of Oil and Gas exploration and production skills (First Phase);

- Developing of onshore oil and gas exploration skills serves as the 2nd phase focus of skills development;
- Globally benchmarked competence;
- A research and development culture at all levels;
- An entrepreneurial culture at all levels.

8. Recommendations

The recommendations below are considered critical and emanate from this document and were consulted on widely with the key stakeholders from government and industry.

Table 9 – Recommendations

Recommendation 1	Improve the quality of skills development capacity across the entire skills pipeline with local, regional (Southern African) and global demand of the offshore oil and gas industry in mind by: - benchmarking skills development against global training standards. - improving the coordination of Oil and Gas focused skills development. - marketing and promoting South Africa as an Oil and Gas skills development hub to; the local, regional (Southern African) and international Oil and Gas industry. - improving articulation between the different levels of education and training offered at TVET colleges and universities
Rationale	Coordinating, evaluating and advancing the above rigorously is critical for success. Although this is largely a DHET function, measures have to be put in place to address quality skills delivery to the oil and gas industry in a focused manner, in an active partnership with key players from industry and government. This document provides an indication of the relevant players and the issues at stake. A detailed plan, addressing recommendation 1 must be developed and aggressively pursued.
Action Measures	DHET is the implement agency. It is assumed that SAIMI will drive the process with the support of partner initiatives,
Timeframe	Work on this recommendation will commence with immediate effect and will be ongoing
Costing	
Recommendation 2	Develop artisanal skills as a significant building block for Oil and Gas Skills. Develop new specialisation programmes on top of existing relevant training in collaboration with industry which is line with industry needs
Rationale	When Offshore Oil and Gas exploration reaches development phase, artisans will be in demand. Artisanal skills are crosscutting with respect to energy, manufacturing, transport and maintenance. Using artisan development as a building block for developing skills in the oil and gas industry is a sensible approach. Oil and gas specialisation training programmes, building on artisanship, should however be developed intentionally and piloted. Oil and Gas specialisation should become an important feature of artisan development. We can never develop too many industry focused skilled artisans. Apart from the local demand for artisans, there will be an increasing demand from Southern Africa for world class artisans. A good artisan will never be unemployed as he/she is able to start a business with relative ease.
Action Measures	DHET, (with NAMB, SAIMI and partners like SAOGA) is the implementing agency.
Timeframe	Work on this recommendation will commence with immediate effect.
Costing	
Recommendation 3	Develop university level capacity to serve and stimulate research and development and university education in the oil and gas exploration sector by; - Basing current and proposed initiatives on local, regional and global demand. - Developing new specialisation programmes on top of existing relevant training in collaboration with industry and in line with industry needs - Developing research and development capacity. - Establish relevant research chairs and a community of Practice

	(COP) - Identifying and developing courses and capacitating academic staff - Stimulating a close working relationship with industry to ensure industry relevance of courses - developing relationships with global institutions - promoting opportunities for visiting lecturers
Rationale	A focused approach, working laterally across participating universities is envisaged by establishing a Community of Practice (COP) with NRF support. This will facilitate a concentration of research and development and capacity building efforts. Research chairs will drive research and development in close collaboration with industry
Action Measures	A Community of Practice (COP) to be initiated and Research chairs to be established. DST, NRF and DHET and selected SETA's are the key players with SAIMI driving the processes.
Timeframe	Work on this recommendation will commence with immediate effect. It is important to enhance current related activities in the process.
Costing	
Recommendation 4	Develop drilling training capacity at TVET level. This could done in the form of specialised training in collaboration with selected TVET colleges and/or with private enterprises.
Rationale	South Africans generally have an excellent reputation in the Offshore industry with thousands of them finding their way into the industry. Not much is being done to develop a system to enhance this offering. We now have OPITO accredited training centres in country. Developing drilling training competence will complement this offering and will continue to position South Africa as an important skills development hub in the region and in the world, whilst focusing the developing of locals as offshore professionals with greater intentionality. Onshore and offshore initiatives will benefit from drilling training.
Action Measures	Two drilling schools to be established. Due to the high set up costs of simulators, equipment and staffing and the current infant stage of the offshore oil and gas industry in South Africa, a strategic approach is envisaged with seed capital form government to start the drilling schools.
Timeframe	To be initiated in 2017
Costing	
Recommendation 5	Develop a quality local and regional internship programme in close collaboration with industry
Rationale	As South Africa currently does not have a significant Offshore oil and gas industry, we have a need to innovatively engage with industry and training providers to develop an internship programme that will see local capacity develop both inside and outside of South Africa.
Action Measures	Negotiate internship programme with oil and gas companies. The key players are DHET, industry associations and industry
Timeframe	In the course of 2016
Costing	Will vary depending on uptake. Funding should cover coordination, stipends and special costs like accommodation and travel.
Recommendation 6	Monitoring and evaluation
Rationale	Ongoing monitoring and evaluation of the implementation of the skills roadmap is required in order to measure success and to inform future initiatives. This is particularly important due to the dynamic nature of the industry.
Action Measures	A monitoring and evaluation committee should be established
Timeframe	When/before the working group completes its work.
Costing	Funding is needed for travel and accommodation and coordination

Table 10 – Phase 1: June 2015 – June 2016

Key Focus	Identify and define gaps between the current and the desired state and initiate pilot initiatives	Cost Estimate
Research And R&D	SAIMI initiated Role players identified Plan for implementation of Oil and Gas Exploration research chair/s. Initiate COP activities Do research on refining the Oil and Gas offshore exploration skills roadmap	R1 000 000.00
Engineering and related	Support existing fledgling initiatives like the UWC Petroleum GeoSciences Masters degree. Determine gaps Universities identified/invited to participate/proposal invited to offer/develop specialisation programmes to fill gaps	R25 000 000.00
Technician	Define demand Map supply capability Determine gaps Develop strategy to fill gaps Focused consultations with Universities of Technology Do planning for developing specialisation programmes on top of existing courses. Implement pilots	R2 000 000.00
Drilling Staff	Determine local capability to deliver training Develop a strategy for developing drilling and support staff Visit global centres of excellent for knowledge transfer	R4 000 000.00
e-learning	Map appropriate e-learning courses to supplement training and development. Pilot selected courses.	R300 000.00
Web Based Skills platform and knowledge management infrastructure	Develop a web based skills platform and knowledge management capacity	1 000 000.00
Curriculum Initiatives	Develop curriculum interventions based on gaps identified across the green path Stimulate articulation Articulate with SETA Sector Skills Plans Articulate with OFO and identify new occupations to be registered on the OFO Articulate with HRDC Task Team recommendations Use SIP methodology to refine skills roadmap	R1 500 000.00
Links with Artisanship	Identify overlaps and gaps Initiate pilot programmes to address gaps	R15 000 000.00
Source Funding	Identify sources for funding Define potential interventions Develop proposals and business plans Prioritise interventions	R500 000.00
Related training	Identify related current training Develop a strategy to enhance capacity and implement	R1 000 000.00
Career development	Establish an interactive platform for career development	R500 000.00
Industry engagement and global benchmarking	Develop and implement a robust industry engagement strategy	R1 500 000.00
Internship programme	Develop and implement an internship programme in partnership with industry	R20 000 000.00
Monitoring and evaluation	Ongoing monitoring and evaluation	R1 000 000.00
TOTAL		**R73 300 000.00**

Table 11 – Phase 2: June 2016 – Dec 2017

Key Focus	Refine Skills Roadmap and Phase A Implementation	Cost Estimate
Research and R&D	SAIMI and partners Initiate and coordinate research and R&D initiatives Advertise/Search for Oil and Gas Exploration research chair/s. Facilitate the appointing of 2 Chairs Continue with COP initiatives	R10 000 000.00
Engineering and related	Development and offering of courses. Support to develop existing programmes	R50 000 000.00
Technician	Develop and offer initial courses/specialisation	R25 000 000.00
Drilling Training centre	Implement strategy Plan and initiate a training centre/s Initiate selected courses	R70 000 000.00
e-learning	Fund e-learning courses	R10 000 000.00
Curriculum Initiatives	Ongoing curriculum development	R1 000 000.00
Web based skills platform an knowledge management infrastructure	Maintain a dynamic web based skills platform and promote	R1 000 000.00
Links with Artisanship	Nurture optimization Develop specialisation courses Run pilot/s	R20 000 000.00
Source Funding	Coordinate funds and projects Ongoing proposal development	R1 000 000.00
Related training	Map related training and initiate skills development projects to optimise crosscutting training and development	R2 000 000.00
Career development	Promote and maintain career platform	R300 000.00
Industry engagement and global benchmarking	Consistently articulate with industry and global standards Coordinate industry experts lecturing Relate to supplier development and develop selected focused projects	R2 000 000.00
Internship	Coordinate and administer an internship programme in collaboration with industry	R30 000 000.00
Monitoring and evaluation	Ongoing	R1 000 000.00
TOTAL		**R223 300 000.00**

Table 12 – Phase 3: January 2018 – Dec 2020

Key Focus	Phase B – Implementation	Cost Estimate
Research	SAIMI and partners 2 Oil and Gas Exploration related research chair/s in place and an additional 2 chairs in the process of being implemented. An oil and gas related COP established and functioning Research and development activities continues in close collaboration with industry	R15 000 000.00
Engineering and related	Courses offered	R50 000 000.00
Technician	Courses offered	R10 000 000.00
Drilling Staff	Implement strategy and offer training	R100 000 000.00
e-learning	Fund eLearning and simulation initiatives	R25 000 000.00

Curriculum Initiatives	Ongoing Curriculum development and material development work	R1 000 000.00
Web based skills platform and knowledge management infrastructure	Maintain and promote	R1 000 000.00
Links with Artisanship	Offer specialisation courses	R20 000 000.00
Source Funding	Ongoing planning and development work	R2 000 0000.00
Post Technical and related training	Implement strategy and offer courses	R15 000 000.00
Career development	Maintain and promote an interactive platform	R400 000.00
Industry engagement and global benchmarking	Continue to implement and evaluate industry engagement strategy	R2 000 000.00
Internship	Coordinate and administer an internship programme in collaboration with industry	R30 000 000.00
Monitoring and evaluation	Ongoing monitoring and evaluation	R1 000 000.00
Total		**R272 400 000.00**

Table 13 – Phase 4: Medium to Long Term Considerations

Key Focus	**Phase C – Implementation**	**Cost Estimate per year**
Research and R&D	SAIMI and partners 4 oil and Gas exploration related research chairs in place. A well-oiled COP focusing on oil and Gas exploration Ongoing research and development in close collaboration with local and global industry.	R15 000 000.00
Engineering and related	A critical mass of Oil and gas courses offered	R50 000 000.00
Technician	A critical mass of courses offered	R50 000 000.00
Drilling Staff	Implement strategy and offer training	R100 000 000.00
e-learning	Fund eLearning	R25 000 000.00
Curriculum Initiatives	Ongoing Curriculum development work	R3 000 000.00
Web based skills platform and knowledge management infrastructure	Maintain and promote	R500 000.00
Links with Artisanship	Offer specialisation courses	R20 000 000.00
Source Funding	Ongoing planning and development work	R3 000 0000.00
Related training	Implement strategy to enhance related courses	R20 000 000.00
Career development	Maintain and promote an interactive platform	R500 000.00
Industry engagement and	Continue to implement and evaluate industry engagement strategy	R2 000 000.00

Key Focus	Phase C – Implementation	Cost Estimate per year
global benchmarking		
Internship programme	Coordinate and administer an internship programme in collaboration with industry	R30 000 000.00
Monitoring and evaluation	Ongoing	R1 000 000.00
Total		**R320 000 000.00**

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