



Petroleum Industry
Human Resources Committee
Newfoundland & Labrador

Newfoundland and Labrador Oil and Gas Industry Human Resources Skills Gap Analysis Study

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1. Executive Summary

The Petroleum Industry Human Resources Committee (PIHRC) engaged Strategic Directions Inc. to provide a comprehensive, detailed view of the current and future labour force needs for the exploration, construction, commissioning, and production phases of the Newfoundland and Labrador upstream oil and gas industry. The primary objectives of the study were to develop an employment forecast for the province's offshore oil and gas industry for identified occupations over the 2018-2022 and 2023-2027 timeframes on the basis of three potential level-of-activity scenarios; to examine the potential supply of workers from current post-secondary offerings for the same timeframes; to complete a skills gap analysis for those occupations; and to identify workforce occupational areas, including difficult to recruit occupations, needing attention.

More than 30 companies, representing as many as 40 companies (when groups of companies were considered) participated in the Human Resources Skills Gap Analysis Study through interviews conducted between November 2017 and June 2018. Participating companies included those companies involved in the production, development, and exploration phases of the oil and gas industry and construction projects related to the oil and gas industry. A key informant interview guide was used to conduct the interviews and study participants were also asked to complete the employment matrix (see Appendix A) which identified position titles. As indicated in section 3.1, these position titles were then categorized as per the National Occupational Classification (NOC) 2016. The data were aggregated (combined) and have not been attributed. As required by the study scope the scenario-based forecasted workforce demand for all occupations has been included in the study.

Occupations to be included in the post-secondary supply projections were identified on the basis of employment requirements indicated by industry participants and by the occupational Employment Requirements specified in the National Occupational Classification (NOC) codes, cross referenced with position titles and employment requirements. Labour supply projections are provided for those occupations requiring post-secondary education. These supply projections are based on graduate information provided by the province's post-secondary institutions.

Program and course offerings related to oil and gas industry occupations were identified at the three campuses of Memorial University, at 16 campuses of the College of the North Atlantic, and at 12 of the province's private post-secondary institutions comprising 19 campuses. Graduation data and other information on program and course offerings were gathered through a survey developed for the purpose, from Memorial University's Fact Book 2016 and Fact Book 2017, and through follow-up consultation with institutional officials to compile 2012 – 2017 data on relevant course and program offerings.

Limitations of the occupational demand and supply methodology are described in section 4.0.

1.1 Labour Demand

The baseline labour demand (employment) for the four production facilities and the two rigs for the baseline activity was approximately 4,600 across 95 National Occupational Classifications (NOCs). This is comparable to the 4,766 total direct employment reported by Suncor Energy (Terra Nova FPSO), Hibernia Management and Development Company Ltd. (Hibernia), ExxonMobil Canada Properties (Hebron), and Husky Energy (SeaRose) in their Canada-Newfoundland and Labrador Annual Benefits Reports for 2017.

The study compared the change in labour demand (employment) by NOC from the Baseline Activity to five scenarios representing low, medium, and high levels of activity which were developed in consultation with industry representatives.

Table 4 below in section 6.2.1 shows the change in NOCs and overall change in labour demand (employment) in each scenario.

Demand – WWRP Construction

As shown in Table 4, the estimated peak construction employment of 2,080 for the West White Rose Project (WWRP), expected to occur in 2018, comprises more than 150 managers and administration positions; more than 200 engineers; 120 technicians and technologists; 570 trades; and almost 1,000 construction and other trades helpers and labourers.

Comparison of Labour Demand and Supply for Baseline Activity and WWRP Construction

The comparison of labour demand and supply for Baseline Activity and WWRP Construction indicates there are a small number of potential labour shortages. However, it is expected the shortages for NOC 0211 Engineering managers, NOC 0711 Construction managers, NOC 2131 Civil engineers and NOC 2145 Petroleum engineers are likely to be addressed through companies' internal professional development activities and will be filled by personnel from within the companies' resources or through recruitment. While a small shortage of NOC 2253 Drafting technologists and technicians is indicated at peak, in practice these positions are also often filled by other related occupations including technologists and technicians in the disciplines of civil, mechanical and electrical and electronics engineering and therefore a shortage is not expected.

In general, study participants indicated they did not expect a labour shortage to be experienced during the WWRP construction. Since the workforce requirement for the WWRP is similar to, but smaller and of shorter duration than the requirement for the Hebron project supply shortages were not anticipated. Potential shortfalls of ironworkers (113), pipefitters (a small number), and carpenters (250) were identified.

Scenarios

In scenario 1 the wellhead platform operations commence and the rig count is reduced by one. While the two events are separated by some time, the net effect on the labour force is lessened. The net effect is an increase of 90 from the Baseline Activity total of 4,590 to 4,680 positions. The most notable changes in the occupational demand are the increase in NOC 8232 Oil and gas well drillers, servicers, testers and related workers and the reduction in marine occupations as fewer support vessels are required (NOC 2773 Deck officers, NOC 2774 Engineer officers, and NOC 7532 Water transport deck and engine room crew).

Scenario 2 reflects the effect of a further decline in the number of operating rigs to zero. For purposes of this analysis it is assumed that the rig count is reduced by two rigs in 2022 as the effect of the departure of the rig is the same in the scenario regardless of the year in which it occurs. As Table 4 demonstrates, the result is an employment reduction of approximately 400 positions from the Baseline Activity, primarily in the semi-submersible crew, drilling and well services, support vessel, and helicopter transportation requirements.

Total employment for the offshore oil and gas activity in Scenario 2 is approximately 4,200. Supply shortages are not expected as a result of the activity in Scenario 2. Shortfalls that are evident are the same as those in Baseline Activity and are related to replacement demand.

In the medium scenario, Scenario 3, during the period 2023 – 2027 the Baseline Activity of the oil and gas industry continues with the four existing production facilities and two drill rigs, and the West White Rose wellhead platform commences operations with first oil in 2022.

The effect of this scenario is an increase in occupational demand for the wellhead platform operations and its assigned support vessels, etc. Total employment for Scenario 3 is estimated at 5,100, an increase of approximately 525 positions from Baseline Activity arising from the addition of the wellhead platform. As shown in Table 4, increased activity in production, marine vessel support, and drilling and well services results in an increase in demand across a number of occupations.

In scenario 4, during the period 2023 – 2027 the oil and gas activity increases from the base of four facilities, the WWR wellhead platform and two rigs, to an additional rig bringing the count to three rigs and two or three subsea tiebacks under development. Total employment is estimated at approximately 5,600 for the steady state operations. For purposes of this scenario estimated occupational demand is provided separately for one subsea tieback (it is considered unlikely that two tiebacks would be developed at the same time) a model which can be applied to multiple tiebacks. As shown in Table 9 the total peak occupational demand for one tieback is 328 across 16 occupations and an aggregated group of occupations.

In scenario 5, the number of facilities increases from four to five, the WWR wellhead platform is in operation, three or four tiebacks are in production and four rigs are drilling development

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wells, or undertaking subsea and exploration activity. The change in steady state operations from Baseline Activity to Scenario 5 is approximately 2,100 positions.

Labour Demand and Supply

Table 1 provides a summary of the labour supply shortfalls in each scenario by occupation. Sixteen occupations had some level of labour supply shortage in one or more of the scenarios. (Note in Table 1 the acronym WHP is Wellhead Platform.)

Table 1 – Potential Labour Supply Shortfalls by Scenario (including occupational attrition)

NOC Code	NOC Description	Baseline Activity (2018)	Scenario 1 (2023)	Scenario 2 (2023)	Scenario 3 (2023)	Scenario 4 (2024)	Scenario 5 (2024)
		4 facilities 1 WHP (Constrn) 2 rigs	4 facilities 1 WHP (Prodn) 1 rig	4 facilities 1 WHP (Prodn) 0 rigs	4 facilities 1 WHP (Prodn) 2 rigs	4 facilities 1 WHP (Prodn) 3 rigs 1 subsea tieback under dev (applicable to multiple tiebacks)	5 facilities 1 WHP (Prodn) 4 rigs 3 or 4 tiebacks in prodn
0211	Engineering managers	(x)	(x)			-20	-36
0711	Construction managers	(x)	(x)			-97	-95
2131	Civil engineers	-99				-14	
2145	Petroleum engineers	(x)	-28		-48	-71	-136
2231	Civil engineering technologists and technicians	-14					
2241	Electrical and electronics engineering technologists and technicians		-47			-82	-95
2253	Drafting technologists and technicians	-48	-12			-19	
2263	Inspectors in public and environmental health and occupational health and safety		-75		(x)	-136	(x)
2273	Deck officers, water transport				-12	-42	-117
2274	Engineer officers, water transport				-8	-33	-95
6322	Cooks						-34
7236	Ironworkers	-113				-50	
7246	Telecommunications installation and repair workers		-12			-13	-23
7252	Steamfitters, pipefitters and sprinkler system installers	(x)					
7271	Carpenters	-205					

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NOC Code	NOC Description	Baseline Activity (2018)	Scenario 1 (2023)	Scenario 2 (2023)	Scenario 3 (2023)	Scenario 4 (2024)	Scenario 5 (2024)
		7611	Construction trades helpers and labourers	<ul style="list-style-type: none"> • 4 facilities • 1 WHP (Constrn) • 2 rigs 	<ul style="list-style-type: none"> • 4 facilities • 1 WHP (Prodn) • 1 rig 	<ul style="list-style-type: none"> • 4 facilities • 1 WHP (Prodn) • 0 rigs 	<ul style="list-style-type: none"> • 4 facilities • 1 WHP (Prodn) • 2 rigs

(Please note that NOC demand information that was provided in a group or was not provided as it was 10 or less is indicated by x in the table.)

Across the occupational shortfalls these explanations apply:

- NOC 0211 Engineering managers and NOC 0711 Construction managers

While Engineering Managers and Construction Managers are potential shortfall occupations, these are positions requiring years of experience. In addition, the qualifications for both include an engineering background, although Construction Managers may be drawn from a construction diploma program. Both Engineering Managers and Construction Managers are likely to be part of companies' professional development activities and promotion through supervisory and management positions.

- NOC 2131 Civil engineers and NOC 2145 Petroleum engineers

Several scenarios forecast a shortage of Civil Engineers and/or a shortage of Petroleum Engineers. However, industry representatives have indicated during interviews and at the Consultation Forum on June 13, 2018 that their hiring practices do not place significant weight on specific engineering disciplines. Instead, companies tend to identify and hire engineers from across the disciplines and provide them with specialized add-on training and on-the-job experience related to their positions. In addition, many of these positions require years of experience and are likely to be filled by personnel from within the companies' resources or through recruitment.

- NOC 2253 Drafting technologists and technicians

While small shortages of drafting technicians and technologies is indicated in several scenarios, in practice these positions are also filled by other related occupations including civil engineering technologists and technicians, mechanical engineering technologists and technicians and electrical and electronics engineering technologists and technicians. Some employers indicated the engineering technologist and technician programs provide a background that can be applied interchangeably to many positions

in the industry. In addition, this occupational requirement peaked in 2018 and no study participants indicated difficulty recruiting for it.

- NOC 2273 Deck officers, water transport and NOC 2274 Engineer officers, water transport

The longstanding, worldwide shortage of ships' officers (deck and engineering) is well-documented. The most recent of the BIMCO/ICS five-year updates published in 2016, *Manpower Report: The global supply and demand for seafarers in 2015*, estimated a 2015 global shortage of about 16,500 ships' officers and projected that over the next ten years the shortage in the supply of officers will continue.

Scenarios 3, 4, and 5 assume an expansion in offshore activity that would require an increase in the number of vessels supporting the activity and would result in a shortfall of deck officers, and engineering officers. An expansion in activity could further aggravate the situation by increasing the number of mariners leaving at-sea positions to take shore-based positions.

- NOC 6322 Cooks

Marine cooks were identified as difficult to recruit. Officials of post-secondary training institutions reported high demand for graduates of nine-month pre-employment cooking programs. Marine cooks, in particular, appear to be in short supply and some companies recruit them directly from training programs before they graduate. In the high scenario, scenario 5, cooks appear as a shortage.

Several occupational shortfalls were forecast during the WWR construction project peak activity: NOC 7236 Ironworkers, NOC 7252 Steamfitters/Pipefitters and NOC 7271 Carpenters.

- NOC 7236 Ironworkers

A shortfall of 113 ironworkers is forecast at peak. This shortage relates to the construction project and is of short duration.

- NOC 7252 Steamfitters/Pipefitters

A small shortfall of pipefitters is forecast at peak.

- NOC 7271 Carpenters

While a shortage of 205 carpenters is projected, with reduced activity in both residential and industrial construction, a shortage of carpenters is not anticipated.

- NOC 7611 Construction trades helpers and labourers

In general, the employment requirements for Construction trades helpers and labourers do not include post-secondary education. However, included in this group are riggers and scaffolders and these positions do have post-secondary requirements. Scaffolders is a specific position within NOC 7611 which does require completion of post-secondary training. Rigger is a NOC 7371 Crane operator position. However, some study participants indicated a combined scaffolders/riggers requirement; consequently, where both scaffolders/riggers were identified they were included in NOC 7611 for the purposes of this study. The NOC 7611 shortage arises from demand in the scenario 1 for approximately 80 scaffolder/riggers. The retirements and deaths (R&D) calculation is based on the workforce for NOC 7611 Construction trades helpers and labourers which included a total of 5,530 workers in the Census 2016 data. There is no information available to indicate how many of these are scaffolders. There was no indication from the study participant interviews that a shortage of scaffolders and riggers was expected.

For several occupations, shortfalls are due to attrition (i.e., the number of post-secondary graduates is less than the projected attrition (retirements and deaths)):

- NOC 2241 – Electrical and electronics engineering technologists and technicians
- NOC 2263 – Inspectors in public and environmental health and occupational health and safety
- NOC 7246 – Telecommunications installation and repair workers.

1.2 Difficult to Recruit

Study participants were asked to identify positions for which they had difficulty recruiting. In this study difficulty recruiting was signified most often by receipt of small numbers of resumes from applicants possessing the required qualifications for the positions identified. Other indications of difficulty in recruiting such as extended recruitment periods, were not identified as a concern.

Recruitment difficulties were identified primarily in drilling and well services, and in marine transportation. Approximately 30 positions were identified as difficult to recruit:

1. Drilling - Experienced personnel for drilling positions
 - Drillers and Toolpushers for Mobile Offshore Drilling Units (MODUs)
 - Crane Operators with experience on a moving platform and a valid Stage 3 Offshore Crane Operator Assessment
 - Marine Electricians
 - Mechanics (Hydraulic Technicians) with offshore experience
 - Instrumentation/Electronics Technicians with offshore experience
 - Drilling Supervisor and Superintendent with 5 to 10 years' experience

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2. Well Services
 - Well services offshore supervisory positions (e.g., slickline, drilling fluids)
 - Wireline and slickline positions with required experience on specialized equipment
 - Environmental Solutions Specialists and Drilling Fluids Specialists are expected to be more difficult to recruit with increased activity in the industry
3. Other offshore positions
 - Ice Observers – seasonality of the positions contributes to difficulty in recruitment and retention
 - Maintenance and repair positions for specialized equipment which are required on an irregular, short-term basis
4. Ad hoc positions – retention of experienced personnel in ad hoc positions is challenging
5. Marine
 - Captain/Master Mariner with offshore oil and gas industry experience
 - Deck Officers
 - Chief Engineers
 - Second Class Marine Engineers
 - Third Class Marine Engineers with hydraulic and drilling equipment experience
 - Marine Electricians
 - Marine Cooks.
6. Engineering Design and Fabrication
 - Design Engineers with 5 to 10 years' experience
 - Mechanical Engineers with 10 to 15 years' of asset integrity experience
 - Piping Engineers – mechanical engineers with piping experience
 - Non-destructive testing (NDT) technicians with Magnetic Particle Inspection (MPI), Liquid Penetration Inspection (LPI) and Radiographic and Ultrasonic Weld Inspection certification
 - Lifting Inspectors/Technicians.
7. Other Positions
 - Offshore Installation Manager (OIM)
 - Marine Geologist with 5 to 10 years' experience
 - Aircraft Maintenance Engineering Technician (an international shortage)
 - Bird Biologist at the masters level with greater than 5 years' experience.

The primary reasons indicated for difficulty in recruitment are: senior positions require years of industry experience; some positions require specialized experience with specific equipment; some occupations/positions are in high demand internationally; some occupations/positions have a limited occupational supply; certain occupations require years of experience and training to gain the required certifications; and/or some occupations will be in demand internationally when the industry rebounds.

1.3 Potential Impacts on Occupational Demand and Supply

When asked to identify oil and gas activities that would strengthen occupational demand, study participants identified: new exploration activity; West White Rose Project construction and operations; Bay du Nord development; a significant new oil find that couldn't be tied into an existing platform or FPSO; exploration in the Labrador South Region; and technology requirements.

When asked to identify oil and gas activities that could weaken occupational supply, study participants identified: rebound in global oil and gas production which would likely result in the return of many foreign workers and former Newfoundland and Labrador expatriates to international employment; increased oil and gas activity in Western Canada; increased oil and gas activity in Nova Scotia.

1.4 Conclusions and Recommendations

1.4.1 Conclusions

Labour Demand

- The provincial government's Budget 2018 document, *Building for our Future*, projected that "labour market indicators are expected to remain weak for several years beyond 2018..." (Government of Newfoundland and Labrador, 2018a). This is attributable primarily to lower construction activity with several major development projects ramping down. Many study participants indicated that the recent (June 2017) completion of the Hebron construction project, which employed more than 7,500 personnel during peak construction, together with the completion or near completion of other large projects unrelated to the oil and gas industry, meant that an experienced workforce will be available for the smaller White Rose project. Since the workforce requirement for the WWRP will be similar to, but smaller and of shorter duration than the requirement for the Hebron project, occupational supply shortages were not anticipated.
- While potential labour shortages were identified in a small number of occupations, it is important to note that the labour demand and supply model for construction takes into account peak occupational demand in the peak year of activity, and as this is a relatively short project the duration of the peaks is often short. In addition, the peak year for the WWRP was 2018 and this peak demand has essentially been concluded.
- Some study participants pointed out that the experience and knowledge gained during design and construction work that transfers with personnel moving from construction into operations is beneficial to the operations throughout the life of the asset.

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- The Canadian Occupational Projection System (COPS) attrition rates for retirements and deaths by occupation is provided at the national level; it is not available on a provincial level. Differences in national and provincial labour force age demographics could cause underestimation of attrition (retirements and deaths) replacement demand in some occupations.

Labour Supply

- The diversity of position titles, position descriptions, and position employment requirements in the oil and gas industry makes occupational classification and mapping to NOC codes challenging and, in some cases, the assignment of positions to NOC codes may be somewhat subjective.
- Post-secondary institutions indicated difficulty projecting the number of graduates from each of their identified offerings for five years or ten years citing factors such as the uncertainty of demand, government funding priorities, and the need to be responsive to several other labour market variables.
- A number of study participants indicated that relevant post-secondary programs provided appropriate entry-level knowledge and skills. Some forum participants indicated that accredited add-on courses would be beneficial for some offshore occupations requiring higher levels of specialization.
- Several oil and gas career websites were identified and used during the course of the study – PetroLMI; Offshore Petroleum Industry Training Organization (OPITO) – that could be useful sources of career information to supplement local career information sources such as PIHRC and COMPASS.

Difficult to Recruit Positions

- Study participants identified approximately 30 positions as difficult to recruit, primarily in drilling, well services, other offshore occupations, ad hoc occupations, marine transportation, and engineering design and fabrication. Many of these positions are difficult to recruit because of experience requirements, others because of shortages on an international basis. From a skills perspective, anchor handling for deck/bridge officers and deckhands, and dynamic positioning certification and experience for ships' officers were identified.
- Forum participants pointed to the patterns of human resources mobility within the industry with experienced employees moving from ad hoc positions and from positions on MODUs to longer term employment opportunities on production facilities; senior personnel moving to international positions in a tighter labour market.

- With new demand such as positions on additional facilities or rigs it is anticipated that lateral movement will occur in some positions. Forum participants indicated ad hoc offshore, drilling and senior operations positions may be affected as the long-term positions on a fixed drilling facility will be attractive.
- Two factors identified as affecting difficult to recruit positions were loss of personnel to longer term positions on production facilities and anticipated loss of former expatriates when the international market improves.
- Any expansion in offshore activity that would require an increase in the number of vessels supporting the activity would exacerbate the shortage of deck officers, engineering officers, and marine cooks. An expansion in activity could further aggravate the situation by increasing the number of mariners leaving at-sea positions to take shore-based positions.
- Difficulty in recruiting marine engineers is expected to ease with the implementation of the proposed amendment to the Marine Personnel Regulations (MPR) to adopt a three-certificate model for marine engineers (Chief Engineer, Second Engineer, and Watchkeeping Engineer) to replace the current four-certificate program. The proposed regulatory amendment, scheduled for implementation during the summer of 2019, is expected to enhance the progression of junior marine engineers to higher-level certification (Transport Canada Marine Safety Division, 2017).
- Supervisory positions that require 5 to 10 years of experience are difficult to recruit locally. The general practice in the past has been to bring in outside personnel on a contractual basis. It has been difficult to replace these with residents of Newfoundland and Labrador because of the experience requirement. However, some operators have begun to develop their own resources to prepare personnel for positions such as Drilling Supervisor (Offshore) and Superintendent (Onshore). Personnel in these positions generally have a technology or engineering background.
- Some study participants noted that as skilled, experienced personnel who developed their capabilities on the job retire, the regulatory expectation seems to be that they be replaced with personnel who have certification and experience.

Automation, Robotics and Digitalization

- Current research and relevant studies indicate that automation, robotics, and digitalization will ultimately have a significant impact on employment requirements and workforce skill requirements in the oil and gas industry, both globally and locally.
- Study participants did not provide substantive or detailed projections of the impact of technology, specifically digitalization on local operations or timelines for anticipated changes in workforce skill requirements.

1.4.2 Recommendations

- Consideration should be given to ways to maximize the potential for transferring workforce experience gained during facilities design and construction phases of offshore facilities projects to the facilities' operations phase.
- Consideration should be given to establishing a mechanism to facilitate more consistent position titles and basic job descriptions across the oil and gas industry and enhance consistent mapping of oil and gas industry positions to NOC codes.
- Consideration should be given to establishing an ongoing industry-government-educational mechanism to track/project future workforce skills requirements and develop plans to meet evolving needs.
- Consideration should be given to the potential for local oil and gas and marine transportation career information websites to link with relevant national and international websites providing similar information and career services.
- Consideration should be given to developing initiatives to retain difficult to recruit capabilities in the face of national and international competition as labour market conditions change.
- Consideration should be given to exploring joint oil and gas industry stakeholder initiatives to enhance awareness of the anticipated impacts of automation, robotics, and digitalization on current and future workforce capabilities and requirements and their probable timelines in order to enable industry and post-secondary providers to assess and prepare for them.

2. Introduction

The Petroleum Industry Human Resources Committee (PIHRC) engaged Strategic Directions Inc. to provide a comprehensive, detailed view of the current and future labour force needs for the exploration, construction, commissioning, and production phases of the Newfoundland and Labrador upstream oil and gas industry. The Request for Proposals (RFP) for the Newfoundland and Labrador Oil and Gas Industry Human Resources Skills Gap Analysis outlined a Scope of Work requiring development of an employment forecast for offshore oil and gas industry activities based on three potential scenarios and the projection of workforce supply based on the potential supply of workers from current post-secondary training programs in Newfoundland and Labrador.

The primary objectives of the study were to develop an employment forecast for the province's offshore oil and gas industry for identified occupations over the 2018-2022 and 2023-2027 timeframes on the basis of three potential level-of-activity scenarios; to examine the potential supply of workers from current post-secondary offerings for the same timeframes; to complete a skills gap analysis for those occupations; and to identify workforce occupational areas, including difficult to recruit occupations, needing attention.

The study identifies any gaps in workforce availability and identifies areas where emphasis and resources should be applied in the areas of employment, skill, competency development, education, and training. The timeframe for forecasting is near future (up to 5 years) and longer term (5 – 10 years).

3. Methodology

3.1 Identifying and Classifying Industry Occupations

The PIHRC Skills Gap Analysis Sub-Committee provided a list of 245 position titles for the exploration and production phases. For the construction phase positions were drawn from various published sources. Other positions identified during industry interviews were added to these lists as they were identified. Positions were classified by occupation in accordance with National Occupational Classification (NOC) codes <http://noc.esdc.gc.ca/English/NOC/welcome.aspx?ver=16> and grouped accordingly. NOC assignments were also aligned with the oil and gas industry career progression information available on the PIHRC website <http://www.oilandgascareerinfo.ca/careers/career-infographics/> and with the NOC assignments used in the following studies where appropriate:

- *Labour Market Assessment of the Offshore Oil and Gas Industry Supply and Service Sector in Newfoundland and Labrador*, Strategic Directions Inc., 2003
- *Estimation of Direct Human Resource Requirements Offshore Exploration and Production Newfoundland and Nova Scotia 2000 – 2010*, CAPP, 1999

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- *Future Human Resources Development in British Columbia's Offshore Oil & Gas Industry*, BC Innovation Council, 2004
http://www.empr.gov.bc.ca/Mining/Geoscience/MapPlace/thematicmaps/OffshoreMapGallery/Documents/Innovation_Human_Development_June2004.pdf
- *Labour Market Outlook 2017 to 2021: Canada's Oil and Gas Industry*, PetrolMI/Enform, 2017 https://careers-oil-gas.s3.amazonaws.com/publications/20/en/CanadaWideReport_final.pdf

NOC assignments also included consideration of the occupational requirements stated in the Atlantic Canada Offshore Petroleum Training and Qualifications Committee, Atlantic Canada Offshore Petroleum Standard Practice for the Training and Qualifications of Offshore Personnel, November 2017 www.capp.ca/initiatives/atlantic-canada-offshore.

3.2 Determining Industry Occupational Demand

Interviews with oil and gas industry representatives and major suppliers were conducted between November 2017 and June 2018. A key participant interview guide was used to conduct the interviews and study participants were also asked to complete the employment matrix (see Appendix A) which identified position titles. As indicated in section 2.1, these position titles were then categorized as per the National Occupational Classification (NOC) 2016. The data were aggregated (combined) and have not been attributed. As required by the study scope the scenario-based forecasted workforce demand for all occupations has been included in the study.

3.3 Identifying Occupations for Labour Supply Projections

Occupations to be included in the post-secondary supply projections were identified on the basis of employment requirements indicated by industry participants and by the occupational Employment Requirements specified in the National Occupational Classification (NOC) codes, cross referenced with position titles and employment requirements. Labour supply projections are provided for those occupations requiring post-secondary education. These supply projections are based on graduate information provided by the province's post-secondary institutions.

Positions which do not require the completion of post-secondary programs are not included in the workforce supply analysis. Positions such as roustabouts, certain technical and supervisory positions, and general labourers require completion of secondary school, previous work experience and /or on-the-job training.

3.4 Identifying Post-Secondary Supply Sources

The program and course offerings of the province's public post-secondary institutions, Memorial University and the College of the North Atlantic, and all private post-secondary institutions in the province were reviewed to identify potential supply programs and courses for the 245

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positions identified at the beginning of the project. The information collected was also applicable/relevant to other positions identified through the course of the project. Program and course offerings related to oil and gas industry occupations were identified at the three campuses of Memorial University, at 16 campuses of the College of the North Atlantic, and at 12 of the province's private post-secondary institutions comprising 19 campuses.

3.4.1 Surveying Private Colleges

A survey instrument was developed to gather information on the private colleges' program and course offerings related to the offshore oil and gas industry. The colleges were asked to provide graduation data for identified offerings; to identify and provide graduation data for other program and course offerings they considered to be related to the offshore oil and gas industry; to identify new or projected related offerings; and to identify related offerings that had been, or were projected to be, discontinued.

The colleges were advised that the information they provided would be managed in a confidential manner and analyzed and reported on a consolidated basis, and that only aggregate data would be included in the report. The survey of private colleges, initiated on December 11, 2017, was completed on March 12, 2018.

3.4.2 Surveying the College of the North Atlantic

The College of the North Atlantic (CNA) provided graduation data for a range of offerings at various campuses in Human Resources Management, Accounting/Business Management, Office Administration/Secretarial, and Computers and Information Technology, as well as a number of programs in Engineering & Related Technologies; Trades, Construction & Repair/Transportation and Heavy Equipment; and Food & Nutrition/Health Care and Related.

3.4.3 Surveying Memorial University

Memorial University's Fact Book 2016 and Fact Book 2017, which provide comprehensive student profiles including graduation statistics for current and previous years, were used to compile 2012-2017 data on relevant degree programs offered by Memorial, including the Grenfell Campus and the Fisheries and Marine Institute. The Faculty of Engineering and the Marine Institute of Memorial University were also consulted to obtain more detailed information and gain greater insight into enrolment trends and projections, program changes, future curriculum directions, emerging and declining programs, and other relevant information. In addition to the data collected from the MUN Fact Books relating to its degree programs, the Marine Institute also provided graduation data specific to a number of diploma of technology programs and three certificate programs. The Marine Institute's Bachelor of Maritime Studies and Bachelor of Technology programs were not included in post-secondary supply since graduates of these programs would have been previous graduates of diploma of technology programs, including those offered by the Marine Institute and the College of the North Atlantic, and most would already have been counted among the diploma program graduates.

3.5 Establishing Baseline Supply

Baseline occupational supply was established for the workforce projection starting point (2018). Census 2016 identified the number of workers in the province at the Census date (May 2016) for each occupation (NOC code); it also specified the number of workers in the occupation who were employed and the number who were unemployed at that time. For each occupation, the post-secondary supply for 2016 and 2017 were combined and then adjusted for annual attrition by applying the Canadian Occupational Projection System (COPS) projected retirement and death rates to determine the NOC's estimated available labour force at the beginning of 2018.

It should be noted that at the time the College of the North Atlantic (CNA) survey was completed (January 2018), graduation results for 2017 were not yet available. CNA graduate numbers for 2017 were estimated.

3.6 Projecting Post-Secondary Supply

The post-secondary institutions were asked to project the number of graduates from each of their identified offerings for the five-year timeframes 2018-2022 and 2023-2027. Most indicated difficulty projecting the number of graduates for five years or ten years, citing factors such as the uncertainty of demand, government funding priorities, and the need to be responsive to several other labour market variables. Where projected graduation numbers were provided, they were used in the calculation of labour supply projections. Otherwise, projected graduation numbers were based primarily on multiples of the average annual graduation rates for the most recent years for which graduation data were available. Since it was anticipated that graduation data for 2017 might not be available for all post-secondary offerings before data collection was completed, the six-year 2012-2017 timeframe was selected to ensure averages would be based on a minimum of five years wherever possible.

3.7 Expanding and Validating Research Findings

Following completion of demand and supply data collection in early June 2018, a Human Resources Skills Gap Analysis Study Forum was conducted on June 13, 2018 to provide an opportunity for oil and gas stakeholders to validate and expand upon the research findings before final analysis and reporting. The half-day stakeholder consultation forum, held in St. John's, included participation by representatives of industry, private and public post-secondary institutions, and relevant government departments.

In addition to validating the primary research findings, the consultation forum participants provided valuable additional input and expanded insight into issues such as labour market factors, recruitment and retention, difficult to recruit positions, education and training, digitalization, and future workforce needs and outlooks. Participant input contributed significantly to the analysis of findings.

4. Methodology Limitations

4.1 Occupational Demand

The following limitations of the occupational demand methodology are noted:

- Assignment of some positions to NOC is subjective. Some of the position assignments were provided by industry; others were completed by the consultants on the basis of best available information.
- While numerous companies participated in the study, there were some gaps in the demand (employment) data. These gaps were addressed based on determining a generic or standardized allocation of positions.
- Demand estimates are based on the aggregated employment estimates by occupation provided by the study participants. This information captures a point in time and does not reflect any changes in the workforce after that period. At the Human Resources Skills Gap Analysis Study Forum held in June 2018, some participants indicated that the employment profile had already changed since the data collection period.

4.2 Occupational Supply Projections

The following limitations in occupational supply projections are noted:

- Changing economic conditions cause fluctuations in demand for trades training and make it unlikely that occupational supply projections based on average graduation numbers or average apprenticeship certifications in previous years will be reliable predictors of future enrolment and graduation for some trades, especially those that are highly sensitive to market conditions.
- Counting graduates of both entry-level courses and advanced level courses supplying apprenticeship trades could result in overestimating the available workforce for apprenticeship trades. Representatives of post-secondary institutions advised that many graduates of advanced level courses would almost certainly have been counted as graduates of previous entry level courses and including them could result in double counting. As a result, only graduates of entry-level trades courses were factored into supply projections. Since not all graduates of advanced level courses would have been included in entry-level courses within the project's timeframe, this could contribute to an underestimation of supply.
- In projecting future post-secondary supply from university degree programs, a factor similar to the caution regarding the potential for double counting in trades programs was identified. When baccalaureate and masters level programs in the same discipline

are offered by Memorial University, it may be that many students enrolled in a masters level program are graduates of the university's baccalaureate program in the same discipline. While the linkage is not as direct as it is for apprenticeship programs, counting the graduates of same-discipline baccalaureate and masters programs could create a probability of double counting significant enough to cause an overestimation of available supply. For this reason, for most of the relevant disciplines only graduates of the baccalaureate programs were factored into the calculation of projected supply. This may lead to underestimation of supply for some occupations, but it is likely to be far more moderate than the overestimation of supply that could result from counting graduates of both levels.

Memorial's Master of Environmental Science program which is primarily a stand-alone program drawing on a number of different disciplines and/or degree types, was also included as a potential supply program.

- The projected post-secondary graduate supply has not been adjusted for demand by other sectors of the economy. The actual proportion of the projected supply available to the oil and gas industry for a specific occupation at any given time will be impacted by the demand for that occupation by other sectors of the economy. Calculating accurate estimates of sector by sector occupational demand over five-year and ten-year timeframes would require extensive research beyond the scope of this study.

5. Provincial Labour Market

The provincial government's Budget 2018 document, *Building for our Future*, projected an overall decline in labour demand in the coming years. Employment in Newfoundland and Labrador averaged 224,100 in 2017, a decline of 8,500 or 3.7% from 2016. This was attributable primarily to lower construction activity on the Hebron, Muskrat Falls, and Long Harbour development projects. Total employment on these three projects decreased from approximately 15,000 in the second quarter of 2016 to 6,900 in the fourth quarter of 2017. The budget document projected a further 1% decline in employment in 2018, and workforce demand was forecast to remain weak for several years beyond 2018. (Government of Newfoundland and Labrador, 2018a).

Higher oil and iron ore production, new development activity on West White Rose, and resumption of the Voisey's Bay underground mine development were cited as projects expected to offset the declining labour force demand beyond 2018 to some extent. However, they are much smaller in scale and will not offset the total projected decline in demand. Overall, despite the fact that the 2017 labour force of 262,900 is forecast to decrease to 252,900 by 2022, labour supply is still expected to exceed demand during that period (Government of Newfoundland and Labrador, 2018a).

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Despite the projected general availability of talent, however, there are factors that will affect, or have the potential to affect, the workforce capabilities of the Newfoundland and Labrador oil and gas industry over the next ten years.

- Here, as elsewhere, the industry will be impacted by the “great crew change” (i.e., retiring baby boomers being replaced by new entrants), a demographic shift that will occur during the next ten years (Biscardini, Morrison, Branson, & Del Maestro, 2018, p. 9).
- New entrants, specifically young people at the beginning of their careers, will become the biggest single source of new labour supply for the Newfoundland and Labrador workforce over the next ten years. However, their numbers, averaging 5,000 annually, will be exceeded by labour market exits. By 2015, it was estimated that for every 100 new entrants to the workforce there were about 125 people exiting. This gap will continue to widen (Department of Advanced Education and Skills, n.d.). While the overall Newfoundland and Labrador workforce supply projections indicate adequate supply for many occupations, it is clear that equipping young talent to replace the experience, knowledge, and capabilities of the province’s retiring workers will need to be a priority.
- The downturn in oil prices in mid-2014 resulted in a reduction in the number of employees in many companies. Worker layoffs at that time have eliminated significant experience, knowledge, and skills from the industry. The high numbers of applications received in response to advertisements for vacant positions indicate that a significant number of workers are currently seeking to return to the industry, but much of the capability has undoubtedly been absorbed into other sectors of the economy, locally or elsewhere.
- A possible global increase in oil and gas production could impact the availability of specialized skill in the industry in Newfoundland and Labrador. Globally, oil and gas companies reduced capital expenditures by more than 40 percent between 2014 and 2016 and some 400,000 workers left the industry (Biscardini, Morrison, Branson, & Del Maestro, 2017). Now there are indications of a rebound that may become a reality sooner than many in the industry have anticipated. (Biscardini et al., 2018, p. 4).

It was noted by some participants during the Human Resources Skills Gap Analysis Forum in June 2018 that a rebound in global oil and gas production could affect the local availability of experienced personnel in areas such as drilling, marine, etc.

- Some industry participants engaged in the skills gap analysis project raised the declining population of the province as a labour force concern. In total, the province’s population of 20-34-year-olds, the primary workforce recruitment population, was projected to decline by more than 13,000 over the next ten years (Department of Finance, Government of Newfoundland and Labrador, 2017).

- Outmigration and out-of-province employment have been long-standing features of life for many residents of this province. In 2014, approximately 20,800 residents of Newfoundland and Labrador were employed in other parts of the country, representing about 8% of all wage-earning residents of the province and about 9% of the province's wages and salaries (Government of Newfoundland and Labrador, 2018a). Overall, outmigration and interprovincial employment are expected to remain stable in the short and medium term and should not exert a greater influence on workforce availability than at present (Government of Newfoundland and Labrador, 2018a).
- The high cost of living in Newfoundland and Labrador and more competitive remuneration and work rotation schedules offered nationally and internationally were cited by some study participants as factors making it challenging for the industry to recruit people from elsewhere to work in this province.

6. Labour (Occupational) Demand and Supply

6.1 Labour Demand and Supply

As noted previously, interviews with oil and gas industry representatives and major suppliers were conducted between November 2017 and June 2018. In most cases one interview was conducted per company; however, follow-up meetings were held with a number of companies to access additional data, and/or to review assumptions or data allocation.

More than 30 companies, representing as many as 40 companies (when groups of companies were considered) participated in the Human Resources Skills Gap Analysis Study. This included companies involved in the production, development, and exploration phases of the oil and gas industry and construction projects related to the oil and gas industry.

Study participants were asked to complete the Employment Matrix (see Appendix A) which provided a standard occupation list grouped by the following subsectors for *steady state operations* providing information for the workforce in the province only. While the initial intent was to collect the employment profile as full-time equivalent (FTE) most study participants indicated the FTE ratio was 1:1; in other words, a count. For ad hoc positions the study participants provided an equivalent to full-time count.

To ensure that a comprehensive employment profile was collected, participants were asked to review all the positions and to indicate which positions were utilized by their company. Many of the positions are utilized by more than one of the following subsectors:

- Project Operator
- Onshore Support
- Engineering, Design and Fabrication
- Marine Logistics and Transportation

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- Warehousing and Logistics
- Catering/Accommodations
- Well Services
- Offshore Operations, Maintenance and CAPEX
- Environmental Consulting
- Offshore/Marine Fabrication
- Specialty Services
- Drilling/Well Development
- Industrial Product Supplies.

6.2 Oil and Gas Industry Activity Scenarios

Table 2 identifies the scenarios developed in consultation with industry for the purposes of the Human Resources Skills Gap Analysis Study only. These scenarios are not in any way a forecast of potential oil and gas activity in Newfoundland and Labrador.

The three scenarios illustrate different levels of activity as defined in the Request for Proposals project scope of work: low (minimal, cautious levels of activity ongoing); medium (reasonable estimate of activity); and high (optimistic levels of activity).

Table 2 – Oil and Gas Activity Scenarios

Oil and Gas Activity Scenario	Current (2017 - 2022)	2023 - 2027	2023 - 2027
Low	Baseline (Current Status)	Scenario 1	Scenario 2
	4 facilities	4 facilities	4 facilities
	1 WHP (Construction)	1 WHP (Production)	1 WHP
	2 rigs	1 rig	0 rigs
Medium	Baseline (Current Status)	Scenario 3	
	4 facilities	4 facilities	
	1 WHP (Construction)	1 WHP (Production)	
	2 rigs	2 rigs	
High	Baseline (Current Status)	Scenario 4	Scenario 5
	4 facilities	4 facilities	5 facilities (includes deep water floater)

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Oil and Gas Activity Scenario	Current (2017 - 2022)	2023 - 2027	2023 - 2027
	1 WHP (Construction)	1 WHP (Production)	1 WHP
	2 rigs	3 rigs	4 rigs (development wells, subsea and exploration activity)
		2 or 3 Subsea tiebacks under development	3 or 4 tiebacks in production

Commissioning of the wellhead platform in the Baseline Activity and construction of the deep water FPSO (which was a separate scenario in the Medium activity scenario) were removed from the study scope by the PIHRC study subcommittee during the course of the project as the information was not available.

6.2.1 Baseline (Current Level of Activity) Oil and Gas Activity: 2018 - 2022

The current level of activity in the oil and gas industry in the province in 2017/2018 is the baseline information (starting point) for each of the low, medium and high scenarios for the five-year period 2018 - 2022. There are four production facilities operating, specifically Hibernia (Hibernia Management and Development Company Ltd.) and Hebron (ExxonMobil Canada Properties), Terra Nova FPSO (Suncor Energy), and SeaRose FPSO (Husky Energy). Two Mobile Offshore Drilling Units (MODUs) are under contract: the Barents (Transocean) to Suncor Energy and the Henry Goodrich (Transocean) to Husky Energy. The MODUs are performing exploration and delineation drilling. In addition, Husky Energy's West White Rose wellhead platform is under construction. The construction project commenced in 2017 and is scheduled to conclude in 2021 with first oil expected in 2022.

Demand – Baseline

Most of the demand information was provided by study participants on the basis of their demand (employment) profile at the time of collection within the data collection period (December 2017 to June 2018). The gaps in the demand (employment) data were addressed by using a generic or standardized allocation of positions based on best available information.

The total steady state labour demand (employment) for the four production facilities and the two rigs for the baseline activity was approximately 4,600. This is comparable to the 4,766 total direct employment reported by Suncor Energy (Terra Nova FPSO), Hibernia Management and Development Company Ltd. (Hibernia), ExxonMobil Canada Properties (Hebron), and Husky Energy (SeaRose) in their Canada-Newfoundland and Labrador Annual Benefits Reports for 2017, as shown in Table 3.

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Table 3 – NL Oil and Gas Industry Direct Employment in 2017

Companies	Direct Employment
Husky Energy (SeaRose)	1,161
Suncor Energy (Terra Nova FPSO)	1,116
Hibernia Management and Development Company Ltd. (Hibernia)	1,410
ExxonMobil Canada Properties (Hebron)	1,079
Total	4,766

Source: 2017 Annual Benefits Reports, C-NLOPB website

As Table 4 illustrates, senior and middle managers account for approximately 120 positions in the baseline activity, while financial, accounting, human resources, supply chain, purchasing, logistics, IT and administration account for more than 600 positions.

Geoscientists and oceanographers (NOC 2113) account for the majority of more than 100 positions, with meteorologist and climatologists (NOC 2114) and biologists and related scientists (NOC 2121) accounting for less than 10 positions each.

A total of approximately 370 engineers are part of the steady state workforce. These include:

- NOC 2131 Civil engineers
- NOC 2132 Mechanical engineers
- NOC 2133 Electrical and electronics engineers
- NOC 2134 Chemical engineers
- NOC 2141 Industrial and manufacturing engineers
- NOC 2142 Metallurgical and materials engineers
- NOC 2144 Geological Engineers
- NOC 2145 Petroleum engineers
- NOC 2148 Other professional engineers, n.e.c.

As noted previously, the assignment of engineers to NOCs is somewhat arbitrary as study participants indicated they recruit engineers in entry level positions without focusing on a specific engineering discipline and then support the engineers' professional development and job proficiency through training and internal assignments.

More than 600 technicians and technologists are part of the steady state workforce. These include:

- NOC 2211 Chemical technologists and technicians
- NOC 2212 Geological and mineral technologists and technicians
- NOC 2231 Civil engineering technologists and technicians
- NOC 2232 Mechanical engineering technologists and technicians

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- NOC 2233 Industrial engineering and manufacturing technologists and technicians
- NOC 2241 Electrical and electronics engineering technologists and technicians
- NOC 2243 Industrial instrument technicians and mechanics
- NOC 2244 Aircraft instrument, electrical and avionics mechanics, technicians and inspectors
- NOC 2253 Drafting technologists and technicians.

As noted previously some study participants indicated that they hire civil, mechanical, industrial and other engineering technologists and technicians with little emphasis on specific disciplines and support their professional development and job proficiency throughout their careers through training and internal assignments.

Baseline activity (steady state) trades employment includes:

- NOC 6322 Cooks
- NOC 7234 Boilermakers
- NOC 7237 Welders
- NOC 7242 Industrial electricians
- NOC 7252 Steamfitters/pipefitters
- NOC 7293 Insulators
- NOC 7311 Millwrights
- NOC 7371 Crane operators and other trades.

Baseline activity (steady state) marine occupations include:

- NOC 2273 Deck officers
- NOC 2274 Engineer officers
- NOC 7352 Deck and engineer room crew.

Baseline activity (steady state) oil and gas well drilling and services of approximately 670 employees include:

- NOC 8222 Contractors and supervisors, oil and gas drilling and services
- NOC 8232 Oil and gas well drillers, services, testers and related workers
- NOC 8412 Oil and gas well drilling and related workers and services operators
- NOC 8615 Oil and gas drilling, servicing and related labourers.

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Table 4 – Peak Labour Demand for Baseline Activity and Scenarios

NOC Code	NOC Description	Baseline Activity – 2017-2018	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Managers							
0016	Senior managers – construction, transportation, production and utilities	123	122	117	125	129	155
0111	Financial managers						
0112	Human resources managers						
0113	Purchasing managers						
0114	Other administrative services managers						
0211	Engineering managers	228	231	216	245	260	313
0212	Architecture and science managers						
0711	Construction managers						
0714	Facility operation and maintenance managers						
0731	Managers in transportation						
0811	Managers in natural resources production and fishing						
Financial, Accounting, Human Resources, Supply Chain, Purchasing, Logistics, Information Technology and Administration							
1111	Financial auditors and accountants	612	613	558	640	683	820
1121	Human resources professionals						
1122	Professional occupations in business management consulting						
1123	Professional occupations in advertising, marketing and public relations						
1211	Supervisors, general office and administrative support workers						

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NOC Code	NOC Description	Baseline Activity – 2017-2018	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
1215	Supervisors, supply chain, tracking and scheduling co-ordination occupations						
1221	Administrative officers						
1223	Human resources and recruitment officers						
1225	Purchasing agents and officers						
1241	Administrative assistants						
1253	Records management technicians						
1411	General office support workers						
1431	Accounting and related clerks						
1432	Payroll administrators						
1521	Shippers and receivers						
1522	Storekeepers and partpersons						
1523	Production logistics co-ordinators						
1525	Dispatchers						
1526	Transportation route and crew schedulers						
2171	Information systems analysts and consultants						
2172	Database analysts and data administrators						
9999	Admin, Finance, HR, etc.						
Natural Sciences							
2113	Geoscientists and oceanographers	105	118	108	120	125	151
2114	Meteorologists and climatologists						

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NOC Code	NOC Description	Baseline Activity – 2017-2018	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
2121	Biologists and related scientists						
Engineers							
	Total engineers	366	404	383	424	447	532
2131	Civil engineers	20	21	21	21	21	22
2132	Mechanical engineers	54	65	64	65	66	73
2133	Electrical and electronics engineers	30	32	32	32	32	37
2134	Chemical engineers	35	37	37	37	37	39
2141	Industrial and manufacturing engineers	28	30	29	30	32	37
2142	Metallurgical and materials engineers						
2144	Geological engineers						
2148	Other professional engineers, n.e.c.						
2145	Petroleum engineers	199	219	200	239	259	324
Technical Occupations							
2211	Chemical technologists and technicians	18	20	18	21	22	29
2212	Geological and mineral technologists and technicians	149	157	135	186	200	231
2231	Civil engineering technologists and technicians	48	46	44	49	53	55
2232	Mechanical engineering technologists and technicians	143	143	133	147	156	184
2233	Industrial engineering and manufacturing technologists and technicians	x	x	x	x	x	x
2234	Construction estimators	46	44	44	46	46	51

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NOC Code	NOC Description	Baseline Activity – 2017-2018	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
2241	Electrical and electronics engineering technologists and technicians	77	75	69	79	89	102
2243	Industrial instrument technicians and mechanics	105	121	104	126	140	167
2244	Aircraft instrument, electrical and avionics mechanics, technicians and inspectors						
2253	Drafting technologists and technicians	57	57	56	57	59	64
2255	Technical occupations in geomatics and meteorology	17	15	13	19	21	25
2261	Non-destructive testers and inspection technicians	60	70	70	70	70	85
2262	Engineering inspectors and regulatory officers	172	179	175	201	207	235
2263	Inspectors in public and environmental health and occupational health and safety						
Other Professional Occupations							
2271	Air pilots, flight engineers and flying instructors	58	56	47	65	73	92
3012	Registered nurses and registered psychiatric nurses						
4112	Lawyer						
Transportation Officers							
2273	Deck officers, water transport	210	202	170	234	266	341
2274	Engineer officers, water transport	165	160	130	190	220	282
Science Policy, Business Development and Technical Sales							
4161	Natural and applied science policy researchers, consultants and program officers	37	33	32	37	38	55
4163	Business development officers and marketing researchers and consultants						

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NOC Code	NOC Description	Baseline Activity – 2017-2018	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
6221	Technical sales specialists – wholesale trade						
Service Representatives and other customers and Personal Services Occupations							
6513	Food and beverage servers	141	133	119	147	162	199
6523	Airline ticket and service agents						
6541	Security guards and related security service occupations						
6741	Dry cleaning, laundry and related occupations						
Trades and Related Occupations							
6322	Cooks	114	107	95	119	131	165
7234	Boilermakers	x	x	x	x	x	x
7237	Welders and related machine operators	12	x	x	12	16	20
7242	Industrial electricians	37	45	41	49	53	66
7246	Telecommunications installation and repair workers	23	29	29	29	29	39
7252	Steamfitters, pipefitters and sprinkler system installers	x	x	x	x	x	x
7293	Insulators	36	36	36	36	36	37
7301	Contractors and supervisors, mechanic trades	x	x	x	x	x	x
7311	Construction millwrights and industrial mechanics	37	41	34	48	54	61
7315	Aircraft mechanics and aircraft inspectors	x	x	x	x	x	x
7371	Crane operators	56	56	48	64	74	91
7384	Other trades and related occupations, n.e.c.	120	114	103	123	136	152
Transport Occupations							

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NOC Code	NOC Description	Baseline Activity – 2017-2018	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
7532	Water transport deck and engine room crew	332	316	272	360	404	513
Trades Helpers, construction labourers and related occupations							
7611	Construction trades helpers and labourers	80	80	80	80	80	86
Other							
8222	Contractors and supervisors, oil and gas drilling and services	183	178	137	218	252	305
8232	Oil and gas well drillers, servicers, testers and related workers	122	164	140	178	202	229
8412	Oil and gas well drilling and related workers and services operators	177	187	155	223	250	300
8615	Oil and gas drilling, servicing and related labourers	120	112	80	144	176	208
9232	Central control and process operators, petroleum, gas and chemical processing	69	69	69	69	69	76
9536	Industrial painters, coaters and metal finishing process operators	53	54	54	54	54	59
8888	Other	x	x	x	x	x	x
Total		4,590	4,680	4,195	5,123	5,579	6,687

(Please note that numbers that are not reported or are 10 or less (indicated by x in the table) are not shown.)

6.2.2 Demand – WWRP Construction

The scope of work for the Human Resources Skills Gap Analysis Study included preparation of a labour demand and supply model for the West White Rose Project (WWRP) construction. Husky Energy participated in the study, providing information on the occupational demand for the WWRP, and encouraging the major contractors to participate as well. Only work to be completed in the province was included in the study's scope of work.

Many study participants indicated that the recent (June 2017) completion of the Hebron construction project, which employed more than 7,500 personnel during peak construction, and the completion or near completion of other large projects unrelated to the oil and gas industry

meant that an experienced workforce will be available for the smaller West White Rose project. Since the workforce requirement for the WWRP will be similar to, but smaller and of shorter duration than the Hebron project requirement, occupational supply shortages were not anticipated.

Some study participants noted the benefit previous projects have gained from the transition of project personnel such as engineers, engineering technologists and technicians, and others from the construction phase to the operations phase because of the depth of knowledge regarding the facilities they bring with them.

The estimated peak construction employment of 2,080 for the West White Rose Project (WWRP) wellhead platform, expected to occur in 2018, is illustrated in Table 5. A second peak in 2019 is expected to be slightly lower than the 2018 peak and there are some changes in the occupational peaks.

As Table 5 shows, the engineering workforce requirements include:

- NOC 2131 Civil engineers (103)
- NOC 2132 Mechanical engineers (69)
- NOC 2133 Electrical and electronic engineers, NOC 2134 Chemical engineers, NOC 2145 Petroleum engineers, NOC 2141 Industrial and manufacturing engineers, NOC 2142 Metallurgical and manufacturing engineers, 2144 Geological engineers and 2148 Other professional engineers, n.e.c. (in smaller numbers).

The workforce requirements for engineering technologists and technicians include NOC 2231 Civil engineering technologists and technicians (42) and smaller numbers of NOC 2232 Mechanical and engineering technologists and technicians and NOC 2241 Electrical and electronics engineering technologists and technicians. A total of 46 NOC 2253 Drafting technologist and technician positions were identified.

Trades workforce requirements include:

- NOC 7236 Ironworkers (127)
- NOC 7241 Electricians (45)
- NOC 7252 Steamfitters/Pipefitters (48)
- NOC 7271 Carpenters (205)
- NOC 7294 Painters and decorators (45)
- NOC 7311 Construction millwrights (30)
- NOC 7521 Heavy equipment operators (except crane) (72).

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Table 5 – Baseline Activity – Estimated Peak Project Employment for WWRP for Peak Year 2018

NOC Code	NOC Description	Total Number of Workers	
0111	Financial managers	60	
0113	Purchasing managers		
0213	Computer and information systems managers		
0211	Engineering managers		
0711	Construction managers		
0731	Managers in transportation		
0811	Managers in natural resources production and fishing		
1111	Financial auditors and accountants	94	
1121	Human resources professionals		
1122	Professional occupations in business management consulting		
1123	Professional occupations in advertising, marketing and public relations		
1221	Administrative officers		
1225	Purchasing agents and officers		
1241	Administrative assistants		
1253	Records management technicians		
1311	Accounting technicians and bookkeepers		
2171	Information systems analysts and consultants		
2172	Database analysts and data administrators		
2113	Geoscientists and oceanographers		x
2131	Civil engineers		103
2132	Mechanical engineers		69
2133	Electrical and electronics engineers	x	
2134	Chemical engineers	x	
2141	Industrial and manufacturing engineers	35	
2142	Metallurgical and materials engineers		
2144	Geological engineers		
2148	Other professional engineers, n.e.c.		
2145	Petroleum engineers	x	
2231	Civil engineering technologists and technicians	42	
2232	Mechanical engineering technologists and technicians	x	
2234	Construction estimators	16	
2241	Electrical and electronics engineering technologists and technicians	x	
2253	Drafting technologists and technicians	46	

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NOC Code	NOC Description	Total Number of Workers
2262	Engineering inspectors and regulatory officers	16
2263	Inspectors in public and environmental health and occupational health and safety	
2151	Architects	x
7201	Contractors and supervisors, machining, metal forming, shaping and erecting trades and related occupations	x
7233	Sheet metal workers	x
7236	Ironworkers	127
7241	Electricians (except industrial and power system)	45
7252	Steamfitters, pipefitters and sprinkler system installers	48
7271	Carpenters	205
7294	Painters and decorators (except interior decorators)	45
7311	Construction millwrights and industrial mechanics	30
7371	Crane operators	x
7521	Heavy equipment operators (except crane)	72
7611	Construction trades helpers and labourers	389
7612	Other trades helpers and labourers	596
Total		2,081

(Please note that numbers of 10 or less (indicated by x in the table) are not shown.)

6.3 Comparing Labour Demand and Supply

The methodology for comparing forecast occupational demand with post-secondary occupational supply is based on the methodology used in the *All the Skills to Succeed: Report of the Newfoundland and Labrador Skills Task Force*, March 2007 following discussions with the Department of Finance, Government of Newfoundland and Labrador. Occupational demand is based on the current estimated demand (Baseline Activity) for the production facilities and rigs operating offshore at present. Peak demand is shown for new activity such as the WWRP construction and/or changes in the number of production facilities and/or rigs as outlined in the various scenarios. As previously noted, for each occupation, the post-secondary supply for 2016 and 2017 was combined and then adjusted for annual attrition by applying the Canadian Occupational Projection System (COPS) projected retirement and death rates to determine the NOC's estimated available labour force at the beginning of 2018. It should be noted that the COPS attrition rates for retirements and deaths by occupation is provided at the national level; it is not available on a provincial level. Differences in national and provincial labour force age demographics could cause underestimation of attrition (retirements and deaths) replacement demand in some occupations.

Post-secondary Educational Qualifications

As noted previously, post-secondary programs which supply workforce for oil and gas industry occupations (NOCs) were identified and the province's post-secondary institutions (Memorial University, College of the North Atlantic and private colleges) offering those programs provided graduation data for the 2012-2017 timeframe.

In some cases, an occupation's workforce is supplied by a single program which is often a pre-requisite qualification for employment in the occupation. Where an occupation draws from only one post-secondary program that doesn't also supply other occupations, the graduates from that program are added to the workforce supply projection for the occupation and applied against the demand for specific projects and scenarios.

Some occupations (NOCs) draw from several post-secondary programs. In order to compare labour demand and supply for these, the occupations and the post-secondary programs supplying them were grouped. The post-secondary supplies were then allocated to occupations on the basis of their proportion of the workforce in the grouped NOCs. Labour shortages or surpluses were determined by comparing identified demands to allocated supplies. In some instances, occupations also draw supply from a broad group of programs not included in the groups. In these cases, supplies may be understated.

The focus of this Study was post-secondary supply. The demand and supply scenarios/analysis do not account for migration adjustments such as workers moving to or from the province and / or new graduates leaving the province or for the availability of unemployed workers in the province with the training required to work in these occupations in the province. These same assumptions were made by the *Skills Task Force* in 2007.

Other Qualifications

For many occupations (NOCs) the employment requirements include secondary school completion without a post-secondary requirement. Employers in the oil and gas industry often provide training programs such as competency programs designed to develop knowledge and skills in specific areas such as company specific tools and procedures. This approach encompasses many positions in the well services sector. Likewise, drilling services offer secondary school graduates an experience-based approach to career progression from entry level positions such as roustabout to senior drilling positions such as driller or toolpusher.

It should be noted that occupational shortfalls that are less than 10 at peak have not been included in the analysis/report.

Table 6 provides a summary of the labour supply shortfalls in each scenario by occupation. Sixteen occupations had some level of labour supply shortage in one or more of the scenarios. A separate table providing detailed information about the potential labour supply shortfalls is provided for each scenario.

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Table 6 – Potential Labour Supply Shortfalls by Scenario (including occupational attrition)

NOC Code	NOC Description	Baseline Activity (2018)	Scenario 1 (2022)	Scenario 2 (2022)	Scenario 3 (2022)	Scenario 4 (2024)	Scenario 5 (2024)
		<ul style="list-style-type: none"> • 4 facilities • 1 WHP (Constrn) • 2 rigs 	<ul style="list-style-type: none"> • 4 facilities • 1 WHP (Prodn) • 1 rig 	<ul style="list-style-type: none"> • 4 facilities • 1 WHP (Prodn) • 0 rigs 	<ul style="list-style-type: none"> • 4 facilities • 1 WHP (Prodn) • 2 rigs 	<ul style="list-style-type: none"> • 4 facilities • 1 WHP (Prodn) • 3 rigs • 1 subsea tieback under dev (applicable to multiple tiebacks) 	<ul style="list-style-type: none"> • 5 facilities • 1 WHP (Prodn) • 4 rigs • 3 or 4 tiebacks in
0211	Engineering managers	(x)	(x)			-20	-36
0711	Construction managers	(x)	(x)			-97	-95
2131	Civil engineers	-99				-14	
2145	Petroleum engineers	(x)	-28		-48	-71	-136
2231	Civil engineering technologists and technicians	-14					
2241	Electrical and electronics engineering technologists and technicians		-47			-82	-95
2253	Drafting technologists and technicians	-48	-12			-19	
2263	Inspectors in public and environmental health and occupational health and safety		-75		(x)	-136	(x)
2273	Deck officers, water transport				-12	-42	-117
2274	Engineer officers, water transport				-8	-33	-95
6322	Cooks						-34
7236	Ironworkers	-113				-50	
7246	Telecommunications installation and repair workers		-12			-13	-23
7252	Steamfitters, pipefitters and sprinkler system installers	(x)					
7271	Carpenters	-205					
7611	Construction trades helpers and labourers	-103					

(Please note that NOC demand information that was provided in a group or was not provided as it was 10 or less is indicated by x in the table.)

Labour Demand and Supply – Baseline Activity and WWRP Construction

The comparison of labour demand and supply for Baseline Activity and WWRP Construction indicates there are a small number of potential labour shortages. Study participants indicated they did not expect a labour shortage to be experienced during the WWR construction project.

Potential occupational shortfalls identified in Baseline Activity are presented in Table 7 - Labour Demand and Supply Analysis (Baseline Activity and WWRP Construction Project Combined).

As shown in Table 7, the potential shortfalls include:

- NOC 0211 Engineering managers and NOC 0711 Construction managers

While Engineering Managers and Construction Managers are potential shortfall occupations, these are positions requiring years of experience. In addition, the qualifications for both include an engineering background, although Construction Managers may be drawn from a construction diploma program. Both Engineering Managers and Construction Managers are likely to be part of companies' professional development activities and promotion through supervisory and management positions.

- NOC 2131 Civil engineers and NOC 2145 Petroleum engineers

A shortage of Civil Engineers (99) and a shortage of Petroleum Engineers are forecast. However, industry representatives have indicated during interviews and at the Consultation Forum on June 13, 2018 that their hiring practices do not place significant weight on specific engineering disciplines. Instead, companies tend to identify and hire engineers from across the disciplines and provide them with specialized add-on training and on-the-job experience related to their positions. In addition, many of these positions require years of experience and are likely to be filled by personnel from within the companies' resources or through recruitment.

- NOC 2253 Drafting technologists and technicians

While a small shortage of drafting technicians and technologies is indicated at peak, in practice these positions are also filled by other related occupations including civil engineering technologists and technicians, mechanical engineering technologists and technicians and electrical and electronics engineering technologists and technicians. Some employers indicated the engineering technologist and technician programs provide a background that can be applied interchangeably to many positions in the industry. In addition, this occupational requirement peaked in 2018 and no study participants indicated difficulty recruiting for it.

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- NOC 7236 Ironworkers

A shortfall of 113 ironworkers is forecast at peak. This shortage relates to the construction project and is of short duration.

- NOC 7252 Steamfitters/Pipefitters

A small shortfall of pipefitters is forecast at peak.

- NOC 7271 Carpenters

While a shortage of 205 carpenters is projected, with reduced activity in both residential and industrial construction, a shortage of carpenters is not anticipated.

- NOC 7611 Construction trades helpers and labourers

In general, the employment requirements for Construction trades helpers and labourers do not include post-secondary education. However, included in this group are riggers and scaffolding and these positions do have post-secondary requirements. Scaffolders is a specific position within NOC 7611 which does require completion of post-secondary training. Rigger is a NOC 7371 Crane operator position. However, some study participants indicated a combined scaffolders/riggers requirement; consequently, where both scaffolders/riggers were identified they were included in NOC 7611 for the purposes of this study. The NOC 7611 shortage arises from demand in the scenario for approximately 80 scaffolder/riggers. The retirements and deaths (R&D) calculation is based on the workforce for NOC 7611 Construction trades helpers and labourers which included a total of 5,530 workers in the Census 2016 data. There is no information available to indicate how many of these are scaffolders. There was no indication from the study participant interviews that a shortage of scaffolders and riggers was expected.

Occupations for which shortages are expected during the peak year of 2018 in Baseline Activity include several for which shortages are due to replacement demand. In other words, the projected number of post-secondary graduates is lower than the projected attrition (retirements and deaths). In Baseline Activity, shortages of less than 10 are forecast for NOC 6632 Cooks, NOC 7234 Boilermakers, and 7246 Telecommunications installation and repair workers, again as a result of the projected number of post-secondary graduates being lower than the projected attrition.

In general, study participants indicated that labour shortages were not expected during the West White Rose Project.

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Table 7 – Baseline Activity Labour Demand and Supply Analysis (Steady State and Wellhead Construction Project Combined)

NOC Code	NOC Description	Workforce (Census 2016)	Peak Demand (2018)	Demand Change	Grads (2016 - 2017)	R&Ds (2016 - 2017)	Grads less R&D's (2016 - 2017)	Shortfall at Peak (2018)
0211	Engineering managers	230	x	x	9	12	(3)	(x)
0711	Construction managers	1,035	x	x	50	67	(17)	(x)
2131	Civil engineers	915	123	103	44	40	4	(99)
2145	Petroleum engineers	425	x	x	17	18	(1)	(x)
2231	Civil engineering technologists and technicians	440	90	42	51	23	28	(14)
2253	Drafting technologists and technicians	255	103	46	x	x	(x)	(48)
7236	Ironworkers	940	127	127	39	25	14	(113)
7252	Steamfitters, pipefitters and sprinkler system installers	1,000	x	x	59	27	32	(x)
7271	Carpenters	4,365	205	205	161	161	x	(205)
7611	Construction trades helpers and labourers	5,530	469	389	x	x	x	(103)

(Please note that NOC demand information that was provided in a group or was not provided as it was 10 or less is indicated by x in the table.)

6.3.1 Low Scenario

In the low scenario, during the period 2023 – 2027, the wellhead platform has commenced production and the impacts of two different levels of semi-submersible rig activity are included: first the reduction of rig count to one and second, the further reduction of rig count to zero.

Scenario 1

Scenario 1 reflects two changes to the oil and gas industry depicted in Baseline Activity: the wellhead platform commences operations with first oil in 2022 and the rig count has been

reduced to one rig. For purposes of this analysis it is assumed that the rig count is reduced by one rig in 2022.

In this scenario the commencement of operations on the wellhead platform reduces the overall impact on the labour force by the departure of one rig. While the two events are separated by some time it is assumed for purposes of the study that the two events occur within 2022 and therefore the net effect on the labour force is lessened.

In Scenario 1 the total number of positions increases by 90 to 4,680 from the Baseline Activity total. The most notable changes in the occupational demand are the increase in NOC 8232 Oil and gas well drillers, servicers, testers and related workers and the reductions in marine occupations as fewer support vessels are required (NOC 2273 Deck officers, NOC 2774 Engineer officers, and NOC 7532 Water transport deck and engine room crew).

Scenario 1 – Labour Demand and Supply

Potential occupational shortfalls identified in Scenario 1 are presented in Table 8 - Scenario 1 Labour Demand and Supply Analysis.

As shown in Table 8, in Scenario 1, the occupations with potential shortfalls in the peak year of 2022 are:

- NOC 0211 Engineering managers and NOC 0711 Construction managers

While NOC 0211 Engineering managers and NOC 0711 Construction managers are potential shortfall occupations, these are positions requiring years of experience. In addition, the qualifications for both include an engineering background, although Construction Managers may be drawn from a construction diploma program. Both Engineering Managers and Construction Managers are likely to be part of companies' professional development activities and promotion through supervisory and management positions.

- NOC 2145 Petroleum Engineers

A shortage of 28 Petroleum Engineers is forecast. However, Industry representatives have indicated during interviews and at the Consultation Forum on June 13, 2018, that their hiring practices do not place significant weight on specific engineering disciplines. Instead, companies tend to identify and hire engineers from across the disciplines and provide them with specialized add-on training and on-the-job experience related to their positions.

- NOC 2253 Drafting Technologists and Technicians

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As noted previously, a shortfall is unlikely in the Drafting Technologists and Technicians occupation as these positions may also be filled by other related occupations including civil engineering technologists and technicians, mechanical engineering technologists and technicians and electrical and electronics engineering technologists and technicians.

Some industry representatives have reported a practice in the selection of engineering technologists and technicians similar to their practice in the selection of engineers i.e., their selection of engineering technologists and technicians is not driven by specific disciplines. The College of the North Atlantic and the Marine Institute of Memorial University together offer more than fifteen engineering technology/technician programs. Some industry personnel have indicated that graduates of technician and technologist programs such as mechanical, electrical, and industrial are well-prepared for entry-level roles in the industry in areas such as engineering design and fabrication, and others.

As in the Baseline Activity, in Scenario 1 there may be shortages in several occupations in 2022 because the projected number of post-secondary graduates is lower than the forecast attrition. These are:

- NOC 2241 Electrical and electronics engineering technologists and technicians (47)
- NOC 2253 Drafting technologists and technicians (12)
- NOC 2263 Inspectors in public and environmental health and occupational health and safety (75)
- NOC 7246 Telecommunications installation and repair workers (12).

Occupational shortfalls under 10 and any demand change related to a change in activity in the scenario that is under 10 are not included in the analysis.

Table 8 - Scenario 1 Labour Demand and Supply Analysis

NOC Code	NOC Description	Workforce (Census 2016)	Peak Demand (2022)	Demand Change	Grads (2016 - 2021)	R&Ds (2016 - 2021)	Grads less R&D's (2016 - 2021)	Shortfall at Peak (2022)
211	Engineering managers	230	x	x	27	39	-12	(x)
711	Construction managers	1,035	x	x	141	204	-63	(x)
2145	Petroleum engineers	425	219	20	50	58	-8	-28

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NOC Code	NOC Description	Workforce (Census 2016)	Peak Demand (2022)	Demand Change	Grads (2016 - 2021)	R&Ds (2016 - 2021)	Grads less R&D's (2016 - 2021)	Shortfall at Peak (2022)
2241	Electrical and electronics engineering technologists and technicians	865	75	-2	104	153	-49	-47
2253	Drafting technologists and technicians	255	57	x	x	x	(x)	-12
2263	Inspectors in public and environmental health and occupational health and safety	1,010	x	x	118	193	-75	-75
7246	Telecommunications installation and repair workers	300	29	6	36	42	-6	-12

(Please note that NOC demand information that was provided in a group is indicated by x in the table.)

Scenario 2

Scenario 2 reflects the effect of a further decline in the number of rigs operating to zero. For purposes of this analysis it is assumed that the rig count is reduced by two rigs in 2022 as the effect of the departure of the rig is the same in the scenario regardless of the year in which it occurs. As Table 4 demonstrates, the result is a decline in employment from the Baseline Activity by approximately 400 positions primarily in the semi-submersible crew, drilling and well services, support vessel, and helicopter transportation requirements. The affected occupations include:

- NOC 8222 Contractors and supervisors, oil and gas drilling and services
- NOC 8232 Oil and gas well drillers, servicers, testers and related workers
- NOC 8412 Oil and gas well drilling and related workers and services operators
- NOC 8615 Oil and gas drilling, servicing and related labourers
- NOC 2273 Deck officer, water transport
- NOC 2274 Engineer officers, water transport
- NOC 6322 Cooks
- NOC 7532 Water transport deck and engine room crew.

Total employment for the offshore oil and gas activity in Scenario 2 is approximately 4,200. Supply shortages are not expected as a result of the activity in Scenario 2. Shortfalls that are evident are the same as those in Baseline Activity and are related to replacement demand.

6.3.2 Medium Scenario

Demand

In the medium scenario, Scenario 3, during the period 2023 – 2027 the Baseline Activity of the oil and gas industry continues with the four existing production facilities and two drill rigs, and the West White Rose wellhead platform has commenced operations with first oil in 2022.

The effect of this scenario is an increase in occupational demand for the wellhead platform operations and its assigned support vessels, etc. Total employment for Scenario 3 is estimated at 5,100, an increase of approximately 525 positions from Baseline Activity arising from the addition of the wellhead platform. As shown in Table 4, increased activity in production, marine vessel support, and drilling and well services results in an increase in demand for the following occupations:

- NOC 2145 Petroleum engineers
- NOC 2212 Geological and mineral technologists and technicians
- NOC 2243 Industrial instrument technicians and mechanics/NOC 2244 Aircraft instrument, electrical and avionics mechanics, technicians and inspectors
- NOC 2262 Engineering inspectors and regulatory officers/NOC 2263 Inspectors in public and environmental health and occupational health and safety
- NOC 2273 Deck officers, water transport
- NOC 2274 Engineer officers, water transport
- NOC 7532 Water transport deck and engine room crew
- NOC 8222 Contractors and supervisors, oil and gas drilling and services
- NOC 8232 Oil and gas well drillers, servicers, testers and related workers
- NOC 8412 Oil and gas well drilling and related workers and service operators
- NOC 8615 Oil and gas drilling, servicing and related labourers.

Labour Demand and Supply – Scenario 3

Potential occupational shortfalls identified in Scenario 3 are presented in Table 9- Scenario 3 Labour Demand and Supply Analysis.

As shown in Table 9, in Scenario 3, the occupations with potential shortfalls in the peak year of 2022 are:

- NOC 2145 Petroleum engineers
- NOC 2263 Inspectors in public and environmental health and occupational health and safety
- NOC 2273 Deck officers, water transport
- NOC 2274 Engineer officers, water transport.

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Although the projected shortfall for NOC 2274 Engineer Officers, Water Transport is slightly lower than 10, it is included in the potential occupational shortages because this occupation has been identified as experiencing an international labour shortfall and study participants had indicated that Engineer Officers are difficult to recruit.

As with Baseline Activity, and Scenarios 1 and 2 several occupations have shortages arising primarily from replacement demand:

- NOC 0211 Engineering managers
- NOC 0711 Construction managers
- NOC 2241 Electrical and electronics engineering technologists and technicians
- NOC 2253 Drafting technologists and technicians
- NOC 7246 Telecommunications installation and repair workers.

Table 9 - Scenario 3 Labour Demand and Supply Analysis

NOC Code	NOC Description	Workforce (Census 2016)	Peak Demand (2022)	Demand Change	Grads (2016 - 2021)	R&Ds (2016-2021)	Grads less R&D's (2016 - 2021)	Shortfall at Peak (2022)
2145	Petroleum engineers	425	239	40	50	58	(8)	(48)
2263	Inspectors in public and environmental health and occupational health and safety	1,010	x	x	118	193	(75)	(x)
2273	Deck officers, water transport	705	234	24	141	129	12	(12)
2274	Engineer officers, water transport	485	190	25	106	89	17	(8)

(Please note that NOC demand information that was provided in a group is indicated by x in the table.)

The original scope of work for the study included a scenario which added the construction of a deep water FPSO. However, study participants did not provide a forecast of employment for construction of the facility as there is a high degree of uncertainty regarding the characteristics of the facility and what aspects of the construction would be completed in the province. Study participants provided an estimate of the occupations and the effect of a fifth facility in operation and this information has been included in Scenario 5.

6.3.3 High Scenario

Scenario 4

In the high scenario, Scenario 4, during the period 2023 – 2027 the oil and gas activity increases from the base of four facilities, the WWR wellhead platform and two rigs, to an additional rig bringing the count to three rigs and two or three subsea tiebacks under development. As shown in Table 4, total employment (excluding the subsea tiebacks development) is estimated at approximately 5,600 for the steady state operations.

The change in steady state operations was approximately 990 positions comprised primarily of:

- NOC 2113 Geoscientists and oceanographers
- NOC 2145 Petroleum engineers
- NOC 2212 Geological and mineral technologists and technicians
- NOC 2243 Industrial Instrument technicians and mechanics/2244 Aircraft instrument, electrical and avionics mechanics, technicians and inspectors
- NOC 2262 Engineering inspectors and regulatory officers/NOC 2263 Inspectors in public and environmental health and occupational health and safety
- NOC 2271 Air pilots. flight engineers and flying instructors, NOC 3012 Registered nurses and registered psychiatric nurses, 4112 Lawyer (group)
- NOC 2273 Deck officers, water transport
- NOC 2274 Engineer officers, water transport
- NOC 6322 Cooks
- NOC 7242 Industrial electricians
- NOC 7311 Construction millwrights and industrial mechanics
- NOC 7371 Crane operators
- NOC 7384 Other trades and related occupations, n.e.c.
- NOC 7532 Water transport deck and engine room crew
- NOC 8222 Contractors and supervisors, oil and gas drilling and services
- NOC 8232 Oil and gas well drillers, servicers, testers and related workers
- NOC 8412 Oil and gas well drilling and related workers and services operators
- NOC 8615 Oil and gas drilling, servicing and related labourers.

For purposes of this scenario estimated occupational demand is provided for one subsea tieback as a separate construction project. Study participants indicated it was unlikely that two subsea tiebacks would be undertaken concurrently. The generic model for the subsea tieback shown in Table 10 provides an estimate of the peak occupational demand requirement.

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Table 10 – Peak Estimated Peak Project Employment for Tieback Construction

NOC Code	NOC Description	Number of workers
0711	Construction managers	x
1241	Administrative assistants	x
2131	Civil engineers	x
2132	Mechanical engineers	x
2141	Industrial and manufacturing engineers	x
2233	Industrial engineering and manufacturing technologists and technicians	18
2234	Construction estimators	x
2252	Industrial designers	x
2263	Inspectors in public and environmental health and occupational health and safety	x
2253	Drafting Technologists and Technicians	x
7236	Ironworkers	106
7252	Steamfitters, pipefitters and sprinkler system installers	31
7293	Insulators	24
7311	Construction millwrights and industrial mechanics	19
7371	Crane operators, Rigger	27
7611	Construction trades helpers and labourers	18
7777	Other construction labour (offshore)	41
Total		328

Peak Occupational Demand - please note that numbers less than 10 (indicated by x in the table) are not shown.

As shown in Table 11, in Scenario 4 occupational shortfalls for both steady state and construction of a tieback are evident in the following NOCs:

- NOC 0211 Engineering managers
- NOC 0711 Construction managers
- NOC 2131 Civil engineers
- NOC 2141 Industrial and manufacturing engineers
- NOC 2145 Petroleum engineers
- NOC 2241 Electrical and electronics engineering technologies and technicians – while a small number of new positions arise from the oil and gas activity, the majority of the shortage is from occupational attrition.

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- NOC 2263 Inspectors in public and environmental health and occupational health and safety
- NOC 2273 Deck officers, water transport
- NOC 2274 Engineer officers, water transport
- NOC 7236 Ironworkers
- NOC 7246 Telecommunications installation and repair workers.

As noted in previous scenarios, several of the shortages arise predominantly as a result of occupational attrition including NOC 0211 Engineering managers, NOC 0711 Construction managers, NOC 2241 Electrical and electronics engineering technologists and technicians, NOC 2253 Drafting technologists and technicians, and NOC 2263 Inspectors in public and environmental health and occupational health and safety.

Table 11 – Scenario 4 Labour Demand and Supply

NOC Code	NOC Description	Workforce (Census 2016)	Peak Demand (2024)	Demand Change	Grads (2016 - 2023)	R&Ds (2016-2023)	Grads less R&D's (2016 - 2023)	Shortfall at Peak (2024)
0211	Engineering managers	230	63	4	36	52	(16)	(20)
0711	Construction managers	1,035	66	12	187	272	(85)	(97)
2131	Civil engineers	915	29	9	165	170	(5)	(14)
2145	Petroleum engineers	425	259	60	67	78	(11)	(71)
2241	Electrical and electronics engineering technologists and technicians	865	89	12	138	208	(70)	(82)
2253	Drafting technologists and technicians	255	59	2	32	49	(17)	(19)
2263	Inspectors in public and environmental health and occupational health and safety	1,010	198	39	156	253	(97)	(136)
2273	Deck officers, water transport	705	266	56	189	175	14	(42)
2274	Engineer officers, water transport	485	220	55	142	120	22	(33)
7236	Ironworkers	940	106	106	171	115	56	(50)

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NOC Code	NOC Description	Workforce (Census 2016)	Peak Demand (2024)	Demand Change	Grads (2016 - 2023)	R&Ds (2016-2023)	Grads less R&D's (2016 - 2023)	Shortfall at Peak (2024)
7246	Telecommunications installation and repair workers	300	29	6	48	55	(7)	(13)

Scenario 5

In Scenario 5, the number of facilities increases from four to five, the WWR wellhead platform is in operation, three or four tiebacks are in production and four rigs are drilling development wells, or undertaking subsea and exploration activity.

As shown in Table 4, total employment is estimated at approximately 6,700 for the steady state operations in Scenario 5.

The change in steady state operations from Baseline Activity to Scenario 5 is approximately 2,100 positions comprising:

- NOC 2113 Geoscientist and oceanographers/NOC 2114 Meteorologists and climatologists/NOC 2121 Biologist and related scientists
- NOC 2132 Mechanical engineers
- NOC 2145 Petroleum engineers
- NOC 2212 Geological and mineral technologists and technicians
- NOC 2232 Mechanical engineering technologists and technicians
- NOC 2241 Electrical and electronics engineering technicians and technologists
- NOC 2243 Industrial instrument technicians and mechanics/2244 Aircraft instrument, electrical and avionics mechanics, technicians and inspectors
- NOC 2261 Non-destructive testers and inspection technicians
- NOC 2262 Engineering inspectors and regulatory officers/NOC 2263 Inspectors in public and environmental health and occupational health and safety
- NOC 2271 Air pilots, flight engineers and flying instructors/NOC 3012 Registered nurses and registered psychiatric nurses/NOC 4112 Lawyer
- NOC 2273 Deck officers, water transport
- NOC 2274 Engineer officers, water transport
- NOC 6322 Cooks
- NOC 6513 Food and beverage servers/NOC 6523 Airline ticket and service agents/NOC 6541 Security guards and related security service occupations/NOC 6741 Dry cleaning, laundry and related occupations
- NOC 7242 Industrial electricians

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- NOC 7311 Construction millwrights and industrial mechanics
- NOC 7371 Crane operators
- NOC 7384 Other trades and related occupations, n.e.c.
- NOC 7532 Water transport deck and engine room crew
- NOC 8222 Contractors and supervisors, oil and gas drilling and services
- NOC 8232 Oil and gas well drillers, servicers, testers and related workers
- NOC 8412 Oil and gas well drilling and related workers and services operators
- NOC 8615 Oil and gas drilling, servicing and related labourers.

Labour Demand and Supply – Scenario 5

As shown in Table 12, the occupations with potential shortfalls in the peak year of 2024 in Scenario 5 are:

- NOC 0211 Engineering managers
- NOC 0711 Construction managers
- NOC 2145 Petroleum engineers
- NOC 2241 Electrical and electronics engineering technologies and technicians
- NOC 2263 Inspectors in public and environmental health and occupational health and safety
- NOC 2273 Deck officers, water transport
- NOC 2274 Engineer officers, water transport
- NOC 6322 Cooks
- NOC 7246 Telecommunications installation and repair workers

While a small number of new electrical and electronics engineering technologies and technicians positions arise from the oil and gas activity, the majority of the shortage is from occupational attrition.

Table 12– Scenario 5 Labour Demand and Supply Analysis

NOC Code	NOC Description	Workforce (Census 2016)	Peak Demand (2024)	Demand Change	Grads (2016 - 2023)	R&Ds (2016-2023)	Grads less R&D's (2016 - 2023)	Shortfall at Peak (2024)
0211	Engineering managers	230	79	20	36	52	(16)	(36)
0711	Construction managers	1,035	64	10	187	272	(85)	(95)
2145	Petroleum engineers	425	324	125	67	78	(11)	(136)

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NOC Code	NOC Description	Workforce (Census 2016)	Peak Demand (2024)	Demand Change	Grads (2016 - 2023)	R&Ds (2016-2023)	Grads less R&D's (2016 - 2023)	Shortfall at Peak (2024)
2241	Electrical and electronics engineering technologists and technicians	865	102	25	138	208	(70)	(95)
2263	Inspectors in public and environmental health and occupational health and safety	1,010	x	x	156	253	(97)	(x)
2273	Deck officers, water transport	705	341	131	189	175	14	(117)
2274	Engineer officers, water transport	485	282	117	142	120	22	(95)
6322	Cooks	3,620	165	51	x	x	x	(34)
7246	Telecommunications installation and repair workers	300	39	16	48	55	(7)	(23)

(Please note that NOC demand information that was provided in a group or could not be disclosed is indicated by x in the table.)

7. Difficult to Recruit Positions

Study participants were asked to identify positions for which they had difficulty recruiting. In this study difficulty recruiting was signified most often by receipt of few resumes from applicants possessing the required qualifications. Other indications of difficulty in recruiting, such as extended recruitment periods, were not identified as a concern.

The impact of changing demand for several occupations in the industry was noted. For example, at the Skills Gap Analysis Forum in June 2018 a participant indicated qualified ice observers are difficult to recruit and retain. One factor is the seasonality of employment as ice observers are required for only about six months a year. Some study participants indicated that in the past these personnel were involved in alternate duties for the remainder of the year.

Recruitment difficulties were identified primarily in drilling and well services, in marine transportation, and in engineering design and fabrication. Table 13 presents a list of the positions identified by study participants as difficult to recruit as well as the reasons why recruiting for these positions may be difficult.

7.1 Difficult to Recruit – Drilling

Some study participants reported difficulty recruiting experienced personnel for drilling positions on Mobile Offshore Drilling Units (MODUs). Industry participants pointed out that drilling personnel will often seek drilling positions on the production platforms, even in less senior positions, since compensation in these positions is competitive and longer-term employment is more probable. MODUs, on the other hand, tend to offer shorter term contracts.

Some study participants indicated that recruiting candidates for senior drilling positions from outside Newfoundland and Labrador is affected by several factors: the tendency for employment on MODUs to be short term, Atlantic Accord requirements regarding hiring, and Transport Canada requirements that only Canadian Citizens/Permanent Residents can hold Canadian marine certification, which restrict the recruitment of ships' officers.

7.1.1 Drillers and Toolpushers

Driller and toolpusher positions were identified as difficult to recruit for MODUs. The skill and experience requirements are unique to the facilities' drilling equipment, and familiarity with the equipment must be developed. Driller and toolpusher positions are often filled by former expatriates who worked internationally prior to the 2014 oil price downturn.

It is anticipated that when longer term driller and toolpusher positions such as those on production or WHP facilities become available, this will facilitate lateral movement in these positions.

Some participants observed that industry willingness to employ junior personnel and train them to move through the career ladder to senior positions appears to be greater on MODUs (exploration/development) than on production facilities.

7.1.2 Crane Operators

Participants indicated difficulty recruiting crane operators with experience on a moving platform and crane operators with the valid Stage 3 Offshore Crane Operator assessments required to perform work over the side of the facility. Crane operators have difficulty obtaining the experience necessary for Stage 3 assessment. They can be trained on board the facilities, but it is challenging to obtain the POB allotment needed to conduct the required offshore assessment.

Study participants also referenced the loss of crane operators to longer term positions on other local facilities and the anticipated loss of former expatriates when the international market improves.

7.1.3 Marine Electricians

Study participants indicated difficulty recruiting marine electricians. The *Atlantic Canada Offshore Petroleum Standard Practice for the Training and Qualifications of Offshore Personnel* outlines the required qualifications for Rig Electrician as successful completion of an approved course in industrial electrical technology at a recognized training institution and apprenticeship experience and/or additional training to the equivalent of that required for a Canadian inter-provincial journeyman's certificate. Rig Electricians must also complete on-the-job training as deemed necessary by the employer (Atlantic Canada Offshore Petroleum Training and Qualifications Committee, 2017). Experience on facility-specific equipment is critical and can help prevent unnecessary downtimes, but few technicians and technologists have acquired the specialized experience.

It was indicated at the Consultation Forum on June 13, 2018 that the demand for marine electrical and marine electronics technicians and technologists is not sufficient for the province's post-secondary institutions to justify offering a full Marine Electrical/Electronics program. The industry's approach has been to hire graduates of approved generic programs and augment their qualifications with short marine add-on components and on-the-job experience. Some Consultation Forum participants recommended development and delivery of short add-on endorsement certificate programs accredited for on-board rig-time equivalency but noted that this would require the support and approval of all regulatory agencies. Rig-time equivalency has not generally been awarded for short training programs.

7.1.4 Mechanics

Mechanics, also referred to as Hydraulic Technicians, with offshore experience, were identified as difficult to recruit. The qualifications for Rig Mechanic include successful completion of a course in practical skills for marine engineers or in diesel mechanics at a recognized training institution, or an equivalent combination of experience and training (Atlantic Canada Offshore Petroleum Training and Qualifications Committee, 2017).

7.1.5 Instrumentation/Electronics Technicians (Systems Control)

Instrumentation/Electronics Technicians with offshore experience have also been identified as difficult to recruit.

For Instrumentation/Electronics Technicians and Mechanics (Hydraulics Technicians) familiarity with a facility's equipment is critical to maintaining it appropriately, initiating repairs quickly, and avoiding long periods of downtime. Some Consultation Forum participants indicated that these technicians must be able to maintain and repair equipment offshore and suggested a six-month or nine-month add-on endorsement certificate course for electronics/instrumentation technicians with the training recognized as being equivalent to rig-time experience. This would require the support of all relevant agencies and would need to be incorporated into the *Standard Practice*. Currently, rig-time equivalency is not granted for add-on training.

7.1.6 Other

Recruitment for entry level positions including Deckhands, Roustabouts, Floorhands and other positions has not been identified as challenging.

7.1.7 Training Considerations for Drilling Operations

Industry participants indicated a preference for post-secondary programs that provide strong training in broad-based skills over training focused on specific disciplines, noting the industry's successful record of providing specialization through on-the-job training and experience and referencing the importance of equipment-specific training and experience. Some proposed consideration of competency-based training to facilitate development of cross-competency, multi-task capabilities, and simulation training for specific drilling positions.

Post-secondary training representatives attending the Consultation Forum indicated that close collaboration with industry through program advisory committees and five-year program reviews helps keep their offerings relevant and responsive to industry needs. However, they also noted the difficulty of getting industry participation in program review initiatives. They indicated, too, a shortage of funding for technology (e.g., simulation equipment) to facilitate the continued alignment of programs with industry training needs. They note also that highly-qualified graduates have had difficulty obtaining employment locally. Consequently, graduates find employment elsewhere and tend not to return, thereby continuing the province's tradition of exporting rather than retaining excellent talent.

7.2 Difficult to Recruit – Well Services

Well services companies invest significant time and resources into providing training specific to the operation and maintenance of their equipment. Some companies noted shortages of personnel for positions requiring training and/or experience relating to platform-specific equipment.

7.2.1 Offshore Positions

Some study participants indicated difficulty recruiting personnel for several offshore positions.

- Supervisory positions that require 5 to 10 years of experience are difficult to recruit locally. The general practice in the past has been to bring in outside personnel on a contractual basis. It has been difficult to replace these with residents of Newfoundland and Labrador because of the experience requirement. However, some operators have begun to develop their own resources to prepare personnel for positions such as Drilling Supervisor (Offshore) and Superintendent (Onshore). Personnel in these positions generally have a technology or engineering background.

- Experience-based wireline and slickline positions are difficult to fill from within the province because of the need for experience on specialized equipment. Qualifications for these positions may include a technical diploma or degree or the relevant specialized experience. Consultation Forum participants indicated that most employees in these positions are expatriates selected on the basis of their experience, which has often been acquired in other jurisdictions such as Alberta, Europe, or the United States.
- Maintenance and repair issues with specialized equipment are sporadic, and it isn't cost-effective to hire permanent personnel to address issues that arise only occasionally; therefore, outside personnel are generally contracted, and the capabilities have not tended to be developed locally.
- With increased activity in the oil and gas industry, Environmental Solutions Specialists and Drilling Fluids Specialists with entry-level engineering degree qualifications are expected to be more difficult to recruit.
- Industry representatives indicated difficulty recruiting and retaining ad hoc employees, noting short notice and lack of employment stability. Many of them work for a number of employers but whenever more permanent employment becomes available onshore or internationally, the local offshore industry tends to lose them.

7.3 Difficult to Recruit – Marine

7.3.1 Background

The longstanding, worldwide shortage of ships' officers (deck and engineering) is well-documented. The most recent of the BIMCO/ICS five-year updates published in 2016, *Manpower Report: The global supply and demand for seafarers in 2015*, estimated a 2015 global shortage of about 16,500 ships' officers and projected that over the next ten years the shortage in the supply of officers will continue.

With the downturn in the oil and gas industry locally, the cost structure of the industry has changed somewhat. Rig and vessel day rates are lower than previously, and local marine companies indicate there are fewer opportunities for marine personnel to gain experience internationally.

The following marine positions were identified by study participants as difficult to recruit:

- Captain/Master Mariner with offshore oil and gas industry experience
- Deck Officers
- Marine Engineers
 - Chief Engineers
 - Second Class Marine Engineers

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- Third Class Marine Engineers – with hydraulic and drilling equipment experience
- Marine Electricians
- Marine Cooks.

Foreign workers are being employed in some of these positions. As of December 31, 2016, a total of 3,529 foreign workers were employed in Newfoundland and Labrador under the Temporary Foreign Workers Program (TFWP) (543) and the International Mobility Program (IMP) (2,986). Deck and Engineering Officer and Marine Cook were among the top five occupations employed here under the TFWP, and Marine Cook was also one of the top five under the IMP (Department of Advanced Education, Skills, and Labour, n.d.).

Any expansion in offshore activity that would require an increase in the number of vessels supporting the activity would exacerbate the shortage of deck officers, engineering officers, and marine cooks. An expansion in activity could further aggravate the situation by increasing the number of mariners leaving at-sea positions to take shore-based positions.

7.3.2 Ships' Officers

Study participants pointed out that progression through the career path for deck officers and marine engineers is stalled or slowed when Second Officers or Marine Engineers, Second Class do not progress further, thereby limiting opportunities for junior officers to gain the experience needed to qualify for higher level certification. The bottlenecking in the progression of marine engineers has been a longstanding concern.

In November 2017, Transport Canada's Marine Safety Division (TCMS), the federal regulator responsible for certifying seafarers in Canada, announced proposed changes to the Marine Personnel Regulations (MPR) that will include adoption of a three-certificate model for marine engineers to replace the current four-certificate system. The proposed regulatory amendment, currently scheduled for implementation during the summer of 2019, will convert Transport Canada's four classes of marine engineer certification into Chief Engineer, Second Engineer, and Watchkeeping Engineer. This is expected to enhance the progression of junior marine engineers to higher-level certification (Transport Canada Marine Safety Division, 2017).

Transport Canada restrictions on immigrant certification inhibit the availability of immigrant marine personnel. Transport Canada regulations require that Canadian ships be crewed by holders of Canadian Certificates of Competency. Only after becoming a Canadian Citizen/Permanent Resident can an immigrant apply for Transport Canada certification. Courses such as Marine Emergency Duties, Simulated Electronic Navigation, Propulsion Plant Simulation, and Marine First Aid are mandatory and may or may not be recognized if completed outside Canada (Transport Canada, 2017).

Having successfully completed or received accreditation for these courses, the immigrant candidate can then apply to take Transport Canada examinations for the appropriate level of certification. There is no automatic recognition of foreign Certificates of Competency and a

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Canadian Certificate of Competency issued by Transport Canada may or may not be equivalent to certification awarded by another country (Transport Canada, 2017).

Skills Gap Analysis Study participants identified the following skills gaps for deck personnel:

- Anchor handling for deck/bridge officers and deckhands. The small number of rigs operating locally and the fact that they don't very often move make it difficult for officers and deckhands to obtain operational experience with anchor handling.
- Dynamic Positioning (DP) certification and experience. It is challenging to recruit ships' officers with DP experience, and under current economic conditions there are few opportunities for them to obtain experience internationally.

7.3.3 Marine Cooks

Officials of post-secondary training institutions reported high demand for graduates of nine-month pre-employment cooking programs. Marine cooks, in particular, appear to be in short supply and some companies recruit them before they graduate.

In addition to its regular cooking program, the College of the North Atlantic (CNA) offers a 39-week Marine Cook program that includes eight days of marine emergency duties training and a 28-day sea-time work term. However, the program is outside the regular CNA core programming and is offered only on a cost-recovery contractual basis with a minimum enrolment requirement.

7.4 Difficult to Recruit – Engineering Design and Fabrication

Study participants reported difficulty recruiting design engineers with 5 – 10 years' experience locally. They noted most topsides design engineering has been executed outside the province or personnel with the requisite experience and qualifications have been recruited or transferred to the province. It was further noted that the experience and knowledge gained during design and construction work that transfers with personnel moving from construction into operations is beneficial to the operations throughout the life of the asset.

Other positions identified as difficult to recruit include the following:

- Mechanical Engineers with 10 – 15 years of asset integrity experience
- Piping Engineers – mechanical engineers with piping experience
- Non-destructive Testing (NDT) Technicians (multi-disciplined)
 - Magnetic Particle Inspection (MPI)
 - Liquid Penetration Inspection (LPI)
 - Radiographic and Ultrasonic Weld Inspection
- Lifting Inspectors/Technicians.

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Some study participants noted that as skilled, experienced personnel who developed their capabilities on the job retire, the regulatory expectation seems to be that they be replaced with personnel who have certification and experience.

7.5 Difficult to Recruit – Other Positions

As noted in section 7.1.2 and 7.1.3, Crane Operators and Marine Electricians have been reported as difficult to recruit. Other positions identified as difficult to recruit include:

- Offshore Installation Manager (OIM) (This has been a longstanding challenge.)
- Marine Geologist with 5 – 10 years’ experience
- Aircraft Maintenance Engineering Technician. There is a shortage of Aircraft Maintenance Engineering Technicians locally and internationally. A two-year Aircraft Maintenance Engineering Technician program is offered by the College of the North Atlantic in Gander. The College’s website indicates graduates of this program earn North American and European certification and can earn an undergraduate degree in Aircraft Systems Maintenance with one additional year of study at the Institute of Technology in Carlow, Ireland.
- Bird Biologist – masters level with greater than 5 years’ experience.

Table 13 – Difficult to Recruit Positions

	Offshore industry experience	Specialized experience with specific equipment	Experience and training to gain required certifications	Limited occupational supply	Occupation will be in demand internationally when industry rebounds	Occupation/ position shortfall internationally	Short-periods of or irregular employment opportunities
Drilling							
Drillers (MODUs)	✓				✓		
Toolpushers (MODUs)	✓				✓		
Crane Operators			✓		✓		
Marine Electricians	✓						
Mechanics (Hydraulic Technicians)	✓						

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	Offshore industry experience	Specialized experience with specific equipment	Experience and training to gain required certifications	Limited occupational supply	Occupation will be in demand internationally when industry rebounds	Occupation/position shortfall internationally	Short-periods of or irregular employment opportunities
Instrumentation / Electronics Technicians	✓						
Drilling Supervisor and Superintendent	5 – 10 years experience						
Well Services							
Well services offshore supervisory positions (e.g., slickline, drilling fluids)	✓						
Wireline and Slickline Positions	✓	✓					
Environmental Solutions Specialists				✓			
Drilling Fluids Specialists				✓			
Other Offshore Positions							
Ice Observers							✓ seasonality
Maintenance and Repair positions for specialized equipment required on an irregular, short-term basis		✓					✓ personnel from other jurisdictions for short periods of time
Ad hoc Positions							✓
Marine							
Captain/Master Mariner	✓					✓	
Deck Officers						✓	
Chief Engineers						✓	

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	Offshore industry experience	Specialized experience with specific equipment	Experience and training to gain required certifications	Limited occupational supply	Occupation will be in demand internationally when industry rebounds	Occupation/position shortfall internationally	Short-periods of or irregular employment opportunities
Second Class Marine Engineers						✓	
Third Class Marine Engineers	Drilling equipment and hydraulic experience					✓	
Marine Electricians						✓	
Marine Cooks				✓			
Engineering Design and Fabrication							
Design Engineers	5 – 10 years experience						
Mechanical Engineers	10 – 15 years experience in asset integrity						
Piping Engineers (Mechanical Engineers)	Piping experience						
Non-Destructive testing (NDT) technicians with Magnetic Particle Inspection (MPI), Liquid Penetration Inspection (LPI) and Radiographic and Ultrasonic Weld Inspection Certification			✓				
Lifting Inspectors / Technicians			✓				
Other Positions							
Offshore Installation Manager (OIM)	✓						

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	Offshore industry experience	Specialized experience with specific equipment	Experience and training to gain required certifications	Limited occupational supply	Occupation will be in demand internationally when industry rebounds	Occupation/position shortfall internationally	Short-periods of or irregular employment opportunities
Marine Geologist	5 – 10 years experience						
Aircraft Maintenance Engineering Technician						✓	
Bird Biologist	More than 5 years experience						

8. Automation, Robotics, and Digitalization: Impact on Workforce and Skills Requirements

The recent market challenges confronting the offshore oil and gas industry have given renewed impetus to the enhancement of operational productivity and efficiency. In the current cost-constrained environment, lowering operating expenditure safely, enhancing flexibility, and boosting productivity and efficiency have become the top priorities. In this market environment, “digital” may be “the game changer for the oil and gas industry and the foundation for its future” (Condom, 2017, p. 1).

While digital technology has been used in the oil and gas industry for decades to automate and simplify processes, digital initiatives have historically focused on specific problems and made incremental improvements.

What’s different now, according to Vidar Hepso (2017) of Equinor and the Norwegian University of Science and Technology, is that rapid technological advances such as the cloud, the Internet of Things, and big data and analytics have created new opportunities for the industry. The truly digital oil company of the future, says Hepso (2017), will:

- Be automated, with unmanned drilling, supply, production, and back-office operations fully supported by technology and software;
- Find and produce more oil and gas by using advanced software capable of combining experience with interpretations and data to improve geological understanding;
- Drive significant reduction in operational costs through automation and optimizing utilization of equipment and production facilities;

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- Ensure major simplification of the integrated value chain with external suppliers and exploration of new business options and models to increase revenue; and
- See changes in workforce and capabilities, as the parts of jobs that do not require creativity, social skill, or human dexterity will disappear.

Digitalization provides a very real opportunity for companies to optimize operations and production. Machines and equipment can be monitored digitally; and analytics from the data generated can be used to learn, predict, and diagnose issues early, allowing operators to implement analytics-based work management programs using predictive maintenance to repair vital equipment before it breaks down, in turn reducing downtime and increasing production.

The shift to more robotics and automation of routine tasks will contribute to safety enhancement by removing people from direct involvement in certain mechanical operations such as handling pipe (Jones, 2017). The use of sensors and analytics can also contribute to environmental protection by spotting maintenance issues early on and enabling preventative maintenance to avoid environmental damage (McCarthy, 2018).

Digitalization will require a workforce with the ability to work collaboratively and interact in very different ways. To understand and maximize the obvious benefits of digitalization and robotics to their operations, the oil and gas industry will need to be fully engaged and invested in collaborative cultural change management. According to Thomas Friedman, Head of Project Development and Programs with Siemens, management will need to ensure the whole company is working in the same direction when it comes to digitalization. It will need to recognize also that while cultural change involves modifying people's perspectives and responsibilities, it also means giving them room to experiment (*OEEC: Deep dive into digitalization*, 2017).

8.1 Impact on Workforce Skills Requirements

What does the intensifying focus on digital technology innovation mean for tomorrow's human workforce? What will change, digitalization authorities suggest, is not the work that needs to be done but the ways in which it will be done:

- Changing roles - roles most susceptible to automation or computerization are those having more routine, less decision making, and larger data handling and transactional components (Frey & Osborne, 2013).
- Changing how work is performed – for example, workers with on-demand, real-time information through mobility apps and wearable technology can make more proactive decisions, improving productivity and reducing costs. It is estimated that by 2025 connected workers in upstream operations, who benefit from improved safety in the field and have access to information on demand, could be up to 15% more productive than their non-connected counterparts (World Economic Forum, 2017).

Dutch Holland and Jim Crompton (2014), authors of *The Future Belongs to the Digital Engineer: Transforming the Industry*, contend that the digital engineer of the future will be “an energy-industry professional with knowledge and skill in the use of science and engineering as well as digital technology ... to enable major process improvements that result in performance increases of both physical and business operations” (p.113). The digital engineer they envisage will continue to have a strong set of core technical skills heavily augmented by increased emphasis on digitalization, the logic of IT, data management, governance, and social intelligence skills (Hepso, 2017).

RAPID’s Eric van Oort concurs: “There’ll be a shift to higher-level jobs, away from working at the rig site to sophisticated data analysis and control systems engineering” (Jones, 2017, p. 2) and future engineers in high demand will be skilled in data analytics, writing control algorithms and control systems that make automated machinery work. Dr. van Oort sees a need for the creation of new subject areas for robotics, particularly data analytics and controls systems. Robotics, which encompasses several different types of engineering that work to develop robots which are then used to substitute for humans in myriad work environments, has gained steam in recent years in the oil and gas industry as companies work toward safer, more efficient means of operations (Jones, 2017).

8.2 Relevant Timelines

Canada’s recent report from PetrolMI (2018), *A Workforce in Transition: Oil and Gas Skills of the Future*, points out that “the low commodity price environment of the last few years stressed the financial ability of many companies to invest in digital technologies”.

In its *Technology Outlook 2025*, DNV GL Oil & Gas highlighted fully autonomous drilling as a technology it expects oil and gas companies to implement by 2025. Tore Kuhnle, principal researcher at DNV GL Oil & Gas, indicated that many companies are unwilling to invest in more fully automated technologies at this time, pointing out that because of current market conditions and production cutbacks, no new rigs are projected for construction over the next few years. “This means that despite the large suppliers of rigs probably being ready to make these quite soon, it will still take time.” (Vella, 2016).

8.3 Changing Skills Demands

PetroLMI's report *A Workforce in Transition: Oil and Gas Skills of the Future* suggests that many of the new or emerging job opportunities will be appealing to workers who are seeking challenging, technology-driven occupations.

“As a greater number of tasks are automated across the industry, Canada’s oil and gas workforce will need to be digitally literate along with having the more traditional mechanical aptitude expected in the industry. It will also need to be more innovative, creative and willing to look for potential productivity improvements as automation takes over these tasks.”

A Workforce in Transition: Oil and Gas Skills of the Future (PetroLMI, 2018, p. 11)

The report identifies the following impacts of automation and data analytics on occupations and skills, specifically the increased need:

- To collect and analyze data and to build and maintain databases
- For software engineers, data management and analytics specialists to measure operations in real-time
- For instrumentation technologists as sensors are applied to more equipment
- For technological literacy skills for field workers
- For technology-based competencies, creative problem-solving, and the ability to manage change to analyze data in real-time in the field, conduct course corrections and innovate
- For IT support roles to support and maintain automated equipment.

Participants in the Skills Gap Analysis Study identified several positions they expected would be affected by technology:

- MWD, Directional Drillers, Wireline (addressed with internal training)
- Marine positions with more automation for vessels
- Non-destructive testing technicians (NDT).

Participants also indicated there would be more requirement for electrical, mechanical and hydraulics positions, and more marine electricians (e.g., trouble shooting).

Some study participants noted that a key technology focus will be to facilitate moving work onshore that can be done onshore (e.g., maintenance planner, materials coordinator) as well as remotely (onshore) monitoring offshore asset/equipment performance. It was noted that

training for operation and maintenance of tools and equipment is addressed primarily by the service provider.

The skills requirements generated by digitalization will have implications for the offshore oil and gas industry in Newfoundland and Labrador, for the education and training institutions that supply the industry's workforce, and for the government departments involved in the planning and implementation of workforce development initiatives.

There are numerous factors that will affect the pace at which the oil and gas industry embraces digitalization, automation and robotics, both globally and locally. Study participants were unable to provide substantive or detailed projections of the impact of technology, specifically digitalization on local operations or timelines for anticipated changes in workforce skill requirements.

Nevertheless, recent workshops, seminars and other events engaging oil and gas industry stakeholders have been held by various groups to discuss the potential impact of automation and digitalization on the oil and gas industry. The 2018 announcement of Canada's Ocean Supercluster also brings attention to the overall focus on digitally-powered, knowledge-based ocean economy by multiple sectors including fisheries, aquaculture, oil and gas, marine bio products, transportation, defence, marine renewables, and ocean technology. The Ocean Supercluster's technology roadmap focus areas include environmental sensing and characterization, genomics, unmanned maritime vehicles, and digital twin. Through its cluster building initiatives the Ocean Supercluster will foster opportunities for ocean technology start ups and small and medium enterprises to work with large firms, and enhance labour force skills and address industry talent needs, among other things.

(<https://oceansupercluster.ca/uploads/documents/Canadas-Ocean-Supercluster-Overview-July-2018.pdf>)

9. Potential Impacts on Occupational Demand and Supply

9.1 General Outlook

In 2017, the province's four oil-producing projects, Hibernia, Terra Nova, White Rose, and Hebron, were providing employment for 5,063 people, representing 2.3% of total employment in the province. A total of 4,478, or 88.4%, of the combined workforce of these four projects were residents of Newfoundland and Labrador (Government of Newfoundland and Labrador, 2018a). Increased activity within the oil and gas industry could strengthen the industry's labour force demand and increase pressure on recruitment for occupations identified as difficult to recruit.

9.2 Oil and Gas Activities That Could Impact Occupational Demand

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Study participants when asked to identify oil and gas activities that would strengthen occupational demand identified the following:

- New Exploration Activity

The C-NLOPB 2018 offshore land sale call for bids included exploration licences within two regions and one production licence. Within the high activity Eastern Newfoundland offshore region, 16 parcels of land, encompassing almost 4 million hectares, were made available. Within the Jeanne d'Arc region, a single parcel, 142,448 hectares in size, was offered. A production licence was offered for the 1,423-hectare area within the Terra Nova production area of the Jeanne d'Arc region formerly known as the Terra Nova K-08 Commercial Discovery Area (C-NLOPB announces 2018 offshore land sale, 2018). Any new exploration or production activity offshore resulting from the awarding of these licences would strengthen labour force demand.

- West White Rose Development

On May 29, 2017, the Province and Husky Energy announced that Husky was moving forward with development of the West White Rose project. The West White Rose project will use a fixed drilling platform tied back to the White Rose production facility, the *SeaRose FPSO*. Construction began in late 2017. The living quarters will be fabricated at Kiewit Offshore Services in Marystown, and the concrete gravity structure will be constructed at the new graving dock in Argentia. Other work that will occur in the province include the fabrication of the flare boom, helideck and life boat stations, and the engineering and fabrication of the accommodation module. An estimated 5,000 person years of direct employment will be generated during the construction period. First oil from the platform is expected in 2022, and it is estimated that the project will create 250 permanent platform jobs once operational (Government of Newfoundland and Labrador, 2018a).

- Bay du Nord Development

On July 26, 2018, the province of Newfoundland and Labrador and Equinor Canada, in partnership with Husky Energy, announced an agreement to develop the Bay du Nord oil project in the Flemish Pass Basin, the first oil project outside the Jeanne d'Arc Basin. The find has an estimated 300 million barrels of recoverable crude, and first oil is expected in 2025.

It is expected that the operations phase will create 500 jobs and the project will generate the equivalent of 11,000 person-years of work during its construction and operational life. Ninety per cent of the project and procurement management will occur in the province with 51 per cent of pre-development and development engineering, including 5,000 metric tonnes of fabrication, also taking place here.

The Bay du Nord project is also expected to generate more than \$14 billion in economic activity (in 2017 dollars); strengthen the focus on subsea engineering and new fabrication capabilities; and provide a minimum of \$75 million in research and development and education and training expenditures over 10 years to position Newfoundland and Labrador as a deep-water centre of excellence.

(<https://theogm.com/2018/07/26/bay-de-nord-oil-project-is-a-go-6-8-billion-to-develop/>)

■ New Find Not Associated with Current Activity

Several companies have proposed long-term exploration programs for the offshore that could result in up to 85 exploration and delineation wells over the next 12 years:

- Equinor's proposed exploration drilling program in the Flemish Pass Basin would include the drilling of up to 10 wells from 2018 to 2028. Equinor also continues to evaluate future drilling activities in other areas of the Flemish Pass Basin;
- Husky Oil's proposed drilling program in both the Jeanne d'Arc Basin and the Flemish Pass Basin would include the drilling of up to 10 wells from 2018 to 2025;
- ExxonMobil's proposed drilling program in both the Jeanne d'Arc Basin and the Flemish Pass Basin would include the drilling of up to 35 wells from 2018 to 2030;
- Nexen Energy ULC's proposed drilling program in the Flemish Pass Basin would include the drilling of up to 10 wells from 2018 to 2028; and
- BP Canada Energy Group ULC's proposed drilling program in the Orphan Basin with BP Canada, Hess Canada Oil and Gas ULC, and Noble Energy Canada LLC would include the drilling of up to 20 wells from 2018 to 2026, with an initial well proposed to be drilled in 2019 or 2020 pending regulatory approval (Government of Newfoundland and Labrador, 2018a).

A significant new find resulting from these proposed programs could increase exploration activity in the Newfoundland and Labrador offshore and strengthen demand. A find in current exploration areas that couldn't be tied into an existing platform or FPSO would create a need for additional platforms or FPSOs, strengthening the demand for oil and gas industry positions and marine transportation industry positions.

■ Exploration in the Labrador South Region

The C-NLOPB issued a Call for Bids for 10 parcels in the Labrador South Region in November 2016. Bids on these parcels will close 120 days following the completion of

the Labrador Strategic Environmental Assessment (SEA) which is currently underway. It is expected that a resource assessment for the Labrador South Region will be released prior to the closing of bids (Government of Newfoundland and Labrador, 2018a).

- Technology Requirements

The North Atlantic provides a harsh and challenging environment for oil and gas extraction that creates its own technical challenges, including an increased emphasis on the reliability of the industry's technology. This, in turn, drives an increased demand for specialized technology and for technicians with specialized skill sets and equipment-specific training.

9.3 Oil and Gas Activities That Could Impact Occupational Supply

Study participants when asked to identify oil and gas activities that could weaken occupational supply identified the following:

- Rebound in Global Oil and Gas Production

While a rebound in global oil and gas production would strengthen demand generally, it would likely also result in the return of many foreign workers and former Newfoundland and Labrador expatriates to international employment, resulting in the loss of highly valuable capabilities brought to the Province by the downturn. Recent predictions of an impending oil supply shortage and a demand for increased production internationally make this a distinct possibility. If it were to occur, this would have a significant impact on the supply of highly skilled and experienced workers.

- Increased Oil and Gas Activity in Western Canada

An upturn in the oil and gas industry would likely also generate renewed activity in western Canada that would create competition for the industry in this province and decrease available supply. It could be expected that the industry in western Canada would seek to attract experienced and new entry talent from this province. It could also be anticipated that many residents who have previously worked in the oil and gas industry in western Canada or who have family connections there would respond and become interprovincial employees. Increased demand in western Canada would also reduce the pool of out-of-province workers who might otherwise be available to the industry here.

- Increased Oil and Gas Activity in Nova Scotia

A significant new find in Nova Scotia would also stimulate increased activity in that province's offshore oil and gas industry, increasing opportunities for workforce members in this province and also reducing the otherwise potentially available supply from Nova Scotia and other provinces.

9.4 Other Sector Activities That Could Impact Occupational Demand and Supply

The current economic outlook for Newfoundland and Labrador does not include any major projects that will have a significant impact on occupational demand. Labour demand is expected to remain weak in the short and medium term as declines in capital investment impact employment levels. A provincial Cabinet Committee on Jobs established in 2017 to support private sector job creation and economic sustainability identified three sectors —aquaculture, agriculture and technology — for potential growth. Increased aquaculture production could generate an estimated additional 1,100 person years of employment, while the agriculture industry could generate an additional 500 person years of employment. In the technology sector, the government projects supporting the growth of 40 technology firms over the next two years and stimulating new private sector employment. The spending of nearly \$3 billion on infrastructure for new and existing schools, health care facilities, roads and bridges, and municipal infrastructure over a five-year period is expected to provide an additional 4,900 person years of employment annually (Government of Newfoundland and Labrador, 2018a).

With regard to supply, the 2014 APEC study, *The Labour Requirements for Major Projects in Atlantic Canada*, pointed out that “most provinces outside of Atlantic Canada are forecasting labour shortages over the next decade [2014-2024]. This suggests intense competition for labour, with workers moving to where the best opportunities are located. In this context, it may continue to be difficult to retain workers in Atlantic Canada, or to entice back previous outmigrants” (Chaundry & Brannon, 2014, p.36).

10. Conclusions and Recommendations

10.1 Conclusions

Labour Demand

- The provincial government's Budget 2018 document, *Building for our Future*, projected that “labour market indicators are expected to remain weak for several years beyond 2018...” (Government of Newfoundland and Labrador, 2018a). This is attributable primarily to lower construction activity with several major development projects ramping down. Many study participants indicated that the recent (June 2017) completion of the Hebron construction project, which employed more than 7,500

personnel during peak construction, together with the completion or near completion of other large projects unrelated to the oil and gas industry, meant that an experienced workforce will be available for the smaller White Rose project. Since the workforce requirement for the WWRP will be similar to, but smaller and of shorter duration than the requirement for the Hebron project, occupational supply shortages were not anticipated.

- While potential labour shortages were identified in a small number of occupations, it is important to note that the labour demand and supply model for construction takes into account peak occupational demand in the peak year of activity, and as this is a relatively short project the duration of the peaks is often short. In addition, the peak year for the WWRP was 2018 and this peak demand has essentially been concluded.
- Some study participants pointed out that the experience and knowledge gained during design and construction work that transfers with personnel moving from construction into operations is beneficial to the operations throughout the life of the asset.
- The Canadian Occupational Projection System (COPS) attrition rates for retirements and deaths by occupation is provided at the national level; it is not available on a provincial level. Differences in national and provincial labour force age demographics could cause underestimation of attrition (retirements and deaths) replacement demand in some occupations.

Labour Supply

- The diversity of position titles, position descriptions, and position employment requirements in the oil and gas industry makes occupational classification and mapping to NOC codes challenging and, in some cases, the assignment of positions to NOC codes may be somewhat subjective.
- Post-secondary institutions indicated difficulty projecting the number of graduates from each of their identified offerings for five years or ten years citing factors such as the uncertainty of demand, government funding priorities, and the need to be responsive to several other labour market variables.
- A number of study participants indicated that relevant post-secondary programs provided appropriate entry-level knowledge and skills. Some forum participants indicated that accredited add-on courses would be beneficial for some offshore occupations requiring higher levels of specialization.
- Several oil and gas career websites were identified and used during the course of the study – PetroLMI; Offshore Petroleum Industry Training Organization (OPITO) – that could be useful sources of career information to supplement local career information sources such as PIHRC and COMPASS.

Difficult to Recruit Positions

- Study participants identified approximately 30 positions as difficult to recruit, primarily in drilling, well services, other offshore occupations, ad hoc occupations, marine transportation, and engineering design and fabrication. Many of these positions are difficult to recruit because of experience requirements, others because of shortages on an international basis. From a skills perspective, anchor handling for deck/bridge officers and deckhands, and dynamic positioning certification and experience for ships' officers were identified.
- Forum participants pointed to the patterns of human resources mobility within the industry with experienced employees moving from ad hoc positions and from positions on MODUs to longer term employment opportunities on production facilities; senior personnel moving to international positions in a tighter labour market.
- With new demand such as positions on additional facilities or rigs it is anticipated that lateral movement will occur in some positions. Forum participants indicated ad hoc offshore, drilling and senior operations positions may be affected as the long-term positions on a fixed drilling facility will be attractive.
- Two factors identified as affecting difficult to recruit positions were loss of personnel to longer term positions on production facilities and anticipated loss of former expatriates when the international market improves.
- Any expansion in offshore activity that would require an increase in the number of vessels supporting the activity would exacerbate the shortage of deck officers, engineering officers, and marine cooks. An expansion in activity could further aggravate the situation by increasing the number of mariners leaving at-sea positions to take shore-based positions.
- Difficulty in recruiting marine engineers is expected to ease with the implementation of the proposed amendment to the Marine Personnel Regulations (MPR) to adopt a three-certificate model for marine engineers (Chief Engineer, Second Engineer, and Watchkeeping Engineer) to replace the current four-certificate program. The proposed regulatory amendment, scheduled for implementation during the summer of 2019, is expected to enhance the progression of junior marine engineers to higher-level certification (Transport Canada Marine Safety Division, 2017).
- Supervisory positions that require 5 to 10 years of experience are difficult to recruit locally. The general practice in the past has been to bring in outside personnel on a contractual basis. It has been difficult to replace these with residents of Newfoundland and Labrador because of the experience requirement. However, some operators have begun to develop their own resources to prepare personnel for positions such as Drilling

Supervisor (Offshore) and Superintendent (Onshore). Personnel in these positions generally have a technology or engineering background.

- Some study participants noted that as skilled, experienced personnel who developed their capabilities on the job retire, the regulatory expectation seems to be that they be replaced with personnel who have certification and experience.

Automation, Robotics and Digitalization

- Current research and relevant studies indicate that automation, robotics, and digitalization will ultimately have a significant impact on employment requirements and workforce skill requirements in the oil and gas industry, both globally and locally.
- Study participants did not provide substantive or detailed projections of the impact of technology, specifically digitalization on local operations or timelines for anticipated changes in workforce skill requirements.

10.2 Recommendations

- Consideration should be given to ways to maximize the potential for transferring workforce experience gained during facilities design and construction phases of offshore projects to the operations phase.
- Consideration should be given to establishing a mechanism to facilitate more consistent position titles and basic job descriptions across the oil and gas industry and enhance consistent mapping of oil and gas industry positions to NOC codes.
- Consideration should be given to establishing an ongoing industry-government-educational mechanism to track/project future workforce skills requirements and develop plans to meet evolving needs.
- Consideration should be given to the potential for local oil and gas and marine transportation career information websites to link with relevant national and international websites providing similar information and career services.
- Consideration should be given to developing initiatives to retain difficult to recruit capabilities in the face of national and international competition as labour market conditions change.
- Consideration should be given to exploring joint oil and gas industry stakeholder initiatives to enhance awareness of the anticipated impacts of automation, robotics, and digitalization on current and future workforce capabilities and requirements and their probable timelines in order to enable industry and post-secondary providers to assess and prepare for them.

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The *Newfoundland and Labrador Oil and Gas Industry Human Resources Skills Gap Analysis Study* complements the information presented in *ADVANCE 2030 A Plan for Growth in the Newfoundland and Labrador Oil and Gas Industry* which was released in February 2018 as part of the Government of Newfoundland and Labrador's initiative *The Way Forward – A Vision for Sustainability and Growth in Newfoundland and Labrador*. *Advance 2030* is available online at www.nr.gov.nl.ca/nr/advance30.

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Appendix A – Oil and Gas Sector Employment Matrix

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Oil and Gas Sector Employment Matrix	
<p>Project Operator/Owner</p> <p>Accounting Analyst Accounting Clerk Administrative Assistant Auditor Business Development and Contract Administration Central Control Room Operator Certification Engineer Client Services Analyst Communications Advisor Completions Engineer Construction Supervisor Contracts Administrator Controls Engineer Corrosion Engineer Directional Drilling Manager Document Control Clerk Drilling Engineer Supervisor Drilling Manager Drilling Superintendent Drilling Technologist Exploration Engineer Facilities Engineer Facilities Engineering Supervisor Field Engineer Financial Analyst Geophysicist HSECO (Health, Environment, Safety, Quality) HSE Advisor Human Resources Advisor Ice Management Specialist/Technician Industrial Benefit Analyst Instrumentation Engineer Instrumentation Technician Lawyer Logistics / Coordinator Maintenance Engineer Maintenance Supervisor Maintenance Technician Marine Coordinator Marine Supervisor Marine Technician Material Coordinator Petroleum Engineering Technologist Petrophysicist Process Engineer Procurement / Contracts / Purchasing Manager Procurement and Purchasing (Supply Chain Management) Production Coordinator Production Operations Superintendent Programmatic Engineer Project Lead Engineer Project Planner / Scheduler and Cost Control Quality Advisor Regulatory Advisor</p>	<p>Project Operator/Owner (Continued)</p> <p>Regulatory Analyst Remote Sensing GIS Specialist Reservoir Engineer Reservoir Manager Reservoir Technologist Structural Engineer Subsea Engineer Training Administrator Vessel Coordinator Corporate Relations Other: Other:</p> <p>Onshore Support</p> <p>Business Analyst Buyer/Supplier Finance/Accounting Manager Human Resources Manager Information Technology Analyst Public Relations Advisor QHSE Advisor Radio Operator (Onshore) Tax Advisor Telecommunications Engineer Terminal Manager Other: Other:</p> <p>Engineering, Design and Fabrication</p> <p>CAD Technician Cost Control Engineer Designer Electrical Engineer Electrician Engineering Manager Engineering Technology Technician Estimator Implementation Coordinator Implementation Technician Instrumentation/Controls Engineer Loss Control Engineer Materials/Welding Engineer Piping Designer Piping Engineer Planner Project Engineer Project Manager Structural Designer Welder Other: Other:</p>
FTE	FTE
<p>Marine Logistics and Transportation</p> <p>Aircraft Technician Avionics Manager Avionics Technician Ballast Control Operator Captain/Master (Master Mariner) Chief Engineer Deck Hand Deck Operator Engine Room Assistant (EHA) Engineer First Mate Fleet Technical Support Engineer Fourth Engineer Fourth Mate Helicopter Pilot Marine Electrician Passenger Movement Coordinator Second Engineer Security Officer Security/Cargo Ships Clerk / Storekeeper Storekeeper (Onshore) Superintendent Technical Support Superintendent Vessels Third Engineer Third Mate Traffic Office Agent Other: Other:</p>	<p>Warehousing and Logistics</p> <p>Crane Operator Material Controller Material Controller Passenger Check-in Agent Pipefitter Technician Receiver/Shipper Warehouse Coordinator Warehouse Technician Other: Other:</p> <p>Catering/Accommodations</p> <p>Catering/Accommodations Coordinator Chef Cook Steward Other: Other:</p>
FTE	FTE

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Oil and Gas Sector Employment Matrix

Well Services	FTE	Offshore Operations, Maintenance and CAPEX	FTE	Specialty Services	FTE
Bulk Plant Operator		Drilling Engineer		Coasting Inspector	
Casing Technician		Drilling Supervisor		Marine Geologist	
Cementing Engineer		Electrical Technician		NDR Technician	
Cementing Manager		Fabric Maintenance Engineer		Occupational Health Nurse/Advisor	
Cementing Operator		Instrumentation/Electronics Technician		On-call Medevac MD	
Cementing Service Supervisor		Insulator		On-call Medevac RN	
Cementing Technician		Maintenance Lead		Pileyard Manager	
Coil Tubing Engineer		Mechanical Technician		Quality Technician	
Coil Tubing Manager		Medic/Offshore Nurse		ROV Pilot Technician	
Coil Tubing Service Supervisor		Offshore Installation Manager (OIM)		ROV Supervisor	
Coil Tubing Specialist		Painter		ROV Technician	
Completions Manager		Pipefitter		Safety and Survival Instructor and Firefighter	
Completions Operator		Process/Field Operator		Safety Technician	
Completions Specialist		Radio Operator		Seismic Survey Engineer	
Completions Supervisor		Rope Access Technician		Weather/Ice Observer	
Completions Technician		Scaffolder/Rigger		Other:	
Deepwater Technical Solutions Technician		Telecommunications Technician		Other:	
Directional Driller		Other:			
Directional Drilling Supervisor		Other:			
Drilling Fluids Engineer		Environmental Consulting		Drilling/Well Development	
Drilling Fluids Laboratory Technician		Biologist		Assistant Derrickman	
Drilling Fluids Supervisor		Economic Technologist		Assistant Driller	
Mud Logging Sample Catcher		Environmental Consultant/Scientist		Assistant Rig Manager/Assistant Toolpusher	
Mudlogger		Environmental Technician		Derrickman	
Mudlogging Coordinator		Laboratory Manager		Driller	
Mudlogging Data Analyst		Laboratory Technician		Drilling Maintenance Coordinator	
MWD/LWD Field Engineer		Marine Biologist		Maintenance Planner	
MWD/LWD Manager		Weather Forecaster		Mechanic	
MWD/LWD Specialist		Other:		Rig Manager/Toolpusher	
MWD/LWD Technician		Other:		Rotating Engineer	
Slideline Operator		Other:		Roughneck/Floorhand	
Slideline Specialist		Other:		Roustabout (Lassahand)	
Slideline Supervisor		Other:		Suavea Engineer (Drilling)	
Slideline Wire Technician		Other:		Other:	
Tubular Drill Pipe Inspector		Other:		Other:	
Well Testing Engineer		Offshore/Marine Fabrication		Industrial Product Supplies	
Well Testing Specialist		Fabrication Coordinator		Lifting Equipment Technicians	
Wireline Engineer		HSE Manager		Other:	
Wireline Manager		Mechanical Engineer		Other:	
Wireline Operator		Milwright			
Wireline Technician		QA / QC Inspector			
Other:		QA Manager			
Other:		Other:			
Other:		Other:			

Company Name: _____
 Contact Person: _____
 Telephone Number: _____
 Date: _____