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欧州諸国における海洋開発分野の人材育成制度に関する調査

2014年3月

一般財団法人日本船舶技術研究協会

はじめに

我が国の企業が海洋開発市場へ参入・成長していく上で、特殊な技術を要する海洋関係の技術者の育成は、長期的な計画的に基づき進める必要がある。

このため、海底油田等の海洋開発分野で実績のある欧州において、海洋開発関係に従事する技術者の育成システムの実態について調査を実施した。

今後の我が国関係者の海洋開発への取組の一助となれば幸いである。

一般財団法人日本船舶技術研究協会

ADS insight

GUIDING YOU THROUGH THE EU

STUDY ON THE EDUCATION SYSTEM OF THE OFFSHORE INDUSTRIES IN EUROPE

MARCH 2014

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1. INTRODUCTION

This study provides detailed information about the educational system and training programmes available in Europe as regards the training of technical personnel for the offshore industry.

In Chapter 2 the study presents a comprehensive overview of programmes on offer in the universities of Aberdeen, Newcastle, Bergen, Norwegian Institute of Technology, and TU Delft. In addition information is provided on relevant ERASMUS Mundi schemes, which concern EU-sponsored cross EU Member State programmes of relevance. The information presented is based on a careful analysis of data made available by the different universities, schools and training institutes.

As will be seen, some of the programmes focus directly on the offshore industry whereas other programmes contain a wide syllabus embracing a diversity of marine skills, including specific courses dedicated to offshore activities.

Following this, Chapter 3 provides information about relevant training courses offered by a selection of offshore development companies. The information presented is based on a combination of data available from the companies' websites and direct contacts with relevant personnel. Considerable efforts have been made to provide a similar level of detail for the different companies, however, many of them were not willing to provide additional information. This suggests that in-house training for technical personnel in the offshore industry is a rather sensitive field of activity, which is characterised by fierce competition between the different operators.

2. UNIVERSITIES SCHOOLS AND RESEARCH INSTITUTES

2.1 ABERDEEN UNIVERSITY

The University of Aberdeen is a public research university, based in the city of Aberdeen in Scotland. The university was first established in 1495, making it one of the oldest universities in the English-speaking world. Located in the heart of the UK's oil and gas industry, the University of Aberdeen offers many courses covering various areas of expertise in the offshore field.

In 2013, the University counted around 13.197 students in total, 10831 undergraduates and 2366 postgraduates. The total number of staff was 3307.

The University is divided into three colleges: the "College of Arts and Social Sciences", the "College of Life Sciences and Medicine" and the "College of Physical Sciences". Each college comprises different schools covering teaching and research in a number of subject areas, and offering undergraduate and postgraduate degrees.

Of particular interest is the"College of Physical Sciences", and its "School of Engineering" and "School of Geosciences". The "College of Arts and Social Sciences" and its "School of Law" teaching oil and gas law is also of interest.

Furthermore, the University has a number of Research Institutes bringing together experts in a wide range of topic areas. Of interest is the "Aberdeen Institute of Energy[1]", recently established to create a global centre of energy research, industry collaboration and education.

The commitment of the University of Aberdeen to energy and the offshore industry is visible through the many initiatives it takes in this field. For example, the University publishes a magazine, "Energeia", providing an insight into work being carried out by the University in the field of energy. It also regularly participates in the "Offshore Europe" conference held in Aberdeen.

[1] http://www.abdn.ac.uk/aie/

2.1.1. UNDERGRADUATE PROGRAMMES

2.1.2. PETROLEUM ENGINEERING BACHELOR OF ENGINEERING

Students in first year	Admission requirements	Duration
	Entry requirements vary according to place of study, but generally prospective students are required to have a good level in mathematics and physics. Detailed entry requirements can be found here.[2]	4 years

Undergraduate Entrance Scholarships are provided by the Aberdeen University for every year of undergraduate study for the length of the degree. Awards are split between merit awards, for students with exceptional academic qualifications, and access awards, for students who might find it difficult to enter higher education without financial support. All UK-based applicants for a full-time undergraduate degree at the University can apply.

Head of Programme: Dr Alfred Akisanya[3]

The degree in Petroleum Engineering (BEng) is provided by the School of Engineering of the College of Physical Sciences and is taught by a selection of compulsory and optional courses. Students can also choose other eligible courses.

The curriculum in the first and second year consists of the following compulsory courses:

- Principles of Electronics
- CAD and Communications in Engineering Practice
- Fundamentals of Engineering Materials
- Chemistry for the Physical Sciences 2
- Engineering Mathematics 1 and 2

[2] http://www.abdn.ac.uk/study/undergraduate/entry-requirements-bsc-and-meng-608.php
[3] http://www.abdn.ac.uk/engineering/people/profiles/a.r.akisanya

- Fundamental Engineering Mechanics
- Fluid Mechanics and Thermodynamics
- Process Engineering
- Design and Computing in Engineering Practice
- Solids and Structures
- Electrical and Mechanical Systems
- Introduction to Geology for Engineers

Furthermore, in the first and second year students need to choose several courses in agreement with the adviser of studies.

In the third year, students choose their specialisation and decide between Master of Engineering (MEng) and Bachelor of Engineering (MEng). Successful BEng candidates will be offered the chance to change to the MEng programme. Following specialisation in third year, honours studies will include:

- Engineering Analysis and Methods 1
- Fluid Mechanics
- Heat, Mass and Momentum Transfer
- Petroleum Geology and Reservoir Characterisation
- Drilling and Well Engineering
- Reservoir Engineering I: Fundamentals
- Petroleum Engineering Design
- Well Testing
- Project & Safety Management

In the fourth year, students have the following mandatory courses:

- Fluid Dynamics
- Reservoir Engineering II: Performance and Modelling
- Drilling and Well Engineering
- Safety and Reliability Engineering
- Petroleum Production Engineering and Economics

In addition, they need to select one of the following optional courses:

- Engineering Project B and Engineering Management II - Engineering Project Management
- Leadership and Teamwork or
- Engineering Project Abroad

The major feature of the fourth year is the undertaking of an individual project in the area of specialisation.

2.1.3. PETROLEUM ENGINEERING MASTER OF ENGINEERING

Students in first year	Admission requirements	Duration
	Entry requirements vary according to place of study, but generally prospective students are required to have a good level in mathematics and physics. Detailed entry requirements can be found here.[4]	5 years

Undergraduate Entrance Scholarships are provided by the Aberdeen University for every year of undergraduate study for the length of the degree. Awards are split between merit awards, for students with exceptional academic qualifications, and access awards, for students who might find it difficult to enter higher education without financial support. All UK-based applicants for a full-time undergraduate degree at the University can apply.

Head of Programme: Dr Alfred Akisanya[5]

This five-year programme is provided by the School of Engineering of the College of Physical Sciences and it consists of the following mandatory courses:

- Principles of Electronics

[4] http://www.abdn.ac.uk/study/undergraduate/entry-requirements-bsc-and-meng-608.php
[5] http://www.abdn.ac.uk/engineering/people/profiles/a.r.akisanya

- CAD and Communications in Engineering Practice
- Fundamentals of Engineering Materials
- Chemistry for the Physical Sciences 2
- Engineering Mathematics 1 and 2
- Fundamental Engineering Mechanics
- Fluid Mechanics and Thermodynamics
- Process Engineering
- Design and Computing in Engineering Practice
- Solids and Structures
- Electrical and Mechanical Systems
- Introduction to Geology for Engineers
- Engineering Analysis and Methods 1
- Fluid Mechanics
- Heat, Mass and Momentum Transfer
- Petroleum Geology and Reservoir Characterisation
- Drilling and Well Engineering
- Reservoir Engineering (I: Fundamentals and II: Performance and Modelling)
- Petroleum Engineering Design
- Well Testing
- Project & Safety Management
- Fluid Dynamics
- Safety and Reliability Engineering
- Petroleum Production Engineering and Economics
- Advanced Topics for MEng Study
- Mathematical Optimisation
- Upstream Oil and Gas Processing
- Engineering Management III - Business Model Innovation
- MEng Group Design
- Applied Numerical Methods

In the fifth year students need to undertake a group design project in addition to courses in Engineering Analysis & Methods and Engineering & Project Management.

Furthermore, in the first and second year students need to choose several courses in agreement with the adviser of studies. In the fourth year, students have to select one of the following optional courses:

- Individual Project and Engineering Management II - Engineering Project Management
- Leadership and Teamwork or
- Individual Project Abroad

2.1.4. POSTGRADUATE PROGRAMMES

2.1.5. OIL AND GAS ENGINEERING MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A minimum of 2:1 (upper second class) UK Honours degree (or an honours degree from a non-UK institution which is judged by the University to be of equivalent worth) in any branch of Engineering, or Physics at a minimum of 2:1 (upper second class) or above, or honours degree in a relevant Physical Sciences subject also at minimum of a 2:1 or above. English language requirement: IELTS overall grade of 6.5 with 6.0 in writing, or equivalent qualification	1 year

Scholarships or other sources of funding: this programme has funded places for Scottish and EU students as a result of funding provided by the Scottish Funding Council. The funding awards, totaling more than half a million pounds, cover tuition fees and living costs (up to £3,500). Decisions will be made based on academic merit. The University of Aberdeen also provides a possibility to obtain a 20-percent discount on one year of postgraduate studies. It is available to UK, EU and international students that have completed a full undergraduate degree at the Aberdeen University and are applying for full time postgraduate study at the same

University. A full list of funding opportunities available can be found on the College of Physical Sciences Funding webpage[6].

Head of Programme: Dr Thangavel Thevar[7]

The Master of Science Degree in Oil & Gas Engineering is offered by the School of Engineering of the College of Physical Sciences. It provides students with a detailed knowledge of the technology required to ensure energy provision in the oil and gas industry and aims to give both a theoretical and practical grounding equipping them to become future managers of energy projects. Teaching is done by experts from the Engineering, Geology, Chemistry, and the Energy Industry.

The curriculum consists of the following courses:

- Energy Technologies: Current Issues and Future Directions
- Fundamental Concepts in Safety Engineering
- Finding Oil: Geosciences in Exploration and Production
- Project Management
- Oil and Gas Chemistry
- Facilities Engineering
- Well & Reservoir Engineering
- Flow Assurance

In the summer term, students are required to complete a dissertation. This is normally specified in collaboration with industrial partners, supervised either in the School of Engineering or in the companies.

2.1.6. OIL AND GAS STRUCTURAL ENGINEERING MASTER OF SCIENCE

Students in first year	Admission requirements	Duration

[6] http://www.abdn.ac.uk/cops/courses/funding-118.php
[7] http://www.abdn.ac.uk/engineering/people/profiles/t.thevar

	A 2:1 honours degree in Civil or Structural Engineering, or equivalent. Applicants with other relevant qualifications will be considered if they also have significant relevant Structural Engineering professional experience. Ideally all applicants must have at least 1 or 2 years (depending on its nature) of relevant experience. English language requirement: IELTS overall grade of 6.5 with 6.0 in writing, or equivalent qualification	Normally 3 years (maximum 6 years)

No specific scholarship programme. However, the Aberdeen University provides a possibility to obtain a 20-percent discount on one year of postgraduate studies. It is available to UK, EU and international students that have completed a full undergraduate degree at the Aberdeen University and are applying for full time postgraduate study at the same University. A full list of funding opportunities available can be found on the College of Physical Sciences Funding webpage[8].

Head of Programme: Dr Paul Davidson[9]

This Master Programme is provided by the School of Engineering of the College of Physical Sciences and has been developed jointly with the industry in response to a clear need for an effective means of transferring knowledge and skills from senior experts in Industry and the University to the new generation of Structural Engineers.

This degree is fully accredited by the Institution of Civil Engineers (ICE), the Institution of Structural Engineers (IStructE), the Institute of Highway Engineers (IHE) and the Chartered Institution of Highways & Transportation (CIHT). It is accredited as meeting the requirements for Further Learning for a Chartered Engineer (CEng) for candidates who have already acquired an Accredited CEng (Partial) BEng (Hons) or an Accredited IEng (Full) BEng/BSc (Hons) undergraduate first degree.

[8] http://www.abdn.ac.uk/cops/courses/funding-118.php
[9] http://www.abdn.ac.uk/engineering/people/profiles/p.c.davidson

Available as part-time (by distance learning) only, this programme is normally taken over three years (maximum of 6 years is permitted), consisting of two modules at a time in each of the two semesters in each year. Half of the modules are delivered by well-respected structural engineers in the Oil and Gas industry in Aberdeen, from a variety of companies. The remaining modules are delivered by recognised Aberdeen University Academics.

The programme consists of twelve taught modules, which are normally taken two at a time, over three years. The modules have been selected to provide maximum relevance to current and future Industry requirements and are subject to constant monitoring and re-appraisal by an Advisory Board of Industry Representatives.

These modules are the following:

- Conceptual Design of Top-Side Modules (year one)
- Fatigue and Fracture Mechanics (year one)
- Structural Dynamics (year one)
- Design of Connections (year one)
- Blast and Fire Engineering (year two)
- Brownfield Engineering (year two)
- Petrochemical Structural Engineering (year two)
- Finite Element Methods (year two)
- Conceptual Design of Jackets and Subsea Structures (year three)
- Design of Stiffened Plates (year three)
- Re-Assessment of Existing Structures by Structural Reliability Analysis (year three)
- Design of Jacket Attachments (year three)

It is possible to leave the programme after four successful modules and to obtain a Postgraduate Certificate in Oil and Gas Structural Engineering, or after 8 modules to obtain a Post Graduate Diploma in Oil and Gas Structural Engineering.

2.1.7. SUBSEA ENGINEERING MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A UK Honours degree (or an honours degree from a non-UK institution which is judged by the University to be of equivalent worth) in any branch of Engineering at a 2:1 (upper second) class or above. Applicants with slightly lower qualifications in an Engineering subject (e.g. a UK equivalent 2:2 (lower second) class honours degree) may be considered if they can demonstrate they have 5 or more years of professional experience judged by the University to be of direct relevance to the programme. English language requirement: IELTS overall grade of 6.5 with 6.0 in writing, or equivalent qualification	1 year (full time) or 27 months (part time distance learning)

Scholarships or other sources of funding: this programme has funded places for Scottish and EU students as a result of funding provided by the Scottish Funding Council. The funding awards, totaling more than half a million pounds, cover tuition fees and living costs (up to £3,500). Decisions will be made based on academic merit. The University of Aberdeen also provides a possibility to obtain a 20-percent discount on one year of postgraduate studies. It is available to UK, EU and international students that have completed a full undergraduate degree at the Aberdeen University and are applying for full time postgraduate study at the same University. A full list of funding opportunities available can be found on the College of Physical Sciences Funding webpage[10].

Head of Programme: Prof. Ekaterina Pavlovskaia[11]

The Master of Science in Subsea Engineering is provided by the School of Engineering of the College of Physical Sciences. The programme seeks to address the needs of the industry in terms of subject areas of fundamental importance. Its objectives are to provide students with increased technical knowledge and understanding of the development and operation of subsea technologies and

[10] http://www.abdn.ac.uk/cops/courses/funding-118.php
[11] http://www.abdn.ac.uk/engineering/people/profiles/e.pavlovskaia

systems, as well as practical skills.

This degree is fully accredited by the Institute of Marine Engineering, Science & Technology (IMarEST) and Institution of Mechanical Engineers (IMechE), the Institution of Civil Engineers (ICE), the Institution of Structural Engineers (IStructE), the Institute of Highway Engineers (IHE) and the Chartered Institution of Highways & Transportation (CIHT).

Subsea Engineering at the University of Aberdeen has a unique relationship with the subsea industry both locally and internationally. The programme receives contributions from local industrial organisations in terms of relevant contributions to teaching and support in the specification of group and individual projects.

The programme is available as both full-time and part-time (distance learning) study. Distance learning students make use of the University's online virtual learning environment to study via the internet.

The curriculum consists of the following courses[12]:

- Fundamental Safety & Risk Management Concepts
- Project Management
- Subsea Integrity
- Subsea Controls
- Subsea Construction, Inspection & Maintenance
- Pipelines & Soil Mechanics
- Riser Systems & Hydrodynamics
- Flow Assurance

In addition, all students who satisfactorily complete the core modules will undertake an individual project after the final examinations. Projects will normally be specified

[12] More information on the content of each course can be found at: http://www.abdn.ac.uk/study/courses/postgraduate/taught/subsea_engineering

in collaboration with industrial partners. Overseas students may undertake their projects with sponsoring companies in their own countries.

2.1.8. INTEGRATED PETROLEUM GEOSCIENCE MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A degree or equivalent qualification at a high 2.1 (upper second class) or above in Geology, Geophysics or in combined honours, covering sufficient Geology. Students with a first degree in Engineering will not be considered. English language requirement: IELTS overall grade of 7.0 with 6.0 in writing, or equivalent qualification	1 year

No specific scholarship programme. However, the Aberdeen University provides a possibility to obtain a 20-percent discount on one year of postgraduate studies. It is available to UK, EU and international students that have completed a full undergraduate degree at the Aberdeen University and are applying for full time postgraduate study at the same University. A full list of funding opportunities available can be found on the College of Physical Sciences funding website[13].

Head of Programme: Professor David Jolley[14]

The programme is provided by the School of Geosciences in the College of Physical Sciences. It has been running since 1973 and is internationally regarded as one of the top vocational training pathways in the world. The overall aim of this programme is to provide a full training in integrated petroleum geoscience, and it is the only course of this type in Europe.

[13] http://www.abdn.ac.uk/cops/courses/funding-118.php
[14] http://www.abdn.ac.uk/geology/people/details.php?id=d.jolley

Components of the course focus on all aspects of upstream geoscience, from initial exploration for new prospects, through field appraisal and development, to maximising recovery from mature and declining fields. Topics covered include: seismic interpretation, petrophysical analysis, geochemical evaluation, sedimentology, structural analysis, and reservoir modelling. Skills in the analysis of the subsurface are further developed by fieldwork on outcrops and by hands-on experience with core logging.

The curriculum contains the following courses:

- Geophysics and Petrophysics (first term)
- Applied Sedimentology (first term)
- Production Geology (second term)
- Regional Exploration (second term)
- Professional Skills incorporating International Field Trip (second term)

In the summer term, students must complete a final project on a relevant and approved topic.

The Department is well equipped for all types of geoscience research and training. As well as a wide range of analytical equipment, it has many state-of-the-art industry software packages on computer workstations, including Petrel and the entire Landmark seismic interpretation, well log correlation, and modelling suite. The course uses the Geographix Discovery suite in the seismic components.

2.1.9. SAFETY AND RELIABILITY ENGINEERING FOR OIL AND GAS MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A 2:1 (upper second class) UK Honours degree (or an honours degree from a non-UK institution which is judged by the University to be of equivalent worth) in any branch of Engineering, Maths or Physics. English language requirement: IELTS overall grade of 6.5 with 6.0 in writing, or equivalent qualification	1 year (full time) or 27-60 months (part-time study)

Scholarships or other sources of funding: The Lloyd's Register Foundation offers between three and five MSc Safety & Reliability Engineering Scholarships. The scholarship is open to all students wishing to commence the full time MSc in Safety & Reliability Engineering. The scholarship is valued at £ 15000 for the one year duration of the MSc Safety & Reliability Engineering degree course. This will cover UK/EU postgraduate tuition fees, with the remainder providing a maintenance stipend. This programme also has funded places for Scottish and EU students as a result of funding provided by the Scottish Funding Council. The funding awards, totalling more than half a million pounds, cover tuition fees and living costs (up to £ 3500). Decisions will be made based on academic merit. The University of Aberdeen also provides a possibility to obtain a 20-percent discount on one year of postgraduate studies. It is available to UK, EU and international students that have completed a full undergraduate degree at the Aberdeen University and are applying for full time postgraduate study at the same University. A full list of funding opportunities available can be found on the College of Physical Sciences Funding webpage[15].

[15] http://www.abdn.ac.uk/cops/courses/funding-118.php

Head of Programme: Dr John Harrigan[16]

The programme is provided by the School of Engineering of the College of Physical Sciences. It aims to provide education and training at postgraduate level for graduate engineers in the general area of safety engineering, reliability engineering, loss prevention and risk management.

It can be taken on a full-time or part-time basis, and also by part-time distance learning. For full-time students the duration of the programme is 12 months. Part-time campus students attend for the equivalent of one or two days per week over a period of two to three years, and part-time distance-learners study for around 20 hours per week for 27 months.

The programme provides an integrated approach to safety and reliability issues across most of the traditional branches of engineering, and allows students to specialise in offshore engineering, technical safety, reliability, legislations and regulations or human factors.

It consists of two half-sessions, the first running from September to January and the second from February to May. A number of industrially based external lecturers contribute to the programme to provide examples of how theoretical concepts are currently being applied in the industry.

The first half session consists of the following courses:

- Fundamental Safety Engineering & Risk Management Concepts
- Statistics & Probability for Safety, Reliability & Quality
- Fire & Explosion Engineering
- Offshore Oil & Gas Production Systems

[16] http://www.abdn.ac.uk/engineering/people/profiles/j.harrigan

The courses of the second half session are:

- Advanced Methods for Risk & Reliability Assessment
- Applied Risk Analysis & Management
- Process Safety & Reliability
- Human Factors

The programme also requires a final individual project, providing an opportunity for personal research and providing a deeper insight into particular safety and reliability problems. Each year, a large number of projects are carried out in industry placements or being supervised by industrial specialists.

For full-time students taking the programme over 12 months, a dissertation has to be prepared on work undertaken during the final individual project, which will normally be specified in collaboration with industrial partners. For part-time students who are sponsored by their company or who are working for a company approved by the University, a dissertation needs to be prepared on approved project work carried out within that company during the second or third year of the programme.

2.1.10. OIL AND GAS LAW WITH PROFESSIONAL SKILLS MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A 2:1 honours degree in Law (or another related discipline) or equivalent, relevant practical experience in the field of commercial law are beneficial.	1 year (full time) or 2 years (part time)

No specific scholarship programme. However, a full list of funding opportunities available can be found on the School of Law webpage on funding[17].

The Masters in Oil and Gas Law is a programme provided by the University of Aberdeen Law School. It aims to provide the skills and knowledge necessary to work on the legal aspects of the oil and gas industry.

It covers private law aspects of the sector (for e.g. joint ventures and contractual arrangements), as well as public law and regulatory aspects (for e.g. environmental protection, health and safety and taxation). Although the programme is focused on UK oil and gas law, it also looks at the global legal regime for oil and gas.

The University of Aberdeen Law School is said to have one of the largest and most able teams of oil and gas faculty in any European law school, which enables the Law School to provide both strength and depth to the courses provided.

Teaching is organised on a modular basis. The topics covered by this programme are the following:

- Critical Legal Thinking and Analysis
- Oil & Gas Law: State Control
- Oil & Gas Law: Taxation of Upstream
- Oil & Gas Law: Regulation

[17] http://www.abdn.ac.uk/law/courses/costs-and-sources-of-funding-158.php

- Oil & Gas Law Skills: Exploration and Production (the so-called "Professional Skills" module)

Additionally, one further course must be selected from the options available, which would normally be Oil & Gas Law.

The Professional Skills module is an option that is delivered through an intensive summer school during June, followed by time spent in the preparation of the extended essay. The LLM Oil & Gas Law with Professional Skills offers students the opportunity to develop key practical skills required for the legal management of Oil & Gas exploration and production activity. Students in this programme will undertake some additional classes, followed by a simulated practical exercise and submission of a report.

2.1.11. PETROLEUM, ENERGY ECONOMICS AND FINANCE MASTER OF SCIENCE (ECON)

Students in first year	Admission requirements	Duration
	At least an upper second-class honours degree, or equivalent, in any discipline with either a significant quantitative component or some component of either economics or finance. For candidates who do not meet normal admission requirements a Graduate Management Admission test (GMAT) may be requested. English language requirement: IELTS 6.5 or equivalent, with 6.0 in writing and reading	1 year

Scholarships or other sources of funding: this programme has funded places for Scottish and EU students as a result of funding provided by the Scottish Funding Council. The funding awards, totaling more than half a million pounds, cover tuition fees and living costs (up to £3,500). Decisions will be made based on academic merit.

The aim of this programme, introduced in 2008 and provided by the Institute of Energy is to address the need for economic and finance skills in complex decision-making in the petroleum and energy industries.

The programme is structured around 3 semesters and includes the following subjects:

- Economic analysis
- Accounting
- Introduction to corporate finance
- Quantitative methods
- Introduction to energy and petroleum economics
- Business strategy
- Real options and decision making
- Issues in energy and petroleum economics
- Empirical methods in energy economics

During the summer term, students are required to carry out a dissertation project on a topic of choice within the field of economic and finance in the petroleum and energy industries. Past topics have included the analysis of issues in energy infrastructure and energy policy analysis. Students can also carry out their dissertations in collaboration with companies involved in the energy industry.

In addition to the formal teaching of the above-mentioned subjects, visiting speakers working in the energy field will be invited to give lectures to students. Study visits will also be organised to energy industry sites.

2.1.12. OIL AND GAS COMPUTING MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	The programme is aimed at graduates in Computer Science or	1 year

	those with an equivalent qualification. Minimum entry requirement is a UK Honours degree (or an honours degree from a non-UK institution which is judged by the University to be of equivalent worth) at 2:1 (upper second) class or above. English language requirement: IELTS 6.5 or equivalent, with a minimum of 6.0 in writing	

Scholarships or other sources of funding: this programme has funded places for Scottish and EU students as a result of funding provided by the Scottish Funding Council. The funding awards, totaling more than half a million pounds, cover tuition fees and living costs (up to £3,500). Decisions will be made based on academic merit.

This programme, provided by the Institute of Energy, has been developed in collaboration with leading oil and gas companies and service providers in the energy industry to ensure the IT skills in demand in the oil and gas sector are met. The aim of this programme is to provide the industry with graduates with advanced computing science expertise that also know about the sector.

The programme is structured around 3 semesters including the following topics:

- Big data in Oil & Gas
- Security for data, software and data centres
- Sensor networks
- Autonomous intelligent systems
- Computer modeling and simulation
- Cloud computing and Web services
- Mobile computing
- Data visualisation
- Data mining
- Legal aspects of Oil & Gas software and data
- Human-computer interaction and computer-mediated human-human interaction

Once students have successfully completed the required modules, they will be asked to carry out an industry-lead summer project. The best candidates will be hosted at a major oil and gas company.

2.1.13. OIL AND GAS LAW WITH DISSERTATION MASTER OF LAWS

Students in first year	Admission requirements	Duration
	An upper-second-class Honours degree in law or another related discipline, or equivalent. English language requirement: IELTS 6.5 with 6.0 in writing and reading, or equivalent	1 year (full time) or 2-3 years (part time)

Scholarships or other sources of funding: this programme has funded places for Scottish and EU students as a result of funding provided by the Scottish Funding Council. The funding awards, totaling more than half a million pounds, cover tuition fees and living costs (up to £3,500). Decisions will be made based on academic merit. A limited amount of funding is also available through the University and the College of Arts and Social Sciences, for further information please refer to the Law School's website on funding[18].

This programme, provided by the School of Law, aims to give students the adequate skills and knowledge necessary to work on the legal aspects of the development of the oil and gas industry. It covers private law aspects of the sector (for e.g. joint ventures and contractual arrangements), as well as public law and regulatory aspects (for e.g. environmental protection, health and safety and taxation). Although the programme is focused on UK oil and gas law, it also looks at the global legal regime for oil and gas.

The topics covered by this programme are the following:

- Oil and gas law - State control

[18] http://www.abdn.ac.uk/law/courses/costs-and-sources-of-funding-158.php

- Oil and gas law - Contracting
- Oil and gas law - Regulation
- Oil and gas law - Taxation of upstream
- Downstream energy law
- International investment arbitration in the energy sector

Students must complete four courses and a dissertation. The dissertation must be on a topic within the area of specialisation.

2.1.14. RENEWABLE ENERGY ENGINEERING MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A UK honours degree (or an honours degree from a non-UK institution which is judged by the University to be of equivalent worth) in any branch of engineering at a upper second class or above, or honours degree in a relevant physical sciences subject also at an upper second class or above English language requirement: IELTS 6.5 or equivalent, with a minimum of 6.0 in writing	1 year

Scholarships or other sources of funding: this programme has funded places for Scottish and EU students as a result of funding provided by the Scottish Funding Council. The funding awards, totaling more than half a million pounds, cover tuition fees and living costs (up to £3,500). Decisions will be made based on academic merit. Additional funding opportunities can be found on the College of Physical Sciences funding website[19].

The programme looks to provide students with a detailed knowledge of all the major renewable energy sources and the engineering skills associated with them. The programme is suitable for students with mechanical, civil, electrical, chemical and

[19] http://www.abdn.ac.uk/cops/courses/postgraduate-funding-121.php

other suitable engineering backgrounds. It is provided by the School of Engineering of the College of Physical Sciences.

The programme is made up of the following modules:

- Electrical Systems for Renewable Energy
- Renewable Energy 1 (Solar and Geothermal)
- Renewable Energy 2 (Biomass)
- Fundamental Concepts in Safety Engineering
- Renewable Energy 3 (Wind, Marine and Hydro)
- Energy Conversion and Storage
- Renewable Energy Integration to Grid
- Legislation, Planning and Economics

In addition, a dissertation is to be prepared on work undertaken during a final individual project. This project is usually specified in collaboration with industrial partners, supervised in the School of Engineering or in the companies.

2.1.15. PETROPHYSICS AND FORMATION EVALUATION MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	Applicants must be employed in a petroleum company, they should have an honours degree in a STEM subject such as geoscience, chemistry, physics, mathematics or engineering. Other qualification will be considered but must be discussed in advance of application. English language requirement: IELTS 6.5 or equivalent	27-60 months

No specific scholarships or sources of funding offered

This programme is a part-time Continuing Professional Development Master of Science only available to professionals already employed as petrophysicists in the oil and gas industry. It is delivered in partnership with Senergy[20], an energy services

[20] http://www.senergyworld.com/

company. It aims to deliver the practical knowledge and understanding necessary for early career petrophysicists or related disciplines to acquire a masters degree.

The programme consists of the following modules[21]:

- Introduction to petrophysics and its role in the oil and gas industry
- Coring and core analysis
- Integrating petrophysics and seismic data for reservoir characterisation
- Reservoir surveillance and operational petrophysics
- Characterisation of complex reservoirs
- Specialist formation evaluation
- Professional skills and research planning

In addition to the taught modules, the programme also includes the completion of a project in petrophysics and formation evaluation. Students are expected to undertake and complete a study of a problem applicable to the use of petrophysics and formation evaluation in the petroleum industry.

Commonly, the projects are constructed around a current problem a company might be facing, but for which it is short of people. These projects usually involve original research, and have not been worked on before. Students are expected to work on their projects in the offices of their employers.

2.1.16. OIL AND GAS CHEMISTRY MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A lower second class honours degree or above in Chemistry or an upper second class honours degree in a Chemistry related degree.	1 year

[21] Detailed information on the content of each module can be found here: http://www.abdn.ac.uk/study/courses/postgraduate/taught/Petrophysics/

	English language requirement: IELTS 6.5 or equivalent, with a minimum of 6.0 in writing	

Scholarships or other sources of funding: Funding opportunities can be found on the College of Physical Sciences funding website[22].

This programme gives students an insight into the chemistry behind the selection of materials and processes used in the oil and gas sector.

The programme consists of three semesters, each with a set number of modules. These modules include:

- Processes, Materials and Bioremediation for the Energy Industry
- Materials for the Oil and Gas Industry
- Interfacial Chemistry and Enhanced Oil Recovery
- Analytical and Instrumental Methods level 1
- The Oil and Gas Industry level 1
- Research Skills
- Environmental Impact Assessment
- Flow Assurance and Oil Field Chemicals
- Natural Gas and Refinery Processes and Chemistry
- Green Chemistry
- Analytical and Instrumental methods level 2
- The Oil and Gas Industry level 2

In addition, students are required to complete an extended research project in the form of a dissertation at the end of the degree.

2.1.17. HYDROCARBON EXPLORATION MASTER OF SCIENCE (EXPLOHUB)

Students in first year	Admission requirements	Duration
	A UK Honours degree (or an honours degree from a non-UK	4 years

[22] http://www.abdn.ac.uk/cops/courses/postgraduate-funding-121.php

	institution which is judged by the University to be of equivalent worth) in geology (or a closely related subject within the geosciences) and will normally be at upper second class BSc level (2.1). Applicants with slightly lower qualifications (e.g. a UK equivalent lower second (2:2) class honours degree) may be considered if they can demonstrate they have 3, or more, years of professional experience judged by the University to be of direct relevance to the programme. English language requirement: IELTS 6.5 or equivalent, with a minimum of 6.0 in writing	(flexible)

No specific scholarships or sources of funding offered: However, students can be sponsored by their current or future employers.

Head of Programme: Dr Stuart Archer[23]

The Master programme in Hydrocarbon Exploration is run by the University of Aberdeen “exploHUB”. “exploHUB” is a joint industry-academia training initiative which provides an environment that prepares exploration geoscientists for the challenge of discovering hydrocarbon resources. Trainees are immersed in a professional exploration environment where they are supported by expert mentors and state-of-the-art industry standard technologies. exploHUB is classed as "continuing professional development" rather than a post-graduate course. exploHUB attracts primarily early to mid-career industry professionals and focuses on "learning while doing" rather than being classroom dominated.

The exploHUB curriculum is structured around three main modules:

- Global Basin Screening
- Petroleum System Fundamentals
- Play and Prospect Analysis

In order to obtain the Master’s degree in Hydrocarbon Exploration, students must

[23] http://www.abdn.ac.uk/geology/people/details.php?id=s.archer

complete a 3-month independent research project. The project can be designed in collaboration with the sponsor or employer. A list of past projects can be found on the exploHUB webpage[24].

Students also learn to use geoscience related software packages.

Students have access to state of the art learning facilities including 2D seiemic layout tables and a 3D visualization suite. Further information on these facilities can be found on the exploHUB webpage[25].

2.1.18. FACILITIES

In addition to the specific facilities available in the different schools, the University of Aberdeen has an extensive range of research facilities. This includes the "Oceanlab" sub-sea research facility. For further information on the University's facilities please refer to the overview of the campus webpage[26].

[24] http://www.abdn.ac.uk/explohub/masters-project-63.php
[25] http://www.abdn.ac.uk/explohub/about/learning-environment-216.php
[26] http://www.abdn.ac.uk/about/campus/index.php

2.2 NEWCASTLE UNIVERSITY

Newcastle University is a public research university, based in Newcastle-Upon-Tyne and is one of the leading universities in the UK. Originally part of the University of Durham, Newcastle University became independent in 1963.

For the academic year 2013-2014, the University counted 22874 students in total, of which around 5000 were from overseas (non-EU). The total number of staff for 2013-2014 was 5429.

The University is divided into three faculties: "Medical Sciences", "Science, Agriculture and Engineering", and "Humanities, Arts and Social Sciences". Each faculty is made up of a number of different schools.

Of particular interest is the Faculty of "Science, Agriculture and Engineering", and its "School of Marine Science and Technology[27]" and "School of Civil Engineering and Geosciences[28]". These schools offers a number of undergraduate and postgraduate degrees teaching various aspects of the offshore profession.

2.2.1. UNDERGRADUATE PROGRAMMES

2.2.2. MARINE TECHNOLOGY WITH OFFSHORE ENGINEERING BACHELOR OF ENGINEERING WITH HONOURS

Students in first year	Admission requirements	Duration
	A level results of AAB-ABB including Mathematics and preferably Physics and/or Chemistry (or other equivalent qualification) English language requirement: IELTS 6.0 or equivalent	3 years

[27] http://www.ncl.ac.uk/marine/
[28] http://www.ncl.ac.uk/ceg/

No specific scholarship programme

This professionally accredited three-year Offshore Engineering Bachelor of Engineering (BEng Honours) degree addresses the demands of the offshore engineering industry and provides students with a basis in engineering fundamentals. Students are taught the ability to design and produce fixed and floating offshore oil and gas production installations, and the crafts which service these and other offshore resource developments.

This degree is accredited by the Institute of Marine Engineering, Science and Technology[29] (IMarEST), the Royal Institution of Naval Architects[30], and the Engineering Council[31], providing industry-wide recognition of this qualification.

The degree is divided into three stages, each stage lasting one academic year. The different modules of these stages include:

Stage 1 - Compulsory modules:

- EEE1007 Electrical Engineering I (For MAR)
- ENG1001 Engineering Mathematics I
- MAR1001 Marine Engineering Practice I
- MAR1002 Marine Statistics
- MAR1003 Naval Architecture I
- MAR1004 Marine Informatics I
- MAR1005 Marine Production Management I
- MAR1006 Marine Engineering Science 1
- MAR1007 Materials in the Marine Environment
- MAR1009 Marine Mechanics

[29] http://www.imarest.org
[30] http://www.rina.org.uk
[31] http://www.engc.org.uk

Stage 2 - Compulsory modules:

- ENG2001 Accounting, Finance and Law for Engineers
- ENG2008 Analytical Methods in Marine Technology
- MAR2001 Marine Dynamics
- MAR2002 Marine Engineering Practice II
- MAR2006 Marine Structures IA
- MAR2007 Marine Structures IB
- MAR2008 Naval Architecture II
- MAR2010 Resistance and Propulsion I
- MAR2012 Engineering Applications
- MAR2013 Marine Production Management II
- MAR2014 Marine Informatics II

Stage 3 - Compulsory modules:

- MAR3003 Offshore Design
- MAR3019 Marine Structures IIA
- MAR3021 Marine Transport Business
- MAR3024 Fluid Structure Interaction Modelling
- MAR3026 Marine and Offshore Mechanics
- MAR3027 Future Marine Projects
- MAR3098 Project and Report

Optional modules:

- EEE3010 Microprocessor Control
- ENG8017 Management of New Product Introduction
- MAR3012 Dynamic Modelling and Simulation
- MAR3013 Internal Combustion Engines
- MAR3015 Small Craft Powering
- MAR3016 Marine Engineering III
- MAR3017 Resistance and Propulsion II
- MAR3022 Maritime Systems Analysis

- MAR3023 Offshore Vehicle Design
- MAR3025 Offshore Studies
- MAR3030 Naval Architecture III
- MAR3031 Ship Manoeuvring Performance and Operability
- MAR8038 High Speed and Advanced Craft

The programme consists of a combination of lectures, seminars (with speakers from industry and academia), and practical work. It also includes study visits in order for students to see the applications of marine technology in a range of organisations, including local and national marine production facilities, offshore rigs, and platform building sites.

This degree is organised by the School of Marine Science and Technology. This School has staff and students from all over the world. Networking opportunities are offered to students through the local joint branch of Naval Architects and the IMarEST, which is hosted in the School.

The student society, WETSOC, organises social activities, trips abroad, visits from employers and trips to conferences around the UK. The School also organises trips during the summer vacation, including visits to the university's marine campus in Singapore. Working in collaboration with the Singapore Institute of Technology, Newcastle University also offers a full-time Bachelor's degree in Offshore Engineering in Singapore.

2.2.3. MARINE TECHNOLOGY WITH OFFSHORE ENGINEERING MASTER OF ENGINEERING HONOURS

Students in first year	Admission requirements	Duration
	A level results of AAB including Mathematics and preferably Physics and/or Chemistry (or other non-UK equivalent qualification) English language requirement: IELTS 6.0 or equivalent	4 years

No specific scholarship programme

This professionally accredited four-year Offshore Engineering Master of Engineering Honours (MEng Honours) degree also addresses the demands of the offshore engineering industry, and provides students with a basis in engineering fundamentals. Compared to the Bachelor of Engineering described above, this degree allows students to study offshore engineering at a greater depth.

Both the Bachelor of Engineering and the Master of Engineering degrees give students the opportunity to become Chartered Engineer's (CEng). However the Master's is considered a more direct route to becoming a Chartered Engineer as students do need to undertake any further study.

With this degree students are taught the ability to design and produce fixed and floating offshore oil and gas production installations, and the crafts which service these and other offshore resource developments.

This degree is also accredited by the Institute of Marine Engineering, Science and Technology[32] (IMarEST), the Royal Institution of Naval Architects[33], and the Engineering Council[34].

This degree is divided into four stages, each stage lasting one academic year. The different modules of these stages include:

Stage 1 - Compulsory modules:

- EEE1007 Electrical Engineering I (For MAR)
- ENG1001 Engineering Mathematics I
- MAR1001 Marine Engineering Practice I
- MAR1002 Marine Statistics

[32] http://www.imarest.org
[33] http://www.rina.org.uk
[34] http://www.engc.org.uk

- MAR1003 Naval Architecture I
- MAR1004 Marine Informatics I
- MAR1005 Marine Production Management I
- MAR1006 Marine Engineering Science 1
- MAR1007 Materials in the Marine Environment
- MAR1009 Marine Mechanics

Stage 2 - Compulsory modules:

- ENG2001 Accounting, Finance and Law for Engineers
- ENG2008 Analytical Methods in Marine Technology
- MAR2001 Marine Dynamics
- MAR2002 Marine Engineering Practice II
- MAR2006 Marine Structures IA
- MAR2007 Marine Structures IB
- MAR2008 Naval Architecture II
- MAR2010 Resistance and Propulsion I
- MAR2012 Engineering Applications
- MAR2013 Marine Production Management II
- MAR2014 Marine Informatics II

Stage 3 - Compulsory modules:

- MAR3003 Offshore Design
- MAR3019 Marine Structures IIA
- MAR3021 Marine Transport Business
- MAR3024 Fluid Structure Interaction Modelling
- MAR3026 Marine and Offshore Mechanics
- MAR3027 Future Marine Projects
- MAR3098 Project and Report

Optional modules:

- EEE3010 Microprocessor Control

- ENG8017 Management of New Product Introduction
- MAR3012 Dynamic Modelling and Simulation
- MAR3013 Internal Combustion Engines
- MAR3015 Small Craft Powering
- MAR3016 Marine Engineering III
- MAR3017 Resistance and Propulsion II
- MAR3022 Maritime Systems Analysis
- MAR3023 Offshore Vehicle Design
- MAR3030 Naval Architecture III
- MAR3031 Ship Manoeuvering Performance and Operability
- MAR8038 High Speed and Advanced Craft

Stage 4 - Compulsory modules:

- MAR8021 Advanced Offshore Design
- MAR8022 Marine Management Technology II
- MAR8043 Shipping Market Analysis and Risk Management
- MAR8059 Mooring and Riser Systems
- MAR8403 Theory of Plates and Grillages
- MAR8499 Group Project and Report

Optional modules:

- CME8012 Business and Environmental Management
- ENG8016 Advanced Computer-Aided Engineering
- ENG8017 Management of New Product Introduction
- MAR8003 Marine Transmission Systems
- MAR8005 Design and Implementation of Experiments
- MAR8024 Ship Performance at Sea
- MAR8026 Marine Machinery Systems
- MAR8027 Structural Response Analysis
- MAR8034 Advanced Hydrodynamics
- MAR8035 Management and Communications

- MAR8038 High Speed and Advanced Craft
- MAR8404 Further Design Studies (Marine Engineering)
- MAR8405 Further Design Studies (Naval Architecture)
- MAR8407 Further Design Studies (Small Craft Technology)

The degree programme, similarly to the Bachelor's degree, consists of a combination of lectures, seminars, practical work and study visits (including to offshore rigs and platform building sites).

This degree is organised by the School of Marine Science and Technology. For further information about the opportunities offered by this school to undergraduate students, please refer to the information in the section above.

2.2.4. POSTGRADUATE PROGRAMMES

2.2.5. RENEWABLE ENERGY ENTERPRISE AND MANAGEMENT (REEM)

Students in first year	Admission requirements	Duration
	A minimum of a second-class Honours degree, or equivalent, in a relevant subject such as geography, planning, surveying, business, economics, social policy, politics, product design, industrial management, environmental management, physical or Earth sciences. Applicants who do not meet the standard entry requirement should submit a CV detailing qualifications and experience. English language requirement: IELTS 6.5 or equivalent	Varies (see below for details)

Scholarship and other sources of funding: Newcastle University offers International Scholarships[35], and provides a list of available funding opportunities by external organisations[36]. Students can also consult their employers for sponsorship opportunities.

[35] http://www.ncl.ac.uk/postgraduate/international/finance/awards/uniawards.htm
[36] http://www.ncl.ac.uk/postgraduate/international/finance/awards/extawards.htm

This postgraduate degree can be taken as a Master of Science (12 months full time; 60 months maximum part time), a Postgraduate Diploma (9 months full time; 60 months maximum part time), or a Postgraduate Certificate (6 months minimum full time; 36 months maximum part time). Certain modules contained in this degree can also be taken in the context of Continuing Professional Development (CPD).

This programme is directed at students from different backgrounds who want to develop knowledge and expertise in renewable energy, enterprise and management. The programme covers issues such as: the social, political and economic climate in which renewable energy must work; the environmental impact of renewable energy exploitation; planning and managing the future development and direction of the renewable energy industry; and starting and running a business.

This programme consists of a combination of distance learning and one-week intensive courses. All students take compulsory modules, and Certificate, Diploma and Master students choose between a number of additional optional modules. Diploma and Master students then undertake a research project.

The compulsory modules include:

- MST8010 Project Management Application
- SPG8009 Renewable Energy: Policy, Politics and Ethics
- SPG8012 Renewable Energy: Energy Management
- SPG8013 Environmental Impact Assessment (Flexible Learning)
- SPG8014 Introduction to Hydro, Wind, Wave and Tidal Energy
- SPG8015 Introduction to Enterprise and Entrepreneurship in Science and Engineering
- SPG8016 Business Enterprise in Science and Engineering
- SPG8017 Introduction to Bioenergy and Photovoltaics
- SPG8024 Quantifying Energy Decision Making
- SPG8025 Energy from Earth
- SPG8094 Enterprise Project

This degree is organised by the School of Marine Science and Technology.

2.2.6. RENEWABLE ENERGY FLEXIBLE TRAINING PROGRAMME (REFLEX)

Students in first year	Admission requirements	Duration
	A minimum of a second-class Honours degree, or equivalent English language requirement: IELTS 6.5 or equivalent	Varies (see below for details)

Scholarship and other sources of funding: Newcastle University offers International Scholarships[37], and provides a list of available funding opportunities by external organisations[38]. Students can also consult their employers for sponsorship opportunities.

This postgraduate degree can be taken as a Master of Science (12 months full time; 60 months maximum part time), a Postgraduate Diploma (nine months full time; 60 months maximum part time), or a Postgraduate Certificate (six months minimum full time; 36 months maximum part time).

This programme, approved by the Energy Institute, The Institute of Marine Engineering, Science & Technology (IMarEST), The Institution of Mechanical Engineers (IMechE) and The Institution of Engineering and Technology (IET), is designed to meet the needs of an expanding and developing renewable energy industry. The programme looks at the complete renewable energy technology industry and provides students with training in mechanical, electrical, chemical, marine/offshore engineering, photovoltaic's, geothermal energy, and economics.
Students of the Master of Science have to complete the 12 modules in addition to a research project and a dissertation. Diploma students must complete nine modules

[37] http://www.ncl.ac.uk/postgraduate/international/finance/awards/uniawards.htm
[38] http://www.ncl.ac.uk/postgraduate/international/finance/awards/extawards.htm

and carry a research project and report. The Certificate students must complete six modules. Each module is delivered by a combination of distance learning and a one-week intensive course.

The compulsory modules include:

- SPG8001 Renewable Energy: Resources
- SPG8002 Renewable Energy: Photovoltaics and Geothermal Energy
- SPG8003 Renewable Energy: Electrical Generation Systems
- SPG8004 Renewable Energy: Grid Systems
- SPG8005 Renewable Energy: Mechanical Power Transmission
- SPG8006 Renewable Energy: Wind and Hydro Energy Technology
- SPG8007 Renewable Energy: Hydrogen and Fuel Cell Technology
- SPG8008 Renewable Energy: Biomass and Waste Technology
- SPG8009 Renewable Energy: Policy, Politics and Ethics
- SPG8010 Renewable Energy: Marine and Offshore Devices
- SPG8011 Renewable Energy: Marine and Offshore Structures and Systems
- SPG8012 Renewable Energy: Energy Management
- SPG8095 Renewable Energy: Masters Project and Report

This degree is organised by the School of Marine Science and Technology.

2.2.7. MARINE AND OFFSHORE POWER SYSTEMS MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A second-class Honours degree, or international equivalent. Relevant professional experience is desirable, although not essential English language requirement: IELTS 6.5 or equivalent	1 year

Scholarship and other sources of funding: Newcastle University offers International Scholarships[39], and provides a list of available funding opportunities by external

[39] http://www.ncl.ac.uk/postgraduate/international/finance/awards/uniawards.htm

organisations[40]. Students can also consult their employers for sponsorship opportunities.

This programme is aimed at graduate engineers who wish to specialise in the design, analysis and operation of power systems on ships and offshore structures. It provides students with an overview of the dynamic behaviour of ocean engineering system and the operational techniques and analysis for its evaluation.

The degree aims to develop the knowledge and understanding of students in:

- Design, selection, analysis and installation of marine transmission systems
- Interaction between the external loading and structural behaviour of ocean engineering system
- Key areas associated with advanced offshore design
- Mathematics and physics appropriate to marine technology and related fields
- Management principles and business practices
- Production practice including codes of practice and regulatory framework

The programme also develops the students' practical skills in order to:

- Select and apply appropriate mathematical and computer based methods for modeling and analysing relevant problems
- Use scientific principles in the development of engineering solutions to practical problems
- Use scientific principles in the modeling and analysis of engineering systems, processes and products
- Test design ideas practically through laboratory work or simulation with technical analysis and to evaluate the results critically
- Integrate and evaluate information and data from a variety of sources

A description of the different modules of this programme can be found below:

[40] http://www.ncl.ac.uk/postgraduate/international/finance/awards/extawards.htm

Compulsory modules:

- MAR8001 Research Skills
- MAR8003 Marine Transmission Systems
- MAR8021 Advanced Offshore Design
- MAR8025 Ship Propulsion
- MAR8026 Marine Machinery Systems
- MAR8063 Marine Electrical Power Systems
- MAR8098 Dissertation

Optional modules:

- MAR8011 Dynamics of Offshore Installations
- MAR8017 Marine Electro-Technology
- MAR8018 Optimal Marine Design
- MAR8022 Marine Production Business
- MAR8023 Surveying Ships and Offshore Installations
- MAR8059 Mooring and Riser Systems

This degree is organised by the School of Marine Science and Technology.

2.2.8. MARINE ENGINEERING MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A second-class Honours degree, or international equivalent. Relevant professional experience is desirable, although not essential. English language requirement: IELTS 6.5 or equivalent	1 year

Scholarship and other sources of funding: Newcastle University offers International Scholarships[41], and provides a list of available funding opportunities by external

[41] http://www.ncl.ac.uk/postgraduate/international/finance/awards/uniawards.htm

organisations[42]. Students can also consult their employers for sponsorship opportunities.

This programme is designed to give students a sound knowledge of marine engineering and its practical application. It provides an overview of subjects associated with 'Naval architecture (hull and propulsion)' and 'Marine Engineering (machinery).

The programme aims at developing the knowledge and understanding of:

- Design, selection, analysis and installation of marine transmission systems
- Key areas associated with advanced offshore design
- Mathematics and physics appropriate to marine technology and related fields
- Management principles and business practices
- Production practice including codes of practice and regulatory framework

The programme also looks to develop practical skills in order to:

- Select and apply appropriate mathematical and computer based methods for modeling and analysing relevant problems
- Use scientific principles in the development of engineering solutions to practical problems
- Use scientific principles in the modeling and analysis of engineering systems, processes and products
- Test design ideas practically through laboratory work or simulation with technical analysis and to evaluate the results critically
- Integrate and evaluate information and data from a variety of sources

A description of the different modules of this programme can be found below:

Compulsory modules:

- MAR8001 Research Skills

[42] http://www.ncl.ac.uk/postgraduate/international/finance/awards/extawards.htm

- MAR8003 Marine Transmission Systems
- MAR8024 Ship Performance at Sea
- MAR8025 Ship Propulsion
- MAR8026 Marine Machinery Systems
- MAR8031 Marine Electrical Power Systems
- MAR8032 Marine Electric Propulsion
- MAR8098 Dissertation

Optional modules:

- MAR8017 Marine Electro-Technology
- MAR8018 Optimal Marine Design
- MAR8022 Marine Production Business
- MAR8023 Surveying Ships and Offshore Installations
- MAR8029 Marine Transport and Economics

This degree is organised by the School of Marine Science and Technology.

2.2.9. MARINE STRUCTURE AND INTEGRITY MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A second-class Honours degree, or international equivalent. Relevant professional experience is desirable, although not essential. English language requirement: IELTS 6.5 or equivalent	1 year

Scholarship and other sources of funding: Newcastle University offers International Scholarships[43], and provides a list of available funding opportunities by external organisations [44]. Students can also consult their employers for sponsorship opportunities.

[43] http://www.ncl.ac.uk/postgraduate/international/finance/awards/uniawards.htm
[44] http://www.ncl.ac.uk/postgraduate/international/finance/awards/extawards.htm

This programme is directed at students wanting to specialise in structural design and analysis of ships, fixed and floating offshore oil and gas platforms and pipelines. The programme includes taught modules, a research project and a dissertation.

A description of the different modules of this programme can be found below:

Compulsory modules:

- CME8040 Corrosion and Corrosion Control
- MAR8001 Research Skills
- MAR8011 Dynamics of Offshore Installations
- MAR8018 Optimal Marine Design
- MAR8027 Structural Response Analysis
- MAR8062 Structural Integrity of Pipelines
- MAR8098 Dissertation
- MAR8403 Theory of Plates and Grillages

Optional modules:

- MAR8012 Design and Construction
- MAR8002 Marine Fluid Dynamics
- MAR8022 Marine Production Business
- MAR8023 Surveying Ships and Offshore Installations

This degree is organised by the School of Marine Science and Technology.

2.2.10. MARINE TECHNOLOGY EDUCATION CONSORTIUM (MTEC)

Students in first year	Admission requirements	Duration
	A second-class Honours degree, or equivalent. English language requirement: IELTS 6.5 or equivalent	Varies (see below for details)

Scholarship and other sources of funding: Nine bursaries of £3,600 are available to students applying for the marine renewable energy technology stream.

This programme is offered by the Marine Technology Education Consortium (MTEC). MTEC is a consortium of four UK universities recognised for their excellence in marine technology education and research: University of Newcastle, University of Strathclyde in Glasgow, University of Southampton and University College London (UCL). It is designed specifically for graduates in the marine industry and teaches new and advanced technical and managerial skills, in conjunction with business and management applications. Each module is delivered by a combination of distance learning and a one-week intensive course.

This postgraduate degree can be taken as a Master of Science, a Postgraduate Diploma, a Postgraduate Certificate or a Certificate (Rolls Royce plc).

The Master and Diploma are accredited for students seeking Chartered Engineer registration by the Institute of Marine Engineering, Science and Technology, the Institution of Mechanical Engineers and the Royal Institution of Naval Architects. The programme also links in with the Rolls-Royce graduate training programme.

Eight technology streams are available for those studying for the Master or Diploma: naval architecture; marine engineering; offshore engineering; small craft design; classification and survey; conversion and repair; defence; and marine renewable energy.

More information about the MTEC modules can be found here: http://www.mtec.ac.uk/mod_list.html

This degree is organised by the School of Marine Science and Technology.

2.2.11. OFFSHORE AND ENVIRONMENTAL TECHNOLOGY MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A second-class Honours degree, or equivalent, in engineering or another relevant subject. Practical experience in the relevant field is desirable, although not essential. English language requirement: IELTS 6.5 or equivalent	1 year

Scholarships or other sources of funding: the School of Marine Science and Technology offers Research Studentships. Newcastle University also offers International Scholarships[45], and provides a list of available funding opportunities by external organisations[46]. Students can also consult their employers for sponsorship opportunities.

This programme is directed at students wanting to specialise in the design and operation of offshore oil and gas platforms, production, process and transportation of hydrocarbons.

The programme looks to provide students with:

- A sound theoretical grasp of offshore engineering, and the ability to apply knowledge practically through real world industry projects
- Awareness of social and environmental needs when applying engineering knowledge
- Experience of testing design ideas through laboratory work or simulation plus technical analysis and critical results evaluation
- Confidence in applying professional judgment to balance risks, costs, benefits, safety, reliability, aesthetics and environmental impact
- Transferable skills in computing, IT, data collection and analysis, problem formulation and solving, and communication

[45] http://www.ncl.ac.uk/postgraduate/international/finance/awards/uniawards.htm
[46] http://www.ncl.ac.uk/postgraduate/international/finance/awards/extawards.htm

On completion of the programme students are expected to:

- Be able to design creative and innovative systems, whilst applying mathematical and computer based methods for modeling and analysis
- Be skilled in management principles and business practices, including project-management
- Have the knowledge required to contribute to the international maritime industry at professional engineering level

The programme consists of a number of taught modules, a research project and a dissertation.

Compulsory modules:

- CME8021 Safety, Risk and Environmental Management
- CME8022 Hydrocarbon Production and Process Engineering
- LAW8035 Foundations of Environmental Law and Policy
- MAR8001 Research Skills
- MAR8002 Marine Fluid Dynamics
- MAR8022 Marine Production Business
- MAR8098 Dissertation

Optional modules:

- CEG3003 Engineering Ethics and Sustainability
- CEG8101 Core Concepts in Environmental Engineering
- LAW3010 Company Law
- MAR8059 Mooring and Riser Systems

This degree is organised by the School of Marine Science and Technology.

2.2.12. OFFSHORE ENGINEERING MASTER OF SCIENCE

Students in first year	Admission requirements	Duration

	A second-class Honours degree, or equivalent, in engineering or another relevant subject. Practical experience in the relevant field is desirable, although not essential. English language requirement: IELTS 6.5 or equivalent	1 year

Scholarships or other sources of funding: the School of Marine Science and Technology offers Research Studentships. The Petrofac/Royal Academy of Engineering also offers Fellowships for the Enhanced Graduate Engineer. In addition, Newcastle University offers International Scholarships[47], and provides a list of available funding opportunities by external organisations[48]. Students can also consult their employers for sponsorship opportunities.

This programme aims at students who want to specialise in the design, dynamic and strength analysis of fixed and floating offshore oil and gas platforms as well as subsea systems including marine systems to produce renewable energy.

The programme looks to provide students with:

- A sound theoretical grasp of offshore engineering, and the ability to apply knowledge practically through real world industry projects
- Awareness of social and environmental needs when applying engineering knowledge
- Experience of testing design ideas through laboratory work or simulation plus technical analysis and critical results evaluation
- Confidence in applying professional judgment to balance risks, costs, benefits, safety, reliability, aesthetics and environmental impact
- Transferable skills in computing, IT, data collection and analysis, problem formulation and solving, and communication

On completion of the programme students are expected to:

[47] http://www.ncl.ac.uk/postgraduate/international/finance/awards/uniawards.htm
[48] http://www.ncl.ac.uk/postgraduate/international/finance/awards/extawards.htm

- Be able to design creative and innovative systems, whilst applying mathematical and computer based methods for modeling and analysis
- Be skilled in management principles and business practices, including project-management
- Have the knowledge required to contribute to the international maritime industry at professional engineering level

The programme consists of a number of taught modules, a research project and a dissertation.

Compulsory modules:

- MAR8001 Research Skills
- MAR8002 Marine Fluid Dynamics
- MAR8021 Advanced Offshore Design
- MAR8027 Structural Response Analysis
- MAR8059 Mooring and Riser Systems
- MAR8062 Structural Integrity of Pipelines
- MAR8098 Dissertation
- MAR8403 Theory of Plates and Grillages

Optional modules :

- MAR8018 Optimal Marine Design
- MAR8022 Marine Production Business
- MAR8023 Surveying Ships and Offshore Installations
- MAR8034 Advanced Hydrodynamics

This degree is organised by the School of Marine Science and Technology.

2.2.13. PETROLEUM GEOCHEMISTRY MASTER OF SCIENCE

Students in first year	Admission requirements	Duration

	A second-class Honours degree, or international equivalent, in an appropriate discipline. Relevant work experience is desirable, although not essential. English language requirement: IELTS 6.5 or equivalent	1 year

Scholarships or other sources of funding: the School of Civil Engineering and Geosciences offers Research Studentships. In addition, Newcastle University offers International Scholarships[49], and provides a list of available funding opportunities by external organisations[50].

This programme is aimed at those wanting to pursue a career in petroleum exploration and its related service industries or further academic research in this area. The programme is accredited by the Geological Society of London and Joint Board of Moderators (JBM).

The programme covers the following areas of expertise:

- Origin of petroleum source rock and processes of oil and gas generation in sedimentary basins
- Processes influencing petroleum migration and trapping
- Geochemistry of petroleum reservoirs
- Geochemistry of molecular marker compounds in sediments and crude oils and their uses and limitations
- Role played by the petroleum geochemist in the oil and gas industries, especially in petroleum systems analysis and appraisals of hydrocarbon prospectively
- Principles, applications and limitations of the main analytical techniques used in petroleum geochemistry
- Theory and practice of microscopy in the study of sedimentary organic matter and its value and limitations

[49] http://www.ncl.ac.uk/postgraduate/international/finance/awards/uniawards.htm
[50] http://www.ncl.ac.uk/postgraduate/international/finance/awards/extawards.htm

Students will gain skills enabling them to:

- Critically assess the quality of data generated by analytical geochemical techniques
- Present and summarise such data in graphical and tabular form, and critically appraise its significance, using statistical techniques where applicable
- Understand the principles, applications and limitations of the main analytical techniques used in petroleum geochemistry
- Acquire practical experience of modern organic geochemical techniques
- Plan, execute and present a research project

This degree is accredited as meeting the requirements for Further Learning for a Chartered Engineer (CEng) for candidates who have already acquired an Accredited CEng (Partial) BEng (Hons) undergraduate first degree or an Accredited IEng (Full) BEng / BSc (Hons) undergraduate first degree.

The programme consists of a compulsory taught modules, followed by a summer research project written up as a dissertation. The modules include:

- CEG8601 Research Methods
- CEG8621 Molecular Marker Compounds
- CEG8623 Maturation and the Generation of Oil and Gas
- CEG8624 Migration and Reservoir Geochemistry
- CEG8625 Chemical Analysis of Organic Matter
- CEG8626 Petroleum in the Environment
- CEG8627 Geology of the Wessex Basin
- CEG8628 Petroleum Systems Analysis of the Wessex Basin
- CEG8629 Petroleum Systems Analysis
- CEG8632 Sedimentary Organic Matter 1
- CEG8633 Sedimentary Organic Matter 2
- CEG8705 Geographic Information Systems
- CEG8699 MSc Project and Dissertation in Geosciences

This degree is organised by the School of Civil Engineering and Geosciences.

2.2.14. ENVIRONMENTAL AND PETROLEUM GEOCHEMISTRY MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A minimum of a second-class Honours degree, or an international equivalent, in an engineering or science subject. Other qualifications or relevant professional experience are also considered. English language requirement: IELTS 6.5, with a minimum of 6.0 in each category, or equivalent	1 year (full time), or up to 4 years part time

Scholarships or other sources of funding: the School of Civil Engineering and Geosciences provides some postgraduate funding.

This programme is an introduction to environmental geochemistry for those wanting to follow a research-oriented career path. It also aims to provide students with advanced understanding, knowledge and specialist technical skills for a career in the environmental industry with a focus on the interactions between petroleum and the environment.

The progamme provides students with an advanced knowledge and understanding in the areas of:

- Low temperature geochemistry of waters, soils and sediments
- The fundamental role of micro-organisms in catalysing low temperature geochemical reactions
- Origins, toxicity and ultimate fates of pollutants
- Modern techniques for the analysis of environmental materials
- Impact and geochemistry of oil in the environment

The programme consists of compulsory taught modules followed by a summer research project written up as a dissertation.

Students can choose between a wide range of dissertation projects including laboratory, field work and computer-based modeling. They will also have the opportunity to work alongside one of the university's established research groups, and some placement projects may be available with industrial partners.

The modules of this programme are:

- CEG8405 Air Pollution
- CEG8601 Research Methods
- CEG8604 Introduction to Microbiology and Microbial Transformation of Pollutants
- CEG8605 Aqueous Geochemistry
- CEG8606 Sources Fates and Control of Pollutants
- CEG8608 Contaminated Land
- CEG8621 Molecular Marker Compounds
- CEG8626 Petroleum in the Environment
- CEG8632 Sedimentary Organic Matter
- CEG8634 Environmental Analytical Geochemistry
- CEG8705 Geographic Information Systems
- CEG8695 Consultancy Project **OR** CEG8696 MSc Project and Dissertation in Geosciences

This degree is organised by the School of Civil Engineering and Geosciences.

2.2.15. PIPELINE ENGINEERING MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	A first-class or upper-second-class Honours degree, or equivalent, in a relevant engineering subject is preferred. English language requirement: IELTS 6.5, or equivalent	Varies (see below for details)

Scholarship and other sources of funding: Newcastle University offers International Scholarships[51], and provides a list of available funding opportunities by external organisations[52]. Students can also consult their employers for sponsorship opportunities.

This postgraduate degree can be taken as a Master of Science (12 months full time; 24 months part time), a Postgraduate Diploma (12 months full time; 24 months maximum part time), or a Postgraduate Certificate (12 months minimum full time; 24 months maximum part time).

This programme is directed at students wanting to practise as pipeline engineers. It is the only accessible Master of Science course dedicated to high pressure oil and gas pipeline engineering in the world.

In order to tailor the programme to the needs of the industry, the oil and gas industry is involved in the development of the curriculum.

The programme aims to give students:

- An understanding of the key steps in a pipeline's lifecycle: design, construction, installation, asset management, maintenance and dismantling, and the technical issues affecting them
- Invaluable experience from specialists in pipeline operating, construction, integrity and consulting, providing real issues, problems and solutions
- The ability to propose, test and evaluate a thesis through selection of appropriate experimental, computer simulation or data analysis procedures
- Skills in identifying, designing and applying laboratory tests to solve pipeline engineering problems
- Knowledge in selecting and applying appropriate mathematical models in the simulation and analysis of pipeline engineering problems and data

[51] http://www.ncl.ac.uk/postgraduate/international/finance/awards/uniawards.htm
[52] http://www.ncl.ac.uk/postgraduate/international/finance/awards/extawards.htm

On completion of the programme students will be regarded as competent to practise as a pipeline engineer by prospective employers.

For the Master of Science students take compulsory modules, in addition to a research project and a dissertation.

For the Postgraduate Diploma and the Postgraduate Certificate students take both compulsory modules and optional modules.

Compulsory modules:

- CME8021 Safety, Risk and Environmental Management
- CME8022 Hydrocarbon Production and Process Engineering
- CME8039 Materials and Fabrication
- CME8040 Corrosion and Corrosion Control
- MAR8009 Fundamentals of Pipeline Engineering
- MAR8010 Pipeline Structural Analysis
- MAR8011 Dynamics of Offshore Installations
- MAR8012 Design and Construction
- MAR8013 Asset Management
- MAR8053 Elements of Economics and Business Finance
- MAR8057 Civil and Geotechnical Aspects of Pipeline Engineering
- MAR8097 Pipeline Engineering Project

This degree is organised by the School of Marine Science and Technology.

2.2.16. SUBSEA ENGINEERING AND MANAGEMENT MASTER OF SCIENCE

Students in first year	Admission requirements	Duration
	An upper-second-class Honours degree in a relevant	1 year (full time),

	discipline, or international equivalent English language requirement: IELTS 6.5, or equivalent	or 2-3 years (part time)

Scholarship and other sources of funding: Newcastle University offers International Scholarships[53], and provides a list of available funding opportunities by external organisations[54]. Students can also consult their employers for sponsorship opportunities.

This programme aims at experienced and recently graduated engineers wanting to develop their subsea knowledge given that subsea engineering plays a vital role in the exploitation of oil and gas resources. In order to tailor make the programme to the needs of the industry, the curriculum has been developed in collaboration with industry partners.

The programme consists of taught modules delivered in short 'intensive schools' and feature industry guest speakers, site visits, industry-based projects and multidisciplinary teaching. The taught modules are sometimes combined with assignments. Students will also undertake a research project leading to a dissertation. The research project is supported by an academic supervisor and may be conducted with an industrial partner which, where appropriate, can be the student's employer.

Compulsory modules:

- EEE8072 Subsea Control and Communication Systems
- MAR8045 Fundamentals of Subsea Engineering - Semester 1
- MAR8046 Materials and Corrosion Aspects of Subsea Engineering
- MAR8047 Reliability and Integrity Management of Subsea Systems
- MAR8048 Subsea Surveying, Positioning and Installation
- MAR8049 Subsea Engineering and Management Project

[53] http://www.ncl.ac.uk/postgraduate/international/finance/awards/uniawards.htm
[54] http://www.ncl.ac.uk/postgraduate/international/finance/awards/extawards.htm

- MAR8050 Deepwater Pipelines
- MAR8051 Design and Manufacture of Pipelines, Risers and Umbilicals
- MAR8052 Dynamics of Subsea Installations
- MST8020 Subsea Project Management Application
- NBS8242 Advanced Operations Management

This degree is organised by the School of Marine Science and Technology.

2.2.17. FACILITIES

The University is well equipped for a range of practical work and students will also have access to local workshops for hands-on experience. The School of Marine Science and Technology in particular has invested in modern laboratories integrated with the central research facilities of the University.

The School also benefits from a dedicated network of computers, many equipped with specialist application software for marine structural design and marine science analysis, including Aveva Marine, Maxsurf, AutoCAD, Primer and many others.

Many of the facilities are unique to Newcastle University and include:

- The only operational cavitation tunnel in the UK, used for testing models of ship propellers and other propulsion devices, submarine vehicles and the immersed parts of other marine structures
- A 37-metre towing tank for ship model experiments
- A combined wind, wave and current tank for complex modelling of the full marine environment
- A new £1m Research Vessel, The Princess Royal, which was designed in-house by staff and students in the School of Marine Science and Technology
- A hydrodynamics laboratory with wave-making and electronic recording equipment
- engineering laboratories, which include facilities to test diesel engines

- A dedicated computer cluster running specialist marine design software a specialist technical library and archive

2.2.18. EMPLOYABILITY

As one of the top 20 'most targeted' universities by the UK's leading employers, Newcastle graduates have an excellent reputation with graduate recruiters.

Over 260 employers visit the University each year to attend recruitment fairs, hold interviews and deliver presentations. The University holds two large, annual recruitment fairs attracting major graduate employers, plus sector specific fairs for IT, engineering and law.

2.3 BERGEN UNIVERSITY

The University of Bergen was founded in 1946 and is a research university with a high international profile. It focuses on basic research, research-based teaching and the development of academic disciplines. In addition to research and education in the traditional university disciplines, the academic profile of the University of Bergen has two major focuses, namely marine research and co-operation with developing countries.

In 2012 (latest figures available) the University of Bergen had a total student population of 14290 of which 1584 were international students. It consists of six faculties and 60 different specialised departments, centres and institutes. Total academic staff amounted to around 2064.

Of particular relevance is the Faculty of Mathematics and Natural Sciences and its three (out of altogether eight) departments:

- The Department of Physics and Technology
- The Department of Earth Science and
- The Geophysical Institute

The Department of Physics and Technology provides bachelor programmes in physics as well as process and technology, 17 lines of studies at master level, and PhD education. The relevant Bachelor programme is the Programme in Petroleum and Process Technology. As for Master Programmes, the ones of importance are the Master's Programme in Petroleum Technology and the Master's Programme in Process Technology.

The Department of Earth Science embodies research and research based education within central geological and geophysical disciplines, specifically marine geoscience,

petroleum, climate and earth quake-seismology. The research is conducted on land and sea all over the globe. Amongst others this Department offers a Master's Programme in Earth Science, which offers specialisations in petroleum geoscience and marine geology and geophysics.

Another relevant department is the Geophysical Institute, which is an internationally acknowledged contributor to the development of marine research and weather forecasting methods. Its research strategy rests upon the use of own cutting-edge measurement techniques developed in collaboration with technology partners in combination with theoretical studies and modelling in geophysics. The relevant programme that the Institute provides is the Master’s programme in Energy, which comprises energy technology as well as renewable and nuclear energy and carbon capture and storage.

2.3.1. UNDERGRADUATE PROGRAMMES

2.3.2. BACHELOR'S PROGRAMME IN PETROLEUM AND PROCESS TECHNOLOGY

Students in first year	Admission requirements	Duration
158 (in 2012), 177 (in 2013)	High School Diploma, sufficient proficiency in Norwegian and English, a Norwegian ID-number	3 years

No specific scholarship programme

Heads of Programme: Prof. Harald Høiland (for petroleum technology) and Associate Prof. Pawel Kosinski (for process technology)

The Bachelor's Programme in Petroleum and Process Technology is provided by the Department of Physics and Technology of the Faculty of Mathematics and Natural Sciences. It includes a variety of courses, such as introductory courses to petroleum and process technology, geology, algebra, chemistry and energy, mechanics, reservoir physics, reservoir technology, chemical thermodynamics, fluid mechanics and heat transfer, and calculus. Furthermore, students can choose between the course on Electromagnetism and Optics and Basic Measurement Science and the one on Experimental Physics. They can also choose between the course on Petroleum geology and the course on Mass Transfer and Phase Equilibrium.

The course "Introduction to Petroleum and Process Technology" entails learning about petroleum exploration, production technology, and about the transport and processing facilities for oil and gas. The course on "Petroleum geology" explains the most important methods utilized in exploration for hydrocarbons and their production.

The programme also contains practical learning, such as designing basic installations for handling one-phase flow in the process industries, and designing basic installations for heat exchange in the process industries.

More details on the content of each course can be found here[55].

2.3.3. POSTGRADUATE PROGRAMMES

2.3.4. MASTER'S PROGRAMME IN PETROLEUM TECHNOLOGY

Students in first year	Admission requirements	Duration
39 (in 2012 and 2013)	Bachelor's degree of 3 or 4 years' duration from an approved institution of higher education, which must include courses in mathematics, physics and chemistry, in addition to geology and reservoir technology, average grade of an international bachelor's degree has to be at least 2nd class, upper division/B (corresponding to a Norwegian grade C), proficiency in English, open only for Norwegian applicants and international applicants residing in Norway	2 years

No specific scholarship programme

Head of Programme: Prof. Harald Høiland

This programme is provided by the Department of Physics and Technology of the Faculty of Mathematics and Natural Sciences.

Students can choose one of the specialised areas[56]:

- Reservoir Chemistry
- Reservoir Geophysics
- Reservoir Physics
- Reservoir Geology
- Reservoir Mechanics

[55] http://www.uib.no/studyprogramme/BAMN-PTEK
[56] http://www.uib.no/studyprogramme/MAMN-PETR

Each of the specialised areas contains various compulsory or elective courses and a Master Thesis. For Reservoir Physics, subjects are chosen in consultation with the student's academic supervisor. The elective courses available are: Reservoir Simulation, Integrated Operations in Drilling and Production, Selected Topics in Petroleum Technology and Reservoir Characterization and Recovery techniques. The course on Integrated Operations in Drilling and Production explains the principles and techniques behind the drilling, directional drilling and placement of the wellbore with respect to the optimisation of production.

Under the specialisation areas Reservoir Geophysics and Reservoir Geology, students choose subjects in consultation with their academic supervisors.

The specialisation area Reservoir Chemistry has two mandatory courses, i.e. Surface and Colloid Chemistry and Experimental Techniques in Physical Chemistry, and the rest of the subjects are chosen in consultation with the student's academic supervisor.

The specialisation field Reservoir Mechanics contains two mandatory courses, namely Flow in Porous Media and Reservoir Simulation. Further to this, the students have to choose between the course Partial Differential Equations and the course Continuum Mechanics. The other half of the subjects is chosen in consultation with the academic supervisor.

2.3.5. MASTER'S PROGRAMME IN PROCESS TECHNOLOGY

Students in first year	Admission requirements	Duration
30 (in 2013) and 26 (in 2012)	Bachelor's degree of 3 or 4 years' duration from an approved institution of higher education, which must include courses in mathematics, physics and chemistry (competence in thermodynamics and fluid mechanics are especially important), average grade of an international Bachelor's degree has to be at least 2nd class, upper division/B (corresponding to a Norwegian	2 years

	grade C), proficiency in English, only open for Norwegian applicants and international applicants residing in Norway	

No specific scholarship programme

Head of Programme: Associate Prof. Pawel Kosinski

This programme is provided by the Department of Physics and Technology of the Faculty of Mathematics and Natural Sciences.

It offers several specialisation areas, of which one needs to be chosen:

- Separation
- Process Safety Technology
- Chemometrics
- Multiphase Systems

The specialisation area Separation provides analyses of different unit operations with respect to energy and flow conditions. It has one mandatory course on Oil and Gas Processing, which aims to give a fundamental understanding of the basic principles of the design of new industrial process plants as well as for the optimisation of existing plants. The elective courses available are on Fluid Mechanics and Heat Transfer as well as Mass Transfer and Phase Equilibrium.

The core of the specialisation area Process Safety Technology consists of the course on explosion hazards in the process industry and on combustion physics. The elective courses are: Fluid Mechanics and Heat Transfer, Mass Transfer and Phase Equilibrium, and Risk Analysis – Methods and Application. The latter is conducted in collaboration with DNV GL. There are several optional courses on Oil and Gas Processing, Introduction to Multiphase Systems, Gas Dynamics and Dust Explosions in the Process Industries.

The specialisation area Chemometrics contains a mandatory course on Process and Environmental Chemometry, which provides an introduction to analysis and monitoring of industrial processes by means of data analytical methods. The methods are illuminated with real examples from both onshore and offshore process industry, e.g. oil-source correlation, modelling of reservoir characteristics from well logs and application on rigs and refineries. Furthermore, there are also several optional courses, from which two need to be chosen: Environmental Chemistry, Petroleum Chemistry (where modern procedures for fractionating and analysing oil and gas are also presented), Chemical Thermodynamics, Reservoir Technology, Measurement Technology, Oil and Gas Processing and other[57]. The elective courses available are on Fluid Mechanics and Heat Transfer and on Mass Transfer and Phase Equilibrium

A Master's in Multiphase Technology focuses on transport phenomena in multiphase systems, i.e. flow and heat and mass transport in such systems. The mandatory course introduces multiphase technology and elective courses available are on Fluid Mechanics and Heat Transfer and on Mass Transfer and Phase Equilibrium. There are also several optional courses, of which minimum one needs to be chosen, on Differential Geometry, Numerical Techniques for Process Technology, Dust Explosions in the Process Industries, Measurement Technology and others[58].

2.3.6. MASTER'S PROGRAMME IN EARTH SCIENCE

Students in first year	Admission requirements	Duration
120	Bachelor's degree or equivalent higher degree, average grade of the Bachelor's degree of at least 2nd class upper division/B or the equivalent as academic result, Bachelor degree must include knowledge and competence in earth science and/or related fields corresponding to 90 ECTS (one and a half academic year), a good command in English, academic degree not older than two years (exceptions	2 years

[57]More details are available at: http://www.uib.no/programmeoption/MAMN-PROKJ - oppbygning
[58]More details are available at: http://www.uib.no/programmeoption/MAMN-PROFL - oppbygning

	possible if the applicant has relevant work experience)	

No specific scholarship programme

Head of Department: Gunn Mangerud[59]

This programme is provided by the Department of Earth Science, one of the departments of the Faculty of Mathematics and Natural Sciences. It aims to give students a broad general knowledge of geoscience, as well as research skills in the chosen speciality. Master's projects range from dealing with theoretical aspects of solid Earth physics to applied geology. The proximity to the North Sea oil fields, and the access to two ocean going research vessels equipped for marine reflection seismics, give students a great opportunity within petroleum and marine research. The department has extensive cooperation with the petroleum industry, and participates in several international research projects in geodynamics.

Within this programme, students can choose between five specialisations, mirroring the five main research groups in the department:

- Quaternary geology and paleoclimate
- Geobiology
- Petroleum geoscience
- Marine geology and geophysics
- Geodynamics

Within each of the specialisation area, students choose their courses in consultation with their academic supervisor. They also have to submit a Master Thesis.

The Master programme in Quaternary geology and palaeoclimate includes knowledge about the geological and climatological history during the last three million years. It also includes work in field and laboratory courses.

[59] http://www.uib.no/personer/Gunn.Mangerud

The Master in Geobiology includes different topics within the interactions between magmatic, metamorphic, hydrothermal, geochemical and biological processes in modern and ancient geological time, biological and (bio)geochemical processes in marine sediments, sedimentary provenance, and weathering reactions and aquatic geochemistry. It also covers marine research cruises and on-land fieldwork, in combination with laboratory research.

Students who specialise in Petroleum Geoscience gain basic skills in geology and geophysics, as well as enhanced recovery of oil and gas in an economic and safe manner. The wide spectrum of courses offered provides the students the skills coherent with the requirements of the industry for petreoleum geoscientific work.

The Master in Marine Geology and Geophysics consists of acquisition and interpretation of geophysical data and geological sampling of marine sediments and rocks.

Under the specialisation area Geodynamics, the important disciplines covered are seismology, tectonics, paleomagnetism and magmatic petrology, which are supported by computer science and mathematics.

2.3.7. MASTER'S PROGRAMME IN ENERGY

Students in first year	Admission requirements	Duration
14 in 2013, 5 in 2012 (start of the programme)	Bachelor's degree or equivalent higher degree, average grade of C or above in the Bachelor's degree major subject (according to the Norwegian grading system), proficiency in English, valid residence permit in Norway/a Norwegian ID number	2 years

No specific scholarship programme

Head of Department (Geophysical Institute): Prof. Nils Gunnar Kvamstø

This programme is offered by the Geophysical Institute, one of the departments of the Faculty of Mathematics and Natural Sciences.

The core curriculum consists of the following courses:

- Energy Resources and Energy Use
- Energy physics and Energy Technology

Other optional subjects are chosen by the students in consultation with their respective academic supervisors.

The specialised areas, of which one has to be chosen, are:

- Energy Technology
- Nuclear Power
- Renewable Energy
- Carbon Capture and Storage

2.3.8. FACILITIES

The facilities of the Faculty of Mathematics and Natural Sciences include reading rooms, computer rooms and a science library, which provides comprehensive collections of literature in mathematics and the natural sciences.

2.3.9. TRAINING OF TEACHERS

There are various opportunities in continuing and further education at the university in addition to internal courses and seminars. Members of staff and persons in leadership positions can take individual external courses and programmes, adapted to the wishes and needs of the individual and the university. These courses include language learning and courses on human resources. The university also offers a wide range of courses and arrangements for English speaking employees.

The Centre for Continuing Education (EVU) is responsible for developing and

operating the Bergen University's life long learning provision. This contains extension studies, continuing education, professional development, adult education, open and distance education, and part time studies.

Technical and administrative staff at the university can also apply for financial support for training initiatives outside the university. Funds for training are allocated by the faculties and the central administration, and the individual unit must also provide an equivalent amount of funding.

2.3.10. RELATIONSHIPS WITH COMPANIES

The Faculty of Mathematics and Natural Sciences of the Bergen University has a comprehensive collaboration with the petroleum industry and participates in a number of international research programmes. It provides some courses in collaboration with companies, such as DNV GL. Furthermore, it has an extensive international collaboration including CERN and the European Space Agency (ESA).

2.3.11. COOPERATION WITH OTHER ACADEMIC INSTITUTIONS

The University of Bergen is heavily involved in international co-operation in research and education. It has signed bilateral agreements with universities, research institutions and academic centres of excellence in all parts of the world. The university is also committed to co-operating with developing countries and has established programmes with universities in Third World Countries in the areas of health, poverty, and resource management.

The University is furthermore engaged in the European Union's Framework programmes for research and technological development and has been designated as a European Research Infrastructure and a Research Training Site in several scientific fields.

2.3.12. SCHOLARSHIPS

The University of Bergen itself does not offer any scholarships. International students can apply for admission either as a self-financing student or a student financed through the Quota Scheme.

The Quota Scheme is a funding scheme offered by the Norwegian Government to students from certain developing countries, countries in the Western Balkans, Eastern Europe and Central Asia. The list of the countries can be found here[60].

At the moment the University of Bergen has 154 study places financed by this scheme. The scheme only finances students at Master and doctoral levels and those that are affiliated with institutions with a formal, active collaboration agreement with the University of Bergen. The list of such collaborating institutions can be found here[61]. As a general rule applicants must have resided in their home country for at least one year prior to the intended study period in Norway. Applicants residing in Norway can apply if they have been financed by a Norwegian state scholarship or research grant, and if they have not been in Norway for more than two years when the programme starts.

In addition there are some possibilities for funding for incoming and outgoing students through various organisations, associations or foundations. International Scholarship Section at the Research Council of Norway provides an overview of scholarships and programmes in the Research Council of Norway. It is possible for students to apply for some of them:

- EEA Grants – Norway
- Fulbright grants
- Norway-America Association grants

[60] http://www.siu.no/eng/Front-Page/Programme-information/Development-cooperation/Quota-Scheme/(view)/5301
[61] http://www.uib.no/en/education/49074/collaborating-institutions-within-quota-scheme-programmes-uib

2.4 NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY – TRONDHEIM (NTNU)

The Norwegian University of Science and Technology was founded in 1996. It is the primary Norwegian university for Bachelor's and Master's education in engineering. Approximately 22000 students are studying at NTNU each year of which about 1800 are international students and 8000 are enrolled in engineering courses. In 2012 over 7750 students were admitted to NTNU and 3326 Bachelor's and Master's degrees were awarded in addition to 374 PhDs.

NTNU offers 50 Bachelor's, 126 Master's programmes (both 1,5-2 and 5-6 years) and 48 PhD programmes taught in 7 faculties. NTNU awards approximately 80% of all advanced engineering degrees in Norway and has a long history of cooperating closely with industry to ensure that programmes it offers are relevant to businesses and curriculum incorporates current research and technology.

From the total staff of 5000 over 3000 are academic or research employees, including 629 full professors. Moreover 25% of academic staff is international.

NTNU participates in many international student exchange programmes and has over 300 cooperation or exchange agreements with 60 universities worldwide. The annual budget of the University is at the level of $890 million.

Of particular relevance is the Faculty of Engineering Science and Technology (Department of Marine Technology), which offers 30 engineering programmes and the Faculty of Information Technology Mathematics and Electrical Engineering (Department of Electric Power Engineering).

NTNU provides International, Norwegian (advanced engineering degree) and Erasmus Mundus Master's programmes and PhD programmes related to offshore development.

2.4.1. POSTGRADUATE PROGRAMMES

2.4.2. MASTER'S DEGREE PROGRAMME IN CIVIL ENVIRONMENTAL ENGINEERING

Students admitted a year	Admission requirements	Duration
200	A high grade average on the secondary school diploma, good level of mathematics and physics and proficiency in Norwegian	5 years

In the first two years of Civil Environmental Engineering Master's programme students focus on core technical and science courses as well as building and environmental courses.

Throughout the programme students learn how to organise and manage building projects in various environments such as domestic buildings, roads, bridges, oil platforms and major public communication systems (railways, airports). They are taught how to plan, design, build and maintain public infrastructure as well as to conduct and present measuring at sea and on shore. Students also study construction loads in different environments, maximum load forces and impact loads and collisions.

The Core Curriculum consists of the following courses:

- Hydraulic and environmental engineering
- Building and construction material
- Design of buildings and structures
- Geotechnical engineering and engineering geology
- Fluid mechanics

- General chemistry
- Technology management
- Calculus
- Statistics
- Mechanics
- Physics
- Building physics, basic course
- Concrete structures 1, basic course
- Philosophy and Theory of Science
- Interdisciplinary project (Experts in Teams)
- Thesis

The specialised areas, of which one has to be chosen, are:

- Building and construction
- Road, transport and geomatics
- Structural engineering
- Hydraulic and environmental engineering

An overview of the programme together with more in depth information about the specialisations is available on the NTNU website [62].

2.4.3. MASTER'S DEGREE IN MARINE TECHNOLOGY

Students in first year	Admission requirements	Duration
	A high grade average on the secondary school diploma, good level of mathematics and physics and proficiency in Norwegian	5 years

Department of Marine Technology, Department Head: Harald Ellingsen

Asst. Dept. Head: Elif Pedersen

[62] http://www.ntnu.edu/studies/mtbygg

This programme is divided into four main parts:

- Non-technological courses
- Technology foundation
- Professional foundation
- Specialisation

It aims to help students gain knowledge within the area of marine engineering by providing a solid base of marine technology basic courses.

Throughout the programme, students gain understanding of various aspects of the marine industry and marine systems. The majority of classes are laboratory activities carried out in groups and only few are given in traditional lecture form. The programme prepares student to perform engineering work related to design, construction and operation of ships, platforms and other marine systems.

The Master's programme in Marine Technology is based on four main elements:

- Marine hydrodynamics
- Marine structural engineering
- Marine engineering systems
- Marine operations and design

The programme has eight specialisations, which combine the disciplines of hydrodynamics, structural engineering and marine systems. An emphasis is placed on students' ability to combine practical understanding with the use of mathematical models and computer-based methods of analysis. The programme also aims to help students develop the ability to see the bigger picture in technical problems related to design, analysis and operations of marine systems. The eight specialisations, to be chosen after the third year of studies, are:

- Marine Structures
- Marine Cybernetics
- Marine Hydrodynamics

- Marine Operations
- Marine Engineering
- Marine Design and Logistics
- Marine Resources
- Aquaculture and Subsea Techniques

The Core Curriculum consists of the following courses:

- Marine Technology – elementary course
- Marine Technology- Marine Structures
- Marine Technology – Hydrodynamics
- Marine Technology- Machinery systems and operations
- Materials Technology
- Thermo Dynamics
- Fluid mechanics
- Information Technology - Introduction
- General Chemistry
- Technology Management
- Calculus 1 to 4
- Statistics
- Mechanics 1 & 2
- Physics
- Philosophy and Theory of Science
- Interdisciplinary project (Experts in Teams)
- Thesis

A detailed overview of the courses can be found on the NTNU website[63].

[63] http://www.ntnu.edu/studies/mtmart

2.4.4. MASTER'S DEGREE IN PETROLEUM GEOSCIENCES AND ENGINEERING

Students in first year	Admission requirements	Duration
+/- 60	A high grade average on the secondary school diploma, good level of mathematics and physics and proficiency in Norwegian	5 years

The Master's programme in Petroleum Geosciences and Engineering provides students with skills and knowledge to solve future tasks and challenges related to the exploration and production of oil and gas. It targets students who would like to work for the oil industry, such as Norwegian and international oil companies, consultancy firms and service providers.

During the first two years students are given theoretical grounding in natural science, geosciences and information technology. In the third year students can chose to specialise in petroleum geosciences or petroleum engineering and later on they can further narrow their main topic to the following six specialisation profiles:

- Drilling Engineering
- Formation Evaluation
- Petroleum Production
- Petroleum Geology
- Petroleum Geophysics
- Reservoir Engineering

The core curriculum consists of the following courses:

- Physics and Geophysics
- Resources of Earth
- Geology, Introduction
- Geomechanics and Flow in Porous Media
- Fluid mechanics
- Information Technology - Introduction

- General Chemistry
- Technology Management
- Calculus 1 to 4
- Statistics
- Mechanics
- Physics
- Philosophy and Theory of Science
- Interdisciplinary project (Experts in Teams)
- Thesis

Moreover, students have the opportunity to spend a year abroad in one of the partner universities, including the Technical University of Delft.

A detailed overview of the courses can be found on the NTNU website[64].

2.4.5. MASTER'S OF SCIENCE DEGREE IN ENGINEERING AND ICT

Students admitted	Admission requirements	Duration
	A high grade average on the secondary school diploma, good level of mathematics and physics and proficiency in Norwegian	5 years

Due to the industry's need for highly qualified engineers with both ICT expertise and an advanced engineering education NTNU offers a five-year Master's Degree programme in Engineering and ICT. Students are taught to understand and further develop the existing computer tools used by engineers. During the first two years students learn basic ICT, mathematics, physics and mechanics.

After two years they choose from the following five specialisations:

- Petroleum geosciences and engineering
- Geomatics

[64] http://www.ntnu.edu/studies/mtpetr

- Marine technology
- Structural engineering
- Product development and process engineering

The core curriculum consists of the following courses:

- Object-oriented Programming
- Algorithms and Data Structures
- Software Engineering
- ERP and PLM Systems
- Technology for IO and Semantic Web
- Applied Procedural Programming
- Supercomputing - Introduction
- Physics
- Discrete Mathematics
- Data Modelling, Database and Database Management Systems
- Fluid mechanics
- Information Technology - Introduction
- Technology Management
- Industrial ICT – Introduction
- Calculus 1 to 4M
- Statistics
- Mechanics 1 & 2
- Philosophy and Theory of Science
- Interdisciplinary project (Experts in Teams)
- Thesis

A detailed overview of the courses can be found on the NTNU website[65].

[65] http://www.ntnu.edu/studies/mting

2.4.6. INTERNATIONAL MASTER'S OF SCIENCE DEGREE IN MARINE TECHNOLOGY – MARINE STRUCTURES, MARINE SYSTEM ENGINEERING AND NAUTICAL SCIENCE

Students admitted	Admission requirements	Duration
25	Bachelor of Science degree or a similar qualification (at least 3 years of university studies) in areas related to marine technology, such as Naval Architecture, Marine Engineering, Offshore Engineering, Ocean Engineering, Marine Technology, Coastal or Harbour Engineering; English language requirements: ▪ TOEFL (Test of English as a Foreign Language) with a minimum score of 600/90 points on the paper based/internet based test ▪ IELTS (International English Language Testing Service) with a minimum score of band 6.5 ▪ APIEL (Advanced Placement International English Language) examination with a minimum score of 3 points	2 years

The Department of Marine Technology offers three streams of the Master's programme:

- Marine Structures
- Marine Systems Engineering
- Nautical Science

During the first three semesters of the programme students attend advanced courses. Teaching and course material are given in English. In addition to the courses, a project within one of the specified areas must be carried out in the 3rd semester. The project work is an introduction and preparation for the thesis research.

This study programme offers seven specialisations:

- Marine Structure
- Marine Cybernetics
- Marine Hydrodynamics

- Marine Operations
- Marine Engineering
- Marine Design and Logistics
- Marin Resources and Aquaculture

The programme include education in the areas of offshore technology, automatic control ship technology, operations & logistics and aquaculture and fisheries.

The Core Curriculum consists of the following course:

- Viscous flows
- Computational heat/fluid flow
- Natural gas technology
- Industrial ecology
- Mechanics 3
- Machine elements
- Design methods
- Risk analysis
- Sustainable utilisation of marine recourses
- Finite elementary methods
- Fatigue/Fracture
- Sea Loads
- Stock theory sealoads
- Safe operations/maintenance
- Modelling Simulation and Analysis of dynamic systems
- Marine electric power and propulsion systems
- Simulation base design
- Safety/ reliability analysis
- Linear system theory
- Nonlinear control system
- Expert in team
- Heat and combustion technology

- Energy utilisation
- Underwater energy BC
- Ship building
- Advanced vessel design
- Design of marine production plants
- Marine structures
- Marine Dynamics
- Design offshore structures
- Buckling/collaps structures
- Hydro high-speed vehicles
- Naval hydrodynamics
- Machinery maintenance
- Marine operations
- Oceanography
- Maritime control system
- International combustions engines
- Pipe system design
- Guidance/control

The specialisation courses are:

- Marine structures
- Maritime control systems
- Marine Hydrodynamics
- Marine engineering
- Operations maintenance engineering
- Marine systems design
- Marine recourses/aquaculture

A detailed overview of the courses can be found on the NTNU website[66].

[66] http://www.ntnu.edu/studies/msn1

2.4.7. JOINT NORDIC MASTER IN MARITIME ENGINEERING

Students in first year	Admission requirements	Duration
NA	Strong working knowledge of mathematics and mechanics and proved completion of: ▪ Mathematics: 25 ECTS including linear algebra, calculus and differential equations; ▪ Statistics and probability theory: 5 ECTS; ▪ Statics, mechanical vibrations, and strength of materials: 10-15 ECTS; ▪ Fluid mechanics: min. 5 ECTS; ▪ Sufficient qualifications within numerical methods and elementary programming using e.g. MATLAB or a similar programming language; Students without this qualification must be prepared to complete their curriculum during the first year. Applicants with a Polytechnic (FI), Högskoleingeniör (SE) and Diplomingeniør (DK) degree may be expected to do extra course work to qualify for the programme. English language requirements: ▪ TOEFL (Test of English as a Foreign Language) with a minimum score of 600/90 points on the paper based/internet based test ▪ IELTS (International English Language Testing Service) with a minimum score of band 6.5 ▪ APIEL (Advanced Placement International English Language) examination with a minimum score of 3 points	2 years

The Nordic Master Programme in Maritime Engineering is offered by a consortium of five leading technical universities in the Nordic countries, working together within the framework of the Nordic Five Tech university alliance[67]:

- Aalto: Aalto University, Helsinki, Finland
- Chalmers: Chalmers University of Technology, Gothenburg, Sweden
- DTU: Technical University of Denmark, Copenhagen (Lyngby), Denmark
- KTH: Royal Institute of Technology, Stockholm, Sweden
- NTNU: Norwegian University of Science and Technology, Trondheim, Norway

[67] http://www.nordicfivetech.org/

The Nordic Master in Maritime Engineering offers education in the following areas of expertise: naval architecture, offshore engineering and maritime engineering. It provides knowledge within design, construction and operation of ship and offshore structures, including hydrostatics and stability, hydrodynamics, wave and wind loads and structural analyses.

The teaching comprises lectures, assignments, workshops and project work. Students are taught to apply rational methods within mathematics, numeric analyses, fluid mechanics and structural mechanics to analyse, design and technically operate ships and offshore structures.

In the first year, education covers topics of maritime engineering, naval architecture and offshore engineering on Master level: stability, resistance and propulsion, seakeeping, manoeuvring and ship and ocean structures. In addition to maritime engineering courses, courses on general and special engineering competences, such as CFD, structural analysis, composite materials etc are also foreseen. In the second year, students choose a specialisation from the from the topics ocean structures, passenger ships, ship design, ship operations and small craft.

NTNU is responsible for the stream on ocean structures, which covers courses in the following areas:

- Description of the marine environment, including oceanography and theories for ocean waves, current and wind,
- Environmental loads, primarily dealing with hydrodynamic forces from waves and current, and rigid body motions from such loads,
- Load effects, which mean methods for calculation of displacements, internal forces and stresses in any kind of structures from static and dynamic loads. Linear and non-linear finite element analysis is the main tool for such analyses,

- Structural capacity, which covers fatigue and fracture based on material properties, but also buckling of structural elements and total collapse of structures,
- Marine cybernetics, dealing with control theory relevant for marine operations like station keeping, offshore loading, and use of remote operated (ROV) and autonomous underwater vehicles (AUV).

More information about the programme can be found on the Nordic Master Programme website[68].

2.4.8. INTERNATIONAL MASTER'S OF SCIENCE DEGREE IN PETROLEUM ENGINEERING (MSG1)/PETROLEUM GEOSCIENCE (MSG2)

Students in first year	Admission requirements	Duration
MSG1 – 28 MSG2 - 21	BSc/BEng in Petroleum Engineering. Applicants with a BSc/BEng degree in Mechanical or Chemical Engineering may also be considered for admission if they have relevant work experience from the petroleum sector. For the MSc in Petroleum Geoscience a first degree in Applied Geosciences or Geology is required; English language requirements: ▪ TOEFL (Test of English as a Foreign Language) with a minimum score of 600/90 points on the paper based/internet based test ▪ IELTS (International English Language Testing Service) with a minimum score of band 6.5 ▪ APIEL (Advanced Placement International English Language) examination with a minimum score of 3 points	2 years

This master programme has two branches; Petroleum Engineering and Petroleum Geosciences. The programme's main elements include courses related to exploration and production of oil and gas on the Norwegian continental shelf, methods for increased oil recovery factor, development of platform solutions and

[68] http://www.nor-mar-eng.org

subsea production equipment for great water depths, demands for environmental considerations in the northern regions. In addition, students can choose further specialisations.

MSG1 has the following specialisations:

- Reservoir Engineering
- Petroleum Production
- Drilling Technology

MSG2 has the following specialisations:

- Petroleum Geophysics
- Petroleum Geology

The core curriculum consists of the following courses.

For MSG1:

Compulsory and optional courses:

Reservoir fluids

- Unconventional reservoirs
- Reservoir recourses technology
- Subsurface decision analysis
- 3d visualisation of petroleum data
- Petrophysics fund
- Carbonate reservoir characterisation
- High deviation drilling
- Well testing
- Math/computer
- Specialisation in sub surface management
- Expert in team
- Reservoir property determination by core analysis and well testing

- Reservoir simulation
- Drilling techniques pressure control
- Drilling fluid
- Fractured reservoirs
- Field development
- Petroleum economics
- Natural gas
- Carbonate reservoir characterisation
- Formation mechanics
- Well testing
- Electromagnetic methods in oil exploration
- CO_2 storage

Specialisation courses:

- Petroleum production
- Drilling engineering
- Reservoir engineering

For MSG 2

Compulsory and optional courses:

- Structural geology
- Petroleum geology
- Seismic wave propagation
- Reservoir recovery techniques
- 3d visualisation of petroleum data
- Petrophysics
- Carbonate reservoir characterisation
- Formation mechanics
- Gravimetry and magnetometry
- Electromagnetic methods in oil exploration
- Applied Mathematics and computer methods in Petroleum

- Seismic processing
- Expert in team interdisciplinary project
- Basin analysis
- Diagenesis/reservoir quality
- Geological reservoir modelling
- Seismic interpret
- Reservoir seismics
- Petrophysics, interpretation of well data
- Petroleum economics
- Subsurface decision analysis
- Seismic data
- CO2 storage

Specialisation courses:

- Petroleum geology
- Petroleum geophysics

A similar Master's programme is also provided in Norwegian language under the title of Master's Degree in Petroleum Geoscience and Engineering, Specializations: Petroleum Geophysics and Petroleum Geology with the same choice of courses as MSG2.

A detailed overview of the courses can be found on the NTNU website[69].

2.4.9. INTERNATIONAL MASTER'S OF SCIENCE DEGREE IN RELIABILITY, AVAILABILITY, MAINTAINABILITY AND SAFETY

Students in first year	Admission requirements	Duration
10	Completed three years of an engineering programme,	2 years

[69] http://www.ntnu.edu/studies/msg1

	completed an engineering college ("ingeniørhøgskole") in Norway or a similar education from outside Norway (equivalent to a bachelor degree, or 180 credits in the European Credit Transfer System); English language requirements: ▪ TOEFL (Test of English as a Foreign Language) with a minimum score of 600/90 points on the paper based/internet based test ▪ IELTS (International English Language Testing Service) with a minimum score of band 6.5 ▪ APIEL (Advanced Placement International English Language) examination with a minimum score of 3 points	

The objective of this Master's programme is to provide knowledge and skills to enable students in the development and operation of safe, reliable and easily maintainable systems. Students will learn how products and systems can be used safely, and how technical faults can be avoided. Furthermore, students will learn how to plan and cost-effectively perform maintenance.

Students who finish this Master's program are expected to possess deep disciplinary knowledge within the areas of safety, reliability and maintenance and the ability to use these theories and methods.

The core curriculum consists of the following courses:

- Scientific Communication or Risk Governance
- Interdisciplinary project (Experts in Teams)
- Safety and Reliability Analysis
- RAMS Assessment and Optimisation
- RAMS Engineering and Management
- Risk Analysis
- Production and Quality Engineering, specialisation project
- Lifetime Analysis/ Applied Statistics/ or Health, Safety and Environment
- Maintenance Management

- Risk Management in Projects

A detailed overview of the courses can be found on the NTNU website[70].

2.4.10. MASTER'S OF SCIENCE DEGREE IN SUBSEA TECHNOLOGY

Students in first year	Admission requirements	Duration
20	Completed engineering or Bachelor degree, For specialisation in Operation and Maintenance bachelor degree in subsea technology, mechanical engineering , cybernetics / automation, electricity or equivalent is required. For specialisation in Subsea Technology Bachelor's degree from technical marine line is required. It is assumed that applicants have the necessary knowledge of mathematics , statistics and mechanics. At least overall grade of 2.5 or letter grade is C is required. A list of approved programmes form Norwegian universities/collages that meet all the admission criteria is published on the NTNU website.	2 years

Coordinator of Study: Professor Olav Egeland

Responsible for marine underwater technology: Professor Bernt Johan Leira

The Master's Programme in Subsea Technology offers two specialisations:

- Operations and Maintenance
- Marine and Underwater Technology

The programme provides basic knowledge of underwater technology and technologies and students are taught how to produce, transport, install, and maintaining underwater systems. The programme also includes courses on environmental and safety aspects of such systems. Moreover, through its interdisciplinary character, the programme provides a common platform for students with different backgrounds to work on project within the area of Subsea Technology.

[70] http://www.ntnu.edu/studies/msrams

The programme is organised in close cooperation with Bergen University College (HiB) and students are required to spend one semester at HiB.

The Core Curriculum consists of the following courses.

Operations and Maintenance:

- Master Thesis
- Advanced Project
- Underwater production systems
- Processing of petroleum
- Experts in team Interdisciplinary project
- Tribolog and surface engineering
- Mechatronics
- Field development
- Petroleum Engineering
- Blackouts maintenance
- Industrial safety / reliability
- Corrosion

Optional courses:

- Robotics
- Risk management in projects
- Evaluation and optimization of reliability
- Production wells
- Fatigue and fracture of marine structures

Courses in Bergen:

- Marine operations
- Materials for Underwater Technology
- Opportunity Analysis in Business

Marine Subsea Technology:

- Marine construction
- Marin hydrodynamics
- Underwater production systems
- Marine Operations
- Experts in team Interdisciplinary project
- Petroleum engineering course
- Element Method
- Sea loads

Optional courses:

- Corrosion
- Production wells
- Industrial Safety and reliability
- Robotics
- Risk
- Marine engineering
- Fatigue and fracture of marine structures

Courses in Bergen:

- Regulation, modeling, analysis
- Fluid Mechanics, oil hydraulics and hydraulic machines
- Materials for Underwater Technology
- Opportunity Analysis in Business

An overview of the programme together with more in depth information about the specialisations is available on the NTNU website [71].

[71] http://www.ntnu.no/studier/miuvt

2.4.11. FACILITIES

The NTNU Faculty of Engineering Science and Technology is one of the top Norwegian research organisations and currently hosts five elite research centres:

- Centre for Sustainable Arctic Marine and Coastal Technology□SAMCoT

  SAMCoT is a leading national and international centre for the development of robust technology, necessary for sustainable exploration and exploitation of the valuable and vulnerable Arctic region. More information is available on the SAMCoT website[72]
- Centre for Ships and Ocean Structures□

  The Centre for Ships and Ocean Structures focuses on the acquisition of basic knowledge concerning the behaviour of ocean structures. It integrates theoretical and experimental research in hydrodynamics, structural technology and automatic control. The centre supports innovations in the design and operation of the vessels, for platforms, and fish-farming structures of tomorrow. More information is available on the CeSOS website[73].
- Centre for Integrated Operations in the Petroleum Industry□

  The centre conducts research, innovation and education within the IO field, to promote accelerated production, increased oil recovery, reduced operating costs and enhanced safety and environmental standards. More information is available on the Integrated Operations Center website[74].
- Structural Impact Laboratory □SIMLAB

  SIMLAB aims to develop a technology platform for safe and cost-effective structures in aluminium, high-strength steels, and polymers through advances in research areas such as materials, solution techniques, and structures. The research programmes currently include: fracture and crack propagation; connector and joints; polymers; multi-scale modelling of

[72] http://www.ntnu.edu/samcot
[73] http://www.cesos.ntnu.no/
[74] http://www.iocenter.no/

metallic materials; and optimal energy absorption and protection. More information is available on the SIMLab website[75].

In addition to research centers, NTNU has over 100 laboratories, which are used both in research and teaching. The main laboratories are listed below:

- ENGAS Lab Facilities[76] - Cleaning up CO_2
- Wireless Trondheim[77] - Building a wireless city
- Aerodynamics Laboratory[78] - A tunnel used for experiments on everything from oilrig equipment, to speed-skating suits, to bridge structures and components
- NTNU Sealab[79] - working with aquaculture, fisheries and the processing of marine resources.
- Remotelab[80]
- Marine Cybernetics Laboratory (MCLab)[81]

More information about the NTNU research facilities are available of the NTNU website[82].

2.4.12. RELATIONSHIPS WITH COMPANIES

NTNU has numerous partnerships with industry, and is a host of projects funded under the EU's Research Framework. Moreover its Faculty of Engineering Science and Technology actively participates and initiates high quality international research collaborations. A particularly important research partner is SINTEF, the largest independent research organization in Scandinavia.

[75] http://www.ntnu.edu/simlab
[76] http://www.ntnu.edu/energy/engas
[77] http://tradlosetrondheim.no/index.php?la=en
[78] http://www.ntnu.edu/ept/laboratories/aerodynamic
[79] http://www.ntnu.edu/marine/sealab
[80] http://www.remotelab.ntnu.no/
[81] http://www.remotelab.ntnu.no/
[82] http://www.ntnu.edu/research/lab

NTNU offers its students education in industry areas that need highly educated staff. It ensures that programmes match industry needs in terms of knowledge and skills of NTNU graduates. The university and individual faculties and departments build partnerships and cooperation with industry.

The Department of Marine Technology for example is well known within the shipping and offshore industry. These industries are very complex and are offering different kinds of work positions to marine master candidates. This equals great opportunities to the candidates to work within their personal areas of interest. Some start working for engineering and consultancy firms, some join research institutions, some are employed by oil companies and some start working for shipping companies.

Also worth noting is a dedicated website for students and businesses on possible cooperation: http://www.ntnu.edu/business.

2.4.13. COOPERATION WITH OTHER ACADEMIC INSTITUTIONS

The Norwegian University of Science and Technology (NTNU) cooperates with selected partner countries in accordance with stipulated national priorities in Norway. Cooperation in research and education is established with about 200 universities all over the world. Our prioritized geographical areas are the EU, the USA, Japan and China.

2.4.14. SCHOLARSHIPS

As at all Norwegian universities studying at NTNU is free of charge. For students who need support to cover living expenses such as housing, books, food and travel the university provides a list of main funding alternatives available to international students on the NTNU website[83]

[83] http://www.ntnu.edu/studies/financing-and-scholarships

2.4.15. FACTORS INFLUENCING CAREER PATHS

The following factors are important in the graduates' career paths:

- High quality education gained at one of the best Norwegian engineering universities
- Contact with industry through formal and informal activities organised by NTNU
- Practical skills acquired in one of the best research facilities and through cooperation with the industry
- Wide range of English language courses

2.5 TECHNICAL UNIVERSITY OF DELFT

Technical University of Delft (TU Delft) was founded in 1842 and is the largest and oldest Dutch public technical university. In 2012 (latest figures available) it had a total student population of 17.530 of which 2.769 were international students. It offered 15 Bachelor's programmes and 33 Master's programmes, taught in 8 different faculties. Total academic staff amounted to 2.491.

Of particular relevance is the Faculty 3mE and its department of of Maritime Transport Technology (M&TT). It provides Bachelor's, Master's and PhD programmes related to offshore development and works in four focus areas:

- Offshore and Dredging Engineering (Prof.Dr.ir. C. van Rhee)
- Ship Hydromechanics and Structures (Prof.Dr.ir. R.H.M. Huijsmans)
- Ship Design, Production & Operations (Prof.ir. J.J. Hopman)
- Transport Engineering and Logistics (Prof.Dr.ir. G. Lodewijks)

2.5.1. UNDERGRADUATE PROGRAMMES

2.5.2. BACHELOR OF SCIENCE IN MARINE TECHNOLOGY

Students in first year	Admission requirements	Duration
121	High School Diploma, English, willingness to learn Dutch	3 years

No specific scholarship programme

Director of Studies; Prof.ir. J.J. Hopman[84]

This broad-based programme covers maritime subjects such as Maritime Operations, Hydromechanics, Ship Production and Ship Construction, and related subjects

[84] http://www.3me.tudelft.nl/en/about-the-faculty/professors/marine-and-transport-technology/ship-design-production-operations/profir-jj-hopman/

including economics, philosophy, sustainability, environment and management. The programme also contains practical elements, such as the task of designing, building and demonstrating a floating hoist construction. It also foresees an internship in a maritime enterprise in first year. While offshore technology is not the concrete focus the BSc does include engineering aspects of offshore structures. It is an entry qualifications for the more specialised Masters's programmes.

A detailed study guide is available from the TU Delft website[85]. This guide also contains the names and contact details about the professors and lecturers responsible for the individual courses.

2.5.3. POSTGRADUATE PROGRAMMES

2.5.4. MASTER OF SCIENCE IN OFFSHORE & DREDGING ENGINEERING

Students in first year	Admission requirements	Duration
+/- 35	Undergraduate Degree, solid math, basics of solid and fluid mechanics, English	2 years

No specific scholarship programme

Director of Education; Dr.ir. Sape A. Miedema[86], Associate Professor of Dredging Engineering

The overall objective of the Degree is to prepare students to work in and later lead teams of engineers designing all sorts of man-made objects to be used in localised areas of the (deeper) sea. Participants need to follow the Core Curriculum and choose one specialised area.

[85] http://www.studiegids.tudelft.nl/a101_displayProgram.do?program_tree_id=3914
[86] http://www.3me.tudelft.nl/en/about-the-faculty/departments/marine-and-transport-technology/research/offshore-and-dredging-engineering/dredging-engineering/staff/drir-sape-a-miedema/

The core curriculum consists of the following course:

- Survey of Offshore Engineering Lectures
- Survey of Offshore Engineering Project
- Introduction to Offshore Structures
- Physical Oceanography
- Short Waves (not mandatory for students who started in 2008/2009 or later)
- Wind Waves
- Offshore Hydromechanics
- Probabilistic Design
- Soil Mechanics
- Thesis

The specialised areas, of which one has to be chosen are:

- Bottom Founded Structures
- Dredging Engineering
- Floating Offshore Structures
- Ship & Offshore Structures

In addition two elective subjects are available:

- Marine Pipelines
- Subsea Engineering

A detailed study guide is available from the TU Delft website[87]. This guide also contains the names and contact details about the professors and lecturers responsible for the individual courses.

[87] http://www.studiegids.tudelft.nl/a101_displayProgram.do?program_tree_id=12704

2.5.5. MASTER OF SCIENCE IN MARINE TECHNOLOGY

Students in first year	Admission requirements	Duration
+/- 50	Undergraduate Degree, additional preparation depending on Undergraduate Degree ("bridging programme"), English	2 years

No specific scholarship programme

Director of Education; Dr.ir. Sape A. Miedema[88], Associate Professor of Dredging Engineering

Cooperation with Norwegian University of Science and Technology (NTNU)

This programme provides future engineers with the knowledge and skills they need to handle the entire process of design, construction, production and operation of ships and marine systems. Students are offered two track: Science & Design and Production & Operation.

2.5.6. SCIENCE & DESIGN

In this track students focus on mathematics, advanced hydrodynamics, properties of new materials, advanced methods of structural analysis and advanced ship concepts.

In addition they choose between two specialisations:

- Ship Hydromechanics (SH)
- Ship and Offshore Structures (SOS)

A detailed overview or courses and contact details of professors and lecturers for this track is available from the TU Delft website[89].

2.5.7. PRODUCTION & OPERATION

This track is offered in cooperation with NTNU in Trondheim, where students spent

[88] http://www.3me.tudelft.nl/en/about-the-faculty/departments/marine-and-transport-technology/research/offshore-and-dredging-engineering/dredging-engineering/staff/drir-sape-a-miedema/
[89] http://www.studiegids.tudelft.nl/a101_displayProgram.do?program_tree_id=12629

their first semester. Students choose between four technical specialisations, to be combined with either logistics, technical marketing, management, or safety and sustainability.

The four specialisations are:

- Ship Design
- Ship Production
- Shipping Management
- Marine Engineering

In their second year, students may combine their elective internship with their graduation project, addressing a single topic and working at the same company while completing both requirements.

A detailed overview or courses and contact details of professors and lecturers for this track is available from the TU Delft website[90].

2.5.8. FACILITIES

TU Delft takes pride in its 'state-of-the-art' research facilities. They include many wind tunnels, a high voltage lab and a fluid dynamics lab.

A complete database of facilities can be browsed online[91].

[90] http://www.studiegids.tudelft.nl/a101_displayProgram.do?program_tree_id=12638
[91] http://labs.tudelft.nl/index.php?action=cat&id=4

2.6 THE ERASMUS MUNDUS PROGRAMME

Erasmus Mundus is a cooperation and mobility programme focused on higher education in Europe, with the objective to promote intercultural dialogue and foster the quality of higher education. The programme, established in 2004, is a European Commission initiative managed by the Commission's Executive Agency for Education, Audiovisual and Culture (EAEAC). The 2009-2013 Erasmus Mundus' Action Programme and budgetary allocations were established by Decision 1298/2008/EC[92].

In particular, the Erasmus Mundus 2009-2013 was based on the following three actions:

- Action 1: Erasmus Mundus joint programmes of outstanding academic quality at master level (action A1) and doctoral level (action A2)

  Joint programmes under Action 1 are implemented by a consortium of universities from at least three different higher education institutions from European countries and possibly third countries. Action 1 provides scholarships and fellowships to master and doctoral students from European and third countries, as well as short-term scholarships for academics to carry out research or teaching assignments under the Erasmus Mundus Masters courses.
- Action 2: Erasmus Mundus Partnerships between European and Third Country higher education institutions

  This action supports the establishment of cooperation partnerships between higher education institutions from EU Member States and selected third countries. It also provides dedicated scholarships to European and third country individuals, the content and duration of which depend on the partnership agreement.
- Action 3: Promotion of European Higher Education

  Action 3 provides support to selected projects aimed at fostering the international dimension of higher education. Such initiatives may related to the

[92] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:340:0083:0098:EN:PDF

accessibility of higher education, quality assurance, credit recognition, mutual recognition of qualifications, curriculum development and mobility.

The total budget for Action 1 and 3 of the 2009-2013 Programme was of EUR 493.7 billion, while Action 2 was funded under the different financial instruments available for the External Relations activities of the EU.

The Erasmus Mundus Programme came to an end on 31 December 2013. While no more calls for proposal will be launched, consortia with an ongoing framework agreement for Master and Doctoral courses (Action 1) will continue to select students and award scholarships in 2014.

Furthermore, Action 1 of the Erasmus Mundus will receive funding until 2017 under the newly established Erasmus+[93], the EU programme for Education, Training, Youth and Sport 2014-2020. Erasmus+ can be seen as the successor of Erasmus Mundus and aims at streamlining existing life-long learning programmes, international higher education programmes (including Erasmus Mundus) and the Youth in Action programme, with the objective i.a. to further promote mobility of students and scholars. The first Erasmus+ call for proposal for consortia offering Joint Master Degrees will close on 27 March 2014.

An overview of the relevant Master courses offered under Erasmus Mundus programme is provided below.

2.6.1. COMEM – COASTAL AND MARINE ENGINEERING AND MANAGEMENT

The CoMEM Programme is a two-year joint Master in Civil Engineering designed and managed by a consortium of the following five universities:

- Technical University of Delft (TU Delft), The Netherlands

[93] http://new.eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1288&from=EN

- Norwegian University of Science and Technology (NTNU), Trondheim, Norway
- Universitat Politecnica de Catalunya (UPC), Barcelona, Spain
- City University London, United Kingdom
- University of Southampton (SOTON), United Kingdom

Furthermore, the consortium includes 17 associated partners and supporting organisations. A complete list is available here[94].

Students in first year	Admission requirements	Duration
	University BSc degree in civil engineering, environmental engineering or degree in a subject relevant to the CoMEM Programme A BSc Cumulative Grade Point Average (GPA) of at least 75 % Proof of English Language proficiency, such as Toefl (iBT score of at least 90), IELTS (total score of at least 6.5) or University of Cambridge's Certificate of Proficiency in English or Certificate in Advanced English A clear and CoMEM relevant essay	2 years

Erasmus Mundus Scholarships

Students admitted to the CoMEM Master programme are eligible for Erasmus Mundus scholarships. CoMEM Universities select eligible scholarship applicants, which are then submitted to the European Commission for approval.

Two types of scholarships are available:

- "Category A" scholarships, available to non-EU, non-EEA/EFTA States[95] students. Category A scholarships provide a contribution of € 48,000 for the duration of the programme (two academic years), of which € 16,000 cover the participation costs (€ 8,000 per semester for non-EU students)
- "Category B" scholarships, available for students from the EU Member States or EEA/EFTA States, or students that have resided in one or several of the

[94] http://www.ntnu.edu/studies/mscomem/associated-partners
[95] Iceland, Norway and Liechtenstein

countries listed above for 12 months or more during the past 5 years. Category A scholarships provide a contribution of € 20,000 for the duration of the programme of which € 8,000 cover the participation costs (€ 4,000 per semester for non-EU students).

The number of scholarships awarded to CoMEM students varies between 7 and 17 each year.

2.6.2. COMEM PROGRAMME CONTENT

The CoMEM programme includes one common semester and five specialisations "mobility tracks", according to the following structure[96]:

- Semester 1: all students attend the same classes at NTNU, Trondheim
- Semester 2: Track 1 and Track 4 students attend TU Delft, Track 2, Track 3 and Track 5 students live in Barcelona
- Semester 3: Track 1 students attend classes at TU Delft, Track 2 students at the University of London and Track 3, Track 4 and Track 5 students at the University of Southampton
- Semester 4: students work on their Master thesis at their Track home university

An overview of the mobility tracks can be found below.

Track 1: Arctic, Marine Coastal Engineering (NTNU)

Track Tutor: Prof. Raed Lubbad

This mobility track aims at providing students with the knowledge and skills for marine and coastal development in the Arctic region, with an emphasis on ports and coastal and offshore structures. Track 1 classes take place at NTNU and TU Delft,

[96] http://www.ntnu.edu/documents/4369942/4580391/CoMEM+2013-2019/f453d962-d3e5-4fa6-a42c-9e098a0fb0c1?version=1.0&t=1345033452751

allowing students to undertake coastal fieldwork in the Norwegian Arctic region and along the coast of the Netherlands.

An overview of Track 1 optional and compulsory classes is provided below.

Semester 1 (NTNU)

Compulsory courses:

- TBA4145 Port and Coastal Facilities (7.5 ECTS[97])
- TBA4265 Arctic and Marine Civil Engineering (7.5 ECTS)
- TBA4275 Dynamic Response to Irregular Loadings (7.5 ECTS)

Optional courses:

- TBA5100 Theoretical Soil Mechanics (7.5 ECTS)
- TBA4325 Spreading of Pollution (7.5 ECTS)

Recommended extra course:

- Norwegian Elementary (3 ECTS)

Semester 2 (TU Delft)

Compulsory courses:

- CIE4061-09 Multidisciplinary Project (10 ECTS)
- CIE4305 Coastal Dynamics 1 (6 ECTS)
- WM0312CIE Philosophy, Technology Assessment and Ethics for Civil Engineering (4 ECTS)
- OE4680-12 Arctic Engineering (4 ECTS)

Optional courses - recommended:

- OE4651-12 Bottom Founded Structures (5 ECTS)
- CIE4309 Coastal Dynamics 2 (5 ECTS)
- CIE5308 Breakwaters and Closure Dams (4 ECTS)

[97] European Credit Transfer and Accumulation System

Other optional courses:

- CIE5314 Flood Defences (3 ECTS)
- CIE5307 Coastal Zone Management (3 ECTS)
- CIE5312 Turbulence in Hydraulics (3 ECTS)

Recommended extra course:

- CIE4040-09 Traineeship - summer internship (10 ECTS)
- Dutch Elementary (3 ECTS)

Semester 3 (TU Delft)

Compulsory courses:

- CIE4130 Probabilistic Design and Risk Management (4 ECTS)
- CIE4310 Bed, Bank and Shoreline Protection (4 ECTS)
- CIE4340 Computational Modelling of Flow and Transport (4 ECTS)
- AT-327 Arctic Offshore Engineering (7.5 ECTS)

Optional courses - recommended:

- CIE4190 Analysis of Slender Structures (4 ECTS)
- CIE4330 Ports and Waterways 1 (4 ECTS)
- CIE5318 Fieldwork Hydraulic Engineering (4 ECTS)

Other optional courses:

- CIE4115 Steel Structures 2 (4 ECTS)
- OE4606 Introduction to Offshore Engineering (3 ECTS)
- OE4607 Introduction to Dredging Engineering (3 ECTS)
- OE4624 Offshore Soil Mechanics (3 ECTS)

Semester 4 (NTNU)

Compulsory course:

- TBA4920 MSc Thesis on Arctic Marine Coastal Engineering (30 ECTS)

Optional extra course:

- AT-307F Arctic Offshore Engineering – Fieldwork (3 ECTS)

Track 2: Marine Operation and Management (City University London)

Track Tutor: Laurie Boswell

Students following Track 2 will learn to understand the workings of maritime operations and technology and the related business environments. Furthermore, they will acquire competences as regards the design of ship and offshore installations, as well as the business, legal and economic environment in which the maritime and offshore industry operates. Track 2's classes take place in Norway, London and Barcelona.

An overview of Track 2 optional and compulsory classes is provided below.

Semester 1 (NTNU)

Compulsory courses:

- TBA4265 Arctic and Marine Civil Engineering (ECTS 7.5)
- TBA4145 Port and Coastal Facilities (ECTS 7.5)
- FI5205 Corporate Responsibility and Ethics (ECTS 7.5)

Optional courses - recommended:

- TBA4325 Spreading of Pollution (ECTS 7.5)
- TMR4137 Sustainable Utilization of Marine Resources (ECTS 7.5)

Other optional courses:

- TPK4120 Safety and Reliability Analysis (ECTS 7.5)
- TBA4275 Dynamic Response to Irregular Loadings (ECTS 7.5)
- TBA5100 Theoretical Soil Mechanics (ECTS 7.5)

Recommended extra course:

- Norwegian Elementary (ECTS 3)

Semester 2 (UPC)

Compulsory courses:

- 250600 Coastal Processes and Dynamics (ECTS 5)
- 250601 Coastal Sustainability: Defence and Realignment (ECTS 5)
- 250602 Coastal Zone Planning and Management (ECTS 5)
- 250603 Coastal Multidisciplinary Project: Sustainable Engineering in the Coastal Zone (ECTS 6)

Optional courses:

- 250604 Design of Coastal and Harbour Structures: Deterministic and Probabilistic (ECTS 3)
- 250605 Impacts, Conflicts and Risks: Present and Future Conditions (ECTS 3)
- 250606 Climate Effects on the Water Cycle: Floods and Droughts (ECTS 3)
- 250607 Early Warning Systems for Flash Floods and Debris Flows (ECTS 3)
- 250608 Meteo-Oceanographic Time Series: Time and Frequency Analyses (ECTS 3)
- 250609 Marine Environmental Turbulence (ECTS 3)
- 250610 Port Management and Exploitation (ECTS 3)

Recommended extra course:

- Spanish Elementary (ECTS 3)

Semester 3 (London City)

- EPM 782 Maritime Operations (ECTS 7.5)
- EPM 784 Maritime Technology (ECTS 7.5)

- EPM 783 Maritime Economics and Accounting (ECTS 7.5)
- EPM 785 Maritime Management (ECTS 7.5)

Recommended extra course:

- EPM 786 Maritime Law (ECTS 7.5)

Semester 4 (London City)

Compulsory course:

- EPM 402 Dissertation - Marine Operations and Management (ECTS 30)

Track 3: Environment and Management (SOTON)

Track Tutor: Robert Nicholls

Track 3 combines the knowledge of coastal and marine engineering with management. Students attending track 3 are provided with the tools to work for coastal engineering consultancies or to continue their studies at a PhD level. The programme builds a solid basis in coastal engineering while also covering soft engineering, shoreline management planning and preparation for sea-level rise and climate change in coastal areas.

An overview of Track 3 optional and compulsory classes is provided below.

Semester 1 (NTNU)

*C*ompulsory courses:

- TBA4265 Arctic and Marine Civil Engineering (ECTS 7.5)
- TBA4145 Port and Coastal Facilities (ECTS 7.5)
- FI5205 Corporate Responsibility and Ethics (ECTS 7.5)

Optional courses - recommended:

- TBA4325 Spreading of Pollution (ECTS 7.5)
- TMR4137 Sustainable Utilization of Marine Resources (ECTS 7.5)

Other optional courses:

- TPK4120 Safety and Reliability Analysis (ECTS 7.5)
- TBA4275 Dynamic Response to Irregular Loadings (ECTS 7.5)
- TBA5100 Theoretical Soil Mechanics (ECTS 7.5)

Recommended extra courses:

- Norwegian Elementary (ECTS 3)

Semester 2 (UPC)

Compulsory courses:

- 250600 Coastal Processes and Dynamics (ECTS 5)
- 250601 Coastal Sustainability: Defence and Realignment (ECTS 5)
- 250602 Coastal Zone Planning and Management (ECTS 5)
- 250603 Coastal Multidisciplinary Project: Sustainable Engineering in the Coastal Zone (ECTS 6)

Optional courses:

250604 Design of Coastal and Harbour Structures: Deterministic and Probabilistic (ECTS 3)

- 250605 Impacts, Conflicts and Risks: Present and Future Conditions (ECTS 3)
- 250606 Climate Effects on the Water Cycle: Floods and Droughts (ECTS 3)
- 250607 Early Warning Systems for Flash Floods and Debris Flows (ECTS 3)
- 250608 Meteo-Oceanographic Time Series: Time and Frequency Analyses (ECTS 3)
- 250609 Marine Environmental Turbulence (ECTS 3)
- 250610 Port Management and Exploitation (ECTS 3)

Recommended extra course:

- Spanish Elementary (ECTS 3)

Semester 3 (SOTON)

Compulsory courses:

- CENV6084 Maritime and Coastal Engineering and Energy (ECTS 7.5)
- CENV6126 Coastal Morphodynamics (ECTS 7.5)
- CENV6139 Geographic Information Systems (ECTS 7.5)

Optional courses:

- ENSV6028 Environmental Impact Assessment (ECTS 7.5)
- SOES3014 Coastal Sediment Dynamics (ECTS 7.5)

Semester 4 (SOTON)

Compulsory course:

- CENV6149 MSc Thesis/Dissertation - Environment and Management (ECTS 30)

Track 4: Coastal Engineering (TU Delft)

Track Tutor: Paul Visser

Track 4 combines basic coastal engineering competence with soft engineering by providing the students with first hand experience on different coastal engineering issues in Norway, the Netherlands and the UK.

An overview of Track 4 optional and compulsory classes is provided below.

Semester 1 (NTNU)

Compulsory courses:

- TBA4265 Arctic and Marine Civil Engineering (ECTS 7.5)
- TBA4145 Port and Coastal Facilities (ECTS 7.5)

Optional courses - recommended:

- TBA4325 Spreading of Pollution (ECTS 7.5)
- TMR4137 Sustainable Utilization of Marine Resources (ECTS 7.5)

Other optional courses:

- TPK4120 Safety and Reliability Analysis (ECTS 7.5)
- TBA4275 Dynamic Response to Irregular Loadings (ECTS 7.5)
- TBA5100 Theoretical Soil Mechanics (ECTS 7.5)

Recommended extra courses:

- Norwegian Elementary (ECTS 3)

Semester 2 (TU Delft)

Compulsory courses:

- CIE4061-09 Multidisciplinary Project (10 ECTS)
- CIE4305 Coastal Dynamics 1 (6 ECTS)
- WM0312CIE Philosophy, Technology Assessment and Ethics for Civil Engineering (4 ECTS)
- CIE4340 Computational Modelling of Flow and Transport (4 ECTS)

Optional courses - recommended:

- CIE4130 Probabilistic Design and Risk Management (not if TPK4120 completed in Norway) (ECTS 4)
- CIE4310 Bed, Bank and Shoreline Protection (ECTS 4)
- CIE5300 Dredging Technology (ECTS 4)
- CIE5302 Stratified Flows (ECTS 3)
- CIE5307 Coastal Zone Management (ECTS 3)
- CIE5308 Breakwaters and Closure Dams (ECTS 3)

- CIE5312 Turbulence in Hydraulics (ECTS 3)
- CIE5314 Flood Defences (ECTS 3)

Other optional courses:

- CIE4460 Polders and Flood Control (ECTS 4)
- CIE5304 Waterpower Engineering (ECTS 3)

Recommended extra course:

- CIE4040-09 Traineeship - summer internship (10 ECTS)
- Dutch Elementary (3 ECTS)

Semester 3 (SOTON)

Compulsory courses:

- CENV6084 Maritime and Coastal Engineering and Energy (ECTS 7.5)
- CENV6126 Coastal Morphodynamics (ECTS 7.5)
- CENV6139 Geographic Information Systems (ECTS 7.5)

Optional courses:

- ENSV6028 Environmental Impact Assessment (ECTS 7.5)
- SOES3014 Coastal Sediment Dynamics (ECTS 7.5)

Semester 4 (TU Delft)

Compulsory course:

- CIE5030 MSc Thesis - Coastal Engineering (30 ECTS)

Track 5 – Engineering and Environment (UPC)

Track Tutor: César Mösso

Track 5 combines engineering project fundamentals with environmental and managerial skills. I.a. students will acquire competences as regards coastal

engineering and oceanography and modeling and evaluation skills with regard to coastal processes and structures and their interactions and behaviour of structure in the coastal environment.

An overview of Track 5 optional and compulsory classes is provided below.

Semester 1 (NTNU)

Compulsory courses:

- TBA4265 Arctic and Marine Civil Engineering (ECTS 7.5)
- TBA4145 Port and Coastal Facilities (ECTS 7.5)
- FI5205 Corporate Responsibility and Ethics (ECTS 7.5)

Optional courses - recommended:

- TBA4325 Spreading of Pollution (ECTS 7.5)
- TMR4137 Sustainable Utilization of Marine Resources (ECTS 7.5)

Other optional courses:

- TPK4120 Safety and Reliability Analysis (ECTS 7.5)
- TBA4275 Dynamic Response to Irregular Loadings (ECTS 7.5)
- TBA5100 Theoretical Soil Mechanics (ECTS 7.5)

Recommended extra courses:

- Norwegian Elementary (ECTS 3)

Semester 2 (UPC)

Compulsory courses:

- 250600 Coastal Processes and Dynamics (ECTS 5)
- 250601 Coastal Sustainability: Defence and Realignment (ECTS 5)
- 250602 Coastal Zone Planning and Management (ECTS 5)

- 250603 Coastal Multidisciplinary Project: Sustainable Engineering in the Coastal Zone (ECTS 6)

Optional courses:

- 250604 Design of Coastal and Harbour Structures: Deterministic and Probabilistic (ECTS 3)
- 250605 Impacts, Conflicts and Risks: Present and Future Conditions (ECTS 3)
- 250606 Climate Effects on the Water Cycle: Floods and Droughts (ECTS 3)
- 250607 Early Warning Systems for Flash Floods and Debris Flows (ECTS 3)
- 250608 Meteo-Oceanographic Time Series: Time and Frequency Analyses (ECTS 3)
- 250609 Marine Environmental Turbulence (ECTS 3)
- 250610 Port Management and Exploitation (ECTS 3)

Recommended extra course:

Spanish Elementary (ECTS 3)

Semester 3 (SOTON)

Compulsory courses:

- CENV6084 Maritime and Coastal Engineering and Energy (ECTS 7.5)
- CENV6126 Coastal Morphodynamics (ECTS 7.5)
- CENV6139 Geographic Information Systems (ECTS 7.5)

Optional courses:

- ENSV6028 Environmental Impact Assessment (ECTS 7.5)
- SOES3014 Coastal Sediment Dynamics (ECTS 7.5)

Semester 4 (UPC)

- 31606 MSc Thesis - Engineering and Environment (30 ECTS)

3. IN-HOUSE TRAINING IN OFFSHORE DEVELOPMENT COMPANIES

3.1 AKER SOLUTIONS

Aker Solutions[98] is a global provider of products, systems and services to the oil and gas industry, with origins dating back to the 19th century. Aker Solutions ASA is the parent company in the group, which consists of a number of separate legal entities. Aker Solutions is used as the common brand and trademark for most of these entities.

Approximately 26,000 staff, spread over about 30 countries, work at Aker Solutions. In 2013, Aker Solutions had an operating revenue of NOK 42.9 bn (around $7.1 bn).

3.1.1. STUDENTS AND GRADUATES

Internships: Aker Solutions provides summer internships with a duration of approximately six weeks. These internships are designed to provide participants with the opportunity to discover what it is like to work at Aker Solutions.

Graduate Trainee Programmes: Aker Solutions offers various trainee programmes in different locations. The assignments are “real jobs” and participants are provided with structured and systematic training and development. Several of the graduate trainee programmes are of interest as they focus on technical training.

Of particular interest is the **Subsea Technical Trainee** programme (Oslo, Norway). This two-year programme comprises three job rotations and is aimed at students who already hold a Master of Science degree. Participants are placed within the subsea product areas and subsea life-cycle services teams. The programme offers learning and development according to the technical career path (or other career paths), a technical mentor, and regular intensive workshops.

[98] https://www.akersolutions.com

A similar **Subsea Graduate Programme** is offered in the UK. This two-year rotational programme aims at European engineers (mechanical, electrical & electronic, software) or business graduates with an interest in subsea engineering. The programme offers on-the-job training, formal training courses and project and departmental assignments. Participants will get an overview of subsea engineering and business processes. Additionally, there is the possibility of employment with the relevant institute after the trainee programme is completed. Experienced supervisors, mentors and coaches provide guidance, assistance and advice.

Also relevant for this study is the **Graduate Engineering Programme** (London, UK), which lasts for four years. It is aimed at holders of a Masters of Engineering in mechanical, electrical & electronic, chemical or civil engineering, with an interest in the oil and gas industry. The programme consists of a combination of on-the-job and formal training. There are opportunities in the following disciplines: process, mechanical, electrical, structural, design safety, instrumentation and control.

While taking place outside Europe it is also worth mentioning the following three programmes:

The **Engineer Trainee Programme** (Curitiba/ Rio das Ostras, Brazil) is offered to students with an engineering degree in mechanical, electronics, mechatronics, or production that have an interest in subsea engineering. The programme is spread over ten months and offers training in the following fields: technical, business view, and behavioural. Practical training in the key areas of Manufacturing and Technology engineering complements the formal classroom training.

The **Subsea Graduate Engineering Programme** (Malaysia) is a two-year rotational programme for graduates (mechanical, electrical, civil, or software engineering) with an interest in subsea engineering. The participants receive on-the-job training, work alongside experienced engineers and managers, and are exposed to the various technical aspects within the subsea manufacturing environment.

The **Campus to Corporate (c2C) Trainee Programme** (India) aims to ease the transition for graduate engineers from college to professional life. Two hours per day are dedicated for c2C training while the remaining hours are devoted to on-the-job training. A large part of the programme has a technical focus. Participants are trained in critical soft skill areas like business communication, time and goal management, and cross-cultural awareness. This programme is divided into three phases:

- The first phase gives a general overview of the company and of each engineering discipline.
- The second phase covers a number of technical topics in great depth, giving the trainees an insight into the functioning of each discipline.
- The third phase includes inter-departmental interface training, project work and site visits.

For more information on internships and graduate programmes, please click here[99].

Contact information:

Malaysia - Centre for people administration

Phone: +603 23005221

Norway - Centre for people administration

Phone: Call +47 51 85 15 00 and press 2

USA - Centre for people administration

Phone: +1 713-685-5770

3.1.2. TRAINING AND COURSES OFFERED TO THIRD PARTIES

Aker Solutions offers lifecycle services for all of its **drilling equipment and systems**, ranging from top drives and drawworks to drilling risers and mud mixing systems.

Aker Solutions has set up regional strategic hubs for its training services in:

[99] http://www.akersolutions.com/en/Global-menu/Career/Students-and-graduates/

- Kristiansand, Norway
- Rio das Ostras, Brazil
- Singapore, Singapore
- Okpo, South Korea
- Houston, US

Each hub is staffed with experienced industry professionals and is equipped with Aker Solutions' drilling simulators that offer customers onshore training opportunities. The training facilities comprise fully equipped classrooms, simulator facilities, single equipment simulators and a technical training lab.

The following courses are available:

- MH hydraulic roughneck (HRN) 1898
- MH hydraulic roughneck (HRN) 1899
- MH derrick drilling machine (DDM)
- Technical training laboratory (TTL)
- MH drillstring compensator (DSC)
- MH active heave compensator (AHC)
- MH crown mounted compensator (CMC)
- MH direct acting tensioner (DAT)
- MH wire line tensioner (WLT)
- Equipment maintenance course
- Conventional rig simulator training
- RamRig simulator training
- Instrumentation and control system course

Aside from these specific courses, it is possible to book a tailor made training, including a selection or all of the following modules: E-learning, classroom training, simulator training, and practical training. The full training programme is provided in Kristiansand, Norway. However, classroom and simulator training can also be provided in Stavanger (Norway) as well as Macaé (Brazil), Houston, (TX), Singapore

and Korea. The practical training courses can take place in the technical training laboratory or onboard the customer's rig, depending on the participant's background. In short, training is offered on all kinds of equipment and services offered by Aker Solutions' drilling technologies.

The standard language for these courses is English. However, on request it is possible to have courses in other languages. Participants have to sign up for a course at least three weeks in advance of the scheduled start date. For more information on the start dates, or on other aspects of the courses, please click here[100].

Of particular interest among these training centers, is the Aker's Technical Training Laboratory (TTL). The TTL is operated by Aker MH, a subsidiary of Aker Solutions, and headquartered in Kristiansand (Norway). An important field of business for Aker is training offshore rig operating personnel in the TTL. Aker uses the same automation hardware and software, and the same operating environment as on the offshore rigs. In this way, all procedures can be practiced in a realistic simulation, in real time and in 3-D, without having to move the large machines and systems. All of the courses can be tailor made in order to reflect the clients' specific requirements.

The TTL also offers training to maintenance personnel with an electro/instrument or hydraulic background. Aside from the hands-on training on Aker Solutions' live systems, training in the TTL includes an in-depth understanding of the most commonly used components of Aker equipment. Courses are limited to a maximum of 8 participants.

For more information on drilling training and the TTL, please click here[101].

Contact information of the main office of these training centres:

[100] http://www.akersolutions.com/Documents/Global DLS/Brochure for training_2014_web-ny.pdf
[101] http://www.akersolutions.com/en/Global-menu/Products-and-Services/Drilling-technologies/Drilling-lifecycle-services/Training-courses/

Norway

Tel: +47 3805 7000

24/7 support centre

Tel: +47 3805 7911

911support@akersolutions.com

Another training center with a wide range of courses is located in Erkelenz (Germany). This center also uses a modularised training concept, allowing for flexibility as regards the different modules. The courses have been developed in cooperation with the independent training experts from the Chamber of Commerce and Industry and are certified according to DIN EN ISO 9001, OHSAS 18001 and DIN EN ISO 14001. The training focuses on Wirth products and complex control systems with high-end media equipment.

The following training is available:

Training packages

- Mud pump training (standard package)
- Mud pump training (customised package)
- Slurry pump training (standard package)
- Slurry pump training (customised package)
- Drawworks training (standard package)
- Drawworks training (customised package)
- Rotary table training (standard package)
- Rotary table training (customised package)

Single training modules

- Wirth equipment presentation
- Factory tour
- Basic drilling course
- Hydraulic basic course
- Hydraulic schematic course

- Simulator training
- Methodical oil maintenance
- Mud pump training – theoretical part
- Mud pump training – practical part
- Individual workshop training for mud pump
- Simulator training for mud pump
- Slurry pump training – theoretical part
- Slurry pump training – practical part
- Individual workshop training for slurry pump
- Hands-on training at customers job-site
- Classroom training at customers job-site
- Drawworks training – theoretical part: main components
- Drawworks training – theoretical part: operation based on
- Drawworks training – theoretical part: control systems
- Drawworks training – theoretical part: documentation
- Drawworks training – theoretical part: maintenance
- Drawworks training – practical part
- Brake bedding instruction
- Electrical schematic course for drawworks
- Simulator training for drawworks
- Individual workshop training for drawworks
- Electrical schematic course for drawworks
- Hands-on training at customers job-site
- Classroom training at customers job-site
- Rotary table training – theoretical part
- Simulator training for rotary table
- Individual workshop training for rotary table

For more information, please click here[102].

[102] http://www.akersolutions.com/en/Global-menu/Products-and-Services/Drilling-technologies/Drilling-lifecycle-services/Training-courses/

Contact information:
Mario Bühler - Manager training
P +49 2431 83-161
mario.buehler@akersolutions.com

3.2 BLUEWATER

Bluewater[103] is specialised in the design, development, lease and operation of tanker- based production and storage systems, and has become a leading provider of innovative Single Point Mooring systems. Headquartered in the Netherlands, Bluewater also has offices in the United Kingdom, Australia, China and West Africa.

The core business of Bluewater is to design, engineer, construct, install and deliver Floating Production, Storage and Offloading (FPSO) systems, Floating Storage and Offloading (FSO) systems and Single Point Mooring (SPM) systems. Its products and technology include floating production & storage facilities, mooring systems, LNG loading & offloading systems, multi product swivels, and tidal energy conversion.

Student funding: Bluewater does not provide scholarships to students.
Internships: Bluewater offers internships and graduation projects to students of universities and vocational schools.

Even though most of Bluewater's employees (70% to 80%) benefit from ongoing training, Bluewater was not able (or willing) to provide details on these activities, claiming its training programme is still in its infancy.

[103] http://www.bluewater.com

3.3 BP

BP[104] is a multinational oil and gas company headquartered in London, England. BP provides customers with fuel for transportation, energy for heat and light, lubricants to keep engines moving, and the petrochemicals products used to make everyday items. With 85,900 employees, BP operates in over 80 countries.

3.3.1. STUDENTS AND GRADUATES

Internships: In Europe BP offers paid internship opportunities in Spain, Germany, Norway, United Kingdom and Azerbaijan. The internships vary in duration, but usually last between 8-10 weeks (in case of summer internships) or a full year.

BP offers internships in many disciplines, such as:

- Chemical engineering
- Process engineering
- Mechanical engineering
- Electrical and automation engineering
- Chemistry
- Drilling and completion/wells
- Reservoir and development – geology and geophysics
- Reservoir and development – petroleum and reservoir engineering
- Surface engineering – mechanical engineering
- Surface engineering – electrical engineering
- Surface engineering – pipeline engineering
- Surface engineering – process engineering
- Surface engineering – corrosion engineering
- Surface engineering – instrument and control engineering
- Surface engineering – civil and structural engineering

[104] http://www.bp.com

For more information on internship opportunities in Europe, please consult country specific information available here[105].

Graduates: BP offers training programmes for graduates and post-graduates to develop the company's future leaders. The graduate development programme currently has around 1,600 participants. To address increasing demands for skilled people outside the US and UK, more than 40% of 2013's graduate recruitment is targeted at universities in growing markets. BP invests in universities worldwide to further develop the quality of potential recruits.[106]

3.3.1.1. SCHOLARSHIP PROGRAMME FOR SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS UNDERGRADUATES

In November 2012 BP launched a new $7.2 million scholarship programme for talented science, technology, engineering and mathematics (STEM) undergraduates who study at nine selected universities in the UK. In its first year the programme provided 90 scholarships, each worth around $7,950 (10 scholars at each of the nine universities). As the programme is rolled out of its initial four years it will be expanded, providing a total scholarship fund of around $7.2 million. Eventually, annual scholarship funding from the programme will amount to around $2.9 million per year. The universities that have been selected by BP to participate in the scholarship funding programme are Bath, Birmingham, Cambridge, Durham, Manchester, Nottingham, Oxford and Strathclyde, as well as Imperial College (part of London University).

This scholarship programme is aimed at building capacity in skills and knowledge in the energy industry and will focus on supporting the education and development of the next generation of the UK's engineers and scientists. In each year of their degree BP Scholars will be invited to participate in a range of activities both on campus and on site with BP. These will include a two to three day interactive event designed to

[105] http://www.bp.com/en/global/corporate/careers/students-and-graduates/graduate-locations.html
[106] http://www.bp.com/content/dam/bp/pdf/investors/BP_Annual_Report_and_Form_20F_2012.pdf

help students understand more about the oil and gas industry, with the opportunity to shadow a BP intern for two to three days during the summer, as well as early access to apply for both the BP Internship programme and graduate programme. Undergraduates are selected on the basis of an on online application form, ability test and face-to-face interview.

More information on STEM scholarships is available here[107].

3.3.1.2. CHALLENGE PROGRAMME FOR GRADUATES[108]

The Challenge Programme offers early development of both technical and professional skills, along with practical experience working on live projects and formal learning. With real responsibility, great variety and plenty of support, it aims to propel talented graduates into senior roles within BP.

The Challenge Programme is divided into three branches: Upstream (Exploration & Production), Downstream, and the Integrated Supply & Trading Development Programme. Typically, the duration of these rotational development programmes is between 18 and 36 months. It provides information regarding how BP works in a chosen field. The training covers technical competencies, communications, team building and other skills that are necessary throughout the career. For the purpose of this study, the most relevant is the Upstream (Exploration & Production) Challenge Programme.

Upstream (Exploration & Production) Challenge Programme

The Upstream Challenge Program entails participating in structured rotations designed to develop technical and commercial skills. Integrated and holistic, the programme comprises three separate job placements typically lasting between 12 to 18 months each. However, this is a program that's not time-based, but competency-based. Successful completion depends on performance.

[107] http://www.bp.com/en/global/corporate/press/press-releases/bp-establishes-initial-four-year-4.5million-uk-undergraduate-scholarship-fund.html
[108] http://www.bp.com/en/global/corporate/careers/working-at-bp/learning-and-development.html

3.3.2. TRAINING AND COURSES

BP provides training programmes for operational personnel at all levels. This training includes academy programmes for senior management, delivered in partnership with the Massachusetts Institute of Technology. It involves specialised operational and technical management programmes, for example, courses in engineering and project management at the University of Manchester, and process safety and management training for front-line leaders, delivered under the operating essentials programme. In 2012 over 6,000 modules were delivered to managers, supervisors and technicians across the BP group. Both non-executive and senior management team members addressed operations academy participants during sessions in 2012. BP also offers a substantial programme of E-learning modules. Generally speaking, BP provides development opportunities for all employees, including external and on-the-job training, international assignments, mentoring, team development days, workshops, seminars and online learning. BP encourages all employees to take at least five training days per year. BP provides world-class education opportunities for its employees, partnering with 19 academies and institutes that deliver technical learning and development.

3.3.2.1. UPSTREAM LEARNING CENTER

As of 2014 an Upstream Learning Centre will be located in BP's Sunbury Business Park. It will provide flagship training for upstream employees around the world. The aim will be to build the capabilities of petrotechnical employees, as well as those in finance, leadership development and supply chain management. In addition to classrooms, break-out rooms and conference facilities, the centre includes life-size simulators, 3D visualization capability and HD video-conferencing suites. Training is also provided by the global wells organisation (GWO) and the global projects organisation (GPO). Both organisations are part of BP's Developments subdivision and dispose of corresponding learning centres, i.e. the Global Wells Institute and the Global Projects Institute.

GWO's mission is to deliver safe, compliant and reliable wells. Launched in 2010, it allows centralising all BP's wells activities under one single management. The offshore operations across the Global Wells Organization accounted for 50% of BP's net new well and well work production in 2013. In order to develop personal and professional skills of the personnel, the Global Wells Institute in GWO offers access to learning and development through structured courses, online learning, mentors and other methods. For more information on the GWO and GWI, please click here[109].

The following training programmes offered by GWI are of particular relevance within the context of this study:

Wellsite Leader of the Future Programme (WSLf)

BP has developed several industry-leading accelerated development programmes for wellsite leaders, focusing both on onshore roles and deep water wellsite leaders. These programmes are highly structured with intense coaching and focused technical and leadership learning opportunities. Additionally, career paths exist for wellsite leaders to progress into wells team leader roles and beyond. GWO also offers several accelerated development programmes (ADPs) in the areas of sand control, hydraulic fracturing and well interventions.

Drilling Engineer of the Future Programme (DEf)

The DEF programme is an intensive competency development programme aimed at training engineers with previous experience to graduate as drilling engineers with BP. The programme has a dedicated support and management structure, including a dedicated instructor, field coaches and team leads.

The wells leadership mastery programme

The wells leadership mastery programme is the discipline's flagship development programme for team leaders and managers. Held over two residential week-long

[109] http://www.bp.com/en/global/corporate/careers/who-we-are/upstream/gwo.html

modules, scheduled a few months apart, it explores the purpose of BP's wells strategy and the role of individual leaders in bringing it to life within their teams.

3.4 DNV GL

DNV GL[110] is a leading ship and offshore classification society. Created in 2013 by the merger of Det Norske Veritas and Germanischer Lloyd, the company provides technical consulting to the global oil and gas industry, and expertise on the energy value chain including renewables and energy efficiency. Disposing of a workforce of more than 16,000 employees, DNV GL operates in over 100 countries.

3.4.1. STUDENTS AND GRADUATES

Traineeship: DNV GL offers traineeships in different departments of the company. The most relevant is the global technical trainee programme, with duration of two years. The qualifications required from the candidates are:

- Post-graduate qualification, i.e. MEng, MSc, or equivalent
- Strong academic results, international experience, extracurricular activities
- Maximum one year of working experience (a good mix of academic and practical skills is a pre-requisite)
- Fluent English, spoken and written

More information on the global technical trainee programme, can found here[111].

3.4.2. SUBSEA PRODUCTION SYSTEMS TRAINING

The company offers a wide range of training programmes aimed at developing relevant standards and practices in the oil and gas industry.[112] Of particular relevance is the Subsea Production Systems Training.

[110] http://www.dnvgl.com
[111] http://www.dnv.com/moreondnv/careers/newgratuatesandstudents/globaltechnicaltraineeprogramme.asp
[112] http://www.dnv.com/industry/oil_gas/training/

Learning objective:

- Obtain a general knowledge of subsea development and production systems
- Understand the building blocks forming a subsea production system
- Understand the hierarchy of codes, rules and regulations

Target group:

- Professionals involved in subsea activities, and engineers willing to get a good foundation for XMT design, subsea separator design, and other specialist courses
- Personnel coming from other industry segments or those working within a specific field in the subsea industry – to gain better understanding of subsea systems and components.

The course addresses the following topics:

- What is Subsea?
- Drilling and Wellhead Systems
- XT Concepts and Running Tools
- Templates & Manifolds
- Umbilicals
- Tie-ins
- Production Control Systems
- Workover Systems
- ROV Intervention Systems and Tooling
- Codes and Standards
- FAT / PVT / SIT Testing
- Valves
- Corrosion and Cathodic Protection
- Geotechnical Aspects
- Processing and Boosting

The course is taught by highly experienced consultants, who have worked 15 – 20 years in the oil and gas sector. The course is run either as open public event or as in-house course tailored for a specific customer.

For more information on DNV GL's Subsea Productions System Training, please click here[113].

3.5 FABRICOM

Fabricom Offshore Services[114] is part of the GDF SUEZ Group and is specialised in offshore engineering services for the oil and gas industry. The company was launched in 2007 in Tyneside (United Kingdom), but has now several offices in the United Kingdom, as well as in the Netherlands, Norway, and Belgium.

In order to train and develop its workforce, Fabricom Offshore Services set up the Fabricom Offshore Services Academy in 2013. Around 40 participants were expected to take part in the programme that year. This training centre has three key distinct Learning & Development service elements:

- Whole Company Training & Development Services: A wide range of weekly, monthly, quarterly, and ad-hoc technical and non-technical skills, and knowledge based training programmes for staff and contractors working at Fabricom Offshore Services
- Competence-Based Learning and Development Programmes: Continuing Personal and/or Professional Development (CPPD) programmes that are either industry or lead-body specific
- Monitored Professional Development Schemes (MPDS): Delivering Engineering Apprenticeships, Graduate Schemes, Trainee Development programmes and Engineering Chartership status

[113] http://www.dnv.com/industry/oil_gas/training/subsea/subsea_production_systems.asp
[114] http://www.fabricomoffshore.co.uk/default.aspx

Apprenticeships: Fabricom Offshore Services offers a four-year Modern Apprentice Scheme to students with a minimum of 5 GSCEs (General Certificate of Secondary Education) A-C with subjects in maths, English, and science or technology based subjects.

The apprenticeship scheme covers all the engineering departments including mechanical, structural, electrical and instrumentation. All apprentices are encouraged to register as Engineering Technicians on completion of their apprenticeship. ⍰⍰

The first six months are spent 'off the job' at a local college in order to provide students with basic knowledge required for a career in engineering. The following three years are based on site at Fabricom Offshore Services (Quorum Business Park, Longbenton) and consist of practical training in the various engineering disciplines (piping, electrical & instrumentation, structural). In addition, participants attend day release at a local college to gain NVQ (National Vocational Qualification) Level 3 and HNC (Higher National Certificate) qualifications.

The key learning support structures are as follows:

- Mentoring
- Tracked competency development by means of a quarterly report
- Formal training courses – externally and internally
- Experiential learning through progressively staged tasks & projects
- Action Learning Sets

As the priorities of the company change, new apprenticeship schemes could be added. The programmes and their content are thus constantly being reviewed. More information can be found here[115].

[115] http://www.fabricomoffshore.co.uk/apprentices.aspx

Graduates: Fabricom Offshore Services offers a four-year graduate training programme, open to candidates coming from one of the following disciplines: electrical engineering, chemical engineering, instrumentation and control, mechanical engineering, or civil engineering.

The company uses a 'blended learning' approach for the development of its graduates. The programme involves on the job training, structured performance management, as well as formal training activities. The graduate programme is structured along a discipline specific development plan with a focus on the UK Engineering Specifications. Furthermore, line managers and graduate mentors support the participants.

Similar to the apprenticeship programmes, the graduate programmes are constantly being revised in line with the company's priorities. More information can be found here[116].

Contact details:
Email: academy@fabricomoffshore.co.uk

3.6 GE OIL & GAS

GE[117] is a multinational corporation created in 1892 and operating in diverse industries, such as energy, aviation, healthcare and many others. GE Oil & Gas is a division of GE active in the following fields:

- Drilling Solutions: Land and Offshore
- Offshore Solutions
- Subsea Solutions
- Enhanced Oil Recovery (EOR) Solutions
- Unconventional Resources

[116] http://www.fabricomoffshore.co.uk/graduates.aspx
[117] http://www.ge-energy.com/about/index.jsp

- Full Range LNG Solutions
- Industrial Power Generation
- Refinery & Petrochemicals
- Gas Storage & Pipeline

With 43,000 employees in 100 countries GE Oil & Gas supports customers across the industry — from extraction through transportation to end-use.

3.6.1. STUDENTS AND GRADUATES

3.6.1.1. EDISON ENGINEERING DEVELOPMENT PROGRAMME

GE offers entry-level Leadership Programmes to university students. In the field of engineering the company organises the Edison Engineering Development Programme (EEDP), which differs according to the region in which one wishes to apply. EEDP is designed to accelerate participants' professional development through intense technical training and a variety of business-critical assignments. Edison graduates have the technical and business foundation to proactively and continually make innovative contributions to GE's future. The following is a description of this programme's offer in Europe.

EEDP is a two to three-year entry-level programme consisting of three or more rotational assignments. Rotational assignments are engineering projects driven by real GE business priorities. These assignments may include experiences in systems, analysis, design, quality, reliability, integration, and testing. The programme cultivates technical problem-solving skills via advanced engineering coursework, formal reports and presentations to senior leadership, in addition to valuable work experience. Participants have the opportunity to earn credit towards a Master of Science degree in engineering or other real world application technologies.

The EEDP programme provides opportunities for the accelerated development of technical and professional skills. It gives the participant the ability to make a

measurable impact by working on vitally important projects. The programme also provides contacts with technical and business leaders who foster personal development through coaching and mentoring. The varied rotational assignments allow the participant to contribute to different technical areas in just a few years.

For more information on the EEDP, please click here[118].

3.6.2. TRAINING AND COURSES OFFERED TO THIRD PARTIES

GE offers remote and onsite training, as well as online solutions to its clients, with the view of giving the plant personnel all the guidance they need to operate GE equipment safely and effectively. Whether ordering parts, planning an outage, or optimising the plant operations, GE offers the following online solutions to help plan and execute critical business processes.

Drilling Measurements Training Programme[119]

The programme drives the technical development of field engineers and technicians by covering the key aspects of theory, operations, maintenance and support from initial introduction to focused operational task assessments and the application of advanced industry concepts. It is presented as a series of modules or courses, which can be delivered as stand-alone units or integrated into defined learning plans matched to candidate profiles.

Measurement & Control Solutions Training[120]

This training offers in-depth technical courses designed to train users in optimising the use of GE equipment. The courses can be presented at the customer site or at one of GE's training centres. In addition to traditional instructor-led courses, self-paced computer-based training is also offered.

[118] http://www.ge.com/careers/culture/university-students/edison-engineering-development-program/europe
[119] http://www.ge-energy.com/tools_and_training/training/drilling_measurements_training_program.jsp
[120] http://www.ge-energy.com/tools_and_training/training/measurement_and_control_solutions_training.jsp

Oil & Gas Technical Training[121]

GE Oil & Gas provides a comprehensive portfolio of technical training courses for a wide range of products. These courses can be conducted at the customer's site, in GE's Florence Learning Centre, or in one of the GE's Training Facilities located throughout the world. The offer includes mechanical and control courses, customised and multi-customers trainings (a list of multi-customer courses for 2014 is available online[122]), Hands-On-Training (HOT) for aeroderivative technologies and Certified Operator for Rotating Equipment (CORE) Training.[123]

Environmental Services Events, Training, and Seminars[124]

Throughout the year, GE offers training, seminars, and webinars designed to help their customers lower energy costs, increase efficiency, and reduce downtime. Currently, information sessions are available in aspire hydrophilic, dust collection and fabric filter.

GE Energy Learning Centre - Energy Technical Training[125]

The GE Energy Learning Centre offers technical training from experts on the field of OEM design, installation, maintenance and start-up expertise. The classroom and online trainings available are:

- Open Enrolment Technical Training courses, designed to maintain a trained workforce that is skilled in controls, operations, and maintenance
- Site Specific Customer Training, tailored to a particular plant and equipment requirement
- Hosted Interactive Training, designed for operators, maintenance, or engineering personnel interested in learning to operate turbine control systems using the Human to Machine Interface (HMI) computer

[121] http://www.ge-energy.com/tools_and_training/training/oil_and_gas_technical_training.jsp
[122] http://site.ge-energy.com/businesses/ge_oilandgas/en/streams_app/global_services/2014_training_schedule.htm
[123] http://www.ge-energy.com/content/multimedia/_files/downloads/Oil%20%26%20Gas%20Technical%20Training%20Brochure.pdf
[124] http://www.ge-energy.com/tools_and_training/training/environmental_services_events_and_tradeshows.jsp
[125] https://www.geenergytechnicaltraining.com/momentum/index.php

- Control Systems Overview, providing technicians, engineers, and managers with general knowledge about their control systems and guidelines for making informed decisions.

3.7 SCHLUMBERGER

Schlumberger[126] is a leading supplier of technology, integrated project management and information solutions for the oil and gas industry. Its products and services range from exploration to production. Spread over 85 countries, approximately 123,000 people work at Schlumberger.

3.7.1. STUDENTS AND GRADUATES

Student funding: The Faculty for the Future programme encourages women to pursue academic careers in science and technology by providing them with fellowships and logistical support. The Schlumberger Foundation, an independent non-profit entity that supports science and technology education, manages this programme. The Faculty for the Future Programme, launched in 2004, targets women from developing and emerging countries wishing to pursue a PhD or post-doctoral studies in the physical sciences, engineering and technology at a leading university abroad. Grant recipients are expected to return to their home countries and continue their academic and research careers. Up to $ 50,000 per year can be covered by the fund. So far, 321 women from 63 countries have benefited from Faculty for the Future fellowships. More information can be found here[127].

Aside from student funding, Schlumberger also contributes to its relation with universities through the Ambassador Programme and the Schlumberger Worldwide University Software Programme. The first is a network of sixty universities worldwide where managers from Schlumberger act as Ambassadors for the company. The second programme offers software, developed by Schlumberger Information Solutions, to selected colleges and universities at a minimal cost.

[126] http://www.slb.com
[127] http://www.facultyforthefuture.net

Internships: Schlumberger attaches great importance to internships for students. Depending on the kind of internship, the training programme is adapted. Trainings can be technical and off-the-job training, or on-the-job and interspersed with formal seminars.

Traineeships: Oilfield trainees have to follow a fixed-step training programme for three years, which includes technical, safety, personal development, business and managerial courses, and on-the-job validated training.

For more information on the requirements and content of opportunities for students and recent graduates, please click here[128].

3.7.2. TRAINING AND COURSES OFFERED TO THIRD PARTIES

Schlumberger has a global network of learning centres that are busy all year round and provide a variety of concurrent courses. Courses held in those centers range from a few days to 12 weeks in duration.

Of particular interest is the Network for Excellence in Training (hereinafter- NExT). It was created in 2000 by a cooperation between Schlumberger and three universities (Texas A&M University, University of Oklahoma, and Heriot Watt University). Today, over 1000 instructors are involved in the training of around 10,000 technical experts in eleven core disciplines. Training courses are provided both at introductory and advanced level. Amongst others, NExT provides specific courses to develop exploration, drilling, and production skills in deep water. In addition, NExT offers geological field trips focusing on a range of topics such as turbidites and deep-marine clastics. Once a course is completed, participants can continue learning by using the NExT technical forum, which allows for in-class discussion on an online-platform. Last year, NExT's curriculum won the Oil & Gas Education/Training Provider of the Year at the Getenergy Annual Event.

[128] http://careers.slb.com/recentgraduates.aspx

More detailed information on NExT's portfolio, its courses (over 420), and the calendar for 2014, can be found here[129] and here[130].

For ease of reference courses in the Oil and Gas Training and Competency Development are presented below:

Petrotechnical

- E&P Introduction and Fundamentals
- Field Development Planning
- Geology
- Geophysics
- Petrophysics
- Drilling Engineering
- Reservoir Engineering
- Production Engineering
- Information Management
- Open Technology

Facilities/Operations and Maintenance

- Surface Facilities Design and Engineering
- Technician and Operator Training

Management, Economics, and Finance

- Management and Leadership
- Economics and Finance

Technical Challenges

- Deepwater Exploration and Production

[129] http://www.nexttraining.net/resources/oil-and-gas-course-catalog.aspx
[130] http://www.nexttraining.net

- Geomechanics
- Unconventional Resources

Due to their specific relevance the following three NExT programmes are presented in some more detail below:

- The Masters Degree in Management of the Oil and Gas Industry
- The Integrated Field Development Programme
- The Multidomain Shale Training Programme

3.7.2.1. MASTERS DEGREE IN MANAGEMENT OF THE OIL AND GAS INDUSTRY

The Masters Degree in Management of the Oil and Gas Industry (IMMOGI) is developed and instructed in partnership between NExT and Heriot-Watt University. Upon successful completion, students receive a Masters Degree in Management of the Oil and Gas Industry from the Edinburgh Business School, Heriot Watt University.

Students in first year	Admission requirements	Duration
	A bachelor's degree, preferably in engineering or geoscience disciplines.	3 years. However, courses can be completed more quickly if required.

Location: Workshops can take place on the Heriot-Watt campus (Edinburgh, Scotland) or at others venues worldwide. This geographic flexibility is also available for exams, which are proctored twice a year in 360 locations.

The IMMOGI comprises 10 modules each of approximatley 180 hours. Each module consists of distance learning and one instructor-led workshop (40 hours). This set-up allows students to maintain job responsibilities while following the programme. The two core modules are business and technical oriented. Advanced modules build on this by applying concepts to real-life situations. Finally, students have to select one elective module.

The modules are built up as follows:

Business

- Finance
- Project Management
- Strategic Planning

Technical

- Petroleum Geoscience
- Production Technology
- Reservoir Engineering

Advance Topics

- Project Management for the Oil & Gas Industry
- Finance for the Oil & Gas Industry
- Strategic Planning for the Oil & Gas Industry

Elective Topics

- Accounting
- Alliances and Partnerships
- Economics
- Marketing
- Mergers and Acquisitions
- Negotiation
- Organisational Behaviour
- Strategic Risk Management

For more information, please click here[131].

[131] http://www.nexttraining.net/App_Common/136/134/Library/8/Master in Management of the Oil and Gas Industry.pdf

3.7.2.2. INTEGRATED FIELD DEVELOPMENT PROGRAMME

The Integrated Field Development Programme is designed to teach participants fundamental approaches in developing and working with a Field Development Plan (FDP). These FDP training programmes are flexible and adjustable to individual needs and knowlege. Both in-class workshops and hands-on practical training modules are part of the programme. The training modules can be completed by using public data, or proprietary data.

The FDP programme comes in three different versions; a comprehensive, accelerated, and a rapid one.

Students in first year	Admission requirements	Duration
	Although no clear admisson requirements are provided, the programme is said to be designed for reservoir engineers, production engineers, geoscientists, managers, drilling engineers, finace engineers, finance analysts, or individuals involved in FDP projects. The Rapid programme is developed for non-FDP professonals, managers, or both.	Comprehensive: 18 weeks Accelerated: 8 weeks Rapid: 4 weeks

The comprehensive Next FDP covers:

- All disciplines
- Static and dynamic modeling
- The Petrel platform's fundamentals and reservoir-engineering modules
- Three separate development scenarios

The accelerated Next FDP covers:

- The main components of FDP
- Static and dynamic modeling (with field data only)
- The Petrel platform's the fundamentals and reservoir-engineering modules

The rapid Next FDP covers:

- The main components of FDP

For more information, please click here[132].

3.7.2.3. MULTIDOMAIN SHALE TRAINING PROGRAMME

The Multidomain Shale Training Programme focuses on shale reserves. Students first learn about the science behind exploration & production concepts, then they apply enabling technologies and workflows, and finally participants practice themselves using field data. The programme includes modeling actual shale prospects, visiting core laboratories, taking field trips, and ultimately presenting a pilot project developed in class.

Students in first year	Admission requirements	Duration
	The programme is developed for Exploration & Production professionals.	12 weeks

The programme comprises two modules; Geoscience and Engineering. Upon completion, participants will have the necessary knowledge to:

- Map, model, and characterise sweet spots
- Identify well spacing and pad locations more accurately
- Place wells and extract hydrocarbons at a lower cost and with a greater overall success
- Optimise well designs and drilling trajectories
- Enhance completion and stimualtion strategies
- Improve operational efficiencies
- Improve operational efficiencies
- Prevent environmental impact

For more information, please click here[133].

[132] http://www.nexttraining.net/immersive-learning-programs/training-programs/integrated-field-development-program.aspx
[133] http://www.slb.com/services/additional/training/focused_practical_training/shale_training.aspx

Contact information:

NExT's headquarters are located in Dubai (United Arab Emirates) and can be contacted at: +971 4 306 7777

3.8 SHELL

Shell[134] is a global group of energy and petrochemical companies headquartered in the Netherlands (Den Haag). Spread over 70 countries, approximately 87,000 people work at Shell. In 2012, Shell generated a revenue of $467,2 billion and invested $1,3 billion in research and development.

The products and services of Shell are divided in three categories: "On the road", "Solutions for Businesses", and "Shell Motorsport". Its businesses are involved in "Upstream", "Downstream", and "Projects & Technology". Of particular interest is Shell's Upstream business, which deals with the exploration and extraction of crude oil and natural gas.

The core of Shell's training activities in the field of offshore oil and gas take place in the United States. The staff trained there is however deployed globally and is therefore also relevant for Europe. More limited training activities are organised in the Netherlands. Therefore, this study will complement its overview of training activities in the Netherlands with those in the US.

3.8.1. STUDENTS AND GRADUATES

Graduate programmes in the Netherlands: The Shell Graduate Programme in the Netherlands is offered to recent graduates. Every working domain within Shell has its own programme, which follows the globally standardised Shell structure. As part of the Graduate Programme, participants learn through training, E-learning, and workshops, as well as by gaining practical experience. Participants receive the

[134] http://www.shell.com

support and guidance of supervisors, mentors and other professionals. For more information, please click here[135].

Internships and graduate programmes in the US: Shell offers internships to students. In the graduate programme participants receive continuous training taking the shape of courses, E-learning modules and workshops. Of particular interest are the graduate programmes in technical disciplines such as engineering or exploration and development. In these programmes, participants enrol for a duration of two to three years in competence-based tasks in combination with a course of formal learning with the support of technical coaches. The formal training focuses on subjects such as pethrophysics foundation or geology subsurface integration. Every six months a progress check verifies whether participants are on track. Fore more information, please click here.[136]

3.8.2. TRAINING AND COURSES OFFERED TO THIRD PARTIES

Training centres in the Netherlands: The most important training centre in the Netherlands is located in Rijswijk[137]. Each year around 10,000 Shell employees from locations around the world come to Rijswijk to expand their technological know-how in many areas.

The training centre offers a wide range of course in oil and gas exploration, production and processing. The modern building offers innovative IT facilities and separate study areas to allow for a combination of formal lessons and online learning.

In the Netherlands Shell offers training to its staff in disciplines supporting subsea activities such as:

- Health, Safety, Security and Environment (HSSE)

[135] http://www.shell.nl/nld/aboutshell/careers-tpkg/students-and-graduates/is-shell-right-for-me/graduate-programme.html
[136] http://s06.static-shell.com/content/dam/shell-new/local/corporate/careers/downloads/pdf/E627_Graduate_Recruitment_SinglePage.pdf
[137] http://www.shell.nl/nld/aboutshell/who-we-are/locations/rijswijk-e.html

- Project Management
- Electrical Engineering
- Rotating equipment
- Control systems

Training centres in the US: The Shell Robert Training & Conference Center (RTCC), located in Louisiana, offers thousands of courses to prepare personnel for roles in the oil and gas industry. Originally set up for the training of Shell's domestic staff, the RTCC is now open for the industry as a whole.

The RTCC's labs are equipped with the same control rooms, electrical panels, instruments, blow out preventers, subsea control system, computer networks, and other drilling and production equipment that participants must deal with on the job. Each course is a combination of classroom instruction and hands-on experience.

Courses are provided in the following fields[138]:

- Drilling
- Electrical
- Instrumentation
- MMS/USCG Approved
- Production Operations
- Safety & Environment
- Subsea Operations

The courses covered by drilling[139] are the following:

- Practical Open & Cased-Hole Log Interpretation
- Drilling/Completion 101
- Well Control for Engineers
- IADC Drilling/Completion Well Control (Basic)
- IADC Drilling/Completion Well Control

[138] http://www.shell.us/aboutshell/projects-locations/robert-training-conference-center/course-catalog.html
[139] http://www.shell.us/aboutshell/projects-locations/robert-training-conference-center/course-catalog/drilling.html

- Well Servicing - Wireline
- Well Servicing/Wireline Well Control Refresher
- IADC WellCAP Introductory Well Control
- ADC WellCAP Drilling/Workover Surface/Subsea Contract Supervisor Well Control

The MMS/USG Approved[140] courses might also be of interest as they cover Tension Leg Platforms. Three courses are available:

- Tension Leg Platform Principles
- MMS Combination Basic Certification Well Control
- Surface Unit Stability Course

The topics covered by Subsea Operations[141] are:

- Subsea Production Operator Training (Phase I)
- Subsea Simulator Workshop
- Subsea Concepts

Many courses are approved and/or certified by:

- US Coast Guard - Surface Unit – Floating Stability (MODU)
- US Coast Guard - TLP Unit Stability
- US Coast Guard - OIM/BCO/Barge Supervisor Required Training
- American Petroleum Institute
- International Association of Drilling Contractors
- SafeGulf

Contact details RTCC:

- *Mailing Address:* SHELL ROBERT TRAINING & CONFERENCE CENTER, 23260 Shell Lane Robert, LA 70455
- *Primary Numbers*: Main Office - 985-543-1200, Emergency - 985-507-8554

[140] http://www.shell.us/aboutshell/projects-locations/robert-training-conference-center/course-catalog/mms-api.html
[141] http://www.shell.us/aboutshell/projects-locations/robert-training-conference-center/course-catalog/subsea.html

3.9 STATOIL

Statoil[142] is an international energy company operating in 33 countries, with over 40 years of experience in oil and gas production on the Norwegian continental shelf. Headquartered in Stavanger, Norway with approximately 23,000 employees worldwide, Statoil is listed on the New York and Oslo stock exchanges.

3.9.1. STUDENTS AND GRADUATES

Internships: Every year Statoil offers a number of paid summer internships in several locations in areas such as engineering, geoscience, land, finance, procurement and legal. The internships are offered to students who have completed at least two years of their degree by the time the training starts.

Graduates: Statoil offers a corporate graduate programme in different activity areas (drilling and well, facility management, exploration, human resources, IT, legal, petroleum technologies, etc.) to graduates fulfilling the following criteria:

- Completed or enrolled in the final year of masters or PhD studies
- One year's work experience or less
- Fluent English preferably in addition to a second working language
- International work or study experience

A description of those graduate programmes, which are of particular relevance within the context of this study, is provided below:

Drilling and well[143]

Scope of the Programme

The graduate programme in drilling and well lasts for approximately three years and typically includes two assignments designed to help participants build business and

[142] http://www.statoil.com/en/Pages/default.aspx
[143] http://www.statoil.com/en/Careers/Students/Graduateprogrammet/Pages/graduateprocessdw.aspx

technical skills. Graduates are based in one of the operations offices in Stavanger, Bergen, Stjørdal or Harstad. Besides the competency building rotations, professional and personal development is further accelerated by prioritised training, offshore exposure and dedicated coaching from senior engineers.

Admission requirements:
MSc or PhD in petroleum engineering, mechanical engineering, mathematics, physics or chemical engineering.

Exploration[144]

Scope of the Programme

Graduates rotate between different units, organisation levels and/or competence areas. In order to develop from geologist or geophysicist to senior geologist or geophysicist and further to principal geologist or geophysicist, the participant needs to rotate between different positions. Placements can embrace activities on the Norwegian continental shelf, in global ventures or geophysical operations. Graduates with a background in geology, geophysics or geoscience can also rotate between the exploration and petroleum technology networks as well as into research and development.

Education requirements:
MSc or PhD in geology, geophysics, geoscience, physics, statistics or mathematics.

Petroleum Technology[145]

Scope of the programme

The first assignment for new graduates typically last for at least two years but should not exceed four years. In order to develop from engineer to senior engineer and further to principal engineer, there is a need to rotate between different positions:

[144] http://www.statoil.com/en/Careers/Students/Graduateprogrammet/Pages/graduateprocessexp.aspx
[145] http://www.statoil.com/en/Careers/Students/Graduateprogrammet/Pages/graduateprocesspetech.aspx

- Field production
- Field development
- Technical services
- Research and development
- Geo-operations
- Other subsurface networks

Relevant education:
MSc or PhD in geology, geophysics, petrophysics, reservoir and production engineering, petroleum engineering or other relevant natural sciences educations.

For further information regarding all corporate graduate programmes offered by Statoil please follow this link[146].

3.9.2. TRAINING AND COURSES

3.9.2.1. TRAININGS OFFERED TO EMPLOYEES

LEAP[147] (Learn – Engage – Advance – Perform) is Statoil's corporate university – its main task is to improve knowledge and competence and increase opportunities among Statoil employees. LEAP's ultimate goal is to sharpen Statoil's business performance through high-quality learning and development. All LEAP learning activities are driven by business objectives.

LEAP offers both formal and informal learning opportunities. LEAP's formal learning programmes are developed cooperatively with knowledge institutions worldwide and offered globally through classroom courses, seminars, E-learning, etc. A wide range of on-demand degree studies is also provided.

[146] http://www.statoil.com/en/careers/students/graduateprogrammet/Pages/graduateprogramoverview.aspx
[147] http://www.statoil.com/en/careers/yourdevelopment/leapcorporateuniversity/pages/default.aspx

In addition to theoretical instruction, LEAP encourages skills and knowledge development through real business opportunities and challenges. Some LEAP academies offer practical hands-on instruction, for example training in a drilling simulator, working in a geological team plotting frontier exploration strategies, and probing virtual well solutions in one of the global 3D reservoir imaging centres.

LEAP's learning programmes cover everything from strategic business development, risk management and communication to exploration, security and drilling and wells.

3.9.2.2. TRAINING OFFERED TO THIRD PARTIES

In cooperation with other Norwegian companies operating in the fields of Energy, Oil and Gas or Building and Construction, Statoil offers a wide range of trainings to contractors through the Statoil Trainingportal[148]. At the time of the drafting of this study 365 courses were available, 157 of which concern the area of offshore development in the following fields:

- Cranes and lifting (41 trainings)
- Safety (31)
- Drilling and well intervention (23)
- Emergency preparedness (12)
- Gas metering (11)
- Flange work (7)
- Working at heights (5)
- Pressure control/Pressure testing (5)
- Valves (4)
- Regulations (3)
- Fittings (1)
- Winch (1)
- Potable water (1)

[148] https://www.trainingportal.no

Given the large number of courses available through the Statoil Trainingportal, this study contains only exemplary descriptions of a selection of courses, in order to demonstrate what kind of training and information is available. Currently Statoil does not provide any training in the field of offshore exploration, therefore the information presented refers to courses given by other providers through the Statoil Trainingportal.

In order to access information about all trainings offered to contractors, it is possible to register with the Statoil Trainingportal.

Examples of the most relevant courses are provided below:

Introduction to Drilling Technology

At a glance	Objectives
Pre-Requisites None **Duration** 3 days **Language** Norwegian **Learning Tools and Methods** Classroom course **Provider** Maersk Training	Focus is given to various phases of a drilling operation. Upon completion of this course, participants should be able to describe the various phases of a drilling operation. They should be able to identify, state the position and give an account of how drilling equipment is used on a platform.

Oil and Gas Extraction

At a glance	Course main contents
Pre-Requisites Not set **Duration** 150 min. **Language** English **Learning Tools and Methods** E-learning course **Provider** Mintra Trainingportal	▪ Section 1: Introduction to Oil and Gas ▪ Section 2: Principles and Methods of Oil and Gas Exploration ▪ Section 3: Drilling ▪ Section 4: Well Completion ▪ Section 5: Wellheads and Christmas Trees ▪ Section 6: Artificial Lift ▪ Section 7: Stimulation Methods and Enhanced Oil Recovery

Well Production Technology

At a glance	Objectives
Pre-Requisites Not set **Duration** 30 min. **Language** English **Learning Tools and Methods** E-learning course **Provider** Mintra Trainingportal	This aim of the course is to: ▪ Provide an overview of some of the most common types of technology used in the recovery of oil and gas ▪ Explain how hydrocarbons are recovered from reservoirs ▪ Give an overview of different artificial lift methods ▪ Give an overview of typical beam pump production ▪ Identify when well workovers may be required ▪ Give an overview of acid squeeze / acid fracturing ▪ Give an overview of hydraulic fracturing ▪ Explain how to clean well perforations ▪ Explain how to use coiled tubing ▪ Give an overview of steam-assisted gravity drainage

Basic Introduction to Oil and Gas Production

At a glance	Objectives
Pre-Requisites Not set **Duration** 2 days **Language** English **Learning Tools and Methods** Classroom course **Provider** TS Impro	The course provides course participants with basic knowledge of oil and gas production, systems and work methods. Suited for new employees, maintenance and safety personnel, and others who should know something about the process and safety systems in the oil and gas production.

Drilling Calculations

At a glance	Objectives
Pre-Requisites Basic Mathematics course,	The objective of the course is to give the professional junior drilling staff the necessary

Drilling Technology 1 and 2 certificates and sufficient practical experience **Duration** 5 days **Language** English **Learning Tools and Methods** Classroom course **Provider** Maersk Training	knowledge regarding common formulas and calculations used in the oilfield. Participants are also introduced to well control principles and kill sheets, prior to attending their first well control course.

Introduction to Petroleum Geology

At a glance	Objectives
Pre-Requisites None **Duration** 2 days **Language** Norwegian **Learning Tools and Methods** Classroom course **Provider** Maersk Training	The aim of the course is to teach how oil and gas are formed and how oil is located on the Norwegian continental shelf. Upon completion of this course, participants should be able to describe the formation of the earth and the internal and external forces that influence the earth, for example the formation of continents, mountain ranges, volcanoes, earthquakes and the different types of natural terrain: mountains, dales, beach surfaces and the sea bed. Participants will be able to recognize the most important minerals and rock types. In addition, they should be able to talk about the main geological features of the Norwegian shelf, and the methods used to locate and determine the qualities of oil and gas fields.

3.10 TECHNIP

Technip[149] is a project management, engineering and construction company for the energy industry established in Paris in 1958. Technip's business activities serve many sectors of the energy industry worldwide, but in particular the oil and gas sector, where they are active in three business activities: subsea, onshore and offshore. The oil and gas market represents 97% of the Group's revenues and continues to grow at

[149] http://www.technip.com/en

a sustained pace. With a workforce of 40,000 employees, Technip is present in 48 countries. The Technip fleet currently counts 27 vessels with an additional 7 currently under construction. Technip has recently announced major investments in state-of-the-art vessels as part of its fleet development strategy.

3.10.1. TECHNIP UNIVERSITY

Technip University (TPU) operates in different regions and is dedicated to promoting knowledge and talent for the future. TPU is focused on filling leadership pipelines for project, managerial and technical leaders. The university also helps strengthen Technip's corporate culture and values through awareness programmes on company priorities.

Since 2009, TPU has delivered services to the business, organised as a virtual concept. It has a central organising team in headquarters in Paris and is linked to employees in 50 countries through the Global Training Network. TPU relies on many assets. The most important of these are the field-tested expertise and human capital. TPU also helps spread and strengthen a shared corporate culture and values through awareness programmes on company priorities.

3.10.1.1. PROJECT LEADER DEVELOPMENT PROGRAMME

TPU has developed the Project Leader Development Programme, in which employees agree with their managers which learning activities will be undertaken.

These activities usually fall into the following categories:

- Learning from experience
- Learning from others
- Learning from training

Technip University oversees the Group learning and development programmes for employees who aspire to become technical leaders, project leaders or managerial leaders.

Learning from experience

Most learning and development happens during naturally occurring work events. A plan helps focus the experience so that learning is intentional and can be quantified. Learning through experience accounts for 70% of the training and is guided by the Skills Development Plans.

Learning from others

In some cases, knowledge transfer projects are set up to ensure an effective skill transfer between a recognised internal expert and an apprentice. Participants use a customised skill development plan to mark progress. Around 20% of the development should have the form of learning from others. Such training is provided in the form of mentoring and coaching or under the Knowledge Transfer Projects.

There are three consecutive steps of a Knowledge Transfer Project:

1. Technip uses 16 Knowledge Areas and the online assessment tool to create the **Knowledge Silo Matrix**. The Matrix exposes the bench strength risks and shows were important knowledge is siloed.
2. TPU creates a **Skill Development Plan** (SDP) for each Knowledge Area. There are 20-80 skills for each SDP. These SDPs identify the skills, wisdom and tacit knowledge that must be transferred to reduce risk.
3. TPU hosts a two-day **Knowledge Transfer Workshop** to train experts how to teach, and apprentices how to learn, using the Knowledge Transfer method. Experts and apprentices go back to the work place and spend three to five hours a week until the SDP is complete. Then, the apprentice moves to another expert and to a new SDP.

Learning from training

Training managers in the regions oversee the delivery of instructor-led courses and E-Learning programmes relevant to the business needs in their region. Technip University also delivers courses that are of general interest to all Group employees.

Registration is handled by local training officers. Learning through training accounts for around 10% of the programme and can take the form of:

- Classes
- Seminars
- Simulations
- E-Learning
- Attending Lessons Learned Sessions

Classroom training

TPU works with Technip's College of Experts to facilitate the development of university curricula, and in some cases contributes to the development of master degrees in engineering specialties.

E-Learning

TPU's suite of energy E-Learning is said to be a user-friendly, flexible learning solution that allows participants to learn at their own pace without the time and location constraints of a classroom. Training can be accessed anywhere, anytime by a high number of participants in all regions. Topics covered include the exploration and production of oil and gas, the infrastructure, processes and risks involved in the transportation of oil natural gas from the point of production to end-user markets. The courses transmit an understanding of the economic, business and environmental risks and opportunities associated with the oil and gas industry. Among the topics covered by the E-Learning tool are the following.

Understanding the Oil and Gas Industry:

- Oil: From wellhead to market
- Exploration & production
- The natural gas industry

Electric Power and Renewables:

- Power overview

- Non-renewable energy
- Renewable energy
- Power distribution
- Understanding energy (introductory module)

Environment:

- Introduction to climate change
- Climate change: Technology solutions
- Climate change: Economics & politics
- Non-carbon environmental issues

Geopolitics and Energy:

- Geopolitics and energy: part 1
- Geopolitics and energy: part 2

3.10.1.2. TRAINING COURSES FOR THIRD PARTIES

Technip University offers training courses that are of general interest to clients and partners. Below short abstracts of relevant courses are provided:

Introduction to Offshore Facilities

At a glance	Objectives	Course main contents
Who should attend? Project Teams from Onshore business, Lead Discipline Engineers from Onshore, ECP Engineers, and relevant project support staff. **Pre-Requisites** None **Duration** 4 hours **Language**	▪ State the phases in the energy lifecycle; Identify major phases of an offshore field development and recall where offshore drilling and production factor in ▪ Recall key vocabulary of the Offshore Industry ▪ Name the major components of a producing offshore	▪ Offshore Field Development and Facilities ▪ Offshore Equipment ▪ Offshore Project Execution and Controls

English **Programme Capacity** 30 participants	field-topsides and seabed ▪ Distinguish between floating and fixed platforms and identify the main criteria for their selection ▪ Identify major execution steps and controls in an Offshore Project and state why each one is important ▪ Be able to describe Technip's Scope of Supply in Offshore Oil & Gas drilling and production.	
Learning Tools and Methods: Technip Professor - Power Point Presentation, Videos, Quiz		

Introduction to Offshore Platform Technologies

At a glance	Objectives	Course main contents
Who should attend? Experienced Engineers from Onshore, Newly hired Offshore Engineers **Pre-Requisites** Engineering experience **Duration** 16 hours Two 8-hour sessions **Language** English **Programme Capacity** 30 participants	▪ Use the vocabulary unique to this sector ▪ Recall the major phases in offshore field development- Exploration & Production value chain (high level overview) ▪ Recall the history and evolution of offshore fixed platforms ▪ State the technical drivers and design considerations for the types of platforms Technip offers the industry ▪ Recall major offshore project phases and the sequence of activities in each one	▪ Offshore Field Development ▪ Offshore Facilities ▪ Offshore Systems and Equipment ▪ Offshore Project Execution

	▪ Describe the major components of each type of platform ▪ Describe the major systems and components of topsides ▪ Recall the significance of load and footprint for Offshore Facilities ▪ Recall typical types of contracts and scopes	
Learning Tools and Methods: Technip Professor - Power Point Presentation, Quizzes and Exercises		

Leading to Results

At a glance	Objectives	Course main contents
Who should attend? Project Managers, Project Engineering Managers, Field Engineering Managers, Project Engineers **Pre-Requisites** Basic understanding and knowledge of Project Management **Language** English	**This course helps build skills in the following leadership competencies:** ▪ Understanding Clients and Stakeholders ▪ Understanding Others ▪ Self-Confidence ▪ Communication ▪ Team Leadership ▪ Coaching ▪ Teamwork/Collaboration ▪ Self-Control ▪ Reliability	▪ **Module 1 Leadership in a Matrix Organization** Topics in this module include tips on how to leverage power sources for maximum impact and how to build influencing skills. Participants will deepen their leadership expertise by learning how to apply a model using different types of power, and how to most effectively influence others. ▪ **Module 2 Building The Team and Leading Change** This module examines methods for building a cohesive team. This module will teach the participants how to facilitate the completion of team goals. Topics include creating a “sense

		of team", understanding team dynamics and development, identifying teamwork barriers and enablers. Participants will be introduced to the science behind change management and learn tools to lead change. ▪ **Module 3 Aligning Internal and External Stakeholders** In this module participants will learn a process that builds strong client and stakeholder relationships. They will learn diplomatic approach to resolving issues before these turn in conflict. Topics include building trust, credibility, and rapport, gaining alignment to meet the needs of the customer/stakeholder (Listening to the Customer), exploring how different roles can support each other and diffusing the emotional component of stakeholder issues and customer problems. ▪ **Module 4 Coaching for Performance** In this module participants will learn how to effectively coach their teams' members for maximum performance. Topics include strategies for enhancing team effectiveness, identifying

		what characterizes a high performing team, managing conflict more productively and introduces the elements of a principled negotiation approach to conflict resolution.
Learning Tools and Methods: Lecture, Workshops and Simulations - Taught by a Technip Contractor		

SimulTrain: Project Management Simulator

At a glance	Objectives	Course main contents
Who should attend? Project Managers, Engineering Managers, Project Engineers **Pre-Requisites** None **Facilitators** DEMOS Group & Joseph Remigereau Technip Professor **Duration** 2 days **Language** English **Programme Capacity** 16 participants per session	Build skills in the Project Management Competencies with a focus on some personal competencies such as: ▪ **Organisation / Priority Setting** Participants will organise a project and assign people to tasks according to the constraints and goals of the project, taking account of the skills required from the team and the potential for synergy. ▪ **Reliability** By understanding the strengths, preferences and motivations of the team, participants will be able to manage all kinds of project situation in a dependable and agile manner. ▪ **Result-driven** In order to keep the team focused on results, participants must manage the key performance indicators of quality, time, cost and motivation,	In teams of four, learners play the role of the project manager in a simulated project environment. The teams have to plan and execute a typical small/mid-sized project. Full of multimedia interaction, SimulTrain provides teams with phone calls, emails, and voicemails to create a realistic and stressful environment – just as in real life. The simulation is split into two parts over two days and combined with other learning.

	which are constantly evolving on the project dashboard. ▪ **Self-confidence** The experience of keeping a team composed of diverse personalities aligned with the project end goals will develop confidence that success comes through regular supportive communication. ▪ **Team Leadership** By managing the motivations and personal development that are part of team growth, participants will gain insights and practice into leading a team of creative people with sensitivity and empathy. ▪ **Resistance to stress / Self-control** Time pressures, a team with different interests, a demanding manager and an important customer-facing these challenges the participants will learn how to make decisions and how to manage their energy and the energy of the team.	
Learning Tools and Methods: Serious Game, Demos 'SimulTrain' Project Management Simulator		

Subsea Group Products and Services (Subsea GPS)

At a glance	Objectives	Course main contents
Who should attend? Recently recruited engineers (0-2 years of subsea experience) Subsea	▪ Use the vocabulary unique to this sector ▪ Recall the main aspects of the subsea	▪ Subsea: what are the issues? ▪ Rigid pipe – design principles, installation

Business development employees **Pre-Requisites** None **Duration** 2 days **Language** English **Programme Capacity** 25 participants	domain ▪ Recall what role Technip plays in the subsea domain ▪ Recall the key steps in and the important technical aspects of subsea project execution ▪ State the different challenges which arise in subsea projects and activities ▪ Be prepared to contribute to the project	and spool base activity ▪ Flexible pipe and ancillary equipment presentation and manufacturing process ▪ Umbilicals design principles and manufacturing ▪ Subsea operations ▪ The Technip Fleet ▪ Diving and Remote Intervention ▪ Integration within a project
Learning Tools and Methods: Technip Professor - Power Point Presentation, Videos, Quizzes, Case Study		

3.11 TOTAL

Total[150] is an international energy operator, active in every segment of the oil and gas industry. With more than 97,000 employees in 130 countries, Total's revenue in 2012 was €200.06 billion. The company conducts oil and gas exploration and production operations in more than 50 countries. Total's structure is organised into three interrelated business segments: Upstream, Marketing & Services and Refining & Chemicals. The Upstream business segment encompasses the Exploration & Production business and the Gas & Power Division.

3.11.1. STUDENTS AND GRADUATES

Internships: Nearly 4,000 internships and 700 work-study contracts are offered each year. These programmes provide students an opportunity to explore Total's activities and businesses. Assignments are available in every professional discipline, at corporate headquarters and in refineries, regional offices and affiliates in France and worldwide. They are open to applicants from any background.

[150] http://total.com/en

The Total Summer School

Each year, nearly 100 students from around the world are invited to spend a week in Paris as part of the Total Summer School. Founded in 2006, the school offers an in-depth look at Total's activities and issues facing the energy industry. Students take part in lectures and discussions led by Total employees and experts in the field. The Summer School also provides an opportunity to meet with the company's recruiters to talk about professional opportunities, careers and internships at Total.

Volunteer for International Experience (VIE) Co-op Placements

Each year, about 120 young Europeans accept a VIE co-op placement in Total's affiliates worldwide. The programme is open to graduates from the European Economic Area with five years of post-secondary education. They spend 12 to 24 months in business, with responsibilities covering the full spectrum of Total's technical, commercial and support professional disciplines.

An additional group of 20 or so students is recruited each year to participate in the Volunteer for International Science (VIS) program. The students take part in R&D projects in a variety of fields, including geology, process engineering and chemistry. Their research is conducted in partnership with Total laboratories and academic research laboratories around the world.

More information on opportunities for students can be found here[151].

3.11.2. TRAINING AND COURSES OFFERED TO EMPLOYEES

Regarding career development opportunities for personnel, the training plans are defined on the basis of individual employee needs. They may focus on:

- Strengthening employees' skills so they can advance professionally
- Helping employees acquire additional skills in order to take on new

[151] http://total.com/en/careers/career-development/student-programs

responsibilities or prepare for a new career direction

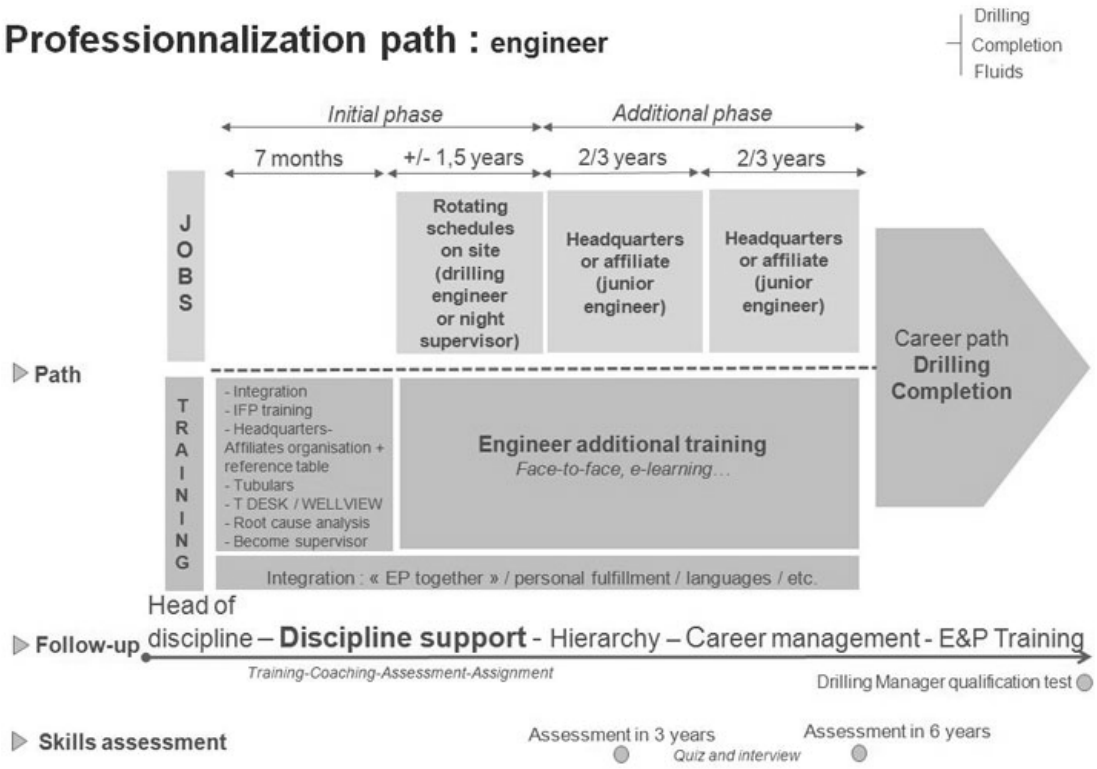
In 2011, 81.6% of Total's workforce took part in training programmes, for an overall spending of €373 million. Employees received an average of 5.8 days of training, representing 2.51% of hours worked worldwide. In areas of strong growth — Africa, Asia and the Middle East — individual training accounted for up to 13 days per year. In addition, 54,957 learners have access to online training (E-learning).

3.11.2.1. TRAINING OF JUNIOR EMPLOYEES IN DRILLING & COMPLETION

After being hired, junior employees all complete a highly structured training programme, which is the same for all affiliates. The professional skills acquisition programme has two distinct tracks, depending on the employee's background.

Engineering Track (Master's Degree)

The drilling or completion engineering curriculum lasts six years. It starts with seven months of classes and courses to bring employees up to speed. Taught by both IFP Training and internal staff, instruction covers different techniques, applications and software, and all Total guidance. The programme continues with a year and a half of rotating, on-the-job training, in drilling engineer or night supervisor positions (eight to ten rotations). The curriculum finishes up with two junior engineer assignments at headquarters or in an affiliate. Experience in the different positions is supplemented by an onboarding process and additional training. Drilling & Completion engineering is the natural way to work up to drilling manager. However, it also prepares people for responsible positions in other areas, such as field development and large-scale project management, which can be a stepping-stone to senior management jobs.

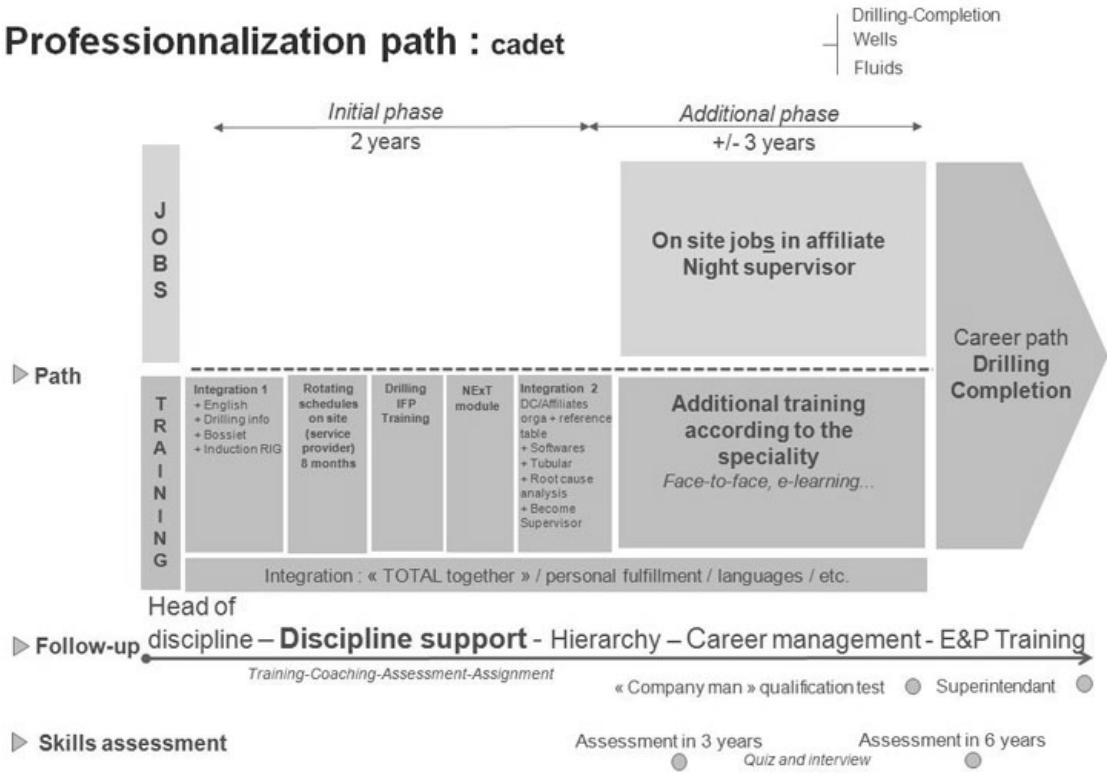


Source: THEMA: Insight into Total Human Resources[152]

Cadet Drilling Engineer Programme (Two or Three-Year Postsecondary Degree)

Cadet engineers in drilling and completion, wells, or fluids and cements are trained for operational supervisor positions. They alternate between classroom instruction and on-the-job training for two years, rotating with a service provider before starting their first "junior" position.

[152] https://careers.total.com/forage/en/rub4-2.html



Source: THEMA: Insight into Total Human Resources[153]

To find out more about junior employees training in Total's Drilling & Completion division, please click here[154].

[153] https://careers.total.com/forage/en/rub4-2.html
[154] https://careers.total.com/forage/en/rub4-2.html

4. CONCLUSION

This study provided detailed information about the educational system and training programmes available in Europe as regards the training of technical personnel for the offshore industry.

Chapter 2 was dedicated to the numerous relevant programmes on offer in the universities of Aberdeen, Newcastle, Bergen, Norwegian Institute of Technology, and TU Delft. This Chapter also provided additional information about the EU's ERASMUS Mundi programme, which adds a cross-border and European dimension to relevant programmes. Based on this research a conclusion can be made that the above-mentioned universities compete quite clearly for the most capable students. They make available detailed information about their educational offer and all present themselves as the ideal place to take up studies in a relevant discipline for a technical profession in the offshore industry.

Subsequently, Chapter 3 provided an overview of the relevant training courses offered by a selection of offshore development companies. In sharp contrast to Chapter 2 many of the contacted companies were rather reluctant to provide detailed information about their in-house training activities. Nonetheless, detailed information is available whenever training programmes are commercialised.

Interestingly, all of the companies make available rather general information about the possibility for graduates to join them. In order to attract talent they make intensive use of internship opportunities and graduate programmes. It lies within the nature of such programmes that they do not focus on one particular activity or area of specialisation, but rather provide trainees with an as wide as possible overview of the company's activities. However, in view of the focus of this study on companies active in the offshore sector it can be assumed that following completion of the programme many trainees will stay in the company in order to specialise in a

technical activity. To ease the search and selection of best undergraduate and graduate candidates, companies also tend to establish long lasting cooperation relations with selected Universities, e.g. in the form of targeted internships or scholarships.

Furthermore, it is important to note that manufacturers of technology used in the offshore industry, such as Aker Solutions, Schlumberger, or Technip, all provide specific training to third parties, in order to educate them about the products offered and to ensure the optimal use of the latter. An exception to this is DNV GL, which highlighted that its courses are neutral as regards the technology used.

In the final analysis it is clear that the training of technical personnel for the offshore industry in Europe is a highly dynamic and diversified activity. It involves numerous different players both at academic and company level, who tend to offer similar products, solutions and training programmes. Moreover, in most companies the trainings available for offshore personnel differ significantly according to location and are aligned with the particular local conditions. However, specific information on such local trainings is hardly accessible.

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