



Ministry of Economic Affairs
and Employment of Finland

Prizztech



Meriteollisuus
Finnish Marine Industries



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Finnish Offshore Industry 2016-2017

This study describes Finnish offshore industry, its structure and business volumes as well as future outlook. This report is a continuum to the Finnish Offshore Industry-reports conducted in 2012, 2013, 2014 and 2015. The project team is commissioned by Prizztech Oy (www.prizztech.fi) and the report is also supporting the work of Ministry of Employment and the Economy (MEE) Maritime industry operational environment development programme. Financially the study is supported by MEE.

VALOR

Forewords



Finnish arctic seafaring and marine technology have long traditions. The know-how of winter seafaring has been and still is a lifeline for Finland, as about 80 % of our foreign trade is transported by sea. Finland is also the only country in the world whose sea around the ports can be frozen during every winter. These facts with the shallow and fragile Baltic Sea have been a catalyst for Finns to develop innovative Arctic technology and know-how.

Marine industry, including offshore industry, is one of the most internationalised and global business branches in the Finnish economy. The Finnish marine industry bounds together a strong network of middle and small size companies that increasingly extend their business internationally. The Finnish marine industry involves many global

brands, products, and companies setting the course of world markets.

One example of the innovative nature of Finnish marine industry is autonomous maritime ecosystem programme, launched in September 2016. The aim is to provide world's first unmanned maritime products, services and vivid ecosystem by 2025 – including testing of autonomous vessels in the harsh weather conditions in Finland. It is a concrete action of Finnish digitalization strategy and Finnish Marine Industries envisioning on PPP- bases. Finnish industry – both marine technology and ICT companies – and the Finnish Funding Agency for Innovation, TEKES, have joined their forces for this challenging target.

In the offshore sector Finnish companies have already been involved since the early days of the North Sea economic development. Nowadays our offshore companies are in the vanguard of developing solutions to the extreme conditions of the Arctic Ocean. In terms of the natural environment, the Arctic region is one of the purest and best preserved in the world. This is very significant from Finland's perspective, and we seek to lead the way in the sustainable development of the region.

Year 2017 will be the centenary of Finland's independence, as Finland became an independent state on 6 December 1917. One hundred years later we will take over the two-year chairmanships of the Arctic Council and Arctic Economic Council. The proposed themes of the programme for Finland's chairmanship of the Arctic Council include addressing the climate change in the Arctic, wellbeing in arctic communities, and meteorological cooperation. These both chairmanships give a great opportunity for our industry, especially the Arctic marine industry, to present itself and its Arctic know-how to experts taking part into different events in Finland during the chairmanships.

Dr Olli Rehn

Minister of Economic Affairs

Move on to Offshore markets, Momentum for the Finnish Marine Industry



Strong Competitive Network in offshore market deliveries is the key for the Finnish offshore industry, an integral and growing part of the Finnish marine industry. Statistics reveal that offshore marine industry employs five thousand people, one fourth of the whole workforce in marine industry.

This co-operation and networking is essential in delivering competitive parts and larger equipment for oil & gas production fields. Due to low oil price, investors are looking for cost savings in investments and ways to lower the break-even point of production. There are more than 900 marine industry companies in Finland, and they can join forces to provide more comprehensive concepts and larger projects with

competitive prices.

Co-operation is needed also in RDI in order to develop smart, safe, effective, environmentally safe and profitable vessels and solutions for extreme conditions in offshore sector, like those in the freezing cold Arctic Ocean. This is the competence that Finland has. Tekes – the Finnish Funding Agency for Innovation - supports research, development and innovation projects that create the greatest benefits for economy and society in the long-term. Currently, there are plenty of competence and business opportunities in this sector in the blue growth.

Offshore is one of the six major marine industry sectors in Finland. According to the report conducted by VALOR, offshore export will reach over 1.2 billion euros in 2016, a large proportion of the total export of seven billion euros of the Finnish marine industries. This emphasizes the importance of offshore to the whole maritime industry.

Material and system suppliers manufacture many known products such as LNG engines aimed at saving the environment, and the most advanced propulsion systems for energy efficiency and water mist fire-protection systems. Finnish turn-key companies are able to deliver complete spaces for vessels, such as fully equipped kitchens and cabin modules. Design offices offer concept design, research and development services. Software and system providers offer design software to the offshore industry. Customers include owners, operators, and the drilling and production platform designers.

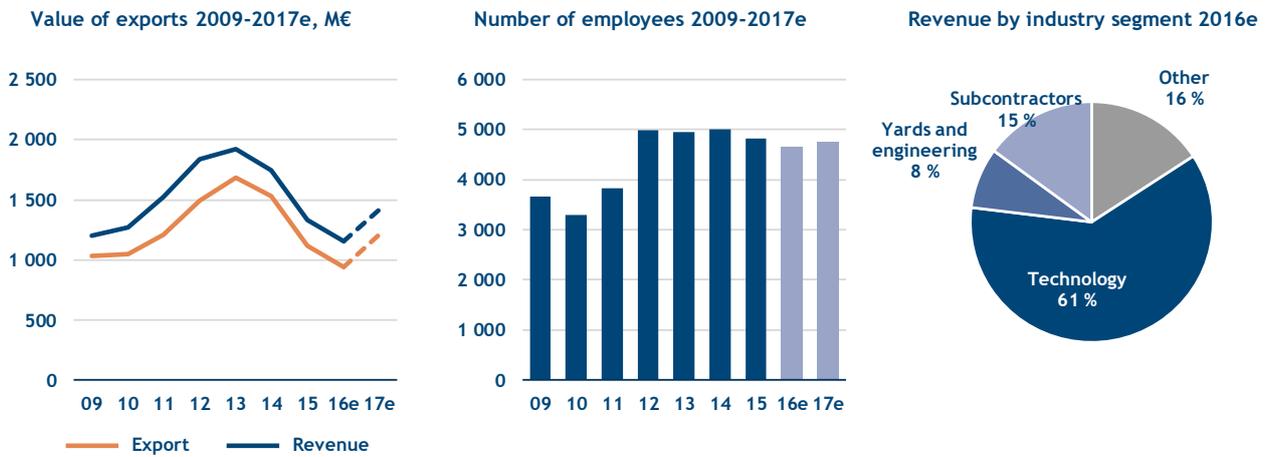
Shipyards build the most visible products: floating offshore structures, many types of vessels such as the biggest and most luxurious cruise ships, most of the world's icebreakers and many types of special vessels for offshore support, supply and rescue operations such as oil spill recovery, firefighting and towing operations. Repair yards provide life-cycle services for ships.

These six sectors are not separate but interconnected as Competitive Network for offshore market deliveries. The Finnish marine industry is known for networking, innovation, ability to solve complex engineering problems and on time deliveries with competitive price levels.

Merja Salmi-Lindgren
Secretary General
Finnish Marine Industries

Key figures

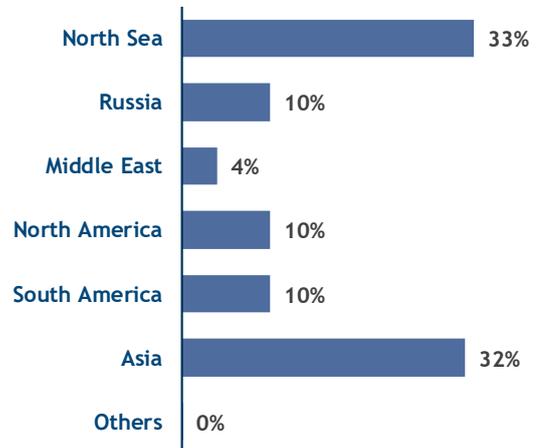
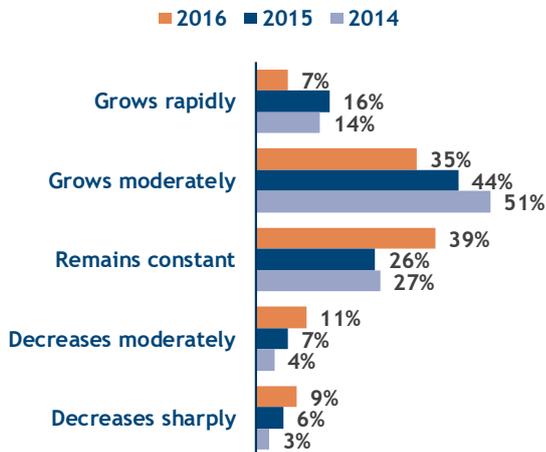
Overview of the Finnish offshore industry



Sources: information provided by the companies, VALOR analysis

Companies' outlook for their offshore businesses

Exports of the Finnish offshore industry in 2016

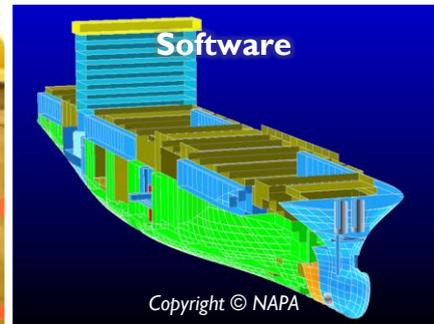
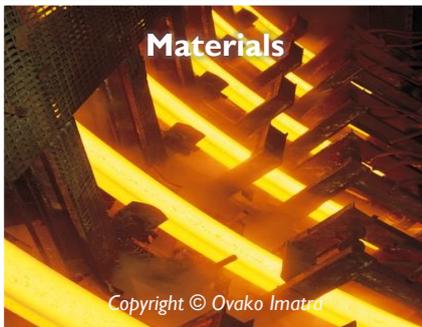


Sources: information provided by the companies, VALOR analysis

Finnish offshore industry business areas

Finnish companies possess world-class knowledge and competence in offshore industry. The knowhow originates to a large extent from the strong shipbuilding industry as well as from the competitive high technology cluster in Finland. These have created platform for innovative and high quality products and services in the Finnish offshore industry.

Examples of offshore business areas where Finnish know-how is recognized globally



Executive Summary

Offshore continues to be a major industry in Finland. In 2016 total revenues of the Finnish offshore cluster are expected to amount to approximately 1.2 billion euros, of which exports accounts for 1.0 billion euros. Over 170 companies operate actively in the Finnish offshore industry and the industry employs approximately 4 600 persons.

The industry has experienced a rapid growth in Finland with an annual growth rate of around 10 % in 2009-2014. A prolonged period of low oil and gas prices has wiped out upstream profits and increased uncertainty. This has led to substantial reductions in oil and gas drilling and other activities in traditional offshore business. Consequently, total revenues of the Finnish offshore cluster fell 24 % in 2015 and 13 % in 2016, representing 1.2 billion euros in 2016. However, a majority of the companies believe that both offshore revenues and exports will grow moderately in 2017.

To stay competitive, companies in offshore have streamlined their business operations. However, major cuts in operating and capital costs have been made, and now Finnish companies are focusing more on finding growth prospects and new business opportunities. In addition, many start-ups and smaller players have sprung up in Finland and are developing unique technology solutions that meet previously unfulfilled customer needs. Finnish offshore sector is presently undergoing change towards a smarter and more modern industry. With squeezed margins and staff numbers, innovation and technological expertise is more widely seen as the key to long-term profitability.

Solid references in shipbuilding form another advantage for the Finnish offshore players. Finnish shipyards have earned a strong reference base in specific product areas, such as spar platforms and subsea structures. This is partly attributed to the fact that Finland has managed to build a well-functioning network in maritime sector, where the use of partners and existing infrastructure is easy. Finland is also known for putting great effort in researching and developing smart, energy efficient and sustainable solutions across sectors. The latest reference is the world's most environmentally friendly ice-breaker, *Polaris*, which is manufactured in 2016.

Along with technological expertise and solid references in offshore business, Finnish companies are known for their uncompromising quality in products and services, which stems from the fact that the Finnish offshore cluster is particularly advanced in project management. While players across the offshore sector have made substantial cuts in capital investments and operational expenses in the last two years, customers continue to be focused on the quality of the services and products.

Companies in the offshore market are waiting the price of oil to resurge to a level where oil and gas operation and exploration become profitable. Meanwhile, various attractive growth opportunities exist in the market. Some of the most promising opportunities emerge from automation, digitalization, offshore fish farming, and offshore accommodation. Although companies have expanded their product and service portfolio outside traditional offshore business, developing more efficient ways of oil and gas drilling will remain important.

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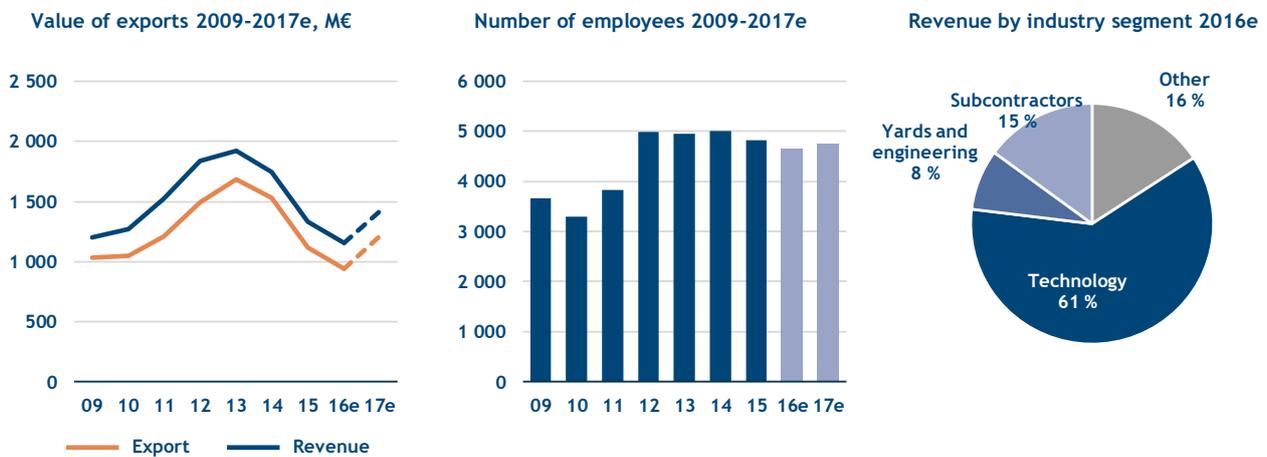
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Finnish offshore industry

I.1. Overview of the industry in Finland

The offshore industry remains to be a significantly important sector in Finland in terms of exports and employment effects. In 2016 total revenues of the Finnish offshore cluster are expected to amount to approximately 1.2 billion euros, of which exports accounts for approximately 1.0 billion euros. Offshore revenues are expected to increase over 20 % in 2017 mainly due to a strong order book of shipyards. The offshore industry employs directly over 4 600 persons and Finnish companies are seeking to recruit additional employees within the next year.

Overview of the Finnish offshore industry



Sources: information provided by the companies, VALOR analysis

Over 170 companies operate actively in the offshore industry in Finland. The results of this study reveal that Finnish companies regard offshore as an attractive industry with substantial growth prospects and new business opportunities despite current low oil and gas prices. Low oil prices have resulted in lower margins, and companies across the sector have reduced costs to mitigate reduced margins and stay competitive. Established players have thus decreased their marketing efforts in offshore business and they operate both the existing and the new projects with smaller headcounts. However, Finnish companies see the slowdown of the offshore market acting as a good motivating force to develop more intelligent and cost-efficient services. One example of Finland's innovative-driven approach to market challenges is the rise of start-ups entering the offshore market. With oil price fluctuating below and above \$50 per barrel, the role of innovation and technology in the sector is more and more seen as the key for long-term profitability.

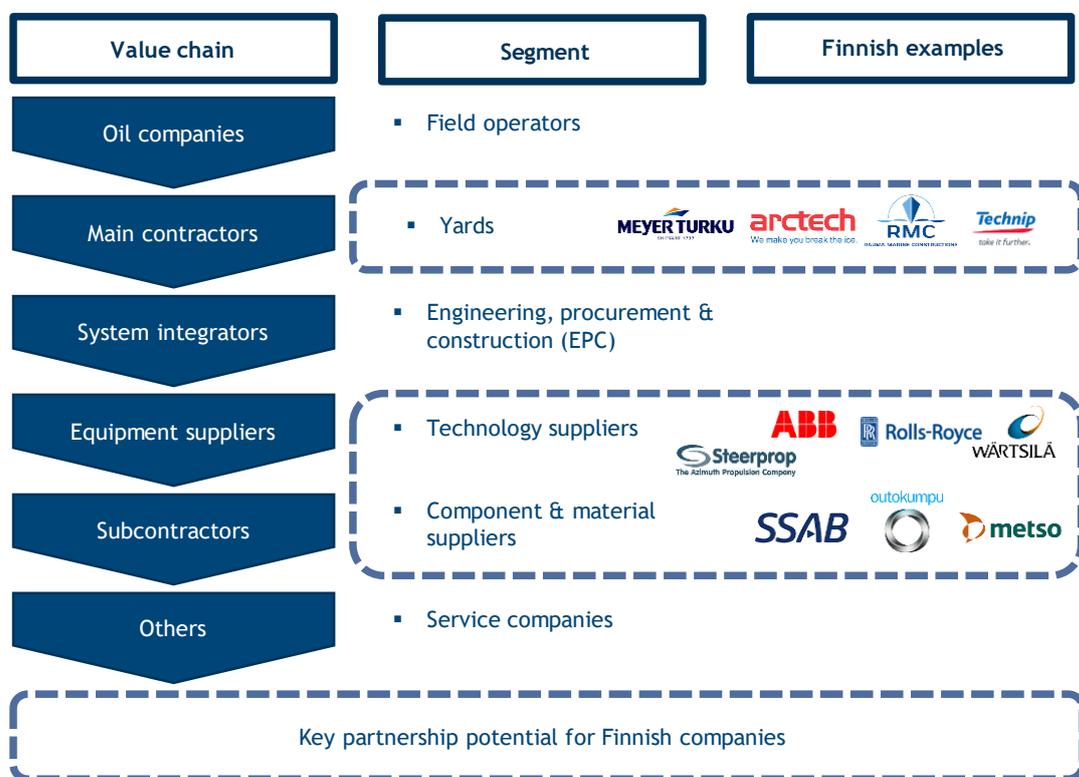
The industry experienced a rapid growth in Finland with an annual growth rate of around 10 % between the years 2009 and 2014. With a prolonged period of low oil prices, offshore oil and gas activities have been in downbeat mood in 2015 and 2016. Consequently, the offshore market fell

more than expected, resulting in a decline of 24 % in 2015 and 13 % in 2016. However, a majority of the companies believe that both offshore revenues and exports will grow moderately in 2017.

The largest sub-sector of the Finnish offshore industry is technology sector, constituting approximately 60 per cent of the total revenues of the Finnish offshore industry. The convergence between the traditional marine industry and the offshore industry has been one of the key underlying factors driving technology companies, particularly in the propulsion- and motor technology sector, to become the single largest product and service providers in the Finnish offshore industry. The rest of the technology sector in Finland comprises of both marine technology companies and of companies with a background in other industries than marine or offshore. These companies possess strong technological expertise in a variety of technologies and businesses such as design and engineering, cranes and lifting, living and wellbeing, automation solutions, electrical solutions, process technology, or HSEQ technologies.

In 2016, the total offshore revenue of Finnish technology companies amounted to approximately 700 million euros, which is notably less than 1.1 billion euros in 2014. Several factors explain revenue slump; the number of enquiries has dropped, order sizes are typically smaller, service and maintenance business generates less euros than new-build projects and hardware selling. However, investments in oil exploration and production are expected to resurge at some point in the near future. Then firms that have invested in their offering and marketing efforts have better prerequisites to thrive.

Finnish offshore industry offering in relation to the industry's value chain



Sources: VALOR analysis

The Finnish shipbuilding industry has been active in finding new growth opportunities. Technip Offshore Finland has built most of the world's spar platforms and is actively seeking opportunities to construct other platforms as well. Meyer Werft's investments in Turku Shipyard have led to a positive impact on the Finnish shipbuilding industry and the shipyard's extremely strong order backlog will last to 2020. However, the current business focus of Meyer Turku is outside offshore. Arctech Helsinki shipyard is gaining momentum in a specialized niche segment of the shipyard industry. Through continuous innovations the company was awarded with 4 offshore ice-breaker contracts in 2014, which are delivered to customer in 2017. Furthermore, new offshore yard Rauma Marine Constructions (RMC) is creating future growth opportunities for the Finnish offshore shipyard sector. RMC started operating at the end of 2014 and total revenues are expected to reach 80 million euros in 2017. Offshore revenues account for 20 – 30 % of the total revenues and currently the main export market is the Middle East.

Similarly, Finnish engineering companies have in recent years been active in seeking growth outside their traditional lines of business. Engineering companies have set their sights on opportunities abroad, and created international business both organically and through acquisitions and strategic partnerships. For example, Elomatic and Wellquip merged their offshore business in 2014. A few years later Wellquip restructured its operations, with Wellquip Holding Oy providing enhanced oil recovery solutions with artificial lift technology and Elomatic providing offshore consulting and engineering activities. On the other hand, Deltamarin's owners and management found a new partner to fuel the company's growth by selling a majority of its shares to AVIC International Investments Ltd., creating robust platform for future expansion in offshore business. Besides growth in the offshore industry, deepwater operations with operational needs similar to those of the maritime industry, has provided Finnish maritime engineering companies with a new opportunity to expand the scope of their business. This all has enabled Finnish engineering companies to take advantage of growth opportunities in the offshore industry.

Subcontractors that have traditionally been focused on the domestic shipyard and technology sector, have also been able to penetrate international markets and in 2016 approximately 40 % of their offshore revenues are expected to come from exports. Finnish subcontractors are typically engineering workshop companies specialising in one product or service area. The companies are particularly competitive in highly customised deliveries with short lead-times and small batch size, or in a specific product area such as gears or casting.

In addition to the abovementioned sectors, Finnish companies are providing materials and other services in offshore industry. As an example, Arctia is a company pioneering in ice-management operations in the arctic offshore fields. The relative importance of the offshore business for companies operating in the industry is slightly decreasing. The share of revenues stemming from the offshore business is decreasing to 7 % in 2016 from 10 % in 2014. This is partly explained by the construction boom in the cruise ship industry, especially in Turku shipyard. On the other hand, substantial investment cuts in the offshore sector have forced companies to find new growth opportunities outside offshore business. However, in the longer term Finnish companies believe that the offshore business is growing in importance as the industry is moving towards more challenging environments such as deeper waters and the Arctic.

1.2. Growth opportunities under challenging market environment

The oil industry with its history of booms and busts has been its deepest downturn since 1990s. A prolonged period of low oil and gas prices has wiped out upstream profits and increased uncertainty. WTI crude oil price per barrel has fluctuated from \$29 to \$53 in 2015 – 2016. Current oil prices are below what producers need to drill wells profitably. Players in the offshore market are waiting oil price to resurge to a level where oil and gas operation and exploration is profitable. Meanwhile, there are various attractive growth opportunities in the market. Some of the most promising opportunities are introduced below.

Major growth opportunities in global offshore business

	1. Increasing opportunities in automation, digitalization, big data and IoT		5. Offshore accommodation
	2. Soaring interest for offshore fish farming		6. Decommissioning of old oil rigs and vessels
	3. Growing importance of maintenance and service business		7. Three I's (Iran, India & Indonesia)
	4. Tightening environmental and safety regulations		8. Ever more challenging technology for multi-function vessels

Sources: VALOR analysis

Increasing opportunities in automation, digitalisation, big data and IoT

The future of oil and gas industry will be more digital and automated. Smart well operations, subsea drilling and mining system technology, and autonomous pipeline inspection are gaining popularity in the offshore industry. Increased cost pressures, efforts to ambitiously reduce carbon emissions and expected growth in natural gas production will drive the industry in the following years. As a result, safety, predictability and reliability demands in offshore business have intensified. Operators aim to streamline offshore operations by minimizing unexpected downtime and maximizing scheduled uptime. Digitalisation offers many applications and companies are now investing in 3D-planning, intelligent energy management solutions and unmanned vessels to name a few product and service development areas.

Soaring interest for offshore fish farming

Fish farming typically involves raising fishes in tanks, ponds or ocean enclosures, usually for food. Due to the need for space and efforts to cut environmental footprint of fish farming, offshore farming has become increasingly interesting business opportunity for aquaculture companies. Therefore, offshore fish farming offers an attractive business opportunity for the whole offshore industry. For instance, handling and connecting of large heavy modules, automation and sensor technology, and

related analyses. Especially Norway has been active in developing new business within offshore fish farming. Norway Royal Salmon (NRS) is planning on going into offshore salmon farming and has developed in co-operation with Aker a completely new type of an offshore farm, designed for harsh weather conditions. The farms are planned to be placed far away from the coast in order to increase the area utilization and minimize the environmental footprint.

Growing importance of maintenance and service business

Prices for crude oil and gas have sunk and are likely to remain depressed for the next few years. After many years of heavy investments in oil and gas industry, the great majority of oil companies are focusing on securing prominent cash flows and making their operations as efficient as possible. Oil companies' aims to streamline their operations are currently driving the demand for innovative and well-timed maintenance services. Previously, maintenance programmes were calendar-based given by equipment manufacturers. Nowadays, smart maintenance programmes are based on knowledge and real data, and risk management processes are continuously improved. Similarly, simulation, visualization and remote support services continue to be digitalized. Operators utilizing smart maintenance and other service solutions have a competitive edge as they are in a better position to provide safe and uninterrupted production throughout contract periods.

Tightening environmental and safety regulations

Serious accidents, such as the 2010 Deepwater Horizon disaster in the Gulf of Mexico, illustrate the need for holistic safety measures. Safety issues are becoming increasingly important for individual operators, countries and multinational organizations since an accident typically causes damage across the border lines. In April 2016, the U.S. government announced new well control regulations to reduce the risk of an offshore oil or gas blowout. The new regulations represent one of the most significant safety and environmental reforms that has undertaken since the Deepwater Horizon accident. New regulations specifically address the full range of systems and equipment related to well control operations focusing on blowout prevention requirements. Tightening environmental and safety requirements increase the demand for functions. Furthermore, the need for new kinds of professional services, such as comprehensive well safety reviews, rig inspections and other consulting services, are increasing significantly after the reforms.

Offshore accommodation

To escape the busy and hectic city life and embrace new forms of mobility and freedom, many consumers are willing to pay for extraordinary products and services. In addition, land prices in world's major metropolitan areas are soaring. Therefore, floating accommodation may play a bigger role in the future's accommodation market. In many popular tropical paradises from Dubai to Maldives, floating hotels have already become something of a trend in the last few years. Hotel companies are increasingly looking out to sea when considering where to build next resorts. Various Finnish offshore companies have gained high level experience in producing products and services for offshore accommodation sector. For instance, Finnish companies Admares and RMC joined forces in 2015 in order to provide an ultra-luxurious floating terrace for Dubai's famous landmark hotel Burj Al Arab. Regardless of Burj Al Arab Terrace being one of the most ambitious floating

accommodation projects ever built, Admares and RMC managed to deliver the terrace to the customer in a record time with immaculate quality.

Decommissioning of old oil rigs and vessels

During the next 30 years, approximately 500 offshore installations will need to be decommissioned in the North Sea's UK Continental Shelf alone. Global offshore oil and gas installations decommissioning market is expected to increase at a CAGR over 20 % until 2020. The major drivers for offshore decommissioning market are abandoned rigs and ageing oil reserves. Globally North America remains to be the leading market area for decommissioning due to USA's maturing oil reserves in the Gulf of Mexico. In addition, North Sea area in Europe is expected to see a rapid growth rate. While flat oil prices and rising costs could challenge future oil exploring and drilling operations, decommissioning typically remains mandatory since abandoned structures and wells damaged by storms could cause an environmental disaster.

Three I's (Iran, India & Indonesia)

The nuclear agreement reached between Iran and its counter parties in January 2016 put an end to the economic and financial sanctions set against the country. Under the U.S. led agreement, most nuclear-related sanctions will be removed during 2016 and the following year. Fading sanctions will reopen Iranian oil markets and return billions of dollars in frozen oil money to the country. Booming investments to oil industry and increasing production are creating business potential for offshore companies all over the globe. Furthermore, the governments and major oil companies in India and Indonesia have established ambitious plans for expanding national oil exploration and drilling operations. For instance, the Indonesian government is planning a major increase in its oil production quantity, which requires large-scale investments in oil exploration and drilling facilities.

Ever more challenging technology for multi-function vessels

Cruise ship construction has boomed in recent years and the oil and gas industry is expected to recover in a few years. Then, multi-purpose OSVs (offshore supply vessel) will steal market share i.e. in pipelay and maintenance and repair of offshore facilities from traditional purpose built rigs as they become outdated. Future OSVs are becoming larger, smarter and ever more technologically advanced. Repair and maintenance OSVs are being equipped with heavy-lift cranes, helidecks and streamlined bow forms in order to operate in harsh deep water environments. In late 2015, Norwegian shipbuilder Ulstein finished work and launched Island Venture, the largest and most sophisticated subsea construction vessel ever built, indicating renewed confidence in future deep water construction.

Weak signals in offshore business

Offshore oil and gas industry today is indeed facing the "where to invest and where to save" decision. Operators for the last two years have required solutions that significantly reduce field development and operating costs. In 2015-16 the industry has, to a large extent, adjusted itself to the current market conditions by downsizing and cutting costs. However, the process of reshaping the industry for sustainable future is by far not completed. Along with major growth opportunities in offshore

business, there are also some new emerging market opportunities supported by the following changes in customer needs and demands:

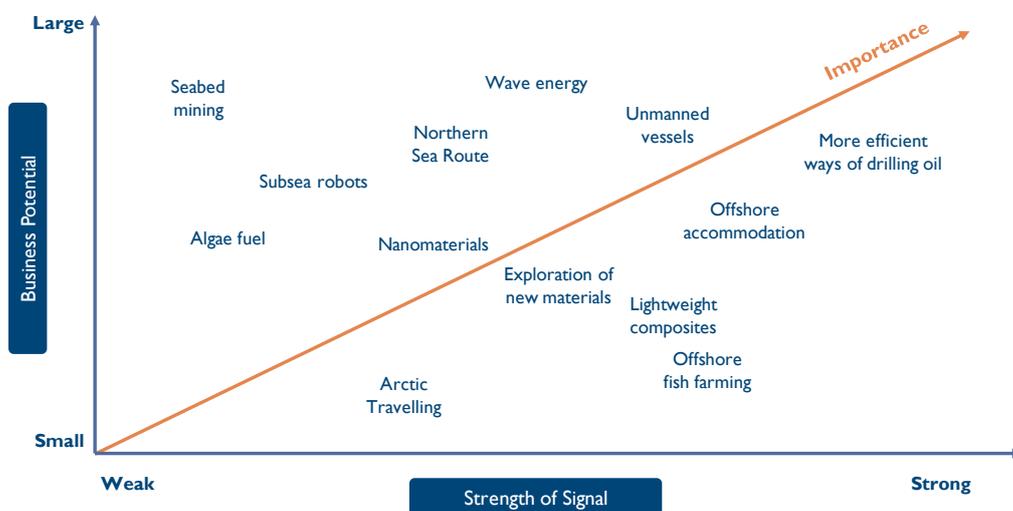
- It is easier to get meetings organized with the customers to introduce new cost saving ideas than it used to be
- Customers appreciate proactive problem solving and are responsive to solid cost saving technology, value adding services, supply chain management initiatives and operating models
- Customers are looking for long-term commitment
- Network-based way of working is emerging

For instance, hybrid and composite materials have many applications in offshore. In the traditional marine sector, firmer materials and lighter composites have long been in the middle of interest. As the technology becomes more advanced, the most progressive solutions may be applied to the offshore industry as well, especially if they can contribute to cost savings.

Algae as a feedstock for biofuel production is another interesting topic. Algae oil is one of Neste’s long-term raw material research topics. The company has been and continue to be involved in international research topics, e.g. in the Netherlands and Australia. The goal is to enable cost-effective and sustainable use of algae oil as a feedstock for renewable fuel and other renewable solutions. Neste’s research has proved that high-quality algae oil would be suitable as a feedstock for Neste’s renewable products. However, it is not yet possible to cultivate microalgae that produces algae oil on an industrial scale due to high costs. The company has prepared to change the situation by making conditional purchase agreements with algae oil producers

Seabed mining is an experimental industrial field involving extracting minerals and materials from the sea floor. Even though seabed mining may sound implausible, there are existing cases already in the field. For instance, Nautilus Minerals Inc. is seeking to remove gold and copper from the ocean floor in Papua New Guinea’s sea zone in 2017. Current high prices for gold and other noble metals and the fast progress in technology makes the seabed mining market more interesting than ever.

Weak signals in offshore business



Source: VALOR analysis

1.3. Competitiveness and strengths of the Finnish offshore industry

Cost awareness at the marketplace

In the offshore market, risk aversion, cost awareness and quality requirements have gained weight in the decision making during 2016. These changes in customer behaviour can be seen as a window of opportunity for the Finnish players operating in the offshore market. As offshore market tends to be quite conservative and currently operating in low volumes, operators rely on customary suppliers and value strong references. On the other hand, low business volumes require more efficient and innovative solutions. Uncertainty concerning oil prices as well as environmental regulations and production quotas in the longer term increase demand for cost efficient and environment-friendly solutions. Under current market trends, Finland has good prerequisites to gain market share even when the total offshore market is squeezed. This assumption attributes to many competitive strengths that Finnish players have attained in offshore business. Relevant strengths and areas of competitiveness are described below.

Finnish offshore industry strengths and areas of competitiveness



Source: VALOR analysis

State-of-art-the technology and innovativeness key to profitability

With lower margins and squeezed staff numbers, innovation and technology are considered more and more as the key for longer term profitability. Technological expertise and innovativeness are one of the most prominent strengths of the Finnish offshore cluster. Numerous Finnish companies are globally in a strong position in providing technology solutions within selected areas. The single largest product area, in which technological know-how has accumulated and expanded broadly during the past decades, is propulsion systems. In this product area, Wärtsilä, Rolls-Royce, ABB and Steerprop are major global players in specific sub-segments of the market. Rolls-Royce Finland and Wärtsilä have been successful in delivering a large share of propulsion systems for advanced solutions in offshore platforms and vessels used e.g. in drilling, production and supporting activities in the offshore industry worldwide. Steerprop and ABB are renowned for their solutions in powerful

propulsion systems. Moreover, it is important to note that an internationally unique cluster of expertise has evolved within the supply chain to support the development of the cluster of propulsion systems in Finland.

Selected applications of technology

The rest of the technology sector includes companies that are specialised in selected applications where they maintain a leading role internationally. Typically, these companies have a background in the maritime industry as well as in other industries. For example, Kemira is a well-known chemicals supplier, GS-Hydro is a globally established company supplying non-welded piping systems, Marioff provides fire protection systems to customers worldwide and Vaisala is the producer of one of the most renowned high-end environmental measurement systems. Vacon (part of Danfoss since 2014) and ABB instead provide customers with drives and other frequency convertors. These companies have strong references in providing offshore oil & gas exploration and production solutions as well.

Specialized shipyards

Finnish shipyards have earned a strong reference base in specific product areas where they are particularly competitive. For example, a majority of spar platforms ever build has been constructed in Technip Offshore Finland. Shipyards have been awarded many other offshore projects as well, and have the capability to construct e.g. subsea structures and semi-submersible along with FPSO platforms. Arctech Helsinki Shipyard, a company owned by United Shipbuilding Corporation, is specialised in Arctic shipbuilding technology and has constructed approximately 60 % of currently operational icebreakers in the world. These icebreakers and other special vessels are also operating in offshore and have become an essential part of the global offshore cluster.

Arctic know-how and solutions

It is important to notice that icebreaker and arctic project deliveries have been backed by the expertise of numerous Finnish engineering and subcontracting companies. This has laid the ground for the development of a global arctic maritime technology centre of excellence in Finland. As an illustration the icebreaking and special purpose vessel service provider Arctia has taken advantage of its ice management know-how and is providing customers with related services in arctic offshore projects. Aker Arctic Technology is a company specialising in engineering services for the ice going vessels, icebreakers and the offshore industry, possessing unique know-how, testing facilities and databank of ice data. Finnish knowledge in arctic solutions is viewed as a highly important area of competence for the offshore cluster in Finland particularly in the future when offshore investments actuate in the Arctic region.

Focus in quality of products and services

In addition to the technological expertise and solid references in offshore business, Finnish companies are known for their uncompromising quality in products and services. Quality is viewed as a holistic concept covering traditional aspect of product quality, such as technical properties and product durability as well as delivery reliability, vertical communication and cooperation both with customers and suppliers. This is an important consideration in the offshore industry, especially in

advanced solutions where high and rigid standards and quality requirements as well as full traceability are requirements throughout the value chain. Finnish companies base their competitiveness on quality, delivery reliability and value-adding life-cycle services and at the same time being competitive in price. While players across the offshore sector have made substantial cuts in capital investments and operational expenses in the last two years, customers are ever more concerned about the quality of the services and products.

Competitive engineering services

Many companies also note that Finnish engineering work is of high standard. Finnish firms stand out in providing tailored and advanced engineering solutions, yet at a competitive price. Price competitiveness is particularly well-grounded if compared to other developed countries. For example, at present the average gross salary of a highly qualified Finnish engineer is approximately 30 % below the corresponding figure of local engineering work in Norway. According to the study results, Finnish engineers operating in offshore are with a few exceptions graduates with a diploma from a university- or a university of applied sciences.

Logistical position

Another advantage for the Finnish offshore industry stems from geographical location near two large offshore markets Norway and Russia. Geographical proximity not only reduces costs associated with logistics and delivery time but also enhances customer communication between Finnish companies and customers. Reduced response time is particularly important in the offshore industry where problems and issues may escalate rapidly to a massive scale. In addition, time zone and cultural differences are all adding complexity in communication. Therefore, geographical proximity and knowledge of environment are regarded as an important aspect of product and service quality. This creates clear advantage for Finnish companies in relation to markets in Norway and Russia.

Supportive political atmosphere

The Finnish political atmosphere has also become increasingly supportive for the development of the offshore industry. The objective of the Ministry of Employment and Economy (MEE) development programme for the maritime industry's operational environment is to increase the competitiveness of the Finnish maritime industry so that top level expertise remains in Finland. The programme is based on the assumption that Finland has opportunities especially in the offshore industry and arctic business. The programme supports activities of Finnish companies and other market participants developing new- and leveraging existing know-how, products and services that create new opportunities in the offshore industry and arctic business for Finnish companies. Furthermore, the Finnish government has also shown its intention to support the maritime and offshore industry through ownership arrangements in e.g. engineering and shipyard sectors. With the support of Finnish Transport Agency, the world's most environmentally friendly ice-breaker, *Polaris*, is scheduled for delivery in 2016.

Energy efficient and sustainable solutions supported by research

In general, Finland is known for putting great effort in developing energy efficient and environmental sustainable solutions across sectors. The achievement of energy efficiency on board conventional vessels is a research topic that has attracted attention in Finland over the past few years. As maritime and offshore sectors are navigating towards zero-emission ships and sustainable oil drilling, energy efficient solutions provide a competitive advantage. For instance, weight-efficient, recyclable floating solutions for offshore oil and gas production are critical issues in many production facilities. Finland is known to have a strong background in weight-saving structural solutions and new materials for large cruise vessels. In Arctic conditions, understanding potential loading on different types of offshore structures is a key factor in weight savings and sustainable solutions. Finland has considerable expertise in the field of mathematical modelling of ice fields and their dynamic formulations that can be used to study the impact of harsh winters on offshore and marine objects.

Utilisation of local networks and partnerships

New contacts with many different stakeholders are important to make successful business and build customer relationships abroad as well. Utilizing networks has an impact both on cost and duration of offshore projects. The maritime and offshore cluster in Finland is highly networked and companies know each other's capabilities and advantages well which allows the cluster to utilize its knowledge on design and construction. Therefore, the Finnish offshore cluster is able to offer a broad range of high quality products and services combining the best know-how of local offshore operators. For instance, Finnish shipyard RMC is known for its capabilities of gathering the best talents for every project from a pool of partners in order to deliver the results for the customer. In June 2016, when RMC received an order for a car ferry for Mols-Linien, the order is expected to provide a thousand man-year of work, mainly for RMC's engineering, designing and manufacturing partners. RMC is applying the "round-table" model, in which all members are acting as partners all the way from preparing the proposal until the point of delivery.



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I.4. SHIPYARDS

Finnish shipyards active in offshore:

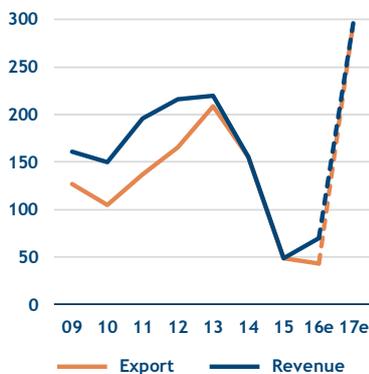


Revenue volumes of shipyards operating in the offshore market vary considerably from year to year due to the nature of business. Although many shipyards are fully booked their offshore revenue may show zero for a given year, as the revenue is realized in the year when the ships are delivered to customers. In addition, offshore revenues are volatile to order volumes, since the customer buys at minimum one ship.

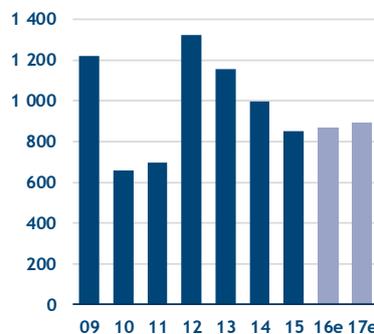
In 2015, Finnish shipyards generated approximately 120 million euros in offshore business and it is expected to increase by 30 million in 2016 and 200 million in 2017. The offshore share of total revenues is high, varying between 56-90 % in 2013-2015. The share of offshore business has increased rapidly due to the low activity in the Finnish multipurpose ice-breaker investments. The offshore share is expected to stay high in the

Finnish shipyards in offshore business

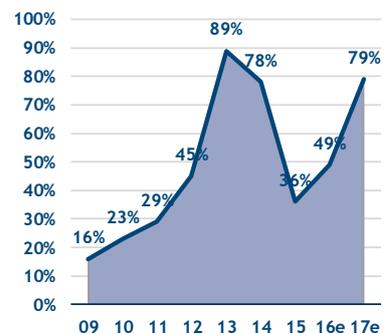
Offshore revenues and exports 2009-2017e, M€



Number of offshore employees* 2009-2017e



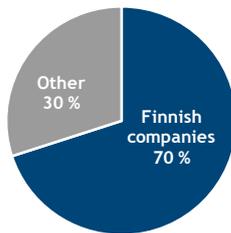
Offshore share of total revenues** 2009-2017e



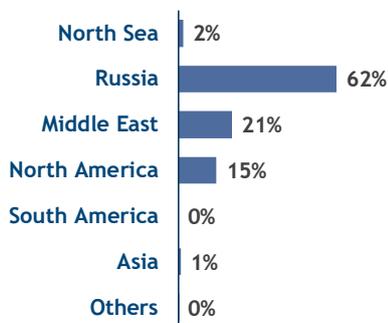
Sources: Company information and forecast, VALOR analysis

*) Does not represent FTE's
 **) Companies involved in the study

Global share of spar platform hulls deliveries



Exports



Sources: Company forecasts, VALOR analysis

Location of companies



Source: VALOR analysis

coming years as the cruise shipbuilding boom in Finland calms down

Offshore shipyards are large and employ directly hundreds of persons and indirectly even thousands when business and construction activity is peaking. Especially material suppliers and subcontractors benefit from these indirect effects. In 2015 there were approximately 800 employees operating in offshore business and the number of employees is expected to slightly increase in 2016 and 2017. However, it is worth noting that the number of offshore employees does not refer to the number of full time equivalent workers. Thus, the amount includes suspended employees without pay as well.

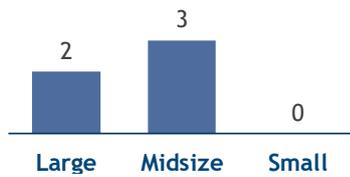
The Finnish shipyard sector is actively finding ways to increase the scope of its business. Arctech Helsinki Shipyard has been highly successful in providing icebreaking supply vessels and is demonstrating a viable business model specialising in arctic shipbuilding technology. In 2014, the company was awarded agreements to construct 4 ice-breakers to arctic offshore fields, which are delivered in 2017. Another reference of Finnish shipbuilding capabilities is the construction and design of the new icebreaker Polaris. It is the world's most environmentally friendly icebreaker which operates on both liquefied natural gas (LNG) and low sulphur diesel fuel.

Technip Offshore Finland has mainly been focusing on spar platforms during the 2000s. In addition to spars, it has an over decade long experience of constructing semi-submersible platforms. Additionally, Technip Offshore Finland has capabilities in subsea undertakings and it is actively developing offshore wind solutions. Recently, the yard has engaged more in subsea projects, as worldwide mobile offshore drilling rig utilization rate is at the lowest level in 30 years. The rate dropped from 87 % in 2015 to 73 % in 2016 (Clarksons Research Services Ltd).

Rauma Marine Constructions (RMC), a recently reorganized shipyard, on the other hand has succeeded in the offshore market with a new operating model based on flexibility and a strong network of partners. The RMC facilities enable construction of ice-going offshore service and construction vessels. Its latest offshore related project is the construction of the luxurious floating terrace in Dubai. In all, RMC has obtained many shipbuilding projects, which has reflected in a steady

Structure of the segment

no. of companies in each size category



Source: VALOR analysis

double-digit growth rate of revenues. For example, Danish ship owner Mols Linien ordered a passenger ferry at a cost of 68 million euros from RMC in 2016.

In 2016, all revenues of shipyards are expected to come from exports, as there is a limited number of domestic end-customers. In practice government is the sole buyer of multipurpose ice-breakers, but the investment frequency is low. Potential export markets for the Finnish shipyards include the North Sea, Northern Europe, Russia and North America, all of which are markets where arctic conditions are applicable.

In this study 5 Finnish offshore shipyard companies were identified. These companies include 2 large and 3 mid-sized. The smaller shipyards are only capable of doing ship repairs whereas the larger shipyards are also doing larger floating structures, especially newbuild OSV's and spars. In total, 4 yards participated in the study in 2016.

- Finnish shipyards are world-class in both arctic ships and arctic floating structures and most of the modern offshore ice-management fleet and many of the arctic OSV's have been constructed in Finland
- Technip Offshore Finland has produced most of the world's spar platforms and has capabilities to construct other floating offshore structures
- Finnish shipyard industry is currently growing rapidly as Turku shipyard has won several cruise ship orders



I.5. DESIGN & ENGINEERING

Finnish design & engineering companies active in offshore:

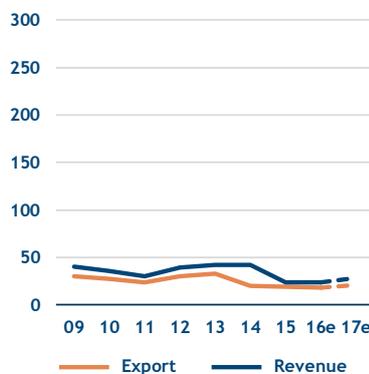


Design and engineering companies have built their capabilities and customer relationships through a strong history with the Finnish shipbuilding industry and by providing solutions for related industries such as the chemical and the oil & gas industry. Traditionally, offshore has been an important industry to find new business opportunities for these companies. At the moment, it is hard to gain additional revenue in the offshore market, as oil companies and shipyards concentrate on conversion and maintenance projects at the expense of building new capacity.

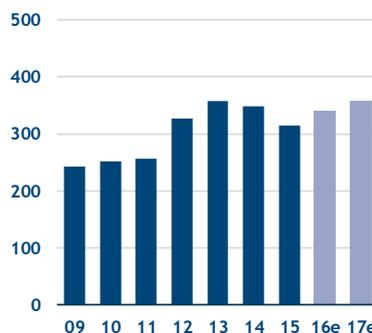
Offshore rig utilization has been quite low and continues to be, due to decreased demand for oil. The drillship utilization rate fell to 67 % in April 2016 from 77 % in April 2015 (Rigzone). In

Finnish design and engineering sector in offshore business

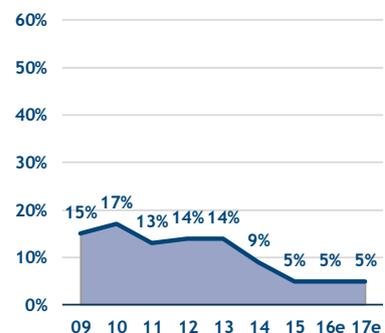
Offshore revenues and exports 2009-2017e, M€



Number of offshore employees* 2009-2017e



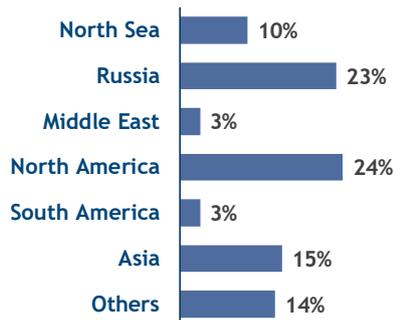
Offshore share of total revenues 2009-2017e**



Sources: Company information and forecast, VALOR analysis

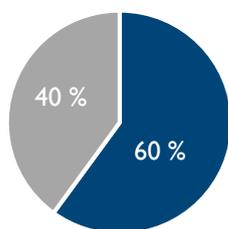
*) Does not represent FTE's
 **) Companies involved in the study

Exports



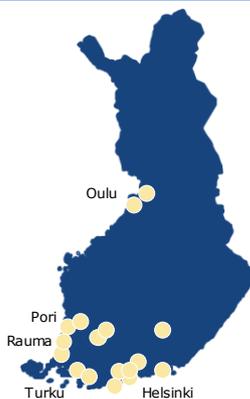
Sources: Company forecasts, VALOR analysis

Arctic ship deliveries



Finnish companies have delivered 60 % of arctic ships deliveries

Location of companies



Source: VALOR analysis

2016, design and engineering companies are expected to generate less than 20 million euros in offshore revenues, which is approximately 10 % less than in 2014. The offshore revenues accounted for over 10 % of total revenues in 2014, which has now decreased to 5 %. On the one hand, conversion and survey projects are less profitable than designing new ships and rigs. On the other hand, total revenues of design and engineering companies have increased. This can be attributed to the fact that flexible design and engineering companies find growth opportunities outside the offshore sector.

Despite challenging market conditions, Finnish design and engineering companies still regard offshore business as a promising market to increase revenues in the mid-term. For example, the opening of the Iranian offshore oil market, the rise of LNG use and the growing importance of environmentally sustainable solutions are acknowledged as good business opportunities where Finnish design and engineering companies have competitive advantages. Mid-sized Finnish companies are competitive compared to major design and engineering companies with heavy hierarchical structures in surveys and smaller projects.

In 2016 design and engineering companies employed over 340 persons in offshore business and the number is expected to slightly increase in 2017. Owing to the cruise shipbuilding boom in Finland and the thriving business outside offshore, layoffs have been minor in the design and engineering sector. The need for skilled workers is anticipated to increase in the sector as technologies become more complex and customers more demanding.

Finnish design and engineering companies offer a broad portfolio of design and engineering solutions for the offshore industry. They have references from a number of new-build and conversion projects. Conversion projects have typically been modernisation work or modification work related to ice-going or arctic requirements.

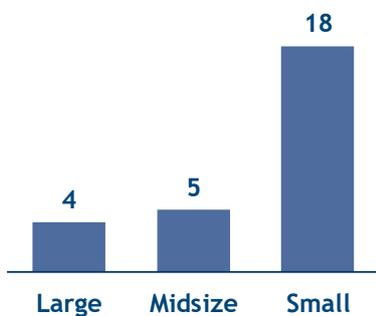
Design companies provide design solutions for their speciality areas that can cover, for example, the entire life cycle of shipbuilding and offshore projects, e.g. from concept design to installations, commissioning and maintenance. Engineering companies provide engineering solutions from single discipline to turnkey solutions including concept design to, basic- and

INFOBOX

Aker Arctic has the world's largest Arctic reference for icebreakers, past references include 60 % of all the world's icebreakers, many Arctic or Antarctic research vessels, and a large variety of cargo vessels and concepts for offshore structures. Aker Arctic operates a special ice test facility in Helsinki.

Structure of the segment

no. of companies in each size category



Source: VALOR analysis

detailed engineering. Speciality areas include, for example, electrical-, automation-, energy and power engineering.

Finnish offshore design companies provide a comprehensive service offering. Deltamarin focuses on designing different types of offshore vessels. Elomatic provides project management consulting for rig constructors and owner/operators and is specialized in arctic offshore design and engineering. Citec offers multi-discipline engineering, information and project management services for the offshore industry. Aker Arctic designs arctic solutions & tests them.

The markets for the Finnish engineering sector are international due to a limited number of end-customers in Finland. Key export markets to Finnish design and engineering companies are the North Sea, Northern Europe, Russia and North America, which all are markets where arctic conditions are applicable. Recently Asian markets have grown in importance.

The size of the offshore design and engineering companies varies from small engineering boutiques to large corporations. In this study 27 Finnish offshore design and engineering companies were identified. These companies include 4 large, 5 mid-sized and 18 small companies. A total of 18 design and engineering companies participated in the study in 2016.

- Finland has been forerunner in ice model testing and icebreaking technologies due to the long tradition and use of icebreakers in our proximate waters and strong investments in R&D
- The first ice breaking modelling test facilities were up and running over 45 years ago in 1969
- The Finnish design & engineering offering includes turnkey solutions and more specialized solutions for both newbuild and conversion projects



I.6. TECHNOLOGY

The impact of oil price plunge at the end of 2014 on upstream oil and gas investments has been enormous. In 2016–2017 investments on oil and gas exploration and production will be down 30 %¹. Oil companies' cost cuts have been detrimental to technology companies operating in offshore business.

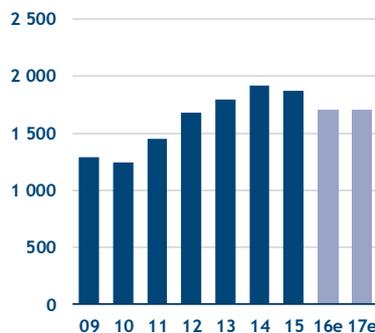
Technology companies are expected to generate around 700 million euros in 2016, which is almost half the revenue level in 2013. However, many Finnish companies regard offshore important and have expanded business portfolio and developed new service concepts to gain market share. Rolls-Royce invested almost 70 million euros in modernizing their production factory in 2016. Also, many start-ups and smaller

Finnish offshore technology in offshore business

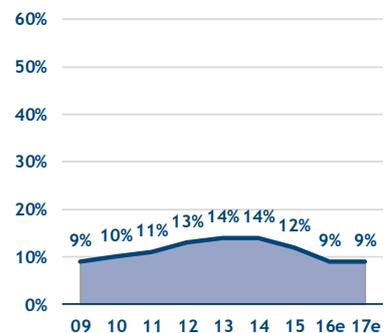
Offshore revenues and exports 2009-2017e, M€



Number of offshore employees* 2009-2017e



Offshore share of total revenues 2009-2017e**



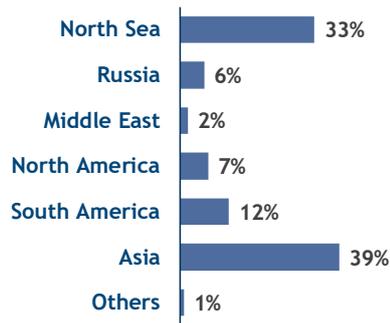
Sources: Company information and forecast, VALOR analysis

*) Does not represent FTE's

***) Companies involved in the study

¹¹Wood Mackenzie 2016

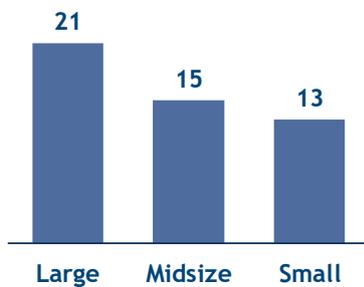
Exports



Sources: Company forecasts, VALOR analysis

Structure of the segment

no. of companies in each size category



Source: VALOR analysis

Location of companies



Source: VALOR analysis

players have or are developing unique technology solutions which meet previously unfulfilled customer needs.

To stay competitive, Finnish technology companies have streamlined their business operations. One consequence of this is job losses. The technology sector is expected to employ approximately 1 700 persons in 2016 compared to 1 900 in 2015. However, reductions of personnel have been less dramatic than revenue fall. This reflects partly that the number of employees includes suspended workers without pay as well. It also indicates that these companies aim to reach economic recovery with own resources.

Finnish technology companies export on average over 95 % of their offshore products and services, representing 680 million euros in 2016. Asia and North Sea are the most important export markets. The share of Asian countries has stayed high and was 39 % in 2016 compared to 44 % in 2015. Because of global economic slowdown, export market has become more fragmented. Partly for this reason, Middle East has gained relative weight.

Finnish companies have typically built their business strongly on their core competencies and specific product areas with globally leading technology. These companies have a diverse background. Globally the most well-established companies with strong industry background are Rolls-Royce, Wärtsilä, ABB Finland and Cargotec. Rolls-Royce and Wärtsilä are global market leaders in providing advanced propulsion and power transmission solutions to drilling and OSV vessels. ABB is known for its technological innovations. Other traditionally strong marine industry companies in the sector are Vaisala, GS-Hydro, Vacon and Napa. The technology sector also includes companies that have a firm background in other industries but have been able to leverage their expertise in offshore. These companies typically have a proven technology with strong competence and reference in a specific product area.

For technology companies offshore represents a market where competition has not eroded price levels significantly. Rather it is a market where customers are willing to pay for quality and the best possible solutions. The key purchasing criteria include not only price, but also health, security, environment and quality (HSEQ) considerations and aspects such as life-cycle costs, product reliability, traceability and innovativeness. This is why

offshore is seen as an attractive market for Finnish companies as they represent globally renowned high-end technology solutions and leading innovations.

In the study, 49 Finnish offshore technology companies were identified. Of the 49 identified companies, 31 companies participated in the study and represent 95 % of the total estimated revenues of technology sector. Several offshore technology companies are either large or mid-sized. The tendency for them to be relatively large is explained by the fact that companies need to be internationally recognised and credible to be included in supplier short-lists for the offshore projects and deliveries. For example, earlier references, especially in offshore projects, are considered essential for technology companies to show they have proven solutions available for the offshore sector. In addition, it is becoming more and more important to have a service network world-wide to increase product availability in offshore.

A few Finnish offshore technology companies are established almost entirely on a global basis and do not have operations in Finland within offshore market. For example, Cagrotec's offshore business is entirely based abroad and employees, assets and service networks are located near offshore markets. Accordingly, by definition these companies are excluded from the figures of this study and the corresponding business abroad is not included in the Finnish offshore industry numbers. These born global companies, however, support the development of offshore knowledge and expertise in Finland.

- Finnish technology companies provide the offshore industry with a number of services i.e. propulsion systems, design and engineering, cranes & lifting, living & wellbeing, automation, HSEQ equipment and systems, process technology solutions
- Finnish technology companies represent over 60 % of the total Finnish offshore exports and the high-tech share of exports is constantly growing

I.6. TECHNOLOGY

I.6.1. Finnish propulsion systems providers lead the way in offshore



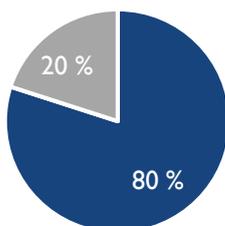
Finnish propulsion systems providers:



Many of the world's leading propulsion systems companies have their centre of excellence and production located in Finland. Rolls-Royce and Steerprop have operative facilities in Rauma. Wärtsilä has operative facilities in Vaasa and ABB has a operative plant in Helsinki. Propulsion systems technological expertise and innovativeness is one of the most prominent strengths of the Finnish offshore cluster. Numerous companies in the Finnish offshore cluster are in a strong position globally in providing technology solutions within selected areas, but the single largest product area in which technological know-how has accumulated and expanded broadly during the past decades is propulsion systems.

In this product area, the Finnish operations of Wärtsilä, Rolls-Royce, ABB and Steerprop are major global players in their specific applications. Particularly Rolls-Royce Finland and Wärtsilä have been able to deliver a large share of propulsion systems for advanced solutions in offshore platforms and vessels used e.g. in drilling, production and supporting activities in offshore worldwide. Steerprop and ABB are instead renowned for their solutions in powerful propulsion systems. Moreover, it is important to note that an internationally unique cluster of expertise has evolved within the supply chain to support the development of this unique cluster of propulsion systems in Finland. In addition, Finnish propulsion systems providers have a strong focus on R&D in-house and in co-operation with Finnish research organizations such as the Technical Research Centre of Finland Ltd and Aalto University.

Finnish azimuth thrusters are installed in over 80% of offshore ships and rigs



Sources: Rolls-Royce, Wärtsilä, Steerprop, VALOR analysis

- Finland has been pioneering the azimuth thruster and propulsion market since 1965 when first azimuth thrusters were made in Rauma
- The world's most powerful azimuth thrusters are built by the Finns: the largest delivered individual thrusters have surpassed 10 MW and largest azimuth thruster systems have been over 21 MW in total power
- Finland continues to innovate and lead the azimuth propulsion market with new, more powerful and cost-effective solutions

I.6. TECHNOLOGY

I.6.2. Living and wellbeing solutions – luxury to even the remotest of places



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Finnish living & wellbeing companies:



Finnish living and wellbeing companies have been successful in serving the offshore and marine industry with a wide range of solutions. Many of these companies have built their capabilities as a subcontractor for the Finnish shipbuilding industry. These companies have proven solutions with a number of offshore and marine references in new building as well as in conversion projects in their specific living and wellbeing solution areas.

The offerings of Finnish living and wellbeing companies include the following product areas: heating, ventilating, and air condition systems (HVAC), interior solutions for accommodation, public spaces and food handling areas, complete customized kitchen solutions, freshwater, waste collection and treatment solutions for the offshore rigs and vessels. Most of the companies in this sub-segment are able to provide turnkey solutions from design, equipment, installation, training to after-sales services.

This sub-segment includes companies such as Almaco Group that is focusing on accommodation and food handling areas and Evac that provides environmentally friendly freshwater, dry and wet waste collection and treatment solutions, and Koja, which designs and manufactures air conditioning solutions for the marine industry. Almaco Group and Evac have already built a wide presence in all major ship building countries.

- Finnish living and wellbeing solutions typically have a strong history with the Finnish shipyard industry which has led to a long list of references from the marine industry
- Offering portfolio includes turnkey solutions for example in areas of HVAC, accommodation and public spaces, kitchen, and waste solutions.

I.6. TECHNOLOGY

I.6.3. Cranes & lifting – state-of-the-art technology from Finland



Finnish cranes & lifting companies:



INFOBOX

Konecranes has supplied the world's largest Goliath Cantry crane to a Brazilian shipyard. The crane has a lifting capability up to 2000 tons and a railspan of 210 meters.

Finnish companies are globally leading providers of cranes and lifting solutions for industrial companies. Global players such as Konecranes, Cargotec and Kone are well known for their capability to offer competitive and reliable solutions for the offshore industry. These companies base their competitive strength on high quality, technical expertise and innovative solutions.

Cranes & lifting sub-segment solutions have a variety of applications in the offshore industry. Konecranes provides lifting equipment for industrial purposes, heavy-duty industrial cranes for shipyards to ensure efficient operations and handling of heavy components. Industrial cranes are assembled and installed on location, but Konecranes designs and manufactures key components of the cranes, such as gearboxes, in Hyvinkää, Finland. Cargotec's MacGregor business division produces integrated solutions for load handling, anchor handling, towing and mooring operations for offshore ships and vessels and for subsea load handling. In addition, Cargotec provides leading deck machinery solutions for oil and gas carriers. Kone is well-known for its elevator solutions in the marine industry. Even though it represents a relatively small part of their total revenue, the offshore industry represents an attractive segment for the above mentioned companies as they are able to effectively leverage their core expertise.

- Finnish cranes & lifting companies offer solutions for shipyards, vessels deck machinery and subsea operations
- Finnish cranes & lifting companies have over 80 years of experience in industrial solutions and over 50 years' experience in working with shipyards
- Cranes & lifting solutions are pivotal for efficient ship building processes in shipyards by enabling moving of heavy components

I.6. TECHNOLOGY

I.6.4. HSEQ – ensuring continuous operations without compromises

Finnish HSEQ companies:



Health, safety, environment and quality (HSEQ) requirements are an utmost priority to companies throughout the offshore industry. Based on the company interviews, HSEQ awareness and requirements have been increasing throughout the industry in recent years. In addition, environmental organizations, media and public opinion put increasing pressure on the offshore companies to avoid any risks of environmental hazards. Finnish HSEQ sub-segment companies are well placed to address some of the HSEQ challenges that offshore companies are facing by offering specialized products and solutions in their field of HSEQ.

Finnish HSEQ companies are specialized in areas such as oil spill recovery, weather monitoring systems, speciality safety products and solutions. Speciality safety products and solutions include for example safety doors and fire rated glass structures.

Finnish HSEQ offshore companies include for example Vaisala which is known for its environmental measurement systems that are used for example in offshore helidecks to ensure safe and operationally efficient decision making, Frictape is the world's largest manufacturer of helideck safety nets, Lamor Corporation focuses on oil spill response solutions and equipment. In addition, based on the company interviews with all offshore related companies HSEQ is seen as a key factor for success in the offshore industry.

INFOBOX

Vaisala's weather monitoring systems are used for offshore helideck operations globally. Interestingly, also NASA's Mars exploration vehicle uses instruments based on Vaisala's technology

Frictape is the world's largest manufacturer of safety nets on offshore structures and vessels

Lamor corporations is a market leader in providing state-of-the-art oil spill response solutions, service and equipment

- Finnish HSEQ companies serve the offshore industry with a wide portfolio of solutions that are key for safe and efficient offshore operations
- HSEQ is a vital part of offshore operations and its importance is increasing, especially as the offshore operations are moving to deep waters and to the arctic
- Finnish companies are experienced in the challenging environments of arctic and deep water offshore fields, providing state-of-the-art HSEQ solutions

I.6. TECHNOLOGY

I.6.5. Automation systems – smart vessels and processes



Finnish automation systems providers:



INFOBOX

Wärtsilä automation systems was part of the world's first hybrid platform supply vessel Viking Lady. Hybrid power generation system enables 15 % savings on fuel costs and 25 % lower nitrogen oxide emissions. Wärtsilä is one of the largest providers of navigation and automation in the world with an estimated 40-60% market share in many of the largest ship and vessel categories.

Valmet provides automation and navigation systems for most types of vessels in offshore.

ABB is one of the leading global power and automation solutions providers for the offshore industry – recent references include FPSO for the coast of Angola.

Automation systems play a key role in offshore vessels and rigs to ensure safe, reliable and efficient operations. Automation systems are used for a number of functions, from small monitor and control systems to more advanced systems that integrate most of the systems needed to operate the vessel. Automation systems can focus on e.g. propulsion power management, processes, electricity or alarm systems.

Automation systems have an important role in increasing operational efficiency of the vessels and thus enabling life-cycle cost efficiency and lower emissions. Finnish companies have been able to build innovative automation solutions that have resulted in improvements in the abovementioned areas.

Finnish offshore companies providing automation systems include for example ABB that offers a broad portfolio of automation solutions for the marine and offshore industry, Wärtsilä which offers integrated automation systems for the offshore and marine industry and Satmatic that provides more specialized automation solutions and equipment focusing on electricity and pneumatics.

- Finnish automation systems providers offer integrated and specialized solutions for offshore vessels and production
- Automation systems have been a natural step for Finnish marine technology providers, which has led into more integrated automation systems offering
- Wärtsilä acquired L-3 Marine Systems International in late 2014 which strengthened Wärtsilä's offering in automation, especially in the area of electric solutions and dynamic positioning systems

I.6. TECHNOLOGY

I.6.6. Electric solutions – greener offshore solutions



Example of Finnish electricity solutions providers:



INFOBOX

Finnish frequency converters made by ABB, Vacon or Wärtsilä are used in a majority of offshore drilling and production platforms.

Additionally ABB's subsea electrical solutions have been installed in a majority of subsea projects.

The centre of Finnish electricity solutions is located in the city of Vaasa in western Finland. Companies such as ABB and Vacon, which was recently acquired by Danish Danfoss, have a long tradition and accumulated knowledge of electricity solutions in this region. The Vaasa area is recognized as the leading energy cluster in the Nordics.

ABB offers a wide range of electricity solutions for the offshore industry, for example ABB provides energy efficient electrical motors and generators for industrial use which have a number of applications in the offshore industry. ABB Finland has also pioneered in subsea electrical solutions since 1984 and remains the world's leading manufacturer of subsea transformers.

Vacon's AC drivers have high power and torque capabilities which are necessary for offshore processes in demanding environments. Vacon's products have a proven track record of usage on offshore platforms, drill ships, drill barges and land rigs.

Trafotek offers a wide range of solutions for the offshore industry, where applications can vary from power production for lightning and instruments to heavy-duty winches, lifts and pumps.

- Finnish electric solutions are used in offshore production solutions for example in integrated electrical distribution, control, safety and power management, and low and medium drives.
- Vaasa area energy cluster has more than 140 companies with total business turnover around 4.4 billion euros and export rate of over 80 %

I.6. TECHNOLOGY

I.6.7. Process technology solutions – ensuring continuous operations

Example of Finnish process technology solutions providers:



The offshore operating environment sets high standards and requirements for process technology solutions. Finnish companies have been able to address this challenge by providing reliable, safe and efficient solutions in this sub-segment. Process technology solutions are one of the key areas of Finnish offshore technology subcontractors. These companies typically serve a number of other industries. However, based on the company interviews offshore industry is seen as a priority market where Finnish companies have many advantages.

Process technology solutions include valves, pumps and hydraulic solutions. Valves and pumps have a wide array of applications in offshore industry processes. Similarly, hydraulic solutions have many applications in the offshore industry from production to transportation related processes or operations.

INFOBOX

Metso is the world's fifth largest provider of valves control systems for the oil and gas industry.

Finnish offshore companies in this sub-segment include for example GS-hydro that offers non-welded piping systems that are used on different types of offshore drilling and production installations, Metso that is one of the leading producers of valve systems globally including equipment and control systems which enable monitoring of valve functionality in the offshore environment.

- Finnish process technology solutions are used for example in valves, pumps and hydraulics in the offshore industry
- The offshore environment is challenging for technology solutions due to high safety requirements and harsh conditions. It is also demanding to access process area locations which emphasize life-cycle management solutions

I.6. TECHNOLOGY

I.6.8. Other technology – new enabling technology simplifying manufacturing processes and design & engineering

Example of other Finnish technology solutions providers:



INFOBOX

Kemppi's IoT-solutions in welding technology enable high-quality, continuous documentation of the welding.

PEMA's knowledge of the mechanization and automation of modern shipbuilding and offshore industry welding processes has a 40 year history and is currently a leader in automating the welding processes.

Beacon Finland's smart solutions in maintenance and service business provide cost savings in energy and improve offshore operations. Beacon has i.e. developed different types of locking and connecting devices for transportation and offshore vessels.

Wello's and AW energy's wave power plants are very promising wave power plant technologies currently piloting in a larger scale.

Finland is also providing various other technological solutions for offshore markets. For example, in engineering software, Tekla and NAPA have been pioneers in structural design software. Both companies have solutions that support offshore structure and vessel design, enabling engineering companies to create more robust and cost-effective offshore structures, as well as increasing maintainability and energy efficiency of offshore platform & vessel operations.

In addition, many companies, such as Beacon Finland, focus on customer-based concept development. The company's product and service portfolio include design, manufacturing and sales of ship equipment. Beacon has been very successful with thruster and other solutions enabling thruster maintenance and repair on-site on drilling ships, FPSO's, FLNG's and FPDSO's.

In welding automation, companies have created unique solutions for offshore markets which enable yards to significantly improve their welding processes, both in terms of throughput and quality. For example, Kemppi has invested in Industrial Internet (IoT) solutions that enable automatic documentation of the welding process and PEMA in equipment automating welding processes in shipyards.

In offshore energy, Finnish companies are pioneering in wave energy. Some of the most advanced wave energy technology is developed by the Finns and a large-scale pilots are currently in operations in Portugal and Nordics.

- Finnish other technology sub-segment includes i.e. companies offering state-of-art software and service solutions, and welding automation systems for the offshore industry
- These solutions have the potential to dramatically improve ship design and fabrication processes to ensure cost-efficiency and shorter throughput times

I.6. TECHNOLOGY

I.6.9. Finnish offshore industry start-ups

ICEYE

Traditionally, space technology has been an arena for billion-dollar research projects spanning dozens of years from planning to results. Finnish space technology company ICEYE is changing that by creating small satellites with vastly reduced costs and shorter time-to-market. ICEYE's service can be used to provide nearly real-time imagery information. The radar developed by ICEYE makes it possible to produce images also in the dark and regardless of weather conditions. Company's first commercial satellite is expected to be launched in 2018.



Copyright © ICEYE

"ICEYE's information can be used for monitoring ice movement, detecting illegal fishing and providing support in natural disasters, for instance. ICEYE's major customer segments include marine and offshore industries, insurance companies and governmental organizations such as border control offices", says ICEYE's CFO Pekka Laurila.

Currently, ICEYE has its headquarters in Espoo, Finland and has 24 employees. Firm's aim is to grow rapidly and ultimately become a leading global operator in radar imagery business. ICEYE has just recently received over 2.5 million euros of funding from United States based True Ventures and Founders.org and Lifeline Ventures from Finland. Previously Finnish Tekes has provided a product development loan of 1.7 million euros to ICEYE.



Efficient communication is essential for every company willing to operate in offshore business. Finnish firm KNL Networks has developed reliable and secure long-range communication system that is applicable on anywhere on the globe, including the polar areas. Previously, in areas with no cellular coverage or wired connectivity, satellite communications were the sole option, which is expensive and unreliable.



Copyright © Kyynel

KNL Network's business is expanding rapidly. The firm has signed its first deal with Swedish, German and Arab Emirates customers and is searching for more customers in completely new market areas. Company's annual revenue is expected to grow far beyond 10 million by 2017.

"In our core technology, there are currently no competitors. We are the disrupting player on the market and competing against traditional, satellite-based operators. Customer are thrilled with our pioneering short wave radio transmission technology", explains CEO Toni Linden.



Founded in 2011, Operative Recovery Solutions (ORS) provides solutions for cleaning and recovery of oil spills based on ORS-Sorb® technology. Products are suitable for all liquids. The original product and its technology was created by a Finnish inventor during 1990's. Since then, ORS has invested vastly in R&D in order to make its product world-class. Company's leading products have been used by global oil giants such as Exxon Mobil.



ORS's first production mill was built in 2012. Within the next few years, ORS expanded its shareholder structure and focused more on R&D. The most important customer segments for ORS are oil & gas and agriculture businesses. Today ORS is a well-known forerunner within its business and keeps on inventing better solutions for soaking oil and other liquids from water and soil.

ORS's new flagship product, ORS-Sorb®, can soak oil spills from the water without making the oil unusable. In addition, ORS-Sorb® is made completely from recycled materials. Therefore, with ORS-Sorb® one is able to reuse the oil minimizing the harm caused to the environment. The launch of ORS-Sorb® incurred widespread attention amongst ORS's customers and the sales have exceeded expectations.



A start-up company AdhocHaus Oy (founded in 2013) solves problems concerning temporary accommodation and other similar problems which require safety, comfort, cost-effectiveness, flexibility, efficient use of space and quick introduction of facilities.

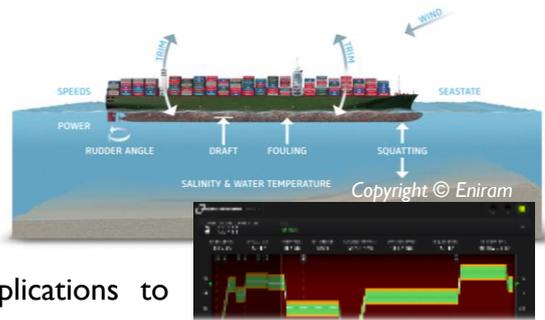


AdhocHaus is owned by E.U. -Adhoc Project. The company's shareholders have been involved in modular construction and contracting in shipbuilding industry since 1999. The latest references are from Meyer Turku and Mitsubishi Nagasaki shipyards.

The company has invested heavily in product development. Currently, TEKES is funding the pilot project REST Inn Raisio which aims at exporting Restin accommodation module for temporary accommodation in various ranges of applications. Resting products are perfect for creating practical and space-saving accommodation solutions due to various modules: accommodation, WC/shower, kitchen, office and even sauna. Modular alternatives enable customized spatial solutions. In addition, the Restin accommodation module takes into account workers' needs for privacy and peace. Smart Resting is highly digitalized and safety runs the product development.



Finnish technology startup, acquired by Wärtsilä in June 2016, has managed to prove that significant fuel reduction gains can be reached by advising the ship crew on how to operate the vessel more efficiently. Utilizing solutions ranging from single onboard applications to comprehensive fleet analysis, bulk carriers and whole shipping companies can mend their diminishing margins.



Eniram's software collects data from multiple sensors and analyze it with sophisticated models to find the right adjustments for power, rudder, trim, etc., whether the goal is to optimize fuel efficiency, speed or just-in-time arrival at port. This type of information could be highly valuable when applied to offshore vessels, e.g. in pipelay and icebreaking.



Delta Cygni Labs, a spinoff from VTT - Technical Research Centre of Finland, brings "Pointr Easy Remote Support" solution to maritime industry. Pointr offers a unique opportunity to support customers and technical personnel through live video chat and Augmented Reality annotations for rapid situational awareness.



Machine building industry is facing a significant challenge to support customers globally and to deliver services competitively. Off-nominal maintenance and unpredictable interruptions in production can have dramatic impact on the profitability and often require immediate resolution to minimise losses. Strict customer requirements on production uptime and rapid response time for services are further amplifying this challenge. Pointr users can overcome these problems by streamlining their processes by reducing downtime and offering unbeatable response time.

Leading Finnish industries have been eager to take Pointr into use. Reference customers include e.g. KONE, Valmet, Wärtsilä and Valtra. The industry grade Pointr solution is designed for extreme conditions and it is resistant to network interruptions. Tested across continents through satellite networks, it is one of the leading digitalisation tools readily available on the market.

Pointr is now available for maritime industry with the satellite networks compatibility. Android, iOS and desktop versions of "Pointr Easy Remote Support" can be found on the company website (www.pointr.it).



I.7. SUBCONTRACTING

Finnish subcontracting companies active in offshore:



Subcontractors' promising growth track in offshore business ceased in 2015 due to the challenging environment. First widespread cost cutting on capital were made in the oil and gas sector, which resulted in fewer new work orders. In 2016 further cuts with a greater focus on operational cost reductions took place. Subcontractors' main customers in offshore business, Finnish shipyards and technology companies, were facing lower margins, higher risk and squeezed staff numbers. For this reason, some companies decreased the use of Finnish subcontractors in favor of lower cost European countries.

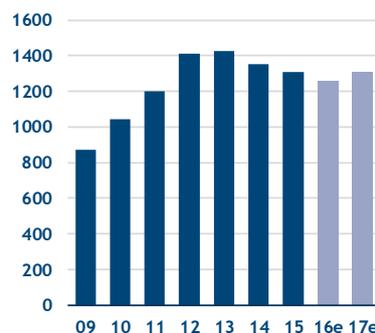
Offshore revenues increased annually over 20 % in 2009-2014 total offshore revenues of the subcontracting sector are

Finnish subcontracting sector in offshore business

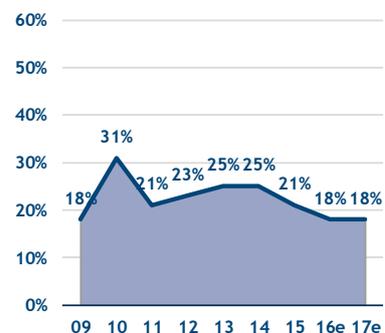
Offshore revenues and exports 2009-2017e, M€



Number of offshore employees* 2009-2017e



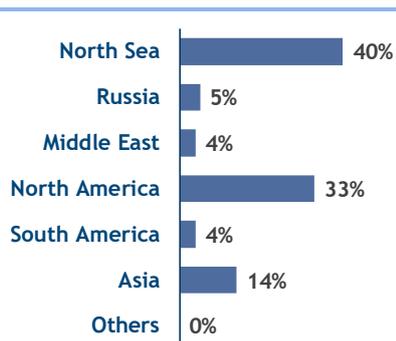
Offshore share of total revenues** 2009-2017e



Sources: Company information and forecast, VALOR analysis

*) Does not represent FTE's
 **) Companies involved in the study

Exports

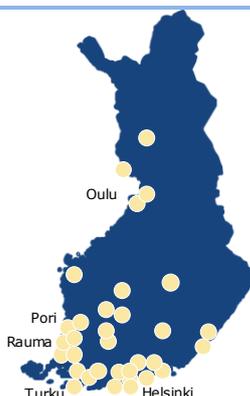


Sources: Company forecasts, VALOR analysis

expected to amount to 170 million euros, of which 70 million euros are exports. In 2017 offshore revenues and exports are expected to grow moderately.

Historically, subcontractors have mostly relied on serving domestic customers, particularly Finnish shipyards and technology sector, and hence export revenues have been modest. In 2009 exports amounted to 30 % of the offshore revenues, while the corresponding figure was over 50 % in 2014. In 2016, the figure has dropped below 40 %. This implies that Finnish subcontractors have acquired international customers within their competence areas. According to company interviews and questionnaire comments, Finnish subcontractors regard specifically Norway as a very attractive market and are actively looking growth opportunities in there.

Location of companies

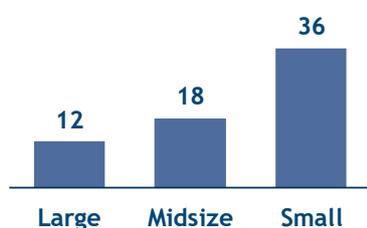


Source: VALOR analysis

Various companies have been developing new value added services and customized products to Norwegian customers. However, a prolonged period of low oil price together with upstream operators' cost cutting on capital costs in Norway and elsewhere in the world have slowed down the internationalization process made by Finnish subcontractors. For example, a company manufacturing dry suits for oil rig working and transportation, Ursuk, developed a product aimed to Norwegian customers at the end of 2014, but the market faded away in 2015.

Structure of the segment

no. of companies in each size category



Source: VALOR analysis

Finnish subcontractors have good possibilities to succeed in international market after oil price starts to increase given that they will continue entering to the global market. Finnish manufacturing subcontractors are especially competitive in heavy workshop engineering, welding, assembly, machining, material coating and heat treating. Other capabilities stem from providing labour hire for projects and supplying components from engineering to assembly. A key feature of Finnish subcontractors is to supply components, such as special metal components, electrical equipment and other products as comprehensive projects deliveries. Although, Finnish subcontractors regard Norway as the primary export market, they find offshore business opportunities from Asia and Russia as well.

In 2016 subcontractors are expected to employ approximately 1 200 employees, according to the study. Booming cruise shipbuilding have supported the vitality of subcontractor sector in Finland. A majority of the offshore subcontractors are SME

companies. However, the average company size is increasing due to the market exits of smaller players.

Several subcontractors are important partners to large companies. Often large companies have their own networks of trusted subcontractors backing them in offshore undertakings. For example, Technip Offshore Finland has cooperated actively with over 100 subcontractors during the offshore undertakings in the Mäntyluoto shipyard and shipyards in Turku. Also, technology companies, such as Wärtsilä and Rolls-Royce Finland, have their own network of proven workshops as partners. Often technology companies are willing to invest in their subcontractor partners to support their own business.

The majority of subcontractors' deliveries include projects with detailed specifications and a blueprint from the customer. Additionally, subcontractors have been able to further commercialise their advanced products and services so that in practice they have moved up in the hierarchy of the supply chain and become a company resembling a technology provider. For example, in hydraulic heavy workshop engineering, casted propellers are products in which Finnish subcontractors have become strategic partners to selected technology companies not only domestically but also internationally. In this study, 66 subcontractors were identified to have offshore business or capabilities to offer for offshore market. These companies include 12 large, 18 mid-sized and 36 small companies. Of these 36 companies participated in the study through offshore industry survey and interviews.

- Finnish subcontractors offer a wide portfolio of services to the offshore industry ranging from heavy workshop manufacturing to finish treatment for metals
- Subcontractor segment has been broadening its offshore business successfully during the last years – currently 40 % of their offshore business is export
- Norway is considered as a home market in offshore and companies are willing to increase their offshore business in Norway



I.8. MATERIAL SUPPLIERS

Finnish companies providing materials for offshore:



In 2016, material suppliers employed approximately 330 persons in total in the offshore business. The aggregate revenues of the material companies is expected to be 135 million euros, of which approximately 90 million euros is exports. The corresponding figures are not expected to change in 2017.

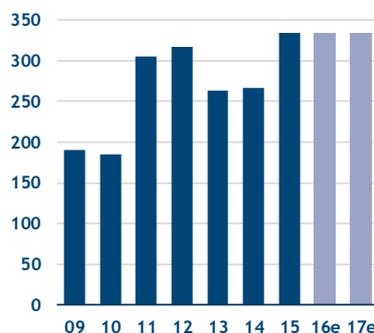
The offshore business of material providers is typically highly dependent on the Finnish shipyards' business volumes as material suppliers typically are domestic in their offshore specific business. This is because most of the bulk and basic material is sourced locally, as elements delivered to offshore platforms and vessels are very heavy - weighting tens of thousands of tons - and consisting of substantial amount of

Finnish material suppliers in offshore business

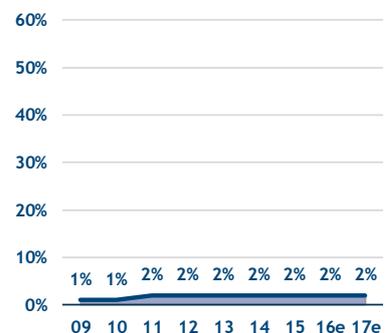
Offshore revenues and exports 2009-2017e, M€



Number of offshore employees* 2009-2017e



Offshore share of total revenues** 2009-2017e

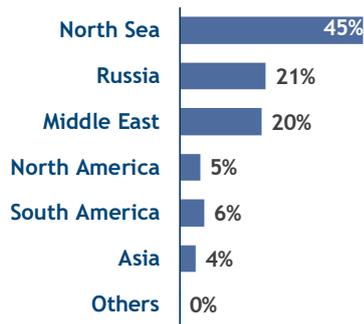


Sources: Company information and forecast, VALOR analysis

*) Does not represent FTE's

**) Companies involved in the study

Exports



Sources: Company forecasts, VALOR analysis

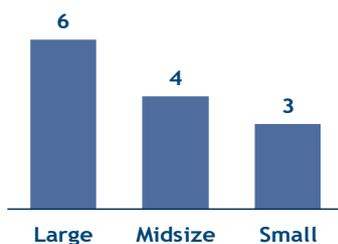
Location of companies



Source: VALOR analysis

Structure of the segment

no. of companies in each size category



Source: VALOR analysis

INFOBOX

Arctia provides pioneering ice management solutions for Shell's offshore production in northern Alaska.

Ice management enables safe oil drilling in icy conditions by keeping ice formations at a safe distance from the drilling zone. Safeguarding traffic in the drilling zone is also an important part of the Ice Management service.

metal, steel and other materials. On the other hand, some material providers, particularly those who are specialized in some specific offshore product, are also globally established in offshore business and their offshore business volume is less correlated with domestic demand.

It is important to notice that for some of the largest material companies, offshore represents only a small fraction of their total revenues. Thus, large volatility in offshore business does not critically impact on total volumes: offshore amounted to some 2 % of company total revenues based to the results of the survey in 2016. On the other hand, many material suppliers consider offshore as an interesting opportunity as many other industries are experiencing a downturn in Europe. Therefore, many companies are investing in their offshore business and developing new solutions. Finnish companies have actively developed e.g. new offshore wind basement solutions and more advanced materials to the needs of offshore solutions. Particularly solutions developed to the Arctic area are seen as a long-term opportunity.

In total, 13 Finnish offshore material suppliers were identified. Companies include 6 large, 4 mid-sized and 3 small companies. 7 companies contributed to the study this year. Many material suppliers are large international companies with significant business world-wide. Medium-sized and small companies are typically specialized in niche products, like welding consumables, assorted electrical products or treated metal products. A differentiation strategy enables them to build their competitive advantage on specific solutions and therefore increasing their credibility and significance not only domestically but also internationally.

- Finnish material suppliers in the offshore industry offer e.g. steels in either normalized or thermomechanically rolled condition, steel bars and rolled and forged ring products, high performance stainless steels and alloys, stainless hollow sections, chemicals to the oil & gas industry and paints for offshore applications
- Additionally, a number of other Finnish companies supply the offshore industry with materials ranging from welding consumables to plastics



Copyright © Arctech Helsinki Shipyard

I.9. OPERATIONS SUPPORT

Other identified offshore business in Finland is mostly related to shipping, ice management services and offshore wind power. The total volume of the sector is modest compared to other sectors identified in this study, partly because this sector includes segments that are still in a development phase. More specifically, the revenues of the operations support are expected to amount to approximately 60 million euros in 2016 and 2017 as well.

Offshore wave energy is promising businesses but currently only at a development phase from an investor perspective and, based on the interview comments, are not economically viable businesses yet at a large scale given the current political climate in Finland. Instead, offshore wind power, shipping services and other service operations at sea are currently regarded as highly relevant business areas for Finnish offshore industry. Companies consider services related to the Arctic area a particularly interesting market as Finland is one of the world's key hubs for Arctic knowledge and R&D. For example, Finnish companies have robust experience in ice-breaking and ice management operations which can be leveraged in providing critical services to the offshore sector in the Arctic area.



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For example, Finnish company Arctia, a state-owned company specialised in providing ice management operations, is an example of a Finnish company leveraging its ice-breaking expertise in the offshore business. The company is especially competitive in the Arctic area supporting oil & gas exploration and production activities from ice management to oil recovery services with their multipurpose vessels. However, their vessels have also been serving customers in the North Sea, the Gulf of Mexico, West Africa and the Mediterranean.

I.10 RESEARCH

Finnish Marine Industries co-ordinates the strategic research agenda of maritime cluster, which aims to identify the main themes and areas of research reflecting market trends and customer needs. The agenda is currently being updated and the newest strategic research agenda for 2016-2025 focuses on competitiveness and competence, cross-cutting themes, energy, environment and sustainability, intelligent ships, systems and product specific themes, cruise ships and ferries, arctic technology and offshore. The research segments are described below in more detail. Along with the strategic agenda, several companies invest heavily in research and development of smart maritime technology solutions. Especially, ABB is known for advanced offshore vessels and Rolls-Royce has taken part in research of enabling remote and autonomous shipping in the short to medium term.

The goal of the Finnish Maritime Cluster is that Finland has the most competent and co-operative network of highly skilled people to tap business opportunities at the current and emerging markets for marine technology.

Energy use, sustainability and environment

Safety and environmental aspects are becoming increasingly important in offshore operations, which reflect on stricter requirements for the industry. Thus, energy management in oil and gas production as well as sustainable use of materials are expected to be major cost factors in future offshore business. Researching and developing sustainable and environment-friendly offshore products (platforms, equipment and subsea technology) can create new growth opportunities for the Finnish maritime cluster.

Important research topics in this area are energy-efficient floating production solutions, offshore production solutions combined with safety and efficiency in decommissioning and recycling, oil spill response techniques and maintenance in offshore wind parks. Many established players are already active in developing new products and service models in these areas. For example, Technip Offshore Finland will manufacture subsea foundations for the world's first offshore wind farm suitable for icy conditions. The turbines should be erected by the summer 2017. Renewable energy production based on offshore wind farms, tidal power and wave energy is gaining importance as the exploitation of fossil fuels becomes less economically feasible.

Intelligent ships and equipment

Internet of things and machine-to-machine (M2M) evolution have created many applications in offshore business. Automation solutions and digital services aim to increase the quality of monitoring, accuracy of control and handling, and better communication in the Arctic conditions. However, operators in offshore tends to be quite conservative and are slowly adopting new technology. Thus, technical development should have a clear customer focus and support commercial aspects as well.

Digitalization is transforming business models across the sector from a hardware manufacturer to a software and service provider. Digital services decrease the need for heavy investments in products and factory infrastructure. For example, ICEYE is developing a new satellite, that is rest on software

business instead of enormous and expensive investments in technology. In future, cybersafe software controlling device capabilities and capacity, is becoming a strategic differentiator and the key to monetization and profitability.

The basic research focuses on automation of safety management systems and modelling of ice and metocean conditions. Identified themes for strategic research and development activities are for example remotely controlled and unmanned operations, maintenance robots, safety driven automation and simulation of operations.

Emerging businesses in the maritime industry

The competencies developed in other maritime sectors can be utilized and further developed to create a competitive edge in the offshore sector. Finland has managed to build a well-functioning network in the maritime sector, where the use of partners and existing infrastructure is easy. Members of the Finnish marine industry networks producing ships, offshore structures, ship systems and solutions and cargo-handling solutions are highly competent in specific business areas and possess capabilities to further expand their business to global markets.

Collaborative development of products, services and concepts is expected to become more general and benefiting companies outside the network as well. For example, maintaining and upgrading products is becoming more important as society imposes greater requirements in relation to energy and sustainable environment. Future research should deepen the understanding and provide applied business models in areas such as value-creation in networks, managing project-based operations, and ecosystems of companies. Business opportunities utilizing networks stem from subsea considerations, life cycle business, refurbishment services, de-icing and construction of Arctic harbours.

Competence development

Although the competence of the Finnish Maritime cluster is high, further development is needed to stay competitive globally. Finland is known to invest in long-term education and the Finnish maritime cluster provides many supplementary courses to further educate its workers.

Finland has research expertise in weight-saving structural solutions and new materials for large cruise vessels, which could be expanded to cover floating offshore structures. Understanding loading of different material types of offshore structures in arctic conditions are necessary to weight-savings and sustainable solutions. Especially know-how of mathematical modelling of ice fields and their dynamic formulations can be utilized to study the impact of harsh winters on offshore and marine objects. Identified research areas where Finnish competencies can be easily strengthened are weight-efficient and sustainable offshore production with enhanced safety, cost and time efficient production solutions for large offshore objects and network-based business models.

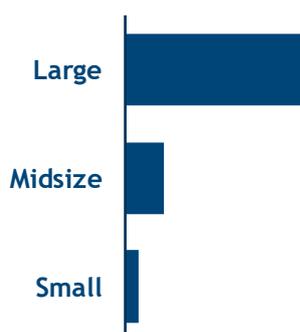
2. Finnish offshore cluster composition

2.1. Finnish offshore company size & employment

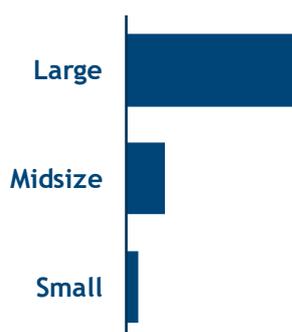
Offshore companies in Finland include many established global large corporations having well-known products and services, and significant business volumes in the offshore industry. In addition to these key international companies, offshore industry includes many mid-sized and small companies. According to the results of the study, large companies create 78 %, and small and mid-sized (SME) companies constitute the remaining 22 % of the total industry revenues. However, the importance of SMEs in terms of employment effects is relatively larger as those employ approximately 30 % of the total employees in the offshore industry in Finland – the rest, i.e. 70 % of the employees are working in large companies. SMEs are typically more labour-intensive companies especially in the subcontracting sector.

Offshore industry by size of company*

Offshore industry revenues
by company size 2016e



Offshore industry employment by
company size 2016e



Sources: Company information and forecast, VALOR analysis

*) Companies involved in the study

Offshore specific stringent requirements and the global nature of the business provide large companies increased opportunities as they have the capability to make the required investments to comply with the requirements. For example, maintaining a global network of offices and service operations, and building international networks of customers, suppliers and other stakeholders in the offshore industry require resources and long-term commitment to the business. Equally important is to have proven references in the oil & gas industry and to be a credible solution provider. However, SMEs are also able to benefit from being part of the supply chain network of a large corporation. This is because, according to company comments, SMEs are often given the opportunity to assume an increased role & responsibilities in the supply chain of large companies, e.g. by specializing in a specific product- or service area.

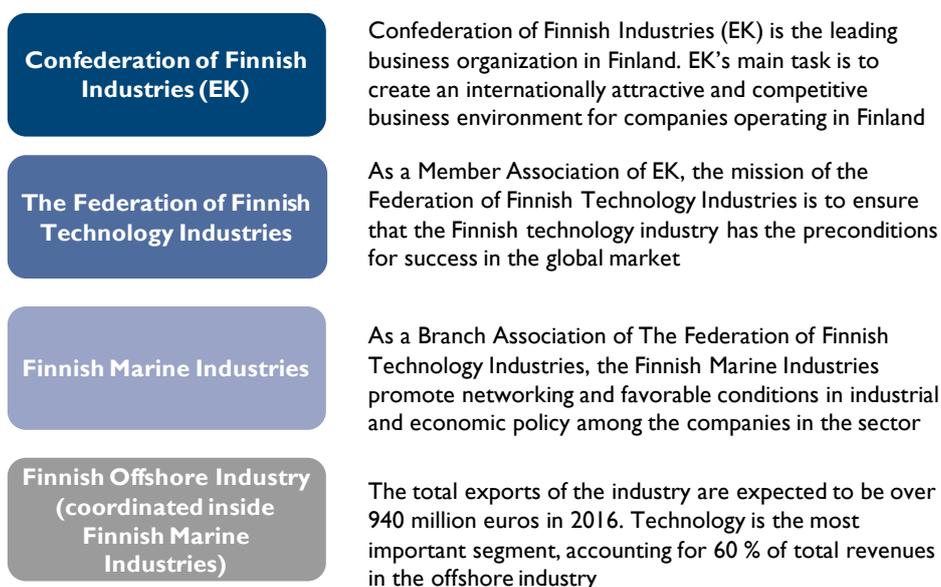
2.2. Finnish offshore industry organizations

Offshore markets are considered as a natural extension to Finnish marine industry expertise. The annual turnover of the Finnish marine industry is around 7.9 billion euros and it employs approximately 29 000 persons in Finland.

Offshore industry is a significant part of Finnish marine industries, having revenues of approximately 1.2 billion euros. Since 2012, the Finnish Offshore Industry –reports have documented the Finnish offshore industry. During 2012-2014 offshore industry was the quickest growing part of Finnish marine industries. Technology products and services are the single most significant business in the Finnish offshore industry, corresponding to approximately 60 % of the total industry revenues. Due to current weak market conditions, the total revenues of the technology companies in offshore are expected to decline to a level of 700 million euros, of which exports accounts for 95 % in 2016. Much of the offshore technology is based on the strong Finnish marine industry know-how.

Finnish Marine Industries is the organization that coordinates Finnish offshore industry cooperation and other activities. The picture below illustrates the Finnish Offshore Industry as a part of Confederation of Finnish Industries (EK).

Finnish offshore industry as a part of Confederation of Finnish Industries (EK)



Sources: VALOR analysis

2.3. Finnish offshore industry key initiatives

There are many offshore related initiatives and projects supporting the Finnish offshore industry to find new opportunities and to build networks internationally and nationally.

2.3.1. Arctic Council

The Arctic Council is the leading intergovernmental forum promoting cooperation, coordination and integration among the Arctic States, arctic indigenous communities and other arctic inhabitants on common arctic issues focusing particularly on sustainable development of arctic area. Other members of the Council include countries such as Norway, Russia, Canada and the United States. Starting from 2017, Finland will hold the chairmanship of the Arctic Council for two years.

2.3.2. Marine industry development initiative

The Ministry of Employment and Economy has started the Marine Industry Development initiative for the years 2014-2016. The aim of the initiative is to improve the competitiveness of the Finnish marine industry. Additionally, the initiative aims to increase cooperation between research facilities, universities and companies in the marine and offshore industry, support Finnish companies' growth and to increase R&D and product and service innovations in the sector.

The initiative includes 10 projects. Examples include Team Arctic, an initiative that brings Finnish companies operating in the Arctic region together, and Marine and Technology Industries' Customer Centric Growth program that is focusing on enabling market opportunities in oil and gas and offshore in the arctic areas, especially in Norway and Russia.

2.3.3. Tekes Arctic Seas program

Tekes Arctic Seas program for the years 2014-2017 aims at turning Finland into an internationally attractive centre of Arctic know-how. Arctic Seas program offers financing for research, development and innovation to internationalizing companies. Tekes is the Finnish Funding Agency for Innovation.

Goals of the Arctic Seas program

- Finland is an internationally recognized Arctic know-how hub
- Creating new Arctic business activities
- Networking Finnish actors into internationally significant investment projects

Budget

- Total: € 100M
- Tekes funding € 45M + companies € 55M
- Tekes funding for research institutes c.€ 12M

2.3.4. Finland Maritime and Offshore program

Finland Maritime and Offshore program is targeted to Finnish companies operating in shipbuilding, in offshore, in maritime technologies and in building. The internationalization program is carried out by Finpro in cooperation with Team Finland players.

Program targets

The target of the Finland Maritime and Offshore program is to increase the business related to the program at least with 500 million euros in 2015-2017. This will be carried out by activating Finnish companies to internationalize and by helping them to get involved in to major shipbuilding, oil and gas projects in international markets. The goal of the program is to network Finnish companies and to enable common offering, which increases the efficiency in internationalization and the visibility of Finnish companies. The program increases also the visibility of Finnish maritime know-how and the flow of investments to Finland.

2.3.5. Other key initiatives

Finland Maritime and Offshore program, run by Finpro, is targeting to increase exports of the industry. Program includes focuses on exporting activities and networking opportunities for Finnish companies inside the offshore industry in Finland and internationally.

In addition, there are several projects linked directly or indirectly to the offshore industry that are typically coordinated by regional commercial development organizations.

Key offshore industry initiatives and projects

- Marine Industry Development program by the Ministry of Employment and Development
- Several projects by regional commercial development organizations and offshore companies

3. Background, methodology and reliability of the study

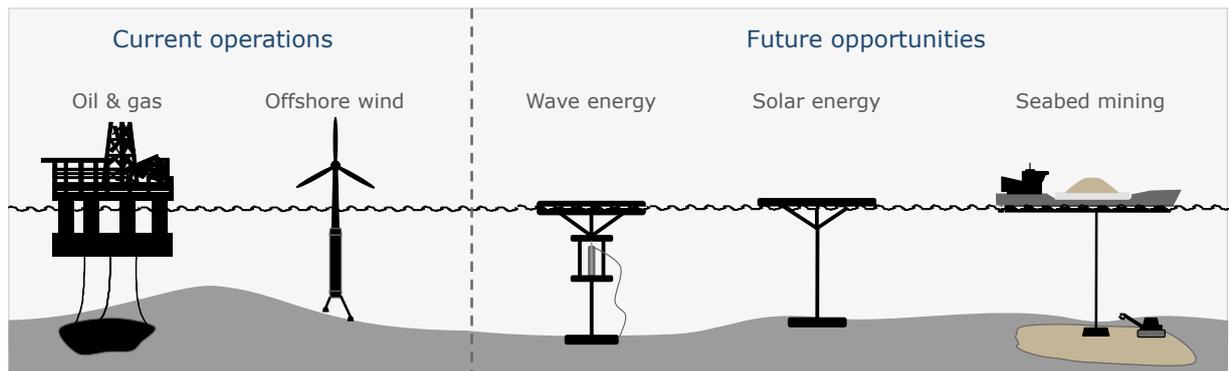
3.1. Background

The Finnish offshore industry 2016-2017 –study describes the Finnish offshore industry, its structure and business volumes as well as the future industry outlook. This report is a continuation to the Finnish Offshore Industry -reports conducted between 2012 and 2015. The project is commissioned by Prizztech Oy (www.prizz.fi) and Finnish Marine Industries. The report supports the work of the Finnish Ministry of Employment and the Economy (MEE) Maritime industry operational environment development programme. Financially the study is supported by MEE in co-operation with Finnish Marine Industries.

This study is conducted by VALOR Partners Oy (www.valor.fi) and it was completed between May and June 2016 and written in June and July 2016. The focus of the study is on Finland, and Finnish products and services within the offshore industry.

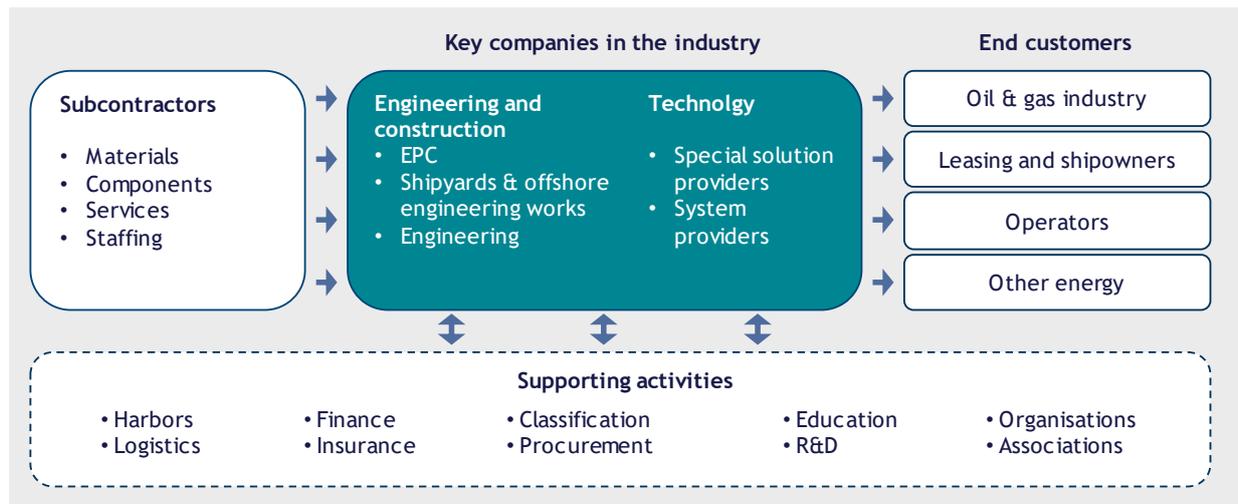
Offshore as a term refers regularly to the production and exploration of oil & gas at sea. A key characteristic describing the offshore industry is the high-quality requirements being imposed throughout the supply chain and on other companies and stakeholders being part of the offshore industry. Therefore, in this report, offshore industry is regarded comprehensively by taking into account a wide array of functions that satisfy the conditions of the stringent quality requirements. Figure below illustrates examples of the offshore end-customer industries. Also, the structure of the offshore cluster in Finland is illustrated.

Offshore end-customer industries



Source: VALOR analysis

The structure of the offshore cluster



Source: VALOR analysis

Based on the discussion above, in this report the offshore industry is defined as including businesses conducting or supporting offshore oil & gas exploration and production as well as other production and related activity at sea (for example, offshore wind and wave energy, seabed mining and offshore fish farming). However, the offshore industry does not include oil & gas logistics related tanker or harbour activities since quality requirements are not strictly shared with the offshore industry.

3.2. Report objectives

The purpose of the Finnish Offshore Industry 2016-2017 study is to increase the understanding of the Finnish offshore industry and its companies, the structure and volume of the industry in Finland, and Finnish companies' prospects in the offshore industry. In this year's report, special attention was directed at identifying Finnish start-ups and smaller players entering the offshore market

3.3. Methodology

As the main methodology of the study, both a web-based questionnaire and semi-structured interviews with selected companies as well as other financial data publicly available were used in creating the data for understanding the Finnish offshore industry. Therefore, this study uses a unique dataset that is collected only for this study.

The questionnaire was sent to each identified company potentially having business in the offshore industry, within shipyards and technology sector as well as in their identified supply chains. The base list of companies was recognized using the list of offshore companies in the offshore studies conducted in 2012-2015. The base list was then supplemented systematically utilising information from Finnish Marine Industries' and Prizztech Oy's databases of potential offshore companies as well as by searching for companies in public databases using industry association codes. The list was then updated by using a systematic internet search strategy. The strategy included entering search words like "offshore", "oil", "gas", "wind", "references", "FPSO", "jack up", "semisub", "spar", "statoil" and

“norsok” among others. Moreover, .fi –domains or company websites with a word “Finland” were prioritized. In addition, interviews and questionnaire results served their purpose in identifying offshore companies in Finland.

In total, 241 companies were invited to take part in the questionnaire and 21 key companies were interviewed. The questionnaire was internet-based and the invitations were sent through e-mail to each identified offshore company. In the SME sector, the questionnaire was sent to the CEO of the company, if no other offshore specific contact person was recognized in earlier studies. In large companies, the respondent was the director/vice president of marine/offshore business or alternatively the person responsible for oil & gas or offshore industry sales in Finland/Nordics. However, to increase the rate of response, reminder messages were sent to those companies that did not answer the invitation message. In addition, the project team tried to reach 220 companies who did not answer the reminder messages by phone calls. Phone calls were prioritized to companies with the largest offshore revenues based on project team assessment.

Selected offshore companies were interviewed. The selection of companies was based on project team’s proposition of a list of the most relevant offshore companies in Finland for this year’s study and then the final list was agreed on together with the customer steering group in a project meeting. Interviews were conducted either face-to-face or by phone. Face-to-face interviews were prioritized, however. Typically, the duration of interviews was between 30 and 60 minutes. Interviewees were e.g. CEOs, offshore/marine directors, technical directors, sales managers, country managers or project managers. The list of companies interviewed is attached.

3.4. Reliability of the study

In total, 104 companies participated in the study, of which 21 companies were interviewed. In addition, 32 companies reported that they do not anymore/yet operate in the offshore business. Thus, the rate of respond was 61 % (104 out of 171 recognized offshore companies). The list of companies is attached. Compared to the study in 2015, 30 new companies responded with an estimation of their offshore business. A few companies did not estimate their offshore business as they did not know their offshore business volumes as they did not have close interface with end-customer. This was mostly related to companies having no offshore specific products in their offering or companies without direct interface with offshore business in their operations.

In order to increase the validity of the study, the questionnaire and interview structure was similar to that of reports conducted in 2012-2015. This increases the comparability of the questionnaire and interview results to those of in 2012-2015. Additionally, in order to increase the reliability of the study, each step of the study was documented to a database designed for this study. Because of this, the report may be conducted with similar methods also in the future.

The total Finland-based revenues of the companies involved in this study amounted to over 16 billion euros in 2016 based on the latest revenues figures. The interview and questionnaire results in 2016 represent 85 % of the total offshore revenues in Finland. Therefore, the reliability and coverage of the study may be considered high. Also, this year’s report is highly comparable to reports conducted in 2013-2015.

Nevertheless, it is important to notice that some companies do not separate offshore business in their bookkeeping or they do not have precise information otherwise available of their offshore business. In these cases their figures are based on company estimations by the person interviewed or the respondent of the questionnaire. Based on VALOR experience, in these kinds of cases the inaccuracy is not often related to the volume of the business but rather on the timing of the offshore business. This is typically because offshore projects are also significant in size and value. However, the problem was minimized by carefully selecting the person or persons interviewed and the respondent of the questionnaire. The persons with the best knowledge of the company's offshore business were prioritized.

Industry revenues of the identified companies that did not answer the questionnaire was estimated using the results of earlier years' offshore reports, or qualitatively with company profiles and using benchmark information.

The conclusions and inferences drawn in the study are formed objectively using company interviews and questionnaire answers. The results are based on a synthesis created by VALOR based on interview discussions and questionnaire results, and do not specifically represent company or industry association opinions.

Appendix: Finnish Offshore Industry links

FinOffshore Directory

www.finoffshore.fi

The Finnish Offshore Directory, FinOffshore, contains information about the Finnish companies operating in the Offshore Industry. The Directory is updated continuously online and published annually as the "FinOffshore Directory" -publication.

FinOffshore-website also contains an online version of this report and additional reports as well as links to information about the Finnish offshore industry and its key markets.

Prizztech

www.prizz.fi

Finnish Marine Industries

www.marineindustries.fi

Ministry of Employment and the Economy (MEE)

www.tem.fi

Tekes – the Finnish Funding Agency for Innovation

<http://www.tekes.fi/en/programmes-and-services/tekes-programmes/arctic-seas/>

Team Finland / Finpro – Maritime and Offshore growth

<http://team.finland.fi/en/frontpage>

Appendix: List of companies interviewed

ABB Finland Oy

Actech Helsinki Shipyard Oy

Arctia Oy

Cargotec Oyj

Citec Oy Ab

Elomatic Marine Engineering Oy

GS-Hydro Oy

Iceye Oy

Konecranes Oyj

Kyynel Oy

Lamor Oy

Metso Oyj

Penamek Oy

Rauma Marine Constructions (RMC) Oy

Rolls-Royce Finland Oy

SSAB Europe Oy

Technip Offshore Finland Oy

Tevo Lokomo Oy

Vaisala Oyj

Wellquip Oy

Wärtsilä Finland Oy

Appendix: List of Finnish offshore companies

Yritys	Shipyards					Yritys	Shipyards				
	Design & engineering	Technology	Subcontracting	Materials	Other		Design & engineering	Technology	Subcontracting	Materials	Other
Ab Solving Oy						Memar Oy					
ABB Oy						Meriura Oy					
Ablemans Oy						Merima Oy					
Adwatec Oy						Mesekon Oy					
AIP-Mittaus Oy						Metalliasennus Huuhka Oy					
Aker Arctic Technology Oy						Meteco Oy					
Allfons Häkans Oy						Metos Oy Ab					
Allstars Engineering Oy						Metso Oyj					
Almacco Group Oy						Meyer Turku Oy					
Alupro Oy						Miilukangas Oy					
Antti-Teollisuus Oy						Mobimar Oy					
APX-Metalli Oy						Nakkila Works Oy					
Arctech Helsinki Shipyard Oy						Napa Oy					
Arctia Oy						Neste Jacobs Oy					
Arme Oy						NESTIX Oy					
Asemetals Oy						NIT Naval Interior Team Oy					
Ata Gears Oy						Norrhydro Oy					
Atexor Oy						O Aaltonen Oy					
Aurajoki Oy						Ocotec Oy					
AW-Energy Oy						OMP-Konepaja Oy					
Beacon Finland Oy						Onninen Oy					
Blue Ocean Solutions Ltd						Outokumpu Oyj					
Bosch Rexroth Oy						Ovako Imatra Oy Ab					
Cadmatic Oy						Oy Grundfos Pumput Ab					
Cargotec Oyj						Oy Operative Recovery Solutions JMR Ltd					
Caverion Industria Oy						Oy SteelDone Group Ltd					
Champion Door Oy						Paramet Konepaja Oy					
Citec Oy Ab						Parmarine Oy					
Comatec Oy						Paroc Ab					
Cursor Oy						Peiron Oy					
Danfoss Drives (Vacon)						Pemamek Oy					
Delcon Oy						Piikkiö Works Oy					
Delta Cygni Labs Oy						PK-Tekniikka Oy					
Deltamarin Oy						Pocadel Oy					
Dimco Oy						Polartherm Oy					
Dovre Group Oyj						Porin Satama Oy					
Dunlop Hiflex Oy						Porin Teollisuusputki Oy					
EIE Maskin Oy						Prohoc Oy					
Elinar Oy Ltd						Promeco Group Oy					
Elomatic Marine Engineering Oy						PXP Project Expeditors Oy					
Energense International Oy						Pöyry Finland Oy					
Ensto Finland Oy						Pöytäan Koneistuspalvelu Oy					
EPV Energia Oy						Qualifiinn Engineering Oy					
Esab Oy						Raahen Insinöörisuunnittelu Oy					
Etteplan Oyj						Ramboll Finland Oy					
E.U. -Adhoc Project Oy						Rauma Marine Constructions Oy					
Evac Oy						RB-Asennus Oy					
Fibox Oy Ab						Rauma Interior Oy					
Fluidhouse Oy						Rauma Plan Oy					
Foreship Ltd						Rejlers Oy					
Finnish Staff Office Oy						R&M Ship Technologies Finland Oy					
Frictape Net Ltd						Rolls-Royce Oy Ab					
FSP Finnish Steel Painting Oy						RR Site Service Oy					
Gardner Denver Oy						Saajos Oy					
Gasmot Technologies Oy						Sabik Oy					
GS-Hydro Oy						Sahala Works Oy					
Halton Marine Oy						Sance-Sandelin Consulting and Engineering Oy					
Havator Group Oy						Satmatic Oy					
Heatmasters Group Oy						SBA Interior Oy					
HeatTreat Oy						SSAB Europe Oy					
Helkama Bica Oy						Stalutube Oy					
Henitec Oy Ab						SteelDome Group Oy					
Hollming Oy						Steerprop Oy					
HTT 5 High Tech Tubing Oy						Suisto Engineering Oy					
Hydman Oy						Sulmu Oy					
Hydroline Oy						Sulzer Pumps Finland Oy					
Högfors Oy						Suomen Hyötytuuli Oy					
Iceeye Oy						Suomen Teräsrätilä STR Oy					
Imatran Työstöasennus (ITA)						SWECO Industry Oy					
Indewe Group Oy						TAAR Group Oy					
Insta Automation Oy						Takoma Oyj					
IntLog Oy						Tasowheel Group Oy					
ITA Nordic Oy						Tebul Oy					
Janneniska Oy						Technip Offshore Finland Oy					
Javasko Oy						Tekla Oy					
JTV-Solutions Oy						Teknos Oy					
Jukova Oy						Telatek Oy					
Justuxia Oy						Tevo Oy					
Kaefer Oy						Tevo Lokomo Oy					
Kaplaaki Oy						The Switch					
Katsa Oy						Tikkurila Oyj					
Kavika Oy						Trafotek Oy					
Kemira Oyj						Ulvilan Konepaja Oy					
Kemppi Oy						Ursuk Oy					
KMJ-Engineering Oy						Uudenkaupungin Työvene Oy					
Koja Oy						Uwira Oy					
Kone Oyj						Vahterus Oy					
Konecranes Oyj						Vaisala Oyj					
Konepaja Häkkinen Oy						Valkon Metallit Oy					
Konepaja Wingmet Oy						Valmet Automation Oy					
KUKUKARI Oy						Valta Works Oy					
Kuerner Machinery Oy						Wello Oy					
Kvaerner Finland Oy						Wellquip Oy					
Kyynel Ltd						WE Tech Solutions Oy					
Labkotec Oy						VEM motors Finland Oy					
Lamor Corporation Ab						VEO Oy					
Lautex Oy						Westecon Oy					
Lehtosen Konepaja Oy						Viafin West Welding Oy					
Leinolat Group						Wirtain Metallit Oy					
Leinovaltu Oy						Voith Paper Oy					
Levator Oy						wpd Finland Oy					
LOGSTOR Finland Oy						VRT Finland Oy					
Loitech Alliance Oy						VTT					
Länsiviivain Oy						Wulff Entre Oy					
Machinery Acoustics Oy						Wärtsilä Finland Oy					
Marioff Corporation Oy						Yllin Talli Oy					



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