

EMSO implementation and operation: DEvelopment of instrument module

BUSINESS CASE STUDIES

D8.1

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1. EXECUTIVE SUMMARY

Blue Growth is the long term strategy of the European Union to support sustainable growth in the marine and maritime sectors as a whole which have great potential for innovationⁱ. Work Package 8 (WP8) is EMSODEV's contribution to achieving the goals of the Europe 2020 strategy for smart, sustainable and inclusive growth.

The key objective and challenge for WP8 is to identify and set up activities to increase the potential for innovation of EMSODEV technological output and thus contribute to increase the innovation potential of the EMSO observatories. While many of the deep sea observatory projects have typically focussed on the science drivers behind ocean observation, it is increasingly important that commercial contributions to promising areas are fully developed. This deliverable is focused on assessing market applications and commercialisation opportunities for the generic instrumentation module EGIM and the associated software package in areas like ocean energy, sea bed mining and marine knowledge. This document describes the business case studies of specific products or services delivered by SME's to a particular sector with the business case.

This deliverable reports on the development of case studies with SMEs and other relevant Industry groups that demonstrate specific applications to key niche sectors (e.g. Oil & Gas E&P, Renewable Ocean Energy [including floating offshore wind], Deep Sea Mining, Government/EU Commission [e.g. requirements under MSFD]). The case studies identify key products or services with a potential for high impact in terms of innovation. The case studies will aid in the consolidation of the ocean observatory cluster of product and service suppliers and potential industry end users.

The deliverable focuses on the potential development of the commercial side of EMSO and references developments in the EMSO Eric Business planⁱⁱ towards developing EMSO as a platform for innovation.

2. INTRODUCTION

A key object for EMSO is to translate research and development into commercial products, services and IP. This will be achieved by partnering with academic and industry to develop a range of R&D, validation and proof of concept projects which will use EMSO infrastructure to support to develop economic opportunities for partners.

An innovation platform like EMSO will provide an effective testing environment and supporting infrastructure to develop and enhance these improved sensing technologies and ensure their effective integration into existing cabled observatories for long term monitoring.

The EMSO ERIC platform centres on a core technology or service - the provision of high quality, long time-series marine data - that is essential for a broader, interdependent ecosystem of businesses to develop and supply complementary value-added products and applications to wide multidisciplinary set of users. In other words, it requires third-party innovations to be useful and grow and vice versa.

This deliverable has, as a result of a technology profiling process, identified a number relevant potential innovative technology developments and a number of companies who are developing these technologies and tools for a range of marine related industries including environmental monitoring, Oil and gas, marine renewables and deep sea mining.

2.1. Rationale for selection of business case studies

The process of identifying and selecting the various case studies of specific products or services delivered by industry to a particular sector and associated business cases involved a broad ranging analysis of the European marine technology sector and the process is a development built on previous work carried out by the FIXO3 projectⁱⁱⁱ and the Nexos Project. Both of the EU funded projects completed research on identifying European based marine technology companies – some of whom were partners in these projects themselves.

2.1.1. FIXO3

The selection of Business case studies carried out in this report is in part linked to previous worked carried out under FIXO3 deliverable 5.5.1^{iv} which identified a number of European based companies with innovative products and services operating on FixO³ infrastructure with the intention of promoting them to the commercial sector. The selected products and services are based on background intellectual property rights (IPR) held by FixO³ partners before FixO³ commenced, and also products and services from the wider ocean observatory community. These products and services have been identified as being of interest to commercial developers.

FixO³ will bring these technologies to Technology Readiness Level (TRL)^v 8 or 9, i.e., system technology qualified through successful mission operations, by providing access to FixO³ infrastructure through cooperation with FixO3 WP7 Transnational Access.

The selection of the innovative FixO³ products and services were based on the following criteria:

- Application in environmental monitoring
- Relevant to MSFD descriptors and variables
- Identifiable business case for commercial application
- Potential to be more cost effective than existing technology
- Expressed interest by the supplier in further commercialisation of the product/service

These criteria overlap closely with EMSODEV goals so it was decided to capitalise on the good work carried out and develop the business case studies for the companies involved and find out how they can link to the development of the EGIM.

2.1.2. NeXOS Project

The main objective of NeXOS^{vi} is to develop new cost-effective, innovative and compact integrated multifunctional sensor systems which can be deployed from mobile and fixed ocean observing platforms, not just for the sake of having better marine environmental monitoring means, but with an eye on the potential of the European industry to exploit these new or improved systems. As such, the NeXOS project contributes to raising the competitive position of the European marine sensor industry. To this end, a committee was formed in which all SME companies that are partners in the NeXOS project participate. The NeXOS project set up committee the **ASCS** - Advancement of the SME Competitiveness Subcommittee (ASCS) to ensure, at the outset of the project and during its life cycle, that the design and engineering process followed can be understood and incorporated into the practical implementations by SMEs, industry and the science research and observation community. The ASCS works to enhance the potential of NeXOS's products to penetrate the marine sensor market and assess the economic advantages of the innovations developed within NeXOS. Furthermore the ASCS advises on the management of the NeXOS Intellectual Property Rights to deal with legal provisions for knowledge and technology protection, transfer and exploitation, in accordance with EU regulations.

2.1.3. Drivers for Business Case Study Selection

EMSODEV is building on this approach by strengthening the links between the companies that are involved in FIX03 and Nexos (Next Generation Web-Enabled Sensors for the Monitoring of a Changing Ocean) by highlighting the technology advancements that have been made and looking at opportunities where this technology could be incorporated into the EGIM either as a core technology or core sensor. The Case studies will focus on products or services already identified as having a high innovation impact and investigate with the companies on how the technology can be exploited to the full by EGIM by linking Specific applications match to key niche sectors.

The preliminary list of measurement parameters identified as being part of the EGIM development was also a factor in choosing the companies for the business case study.

Core parameters	Optional parameters (potential)
<ul style="list-style-type: none"> • Temperature • Conductivity 	<ul style="list-style-type: none"> • Fluorescence /Chlorophyll-a • pH

<ul style="list-style-type: none"> • Pressure • Dissolved O₂ • Turbidity • Passive acoustics • Ocean currents 	<ul style="list-style-type: none"> • CO₂ • Imaging cameras
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Table 1: EGIM preliminary list of parameters

In terms of sensor developers the report focuses on primarily on companies that are involved in producing sensors that are aligned with the EGIM list of parameters - this may enhance the development of research initiatives between the companies and the EMSO ERIC partners.

EMSODEV deliverable 2.1 has also identified criteria for equipment to be installed on the EGIM.

These parameters are that the sensor:

- Meets a key Scientific Driver
- Meet s depths and endurance requirements for deployment at EMSO ERIC infrastructure sites
- Is of High TRL Level 7-8
- Reasonable cost to implement

The companies identified and analysed in this delivery have been deemed of significant interest in terms of application of their technology to the EGIM based on their identification in other marine technology development projects like FIXO3 and NEXOS as innovative companies with clear potential for integration into the EMSODEV EGIM or as a potential user of the EGIM when developed.

The organisations that supply the identified products and services were approached to find what barriers to increasing sales to the offshore environmental monitoring sector have been encountered. Business solutions to overcome those barriers are identified. Where appropriate - advice on IPR agreements will be provided and potential technology development partners approached to discuss partnership and licensing options.

2.1.4. Unmet Needs

One of the keystones for the most effective, efficient, and profitable deployment of future products within the prioritized markets is that organizations and entities must adopt strategies for development and deployment of technologies that address these unmet needs. The description of unmet needs, therefore, serves as a foundation that informs technology and product development strategy.^{vii}

2.1.5. Esonet Yellow pages

The ESONET Yellow Pages (<http://www.esonetyellowpages.com/>) aim to organize the information concerning on-the-shelf products for the development and maintenance of Deep-Sea Observatories, which are provided by the private sector. This includes a range of equipment from simple, isolated sensors or parts, to communication systems or even integrated Observatories.

ESONET Yellow Pages also aims to foster the feedback from the scientific community in what concerns the experience with a specific product, addressing reliability for long-term operations and the use in real deep sea or coastal conditions.

The Yellow pages is considered the precursor of the EMSO ERIC innovation platform – has good value as a comprehensive sourcing aide for complex marine infrastructures – it is a useful directory tool for linking with industry. As part of EMSODEV deliverable 8.1 this tool was used to identify potential candidates for the case studies.

The “Promotion and SME Policy” report ^{viii} outlined the strategy developed by the ESONET Network of Excellence - to promote interaction with the general public and SMEs. This strategy is key to the successful development of the observation network, sensors, communications and value added services of deep sea observatories.

Several tools were developed to implement the promotion strategy ^{ix}

- A website - <http://www.esonet-noe.org/>;
- ESONEWS - a newsletter and e-zine;
- PESOS ^x – an industry committee;
- ESONET Yellow Pages

One of the best indicators of success of this strategy is the number of equipment suppliers, service providers and potential customers that attend workshops, contribute to ESONEWS and access the ESONET Yellow Pages.

3. CANDIDATE COMPANIES FOR EVALUATION IN CASE STUDIES

The rationale for the selection of the case study candidates is explained in terms of their technology readiness levels and applicability to different industry sectors, with a particular focus on how the companies involved can work with EMSO partners to develop their products and services. The case studies chosen identify key products or services with a high potential for innovation.

Company Name	Company Size	Technology	Potential Link to EMSODEV
SMID TECHNOLOGY	SME <10 employees	Digital hydrophones	Sensor provider
NKE-Instrumentation	SME size 30-35 employees \$7.4m annual sales	NKE- Noss sensor for water salinity	Sensor provider
Texcel Technology	SME Company Size 51-200 employees	Subsea electronic manufacturing solutions	SubSea component provider
SENSORLAB	SME <10 employees	High accuracy submarine pH sensor	Sensor Provider
BG Group	Large Oil Company >10,000 employees	Subsea engineering and technology	Potential Customer/Collaborator for EGIM
Norwegian Cluster GCE Subsea Global Centers of Expertise	SME operating a large cluster <20 employees	Subsea engineering and technology	Innovation Platform Model for EMSO to follow to develop commercial applications

Table 2 Summary of Business Case Study Candidate Companies

3.1. Case Study 1: SMID Technology



Company Name	SMID (Security Multi-Sensor Integrated Devices)
Country	Italy
Location	SMID Tecnology S.r.l. Via Vincinella, 14 19037-Santo Stefano di Magra SP
Website	http://www.smidtechnology.it/index.php
EU Projects	Fix03, Nexos
General Manager	Alessandra Casale

SMID Technology is a small company devoted to Research and Development in the field of underwater passive monitoring, mainly acoustical. SMID is developing a new kind of small dimension and low power digital hydrophones (single, multi-channel, array, etc).

The core business of the company is the design and manufacturing of new devices, typically developed within funded R&D programs or small supplies for Research Centres and private Companies. While not being a non-profit organization, the main goal of SMID is not the business in itself, but it is rather the development of new technological advanced devices to be commercialized in the future from other companies of the industrial group SMID is ventured with.

SMID expertise offered to NeXOS comes from specialized personnel (employed): three persons devoted to design, manufacture and test underwater equipment, one person for business development, system engineering and project managing activities, one person for administrative and project reporting aspects. Furthermore SMID established a steady and continuous co-operation agreement with AguaTech (www.agua-tech.com) to get proper scientific support in the design and test of underwater devices.

AguaTech is a 2-persons company acting as a partner or as sub-supplier of SMID in almost all R&D activities and industrial jobs SMID is involved in. The two AguaTech persons are scientists (EX NURC, NATO Undersea Research Centre), one expert in underwater acoustics, the other one in system design and test at sea of underwater acoustic devices.

Compact, low power, low noise, digital hydrophone with embedded processing impact, low power, low noise, digital hydrophone with embedded processing

Main Features:

- Two ADC with different gain for true 50 to 180 dB re
- 1uPa dynamic range

- Hi depth: up to 3000 m.
- Configuration via serial protocol:
- Sampling frequency 5 to 100 kS/s.
- Selectable Equalizer: Hi Pass Filter one pole at 3.2 kHz.
- Selectable processing algorithms
- EMBEDDED FUNCTIONS
- NOISE SPECTRA
- ACOUSTIC SHIP SIGNATURE
- MARINE MAMMAL DETECTION
- PREPARED FOR SEISMIC EVENT DETECTION
- OPEN-SOURCE FOR ADD-ON PROGRAMMING
- Digital Hydrophone A1 innovations
- Very compact digital hydrophone with embedded processing
- Designed for Gliders / AUVs, also useable for deep fixed platforms
- Measurements of human activities, nature sounds, seismic events.

Relevance to EMSO Generic Instrument Module Development

Passive Acoustics/Underwater noise has been identified as one of the core parameters to be measured by the EGIM

What is the Technology Readiness Level of the SMID hydrophones ?

TRL currently unavailable

1. Are there technical constraints affecting deep water deployments of SMID sensors ?

Some versions of digital hydrophone can be deployed to deep water at 3000 m depth without particular constraints. In particular it depends on the type of hydrophone ceramic transducer used.

SMID deepwater Digital Hydrophone(maximum depth=4000m)

- 4-channels (ship noise, marine mammals, etc.)
- Digital arrays with up to128 channels

SMID Hydrophones are used as Deep-water sensors: to install either on deep-water platforms(e.g., NEMO^{xi} project), or as payload of ROVs or AUVs

2. What are the calibration requirements ?

The calibration will be done in appropriate laboratories with water tank.

3. Servicing requirements (time, cost etc.) ?

There are not particular servicing requirements, it depends on the application environment.

4. Do your hydrophones require specialized subSea connectors?

For our digital hydrophone, we usually use the standard underwater connector from the typical manufacturers as SEACON, MacArthey, SOURIAU. It usually depends on customer requirements.

5. What industry sectors are you selling to?

Scientific, industrial and military.

6. In which sectors are the most promising growth opportunities for your products in your view ?

Scientific.

7. Who are your main competitors? (both European and worldwide)

SMID specializes in the development of low noise preamplifier and in the design of analogue circuit for the signal digitalization. To date the products have been developed under customer technical specifications, therefore we cannot identify a main competitor.

8. What are the main barriers SMID faces to increasing market share?

Low public economic contributions to the defense and research.

9. Are you interested in meeting with the EGIM development team to explore a potential application for your technology on the EGIM platform?

Yes, as NEXOS partner SMID is developing sensors already suitable for protocols and interfaces compatible with EGIM platform. The protocol (OGC PUCK Protocol) of interface has been developed by UTC, even it NEXOS partner. We cannot provide additional information.

3.2. Case Study 2 : NKE - NOSS SENSOR FOR WATER SALINITY



Company Name	NKE Instrumentation
Country	France
Location	rue Gutenberg Hennebont Bretagne 56700 France
Website	http://www.nke-instrumentation.com/about-nke-instrumentation.html
EU Projects	Fix03, Nexos
General Manager/Contact Point	Damien Malarde - dmalarde@nke.fr

Created in 1984 under the name of Micrel as a study in electronic desk, NKE launched its first products for the oceanographic instrumentation in 1993. It split from end of 2011 into three SMEs, one of these NKE Instrumentation is partner of the consortium NEXOS for the Ocean proposal for Tomorrow. Its main activity is to develop and manufacture oceanographic measuring instruments.

NKE instrumentation activities overview:

- Autonomous recorders for measuring in-situ in continental and marine waters: measure from 10 to 6000m depth parameters physico-chemical (Temperature, pressure, conductivity, dissolved oxygen, turbidity, Fluorescence, pH) and more specific parameters (Force, Erosion slope, fishing Effort)
- Automated instrumented systems and networks for environmental monitoring:
 - Marel measuring station, instrumented buoys (weather and ocean),
 - Recopesca network on fishing vessels,
 - instrumented system deep sea bottom.
- Profilers and drifters to monitoring of the oceans: Profiler ARVOR Argo program. PROVOR for various scientific applications thanks to its high payload capability. (dissolved oxygen, acoustic,, bio-optical, nutriments ...), Carioca buoy accurate dissolved.fCO2 measurement
- Sensors: optic and colorimetry (density, pCO2, pH – Alc), acoustic measurement chain, calibration activity .T, S.

NKE-instrumentation has a permanent team in R & D of 12 people and also uses the resources of the NKE common design office (10 people). A workshop with 8 dedicated employees manufacture the NKE- instrumentation products.

The developments axes of NKE-instrumentation are the placing on the market of new sensors, the supply of buoys instrumented for offshore wind power and the development of profiling floats, specific and low cost.

To support its R & D internal, NKE instrumentation participates in several programs of research in collaboration with scientific bodies (Ifremer, CNRS) and industrial. These projects often approved by the competitiveness clusters

In the project NEXOS ^v, NKE are involved in the chlorophyll and oxygen probes development for the Recopesca system and the integration of the different sensors as well as for the onboard sensor "Canoe".

THE NKE NOSS is a unique underwater sensor for in situ refractive index measurement and is capable of detecting salinity anomalies in seawater. The NOSS sensor is designed for use in harsh environments down to 2000 meters.

The thermodynamic properties of seawater, such as density and enthalpy are now correctly expressed as functions of Absolute Salinity rather than being functions of the conductivity of seawater. Spatial variations of the properties composition of seawater mean that Absolute Salinity is not simply proportional to Practical Salinity.

Possible uses

- Embedding on CTD probes, buoys, gliders, AUV, drifting profiling floats for operational oceanography
- Alternative solution to classical CTD sensors.

Advantages

- Fast sensor configuration (sampling, resolution) and data transfer using serial link.
- Optimize and compact design
- Optimal sensors protection for vibration and pressure resistance (NF X10-812 standard)
- Measured in real-time up to 3 Hz
- Not need calibration after deployment

DESIGNATION	NOSS
Refractive Index	Range : 1.3353 to 1.3458 initial accuracy : >1.10 ⁻⁶
Temperature	Range : -2 +35°C initial accuracy : ± 0.006°C Response time (at 63%) : > 150msec

Operational Depth	Range : 0 to 2100 dbar Initial accuracy : ± 1 dbar
Absolute Salinity (according to TEOS-10)	Range : 15 to 42 g/kg Initial accuracy : ± 0.005
Data output	RS232 Serial Output Data format ASCII
Data storage	No
Sampling rate	Programmable from 1Hz to 3 Hz
Power supply	Range : 6 to 18 Vdc
Power consumption	Approx. 0.065 A at 10.8 Vdc
Dimensions	170 mm x 100 mm
Weight	2.4 kg in air ; 1.7 kg in water
Housing Material	Titanium (with protective guard)
Connector	Connector SUBCONN MCDLSF 8-pin

Table 3 NKE : NOSS sensor specifications.



Figure 1 NKE NOSS - Salinity Sensors

Relevance to EMSODEV

NKE instrumentation is a company that is constantly pioneering new technologies. New, state-of-the-art equipment is required to satisfy the new standards in place, emerging environmental requirements, ever more rigorous quality systems and increasingly accurate traceability.

The company invests massively in research and development and is therefore highly involved in projects certified either by the Sea centre for competitiveness, the ANRT or Europe.

One sensor of particular interest to EMSODEV is the NKE NOSS Sensor a new optical sensor that measures salinity based on the principle of the measurement of optical density.

3.3. Case Study 3: Texcel Technology PLC



Company Name	Texcel Technology Plc.
Country	United Kingdom
Location	Texcel Technology Plc Thames Road Crayford Kent DA1 4SB United Kingdom
Website	http://www.texceltechnology.com/
General Manager/Contact Point	Peter Shawyer
Link to EMSO	FIXO3 – Meeting at Oceanology International

Texcel Technology Plc is an electronic design and manufacturing (CEM) company founded in 1976, based in the United Kingdom. Texcel provides a complete service which includes:

- Concept Electronic Design
- Circuit Design
- PCB Layout
- Firmware Design
- Validation Testing
- Prototype Assembly
- Full PCB Assembly
- Chassis & Wiring
- Full Turn Key Assembly
- Functional Testing

Texcel are an engineering company with a strong focus on good communications and excellent service. Texcel have participated in the NEPTUNE and RSN cabled observations systems, and collaborated with L3-Maripro, Alcatel, Teledyne and others in this area.

Texcel is also a member of the European Seventh Framework Programme consortium team for Fixed Point Open Ocean Observatories Network (FixO3), coordinated by the Natural Environment Research Council. To support this project the company has teamed with L3-MariPro for the supply of a titanium pressure housing, associated testing and including assembly of the Marine Institute provided bulkhead connectors. L-3 MariPro is a leading supplier of cabled ocean observatory infrastructure for marine science applications and have been involved with solutions for the MARS, NEPTUNE Canada and recently are the prime contractor for the Regional Scale Nodes (RSN) program, the world's largest ocean observatory. Texcel partner with Horsebridge networks (<http://horsebridge.net/>) for a robust communications network solution, located in the Shore and in-water equipment. This allows Texcel to reduce the project risk, provide a qualified efficient solution and have excellent upgradeability for future deployment changes.

Texcel Recent Projects

Texcel have operated in a number of areas related to the design and supply of subsea systems and specifically cabled observation systems. Texcel designed and supplied all the power, port switching and internal environmental systems for the Nodes used within NEPTUNE Canada and the shore based element manager. Texcel also provided the same service coupled with a complete network management solution for the USA Regional Scale Node program. These projects have been on-going for a number of years.

In addition to this, Texcel is also the design authority and manufacturers of the Tinsley range of subsea test systems, including the cable Termination Unit required for this project.

Texcel has also teamed up with its partner MariPro in Santa Barbra, CA who have vast experience in constructing complex subsea housings and structures and they have completed a wide range of cabled systems. The L-3 MariPro cabled ocean observatories are a vast network of ocean observing sensors and mobile robots interconnected by submarine fibre optic cable and power cable. The cabled network infrastructure delivers unprecedented levels of power, communications bandwidth and precision timing to the instrumentation that can be remotely accessed and routinely interacted with from a remote network operation centre or connected research campus. The cabled network infrastructure facilitates near real-time continuous data flow from these subsea sensors to shore. The immense data flow is integrated by a shore based sophisticated computing network and is available via the Internet in near real time to researchers, public policy makers, and educational and public engagement programs. This transformative infrastructure will provide new tools for discovery oriented researchers to better study and understand complex ocean processes. Texcel have worked with Teledyne for over 8 years helping to develop and manufacture a range of subsea electronic systems. These are required to operate within towed arrays and as such have a high shock requirements and exacting functional specifications.

Texcel also provides various sub-systems for PFE equipment for both Spellman High Volt and Alcatel-Lucent. This includes the design and/or manufacture of the control electronics, high voltage circuit boards, human operator interface, and ship borne electronic loads.

Texcel also provided the same service coupled with a complete network management solution for the USA Regional Scale Node program. In addition Texcel have worked closely with Teledyne to help develop their latest range of towed array gyroscope systems.

Texcel Case Study: NEPTUNE Canada

NEPTUNE Canada is an operational cabled observation system operating of the coast of Canada. Texcel's scope was to design the power conversion units and scientific port switching electronics. This also includes the environmental monitoring systems. An important feature was the 25 year life of the solution, which was achieved. In addition Texcel provided the element manager controlling the Node and the SQL database for recording the actions and environmental readings. Texcel was responsible for the validation testing and post contract support.

RSN, is a new cabled observation system which is deployed of the West coast of the USA. It is currently going through final acceptance by the end customer. Texcel design and manufactured the primary Node power and Science port switching which included the environmental sensing system.

Texcel also supplied the mirrored high reliability element managers and whole network management system. We have been heavily involved in supporting the equipment in the whole Node. Texcel provided all the validation testing and documentation required for the scope as defined above. The Contract value was in the range of 2M Euro's and the design phase lasted 1/2 year and the manufacturing cycle lasted 1 year. We are currently in the final acceptance phase. Teledyne .

Texcel have worked with Teledyne for over 8 years helping to develop and manufacture a range of subsea electronic systems. These are required to operate in towed arrays and as such have high shock requirements and exacting functional specifications. The contract value is 750K Euros annually.

Power Feed Equipment.

Texcel provides various sub-systems for PFE equipment for both Spellman High Volt and Alcatel-Lucent. This includes the design and/or manufacture of the control electronics, high voltage circuit boards, human operator interface, and ship bourn electronic loads.

Technical Capability

Texcel have designed and manufactured subsea observation nodes for two major projects. To support these projects we have undertaken the validation testing and documentation. Texcel has also developed the software management tools required to operate the equipment in a reliable manor. Texcel has supported all the preliminary and final design reviews for these projects, and we have developed management systems for every piece of communication equipment used.

Texcel have designed and supplied a wide range of medium power convertors, with many operating at 400V DC for the nuclear power industry, operating the refuelling systems with UK based power stations. These have exceptional reliability and robustness, with excellent regulation. Our experience with the design and manufacture of PFE systems will also be advantageous for this project.

The company has the latest facilities for designing assembling and testing electronic circuit boards and systems. The company sees this project as a progression in their plan to develop and expand the design and manufacture of subsea research infrastructure.

The company has over 35,000 sq. ft. of assembly area is fully approved to ISO9001, all assembly staff trained to IPC610 standards and manufacture products to Class III.

Relevance to Emso Generic Instrument Module Development

Texcels' subsea observation nodes could be integrated into the EMSO Generic Interface Module via modifications to the COSTOF2 system.

WHAT TRL level is the Technology

TRL 9 - operational and commercially available technology.

Relevance To Emso Generic Instrument Module Development

Texcel can provide an interface module, source and assembly a wide range of sensors. Provide an integration service onto a frame and undertake system testing. Develop a communications receiver and SQL database repository of asynchronous data. Texcel can also develop appropriate test solutions to support deployment projects of equipment.

Any Technical constraints for Deep Water deployments

Texcel undertake pressure testing at third party locations.

Calibration requirements

Texcel are able to test, validate and calibrate instruments and complete systems pre deployment

Servicing requirements

Texcel provide a servicing and repair service for a wide range of customers.

Any specialist SubSea Connectors required

Texcel purchase a range of subsea connectors as appropriate for the application and agreed with the customers. These cover wet and dry mate connectors as well as penetrators.

What sectors are you selling to?

- SubSea Science observatories
- Sub sea Instrumentation
- Oil & Gas sector
- Marine Systems Radar etc
- Instrumentation
- HV systems (Xray , implantation)
- Communication sector

Who are your main Competitors?

Texcel have different competitors in each of its' fields but for the subsea sector they would include OceanWorks.

What are the major barriers to your company increasing Market share

A number of areas limit our ability to dynamically alter our market share which is growing but at a steady pace. These include customer demand, obtaining experienced staff and access to finance to support the growth.

3.4. Case Study 4: SENSORLAB



Company Name	Sensor Lab
Location	Las Palmas, Spain
Company background	
General Manager/Contact	Hervé Prêcheur-Massieu is the general manager of SensorLab. He has been developing instrumentation in different fields for more than 10 years. He holds a bachelor's degree in electronic engineering. hp@sensorlab.eu
Website	http://www.texceltechnology.com/
EU Projects	FixO3
Link to EMSO	Meeting at Oceanology – Potential Sensor Supplier

SensorLab are a young and small company established in 2011. They develop high accuracy environmental instruments with a special focus in oceanographic research. Sensor labs product line includes high accuracy pH sensors and low power, high stability spectrophotometric led light sources. Customized products for specific customer requirements are also developed.

SensorLab pH sensors are the fruit of many years of development in collaboration with Dr. Melchor González-Dávila at the University of Las Palmas de Gran Canaria. SensorLab have developed a new family of rugged and extremely stable spectrophotometric pH sensors for both lab-based research and buoy monitoring, specifically designed for autonomous operation independently of dye and aging effects in surface waters.

The first sensor prototypes were developed in 2007 and they are still being used today. The SP100-SM was released in 2011 being the first official Sensorlab submarine pH sensor. This sensor was the precursor of the current SP101-SM released in 2013 featuring several improvements over the SP100-SM such as smaller size, lower power consumption, increased corrosion resistance and an enhanced firmware.

SensorLab was established in 2011, and QUIMA group prototypes gave birth to the first commercial submarine sensor, the SP100-SM. The experience acquired with this sensor led to the new SP101-SM, packing several improvements over the previous generation of sensors. These improvements included a 40 percent reduction in the sensor power consumption, thanks to a redesigned higher

efficiency electronic controller, and a new low-power LED light source. The corrosion resistance has also been improved with the addition of an epoxy coating, plus polyurethane finishing on top of the 6060 hard anodized aluminum housing. The sensors use spectrophotometric-based methods to measure the pH, removing the dye effect in each determination. The dye used is m-cressol purple. The design of the pH sensors allows for the same accuracy achievable in the lab, but autonomously deployed in the ocean, enabling long-term measurements without human intervention. As environmental conditions change, the sensor is designed to adjust all the measurement parameters automatically to provide maximum accuracy. An important point to note is that the system also returns the internally calculated error for each measurement. This continuously tracks the system measurement accuracy and can be used as an indicator to plan preventive maintenance cycles.

The sensor can measure pH but also temperature, using the internal high-accuracy temperature sensor, and salinity, through an optional external thermosalinometer. The units can store up to 19,000 measurements in non-volatile memory, including the measurement time and date from the included internal real-time clock

Relevance To Emso Generic Instrument Module Development

pH has been identified as one of the parameters to be measured by the EGIM

Technical constraints for Deep Water deployments

Issue operational pressure 2 bar #20m depth – limited to shallow EMSO Nodes.

Calibration requirements?

The sensors do not require calibration, but performance verification is recommended once a year.

Servicing requirements?

The pH sensor uses liquid reagents, so depending on the sample rate a reagent change can be necessary. The reagent life is estimated to 5000 samples.

Any specialist SubSea Connectors required

Sensorlab sensors are using standard impulse connectors.

What sectors are you selling to?

To the oceanographic research sector

Who are your main Competitors?

Main competitor is mainly Sunburst solutions from USA.

What are the major barriers to your company increasing Market share

The main barrier is related to the market size (a small niche). This does not allow making reasonable volumes (of around some hundreds of pieces per year) that could reduce costs (and consequently the selling prices) dramatically.

3.5. Case Study 5: BG GROUP



Case study – BG Group (BG East Africa)

Company Name	BG Group now part of Royal Dutch Shell
Location	Multiple Global locations – BG East Africa
Company background	Formed in 1997 - BG Group has transformed from an offshoot of a former nationalised utility into an international energy business focused on exploration and production
General Manager/Contact	Contact via Andrew Gates NOC
Website	http://www.bg-group.com/
Link to EMSO	Working with NOC on Subsea technology testing/Potential collaboration with EGIM.

The hydrocarbon industry is expanding in deeper and less explored waters where knowledge of even basic ocean processes can be limited to data gathered during Environmental Impact Assessment and baseline surveys. The infrequent nature of such surveys consequently misses important or extreme variation and data collection typically ceases after the initial assessment. BG Group is an example of a hydrocarbon company with assets globally in water depths ranging from shallow continental seas to the deep Ocean. In order to improve their understanding of the environment they operate in and their impacts on it BG Group has used a variety of collaborative approaches including BG Tanzania carried out Drilling Discharge Modelling to measure the impact of the campaign on the marine environment. Though the results showed that the environmental impact of the drilling campaign was likely to be insignificant, the team wanted to improve their understanding by taking samples from the seabed.

With this in mind, Dr Lodewijk Werre, BG Tanzania’s environmental manager, approached Dr Andrew Gates from the UK’s National Oceanography Centre. They set up a plan to collaborate under a project scheme known as the **Scientific and Environmental ROV Partnership** using **Existing iNdustry Technology** – the SERPENT Project (www.serpentproject.com).

This project allows marine biologists from the centre to operate the cutting-edge remotely operated vehicle (ROV) on board the drill ship, using it to explore the seabed and gain greater understanding of the operating environment

BG East Africa business unit collaborated with the SERPENT Project to use existing remotely operated vehicle ROV infrastructure aboard the drill ship Deep Sea Metro 1 to describe the biological diversity at a range of drilling sites over 1000 m depth in a poorly explored area of the western Indian Ocean.

The approach was also used to observe and monitor the effects of routine drilling disturbance on the seabed environment^{xii},^{xiii}

The publication of data from this collaboration is ongoing but outputs so far include insights into the behaviour of hammerhead sharks^{xiv} and a photographic identification guide to the deep-sea fauna off

Tanzania. This work highlights the value of collaboration between science and industry to improve our understanding of the deep sea.

Testimonial from BG Group

As the scientific community is moving toward a network of sustained ocean observatories to generate real-time, time-series data in order to address ecological and oceanographic questions BG Group recognise the potential benefits to their operations. Improved ocean observation, particularly in poorly explored frontier areas could provide direct benefit to monitoring of environmental influences on subsea infrastructure such as well-heads, manifolds, marine risers and blow-out preventers. Furthermore, basic monitoring of baseline environmental conditions could be improved, with benefits for planning of ongoing and future operations, understanding industry impacts, either to demonstrate good practice or to provide real-time data to help mitigate in the event unintended discharges. Observatory infrastructure such as the EGIM could be of value to hydrocarbon exploration companies such as BG Group through provision of long term ocean observatory capabilities within existing deep-sea hydrocarbon industry infrastructure.

Relevance to EMSODEV and EMSO

This project experience clearly demonstrates the need for real time monitoring in the oil industry and how such systems enhance understanding of operational impacts on marine organisms. This is just one example of a niche, high value sector which EMSODEV is proposing to explore and exploit through the development of the EGIM.

3.6. CASE STUDY 6 : Norwegian Cluster GCE Subsea Global Centers of Expertise



Company Name	GCE Subsea
Location	Norway
Company background	The GCE Subsea cluster established in Norway in 2006 is a world leader in the field of operating, maintaining and modifying subsea equipment in order to recover more oil & gas from the reservoirs.
Company Address	Office Building K2, Kystbasen Ågotnes Viilvite, Thormøhlensgate 51, Bergen
General Manager/Contact	Jon Hellevang Senior Subsea Innovator
Link to EMSO	Exemplar model for EMSO to follow in terms of establishing a strong industry and research cluster in the domain of subsea marine technology.
Website	http://www.gcesubsea.no/

GCE Subsea is a global knowledge hub within oil & gas industry. The combined and varied experience and operational expertise of the industrial players, supporting businesses and the R&D and educational institutions are key factors in the development and expansion of the network.

The Main Hub

The cluster's main hub, Coast Center Base at Ågotnes west of Bergen, is the world's largest base for subsea aftermarket activities. Nowhere in the world has as much subsea equipment gathered in one geographical location with as many people working in and affiliated with the subsea industry. A substantial proportion of the activity is associated with Statoil, which has its largest "subsea pool" for the Norwegian continental shelf at Coast Center Base.

World-Class Expertise

The cluster represents world-class expertise within a range of subsea-related disciplines such as:

- Enhanced recovery of oil & gas through life-of-field services and supply of subsea equipment
- Operation and development of the largest subsea fields globally in terms of number of subsea wells
- Design and engineering of subsea equipment
- Advanced subsea multi-phase and single-phase pumps and compressors
- Advanced subsea instrumentation and sensor technology
- Subsea equipment such as umbilicals, flowlines, connectors, valves, etc.
- Fabrication of subsea equipment
- Meteorology, oceanography and the marine environment

Industrial Centres of Excellence

Some of the larger GCE Subsea companies host industrial centers of excellence.

One Subsea's global hub of expertise for subsea processing solutions is located in Bergen, based at Framo Engineering which was acquired by One Subsea in 2013. OneSubsea, a joint venture between Schlumberger and Cameron, is a global company with more than 6 000 employees.

Emerson's Center of Excellence within multiphase metering is located in Bergen and based on expertise in the company that was formerly Roxar and was acquired by Emerson in 2009. Emerson is a global provider of solutions to the process industry with around 130 000 employees.

NUI in Bergen operates the center for hyperbaric emergencies, with unique facilities for receiving hyperbaric life boats carrying divers needing hyperbaric treatment.

FMC Technologies' base at Ågotnes is a regional headquarters for the Customer Support organisation. It acts as point-of-contact for engineering services, personnel, products and tools needed for installation and life-of-field operations related to subsea wells, and holds operational responsibility for bases in Angola, Australia, Canada, Scotland, the Ivory Coast and Nigeria. FMC Technologies is a global company with more than 19 000 employees.

Key Educational Establishments

The cluster has a well-developed and wide-ranging R&D community. Major educational establishments such as the University of Bergen, Bergen University College and the Norwegian School of Economics are leading centers of expertise with strong international links.

Wide-ranging R&D Community

The key R&D organisations in the cluster are:

- Christian Michelsen Research, partly owned by the University of Bergen, is an industry-oriented R&D organization with particular expertise within instrumentation and sensor technology, energy conversion technologies, information technologies and technical safety. It has a Center of Research Based Innovation (SFI) within instrumentation.
- UNI Research is the University of Bergen's strategic research partner and carries out contract research within all academic fields covered by the University.
- The Institute of Marine Research is Norway's largest center of marine science and has a position as a global leader within its field.

- Polytec is an independent research institute located in Haugesund, focusing on energy, environment, gas technology and safety.
- SINTEF is the largest independent R&D organization in Northern Europe and carries out industrial research within all engineering disciplines.

R&D Infrastructure

The educational and research institutions operate a large and varied R&D infrastructure such as subsea test sites, advanced multiphase flow rigs, facilities for pressure and temperature testing, environmental laboratories, advanced chemical laboratories for fluid characterization and dedicated experimental facilities for enhanced oil recovery.

The GCE Programme

The Global Centre of Expertise is an industry initiative that works to **strengthen** and **internationalize** businesses, R&D and education in the subsea field. The programme has a ten-year perspective and is financed by the Norwegian government. The number of centres is limited so that they can focus their efforts on strengthening ongoing innovation and internationalization processes in the most modern, sustainable and ambitious industrial clusters in Norway.

In June 2015, NCE Subsea was awarded the status Global Centre of Expertise (GCE) and the company name was changed to GCE Subsea

Strength

GCE Subsea strengthens innovation and internationalisation of the Norwegian subsea cluster.

Ambition

GCE Subsea is an industry driven initiative for strengthening and internationalisation of businesses, research and education. We represent the world's most complete cluster for subsea life-of-field solutions. Our goal is to increase the cluster's competitiveness and global market share, and take a leading position in sustainable utilisation of ocean resources.

In order to achieve these goals GCE Subsea focus on:

- Develop competence and attract talents and investors
- Develop subsea solutions beyond oil and gas
- Stimulate technology development
- Create new entrepreneurs and grow businesses
- Succeed in the global market
- Improve work and production processes

Expertise

Norway's subsea industry has succeeded due to hard work, innovation and collaboration. Over time its companies and R&D institutions have developed great expertise that enables us to challenge each other and face common issues together.

Relevance to EMSODEV and EMSO

The model used here is definitely one to look at in terms of the emerging EMSO ERIC business plan. The ambitions and goals of GCE subsea whilst focused on Norway have strong similarities with EMSO in terms of developing relationships and partnerships with industry users in the subsea technology domain.

4. CONCLUSIONS AND NEXT STEPS

One of the objectives of EMSODEV is to promote interaction between the Ocean Observation research community and the commercial sector in order to identify innovative products and services for commercialisation. The innovative products and services being developed by the companies featured in this Business Case study report can give competitive advantage to European companies in the growing marine science and technology business.

One of the goals in WP8 is to consolidate the Ocean Observing cluster (initiated by FIXO3) of product suppliers, potential investors and industry end users through technology workshops, one to one meetings and promotion of EMSO observatory services at conferences and exhibitions to encourage this technology transfer. This process was successfully initiated within EMSODEV and the Oceanology international event in London in March 2016 - see appendix. Follow up discussions with four of the selected companies in this case study deliverable occurred through initial meetings arranged at Oceanology on the fringes of the technology workshops.

The challenge is now to facilitate the involvement of these companies in the development of the EGIM.

Questions that need to be addressed include:

- Can they supply equipment to be integrated into the test EGIM?
- How does this work with the tender process?
- Are there features or functionality that needs to be added to facilitate their integration into the EGIM?

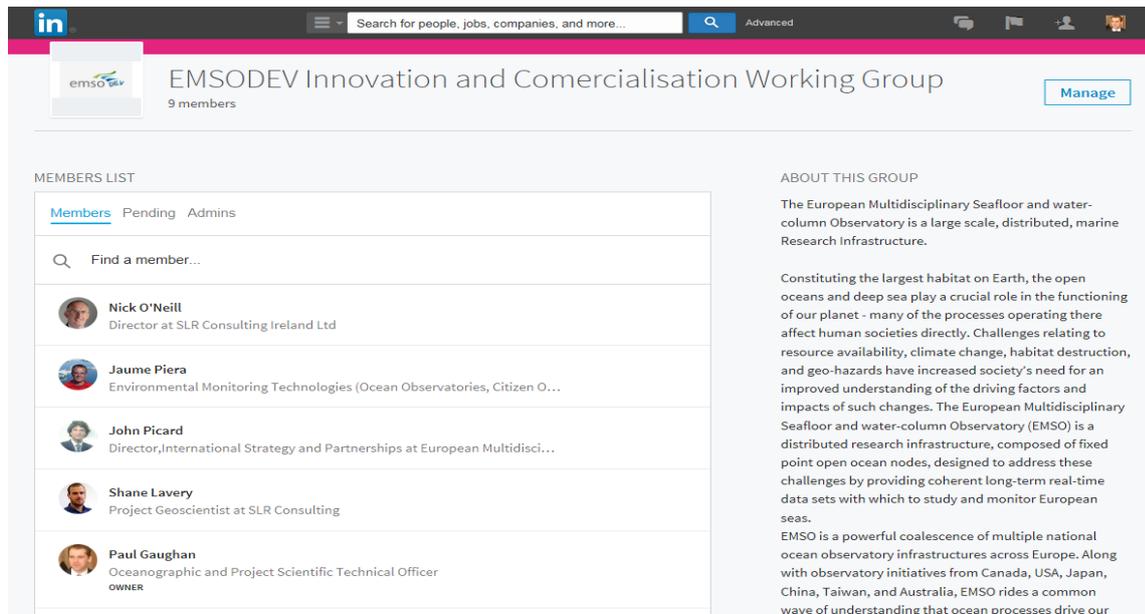
Further tasks that will be addressed based on the results of the business case studies in the development of subsequent WP8 deliverables include:

- What future Industry liason events/showcase test deployments should be used to initiate further industry involvement in the EMSODEV project.
- Link the case study companies to work in Commercial off the shelf technology in EMSODEV Work package 2.3
- How to facilitate technology transfer:
Initiate collaborative technology development projects with developers. A joint industry project is an excellent opportunity for a developer to showcase their technology to potential future clients.
- Link The Business Case study companies to EGIM Technical Team for further collaboration during EGIM build design and build phase – The EMSO innovation group on Linked in ^{xv} will be a platform for doing this.
- Can other funding sources be targeted to facilitate interaction between these companies and the EGIM development partners. For example Jerico Next Project ^{xvi} TransNational access funding calls , a successful application under this call would really help drive industry interaction.
- The EMSO ERIC Business planⁱ will form the basis for developing these future collaborations.
- Technology Surveillance – This approach will follow the model adopted by STAMAR ^{xvii} which promotes transnational, entrepreneurial and innovation networks and more specifically development of knowledge transfers between companies and research centers.

- Use the model identified by GEC SUBSEA in Case Study 3.6 as an exemplar to establish the EMSO technology Cluster. A Technology Cluster has been developed in FIXO3^{xviii}. It is proposed to continue to work closely with EMSODEV partner SLR who are leading the formation of this technology cluster and focus on linking in with EMSO and the companies identified in this case study.
- The Industry Technology Facilitator (ITF)^{xix} is an organisation of international oil and gas operating and service companies to bring forward collaborative funding for research and development initiatives that address shared technology challenges. ITF regularly have calls to support collaborative technology development projects with developers. A joint industry project involving the EMSODEV partners is an excellent opportunity to showcase EMSODEV technology to potential future clients. A key element of an ITF joint industry project is that the intellectual property remains with the developer. As part of meetings of the EMSODEV innovation and commercialization support has been expressed for the partners to prepare and submit a proposal under one of these calls during the lifetime of the project – even if not successful preparation of a submission will raise many issues that would need to be addressed in terms of technology transfer of EMSODEV technology.

An EMSODEV Innovation and Commercialisation group was set up at the kick off meeting in Heraklion in September 2015. As part of this group it was decided to set up a “LinkedIn” group to facilitate information exchange to facilitate technology updates, market intelligence and a forum for collaboration and innovation. This report recommends broadening this linked in group to included industry partners - in particular those identified in these case studies as a means to keep good communications channels open in terms of commercial initiatives related to the EMSODEV EGIM development.

EMSODEV Innovation and Commercialisation Working Group -
<https://www.linkedin.com/groups/8418201>



The screenshot shows the LinkedIn group page for "EMSODEV Innovation and Commercialisation Working Group" with 9 members. The members list includes:

- Nick O'Neill, Director at SLR Consulting Ireland Ltd
- Jaume Piera, Environmental Monitoring Technologies (Ocean Observatories, Citizen O...)
- John Picard, Director, International Strategy and Partnerships at European Multidisci...
- Shane Lavery, Project Geoscientist at SLR Consulting
- Paul Gaughan, Oceanographic and Project Scientific Technical Officer (OWNER)

The "ABOUT THIS GROUP" section states: "The European Multidisciplinary Seafloor and water-column Observatory is a large scale, distributed, marine Research Infrastructure. Constituting the largest habitat on Earth, the open oceans and deep sea play a crucial role in the functioning of our planet - many of the processes operating there affect human societies directly. Challenges relating to resource availability, climate change, habitat destruction, and geo-hazards have increased society's need for an improved understanding of the driving factors and impacts of such changes. The European Multidisciplinary Seafloor and water-column Observatory (EMSO) is a distributed research infrastructure, composed of fixed point open ocean nodes, designed to address these challenges by providing coherent long-term real-time data sets with which to study and monitor European seas. EMSO is a powerful coalescence of multiple national ocean observatory infrastructures across Europe. Along with observatory initiatives from Canada, USA, Japan, China, Taiwan, and Australia, EMSO rides a common wave of understanding that ocean processes drive our..."

Figure 2: Screen shot Of EMSODEV Innovation and Commercialisation Working group Linked In page.

The primary contacts identified from each of the case studies included in this deliverable have been invited to join this group as members.

The European market of marine technology is very active as demonstrated by previous studies (e.g. Providers of Equipment and Services for Observatory Systems forum – PESOS^{ix} in ESONET). Development activities like EMSODEV can take advantage of this vitality through a constant exchange of technological expertise among partners and companies. This in turn will engage industries and SMEs in ways that are wider than just considering them suppliers, tendering and commercialisation work can set the conditions for future joint R&D initiatives. The state-of-art achievements that are under development in EMSODEV will stimulate industries and SMEs to raise their technological level, thus improving their competitive position with the involvement in the Research Infrastructures (RI) implementation and service provision. This deliverable has kicked off the interaction with a number of these companies and the relationship will be strengthened as the EMSODEV project develops over the coming months.

5. APPENDICES



5.1. Oceanology international

Oceanology international is a major international marine technology showcase event.

The Oceanology International event offers one of the world's leading forums where industry, academia and government share knowledge and connect with the marine science and ocean technology communities.

For Work Package 8 - a number of face to face meetings with representatives from the chosen Business Case Studies were carried out and proved most beneficial in getting the companies perspective on a range of issues including marketing challenges, potential for growth, partnerships with EMSO as well as technological challenges involved on integrating equipment with the EGIM.

Oceanology International's exhibitions and conferences help organisations reach buyers from key market regions and sectors worldwide and help them improve their strategies for measuring, exploiting, protecting and operating in the world's oceans. Oceanology International is held in London every two years. In its 46th year, it has firmly established itself as the world leading marine science and ocean technology exhibition and conference. Each edition, Oceanology International brings together the latest technologies and thought leaders worldwide.

Attracting visitors from a variety of industries including oil & gas, engineering, renewables and maritime security and marine science, Oceanology International gives exhibitors the opportunity to do business with key international experts and buyers in one location. Oceanology International offers structured networking opportunities to help suppliers establish relationships and secure business on a global scale.

The multi-faceted **Oceanology International** conference programmes are highly regarded for the quality of their content and exceptional line up of chairpersons and speakers. In 2014, 1,280 unique visitors, from 49 countries, attended the free conference sessions to hear from over 100 experts on the latest marine technology, science, R&D and opportunities across the end user marine industries.

In March 2016, WP8 partners **SLR** organised two industry focused workshops where EMSODEV was highlighted and presented. The audience included many sensor manufacturers who may have a role in supplying equipment for the EGIM as well as end users who may use the EGIM for Operational reasons. Representatives from case study companies **SensorLab** and **NKE** were just some of the industry attendees at these events.

Innovation Meets Industry

Tuesday, 15 March 2016

Trade & Innovation Theatre 14:00 – 17:00

Open to all, showcasing the achievements of open ocean and coastal observatories and the new technologies evolving from the scientific activities of marine observatories across Europe. Attendees will learn about the business case for accessing ocean and coastal observatories; hear about the advances in standardisation, inter-operability, data management, online access to data, and sensor web enablement; and receive an invitation to access existing ocean and coastal observatories to test new equipment in controlled surroundings.

Technology Cluster Workshop

Wednesday, 16 March 2016
 South Gallery Room 09:00 – 11:30

Open to all, this will be an opportunity for end users of marine observation data to provide input to the managers of ocean and coastal observatories on the relevance and impact of different data sets to business activities. Marine environmental data is being generated by a large number of existing ocean and coastal observatories. SMEs can generate commercial products and services based on this data. This workshop is designed to present what data is currently available and learn from the business community and end users which data sets have most relevance and impact in the different business sectors of shipping, ports, metocean forecasting, defence, submarine cables, marine environmental monitoring, deep sea mining, oil and gas exploration and offshore renewable energy operations.

The rapporteur report of the proceedings at both these industry workshops will be used to feed into Business case studies and better inform the industry engagement strategy for the EMSO ERIC.

5.2. Glossary

AtlantOS	Atlantic Ocean Observing System
COOP+	Cooperation of Research Infrastructures to address global challenges in the Environment field
COPERNICUS	formerly GMES-Global Monitoring for Environment and Security
DG ENV	Directorate-General for Environment
DG MARE	Directorate-General for Maritime Affairs and Fisheries
DONET	Dense Oceanfloor Network System for Earthquakes and Tsunamis
ECORD	European Consortium for Ocean Research Drilling
EGIM	EMSO Generic Instrument Module
EGU	European Geoscience Union
EMODNET	European Marine Observation and Data Network
EMSODEV	EMSO implementation and operation: DEvelopment of instrument module
EMSO-PP	EMSO-Preparatory Phase
ENVRIPlus	European research infrastructures for Environmental and Earth System sciences
EOOS	European Ocean Observing System
EPOS	European Plate Observing System

ERA	European Research Area
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategy Forum on Research Infrastructures
ESONET	European Sea Observatory-Network of Excellence
ESONET-Vi	ESONET-Vision
EuroGOOS	European Global Ocean Observing System
EUROSITES	Integration and enhancement of key existing European deep-ocean observatories
FixO3	Fixed Point Open Ocean Observatories Network
GEO BON	Group on Earth Observation Biodiversity Observing Network
GEOSS	Global Earth Observation System of Systems
GES	Good Environmental Status
GOOS	Global Ocean Observing System
ITF	Industry Technology Facilitator
JERICO NEXT	Joint European Research Infrastructure network for Coastal Observatory-Novel European eXpertise for coastal observaTories
JPI Oceans	Joint Programming Initiative Healthy and Productive Seas and Oceans
MIDAS	Managing Impacts of Deep-Sea Resource Exploitation deep-sea mineral and energy extraction
MSFD	Marine Strategy Framework Directive
NEPTUNE	North East Pacific Time-series Underwater Networked Experiments
NeXOS	Development of new advanced sensors for ocean observation
OGC	Open Geospatial Consortium
ONC	Ocean Networks Canada
OOI	Ocean Observatories Initiative
ROV	Remotely Operated Vehicle
RSN	Regional Scale Nodes
STAMAR	Showcasing Technology Applicable to Maritime SMEs in the Atlantic Area
TNA	Transnational Access

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